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TIME WELL SPENT: MODELLING EDUCATION AND SERVICE ACTIVITIES OF JUNIOR DOCTORS UNDER THE EUROPEAN WORKING TIME DIRECTIVE

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TIME WELL SPENT:
MODELLING EDUCATION AND SERVICE ACTIVITIES OF JUNIOR DOCTORS UNDER THE EUROPEAN WORKING TIME DIRECTIVE

by

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ABSTRACT

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Time Well Spent: Modelling Education and Service Activities of Junior Doctors under the European Working Time Directive

A number of professional groups face the conflict of providing a service to their organisation as a whole, and wider to its clients, while continuing to develop their skills and knowledge professionally, in order to be able to perform effectively in their current role as well as future ones, within a certain amount of time available to them.

The introduction of reduced-hours legislation under the European Working Time Directive for junior doctors has posed an organisational problem for NHS Trusts in the UK, who need to reconcile the training and service needs of the profession and the service within the more confined resource of time.

This research has identified a distinct lack of clarification of the concepts of training and service in the literature, and no understanding of how these are linked to the activities that junior doctors participate, nor to the working system in which they exist.

It uses a constructivist mixed method approach to exploring what is meant by training and service, how this is linked to the operational day-to-day activities in the working lives of junior doctors and how changes in these working and

training practices affect the nature and type of service and training activity for the medical workforce and organisational system as a whole.

Its contributions to knowledge are multifaceted, ranging from the contributions to exploring the concepts of "training" and "service" and how they relate to activity, an understanding of the system, its entities and relationships, as well as a new application of a business modelling technique. While it uses junior doctors at Plymouth Hospitals NHS Trust as the specific area for study, its findings are generalisable to the organisational context of other NHS Trusts, as well as other professional groups.

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1. Introduction

Historically, excessive hours have been an integral part of the life of junior doctors worldwide, with long hours on-call, formal lectures and tuition, and the assumption of an osmosis-like process of acquiring knowledge and training through working for many hours alongside more senior doctors in their specialty. Increased recognition of the lack of safety for patients in this practice, and its adverse effects on learning and the health of junior doctors, has lead to the introduction of the 'New Deal' working hours regulations in the UK and a revised junior doctor contract (Health Service Circular 1998/204, Working Time Regulations: Implementation in the NHS). This has limited junior doctor hours to 56 hours a week (from legendary figures of 80+ hours) with additional restrictions on duty lengths and rest breaks. Additionally, the European Working Time Directive (which is the colloquial name for the Council Directive 93/104/EC of 23 November 1993 concerning certain aspects of the organisation of time, Official Journal L 307, 13/12/1993 pages 0018-0024; amended by Directive 2000/34/EC of the European Parliament and of the Council of 22 June 2000), also referred to as EWTD, came into force for junior doctors in the UK in August 2004, also requiring a reduction in working hours to less than 58 hours a week, with further reductions to 48 hours a week by 2009, with a possible extension to 2012 (Department of Health, National Assembly for Wales, *et al.* 2002).

In the UK, local healthcare is provided through non-profit entities called NHS Trusts. Hospitals fall under a Trust's management and the Trust must deliver medical care to patients while providing the training opportunity for junior doctors. In an effort to reduce junior doctors' hours, there have been significant changes in working patterns over the last few years. These changes include moving to shift working, an increase in the number of contract doctors, reduced tiers and increased cross-cover, as well as some of the new ways of working and extended roles piloted by the Department of Health (Department of Health, 2004a).

Further changes to junior doctor working have been forced by the implementation of *Modernising Medical Careers*, which aims to restructure and formalise Junior Doctor training (Department of Health 2002, 2003, 2004b). There have been claims that the reduction in working hours is impacting junior doctor training, as fewer hours spent at work are seen to equate with fewer hours spent training (Kapur & House 1998; Carr 2003). Inherently, this assumes that all hours spent at the hospital are "training" hours. Yet at the same time, it has been widely recognised that junior doctors, and Senior House Officers (SHOs) in particular, provide the bulk of the service – medical attention and treatments - and that a reduction in their hours will also impact on service provision.

Non-compliance is not an option, and failure to train junior medical staff or provide services to patients, results in a withdrawal in funding or other financial penalties. With a continual reduction in working hours and changes to training for junior doctors, Trusts are facing the challenge of continuing to provide high standards of training to junior doctors and service to patients.

This research falls within a complex area that virtually all UK Hospital Trusts are currently facing: how to reconcile training and service needs within a reduced hours context. More specifically, it aims to model the education and service activities of a professional group within an organisational context, taking the junior doctors at Plymouth Hospital NHS Trust (PHNT) as a sample, revealing insights into the problem area with implications of wider remit.

2. Background to the Research

As the reader will quickly identify in reading this "story", this research spans several disciplines and areas of knowledge, so setting its context requires both broad understanding of several disciplines such as operational research, organisational development and decision-making and medical education, and a more detailed specific operational knowledge of the organisational problem it uses as a case study: the training and service activities of junior doctors.

It is therefore not surprising that setting this research into the context of existing knowledge is a challenge. Its applicability and contribution is wide, and so it is necessary to outline the structure of this section at the outset.

The first section describes the organisational "problem" that has sparked this research: the conundrum of providing effective training for junior doctors, while maintaining service provision, under the European Working Time Directive. Following on from this, and as part of understanding this organisational problem, it is important to review the literature and research to date in this specific area (i.e. junior doctor training and the implementation of reduced hours working), as well as some of the legislation around the EWTD (to allow understanding of the debates that are raised within the problem-specific literature). This will enable the reader to understand the operational context of this research. The review of this literature raises a number of concepts pertinent to this organisational 'problem', in particular the concepts of training and service.

However, this organisational problem fits within a wider context: what do we mean by "training" both within medical education and in other professions, what do we mean by "service"? How are these concepts defined in our understanding of them?

It is this review of the background and the literature that helps set the scene for this particular research and allows the research questions to be formulated from the "gaps" in the existing body of knowledge.

2.1 The Organisational Problem

Plymouth Hospitals NHS Trust, whose main site is at Derriford Hospital in Plymouth, provides acute and specialist care services to approximately 450,000 people in Southeast Cornwall and Southwest Devon, and a population of almost 2 million people for some specialist services. With a budget of approximately £250 million, 1300 beds and the busiest A&E department in the South West of England, it employs approximately 6000 people, including approximately 450 junior doctors and 300 consultants. It is a major employer and provider of health services in the Southwest Peninsula.

When the New Deal and revised junior doctor hours contract were negotiated nationally, the Trust responded locally by introducing rotas involving a full shift system, in order to reduce junior doctor hours. In order for this to be possible, it was necessary to hire a number of trust-funded junior doctors, who work equivalent to the junior doctors in training, but whose posts do not have training recognition with the Deanery or Royal Colleges and whose salary was entirely funded by the Trust. Internally, the Trust adopted the policy that these posts should be treated identically from an educational and service point of view to the training posts, but in effect, these doctors were hired for service and hours requirements.

From 2001 until 2003 the numbers of these posts steadily increased until an additional 20% of junior doctors had been recruited. This allowed many specialties to introduce rotas which complied not only to the New Deal but also eventually for August 2004 to the European Working Time Directive. However, this solution is a very expensive one and there have been a number of areas that have been affected by complying with the EWTD, in particular such matters as continuity of care by the same medical staff and exposure to educational experiences have been highlighted as areas affected.

As one of the largest acute Teaching Hospitals in Europe, one of the key interests of the Trust was to identify how to reconcile the training needs of the junior doctors and the service requirements of the Trust and its patients within the reduced-hours context, maintaining quality standards in each. In order for this conundrum to be tackled, it was necessary to carry out research, which enabled a more detailed understanding of the problem.

Plymouth Hospitals NHS Trust decided to engage in a Knowledge Transfer Partnership Project with the University of Plymouth to gain insights into the problems that they would be facing in marrying up training, hours and service. The project commenced in January 2003 and completed in January 2006. It is within this context that this research was conducted.

The Trust itself has faced a turbulent time during the time in which this research has taken place. The introduction of a number of pay initiatives for both medical and non-medical staff (e.g. Agenda for Change and the new Consultant Contract) have affected wage bills and staff morale alike. In particular, with the introduction of the consultant contract, which sees consultants being paid only for the work which they have negotiated and have been approved for them to include in their job plans, has worn good-will thin. Activities that do not come with direct funding to the Trust (such as administration, management, research and education) have been squeezed into a limited amount of time (equivalent to

10 hours per week across all of these activities). Any demands over and above this time need to be done unpaid. This has lifted clinical commitments much higher on consultants' agendas than education, in line with the Trust's targets. Both the contract and the way the Trusts' performance is measured clearly emphasises that patient service is priority.

Additionally, the Trust (as many others in the NHS) has faced severe financial pressures. Increased clinical activity within fixed financial budgets and a financial recovery plan to break even over 5 years, has meant that there have been cut backs in all areas of the hospital, in terms of physical and human resources.

Finally, this research period at the Trust also witnessed a major change in postgraduate medical education through the conception and implementation of *Modernising Medical Careers*, starting with the introduction of the foundation programme in August 2005 (Department of Health, 2003). This had an effect on the research area, in the sense that it required flexibility in the modelling approach and the need to work closely with the model stakeholders to ensure that what was being developed was not only up to date but useful for future planning.

In this research, Plymouth Hospitals is used as an organisational context in which to model the service and educational activities of junior doctors within the EU Working Time Directive. While its results may be qualified to the context, the insights and conclusions can validly be translated to other large acute Trusts in the NHS and other professions more widely, as the situations the Trust faces are not unique. Similar observations and lessons can be found in a number of large public sector organisations and other professions where an apprenticeship model of training and career progression exists.

2.2 Background to the Organisational Context

2.2.1 Hours Legislation

This section reviews the background of working time legislation for junior doctors in the UK. It summarises the details of regulations pertaining to the reduction in hours, their enforcement and how these are being implemented in the NHS. It is important for the reader to understand a basic overview of this legislation, to enable a richer understanding of the organisational context and the subsequent literature review pertaining specifically to the issues around junior doctors and reduction in hours.

A History of Long Hours

Historically, excessive hours have been an integral part of the life of a junior doctor: working long hours on-call, soaking up knowledge and training alongside other grades in their specialty teams (the concept of the "firm"). Seventy or eighty hour weeks have been standard in the past, and indeed part of the lifestyle and profession, and what it meant to be a doctor. Suspicion of this being problematic are not new: claims that long working hours are not safe for patients go back 20 years or more. However, only in the last decade has there been incentive for change.

Increased recognition of the lack of safety for patients in this practice, and its adverse effects on learning and the health of junior doctors, has led to the negotiation of the New Deal working hours regulations in the UK and the revised junior doctor contract. Implementation of the New Deal has been mandatory for pre-registration house officers (PRHOs) from August 2001 and other junior doctor grades (Senior House Officers and Specialist Registrars) from August 2003. Additionally, the European Union Working Time Directive has come into force for junior doctors in the UK, further enforcing a reduction in working hours.

The New Deal Regulations

The New Deal Regulations on working hours recognises the balance needed between total hours worked in a week, work intensity and frequency of out of hours commitments, and thus has different regulations depending on which working pattern is worked. Accordingly, in order to ensure compliance with the regulations, recommendations have been made to match working pattern and rotas to work intensity and likelihood of achieving rest breaks.

Compliance with the New Deal Regulations became mandatory for pre-registration house officers (PRHOs) in August 2001 and for senior house officers (SHOs) and specialist registrars (SpRs) in August 2003. (Please refer to the section on Postgraduate Medical Education 'The process of becoming a doctor' for further explanation of junior doctor grades).

In order to understand New Deal working regulations, it is necessary to be clear about definitions of terms, in particular the distinction between **duty** and **work** and the differences between working patterns: full-shift, partial-shift, 24-hour partial shift, on-call and hybrid rotas.

Duty is defined as "*all time carrying out work for the employer including rest whilst on-call. Duty starts when the doctor arrives for work as scheduled…*".[1] As such, duty is any time the doctor is at the employer's disposal. **Work**, according to New Deal requirements is defined as "*All time carrying out work for the employer, but not including rest whilst on-call.*"[2]

The importance of this distinction is that there are different limits on work and duty hours, depending on the type of working pattern worked. Doctors' working patterns can be categorised into: full-shift, partial-shift, 24-hour partial shift, on-call and hybrid rotas.

The **full shift** is when the 168 hours of the week are divided into definitive shifts, and doctors rotate around these shifts.[3] Often this involves a pattern of day shifts, followed by a period of night shifts.

The **partial shift** is similar to the full-shift in that most weekdays are worked as a "normal" day (e.g. 9am - 5pm), but at times doctors may be asked to "work a different duty for a fixed period of time".[4]

[1] Taken from "Working Patterns and New Deal Requirements" produced by the South West Action Team. See www.swatresource.com for more information.
[2] ibid
[3] ibid
[4] ibid

The **24-hour partial shift** involves weekdays to be worked as "normal" days (e.g. 9am – 5pm), and in turn doctors are rostered to work longer duty periods to cover the out of hours period.[5]

On-call rotas are considered to be the most traditional. These involve working week days as "normal" working days, and out-of-hours duties are covered by doctors working "on-call" in rotation.[6] There is a further distinction between **resident-on-call** and **non-resident on-call**. Resident on-call means that the doctor does not leave the hospital site during the on-call period, and takes rest breaks on site, sleeping in rooms provided. Non-resident on-call means the doctor may leave the site during the on-call period, and provide assistance over the phone from home, travelling to the site when necessary.

Hybrid rotas are composed of a combination of 2 or more different working patterns of the above.[7] In order for this rota to be compliant, each component duty period has to comply with its specific regulations.

The New Deal regulations recognise that each of these working patterns has different demands in terms of work intensity and out-of-hours commitments and thus stipulates different limits on:

- Average duty hour per week
- Longest continuous duty (weekend)
- Longest continuous duty (weekday)
- Minimum Rest during the duty period

[5] ibid
[6] ibid
[7] ibid

- Continuous rest
- Shortest break between duty periods
- Minimum Period off duty
- Minimum Continuous Periods off Duty

The duty regulations are constructed in such a way that junior doctors should on average not exceed a **56-hour working week**, meaning that they should not **work** more than this, though the **duty** periods **can be longer**. (This is why the distinction between work and duty is so important).

The table below summarises the hours and rest requirements as determined by the New Deal regulations, by working pattern.[8]

	On-call Rota	**24-Hr Partial Shift**	**Partial Shift**	**Full Shift**
Average duty hours per week	72	64	64	56
Longest continuous duty (weekend) (hrs)	56	24	16	14
Longest continuous duty (weekday) (hrs)	32	24	16	14
Minimum rest during duty period	½ of out-of-hours period	6 hours	¼ of out-of-hours period	30 minutes continuous breaks
Continuous rest	5 hours between 10pm and 8am	4 hours between 10pm and 8am	N/A	30 minutes after each 4 hour (approx) of continuous duty
Shortest break between duty Periods	12 hours	8 hours	8 hours	8 hours
Minimum period off	-	48 hours	48 hours	48 hours every 13

[8] ibid

duty		every 13 days	every 13 days	days
Minimum continuous periods off duty	48 hrs and 62 hrs in 21 days	48 hrs and 62 hrs in 28 days	48 hrs and 62 hrs in 28 days	48 hrs and 62 hrs in 28 days

Table 1.0 Summary of New Deal Hours and Rest Requirements

N.B. This is only an overview of the regulations. More information on working patterns and summaries of regulations can be obtained from the South West Action Team or from their website www.swatresource.com.

Enforcement

With regulations comes enforcement and as the New Deal is a contractual obligation between the Trust as an employer and the doctor as an employee, there is a monitoring process that accompanies it. National guidelines have been specified, in order to ensure consistency across Trusts in monitoring hours and subsequent pay determination. While Trusts do have some flexibility to alter the monitoring process to suit their circumstances, there is a national framework to be adhered to. Failure of Trusts to implement a monitoring process results in all junior doctors being paid at the highest pay band, as if their rotas are non-compliant.

Monitoring tracks duty periods and rest breaks for junior doctors, through the completion of diary cards (though it is possible for the Trust to choose to collect this data in other ways). Monitoring should take place at least twice a year, and for at least 2 weeks at a time. Doctors on the same rota are monitored at the same time. In order for the data collected to be deemed valid, duty cards for at least 75% of duty periods need to be collected.

If the first round of monitoring is not successful, all doctors on the same rota need to re-monitor and complete diary cards (not just the ones that were missing). Also, if doctors disagree with the outcomes of monitoring, there is the possibility to re-monitor, but then this has to be done within a set amount of time and a successful response rate must be achieved.

In order to facilitate the analysis of monitoring data, the Department of Health contracted software to be written, to be made available to Trusts. This software is called Rotaworks, and is currently available to all Trusts on subsidised licenses. At PHNT, any Trust employee can request to have Rotaworks installed on their computer free of charge; the licenses are paid by the South West Action Team.

Data relating to the rotas scheduled and the actual duty periods (as collected by the monitoring diary cards) is entered on Rotaworks, which subsequently calculates whether the hours worked comply with the New Deal regulations, and if not, which Band they fall in (see Table 2). Rotaworks also has the facility to produce summary reports. National guidelines specify that analysis of monitoring data and production of reports should be completed within 15 working days of the receipt of adequate monitoring data.

Pay banding and the Junior Doctor Contract

As already touched upon, there is a direct relationship between the junior doctor contract, the hours worked and pay received (so-called pay banding).

The New Deal hours regulations initially only represented an agreement between Trusts, the BMA and junior doctors to reduce working hours. However, implementation was limited until it was decided to renegotiate the junior doctor contract to include the reduced hours New Deal regulations, and pay doctors according to compliance or non-compliance with the regulations.

The new junior doctor contract was negotiated nationally and implemented in December 2000. Pay banding was created, whereby junior doctors are paid in "bands", determined by the level of compliance to the New Deal regulations. Pay bands are dependent on average weekly hours of actual work, frequency of out of hours work and frequency of weekends worked, as determined by the data collected through monitoring.

All doctors on the same rota are paid the same band. A summary of the bands can be found below in table 2.

Pay Band	Additional % on Basic Salary	Hours worked
Basic Salary Only	0 %	Less than 40 hours, 8am to 7pm, Monday to Friday
Band 1A	50%	Up to and incl. 48 hours per week, working at high intensity and at most unsocial times, as defined by banding criteria
Band 1B	40%	Up to and incl. 48 hours per week, working at less intensity and at less unsocial times, as defined by banding criteria
Band 1C	20%	Up to and incl. 48 hours per week, working on a low frequency on-call rota from home
Band 2A	80%	Over 48 and less than or equal to 56 hours per week, working at high intensity and at most unsocial times, as defined by banding criteria
Band 2B	50%	Over 48 and less than or equal to 56 hours per week, working at less intensity and at less unsocial times, as defined by

		banding criteria
Band 3	100%	Non-compliant to hours limits and/or rest requirements

Table 2.0 Summary of Pay bands, additional pay percentage, and hours of work needed to be in the band

N.B. Exact details of pay banding criteria can be found from the department of health website at http://www.doh.gov.uk/juniordoctors/jdpaycriteria.pdf

While one would assume that inherently junior doctors would want to work fewer hours and at lesser intensity, and should be compensated for working more than this, the scripting of the contract has actually resulted in some contra-indicative behaviour. While overall the reduction in hours has been welcomed by junior doctors, the reduction in pay has not. There has been resistance to scheduled rotas which see a reduction in pay banding and reduction in hours, which makes achieving New Deal compliance significantly more challenging.

Southwest Action Team

In order to help coordinate the implementation of New Deal regulations and more generally help improve working lives for junior doctors, the Department of Health created Regional Task forces with this remit. In the south west of England, the Southwest Action Team (SWAT) was formed from the Regional Task forces, whose remit is to "ensure delivery of the New Deal targets on junior doctors' hours and improving living and working conditions".[9] SWAT works closely with the Strategic Health Authorities, Workforce Development

[9] Taken from the Remit document, as produced by SWAT, March 2003.

Confederations, Deaneries and Trusts in the Southwest. Following the deadline of the August 2003 for compliance with New Deal regulations, SWAT has been absorbed into the Workforce Development Confederations, and subsequently into the Strategic Health Authority and continues to support improving working lives and reducing hours initiatives for junior doctors.

Current Performance

Performance of Trusts in achieving New Deal requirements is monitored at Trust, regional and national level. Data collected through monitoring is analysed and Trusts are asked to submit summary reports for further analysis and compilation. Results are published twice a year, in March and September, starting in September 2000. Compliance is measured in percentage of junior doctors complying with New Deal requirements, and is evaluated by region, Trust, grade and specialty. Number of junior doctors in each grade, specialty and Trusts is provided too, as a proxy to size. From these it is possible to make inter-Trust, region, specialty or grade comparisons. Further, reasons for non-compliance are given in order to highlight issues or areas of concern that need to be addressed.

At the outset of this research, the latest available data is from March 2003. At that time, PHNT was 71% compliant with New Deal regulations, with 171 of the 241 junior doctors in training posts working New Deal compliant working patterns.[10]

[10] http://www.doh.gov.uk/juniordoctors/2003-martrustcomp.pdf

The European Union Working Time Directive (EWTD)

Background

The European Working Time Directive (EWTD) is officially known as the Council Directive 93/104/EC of 23 November 1993 concerning certain aspects of the organisation of time (Official Journal L 307, 13/12/1993 pages 0018-0024) and was amended by Directive 2000/34/EC of the European Parliament and of the Council of 22 June 2000. From here on in, it will be referred to as the European Working Time Directive (EWTD).

The EWTD was first issued in 1993, at which point the UK did not address it. It wasn't until five years later, that the UK government incorporated the directive under the UK Working Time Regulations in October 1998. However, certain sectors were exempt from the UK Working Time Regulations including: road, rail, air, sea, inland waterway and lake transport, sea fishing, offshore (oil and gas exploration) and junior doctors.[11]

However, these previously excluded sectors have now been ruled to be included. The EWTD is now health & safety legislation, taken into UK law, which applies to Junior Doctors from August 2004. Notably, consultants and other health professionals should have already been working to EWTD compliant hours, though whether this happened in practice is an issue of contempt.

The Regulations

[11] http://www.dti.gov.uk/er/work_time_regs/exsectors.htm

The EWTD applies a maximum average working week of 48 hours (including overtime), averaged over a pre-determined reference period. Currently the reference period for junior doctors has not been decided, though it is likely to be at least 6 months, if not a year.

In addition, there are the following **rest conditions** that need to be met:

- Minimum 11 hours of continuous rest in any 24 hour period
- Minimum rest break of 20 minutes when the working day exceeds 6 hours
- Minimum rest period of 24 hours in each 7 day period, or 48 hours in each 14 day period
- Minimum 4 weeks annual leave

There are specific regulations for "night workers" (see Council Directive 93/104/EC). However, junior doctors are not classified as night workers, as their rotas and rotations do not mean that they are contracted to work most of their hours at night on a permanent basis.

Although ultimately maximum average hours of work are to be limited to **48 hours per week,** there is a 'grace period', which allows a phasing-in of reduced hours for junior doctors. There are interim deadlines of **58 hours** of work per week from **August 2004** and **56 hours of work per week from August 2007**. The **48-hour working week** applies from **August 2009**. (This may be extended to August 2012).

Even though the restrictions on total hours are being phased in gradually, the **rest conditions** apply from **August 2004**.

What is considered work?

The definition of "work" was one of the major debated issues in the EWTD. This was a grey area, until October 2000 when the European Court made a response to a case brought by SIMAP (Spanish equivalent to the BMA). The so-called **SIMAP ruling** dictated that any time the doctor is at the employer's disposal, this is to be defined as work. For hospital doctors, this means that any resident hours are defined as work (irrespective of whether the doctor is asleep or not).

Does training count as work? This is another grey area, but the same rule must be applied. If the doctor is at the employer's disposal while training then this counts as work.

"Bending the rules"

Opting out

It is currently possible to individually opt out of the EWTD and its requirements. This has to be done in writing, signed by the individual, and employers are not allowed to coerce employees into opting out.[12] While opting out is unique to the UK, it will never be a "solution" to the issue of reducing hours, as junior doctors

[12] Taken from "The European Working Time Directive" as produced by the South West Action Team

are still bound by the New Deal, and it is currently the understanding that opting out is not an option for junior doctors.

Derogations from Rest breaks

While the average weekly hours limits imposed by the EWTD are fixed, the Department of Health may "derogate" with respect to rest requirements. This means that rest conditions which are derogated from must be given back in compensatory rest breaks on an hour-for-hour basis. It is currently not clear whether the compensatory rest may fall in time that would have been scheduled off anyway or whether it is taken from "working time". The exact mechanisms for derogation are currently being negotiated.

Relationship between New Deal and EWTD

What are the differences between the two?

As junior doctors had to comply with both the New Deal and the EWTD from August 2004, it is important to understand what the differences between the two are and how they relate to each other. Main differences lie in the penalties for non-compliance, distinction in the definition of work and timings for implementation.

In essence the New Deal is a contractual obligation, specified in the nationally negotiated junior doctor contract, which employers (i.e. Trusts) must adhere to. If junior doctors are consistently asked to work outside their contracted New

Deal compliant hours, there are several implications. Firstly, junior doctors are compensated for working outside New Deal hours by the supplement in pay (so-called Band 3), the cost of which the Trust has to pay. So, it is expensive. Moreover, it is also a breach of contract. If there is a consistent breach of New Deal hours, there may be consequences beyond the financial in the long-term. Currently junior doctor training posts are funded (or part-funded) by the Deanery. Deaneries are the parts of the Strategic Health Authorities whose responsibility it is to commission and quality-assure the delivery of postgraduate medical education. As part of the service level agreements with the Deanery, the Trust (as the training provider) cannot let the doctors in training consistently work outside the New Deal hours. If the Deanery deems that this is the case, then it has the possibility of withdrawing the training posts from the Trust. This means that the Trust would not only have to fill the post by completely funding a Trust doctor post, but also lose its recognition of a high-quality training provider, making it harder to secure training posts in the future.

While the New Deal is a contractual obligation, bound by specific penalties, the EWTD is health and safety legislation, a directive of the European Union, and taken into UK legislation, with some country specific interpretation (such as the opt-out clause). The EWTD is designed to foster a healthy and safe working environment for all employees. Whether the EWTD extends to cover the safety of patients in a hospital has not yet been legally clarified, so it is assumed that it exists to protect both staff and patients. As with any other health and safety legislation, consequences of non-compliance are legal action against the employer (in this case, the chief executive and Trust management). While a lawsuit in this matter has not yet gone to the courts in the UK, it is a very real possibility, and any such case would certainly set the precedence for others to follow. There have been some incidents where doctors have attempted to take their Trusts to courts over long working hours outside of the EWTD, but they have not gone through due to lack of evidence. Plaintiffs need to provide evidence of consistently working outside of the EWTD for extended periods of time, and this has been not the case. Further, if it is decided that the EWTD includes provision of patient safety, non-compliance could theoretically result in patients suing hospitals for malpractice due to long working hours.

In addition to the type of regulation, there is another major distinction between the New Deal and the EWTD. This lies in the definition of work and how this relates to the number of hours worked. The New Deal sets limits on hours of **duty** and differentiates this from work, as it doesn't recognises rest breaks as work and that different working patterns have different intensities, and thus some will involve more "work" than others. Thus, while there is a **limit to 56 hours of work a week**, it is possible to be **on duty for up to 72 hours a week**, if working on-call.

As the EWTD was designed for employees of all sectors, there is no distinction between work and duty or working patterns, and the SIMAP ruling declared that any time the employee is at the employer's disposal is work. This has implications for the type of working patterns that remain feasible under the EWTD and the total number of hours doctors can be available to the hospital, making the EWTD more stringent than the New Deal in some respects.

How do they align?

As junior doctors will have to comply with both the New Deal and the EWTD, it is necessary to understand how their implementations align, both in terms of time lines and possible working patterns.

Timelines of Implementation

New Deal regulations have applied to all Pre-registration House Officers (PRHOs) since August 2001 and Senior House Officers (SHOs) and Specialist Registrars (SpRs) since August 2003. Additionally, the phasing in of the EWTD began in August 2004. The South West Action Team has produced a table of timelines of implementation, which is a very useful visual aid.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Junior Doctors' New Contract in Effect													
		56 Hour Maximum Working Week for PRHOs												
				56 Hour Maximum Working Week for SHOs and SpRs										
SIMAP Judgement Applies					Hours Resident on Call = Hours Working									
Minimum Rest Period Applies					11 Hours Minimum Rest Applies to All Doctors									
Maximum Legal Average Weekly Working Hours under WTD – 3 year Extension					58 Hours			56 Hours		3 Year Extensions at 52 Hours			48 Hours	
Maximum Legal Average Weekly Working Hours under WTD – 2 year Extension					58 Hours			56 Hours		2 Year Extension at 52 Hours		48 Hours		
Maximum Legal Average Weekly Working Hours under WTD – Without Extension					58 Hours			56 Hours		48 Hours				

Table 3 Timelines for Implementation of New Deal and EWTD

Possible Working Patterns

Due to the differences in regulations and the definitions of work, neither the New Deal nor the EWTD can be seen as the overriding regulation. It is not possible to say if one is New Deal compliant, then one is EWTD compliant or vice versa.

While the EWTD is more stringent in terms of total hours of work (after 2007), it is not possible to assume that being EWTD compliant automatically implies being New Deal compliant. While this is true in most cases, there is an exception. If an EWTD compliant full shift pattern is worked, then only a 20 minute minimum rest break is specified. If this is indeed all the doctor gets, then they would be non-compliant with New Deal regulations, as these specify a minimum of 30 minutes continued rest. If New Deal rest breaks are adhered to, then in general being EWTD compliant implies being New Deal compliant.

On the other side, there a number of ways in which New Deal compliant working patterns are likely to not be EWTD compliant. If working to the limits of New Deal on-call, 24-hour partial shift or partial shift, then these will be likely to be EWTD non-compliant as the hours of duty will be seen as work under the EWTD. Especially, the resident on-call working pattern will be difficult to maintain under the EWTD with current staffing levels.

Notably, the most difficult aspect of the EWTD is not as much the total hours limit on work, but rather the 11 hours continuous rest break in every 24 hour period. This makes it difficult to maintain traditional on-call work patterns. The possibility to provide compensatory rest helps, but this still remains an issue.

It appears that the EWTD regulations mean a move to shift-working for doctors and staff, as working patterns containing on-call elements are difficult to maintain without an increase in staff sharing the same rota (i.e. increasing the number of staff to maintain the number of hours at the Trusts' disposal).

How have reducing-hours initiatives been interpreted in the NHS?

Implementation of the New Deal

Trusts across the country have been forced to take action to implement the New Deal hours regulations, due to the financial burden of compensating for long hours, as dictated by the junior doctor contract. The exact set-up and responsibility varies by Trust: some have project teams amending rotas and recruiting, some have left it to each individual specialty to "sort out" their rotas. At PHNT, there is a small junior doctors' hours team, headed by a junior doctors' hours project manager, responsible for ensuring compliance in the medical directorate (containing a major proportion of junior doctors in the Trust). The remaining rotas are determined by directorate or specialty.

Regionally, the government created task forces to help Trusts with the implementation of the New Deal. In the southwest, this task force has developed into the South West Action Team (see section 2.2.2). Further, compliance is measured at Trust level, regionally and nationally to track performance.

Short-term focus – Changing working patterns and Recruitment

Most Trusts have approached New Deal implementation by changing working patterns and rotas and recruiting doctors to maintain the total number of hours. In particular, where possible, there has been a move to a full shift system and recruiting doctors to trust funded posts in order to fill the gaps in hours that arise from reducing the hours of existing posts.

There are a number of reasons why this strategy is of a short-term focus and not necessarily the best way forward. Firstly, is the problem with trust doctor posts. A reduction in the number of hours worked by existing junior doctors, has led to Trusts filling the 'gaps', by recruiting more junior doctors. As these posts are not educational posts, the Trust has to meet the entire costs of the posts. This is an expensive option, as it increases the Trusts total expenditure permanently (if maintained). Additionally, trust-funded posts are difficult to fill, as they are not particularly attractive. As they are not recognised training posts, time spent working in these posts does not contribute to accredited training experience for junior doctors, which means that they are termed purely 'service' posts. If a junior doctor works in a trust funded post, then this prolongs the time before they move onto the next grade. For these reasons, trust doctor posts are not particularly attractive to current doctors in training. As a consequence, these posts tend to be filled by doctors from overseas (or doctors wishing to simply work a post for other reasons, e.g. while making career decisions).

Secondly, the movement to full shift system working has itself a number of consequences. While not thoroughly investigated, there are a number of issues that have been raised as implications of shift-working. These include a lack of continuity of care for patients, increasing problems with handover and a decrease in the quantity and quality of training. On the training side, not only is there a decrease in the amount of exposure doctors are receiving (due to the reduction in hours), but specifically shift working means there may be a reduction in the quality of exposure, due to the lack of continuity of education. Doctors are not in apprenticeship style teams any more, meaning that they are not always on duty with their consultant or educational supervisor. The relationship with superiors is not the same (less of a mentoring style), which has consequences for the delivery of education. Further, a reduction in hours and shift working has increased their workload and pushed it into the traditional working day, making it more difficult for junior doctors to attend formal teaching sessions and educational experiences (such as clinics). The debate about the exact effects of shift working and reduction in hours on medical education and postgraduate training is on-going. However, it does raise the need to look beyond short-term solutions of achieving compliance, and look at more long-term solutions to the hours, service and training problem.

Implementation of the EWTD

From the outset, the Department of Health has recognised that the implementation of the EU Working Time Directive, along with the modernisation of the NHS, is more than simply doing what has always been done and increasing numbers. While it has promised an increase in the number of doctors in the NHS plan, it has taken the stance that implementation of the EU Working Time Directive warrants a new way of working. The focus is on long-term efficiency.

Trusts have been encouraged to look at new ways of working, revising the roles and responsibilities of existing staff and restructuring services, while maintaining training, service and safety standards, in order to bridge the gaps that arise by reducing junior doctors' hours.

As the Department of Health recognises the tremendous challenge that this poses, it has been forthcoming in supporting the search for new solutions and nationwide sharing and learning of experiences, through a variety of initiatives including: EWTD pilots, guidance, and the configuring hospitals project (Hospitals at Night).

EWTD Pilots

With the challenge of implementing the EWTD, the Department of Health recognises the need to restructure, modernise and rethink the workforce and services provided in the NHS (this is also in line with the modernisation agenda of the NHS Plan). In response, the Department of Health commissioned and funded pilot projects of new ways of working to implement the EWTD. Over 400 bids were submitted, of which 19 were chosen and funded.
The pilot projects are trials in the following areas[13]:

[13] http://www.doh.gov.uk/workingtime/pilots.htm

- Medical support workers
- Extended nursing and other healthcare practitioner roles
- Developing medical assessment facilities
- Alternative night cover arrangements
- EWTD modelling and service redesign
- Mental health services
- Consultant role and working patterns

The pilot projects commenced at the beginning of 2003, and provide bi-monthly progress reports. In their evaluations, they presented some successes and challenges alike. Difficulties lay in the transferability of results, as solutions were highly dependent on the circumstances they were developed in (size of hospital, staffing structure, services provided, case loads, etc.)

Overall though, it appears that likely solutions lie in extending existing roles and creating new ones in support of junior doctors, as well as looking at alternative night-time arrangements. These developments are in line with the Changing Workforce Program, another modernisation initiative created by the Department of Health to help modernise the NHS.

Guidance

As the EWTD and its implementation poses such a challenge to the health service, it is unsurprising the there have been responses on the matter, in the form of guidance from the major regulatory bodies relating to junior doctors. Two official documents in response are: the *Guidance of the Academy of*

Medical Royal Colleges, and the *Guidance on Working Patterns for Junior Doctors*, produced jointly by the Department of Health, the National Assembly for Wales, the NHS Confederation and the British Medical Association.

The documents are similar in that they support the modernisation of the NHS, as set out in the NHS plan, and recognise that the implementation of the EWTD will be a challenge. Additionally, both provide guidance by specifying areas that need to be investigated to help implement the EWTD. These include: greater use of skill mix, increasing cross cover between specialties, reducing tiers of cover, alternative night time arrangements and service reconfiguration, bleep policies, and reviewing workload and inappropriate tasks.

Notably, this guidance provides direction to the same areas that are being addressed by the EWTD pilots and indeed by Trusts themselves. It confirms the areas that are generally known to be problems and potential solutions, but does not provide concrete answers.

Configuring Hospitals / Hospitals at Night project

In line with other developments, another major initiative resulting from the NHS plan, is the Department of Health's *Configuring Hospitals*. This looks at reconfiguring hospital services in order to meet the modernisation agenda of the NHS plan. A major element of this is the *Hospitals at Night* project[14], which looks at redefining how medical cover is provided at hospitals during the out of hours period, moving from providing cover according to professional specialty and grade, to cover according to competency (i.e. defining a skills mix needed

[14] http://www.doh.gov.uk/configuringhospitals/hosp-night.htm

to staff a hospital at night). The result of this was EWTD compliant models of staffing a hospital, with observations and lessons learnt for other Trusts to draw on.

Future

While there are currently a variety of pilots, projects and guidance on areas that need to be looked at and what cannot be compromised on, there is limited concrete advice at this point in time on how to deal with implementation of the EWTD, specifically at Trust level. It is evident that long-term solutions do not lie in simply recruiting more trust doctors or draw too much on the nursing workforce (as this is already in shortage of supply), but to look at the creation of new roles in support of junior doctors, and new working arrangements and service provision (particularly during the out-of-hours period). Solutions from the pilot projects and the hospitals at night project are eagerly awaited.

To add to the challenge, junior doctors also faced a change in training, in the form of *Modernising Medical Careers*, which represents a complete change in the structure and delivery of training (see section below). The reduction in hours imposed by the EWTD and the fast tracking of training is likely to see significant changes to junior doctors' lives and the profession as a whole in the near future.

2.2.2 Postgraduate Medical Education

In addition to an understanding of hours regulations (which can be viewed as the "service" aspect of the organisational context), it is important for the reader to understand an overview of postgraduate medical education in the UK (i.e. the "training" side). Although this section mainly focuses on Senior House officer (SHO) training, the process of becoming a hospital doctor is summarised, in order to put the SHO grade into perspective. It does not seek to provide exact details of the qualifications or experience necessary to progress through the career path, nor is it an analysis of training practices in the UK.

The process of becoming a doctor

In order to become a hospital consultant or general practitioner, at the outset of this research, there were several grades one must pass through. (Please note that his was before the introduction of *Modernising Medical Careers* from 2005-2007). Each grade is differentiated by level of experience and exams passed. Figure 1.0 depicts the grades, typical times spent in each grade, and necessary qualifications needed to progress from one grade to the next. Each grade is elaborated on further below.

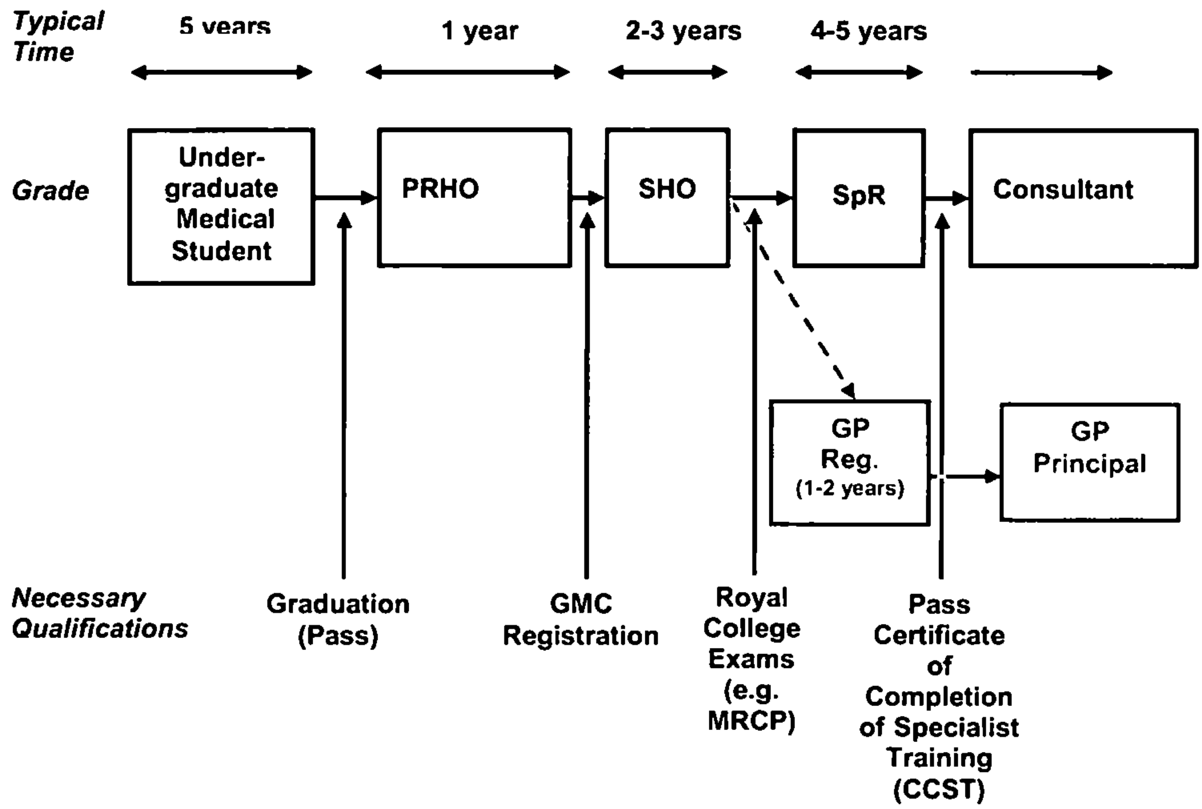


Figure 1 – Overview of the process of becoming a doctor

The Basics

Please note that these are the basics as outlined as at 2003/4. There are many impending changes which occurred in postgraduate medical education during the life of this research. The section on Modernising Medical Careers reviews these changes and timeframes for implementation.

Undergraduate Medical Student

Prospective doctors in the U.K. have to complete an undergraduate medical program at one of the medical schools. The duration of this program is traditionally 5 years. However, more recently there have been moves to pilot undergraduate medical programs of four years' duration.

PRHO year

Upon graduation from medical school, graduates enter their Pre-registration House Officer (PRHO) year in hospitals. During this year, they work in hospitals as part of the medical team, where it is expected that they gain sufficient experience to achieve full registration with the General Medical Council (GMC). Requirements for GMC registration are at least 4 months experience of surgery and at least 4 months experience of medicine within the PRHO year. (Most PRHOs will in fact satisfy this by two 6-month placement, one each in surgery and medicine). At the end of the year, the PRHO's educational supervisor (a named consultant) will determine whether the PRHO has achieved the competence required for GMC registration and will "sign off" the PRHO. Upon successfully achieving GMC registration at the end of their PRHO year, the junior doctor is now a fully registered doctor, able to prescribe medication.

SHO grade

The Senior House Officer (SHO) grade is the level at which junior doctors are registered with the GMC and as such are working as doctors within the medical team, but have not yet passed their exams with the Royal Colleges nor achieved enough experience to be performing certain procedures suitable to the Specialist Registrar grade.

The SHO grade consists of a serious of 6-month posts or "jobs". Junior doctors can either enter a rotation, which consists of a pre-determined set of these jobs for 2 or 3 years, or pick and choose individual 6 month posts that they feel will give them enough knowledge and experience to pass their exams and be able to secure a Specialist Registrar programme. These 6-month jobs do not have to be in one hospital, and many SHOs work across hospital to gain as wide an experience as possible. Pre-set rotations can be either in one hospital or shared with other Trusts.

At the beginning of the SHO grade, SHOs will not necessarily know yet which specialty they wish to work in. However, they will have made the choice of whether their preferences lie in a medical or a surgical specialty and applied for rotations or jobs accordingly.

How long a junior doctor remains an SHO depends on: their ability to gain enough experience and knowledge to pass the Royal College examination particular to their career choice, and their ability to successfully secure a position in a Specialist Registrar programme (which will depend on their experience they have gathered on their CV in comparison to other applicants), once they have passed their examinations.

The shortest amount of time in the SHO grade is 2 years, and the average lies around 2-3 years. However, there are people who remain SHOs for longer (perhaps 4 or 5 years), either due to personal reasons or because they are not able to secure a training post as a Specialist Registrar in their chosen specialty.

Specialist Registrar Grade

The Specialist Registrar (SpR) grade is a level at which junior doctors enter a specialty-specific training program, upon the successful completion of which they will be competent to practice as consultants in that specialty. Since the Calman restructuring of the SpR grade in the 1990s, SpRs follow set training programs, in which they work as Specialist Registrars in their chosen program. Upon gaining sufficient knowledge and experience, they will pass their CCST (Certificate of Completion of Specialist Training) with their respective Royal College, which allows them to practice at consultant level. SpR programs typically last 4-5 years depending on the specialty.

General Practitioners

In order to become a General Practitioner (GP), one must attend medical school and complete the PRHO year, in order to gain GMC registration as described above. In the SHO grade, junior doctors enter what is known as the General Practitioner Vocational Training Scheme (GPVTS) which also consists of 6-month posts, some of which are SHO jobs in hospital departments (as with other SHOs) others which are in the community. On completion of the scheme and success in examinations, they go on to become GP Registrars, and eventually practicing GPs. The college responsible for doctors practicing in General Practice is the Royal College of General Practitioners.

Relationship between exams and experience

In order to graduate from medical school, students have to pass their final examinations. However, this is not the last time they have to sit exams. In order to progress in their career as junior doctors, and eventually become consultants, junior doctors have to pass the relevant Royal College Examinations. Each Royal College examination for membership to the college varies, with most having 2 examinations taken at different times (e.g. the Royal College of Physicians and Royal College of Surgeons have a MRCP Part I and Part II and MRCS Part I and Part II respectively). Some specialties (e.g. Radiology) would expect trainees to have completed the examination of a more general medicine, (e.g. medicine) before taking more specialist examinations at a later stage.

In general examinations are taken during the SHO grade, and are often used as a marker for entry to the Specialist Registrar grade. It is often also used a competitive factor when SHOs compete for SHO jobs.

While the Part I part of royal college examinations often is knowledge based, part II usually draws on experience gained in the workplace and often stipulates a minimum amount of time at SHO level before it can be taken. This ensures that not only do junior doctors have the "know how" but also that they have shown experience as well, judged by the amount of time they have spent in approved SHO training posts.

The Future: Modernising Medical Careers

Following the publication of Sir Liam Donaldson's *Unfinished Business* in 2002 (Department of Health, 2002), which sought to tackle the unstructured SHO grade and reform it in a similar way to which the SpR grade had undergone the Calman reform some years earlier, the concept of Modernising Medical Careers was conceived.

Modernising Medical Careers (MMC) eventually resulted in a restructuring of all grades to allow for seamless training for doctors, with a competency-based curriculum and clearly defined career paths. It also saw the shortening of training programmes, so that the time it takes to become a consultant is shortened from an average of 14 years to 11 years (although this varies dramatically by specialty). It was introduced in phases starting in August 2005 with the introduction of the foundation programme and August 2007 with the introduction of the new run-through specialist training programmes.

Instrumental to MMC was the creation of a new authority and governing body: The Postgraduate Medical Education and Training Board (PMETB), whose remit was overseeing the standards of postgraduate medical education, including the approval of curricula. This was seen as the removal of power from the Royal Colleges and was met with some resistance. However, since its inauguration, PMETB has been working very closely with the Royal Colleges in the creation and approval of competency based curricula. The main point of disagreement still lies within the role of the Royal College exam. The Colleges would like it to be used as a progress marker and entry requirement to specialty training, which is at odds with the competency based progression model of the "conveyor belt" training programmes under MMC.

Below is the diagram of the new training grades under MMC[15]:

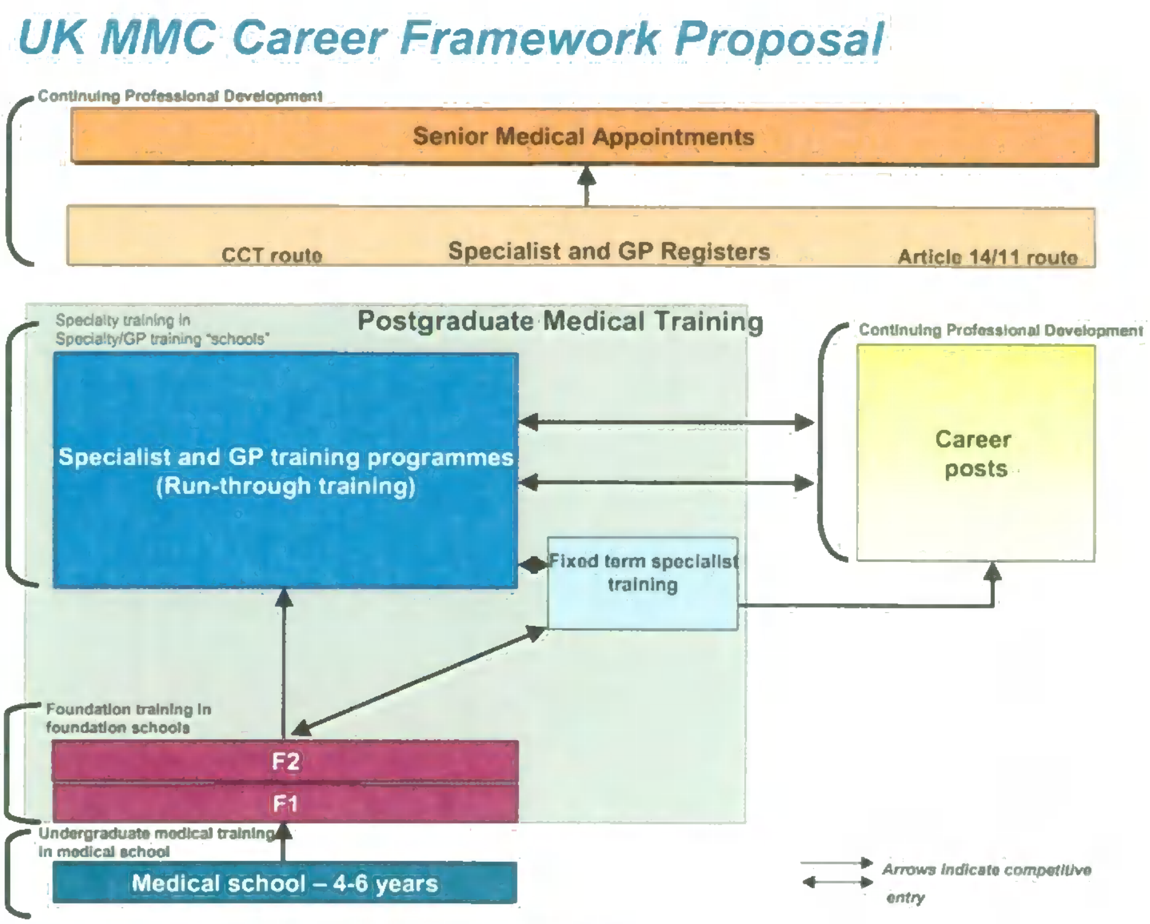


Figure 2 – UK Modernising Medical Careers Framework

After graduation from medical school, graduates enter into a 2-year foundation programme, consisting of 6 4-month placements. Doctors in the first year and second year of the foundation programmes are referred to F1 and F2 doctors respectively. The foundation programme is designed to provide a broad experience of specialities, while junior doctors acquire generic medical and surgical competencies, in particular those in care of the acutely ill patients. As there has been no legislative change, full GMC registration still occurs at the

[15] http://www.mmc.nhs.uk

end of the F1 year (equivalent to the old PRHO grade) after the acquisition of the relevant competencies (demonstrated by a number of new assessment tools, and an evidence-based portfolio) and the relevant time spent in acute general medicine and acute general surgery.

The F1 grade was implemented nationally in August 2005 (being converted mainly from old PRHO jobs), following on from which the F2 grade was created in August 2006. The jobs and finance for this was taken by converting an appropriate number of SHO jobs.

Career decisions have to be made a lot earlier. At the end of F2, trainees apply for a specialty training (ST) programme, designed to progress them on a career path to becoming a consultant in that specialty. There is little scope for them to change their mind once they have been appointed to a specialty training programme, unless they decide to retrain and start at the beginning of the programme. If they are not successful in being appointed to a specialty training programme, they have the option of working as a Fixed Term Specialist Training Appointment (FTSTA) for up to 2 years, while applying for ST programmes.

In 2007, the Medical Training Application Service (MTAS) and MMC made big headlines in the UK press, yielding concerns over the short listing process and the potential for unemployed doctors.

Specialty training programmes were implemented in August 2007 and revised in 2008. At time of writing, it is yet to be seen how these specialty training programmes will be further implemented in the UK to the satisfaction of both the Trusts as employers and the junior doctors as trainees, along with the Royal Colleges as representative of the profession. Changes to the training programmes, examination requirements and recruitment processes are being made continually, as the challenges of the new system present themselves.

3. Literature Review

By now the reader will have a good idea of the changes that have been introduced which affect the working lives of junior doctors: both in terms of their ability to provide a service (hours legislation) and their ability to develop themselves and their career (postgraduate medical education). It is important to have reviewed these external influences imposing change on the organisational context, because it creates a framework for the reader to understand the subsequent literature review, in particular when reviewing the research on the impact of these changes on junior doctors' lives.

3.1 EWTD and Junior Doctors

This section reviews the "core" research and literature that looks at the effects of the European Working Time Directive and shift working on junior doctors. That is, the research that directly looks at the impact of the EWTD on service and training. The review looks not only at the content of the literature and the research to date, but also the approaches taken as this is where a major gap in the existing knowledge lies. It is also useful to review this literature immediately pertinent to the organisational context, as it teases out the most important questions which can then be explored in a wider context.

3.1.1 Working Patterns

In a perfectly controlled environment, investigations and evaluations into the impacts of the EWTD, and comparisons across shift types and different ways of working could be done in a methodologically controlled fashion. Baseline measures of all possible effects could be taken before and after two different working patterns are introduced, and compared thoroughly in a before-and-after scenario. Different working patterns across different grades would be able to be investigated in a logical pair-wise fashion. However, this is not a clinical trial, nor a controlled environment. Hospitals are real social systems that evolve, and changes to rotas are made according to service needs, legislation and current medical staffing, and even once time-tabled, changes occur all the time.

It is therefore not surprising that in all of the relevant literature, there is no study that systematically compares different working patterns, with defined measures of impacts. This has two consequences. Firstly, there are large variances in the types of working patterns investigated and the staffing levels found within them, and secondly there is a considerable lack in definition of the outcomes or impacts. While one could say that it is not possible to establish measures for impacts or effects that are not anticipated, in all cases the researchers anticipated the areas that would be evaluated or compared, primarily being around the three areas: junior doctor training, junior doctors lives and patient care (service). However, universally these areas of investigation are either not defined at all or definitions vary across pieces of research. This will be elaborated on in later sections.

Returning to the first point, there are variances in the types of working patterns and staffing levels researched. When investigating the perceived or anticipated effects of "changes" to working patterns, these "changes" varied significantly, from specifically describing in detail the rotas and staffing to generic working pattern types.

Amongst one of earliest in this specific area, is the work done by McKee and Black (1992) who sought to evaluate proposed changes to junior doctors hours as outlined in the government's *Achieving a Balance* document. They did this by evaluating the "current" long hours system in its relation to patient care and junior doctor medical experience. In this sense, they had nothing to compare it to, apart from the reduced hours framework that was being proposed. West et al (1994) also investigated what junior doctors thought about the proposed changes in working patterns, where the "changes" that this evaluation is in reference to, is the introduction of the 72 hour week: far above the proposed changes of the 48 hour EWTD week. This research pre-dates the negotiation of the junior doctor contract and the enforcement of the 56 hour working week, yet shows that there was even opposition to a reduction in hours to 83 hours per week (1993) and then to 72 hours per week (1994).

While these two studies compare the "old" system against potential new ones, by far the most common comparisons in the research are the comparisons between the traditional "on-call" system of cover where doctors work days, and then provide resident cover during the night (i.e. being on call) taken in turn, and "new" reduced-hours shift systems (either partial shifts or full-shift systems).

Most of these comparisons are evaluation-type research, where a new working pattern is introduced to a specialty or unit, and the impacts of which are then evaluated. A number of studies explore the impacts of introducing either a partial shift system (Raine and Irving 1991; Reid and Moss 1999) or full shift system (Nasmyth, Pickersgill et al. 1991; Rawnsley, Hurst et al. 2004), or just shift-working in general (Mather 2002; Paice and Reid 2004; Rawnsley, Hurst et al. 2004) against the traditional on-call system. Some of the literature evaluates the impacts of shift working hypothetically by walking through the mathematical calculations of reduced hours (Shaw 2002), rather than evaluating real interventions, while others refer to impacts of shift working in general, without reference to specific examples (Flynn 1991; Carr 2003). Comparisons and views across all three (on-call, partial and full shift systems) are also found (Baldwin, Newton et al. 1997; Kapur and House 1998; Kapur and House 1998; Paice 1998; Chandra 2004).

Some of the literature goes into tremendous detail in describing the exact working patterns under investigation, specifying the levels of cover in the shift system (Fisher, Moffat et al. 1994; Murday, Hamilton et al. 2000) or describing the exact staffing and start/ finish times (Gottlieb, Parenti et al. 1991; Turley 1997).

Beyond junior doctors specific literature, there have also been explorations of two different on-call systems with varying weekend and night cover for transplant co-ordinators (Smithers 1995) and an evaluation of new EWTD compliant working patterns for consultants in a haematology department (Will and Will 2002).

As can be seen, there are a variety of ways that different working patterns are represented in the literature, both in terms of which types are referred to and to which level of detail. A lot of this has to do with timing. Only a few select studies were fortunate enough to be conducted in "real-time" during an intervention-type change in working patterns (Gottlieb, Parenti et al. 1991; Nasmyth, Pickersgill et al. 1991; Kapur and House 1998; Reid and Moss 1999; Rawnsley, Hurst et al. 2004) and thus can evaluate directly some of the impacts, while most others have to rely on junior doctors' memories and perceptions of before-and-after or comparisons across the country. What this means is that as Trusts have to be at least New Deal compliant, and EWTD compliant (for the 52 hours since 2007 and 48 hours by August 2009), there is limited scope left to compare from the "old" on-call system to shift working. Even the remaining smaller specialties currently running on-call systems will be operating some form of revised shift system shortly. Thus, any research into impacts of the EWTD will have to rely on memory and perceptions, or dispense of comparisons altogether and evaluate current impacts against ideals, rather than the past. In a sense, this is more beneficial. All the literature evaluates EWTD changes by comparing them to the past, perhaps falsely assuming that past practice was perfect. There has been no attempt to critique what the ideal should be and compare against that, in any of the areas researched, be it training, patient care or junior doctor lives.

3.1.2 Number of Doctors

One of the most immediate responses to the changes imposed by the EWTD, is that if doctors have to reduce their working hours, then more doctors are needed to maintain the current system. However, on this topic the literature appears to be divided.

Certainly in the long term, the Royal College of Physicians' Trainees Committee argues that "increased numbers of both consultants and SpRs will be vital to maintain and improve standards in acute medicine" (Gordon 2002). This is a claim that is echoed repeatedly in personal views expressed by clinicians at various levels and specialties (Pickersgill 2001; Thorpe 2002; Berry 2003; Molloy 2003) and in articles reviewing EWTD progress (Anon 2002; Bateson 2002; Mather 2002; Sheldon 2004). Shaw (2002) calculates exactly how many extra SpRs and Consultants are needed in a neurosurgical unit to maintain existing service, which is an exercise that other practitioners have probably been doing around the country.

There is also recognition that regionally, large teaching hospitals with more doctors may have an easier time implementing the EWTD than smaller district general hospitals (Rawnsley, Hurst et al. 2004). Nationally, the UK seems to be at a disadvantage regarding the number of junior doctors, partly due to historic restrictions on places at medical schools. According to Sheldon (2004), "the ratio of junior to senior doctors is 1.4:1 in the United Kingdom; the EU average is 1:4", allowing junior doctors in training to be far more supported by senior clinicians.

While the cry for more doctors is the general response from the "shop-floor", the Department of Health guidance has been that recruiting extra doctors is not the solution, saying that it is "not the most effective use of financial and human resources" (MacDonald 2003):68. Guidance nationally to implementing the EWTD has been to reduce the number of rotas by reducing tiers or increasing covers, developing new roles, and re-examining activity in the night time period.

While this has been the basis for Trusts' approaches in the absence of funding for extra doctors, increasing the numbers is still a popular opinion. As the consultant Alan Berry puts it:

> "The merit of reducing further the hours of work is for debate elsewhere, but if it is believed to be necessary it is folly to suggest that it can be done without replacing the doctors taken from the wards with others of equal standing. A football team playing with only 10 men is not the same effective unit as the full side. It may make do, by extra effort, for a short while, but it will not be able to sustain performance throughout the season." (Berry, 2003: 929)

3.1.3 Quality of Patient Care

One of the primary concerns about the EWTD (as any change to the National Health Service) is the impact on patient care. This concern manifests itself in three ways: the quality of care, the continuity of care, and "service" provided to patients. Each of these three aspects of patient care has been addressed in the literature on the impacts of the EWTD.

Quality of patient care is a major concern in most of the research and as such its' impacts are either evaluated or addressed in some way or other in most of the literature. However, what is meant with "quality" of patient care? How is it defined and how are the impacts measured?

Some of the research goes to great lengths in defining "quality" and justifying its measures. In their study of the effects of changing junior doctor work schedules in the USA, (Gottlieb, Parenti et al. 1991) are specifically interested in effects on resource utilisation and patient care, which they defined as the "length of stay, and use of laboratory, roentgengraphic, and consultative services" and measured by length of stay and total number of selected laboratory tests, which included "all assays of hemoglobin, sodium, serum urea nitrogen, bilirubin, prothrombin time and urinalysis." (Gottlieb, Parenti et al. 1991:2066). No justifications for these as measures are given, yet the results of their time-series study before and after the change in work schedule revealed that there was a reduction in their measures, indicating better patient quality of care and resource utilization. This study as a whole isn't too relevant in the sense that it doesn't deal with New Deal or EWTD designed rota evaluations, nor is it set in the UK. But it is worth considering showing that also in the U.S. there is the recognition of similar problems and that efficient and tailored design of work schedules can produce efficiencies in resource utilization and improve patient care, as defined by length of stay. The emphasis here is on patient care and resource utilisation and no mention or attention has been given to effects on residents' education and training. This may be because the actual overall hours are not being reduced for residents, and only some reductions for interns, but the total numbers of hours spent at the hospital are still in excess of 70 hours per week at any time. So, this study has some contribution in how it assesses patient care and the relationship this has with doctors working patterns.

Before junior doctor hours were reduced, McKee and Black (1992) sought to evaluate the effect of the use of junior doctors in the U.K. on the quality of medical care. For this purpose, they adopt the stance that "A broad definition of quality of care will be used. It is not sufficient to consider only the technical competence of those providing care. Rather, a high quality service is one that provides effective care and is delivered equitably, humanely and efficiently."

(McKee and Black 1992:550). This broad definition that they adopt means that they do not decide to measure the "quality of care" directly, but decide to measure five principal consequences of the junior doctor staffing structure that they identified were felt to influence the quality of care provided: amount and rest of sleep; supervision; continuity of care; medical training; and job satisfaction. (McKee and Black 1992:550). Interestingly, this means that they are not actually defining what they mean with the "quality of patient care" but rather, are measuring what they believe influences it, which in turn means that the research is based on their assumptions of the causal relationships. Therefore, their conclusions are not surprising when they find that "the existing pattern of medical staffing in the United Kingdom clearly affects the quality of patient care, although the relationship is complex, at times conflicting, and often indirect." (McKee and Black 1992:556). This indicates the need to model this systemically and perhaps understand the need for looking at the most appropriate ontology and epistemology.

Beyond this McKee and Black (1992: 556) found that "four aspects of the system reduce the quality of care: tiredness; lack of supervision; poor quality training; and low job satisfaction." Most interestingly, this article looks at the impact of at the time current or "old" staffing on the quality of patient care (pre-New Deal and EWTD). However, others raise the same issues, when they look at the impacts of reduced hours. So are these issues really new, or are they simply brought to the forefront by the changes to junior doctor working?

In a different approach, Jones, et al (1992) research the effects on quality of care of changes to medical staffing as outlined in the government's *Achieving a*

Balance (again, pre-New Deal or EWTD), gathering consultants' views. In total, they identified 109 separate adverse effects on patient care, which they condensed to 20 principal issues (Jones, et al. 1992: 36) and resulted in four categories, each with concrete and more importantly quantifiable measures:

1. Time to provide a humane service
2. Patient and staff satisfaction
3. Administration and management of cases in the hospital
4. Medical Outcomes

Interviews resulted in issues which "reflected two major concerns: a reduction in the effectiveness of care, and a reduction in the humanity of care." (Jones et al. 1992: 36) The study found that consultants had concerns that the first three categories of measures would all decline, but regarding the fourth:

> "Physicians were uncertain as to whether or not a consequence of fewer junior staff would be an increase in missed or mistaken diagnoses, more frequent incorrect treatment or a rise in fatality rates". (Jones et al, 1992: 39)

This reinforces that although everyone is quick to pick up on the potential impacts on continuity of care, it is extremely difficult to actually assess the impact on the quality of care, in terms of medical treatment, as it is not possible to repeat the same experience twice. Thus, any definition of "quality of patient care" has to be carefully considered, not only to include the humanity and efficiency aspects, but whether the patient is actually "worse off" medically speaking, due to the changes. So there is a strong case for the need to define, what do we mean with effective care?

Beyond these studies, there have been limited attempts in defining quality of patient care in evaluating impacts of reduced hours working, even though it is continually addressed as a concern in the literature. In their survey of what junior doctors think, West et al (1994) wanted to assess "awareness of changes, satisfaction or otherwise of the current hours; and which of the proposed rotas were preferred. Specific questions were asked about how the changes would affect quality and continuity of patient care, adequacy of postgraduate training, professional relationships with other staff, and the effect on overall income and social and domestic life". (West, Weight et al. 1994): 331 Patient care is not defined, but rather referred to in the questionnaire, as what would the effect be on *overall* patient care, which they found was thought to be improved, because the junior doctors thought they would be less tired and therefore would work better. This is encouraging; as this is what reducing hours initiatives and legislation are intended for. However, it must be remembered that the "changes" that this evaluation is in reference to, is the introduction of the 72 hour week - far above the proposed changes of the 48 hour EWTD week. Further, patient care is again linked to other impacts of the system, not a stand-alone result of change, which strengthens the need to model all the impacts and their relationships in the system.

The quality of patient care is further alluded to in the rest of the literature, by concerns that long hours impact on clinical decision making (Baldwin, Dodd et al. 1997) and that this clinical decision making could be improved in shift working by effective handovers (Nasmyth, Pickersgill et al. 1991). Shaw (2002) links quality of patient care to continuity of care, by asserting that lack of continuity would increase the number of mistakes made, and others refer to it more generally simply as "quality of patient care" without definition (Roberton 1998; Gordon 2002; Mather 2002; Rawnsley, Hurst et al. 2004). Finally the aspect of patient care pertaining to safety and risk is also considered. (Murday, Hamilton et al. 2000; Paice and Reid 2004; Sheldon 2004).

So is the quality of patient care affected by changes to junior doctor working patterns (be it through reducing hours and/ or changing working patterns). The results are inconclusive, because it largely depends on what is meant by "quality of patient care" as explored above. On the one hand, the quality of patient care is seen to improve, due to better working conditions and less sleep deprivation for those that treat them, while at the same time there is concern that it could be worse, due to the lack of continuity of care. This is an important point, because there is distinct confusion in the area between continuity of care and quality of care. Just what exactly is the relationship between the two and how is continuity of care affected by the EWTD and what impact does that have on quality of care? This is to date a gray area and largely based on opinion, rather than quantifiable research. While this research does not specifically resolve this issue, it manifests itself in some of the other discussions around the concepts of training and service and their relationship and effectiveness, so it is important that the reader has some awareness of this matter.

3.1.4 Continuity of Care

In the long hours culture of working, continuity of care for patients by junior doctors was ensured through continuous presence at the hospital. Doctors regularly saw the same patients through from admission to treatment to discharge. With the introduction of the EWTD and the consequential move to shift working, there is unanimous consensus in the literature and amongst practitioners that continuity of care, as provided by junior doctors, is and will be disrupted. Particularly, poor handovers between shifts were seen to cause poor continuity of patient care (West, Weight et al. 1994). Contrary to popular opinion, only one partial shift system was described that claimed to operate in acute hospital services without impairing continuity of patient care. (Raine and Irving 1991) However, what is the significance of continuity of care? Why is it important? Mather (2002) admits that this has been questioned in the past, though maintains that its importance was "amply evident from many of the respondents' vivid anecdotes." (Mather, 2002: 431).

In one respect, continuity of care has been linked to the quality of care (Shaw 2002). "It is suggested that continuity improves care by encouraging a closer doctor-patient relationship. Such a relationship is important to enhance the likelihood that correct clinical decisions are made, and that the patient's emotional needs are taken into account. This relationship cannot develop if the patient is seen by a doctor who is not familiar with his or her case." (p. 553) (McKee and Black 1992).

At the same time, continuity of care is generally seen as imperative to quality training for junior doctors, whether this is explicitly outlined (Fisher, Moffat et al. 1994) or inherently assumed (Kapur and House 1998). Chandra (2004: 455) explains that

> "The benefits of staying on-call throughout, and following patients from presentation in hospital all the way through to final outcome are a thorough education and continuity in patient care. The converse is my experience with shift systems...This loss of continuity, in my opinion, results in stunted education and, more importantly, interruption in patient care."

Further continuity of care is found to be an important aspect of job satisfaction for junior doctors. (Baldwin, Newton et al. 1997; Kapur and House 1998)

However, training aspect aside, is it necessary for junior doctors to provide this continuity to patients? While traditionally, this has been the case in the past, Sturmberg argues that this need not necessarily be. "Continuing care doesn't have to be provided by one person necessarily. It can be provided by different providers, the co-ordination is the important thing. And that requires within the practice a good working relationship with your colleagues, a common approach." (Krogstad, Hofoss et al. 2002): 37. Thus, while most are still convinced that continuity of care must be provided by the same person or "firm" (Scott-Coombes 2002), there is a start away from thinking of continuity of care to *continuity of information*, with emphasis on the need for effective teamwork and communication between health professionals. If this indeed is the case, then there is scope to reconcile this aspect of the EWTD and shift working, though measures to do this will have to overcome tremendous resistance, as it has become so engrained in the medical culture that it is no surprise that this is an aspect that practitioners are keen to see continue in the future, and talk about "preserving" it. (Bateson 2002)

Thus, loss of continuity of care is universally cited as one of the impacts of the EWTD and shift working. However, its significance is less clear. While it may be important for the patient *experience*, its effect on actual quality of patient care (in terms of medical outcome) has yet to be proven. Unfortunately, this topic is not clarified, largely due to the lack of definition of quality of care. Similarly, on the training side, continuity of care is seen as important to effective training and education, but it has not been concretely proven that it is due to the loss of continuity of care that training has been affected by shift working. Also, is it continuity of care or rather continuity of information that is important? There appears to be significant amounts of overlap.

3.1.5 Service

The third aspect of patient care that is often addressed in the impacts of EWTD and shift working literature is that of "service." Similarly to "training" and "patient care", in most of the literature there is a distinct lack of definition of what is meant by "service" and it is often either seen as the contrast to or coupled with "training". Further, in this literature, the concept of service is addressed in a number of ways.

In evaluating the impact of the EWTD on "service", the Royal College of Surgeons of England Working Party worked through hypothetical reduced-hours scenarios, calculating how many hours of service surgical SpRs would have under the new regulations. (Chesser, Bowman et al. 2002) However, amongst the extensive discussion of service there is no definition of what is included in these hours of "service", as opposed to "training". In a similar hypothetical scenario calculation of EWTD compliance in a neurosurgical centre, Shaw (2002) is significantly clearer in clarifying what he means with "service" that is lost. He defines "service" in terms of operating sessions, theatre activity, and neurosurgical outpatient clinics, and also relates this to reduced consultant availability. This is a very patient and waiting list centred approach to defining "service". In a complete contrast, service has also been described more elusively as provision of "maximum effectiveness of care for the lowest possible cost" (Roberton 1998): 1032, appearing to be a very managerial or economic point of view.

Additionally, when referring to reduced hours working, service is often referred to as being in direct conflict with training. (Kapur and House 1998; Murday, Hamilton et al. 2000).

> "There is an inherent conflict between the service needs of the hospital system and the educational needs of junior doctors. When the service components are arduous, training suffers." (Kapur and House, 1998b: 432)

Unfortunately, there is no detailed explanation in the literature of what statements like these mean. One is left assuming that there is a sense of priority, that "service" is something that has to be done, but how is this in conflict with "training", unless "training" is something more than on-the-job experience? Is it teaching? What's the difference? And how does learning fit into this? Can't one learn whilst one is providing a service? None of these areas are elaborated or explored when evaluating the impacts of EWTD and shift working. However, lessons could be learnt from work-based learning literature.

Finally "service" is referred to as in the literature as broader "services" in relation to the EWTD. It is broadly recognised that the EWTD cannot be fully implemented in the long term without better organisation of services and/ or changes to the delivery of service. (Pickersgill 2001; Thorpe 2002)

3.1.6 Training

Having reviewed how the working patterns (hours) and patient care ("service") have been explored in the literature, the remaining major area that appears to be affected by the EWTD is junior doctor training. The process and content of postgraduate medical education in the UK was briefly reviewed earlier. In this section it is necessary to review the thoughts and findings around the impacts of the EWTD and shift working on training. As with the other factors, the investigation of "training" impacts suffers from a lack of definition of what is meant with "training": is it classroom teaching, on-the-job experience, teaching, all of the above?

Given this lack of direction, it is not surprising that the results on impacts of shift working and reduced hours on junior doctor training are inconclusive and contradictory.(Scallan 2003) Some studies comparing shift working to on-call patterns have found a significantly lower training experience and training satisfaction scores for the participants (Kapur and House 1998; Carr 2003) while others purport that either training standards are maintained(Rawnsley, Hurst et al. 2004), or even improved due to better learning and working conditions associated with less tiredness. As before mentioned, the literature also refers to adverse impacts on training in relation to loss of continuity of care (Chandra 2004) and that when hours are reduced, there are fewer opportunities for learning (Roberton 1998; Carr 2003), a dilution of experience (Fisher, Moffat et al. 1994) and "service" takes precedence over "training". (Kapur and House 1998; Murday, Hamilton et al. 2000). In contrast to the study of Kapur and House (1998b), Rawnsley et al (2004) in their before-and-after study of the clinical and education implications of shift work found that "the introduction of shifts has not adversely affected the education and training of urology PRHOs." (Rawnsley, Hurst et al. 2004):72. This was based on questionnaires, and reflected the view of the junior doctors. Interestingly, this was not echoed by the Consultants in the same study who "were concerned that shifts had adversely affected PRHO education and training, and felt that the emphasis had moved from training to service provision." (Rawnsley, Hurst et al. 2004):72. Once again, all these findings are limited in that they are perception based, with a distinct lack of definition of what is meant by education and training and how its effectiveness is measured (which is what would be needed to truly understand any changes.)

Moving beyond simply assessing that training and education are adversely affected by shift working patterns, Carr (2003) outlines in more detail some of the impacts namely: a reduction in time available and an "increase in work intensity [which] leads to a further reduction in time and opportunity for experiential learning, less opportunity for personal reflection and interaction and learning with colleagues..." (Carr, 2003: 622) This is starting to move towards a more detailed understanding of impacts on training. Beyond the studies, there is significant amount of literature in the form of personal commentaries, editorials and anecdotes, expressing the concerns over the potential adverse impacts of reduced hours and shift working on education and training of junior doctors at all levels. (Scott-Coombes 2002; Chikwe, De Souzaq et al. 2004; Goodman 2004; Paice and Reid 2004; Sheldon 2004)

Increasingly, what this has meant is that there is widespread recognition that with the EWTD impacting on training as it exists in its current form, that education and training of junior doctors will need to be re-examined, be it in its structure or definition. Khera et al (2001) devote a whole study assessing what the "ideal hospital doctor" would be and how they would be trained. This resulted in the identification of eight broad areas of attributes, which would need to be included in the training, and included skills well beyond clinical knowledge and decision-making. (Khera, Stroobant et al. 2001) Additionally, the government is starting to move away from past assumptions. Professor Graeme Catto, president of the GMC, calls for a new, wider definition of medical education and training under the EWTD (Catto 2002) and has said that:

> "We need to get away from time. Education is not time based. We must move towards competence based outcomes...We should not ask motivated young doctors to work X years to perform Y number of procedures just to support the service." (MacDonald 2002:1235)

A final observation about the effects on training is: is the quality of education and training really a problem due to the reduced hours and shift working? With these tremendous changes to junior doctors' lives, it is easy to forget that things weren't perfect in the past either. There is overwhelming evidence that long hours are not and have not been conducive to learning or working (Baldwin, Dodd et al. 1997; Pickersgill 2001), which is why the New Deal and EWTD reduced hours have been introduced for junior doctors in the first place. So, if in the past training was about quantity not quality, why can it now not be about quality instead of quantity?

3.1.7 Other Identified Factors

In studying the impacts of EWTD and shift working on the central areas of patient care, continuity of care, service and training, a number of other effects have been identified. These include amount of sleep(Gottlieb, Parenti et al. 1991; Nasmyth, Pickersgill et al. 1991; McKee and Black 1992; Smithers 1995), the physicians 'performance' (Gottlieb, Parenti et al. 1991; Baldwin, Dodd et al. 1997; Bateson 2002), resource utilisation (Gottlieb, Parenti et al. 1991), appropriateness of junior doctor tasks (including menial tasks)(Nasmyth, Pickersgill et al. 1991; McKee and Black 1993; Baldwin, Dodd et al. 1997; Roberton 1998; Rawnsley, Hurst et al. 2004), job satisfaction (McKee and Black 1992; Baldwin, Dodd et al. 1997; Baldwin, Newton et al. 1997; Kapur and House 1998; Reid and Moss 1999; Gordon 2002; Mather 2002), junior doctor attitudes (Gordon 2002; Mather 2002), quality of life (Hewett-Silk 1995; Baldwin, Dodd et al. 1997; Reid and Moss 1999; Gordon 2002; Mather 2002; Shaw 2002; Paice and Reid 2004), stress, and professional relationships with other staff (Fisher, Moffat et al. 1994; Hewett-Silk 1995; Baldwin, Newton et al. 1997; Kapur and House 1998; Kapur and House 1998; Mather 2002; Rawnsley, Hurst et al. 2004). The exact nature of these effects is largely inconclusive, due to the fact that results are based on perceptions of a sample and not measured, but the same issues appear continually. Most interestingly, given that there has been such a plethora of identified impacts, there have been no attempts in clarifying how these are related to the central tenets of training and patient care, or what the relationships between these look like.

Approaches

In addition to outlining the impacts of the EWTD and shift working that past research and the literature have identified, it is necessary to review the approaches that have been taken, not only to set the findings into context, but for justification of this research and its methodology. The approaches taken are most easily compared when examined in terms of: research participant groups, contexts, data collection methods employed, and types of publications.

Research Participant Groups

Junior doctors, as a group, are officially classified as any doctor below consultant level. This includes Pre-registration House Officers (PRHOs), Senior House Officers (SHOs) and Specialist Registrars (SpRs). Thus, in researching the impacts of reducing junior doctors' hours and moving them to shift working, a mixture of different grades have been researched. Three studies focus only on PRHOs as their primary target research participants (Nasmyth, Pickersgill et al. 1991; Kapur and House 1998; Kapur and House 1998). This is probably the easiest group to focus on, as they tend to represent the grade with the fewest doctors, the PRHO year is a fairly defined year in terms of experience required for training and what tasks they can perform and which they need to learn. As such, the impacts are probably easier to evaluate, though the value of the research may be limited, especially regarding service impacts, as PRHOs tend to function in a supernumerary capacity in some of the activities. Four articles focus on SHOs, which constitutes proportionally the largest grade, and is by far the most unstructured in training terms (Baldwin, Dodd et al. 1997; Baldwin, Newton et al. 1997; Paice 1998; Chikwe, De Souzaq et al. 2004). One study focuses on PRHOs and SHOs together, as the study is focused on specific changes in a department and appreciates that changes in one grade will have impacts on others (Rawnsley, Hurst et al. 2004). Three further articles focus SpRs(Chesser, Bowman et al. 2002; Gordon 2002; Mather 2002) Additionally, most of the studies triangulate or validate the results by including some other staff group views (e.g. consultants or nursing staff). Three studies involve all junior doctor grades (McKee and Black 1992; Fisher, Moffat et al. 1994; West, Weight et al. 1994),. Thus, there is an even spread in the literature of the types of grades covered in the evaluation of shift working and reduced hours impacts, with all grades being represented to some extent or other. Jones et al (1992) sought solely the opinion of consultants on the potential impacts of changes in junior medical staffing.

Results, in terms of identified impacts, appeared to be similar across staff groups, suggesting that those are issues faced by all grades to different degrees. Most notably, is that all these studies target a sub-sample of the population of junior doctors in the UK, either by targeting specific grades or specific specialties. Even when all grades are targeted, these are all grades in a specific region, Trust or unit. This is probably largely to do with research constraints such as access to accurate lists of participants and resources available.

Contexts

As with the types of staff groups targeted, the contexts in which the studies took place varied tremendously, but all combinations are represented to some degree or other. A number of studies involved more than one Trust (Jones, Sanderson et al. 1992; McKee and Black 1992; West, Weight et al. 1994; Baldwin, Dodd et al. 1997; Paice 1998), but then these tended to be concentrated in a geographical area, such as the study by Jones et al (1992). One exception to this was the study by Baldwin et al (1997b), as they targeted medical students of a medical school, two years on. This ensured that the SHOs would probably be spread across Trusts around the country. At the other end of the scale, some articles concentrated very specifically on the effects of changes to working patterns on a specialty, department or unit within one Trust (Nasmyth, Pickersgill et al. 1991; Fisher, Moffat et al. 1994; Turley 1997; Gordon 2002; Shaw 2002; Will and Will 2002; Chikwe, De Souzaq et al. 2004; Rawnsley, Hurst et al. 2004). This is probably the most controlled environment, explaining its popularity. Alternatively, this could be because the specialty may have commissioned the research or decided to publish its experiences. Of course, this specialty focus will have more implications for generalisation. The remainder of studies concentrated on a cross section of departments across one Trust or nationally (Hewett-Silk 1995; Baldwin, Newton et al. 1997; Mather 2002; Thorpe 2002).

Research Methods

There are a few issues regarding research strategies that explain the data collection methods employed in the literature reviewed. There is inherently a conflict between wanting to adopt a largely positivistic, quantitative research strategy, as is common in medical and health research, in order to validly evaluate impacts of the EWTD on hypothesised factors, and the inability to adopt this research framework completely because of some of the qualitative elements in the nature of the problem. Thus, by far most of the research is based on collecting views on impacts of EWTD and shift working by means of questionnaires, which are then quantitatively analysed. (West, Weight et al. 1994; Smithers 1995; Baldwin, Newton et al. 1997; Kapur and House 1998; Kapur and House 1998; Paice 1998; Murday, Hamilton et al. 2000; Mather 2002) These questionnaires seek to assess participants' views (whichever grade is targeted) on perceived impacts of the working patterns they are looking to evaluate. While this is valid if a constructivist approach is taken, researchers are often too quick to generalise the results of the questionnaire. Thus, if a group of doctors perceive training to be suffering under a new working pattern (and note that this is a perception of a concept that has been poorly defined) then this is quickly generalised, that the EWTD has adverse effects on training, when in fact, this may be a reaction to change or due to other organisational issues. Direct causal relationships are being researched based on perception, without further thought given to definition or the development of measures. Thus, there appears to be an inconsistency in research methodology. What this means is that most of the research becomes of the nature of opinion surveys, when accurate measures are not developed.

Two studies apply tried and tested questionnaires (Baldwin, Dodd et al. 1997; Reid and Moss 1999), though these are in relation to stress-testing, employing standard questionnaires and the accordingly developed measures, such as the Attitudes to Work questionnaire, General Health Questionnaire, Occupational Health questionnaire and the OSI (Occupational Stress Index) questionnaire.

Jones et al (1992) adopted a Delphi study approach to gather consultants' views on what will happen to patient care in light of the proposed changes to junior medical staffing. The authors go to great length in defending the approach, their choice of participants, how generalisable the research is and how they chose to analyse the questionnaire data in terms of descriptive statistics. Once again, impacts of changes to junior doctor working identified result in areas that are not readily measured, nor quantified, yet have knock-on effects. It shows that effects of changes are highlighted anecdotally, by people's views and opinions, and even though there may be a high level of consensus between a high number of participants regarding the impacts on quality of care, that does not necessarily mean it's the "truth", unless of course you adopt the purely constructivist ontology. In general this is a thorough study of consultants' views of the likely effects of proposed changes, seeking consensus and very much in a positivistic framework of research. Interestingly, it only highlights adverse effects, which on one hand is one-sided, but on the other, not surprising as people in general, but senior clinicians in particular, are quick to be adverse to government changes to the way healthcare is run.

In addition to employing questionnaires in their research methods, some studies include other more quantitative data collection methods such as activity diaries (Gottlieb, Parenti et al. 1991; Fisher, Moffat et al. 1994; Hewett-Silk 1995; Will and Will 2002; Rawnsley, Hurst et al. 2004) to assess how junior doctors activity and working lives are affected.

Interviews are also frequently used, but none of these in a constructivist framework, but rather to gather quantitative data, such as the number of incidences and hours worked in the last week (McKee and Black 1992) or to supplement quantitative data collected through questionnaires (Baldwin, Dodd et al. 1997; Reid and Moss 1999). One of the few purely qualitative approaches in which interviewing was employed was the work done by Khera et al (2001) in which they attempt to identify the ideal hospital doctors' competencies and training framework from the perspective of some specialist registrars. Notably, this research was undertaken with an education focus, irrespective of the EWTD.

Overall, it can be said that most of the research and literature is survey and opinion based, where areas of impact are poorly defined, and thus perceptions are easiest to be researched. Basing research on perceptions is not a problem in itself, as long as this is highlighted, or if it is used in working towards definitions. However, most of the research seeks views and opinions on areas that are assumed shared knowledge in the medical culture, but not defined, and this could explain some of the high variations in results. So, even though the quantified impacts are often sought, it is not the impacts that are quantitatively analyzed, but the perceptions. Only the hypothetical projections by Shaw (2002) and Chesser et al (2002) are able to adopt a purely positivistic framework with quantification of effects. However, these could be critiqued because they are based on linear assumptions of relationships without attempts at validating these.

There is need to combine qualitative and quantitative research approaches to this issue, but in a way that is methodologically sound. It is inevitable that research will be based on perceptions in this area to some extent, because it is necessary to draw on the experiences of junior doctors, but this doesn't mean that "soft" issues cannot be defined and measures developed to assess the often very real impacts that these issues have.

Types of Publications

In addition to the standard journal articles publishing results of academic or practitioner surveys, the literature on the impacts of EWTD and shift working draws on a number of different types of publications.,

Medical journals continually feature news updates and reviews of progress on implementing the EWTD, detailing legislative updates, experiences with implementation and reviews of some of the developments ((Northrop and Hearn 1998; Anon 2002; Leiper 2002; MacDonald 2002; MacDonald 2002; MacDonald 2003; Paice and Reid 2004; Sheldon 2004).

Additionally, there are numerous publications and views produced by professional bodies such as the Royal College of Physicians' Trainees Committee (Gordon 2002), the Royal College of Surgeons of England Working Party (Chesser, Bowman et al. 2002)or the Cardio thoracic Surgeons of Britain (Murday, Hamilton et al. 2000).

However, by far the most frequent type of publication regarding the EWTD is personal views in the form of commentaries, responses to studies or editorials. These come from a range of stakeholders, including consultants (Burke 2002; Scott-Coombes 2002; Berry 2003; Goodman 2004), officials of professional bodies (Pickersgill 2001; Catto 2002; Thorpe 2002), junior doctors and other clinicians (Flynn 1991; Raine and Irving 1991; Chandra 2004; Chikwe, De Souzaq et al. 2004) both in the UK and abroad (Roberton 1998; Bateson 2002). Some of these voice very strong and personal opinions, which cannot necessarily be considered as the "truth" but are worth considering complementing the academic literature. Additionally, there has been a brief literature review on the research regarding the EWTD (Scallan 2003).

European and International Comparisons

As the EWTD is applicable to all members of the European Union and doctors have historically worked long hours in the past around the world, it is not surprising that there are some comparisons to health care systems and progress with reducing hours in other countries.

Most common are comparisons with European countries, which include Holland, Denmark, Germany, Ireland, France, Spain, Norway and Slovenia (Rolfe, Gordon et al. 1998; Bollschweiler, Krings et al. 2001; Bateson 2002; Krogstad, Hofoss et al. 2002; MacDonald 2002; Thorpe 2002; Tuffs 2002; Carr 2003; Montgomery 2003; Sheldon 2004). The findings of these are often either that they are experiencing similar impacts on education, or description of how they have achieved compliance, which is often down to the number of doctors in the labour supply of these countries.

Further afield, there are experiences of changes in working patterns in the U.S. (Gottlieb, Parenti et al. 1991; Watson 2002) and Australia (Rolfe, Gordon et al. 1998; Carr 2003) found in the literature. Often these are relating to changes to junior doctor training and working patterns.

3.1.8 Identified Gaps in the Relevant Research

As can be seen from the review of the most directly relevant literature, a number of issues have been identified as outcomes or areas of impact due to the implementation of the European Working Time Directive, in particular through shift working. However, there has been no attempt to identify whether this is due to the doctors working fewer hours or working in shifts (although this would be hard to unpick): the two are treated synonymously.

Moreover, the identified issues, such as training, service, hours and patient care are very hard to isolate. Studies investigate them together, because it is hard to address one without the other, as they are often causally related in some way.

This leads me to directly identify that there is a distinct need to model this research or problem area as a system, identifying and clarifying and defining each and the relationships between them. In particular, the elusive concepts of "training" and "service" and how this relates to the operational detail of what junior doctors do within their hours and how this impacts the hospital system as a whole. No one has yet attempted to see this junior doctors' hours/ training/ service system as a whole and attempt to build a picture of it in order to better understand it.

Another interesting observation is that all the literature on junior doctor training and working evaluates the changes implemented due to the EWTD by comparing them to past practice, perhaps falsely assuming that past practice was perfect. There has been no attempt to critique what the ideal should be and compare against that, in any of the areas researched- be it training, patient care or junior doctors' lives.

Before returning to the point about a lack of systemic approach to understanding this research and problem area, it is useful to concentrate for a moment on the concept of "training" pertaining to junior doctors.

Much effort in postgraduate medical education has gone into researching various aspects of "SHO training".

Disregarding the literature that is mainly of a report style nature, expressing opinions on the state of affairs or imminent changes to SHO training, or the letters and editorials on the matter that are to be found, it is unsurprising to find that with only a few exceptions all research into SHO Training has been conducted in a quantitative framework, given that this type of research methodology is the mainstream in medical research. Only the work done by Clark et al (2002) into identifying the perceptions of the strengths and challenges in the SHO training programme at a dental teaching hospital and indicating areas for improvement was conducted in a truly constructivist light, adopting two rounds of focus groups with SHOs and educational supervisors, in order to gauge perceptions and build consensus around improvements.

Although novel to this area, this piece of action research was valid in that it matched the research methods with its aims, and indeed the authors put a lot of effort into justifying their approaches, simply because it is not typical. Further, because it is of constructivist nature, Clark et al (2002) state that their findings may only be of interest to the specific context, but purport that "the method employed can be transferred to other contexts to support a grass roots approach to change." (Clark, Thomas et al. 2002) It is also of significance that this qualitative research is one of the more recent pieces.

On the quantitative research, there seem to be two main approaches to studying aspects of SHO training: using questionnaires (administered either by post or over the telephone) which are quantitatively analysed, or using existing historical patient oriented case data which is then used to inform the research aims.

A large part of the research literature has employed postal questionnaires (Clark, Conaghan et al. 2000; Watson, Boulton et al. 2004), some of which are subsequently "chased" over the phone,(Davies, Tan et al. 2000; Nor and Plusa 2004) or with second mailings (Taylor and Macdonald 2000), in order to increase response rates, and then quantitatively analysed. Some back up the data from the questionnaires with information from learning logs (Kelly and Murray 1999) or "group discussions" (Carpenter 1999). A number of researchers prefer to administer the questionnaires over the telephone, or conduct structured interviews (Barker and Buss 1993; Lloyd-Davies, Mansel et al. 1996; Tan, Driscoll et al. 1997; Whitaker, Eyre et al. 2004), which some would argue is the same thing. Paice and West (Paice and West 1994) conducted their research by interviewing SHOS "individually or in small groups from the same specialty." (Paice and West 1994). Unfortunately the rationale behind combining data gathered from individual and group interviews is not explained or justified.

As the practice of clinical audits is common place in this environment, it is not surprising that some researchers have taken audit-type approaches to investigating SHO training, indeed even referring to it as 'audit'. Using patient and case data collected from hospital databases, some studies have investigated what SHOs are exposed to, in order to make inferences about the training experience that they are receiving. While this means that large amounts of data can be collected, and indeed gives an accurate picture of what types of patients and cases have been treated in the unit or specialty under consideration, there may be some flaws in what this means for training (more about this later). These activity audits are used to analyse theatre activity on the surgical side (McIndoe and Underwood 2000; Stewart and Spice 2000; Weale, Lear et al. 2002; Khan, Lauffer et al. 2003; Ghosh, Torella et al. 2004) and procedures (Potter, Griffiths et al. 1996) and conditions experienced through being "on take" on the medical side (Pearse, Mitra et al. 1999). (Being "on take" means being the on-call doctor assessing and responding to the needs of all new admissions for the specialty.) Further, other activities such as meetings are "audited", such as when Hargreaves (Hargreaves 1998) analyses the number and style of questions in a daily departmental meeting to assess the training opportunities for SHOs. Finally, this type of audit of patient data is used to calculate theoretical manpower requirements for a 24-hour acute neurology service at Derriford Hospital, Plymouth, in which training requirements are also considered. (Carroll and Zajicek 2004)

When considering approaches and research methods employed, one article displayed a mixed method approach, employing observation, focus groups, semi-structured interviews and a Delphi style survey in order to identify the core and specialty specific competencies of basic surgical SHOs.

It is both comforting and concerning that research into SHO training has been conducted in a wide variety of both surgical and medical specialties. Concerning, because similar findings regarding problems with training are being confirmed across SHO posts and comforting in that this strengthens the argument that there is a universal problem, rather than a local one. Studies are split in that some sample SHOs across regions or nationally, while others concentrate on whole populations within units or specialties, or indeed use individual case studies over longer periods of time (Khan, Lauffer et al. 2003). In addition to surgical (Benson 1995; Lloyd-Davies, Mansel et al. 1996; Milne, Griffiths et al. 1996; Bunch, Bahrami et al. 1998; Ackroyd, Bannister et al. 1999;

Carpenter 1999; Hurley and Paterson-Brown 1999; Clark, Conaghan et al. 2000; Weale, Lear et al. 2002; Nor and Plusa 2004) or medical SHOs in general (Paice and West 1994; Crome 1997; Pearse, Mitra et al. 1999), training in individual specialties such as obstetrics & gynaecology (Kelly and Murray 1999), A&E (Rodenberg 1996; Tan, Driscoll et al. 1997; Kelly and Murray 1999; Reid 2002; Khan, Lauffer et al. 2003), ophthalmology (Watson, Boulton et al. 2004), neurology (Carroll and Zajicek 2004), paediatrics (Davies, Tan et al. 2000), anaesthetics (McIndoe and Underwood 2000), dentistry (Clark, Thomas et al. 2002), cardiothoracics (Hargreaves 1998), geriatric medicine (Johansen 1997), clinical oncology (Taylor and Macdonald 2000), plastic surgery (MacQuillan, Wilson-Jones et al. 2003; Whitaker, Eyre et al. 2004) and a high dependency unit (Ghosh, Torella et al. 2004). A wide variety of areas of the UK are represented in the studies, including Northern Ireland, Wales and Scotland as well as regions all over England. A lot of the research seems to be surgically based studies – maybe because here there has been more cause for concern regarding experience, as there are more manual skills to be learnt in less time (although one study highlights the importance of manual skills in medicine too.)

In addition to the variety in research methods and areas, it is not surprising that in such an elusive are as SHO training, where a plethora of topics can be investigated, different measures and definitions are used. And indeed this should be the case, as measures and concept definitions should always be tailored to the research question.

However, there is a distinct absence of a clear definition of what is meant by "training" and there are no detailed standards of competencies or experience to be achieved for the SHO grade, and there are subsequently wide variations in what is measured in the literature.

Recognition of these inconsistencies in SHO training standards and recommendation has led to the General Medical Council's publication of the booklet on SHO training named "The Early Years" which follows on from "The New Doctor" for Pre-registration House Officers, and subsequent consultations and proposals for changes to the SHO grade (Anon 1998). Indeed, most recent years saw the forming of a Postgraduate Medical Education and Training Board (PMETB) who had been tasked to write a curriculum for SHO education in line with recommendations as outlined in *Modernising Medical Careers*. This will saw the structuring and formalising of the SHO training grade, similar to the Calman Report for the SpR grade in the 1990s. However, until this happened, which was after the time in which this research was conducted, research into SHO training continued singing from different hymn sheets, as to the requirements and standards that SHO "training" is being measured against. Most recent developments since the completion of this research and what impact this has are reviewed at the end of this section.

3.2 The Concepts of Training and Learning

Having identified in the review above that there is a clear lack of definition around the concepts of "training" and "service" for junior doctors in the most pertinent literature, it is worth opening the search for this definition or exploration somewhat wider, to see if light can be shed on these somewhat nebulous concepts, which will allow us to explore them in more detail and the relationship between the two.

What is clear to date is that in postgraduate medical education, practitioners and research alike refer to "training". This brings with it some distinct connotations. First of all, if you are being "trained", this leads to assumptions that this is a passive activity which is done to you, and for which a "trainer" needs to be present. This is distinctly different from "learning" which it could be argued is as, if not more, important for postgraduate medical education.

While it must be made clear that this is not a thesis in education or pedagogy, and thus it won't include an extensive review of learning theory, it is worth very briefly mentioning some of the concepts around learning as they relate to the research area, and review how they are relevant to the understanding in the literature to date into junior doctor "training" and what this means.

One can refer to learning on two levels which would be relevant to this research area: individual learning and organisational learning, both of which come with years' worth of development and research in academic circles, too rich to review in detail here.

50 years worth of individual learning theories have been reviewed by the Chartered Institute of Personnel and Development. In summary, they have grouped individual learning theories into 4 clusters (CIPD 2002):

- Learning as behaviour

- Learning as understanding
- Learning as knowledge construction
- Learning as social practice

Learning as behaviour is concentrated on behaviourist theory and largely the work of B.F. Skinner. The main principle of this type of learning comes from natural science, and hypothesises that an individual's behaviour is a result of responses to events and stimuli and the consequences of these. A key feature of this type of learning is reinforcement, which is designed to strengthen behaviour, and in particular verbal instruction is one way of doing this. It is an instruction-based way of learning, typical in schools, clinical and adult education. It is this learning theory that is closely related to the "training" referred to in postgraduate medical education. While it is an appropriate way of learning skills under controlled conditions, the reason why this cannot and should not be the only way for junior doctors to learn is that it does not equip them with the necessary skills to react to new and different situations in the real world. "Equally, the power relationship between the learner and instructor can limit creativity and self-expression" (CIPD 2002: 2), an observation often made by junior doctors in presence of 'their' consultant or 'boss'.

Cognitive learning theories, or learning as understanding, see learning as a way of us internalising and understanding the world around us and the way we relate to it. In this view of learning, learners observe the world around us and the information we receive from it and process it as knowledge. Cognitive learning will perhaps be more relevant in the discussion of model building of the system as perceived by the problem owners, which will be a key feature in this research.

Learning as knowledge construction has yet another focus. In this cluster, theories view the individual as the centre of the learning experience, who constructs subjective knowledge depending on the context that they are put in. So by comparison, in behaviour learning, the "expert" is the focus and in cognitive learning it's the "content", but in this cluster it is the learner. (CIPD 2002)

Finally learning as social practice does not contradict any of the above, but sees learning as more effective when it occurs in a social context. Thus, organisational culture would play a key part in this process.

It has also been suggested that learning can be put into an organisational context in that you can see learning theories as learning for work, learning at work and learning through work. Certainly all of these principles apply to junior doctors who have to learn in order to be able to do their job in treating patients; learn at work as their main place of education in the clinical setting and learn by doing and actually treating patients, as each case is uniquely different.

While learning theories could be elaborated on at length and what this means for junior doctors, it is important to focus this literature review to the most relevant. While there has been much development in learning theories, postgraduate medical education still refers to junior doctor "training" which carries with it the passive connotation of it being something that is "done" to them. The most referred to "learning" concept in the literature is work-based learning and this is indeed what it is most referred to in medical education literature.

Sobral (2004) looked into the relationship between motivation and learning features for medical students and Bleakley (2002) looks at ward-based learning in the PRHO year. He finds that the traditional psychological model of pedagogy does not suffice in explaining how work-based learning occurs, as it does not account for varying communities of practice, focuses on a teacher to learner direction of information transmission, rather than information and knowledge being held by a group and accessed in different ways. From this, it is evident that the literature is starting to really try to move away from the concept of "training" in medical education.

Dewar and Walker (1999) identify in their research that there is a clear gap between theory and practice in work-based learning for nurses. It would not be surprising if this rings true for doctors too. In particular, they emphasise that in order for work-based learning to take place, the appropriate support systems need to be in place. What would these support systems look like for junior doctors? One element of this support system would still need to be supervision Spouse (2001) who states that "with increasing emphasis on work-based learning one of the many strategies designed to support students and professionals is supervision". (p. 512)

One further concept closely allied to work-based learning is work-based assessment, especially Miller's pyramid for assessing clinical competence

(Norcini 2003) in which he distinguishes between being assessed in practice and in artificial settings.

Unfortunately, the attitude towards "training" still dominantly prevails and as this research is not an educationally focused one, it will be important to take the native language and examine it more closely in what it means operationally for junior doctors and what makes doctors perceive something as "training" or not.

Joseph Raelin, an enthusiast for work-based learning is one of the few to appreciate this distinct difference between work-based learning and training.(Sims 2000:375) In particular, in relation to management learning, he states that "The need to have education precede practice in the professions...does not have to be replicated in an experientially based, messy, interdependent occupation such as management."

The classroom versus workplace debate should not exist for junior doctors: the two should complement each other. However, as can be seen from the literature on junior doctor training above, the assumptions on when junior doctors are "training" and its importance as compared to "learning" or "education" appears to be rather distorted. Bearing in mind these concepts in "learning" it will be interesting to see how these are relevant (or addressed) when the concept of "training" is explored and what it means in practice, as interpreted by the problem stakeholders.

Organisational Learning

While the organisational learning literature would require a book of its own as a review, it is worth mentioning briefly that organisational learning will inevitably feature in this research to some degree, as it will be addressing an organisational problem, which its stakeholders want to learn more about. In understanding this problem, they will inevitably be "learning" about it. Much of this theory will be covered in a later section on modelling applications.

While there is a distinct movement towards "learning" rather than "training" in postgraduate medical education, given that the language, terminology and associated assumptions still exist, any attempt at looking at the education and service activities of junior doctors under the EWTD will need to model "training" or at least the provision of learning experiences, rather than being able to make any statements about what learning is taking place at individual level.

3.3 Updated Literature Review

As much of the data collection of this research was carried out some time before the publication of this thesis, it is prudent to briefly review the literature and key papers published since the research was designed, to ensure that it is still up-to-date, and fits in with recent developments.

Much of the literature regarding junior doctor hours, service and training reviewed to date was published before the 2005. This coincides with when the main part of data collection and modelling was completed, and more importantly, before the introduction of the European Working Time Directive for junior doctors in August 2004, with a need to comply with a 58-hour week. This section updates this literature review for the years from the end of 2004 until early 2009 when this work was submitted.

Key Developments in Postgraduate Medical Education

The 58-hour week was introduced for all junior doctors in August 2004 as part of the phased implementation of the European Working Time Directive. By then, the Department of Health was already finalising the plans for the implementation of the first part of the new system of postgraduate medical education under *Modernising Medical Careers* (Dept. Of Health, 2004b), which commenced with the introduction of the Foundation Programme in August 2005, and the new seamless specialist training programmes in August 2007. For the recruitment to these specialist training programmes, the government introduced a new centralised electronic on-line recruitment system, which caused much controversy in its application and ability to successfully appoint the most suitable candidates into these highly sought after run-through-training programmes, and the experiences in this first year of introduction led to the commissioning of the *Tooke* Report. This report reviewed the principles and the implementation of Modernising Medical Careers and made recommendations for further development which included the return to a 1-year house office training followed by a three-year broader-based training prior to specialist training. It also identified a number of challenges that that MMC was stumbling upon (such as lack of shared policy objectives, leadership, involvement of the medical profession in management, relationship with health education) and also reported the effect that the interpretation of the EWTD was having on training.

In particular the report highlighted the implications that the changes were having on clinical experience and confidence. (Tooke, 2008)

Following the number of rapid changes in postgraduate medical education between 2005 and 2008, the most recent set of changes to junior doctors working lives were experienced this year, when in August 2009, all rotas had to comply to a 48-hour week. The latest development in this respect is the ability for hospital trusts to apply to the European working time directive scrutiny panel to be granted derogation from compliance until August 2011. Wendy Reid, national clinical adviser for the directive has said that "We have always said that we would keep the situation under close review and where there is a genuine need for extra time to safely implement the directive we would allow derogation." (Anon, 2009) Currently around 4% of acute trusts (273 rotas) have been granted derogation.

The sequence of developments in the area of junior doctors' working and training lives has meant that the literature has responded accordingly. In 2004, much of the literature was focused on the implementation of the EWTD (mostly already reviewed), followed by a flurry of research activity around the implementation of MMC, and now post 2007 it has become virtually impossible to separate the two, and therefore much of the research addresses both as changes to the working lives of junior doctors and what impact both are having.

Types of Publications

Similar to the initial review, there is a large variety in types of publications, including original research of both qualitative (Tsouroufli and Payne (2008), Watt et al (2008)) and quantitative nature (Cappuccio et al (2009), Sprigge et al (2006)), Varley et al (2006, Bowhay (2008)) Kim and Zenios (2006) Moss et al (2004)), reviews (Murray et al (2005), Mayor (2005), Nucci (2006) Black (2006) Taylor (2007) Bannon (2006)), audits (Mayed et al, 2006) and letters (Mecci and Syed (2004),Singh (2004, Akerman (2005), Yeluri and Dadayal (2005), Atkinson (2005)), in response to any of these, as well as newspaper and magazine articles providing updates. In particular, there is a growing focus how other countries are coping with the implantation of the working time directive and what can be learnt from them.

International Comparisons

At the end of 2004, after the European Working Time Directive came into force for junior doctors, Mayor et al (2004) reviewed a number of other European countries' progress towards its compliance and found that while the NHS "has been struggling to meet the requirements of the new directive...it is not alone in failing to do so fully." (Mayor et al, 2004:310) They reviewed Austria, Czech Republic, Germany, Portugal, Spain, Ireland, Netherlands, France and Italy and found that with an exception of the Netherlands that countries were not complying with the directive and had varying attitudes towards this, from the Czech Republic's Doctors' Union taking legal action to the French doctors "not even discussing the directive with the government as they consider it 'so totally abstract that it seems inapplicable'." (Mayor et al, 2004:310) Nucci (2006) explains that there are a number of reasons why there is little awareness (and therefore implementation) of the EWTD in Italy. One was that there is a "tendency for Italians at various levels to not perceive European legislation as binding". (Nucci, 2006:814) Moreover, it does not appear to be a concern amongst the medical profession there: in a study of major grievances of doctors in training, hourly workload and issues relating to that were only in eighth place (Nucci, 2006:814). In Holland, doctors have already been working a 48-hour week since 1993, but there may be cost implications for hospitals, in the way that on-call hours are defined under the EWTD. Further afield, doctors in El-Savador are still working 123-hour weeks, which has been identified as having serious impacts on patient safety and an increased number of medical errors, and yet they have taken "no steps at all to limit work hours of medical trainees". (Taylor, 2007:1142) This does help put the importance of the directive into perspective. However, this does not prevent individuals looking to other European countries and drawing parallels to some of the alleged benefits of longer hours: John Atkinson writes "In Brussels I have friends still working the old style 24 hour shifts and coming in the next day to work...the result is that training is being preserved. Junior doctors in the UK are doing little but service provision". (Atkinson, 2005:514)

Key Themes

It is not surprising that the key theme still prevailing in the literature relating to the European working time directive is regarding its impact on "training" both in relation to quality and quantity and the continuity of care. None of the more recent literature negates any of the earlier work as such, but rather contributes updated views, and if anything the flavour of research is much in the way that the changes to junior doctors rotas due to the EWTD and the way in which they are being trained under MMC are both acting together to have a negative impact on the system.

In particular, Tsouroufli and Payne (2008) in their qualitative study of consultant medical trainers' views of MMC and the EWTD identified issues with significant implications to the implementation of MMC with the context of EWTD. Three issues that are particularly highlighted are: the loss of continuity of care, the reduced clinical exposure of medical trainees and the loss of the popular apprenticeship model.

In particular the reduced clinical exposure, or the "quantity" of training, is echoed in other studies. Varley et al (2006) found that surgical trainees now have fewer training opportunities than a decade ago (with number of elective operations available per trainee falling in 3 out of 4 specialties, and the total number of operations available falling to 56% of what it was 10 years ago), and that the introduction of full-shift rotas was removing junior doctors from exposure to this experience. Bowhay's study of trainees' views of the impact of the ETWD in anaesthetic training found that the "majority of respondents thought that it had a negative effect on training...the main themes that emerged ...were that there was less teaching, more emergency work, they were at work more often, and they were getting less experience." (Bowhay, 2008: 43) Kim and Zenios (2006) consider both the impact of EWTD and MMC in their study of training opportunities in paediatric fractures, and highlight the importance of using the range and number of procedures performed, as well as the degree of consultant supervision, as a measure of the educational value of a training post.

It is clear that quantity of clinical exposure (be it in hours or number of procedures) is still an important aspect of the definition of training as well as the extent to which it is supervised. Kim and Zenios (2006) identify a very low level of supervision (13.8% of paediatric fractures performed by junior doctors, including the complex ones), but does suggest operational changes which could help, such as moving non-urgent out of hours surgery to the following morning when more junior doctors are around.

While the most recent literature is highly consistent in its messages around the impact that the EWTD and MMC are having on the amount of training available and the way it is being delivered, some make the next step in identifying some suggestion to ameliorate the situation. These largely involve better planning and coordination of the way in which the service and training are delivered. Varley et al (2006) suggest: expanding use of day surgery and treatment centre facilities for training, introduction of designated training lists, possibility of being "on-call for training", use of simulators, reduction in non-operative workload, and better use of other roles (e.g. clinical assistants and nurses) to create more time for training. (Varley et al, 2006:8-9). In general, most of the research in most recent years has been focused on the "craft" specialties, such as surgery and anaesthesia, which is where the impact is most immediately measurable. 90% of surgical senior house officers in 2005 reported that "revised working patterns had adversely affected their training by reducing their time in operating theatre, contact with the surgeon trainers, and/or time in out-patient clinics." (Mayor, 2005)

As with many things the devil appears to be in the detail. While research has shown some of the benefits of reduced hours and more structured training, which is the ethos behind the EWTD and MMC, it is the way in which it is being interpreted and implemented that is the sticking point. Murray et al (2005) identify that the way in which full shift rotas are being designed and the number of consecutive nights doctors have to work is having an adverse impact on sleep deprivation and clinical safety and that this needs to be adjusted. Cappuccio et al (2009) have quantitatively studied the impact of the introduction of a 48 hour week compliant rota in an assessor-blind pilot comparison and found that while the new rotas drastically improved patient safety in terms of reduced medical errors, that there was a reduction in the number of educational opportunities, and that this will have a long-term impact. The educational impact must be compensated for.

Therefore, this research is still very applicable, both in its approach and content. Operational planners and educationalists are in need to work more closely together to consider training and service together as part of one continuum and that the detail needs to be planned together to make the best of a complex situation.

3.4 Area of Research

3.4.1 The Research Domain

As can most clearly be seen from the review of the literature on the impacts of EWTD for junior doctors, a number of areas of impact have been identified. However, in general there is limited consensus as to both the magnitude and effect of impact, and whether they are directly results of the revised working patterns or simply existing problems in the "system" that have been amplified by the reduced hours. Further, the issues are very hard to unpick, studies investigate them together, because it is hard to address one area of junior doctor lives and the healthcare system without the other, as they are often causally related. There is a distinct need to model this as a system, identifying and clarifying and defining each of these and their relationships. This system can then be evaluated as a whole. This has not yet been done. Methodologically speaking, there have largely been attempts at quantitative analysis, but studies quickly resort to being based on opinions and perceptions, including often anecdotal evidence of comparisons with the past. This largely stems from the lack of definition and clarification of key concepts around "training", "service" and "quality". Further, the literature talks about effects at micro level (e.g. within the tasks that junior doctors perform) and impacts at macro level (i.e. effects on other aspects of the system, service provision, other staff groups, etc) but there has been no reconciliation of the two and how they are related.

It is within these gaps in knowledge and the context in particular that the need has been identified to model the education and service activities of a professional group within an organisational context: namely junior doctors under the EWTD.

The proposed contribution to knowledge from this PhD research falls across a number of areas. Firstly, it is a new application of a systemic approach (namely systems dynamics), and represents the application of an existing modelling method to a new problem. While the application of system dynamics in healthcare policy and decision-making has been growing for a number of years, to-date there has been a limited attempt at systemic modelling of hours/training/service for junior doctors. Ratnarajah & Morecroft (2004) have used system dynamics to model the attrition rate of junior doctors from the British National Health Service due to the implementation of the EWTD. While this is a national model aimed at understanding some of the reasons for junior doctors leaving the profession, and not the model regarding the training and service impacts of reducing hours that is tackled by this research, it confirms that system dynamics is indeed a plausible approach in the area.

More importantly, apart from the systemic approach to studying this problem, the work involved in its development will yield a number of significant contributions to existing knowledge. It will identify the relationship between the structure in this social system and its behaviour, and clarify the relationship between the concepts of junior doctor "training" and "service", at both an operational (micro) and systemic (macro) level. Further, accepting that structure influences behaviour in this social system, this research will be able to identify likely short and long-term impacts and trends in behaviour of the system due to changes in the structure (changes to the training and working patterns of the junior doctors).

3.4.2 Research Questions

This research aims **to model the education and service activities of a professional group within an organisational context**. Specifically, it seeks to clarify the relationship between "training" and "service" at micro level and understand the impacts of changes at this level (i.e. changes to working and training patterns of junior doctors within the reduced-hours context) on the wider system, as perceived by its stakeholders.

In a nutshell, this research seeks to understand how what it is junior doctors do relates to "training" and "service", in order to clarify these concepts and the relationship between them, and model the links between this activity at micro level to impacts and relationships in the wider system of medical education and service provision.

In addressing this overall aim, the research seeks to answer the following particular sub-questions:

(a) What activities do junior doctors participate in? i.e. what activities take up their time?

(b) How do these activities relate to the concepts of training and service? What is considered to be "training" and what is "service"?

(c) What is junior doctor time being spent on?

(d) Do junior doctors spend more time in service than in training?

(e) What are the measures that are being suggested to help with the problem by the stakeholders within the organisational context?

(f) What are the short and long-term impacts of changes to working and training practices inspired by the proposed initiatives?

Using SHOs at Plymouth Hospitals NHS Trust as an example, the research will work with them in understanding what activities they spend their time on, how these can be classified into training/ service, and how much time they spend in "training" or "service" according to the derived classifications. This information will then be used to aid building a model of the junior doctor training and service system and inform the identification and quantification of relationships within the system. The validated model will then be used to evaluate short and long-term impacts of the initiatives introduced to reduce hours worked (e.g. shift working, reducing total hours, no nights, etc.)

3.5 Structure of the PhD

Having set this research into context and outlined the most relevant knowledge to date in the field, it is necessary to briefly outline the layout of this narrative of this work.

As can be seen from both the research area and question(s), this PhD consists of a number of strands of research, which feed into an overall picture. As such it is appropriate to structure this thesis accordingly.

Thus, the section on research methodology was kept intentionally brief, outlining both the ontology and epistemology adopted, which justifies both the overall approach and the individual research methods. Each individual chapter relating to the relevant section of work (and research sub-question) discusses in more detail the data collection and analysis methods and the specific results achieved. These are then brought together in a wider discussion at the end.

This is not a PhD limited to one research method, nor one particular specific research area. It is truly multidisciplinary both in content and approach and thus must be considered accordingly. While an interdisciplinary research topic and approach makes for an extremely interesting discussion and a wealth of contributions to make to a number of areas, it is necessary to view the approaches taken and the discussion of it in light of this broad area. This is not a PhD entirely set within education, employment legislation nor system dynamics. It is about modelling the education and service activities of a professional group within an organisational context, namely junior doctors under the EU Working Time Directive, in order to gain greater understanding of the concepts and system under study. The analysis of this area has warranted a systemic approach, the specific tool within this that was chosen was system dynamics. The analysis leading to the development of the system dynamics model is as important, if not more, than the model itself. The model is not the sought output, but a tool for demonstrating the interrelated nature of the problem and a way of capturing the understanding of the systems, the relationships assumed and the insights and results gained as a consequence.

It was important to design this structure for this thesis, so not to confuse strands of the research by discussing each separately under the headings of methods, results and discussion. Hopefully this adopted structure allows the reader to easily follow the research conducted and results.

4. Research Methodology

4.1 Ontology and Epistemology

Why would it be necessary to devote an entire section to research methodology? The answer to this lies simply in that without specifying what we believe to be knowledge, and how it can be acquired; we cannot define how we will go about seeking to answer the questions we have asked. This chapter covers the research methodology, the ontology and epistemology that have been adopted. This is different from research methods, namely the tools that will be employed in collecting and analysing data. Research methods will be covered separately in the individual sections. The overall research methodology in which they fit is devoted its own section. This is particularly important in this research, as its design is unique to the research problem and requires elaboration and justification in its own right in order to understand the contributions to knowledge that this research produces.

The root definition of ontology is '*the science or study of being*' (Blaikie, 1993: 6). Translated into research methodology, this means that the ontology of a particular approach refers to the assumptions that are being made about the world, and in particular to this case, the social world. It represents what it is we can *know* about the social world, what we claim exists, what it is made up of and how it can interact. The allied concept, epistemology, '*the theory or science of the method or grounds of knowledge*' (Blaikie, 1993:6) consequently represents the assumptions we make on how it is we can acquire that knowledge, whatever we propose it to be, i.e. *how* can and do we know what we know. Therefore our ontological assumptions state what we believe it is that we can know (i.e. what is knowledge?) and our epistemological assumptions state how we believe we can go about acquiring this knowledge (i.e. how can we find out?) It is needless to say that the two are inextricably linked: our ontological assumption lead to the epistemology adopted. If not, then the research approach is fundamentally flawed.

In the development of social science, approaches taken to studying the social world and its phenomena, can be largely grouped into two paradigms, depending on the ontological and epistemological assumptions made: objectivism and constructivism (Bryman, 2001). At the objectivism end of the spectrum, (or which is more often than not inappropriately termed 'quantitative' research), the ontological position on the social world is that it exists independent of its social actors and their activities. It is an ordered reality in which social phenomena are subject to external forces, which can be observed. Positivists, Critical Rationalists and Realists all share this basic ontology, though they differ slightly in some of its elements.

Objectivists assert that 'social phenomena and their meanings have an existence that is independent of social actors.'(Bryman, 2001:17) The epistemological consequence of this is that as this reality is ordered, it can be observed, explained and generalised, to explain other social phenomena. Positivists are at the extreme end of this in their deterministic belief of the social world (i.e. that social phenomena are always the product of external forces.) This is certainly the approach to the natural sciences, and there has been much debate as to whether the methods and techniques of the natural sciences are appropriate to understanding the social world (Williams, 2001). Research under the objectivist ontology and epistemology has largely been termed 'quantitative' research, though the validity of this terminology has increasingly come into question, as it refers to the techniques and methods that are commonly used, rather than the fundamental methodological approach.

At the other end lies the constructivist school of thought. Its ontological position views the social world and its reality as being produced and reproduced by social actors; "it is a pre-interpreted, intersubjective world of cultural objects, meanings and social institutions" (Blaikie, 1993; 203). Consequently (and contrary to the objectivist view), there is the possibility of multiple realities, as perceived by different people. Critical Theory, Structuration Theory, and Feminism are all based on this interpretivism, but again vary in some of the detailed elements of their ontology.

Constructivists (on the other hand) have ontological and epistemological assumptions that appear to be fundamentally at odds with objectivism. At this end of the paradigm, it is thought that the social world is 'produced and reproduced by social actors; it is a pre-interpreted, intersubjective world of cultural objects, meanings and social institutions'. (Blaikie, 1993:203) Consequently, there is a possibility of multiple realities, as perceived by different people (as opposed to the one external reality proposed by objectivists). The epistemological consequence is that social phenomena are interpreted in a given time and space. Research at this end of the paradigm, has largely been coined 'qualitative research', but again this is not necessarily appropriate terminology, as it refers more to the methods employed rather than the approach taken and assumptions made.

What this means is that while there are numerous approaches along a continuum of research paradigm, with various 'names' depending on their ontological and epistemological assumptions, there are fundamentally two views of the world: the objectivist paradigm and the constructivist/ interpretivist paradigm. Often research text books like to term these "quantitative" and "qualitative" research. However, this is not only inappropriate, but false, as these terms refer more aptly to the research methods employed rather than the assumptions made about what knowledge is. As the reader will see in this research (as in many others) it is possible to have quantitative research in a constructivtist paradigm. While it has to be said that there have been attempts to reconcile the two, fundamentally the research always will have to adopt a position that leans more to one paradigm or another, which will have epistemological consequences in how social phenomena is explained and predicted.

Why is so much thought given to research philosophy? The reason for this is that it is not only fundamental to understanding the research approach, but also directly dictates that research design, data collection methods and indeed the analysis and interpretation of results as well as the knowledge that is derived from it. Thus choosing a research philosophy and approach for this research are important considerations.

Disregarding the literature that is mainly of a report style nature, expressing opinions on the state of affairs or imminent changes to junior doctor training, or the letters and editorials on the matter that are to be found, it is unsurprising to find that with only a few exceptions all research into junior doctor training has been conducted in a positivistic and very quantitative framework, given that this type of research methodology is the mainstream in medical research. Only the work done by Clark et al (2002) into identifying the perceptions of the strengths and challenges in the SHO training programme at a dental teaching hospital and indicating areas for improvement was conducted in a truly constructivist light, adopting two rounds of focus groups with SHOs and educational supervisors, in order to gauge perceptions and build consensus around improvements. Although novel to this area, this piece of action research was valid in that it matched the research methods with its aims, and indeed the authors put a lot of effort into justifying their approaches, simply because it is not typical. Further, because it is of constructivist nature, Clark et al (2002) state that their findings may only be of interest to the specific context, but purport that "the method employed can be transferred to other contexts to support a grass roots approach to change." (Clark, Thomas et al. 2002) It is also of significance that this qualitative research is one of the more recent pieces, demonstrating an accepted shift in research focus in this area.

This research is about the educational and service activities of junior doctors within a reduced-hours context and the impact that changes to this system will have on "training" and "service", with a view to exploring and understanding these concepts further. In particular, one of the aims is building an understanding of the system and its problems, as well as gaining an insight into some of the future consequences of changes. The junior doctor system is a social system, with both "hard" (e.g. number of doctors, number of hours worked) and "soft" concepts (e.g. quality of training, quality of service, quality of supervision), which interact in a complex manner to produce both tangible/ measurable outcomes and intangible/ perceived outcomes. While this social system is something very "real" that many of its actors identify with, it is entirely constructed by its actors' perceptions and therefore this research will approach it from quite an interpretivist stand-point. This may be quite a difficult position to explain, but it is worth attempting. Some may argue that concepts such as the number of hours worked and the number of doctors working these hours are facts that would be measurable "hard" concepts and thus one would take a positivistic stand. However, the researcher believes that there are reasons why junior doctors are hired and are working certain hours, which are grounded in decisions that decision-makers are making based on their perceptions of the social system which surrounds it (e.g. there need to be 7 years of postgraduate medical training because that's how long it takes to produce a "good specialist" or if junior doctors work fewer hours we need more of them is based on the perception that they are currently 100% productive and that fewer hours will lead to a loss in production). So measurable decisions are being made based on stakeholders' perception of the system. In order to understand and explain this system, it is necessary to elicit these perceptions and expose them, which requires a phenomenological research position to be adopted. Of course, this does not prevent quantification. As explained earlier, research methods must be aligned with the ontology and epistemology adopted. However, this does not exclude quantification of perceptions, as long as the numbers are only used in comparison and relativity and not in absolute terms.

Thus, if the constructivist ontological and epistemological assumptions are adopted, then observation generates theory, and the research is approached with an open mind, the theory then is time and context bound. The extent to which the research is 'internal' or 'external' to the subjects is another consideration. (Blaikie, 1993)

It is entirely appropriate to adopt a phenomenological approach, as this is studying the system and world as perceived by its actors. The factors that are to be identified are those as constructed by the participants, not pre-determined ones that are being testing. While a positivistic approach could be equally adopted for the purpose, and would not be surprising in healthcare research, it is not in line with the ontology and epistemology in this research as designed by the researcher. Whether doctors are "in training" or "providing a service" while performing activities relating to their vocation is not determined externally, but is down to their perceptions, therefore hypotheses and theory should be constructed inductively.

4.2 The Research Framework

As can be seen from the research question(s) this study constitutes a number of sub-questions which can be seen as individual pieces of research in their own right and yet all are interlinked and feed together in understanding the research area and the knowledge that can be gained from it.

In order to clarify the research framework that was developed in answering the questions, it is possible to summarise the aims, methods and outcomes of each stage of the research and how they are related in the flow diagram below.

Research Framework - Overview Flowchart

Modelling the education and service activities of junior doctors within a reduced hours context.

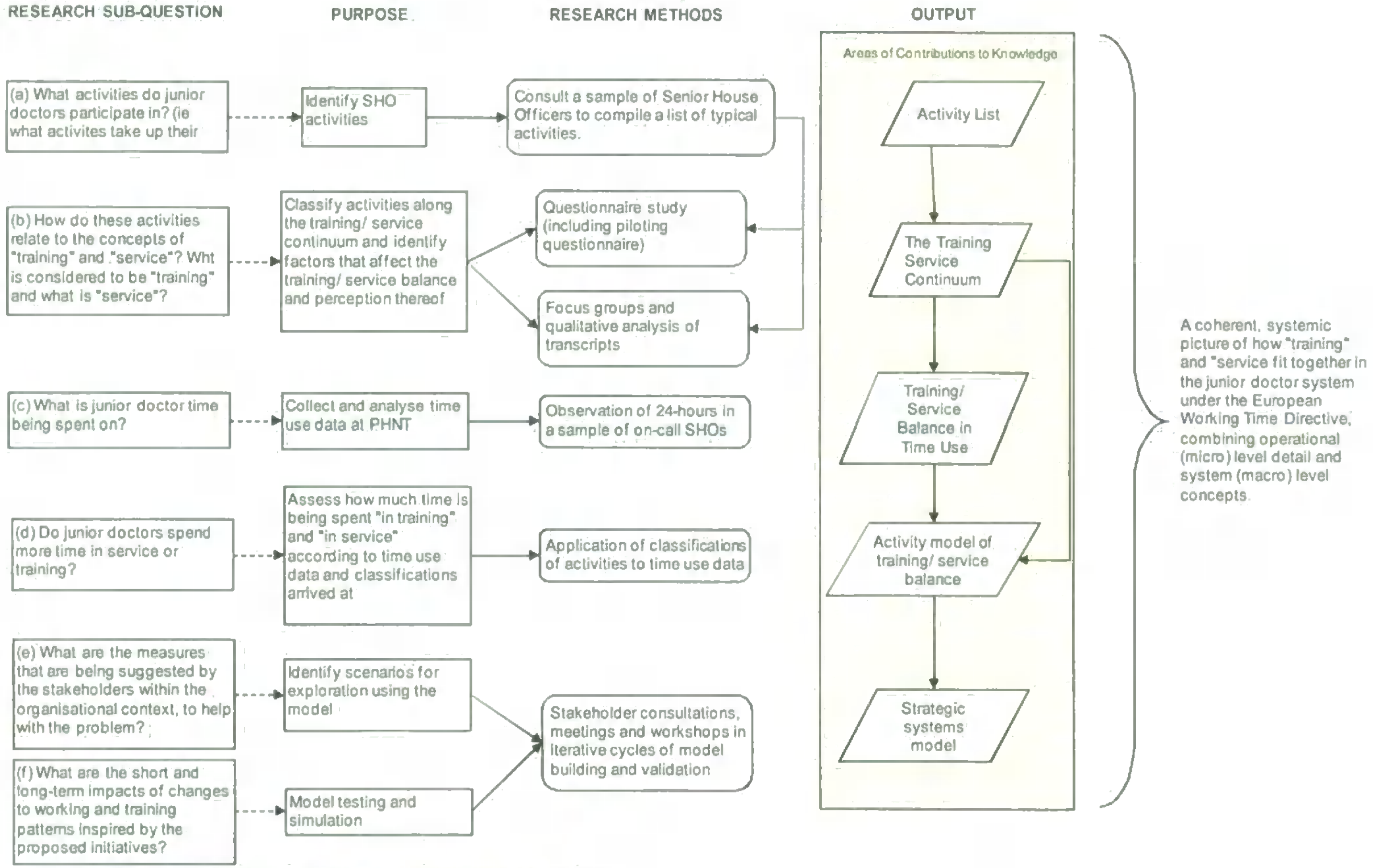


Figure 3 – Research Framework – Overview Flowchart

It is proposed to use system dynamics modelling techniques as part of the overall way of modelling the impact of the reorganisation of the education and service activities of a professional group within an organisational context. Born from Forrester's Industrial Dynamics (Forrester 1961), system dynamics (sometimes referred to as business dynamics) is an approach for studying managed systems. The basic principle lies in the assumptions that there is feedback in systems and that a system's behaviour is directly related to its structure. By representing the structure of a system, be it a physical or social system, with a series of connected stocks and flows with identified relationships, it is possible to concretely model and simulate system behaviour. System dynamics enables not only the understanding of a systems elements and how they are related and influence behaviour, but once the structure of the model has been accepted, it also allows simulation and prediction of future trends and behaviours in the system. However, while the iconography of system dynamics models are formalised and standardised, there is a wide variety of contexts in which they have been applied, and accordingly a wide variety in approaches adopted in the construction of these models.

In identifying systems dynamics as an approach, a number of alternative approaches to answering this research question had been considered, including other operational research techniques, such as cognitive mapping and soft systems methodology. Both satisfy the need for the seeing this "messy problem" as a system and identifying the existence of relationships between concepts, but their limitations lie in the fact that they remain largely qualitative models and shy away from quantifying the nature of relationships. This research area benefits from at least an attempt at quantification of relationships in exploring the nature of the relationship between the concepts of training and service and detail within. An operational research method that does include this quantitative nature is discrete event simulation, which would easily be applicable to modelling the progression of junior doctors through the system, but would struggle to model some of the other elements of the system that are "softer". It is for these reasons, that these methods were initially discounted.

While the ill-defined features and relationships of this problem make it ideal for applying an operational research modelling technique, and the link between structure and behaviour in particular warrants a system dynamics approach, it means that the traditional consultancy-style model building approach with key decision makers does not apply until more clarification has been sought. In order to successfully model this "problem", it has been necessary to design this staged research design which first clarifies core concepts in the system and then allows these to be linked in the way in which the key stakeholders and decision-makers perceive, as well as the actors in the system. This is a truly unique application of the modelling technique using micro-level operational detail as an information-feed to the parameters of the scenarios in the systems model.

In reference to the flow diagram above, this section briefly reviews the research design. However, individual research methods and their design are elaborated on in the individual chapters relevant to the stage.

The first stage of the research was to identify what activities junior doctors participate in during their working day. In the absence of a universal list, SHO operational activities were identified with the help of a sample of SHOs and a clinical tutor at PHNT, as well as drawing on information from previous time use studies, projects and shadowing notes. Feedback on the provisional list was sought from senior medical staff (consultants/ clinical tutors).

It is evident from past research and present practice that junior doctor activities have never been classified according to their training or service content. While some activities were clearly seen as more educational than others, stakeholders found it difficult to categorically state which were "training" or "service" and tended to respond with statements such as "it's all training and service". This led to the conception of the *training/ service continuum*, along which all activities could conceptually be placed.

Questionnaires were used to gauge SHOs perceptions of the extent to which each of the activities are more training- or service-focused, how frequently they participate in them, and whether this is in the presence of a more experienced person. Additionally, some simple questions were asked about how long the participant had been an SHO, how long they expect to be a SHO and if they knew in which specialty they would eventually work. This was to assess whether experience (in terms of length of time or time left) and known career goals were variables relating to the individual (rather than the task) that affected perceptions of training/ service balance. Design and layout of the questionnaire were important considerations in ensuring a high response rate, and feedback was sought by piloting the questionnaire with a convenience sample of SHOs and senior medical staff.

The questionnaire was sent out to all 184 identified Senior House Officers at PHNT. Questionnaires were numbered to allow tracking of returns from specialties and to allow identification of non-returns for a second mail shot.

Focus groups were run to classify activities along the training/ service continuum, allowing comparison with the questionnaire data, and identifying and exploring in more depth the factors that make an activity more 'training' or more 'service' focused. Three focus groups were held to explore the training/ service balance of activities, and the factors affecting these: one for Senior House Officers, one for Consultant/ Educational Supervisors, and one for Clinical/ College Tutors (and other roles related to Postgraduate Medical Education). The purpose of the focus groups were to: place selected SHO activities along the same training/ service continuum addressed in the questionnaires, discuss differences in participants' perceptions of the training/ service balance, and in doing so identifying the factors that affect the balance. A variety of surgical and medical specialties were represented.

Questionnaire data was quantitatively analysed in SPSS (statistical software package). The focus groups were audio taped and transcribed. Transcripts were imported into N6, a qualitative analysis software package. N6 facilitated the development of an appropriate coding frame, coding, and thematic analyses of the text.

The development of the training/ service continuum classification of activities and identification of factors affecting the perceived balance is a novel and pivotal piece of knowledge which contributed greatly in understanding not only the problem area better but built part of the pillar of the eventual activity and systems models.

To identify how much time SHOs spend "in training" and "in service", it was necessary to apply the derived percentages of each of the activities to time-use data, which illustrated how much time SHOs spend on each of the defined 28 activities. This data was collected by structured observation and analysed using the activity categories developed in the training/ service continuum. While it is appreciated that this shadowing data is not representative nor complete, due to the lack of resources, it is used here as an aid to providing a "snap shot" of the training/ service balance, in terms of how much time SHOs spend "in training" and "in service".

The information and knowledge gained from the training/ service continuum and time use data was used to develop an activity model of the training/ service model of junior doctor time. As the time use data could only be relied on for indication, stakeholder meetings were held to validate this data, revising according to experience where appropriate.

Finally a systems dynamics model of the entire problem was developed with the stakeholders and decision makers using information gathered in the earlier stages that had helped clarify and quantify the problem and assumptions of relationships made between elements in the system made by its actors and key decision-makers. The model building approach itself followed cyclical iterations of model building, validation and testing until a version had been developed that suitably models both the structure and anticipated or expected behaviour of the system, as seen by its actors. Once the structure, relationships and assumptions of the model had been accepted by the stakeholders, and the model was deemed representative of the real world system, it was used to simulate the short and long-term impacts of the identified possible scenarios and policies that the decision makers were considering implementing.

4.3 The Role of the Researcher

It is not possible to justifiably discuss research methodology without considering the role of the researcher and the effect this will have on the research outcomes, findings and thus interpretation.

As this research was carried out in the context of a partnership project between Plymouth Hospitals NHS Trust and the University of Plymouth, with the researcher based at the organisation with constant access and communication with the relevant stakeholders, it is not surprising that the design of the research can be seen as action research, and in some parts even ethnographic, although it is not designed to be an ethnography.

Action Research has several features (Wiskers 2001: 157):

- The researcher and those being researched are in partnership. The aims, practices, strategies and findings of the research are shared at each stage.
- The research often aims to develop those researched through their involvement and through their subsequent reflection

- The tendency for action research is to use triangulation of research methods and strategies
- It lends itself to reflection by the researcher and researched
- Feeds into change

Regarding these features of action research, it is clear that this research in general, and the building of the system dynamics model in particular broadly fall in these criteria. The researcher was based virtually daily at the postgraduate medical centre at Derriford Hospital, working closely with the postgraduate medical team (including the Director of Postgraduate Medical Education and Clinical Directors) as well as the consultants and junior doctors targeted in this research. The researcher did not have an organisationally operational role (i.e. she did not fit into a management structure) which allowed her to maintain enough independence to be able to execute the research without becoming too involved in the problems she was researching. At the same time, being based at the Hospital allowed not only to access the participants easily, but also to understand in more detail the system that they were operating in and that ultimately the research was attempting to model.

While this set-up was ideal for accessing data and progressing the research, it does pose some potential risks. It was important for the researcher not to "go native" and become so operationally ingrained in the research that she was not able to see the system objectively enough to analyse the findings objectively.

In particular as this research seeks to model the junior doctor system based on the world as perceived by its actors, collected from a variety of sources, it was important to be able to collate these perceptions objectively in a model of the system, without being swayed by the researcher's own assumptions about the system. This is a fine balance to strike.

However, adopting an action research approach also had some distinct advantages. Because the research was based in practice, some of the problems of recommendations needing to be implemented were avoided. The participants, particularly in the model building process, were the key decision makers in the problem area, and as this research was helping them construct a model of the problem from which recommendations could be made, they quickly developed ownership. The researcher's role was one of facilitation, rather than "problem expert".

4.4 Ethical Approval

Research in the NHS is heavily regulated by legislation in relation to ethics. No research can be carried out without scrutiny of the methodology and principles behind the research by the local research ethics committee, or confirmation by this committee that the research is exempt from seeking approval. Researchers often find this a major obstacle in commencing healthcare related research. While the Knowledge Transfer Partnership Project had been given ethical clearance previously, this PhD research had to seek separate ethical approval by two bodies: the University of Plymouth and the South West Local Research Ethics Committee (SW LREC).

Ethical Approval by the University of Plymouth was sought and granted in February 2004. As part of this application, as statement regarding ethical principles was made, which confirmed that it was designed and executed in full accordance with the University's *Principles for Research involving Human Participants*. In particular, it gave assurance around informed consent, openness and honesty and confidentiality and how these would be addressed in the proposed research methods. It was confirmed that research participants were not expected to be exposed to hazardous procedures in the proposed research activities.

The application for ethical approval to the local NHS research ethics committee was a much more laborious process. The application form requests a significant amount of information, and in addition to completing the relevant forms, it was necessary to provide a number of additional documents such as: the invitations to the focus groups, the training/ service balance questionnaire, consent forms, research flowchart, Curriculum Vitae of all the researchers and contributors, a letter of support from the organisation in which the research was being conducted, and a summary research protocol. To increase the chance of passing this assessment of the research and securing ethical approval, feedback from individual members of the committee were sought in advance of submission, to ensure that all potential queries were answered in advance. This helped increase the chances of success. In July 2004, the South West Research Ethics Committee considered this piece of research and requested a few amendments to the invitation letter of the focus groups, to ensure that the wording did not include emotive words such as "vital". These amended documents were re-submitted immediately and the committee confirmed ethical approval in August 2004.

5. The Training/ Service Continuum

Before one can even begin to model this organisational problem, it is very clear both from the literature and research to date, that the concepts of "training" and "service" within this context need to be explored in more depth, in particular how they relate to each other and the activities junior doctors engage in.

5.1 Introduction

As identified in the literature review, there have been claims that the reduction in working hours is impacting on junior doctor training, because fewer hours spent at work are seen to equate with fewer hours spent training. This assumes that all hours spent at the hospital are "training" hours. Simultaneously it has been widely recognised that as SHOs provide the bulk of the service, reducing their hours will impact on service provision. This assumes that all hours are "service". Which is the case? Is everything that SHOs do simply all training or all service? Are there varying amounts of training and service to be found in what they do? How does the balance between "training" and "service" vary across activities; what factors influence this? These are questions that have not been answered, the synonymous nature of "training" and "service" for junior doctors has not been questioned, and there is a lack of definition of the concepts of "training" and "service".

Once one has identified what activities junior doctors participate in and how they spend their time, the logical next question that follows, from the gap in knowledge that was identified in the literature, is how these activities relate to the concepts of "training" and "service". As identified in the literature, the concepts of training and service are poorly defined, and can vary widely in meaning and interpretation in relation to junior doctors.

In raising these questions, **a training/ service continuum** was conceived: SHO activities can be placed along a continuum ranging from 100% training (consequentially 0% service) to 100% service (consequentially 0% training). Depicting the relationship between training and service in this way allows the depiction of both the conflict and contiguity between the two. Activities can be shown to be very "training" orientated while appreciating that while participating in them, junior doctors provide a service at the same time.

Thus, this section of the research seeks to answer the following sub-questions of the research aim as outlined earlier:

(i) What activities do SHOs typically participate in?

(ii) What is the perceived training/ service balance for each of the identified SHO activities? How are they placed along the training/ service continuum (from 100% training/ 0% service to 0% training/ 100% service)?

(iii) What are the factors that affect the perception of the training/ service balance for SHO activities?

In doing this, the following research activities were undertaken:

1. Identify the tasks and activities that SHOs are involved in

2. Using questionnaires to gauge SHOs perceptions of the extent to which each of the activities they participate in are more training- or service-focused, how frequently they participate in them, and whether this is in the presence of a more experienced person. The hypothesis in this is that frequency of an activity and supervision of this activity are independent variables that may affect the perception of the training/ service balance of the activity. Additionally, information about experience and career goals was collected to see if perceptions vary with experience.
3. Conducting focus groups of SHOs, educational supervisors, and clinical and college tutors to classify activities along the training/ service continuum, and thus verify the data collected by the questionnaires and identifying what makes an activity more 'training' or more 'service.

This helps to understand exactly what the training/ service balance for SHOs looks like, and in particular help to provide information to feed into a model of the junior doctor education and working system and likely impacts of working practice change.

5.2 Approach

In line with the overall methodology described in the methodology chapter, the data collection and analysis methods of this section of work, namely the classification of junior doctor activities along a training/ service continuum, follows a fundamentally constructivist approach in that it represents the world as seen by some of its actors. This is also the approach that is followed through into the model building process, which this piece of analysis feeds into. However, it entails a mixed method approach in terms of data collection and analysis in that it employs both qualitative and quantitative data collection and analysis methods. These were selected to begin to "quantify" some of the softer issues involved in this area of research that have very real "hard" impacts. Quantifying seemingly unquantifiable "soft" issues of training and service is a means to an end. While the numbers themselves may be disputable, measures are constructed in a relative manner – using percentages on an ordinal scale – that allows comparison of activities.

The overall approach to this aspect of the research is also designed to allow collection of data from as many people as possible in the SHO population at the Trust, to increase confidence in the data collection, but complemented with focus groups to not only confirm the broad data collection collected by the questionnaires, but to gain more insight into the reasoning behind it.

Data Collection Methods

In addressing the research questions as outlined, there were two main sources of information: data collected through questionnaires and through focus groups. The two were designed to complement each other: the entire population of SHOs at Derriford Hospital were targeted with the questionnaire, to collect concrete quantitative data about training/ service balance perceptions and possible independent variables influencing these, and then a sample of SHOs, Consultants and Tutors participated in focus groups, to collect qualitative data on the same matter, gauging training/ service balance of activities and identifying factors that affect these. The focus group data helps validate and adds depth to the data collected through the questionnaires.

5.2.1 Questionnaire

Questionnaire Development

There is no universal list of activities that SHOs participate in. In order to compile a list for the purpose of this research, there are two sources for this information: activity lists used in past research and the doctors themselves. An initial list of SHO activities was compiled by drawing on a combination of information: data collected earlier in the year from scoping interviews held with individual SHOs, past time-use studies and projects, and observations made through shadowing. For initial verification, feedback on this list was sought from senior medical staff (consultants/ clinical tutors) before its use in the questionnaire study.

The purpose of the questionnaire was to validate the list of activities, capture any others that had been omitted, establish typically how frequently SHOs participate in them, whether they are likely to perform these in the presence of a more experienced member of staff, and where they perceive the activities to fit along the training/ service continuum. 'More experienced' was specified as the terminology, as supervision of activities or training in that sense, doesn't necessarily have to come from a more senior member of staff or an authority (as is implied in the terms 'supervision'), but rather from someone more experienced (a more experienced person in an activity does not necessarily mean someone more senior). There may be a problem with this measure of supervision, as just because they are doing the task in the presence of a more experienced person, does not actually mean that supervision or 'training' is taking place. They could just generally be there. However, this is a behavioural issue and for the purpose of this work, physical presence has to be taken as a proxy for supervision and training actually taking place. Whether this is an appropriate measure, can be established through actual observation or speaking to doctors at a later stage.

Thus, the questionnaire contained a list of activities, alongside each were tick boxes of how frequently they are likely to participate in the activity (with discrete time periods) and whether they are likely to participate in the activity in the presence of a more experienced member of staff (yes/ no tick box), and if so whom (tick boxes). Additionally, some simple questions were asked about how long the participant had been a SHO, how long they still expect to be a SHO and if they knew which specialty they eventually wanted to work in. This was to assess whether experience (in terms of length of time) and known career goals were variables relating to the individual (rather than the task) that affected perceptions of training/ service balance.

Design and layout of the questionnaire were important considerations. Lengthy or complicated questionnaires potentially reduce response rates. Several drafts were circulated to academic and clinical supervisors for feedback.

To pilot the questionnaire and instructions letter, it was decided to target a convenience sample of SHOs from the population. SHOs are busy people and to minimise time wasting, it was decided to target a sample of SHOs that were currently attending a course at the postgraduate medical centre, during their lunch break. It meant that they would have enough time and less distraction to talk about the questionnaire, structure and content. In particular, the piloting of the questionnaire also allowed validation of the devised SHO activity list.

After showing the questionnaire to 4 SHOs, and explaining its purpose and the wider analysis taking place, there was general enthusiasm for the work. They all agreed that it is a useful piece of work, but at the same time wished me good luck as they appreciated that historically response rates for surveys in general were low. However, they had no concrete solutions for increasing response rates (apart from the obvious incentives and prizes). In terms of content and structure of the questionnaire, only minor changes were suggested: most importantly, it was clear to them what they were being asked to do.

Identifying the target population: compiling a list of all SHOs in the Trust

In order to personally address the questionnaire to each individual SHO, it was necessary to have a list of all SHOs employed in the Trust (no matter whether they are training posts, trust posts or Ministry of Defence posts), and which specialty they work in (or an alternative internal mailing address).

No single universal *accurate* list of this type existed at the Trust. No one person could tell you how many SHOs are working in the Trust. Medical Staffing had a 'Staff in Post' list, which was a good starting point, though it is on a spreadsheet and becomes outdated as soon as there is a change (which happens frequently). Medical Staffing also has individual spreadsheets for each specialty, from which they can pull off the most up to date sheet. Additionally, it is possible to search the Trust's intranet for contact details by specialty. Although there are several lists in existence, each used for its own purposes, they are fundamentally flawed in that they are stored in *lists* – these need to be manually updated. If there was one universal database, which was 'live' and updated, then changes would only need to be made once and everyone could create lists from this database. The result would be that everyone would be making decisions and receiving information from the same source, and all efforts could be made to ensure that this was accurate.

For this purpose, all the most up to date spreadsheets were obtained from Medical Staffing, the Junior Doctors' Hours team and by searching the intranet. From this a database of names of SHOs and which specialty they work in was compiled, for mail merging the questionnaires. This list was double-checked for accuracy by telephoning each specialty. Enquiries revealed that for medical SHOs, there is a formal agreement that all correspondence is sent via the doctors' mess. For other SHOs, mail is to be sent via the specialty and it would then be distributed to them.

Questionnaire Data Collection and Entry

The questionnaire was sent out via internal mail to all 186 identified Senior House Officers at PHNT. (A copy of the final questionnaire can be found in the Appendix I). Questionnaires were numbered to allow tracking of returns from specialties and to allow identification of non-returns for a second mail shot.

Timing of the questionnaire was also important. Throughout the year, there are certain times when there is a certain level of upheaval for SHOs. The beginning of August and February particularly are when the majority of SHOs on 6-month placements change over. Conducting analysis at these times is likely to be unfruitful as SHOs are busy getting used to new departments, colleagues, working practices etc. There are also some SHOs on 3-month rotations, and the beginning of December saw another changeover. Therefore conducting the questionnaire mid- to end of December 2003 ensured that accurate lists of staff in post could be created, but also that those that had changed over had adequate time to get used to their new posts.

After three weeks, the response rate was 15% (27 out of 184 - 2 of the 186 had been returned to sender). In quantitative research this response rate would be considered very low – too low for meaningful analysis and interpretation.

However, there are different considerations to be made here. Firstly, response rates questionnaires targeting junior doctors are historically low. Relatively successful campaigns achieve 30% at most and past analysis done at PHNT has yielded 15-20% across all grades. There are a number of reasons for this. The main one appears to be apathy. Junior doctors as a group are not disciplined or motivated enough for exercises that try to help them. Even when a topic of high interest is approached, somehow filling in questionnaires or forms requires too much effort. Interestingly, while those same SHOs that "do not have the time" to complete questionnaires or aren't interested for the 10-15 minutes it takes, will quite happily talk for an hour on the same topic. However, interviewing each individual is not possible within the available resources or the research framework. Further, a proportion of junior doctors simply don't check their mail. The rationale for this is that if something is *that* important, they will find out about it. Also, there are no universal contact places, so mailing questionnaires can be somewhat hit and miss. Although there was an incentive for completing the questionnaire (2 bottles of champagne to be drawn from the returns), this does not seemed to be enough to motivate. Even when form filling directly affects pay (such as the diary monitoring for New Deal pay banding), junior doctors have in the past struggled to meet a required 75% response rate. Even when SHOs are individually approached to complete the questionnaire, the response is limited.

To increase the response rate, certain strategies were employed, such as targeting doctors in places they gather (e.g. common rooms or the doctors' mess), or departmental meetings. This was especially important for A&E and

Cardiothoracic surgery, as these were two major specialties for which there was not a single return, yet needed to be included for representation.
The researcher attended two specified teaching sessions (one in each dept.) and targeted SHOs, distributing questionnaires, asking them to complete and return them. The Cardiothoracic meeting was attended by four of the eight SHOs, and the A&E teaching session was attended by 5 of the 16 SHOs. With those completed forms, the response rate was increased to 21%.

A major constraint on the chasing of questionnaires was the change in SHO jobs in the first week of February. While many SHOs stay at Derriford, some leave to go on to other SHO jobs in the country, which means that their view is in effect 'lost'. After the February change over in posts, SHOs who had not responded and were still in the hospital were sent out another mail shot, asking them to complete the questionnaire, with respect to the post that they were in during the December 2003/ January 2004 period. The closing date for receiving completed forms was set at Monday, March 1, 2004 giving recipients over 2 weeks to complete and return the questionnaires. After the February change over in posts, the theoretical maximum achievable response rate had fallen to approx. 77%.

The final response rate was 40% (74 out of 184), and all specialities were represented by at least one return. A table containing response rates by specialty can be seen in Table 4.

When entering the data from the questionnaires, the following observations were made:

(i) Even though the questionnaire was anonymous, SHOs were often keen to add their names either at the top or the bottom.

(ii) As instructed, questionnaires did appear to be answered in light of the current SHO job (e.g. Anaesthetics SHO never doing a ward round and care of elderly SHO not operating) which is good, because this should provide a broad sweep of all current situations, in terms of length of time of being an SHO and job they are in.

(iii) When an activity was listed as "never" in terms of frequency, then it was often the case that the subsequent questions weren't answered (i.e. no opinion on the training/ service balance or supervision). This was noted, as these cases were excluded from the subsequent data set for analysis.

(iv) Even though the questionnaire contained closed questions, with discrete categories, and no space for comments was included, numerous SHOs supplemented the data in the questionnaire by adding general comments on the SHO training and related issues.

5.2.2 Focus Groups

Three focus groups were held to explore the training/ service balance of activities, and the factors affecting these: one for Senior House Officers, one for Consultant/ Educational Supervisors, and one for Clinical/ College Tutors (and other roles related to Postgraduate Medical Education).

The purpose of the focus groups were to: place selected SHO activities along the same training/ service continuum as was addressed in the questionnaires, discuss differences in participants' perceptions of the training/ service balance, and in doing so starting to work towards identifying what is meant by "training" and "service" by identifying the factors that affect the balance. Further, there would be discussions about how activities at the service end can be moved towards the training end, in order to start to explore what changes to practices could help compensate for the reduction in exposure and time-based experience as a result of the reduction in hours.

Pragmatically, this part of the focus groups required some adjusting in terms of the number of activities that could be usefully displayed and discussed. The questionnaire study had included a list of 28 activities. It was possible to group these into 11 activities, by taking activities of a similar nature and giving them a broader title. Activities that had solely a designated teaching focus and purpose (such as designated teaching sessions and presentations, appraisals and audit activities) were excluded because they would not usefully allow the groups to identify the difference between the training and service aspects within them. A list of how the activities grouped can be seen below.

Focus Group Activities	Questionnaire Activities
Patient Related Administration	Clerking Admissions
	Patient Related Administration
	Writing Patient Notes
	Collating Results
	Writing Prescriptions
	Preparing for Procedures or Theatre
Talking to Patients and Relatives	Talking to Patients and Relatives
Operating/ Assisting in Theatre	Operating in Theatre
	Assisting in Theatre
	Observing in Theatre
Ward Round	Ward Round
General Medical Procedures	Performing General Medical Procedures
	Assisting General Medical Procedures
	Observing General Medical Procedures
Discussing Patients with Colleagues	Discussing patients with colleagues (incl. GP)
Team Meetings	Formal Team Meetings
Routine Clinical Tasks	Taking Blood/ ECGs/ Cannulation/ Catheterisation
Examining/ Reviewing Patients	Examining/ Reviewing Patient
	Medical History Taking
	Urgent or Emergency Assessment and Management of Patient
Handover	Handover to next JD (or cover)
Attending Clinics	Attending Clinics
Designated Teaching Activities (not included in Focus Group study)	Teaching Medical Students/ Others
	Formal Teaching
	Reading Journals/ Research/ Private Study
	Audit Activities
	Appraisals
	Presentations

Organisation of the focus groups was given significant thought:

(i) Size of the focus groups: a manageable number of participants were needed to run effective focus groups. An upper limit of 10 participants per focus group were set, with an anticipated optimum number of approximately 5 or 6. It was decided that the focus group would be run with at least 2 participants.

(ii) As the dropout rate was likely to be high (due to other commitments of medical staff), a proportionately higher number of participants were invited to attend the focus groups.

(iii) Length of the session: It was anticipated that doctors would probably not be likely to spare more than an hour at a time. For this reason, and to increase the likely turnout, sessions were set up for an hour over lunch (sandwich lunch provided). Participants wouldn't be stopped after an hour if the discussion was lively, but 90 minutes was set as an upper limit.

(iv) The sessions were audio-taped (with informed consent) and participants were reminded of their right to withdraw. There was also visual output from the focus groups, in terms of the placement of activities along the continuum.

(v) Participants' chairs were positioned in a semi-circle around a board, which contained the training/ service continuum. The microphone was positioned at the centre of the semi-circle (see figures 4 and 5)

(vi) As a lot had to be achieved in a relatively small amount of time, it was ensured that participants were adequately briefed in advance, by providing them with letters containing details and an agenda (including an anticipated breakdown of times).

Inviting Participants to the Focus Groups

For the SHO focus group (FG1), the 10 volunteers (identified from the questionnaire returns) were invited, by letter via internal mail, and asked to reply by Jan. 22, 2004 (a week before the focus group).

A complete and accurate list of educational supervisors for the Consultant focus group (FG2) was not available, so potential participants were identified from the Staff in Post List (as at Nov. 2003 – the latest available). The list of college and clinical tutors for the Tutor focus group (FG3) was derived from the membership list of the Postgraduate Medical Education Committee and checked with the Postgraduate Centre Manager.

The invitations to the focus group for FG2 and FG3 needed more planning, as it had to explain the entire analysis, what it is being used for and why it is important for them to participate. In adhering with current practices, it was most efficient to contact these people via email. (They all have offices and desks and communicate formally with management via email). It also allowed for a quicker response.

Replies to Invitations

By the date specified (Thurs. Jan 22 and Friday Jan. 23, 2004) only one SHO replied, confirming his attendance at the focus group. The other 9 had volunteered initially but not responded to the second letter. It was decided to bleep them to find out if they received the letter, and whether they were available to attend.

For the second focus group, nine educational supervisors/ consultants replied stating that they could not attend due to other commitments. One confirmed his definite attendance, and one said that he would try to make it, but may have to pull out at the last minute. A second invitation was sent out, which resulted largely in no replies, with the exception of a few more expressions of interest.

Attendance at focus groups

FG1 was attended by 5 SHOs, FG2 by 3 consultants and FG3 by 2 tutors.

Competing with clinical commitments or other management meetings was the most determining factor in the low attendance of the focus groups amongst the more senior members. Junior Doctors as such have more flexibility as they have less formal/ structured service commitments and are therefore more likely to be able to free up a lunch time at less than six weeks' notice (the required notice for cancellations of clinical commitments – not that this is desired anyway).

Co-facilitation

As it is not possible to 'run' a focus group session and take accurate notes at the same time the help of an assistant, or co-facilitator, was enlisted. The co-facilitator was recruited from research staff at the University of Plymouth. The co-facilitator was briefed on the background of the work and what will actually take place during the hour-long sessions. She was also provided with a co-facilitator checklist, detailing what her role in the focus group entailed and what her notes should focus on.

Layout of the SHO focus group

Birds Eye View Room Layout
N.B. Not to scale

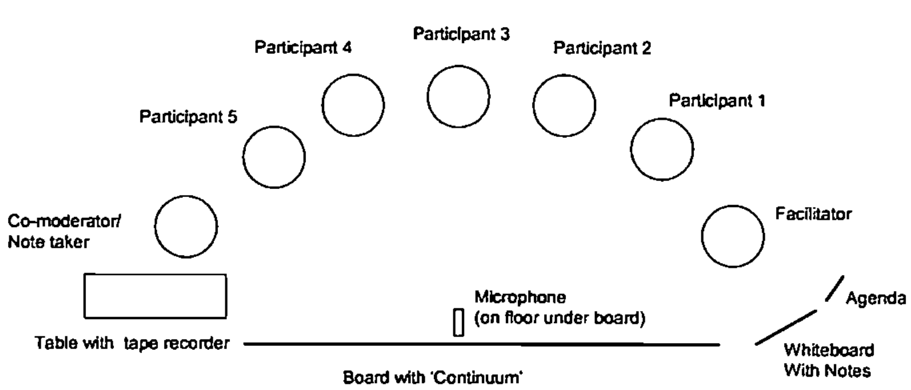


Figure 4 – Bird's Eye View of Room Layout

Figure 5 – Photograph of Focus Group Layout

5.3 Analysis Methods

Questionnaire Data Analysis

Data collected from the questionnaire was entered into an Access database that had been created from the questionnaire format. This was then exported and analysed in SPSS (statistical software package).

Descriptive statistics, correlations and regressions were produced with the aid of SPSS and analysed.

Focus Group Data Analysis

All three focus groups were audio taped and transcribed. Participant names were made anonymous in the transcripts by references to participant number. Tapes and any documents linking participant names to participant numbers were destroyed after transcription was complete.

Transcripts in text format were exported into N6, a qualitative analysis software package. N6 facilitates the development of appropriate codes and frames, coding of text according to the frame developed, and the exploration of patterns in the data. Additionally, it allows text searching and counting of text occurrences.

The process of creating a coding frame for analysis of the qualitative focus group data was partly inductive and partly deductive.

There was a purpose for holding the focus groups, namely to understand the relationship between service and training, classify activities along the continuum and arrive at definitions of what makes something more training and what makes something more service. So inherently, the researcher had a list of codes in her mind, which she would have expected to see from the data. Also, as the researcher had attended the focus groups, she knew the types of issues and she had already started to formulate thoughts on how they could be coded for. So in this sense, it was impossible to develop the codes in a completely data-driven, inductive approach.

However, from a process point of view, a data-driven, bottom-up approach was adopted. Starting with the Consultant focus group (for no particular reason), a coding frame was devised through initial free coding – or rather a list of issues/themes/ topics to code for was drafted. This was then applied to the Tutor focus group. New themes/ issues from this transcript were added. Things that were in the consultant group but not in the tutor group were still included. Through this systematic coding a long list of codes were built up: it was best to include all codes in the first instance, which could then be grouped or eliminated in a later iteration of the coding/ analysis cycle, depending on what was deemed significant.

After the tutor focus group was coded, the same coding frame was then applied to the SHO focus group, amending and editing where necessary. The resultant coding frame consisted of a list of free and tree/branch codes, as well as codes developed from specific text searches. This coding frame is shown in section 5.5.2 and discussed in section 5.6.

It must be emphasised that the approach adopted in the analysis of the qualitative data, is in line with the constructivist view adopted in the overall research of the area, but has also been conducted in a systematic manner, established firmly in social science, which allows structured identification and analysis of qualitative data, beyond "hear say".

5.4 Quantitative Results

Below are the results from the quantitative data collection and analysis. These include results regarding: data description (response rates, independent variables), training/ service percentages for activities (tabular and picture representation) and consensus.

5.4.1 Questionnaire Data Description

Response Rates

186 SHO posts were identified at PHNT from Medical Staffing Records, including Ministry of Defence doctors and doctors on the General Practitioner Vocational Training Scheme in December 2003. Each was sent a questionnaire regarding their perception of the training/ service balance in 28 activities that they, as SHOs are likely to participate in. Two were returned as people who did not work there. This meant that the total population (and the maximum number of returned questionnaires) was 184. After reminders, individual targeting and a second mail-shot of questionnaires, the overall response rate was 40%. Response rates by specialty can be found in the table below. Notably, specialties vary tremendously in size, as do the response rates. It is important for this analysis to ensure that a wide amount of specialties were represented, as well as having relatively high response rates for the major areas (e.g. Anaesthetics, A&E, Obstetrics, Paediatrics and Orthopaedics, amongst others).

Response Rates by Specialty		
Specialty	**Nr. SHOs identified**	**Response Rate**
A&E	16	44%
Anaesthetics	18	61%
Cardiology	7	57%
Cardiothoracic Surgery	8	75%
Dermatology	1	100%
Diabetes/ Endocrinology	5	40%
ENT	3	67%
Gastroenterology	4	0%
Haematology	3	0%
HCE	7	57%
ICU	4	25%
Maxillofacial Surgery	5	40%
Medicine - other	7	14%
Neurology	6	50%
Neurosurgery	6	33%
Obstetrics & Gynaecology	12	25%
Oncology	5	60%
Ophthalmology	6	0%
Orthopaedics	13	23%
Paediatrics	13	31%
Plastic Surgery	5	60%
Psychiatry	1	0%
Renal	7	43%
Respiratory	6	50%
Rheumatology	2	0%
Surgery	12	42%
Urology	2	50%
Total	**184**	40%

Table 4 – Questionnaire Response Rates by Specialty

Experience

To assess level of experience, two questions were asked:

1. How long have you been a SHO?
2. For how much longer do you expect to be a SHO?

Categories of time intervals were offered for responses:

- Less than 6 months
- 6 months to a year
- 1-2 years
- 2-3 years
- 3-4 years
- More than 4 years

Results of these questions for the returned sample of SHOs can be found in the tables and figures below.

Time as SHO

		Frequency	Percent	Cumulative Percent
Valid	Blank	1	1.4	1.4
	Less than 6 months	16	21.6	23
	6 months to a year	5	6.8	29.8
	1-2 years	18	24.3	54.1
	2-3 years	16	21.6	75.7
	3-4 years	8	10.8	86.5
	More than 4 years	10	13.5	100.0
	Total	74	100.0	

Table 5 – Time spent as a SHO for the returned questionnaires

Time as SHO

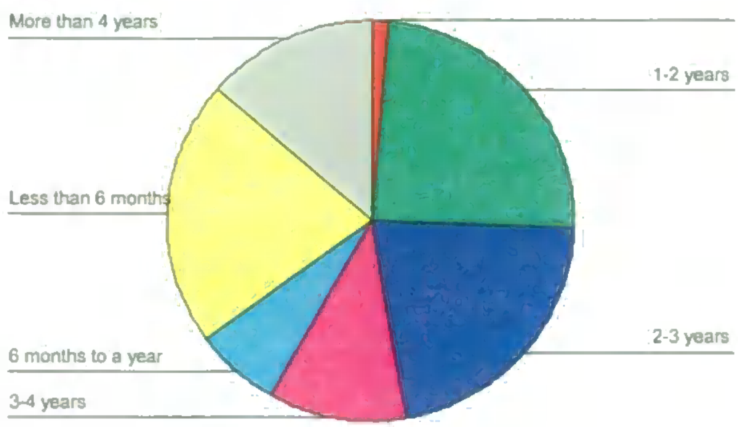


Figure 6 – Pie Chart depicting Time spent as a SHO for the returned questionnaires

Expected future time left as SHO

		Frequency	Percent	Cumulative Percent
Valid	Blank	1	1.4	1.4
	Less than 6 months	8	10.8	12.2
	6 months to a year	16	21.6	33.8
	1-2 years	32	43.2	77.0
	2-3 years	15	20.3	97.3
	3-4 years	1	1.4	98.6
	More than 4 years	1	1.4	100.0
	Total	74	100.0	

Table 6 – Expected time left as a SHO for the returned questionnaires

N.B. There may be discrepancies due to rounding.

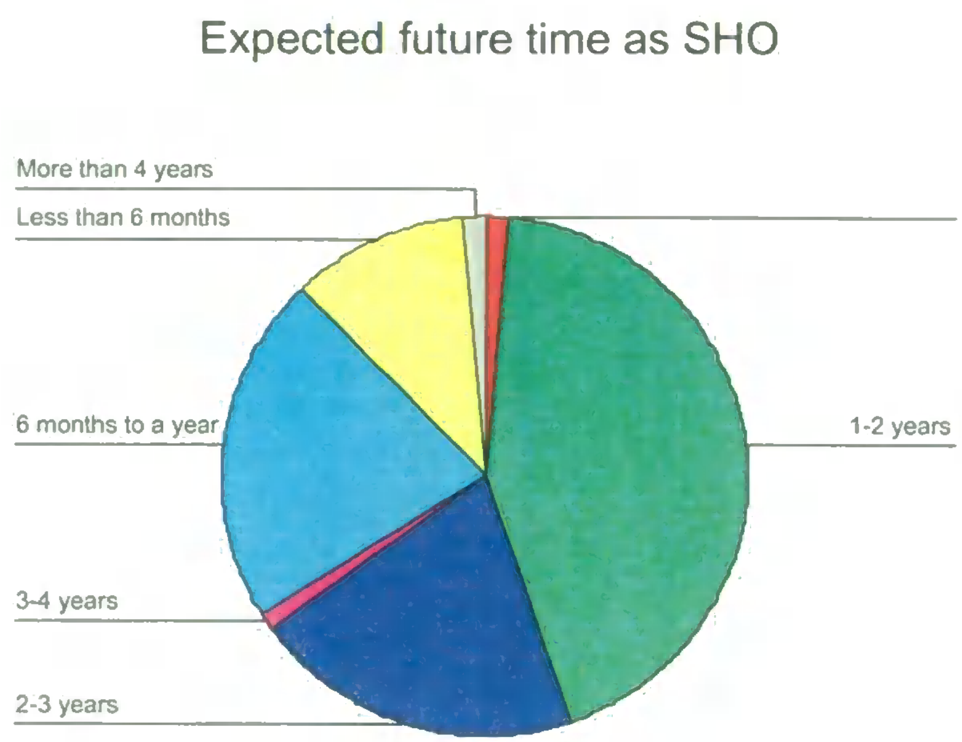


Figure 7 – Pie Chart depicting Expected time left as a SHO for the returned questionnaires

Are time spent as an SHO and expected time left as an SHO associated? If SHO training and career was completely structured and proceeded in a conveyor belt fashion, then one would expect a direct linear negative relationship between time as SHO and expected time left as SHO. However, as can be seen from the tables and charts above, this does not appear to be the case.

To test association on this ordinal data, correlation was calculated, by using Kendall's tau-b and Spearman correlation coefficients. There is **significant correlation** between the **time spent as SHO** and **expected time left as SHO, at the 5% level**. This is to be expected in reality, as the longer one has been a SHO, the less time one would expect to have left. The association not being exact emphasises the lack of structure and variability in time in the training grade.

Career Goals

In addition to asking questions about how long they have been SHOs for and how long they still expect to remain in that grade, it was decided to find out whether they already know what specialty they eventually wish to work in, as this may be another independent variable influencing the perception of the training/ service balance. It could be hypothesised that knowing which specialty you eventually want to work in, means more focus on training in order to get there quicker and thus more activities may be seen as having a training-focus. It also seems obvious that the more progressed you are in your career (i.e. the longer you have been an SHO, or the less time you expect to have left in that grade), the more likely you are to know which specialty you wish to work in.

Do the figures back this up?

Overall, for the SHOs that responded, 78% know which specialty they eventually want to work in, 22% didn't.

Are more experienced SHOs more likely to know which specialty they work in? Below are tables showing whether SHOs knew which specialties they wanted to work in by time as SHO and expected time left as SHO.

Time as SHO * Future Crosstabulation

			Do you know which specialty you eventually want to work in?		Total
			No	Yes	
Time as SHO	Less than 6 months	Count	4	12	16
		% within time as SHO	25.0%	75.0%	100.0%
	6 months to a year	Count	1	4	5
		% within time as SHO	20.0%	80.0%	100.0%
	1-2 years	Count	7	11	18
		% within time as SHO	38.9%	61.1%	100.0%
	2-3 years	Count	0	16	16
		% within time as SHO	.0%	100.0%	100.0%
	3-4 years	Count	2	6	8
		% within time as SHO	25.0%	75.0%	100.0%
	More than 4 years	Count	2	8	10
		% within time as SHO	20.0%	80.0%	100.0%
Total		Count	16	57	73
		% within time as SHO	21.9%	78.1%	100.0%

Table 7 – Replies about Career goals, by time spent as a SHO

Expected time left as SHO * FUTURE Crosstabulation

			Do you know which specialty you eventually want to work in?		Total
			No	Yes	
Expected time left as SHO	Less than 6 months	Count	0	8	8
		% within expected time left as SHO	.0%	100.0%	100.0%
	6 months to a year	Count	2	14	16
		% within expected time left as SHO	12.5%	87.5%	100.0%
	1-2 years	Count	9	23	32
		% within expected time left as SHO	28.1%	71.9%	100.0%
	2-3 years	Count	4	11	15
		% within expected time left as SHO	26.7%	73.3%	100.0%
	3-4 years	Count	0	1	1
		% within expected time left as SHO	.0%	100.0%	100.0%
	More than 4 years	Count	1	0	1
		% within expected time left as SHO	100.0%	.0%	100.0%
Total		Count	16	57	73
		% within expected time left as SHO	21.9%	78.1%	100.0%

Table 8 – Replies about Career goals, by Expected Time left as a SHO

As these frequency tables show, knowing which specialty the SHO wants to work in **does not vary significantly** with how long they have been a SHO or how long they still expect to be a SHO.

5.4.2 Questionnaire Results: Placement of Activities along the Training/ Service Continuum

Below is a table of the median frequency, supervision (dummy variable) and perceived training percentage for each activity. The mode and standard deviations are also shown for the perceived training percentage, to elaborate on the distribution. The median is appropriately close to the most frequent response in most cases, and yet the range of responses is often quite large (i.e. relatively high standard deviation).

Activity Name (Nr.)	Frequency per 6 months (times per SHO post)	Supervision	Perceived Training Percentage		
	Median	Median	Median	Mode	Standard Deviation
Appraisals (27)	2.50	1	90.00	100.00	22.40
Assisting General Medical Procedures (12)	13.00	1	70.00	90.00	27.66
Assisting in Theatre (16)	26.00	1	70.00	50.00	24.00
Attending Clinics (24)	26.00	1	80.00	80.00	21.74
Audit Activities (25)	2.50	1	70.00	50.00	22.19
Clerking Admissions (4)	130.00	0	30.00	20.00	27.65
Collating Results (7)	260.00	0	20.00	0.00	24.53
Discussing patients with colleagues (incl. GP) (20)	130.00	1	50.00	80.00	27.86
Examining/ Reviewing Patient (2)	260.00	0	50.00	60.00	24.40
Formal SHO Teaching (22)	26.00	1	100.00	100.00	10.46
Formal Team Meetings (21)	26.00	1	70.00	50.00	23.39
Handover to next SHO (or cover) (19)	130.00	0	20.00	0.00	23.50
Medical History Taking (3)	260.00	0	50.00	50.00	27.47
Observing General Medical Procedures (13)	13.00	1	80.00	80.00	28.12
Observing in Theatre (17)	26.00	1	80.00	90.00	25.41
Operating in Theatre (15)	26.00	1	80.00	90.00	24.74
Patient Related Administration (5)	260.00	0	10.00	0.00	22.83
Performing General Medical Procedures (11)	26.00	1	70.00	50.00	22.65
Preparing for Procedures or Theatre (14)	26.00	0	30.00	0.00	30.38
Presentations (28)	2.50	1	80.00	80.00	18.09
Reading Journals/ Research/ Private Study (26)	26.00	0	90.00	100.00	14.31
Taking Blood /ECGs/ Cannulation/ Catheterisation (8)	260.00	0	10.00	0.00	23.56
Talking to Patients and Relatives (18)	260.00	0	40.00	50.00	24.94
Teaching Medical Students/ Other (23)	6.00	0	80.00	80.00	25.02
Urgent or Emergency Assessment and Management of Patient (9)	130.00	1	60.00	50.00	24.47
Ward Round (1)	130.00	1	50.00	50.00	25.34
Writing Patient Notes (6)	260.00	0	20.00	10.00	24.24
Writing Prescriptions (10)	260.00	0	10.00	10.00	23.87

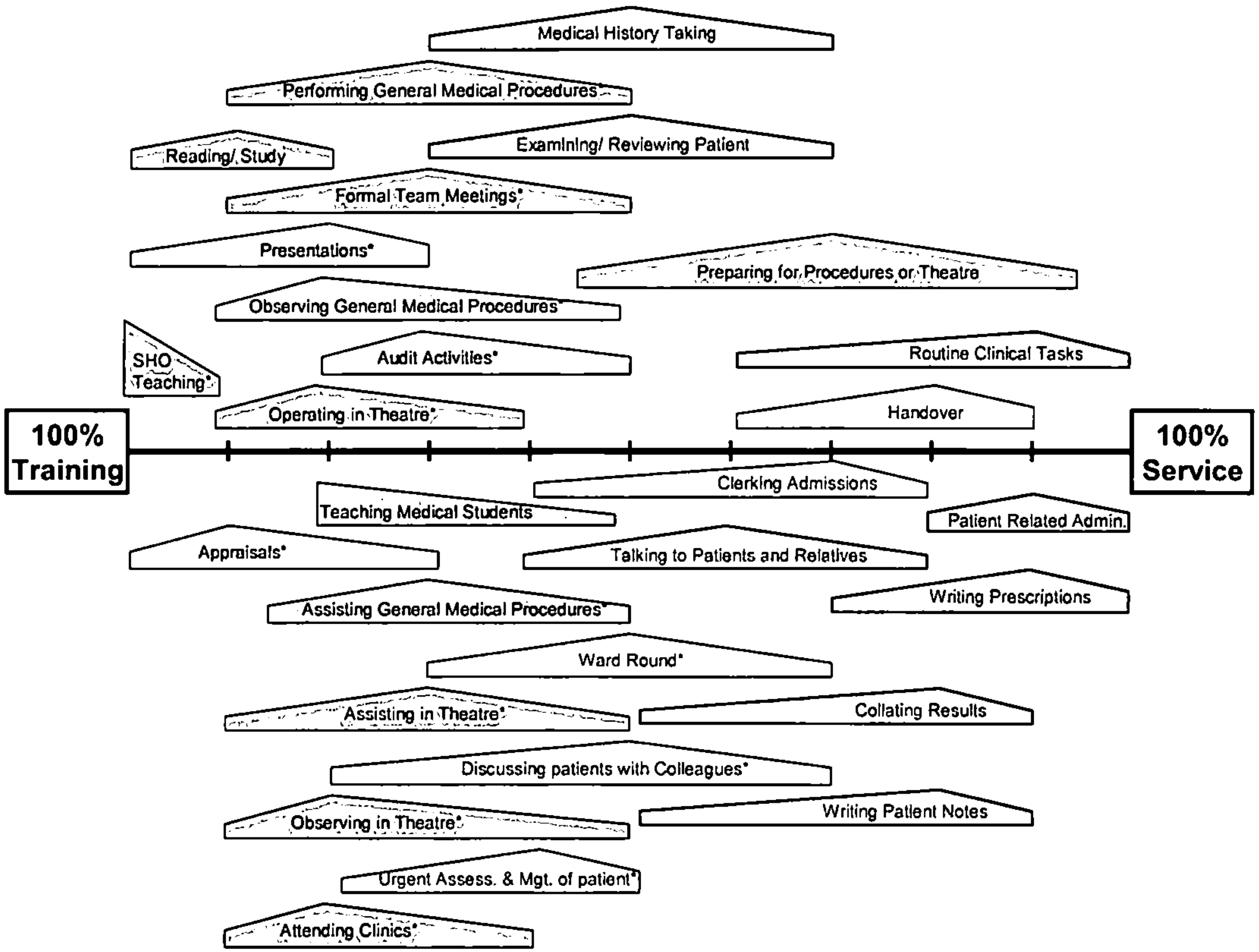
Table 9 – Questionnaire Results: descriptive statistics for the frequency, existence of supervision and the perceived training percentage of SHO activities

N.B. This table excludes any response that was ticked as "never" in terms of frequency. (e.g. medical SHOs never operating), as including this would distort average frequency, supervision and perception, and were mostly left blank. Activity numbers refer to the order in which they appeared in the questionnaire. The questionnaire specified frequency in verbal terms. To allow for analysis, these were given numeric values of how many times they would occur on average per 6 month period (SHO job), as per the following:

Never	*0*
Once per SHO job (i.e. once per 6 months)	*1*
Once every 2-3 months	*2.5*
Once a month	*6*
Once a fortnight	*13*
Once a week	*26*
Once a day (assuming 5 working days)	*130*
More than once a day (i.e. twice the above)	*260*

These results are best displayed visually. Figure 8 shows how the activities are placed along the continuum, depicting the inter-quartile range (the peak displays the median, the higher and lower ends of the shapes show the 75% and 25% quartiles of responses.) This provides an indication of the level of consensus amongst respondents in their perceptions of the training/ service balance in the activities.

Figure 8 – Diagrammatic Representation of Training/ Service Perceptions of SHO activities



There are far more activities towards the training end of the continuum. However, this does not mean that junior doctors are more training focused. When looking at the colour coded frequencies (the darker the more frequent), it can be clearly seen that the ones undertaken more frequently are towards the service end. However, it is not clear which is cause and which is effect: are activities on the service end seen as such because they are done all the time, or have they become "service" because SHOs have become more experienced in them due to the high frequency? Or does it lie in the nature of the activity? Also, the starred activities are the ones that are generally supervised by somebody more experienced (virtually always identified as the Consultant, SpR or both). Here it is immediately apparent that the ones perceived towards the training end of the continuum are those that are more supervised. (Perhaps an indication of the word "training" implies the existence of a trainer?)

Trends in Training/ Service Balance Perceptions

Analysis of perceptions rankings showed that there was no significant relationship between experience and perceptions as a whole (when using median as the "average" perceptions), when all activities are taken into consideration.

Regression results on the original data set (all responses for all activities) yielded no insights into any significant relationships between frequency, supervision and perceptions. However, this is because it strongly depends on which activity is being considered, and due to the variability in responses in all fields (partly to do with specialties).

Thus a new data set was created, using activity, median frequency, median supervision and median training percentage perception.

Regressions and Correlations run on this showed that **just under 70% of variation in training percentage perception can be explained by variations in frequency and supervision across the 28 activities.** (See regression model results in Figure 9 below).

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Supervision, Frequency (times per SHO post)[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Perceived Training Percentage

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.835[a]	.697	.673	15.835

a. Predictors: (Constant), Supervision, Frequency (times per SHO post)

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14416.766	2	7208.383	28.746	.000[a]
	Residual	6268.948	25	250.758		
	Total	20685.714	27			

a. Predictors: (Constant), Supervision, Frequency (times per SHO post)

b. Dependent Variable: Perceived Training Percentage

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	65.464	8.426		7.769	.000
	Frequency (times per SHO post)	-.163	.039	-.631	-4.183	.000
	Supervision	14.451	8.220	.265	1.758	.091

a. Dependent Variable: Perceived Training Percentage

Figure 9 - Results of regressing median frequency and supervision on median training percentage perception

Unsurprisingly, frequency and training percentage perception are significantly negatively correlated (at the 0.01 level), i.e. the more frequent the activity, the lower the training percentage. Similarly, the existence of supervision and the training percentage perception were significantly positively correlated, i.e. the existence of supervision in an activity increases the training perception.

Consensus within Specialties

One of the problems with analysing perceptions of percentages of training and service across all SHOs, is that there is a high variability between specialties, both in terms of the frequency an activity is carried out, whether there is supervision, which may influence perceptions, but also in the way activities are undertaken. Thus, it may prove useful to analyse questionnaire results by specialty.

When broken down into specialties, the number of observations (responses) can become quite low. However, more importantly, is there consensus within specialties? If there is a lack of consensus within specialties, then further analysis with specialty as an independent variable, is not valid.

Standard deviation is used as a measure of variation in responses, and thus a measure of consensus (or lack of it).

There is a varying amount of consensus of training percentage perceptions within specialties, ranging from virtual consensus in some activities and complete lack of it in others. However, contrary to expectations there is also often a lack of consensus within specialties as to how often SHOs participate in activities and whether they are typically supervised.

This variance amongst SHOs responses within specialties, combined with the low number of responses once split by specialty, means it would not be valid to generalise results for specialties.

5.5 Qualitative Results

To complement and further explain the results of the questionnaire study, the focus group data was appropriately analysed as outlined in the data analysis section of this chapter. Below are the results of the focus groups: representations of the boards used for the placement of activities along the Training/ Service Continuum during the focus groups, seen by focus group and by activity (across focus groups), the coding frame and themes identified from the transcripts, patterns identified from analysis of the transcripts and observations on the language used. Comparisons and discussions of results are reserved for Section 6.

5.5.1 Board Results of the Focus Groups

Figure 10 below is the board results of Focus Group 1, representing the placement of activities along the training/ service continuum, as seen by the participating SHOs. Activities can be identified by colour and abbreviation (listed in table 10).

Abbreviation	Activity
PRA	Patient Related Administration
TPR	Talking to Patients and Relatives
O/A T	Operating/ Assisting in Theatre
WR	Ward Round
GMP	General Medical Procedures
DPC	Discussing Patients with Colleagues
TM	Team Meetings
RCT	Routine Clinical Tasks
E/R P	Examining/ Reviewing Patients
H/O	Handover
AC	Attending Clinics

Table 10 – List of Abbreviations on the Board Results and Activities they represent

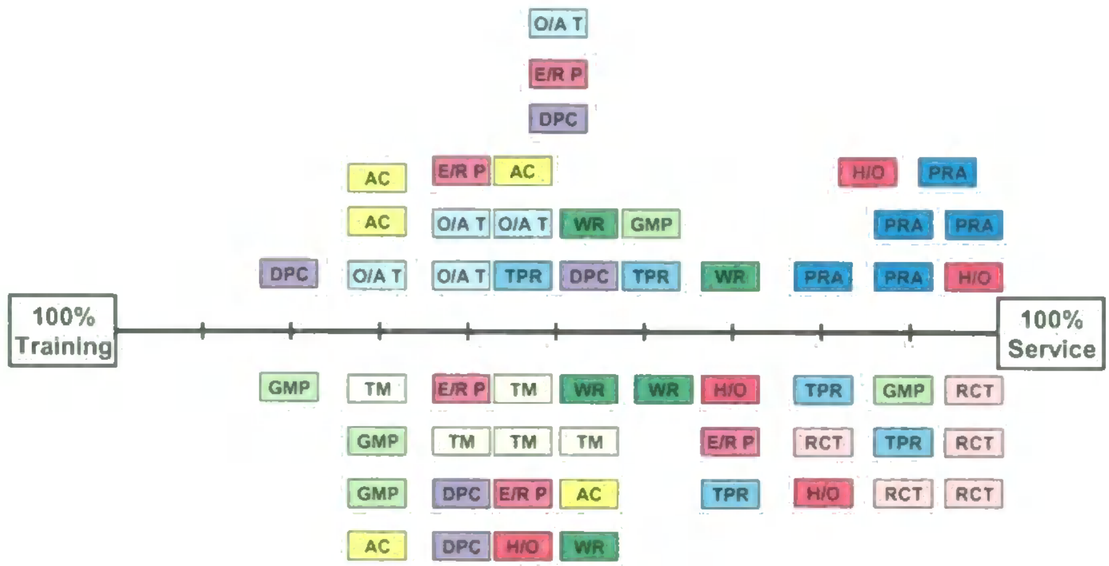


Figure 10 – Board Results of Focus Group 1: Placement of Activities along the Training/ Service Continuum

As can be seen above, SHOs used most of the continuum in their perceptions of the training/ service content. The highest training percentage perceived was

80% training/ 20% service for the listed activities (notable these did not include classroom based, "teaching" activities). While some activities, such as General Medical Procedures are perceived across the continuum, there appears to be a certain amount of consensus between the participants, even though this was not the aim of the focus group. This can be seen more clearly in some of the later figures. There is a particularly high level of consensus amongst the placement of patient related administration and routine clinical tasks, towards the service end of the continuum.

Figure 11 below is the board results of Focus Group 2, representing the placement of activities along the training/ service continuum, as seen by the participating Educational Supervisors/ Consultants.

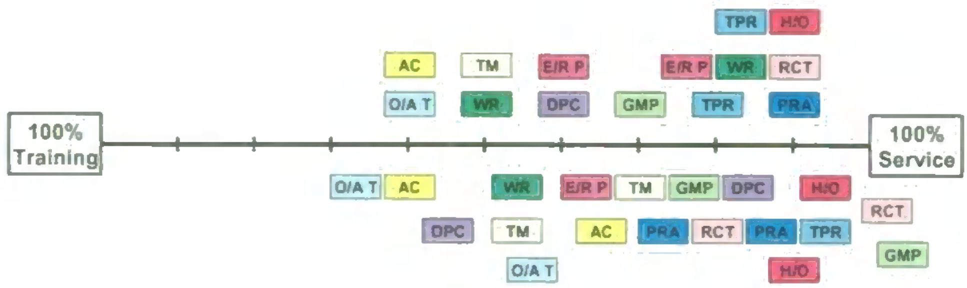


Figure 11 – Board Results of Focus Group 2: Placement of Activities along the Training/ Service Continuum

As seen above, most of the continuum is used, though with an upper limit of 70% training/ 30% service for the activities discussed. There also appear to be a far greater proportion of activities identified in the service half of the continuum, (i.e. more than 50% service) than in the training half, representing the view that the activities that SHOs participate in tend to be more service focused. Again, complete consensus in the placement is not present (and indeed it is not likely to due to varying perceptions), though some activities, such as Handover are more agreed on than others, such as Ward Round.

Figure 12 below is the board results of Focus Group 3, representing the placement of activities along the training/ service continuum, as seen by the participating Tutors.

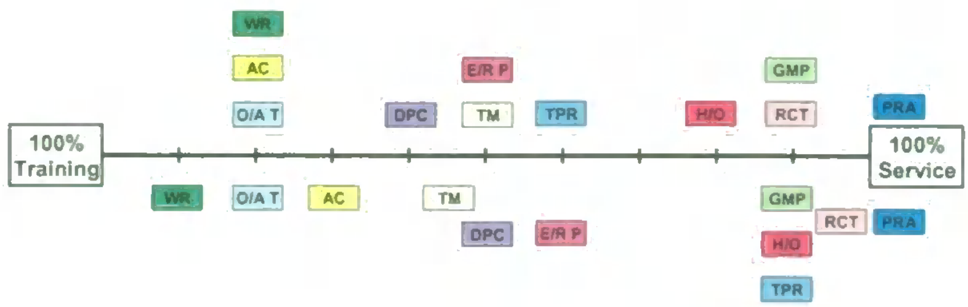


Figure 12 – Board Results of Focus Group 3: Placement of Activities along the Training/ Service Continuum

In focus group 3, almost the entire continuum is used, ranging from 0% Training/ 100% Service to 90% Training/ 10% Service. This means that the Tutors' perceptions reflected a greater range in training/ service balances than SHOs or Consultants/ Educational Supervisors. Interestingly, there is a high level of consensus between the participants in focus group 3 (educational supervisors/ tutors).

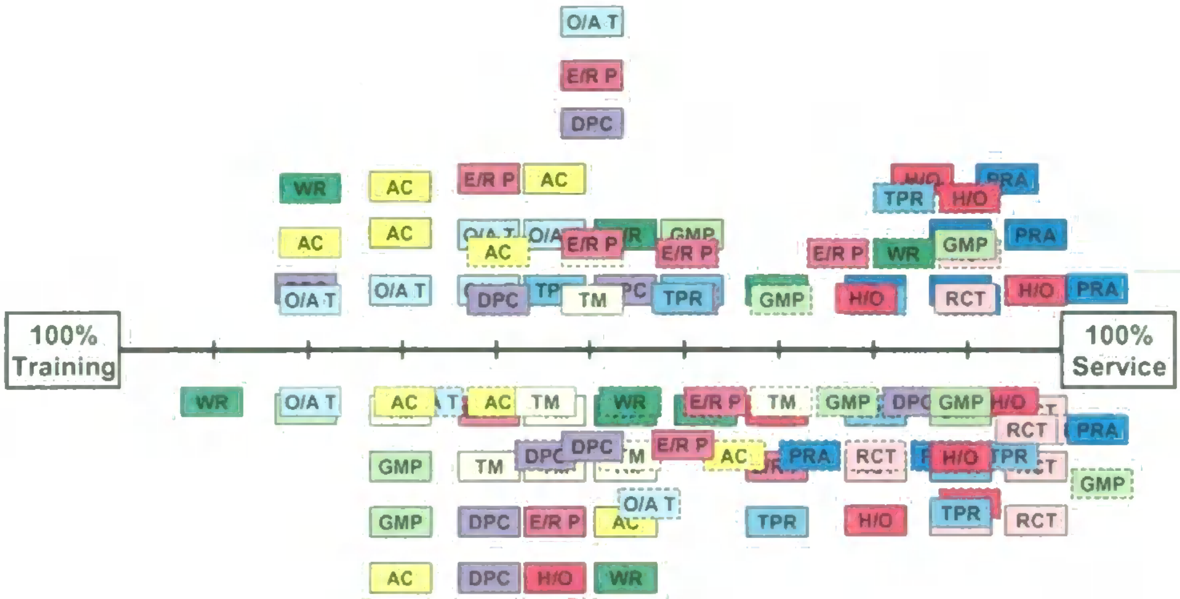


Figure 13 – The superimposed board results for all three focus groups

In figure 13 above, the results of all three focus group boards have been superimposed on each other. Different focus groups can be identified by the border of the square.

Solid outline – SHO Focus Group

Wide block outline – Consultant/ Educational Supervisor Focus Group

Fine dotted outline – Tutor Focus Group

To make sense of these combined results, it is easiest, if results are viewed by activity. This allows for comparison of placements of activities not only between participants but also across focus groups to see any clustering and consensus over the perception of the training/ service balance of the eleven activities addressed in the focus groups. Results for all three focus groups can be seen by activity in the figures below.

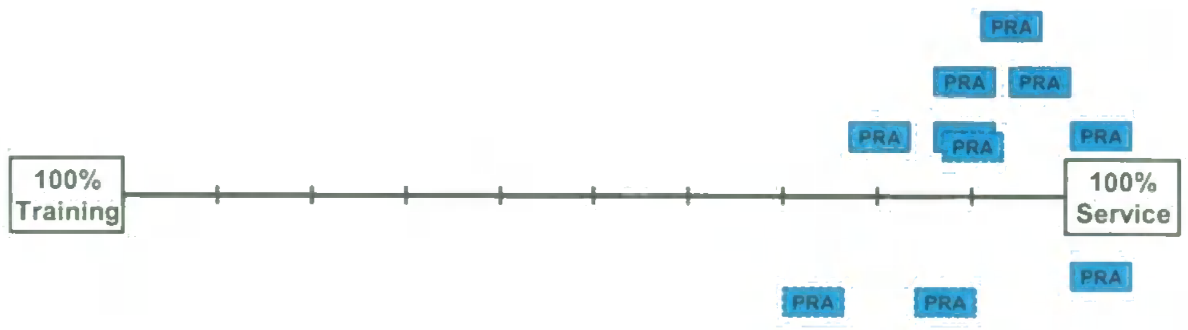


Figure 14 – Board Results for all three focus groups for Patient Related Administration

It is very clear that patient related administration is generally seen to be a service oriented activity with limited training content, and there is a fairly high level of consensus between the groups

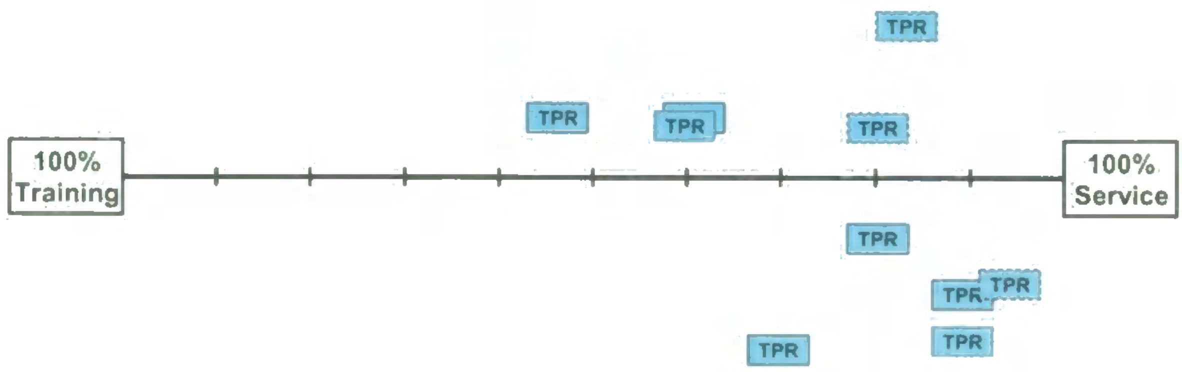


Figure 15 – Board Results for all three focus groups for Talking to Patients and Relatives

Unlike patient related administration, talking to patients and relatives is still seen largely a service activity, but with more training content. However, here there is a lower level of consensus, with one SHO even perceiving it as more towards the training end of the continuum.

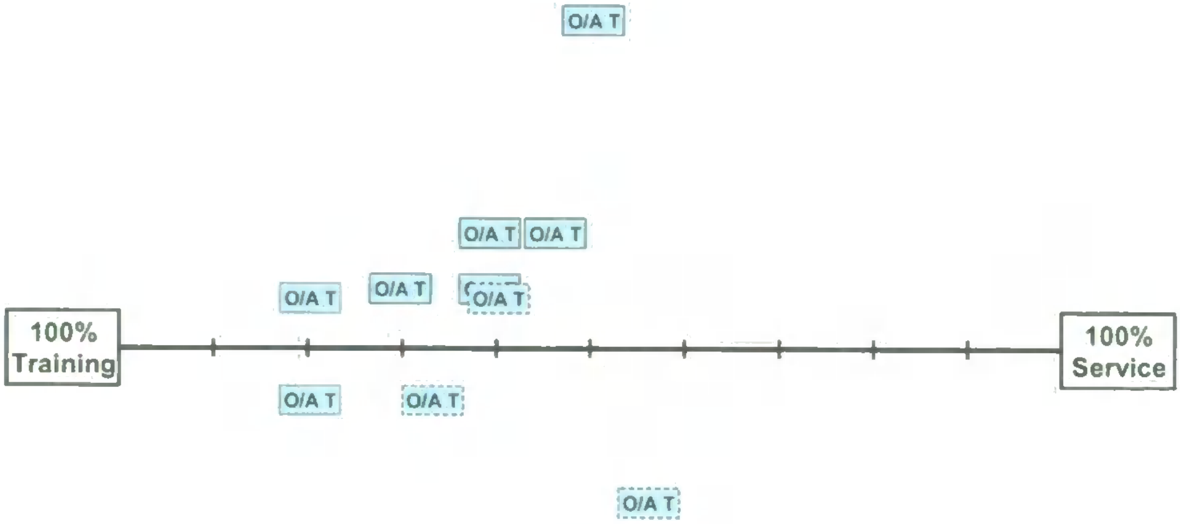


Figure 16 – Board Results for all three focus groups for Operating/ Assisting in Theatre

It was generally agreed that operating/ assisting in theatre was an activity with a relatively high training content, with some service element.

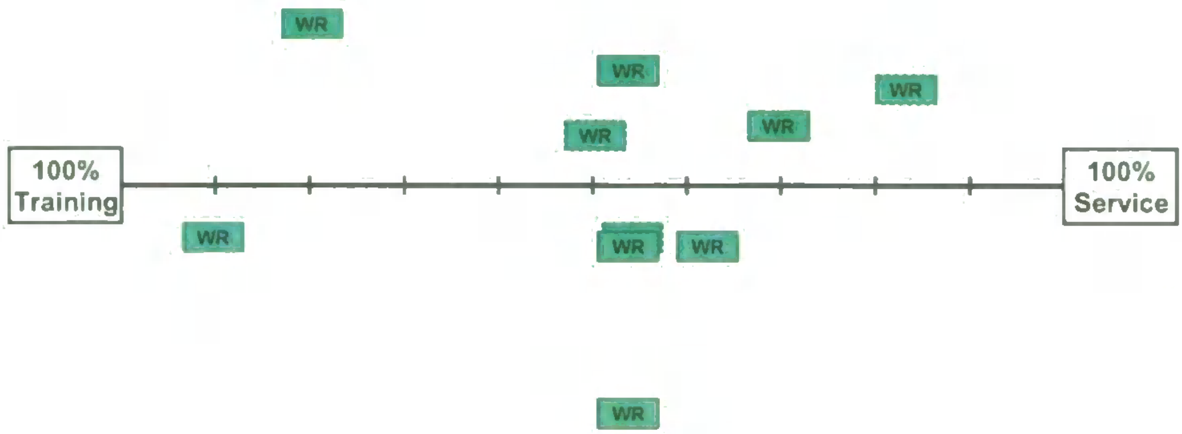


Figure 17 – Board Results for all three focus groups for Ward Round

Placing ward rounds yielded a very low level of consensus both within and between groups. This may be due to the fact that there are different types of ward rounds, some with a more educational focus than others, depending on a number of things such as how many patients needed to be seen, whether it was purely to list jobs outstanding on each patient or whether there was a designated teaching focus. These insights were not gathered until the differences were explored in the focus groups.

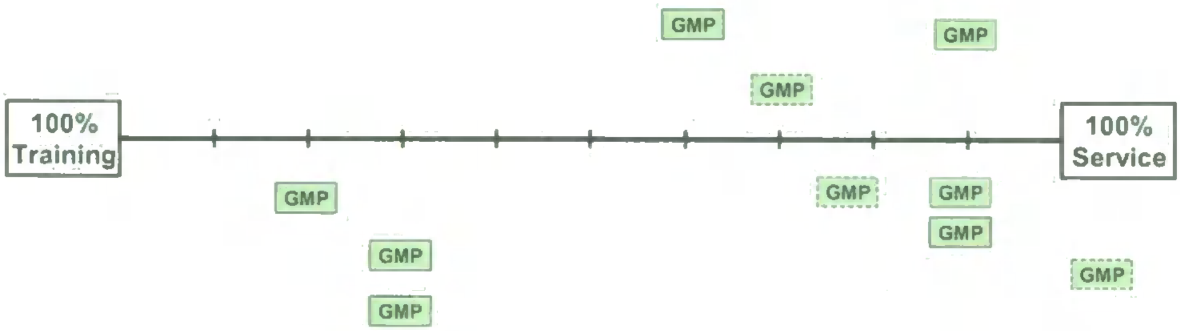


Figure 18 – Board Results for all three focus groups for General Medical Procedures

Similarly to ward rounds, there was a low level of consensus about the placing of general medical procedures. The more experienced of the focus groups (consultants and tutors) commented less on the training content for these, but 3 of the SHOs perceived these has having a relatively high educational content. This may be due to the level of experience in general medical procedures between the groups: consultants are far more experienced and are therefore more likely to see this as less educational than the junior doctors who are relatively new to these procedures.

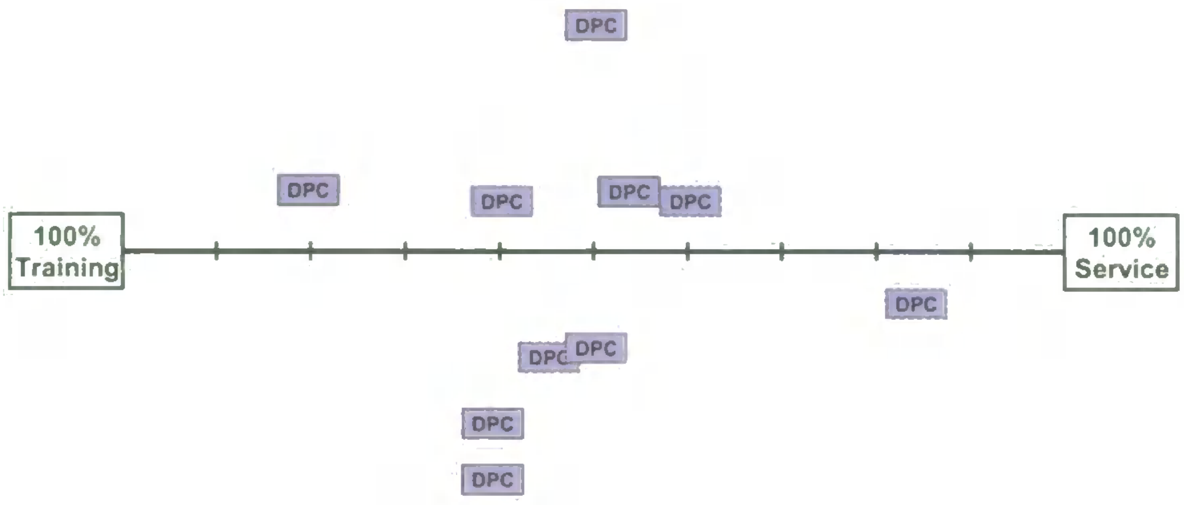


Figure 19 – Board Results for all three focus groups for Discussing Patients with Colleagues

There was a very low level of consensus about discussing patients with colleagues. This could be explained by the motivation and attitude of the individual to be able to learn from the experience. Of course the nature of the discussion and who they are talking to regarding the patient will also affect the perception of the training/ service balance in the activity.

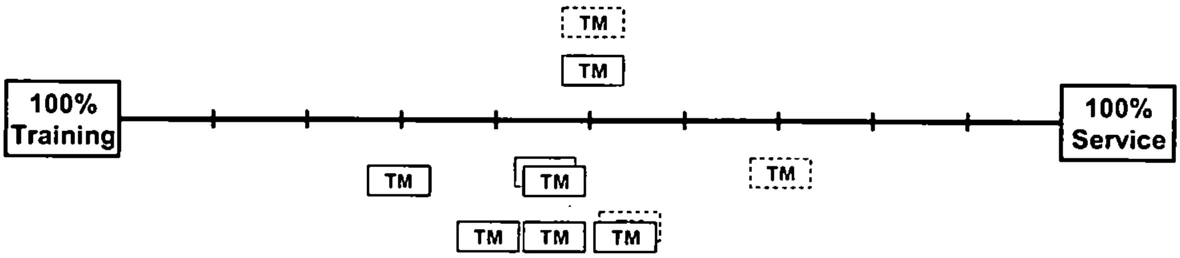


Figure 20 – Board Results for all three focus groups for Team Meetings

One of the few activities where there was a fairly even balance between training and service and a relatively high consensus about this was team meetings. It was agreed that team meetings had a service purpose but were also very educational.

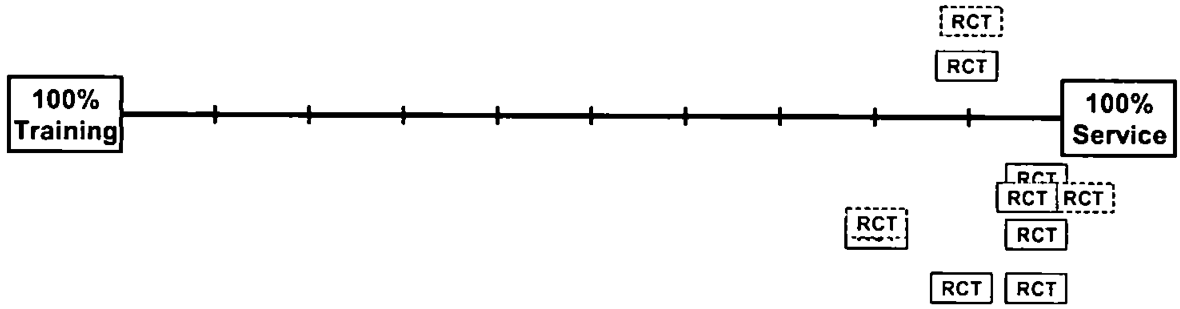


Figure 21 – Board Results for all three focus groups for Routine Clinical Tasks

Very similar to patient related administration, there was a very high level of consensus that routine clinical tasks (e.g. phlebotomy, cannulation, catheterisation) has a very low level of educational content and is mostly service (if not all). This is largely to do with the frequency that these tasks are carried out, several times everyday so that limited additional learning can be gained from completing these.

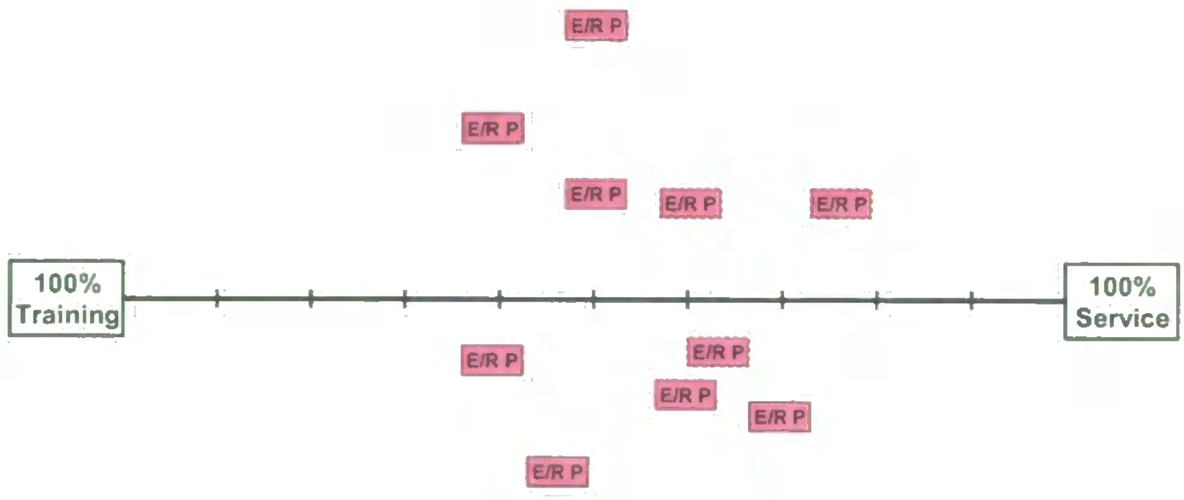


Figure 22 – Board Results for all three focus groups for Examining/ Reviewing Patients

Although there wasn't a high level of consensus as to the exact balance, all placed the activity so that there was a relatively even balance of training and service, with slightly more leaning to a slightly higher service element.

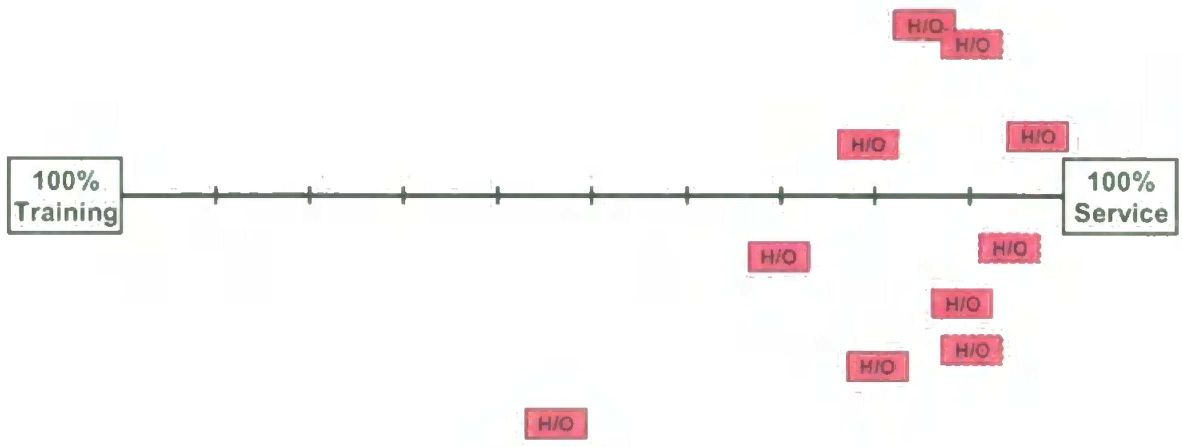


Figure 23 – Board Results for all three focus groups for Handover

Apart from one or two SHOs, the majority of all groups agreed that Handover is a service oriented activity. Interestingly, this is the activity that government initiatives regarding the EU Working Time Directives and Shift working agree could be most educational if executed in a different manner. The way handover is conducted at the moment, it is seen to be largely a passing over of tasks from one doctor or group to another, with limited educational value.

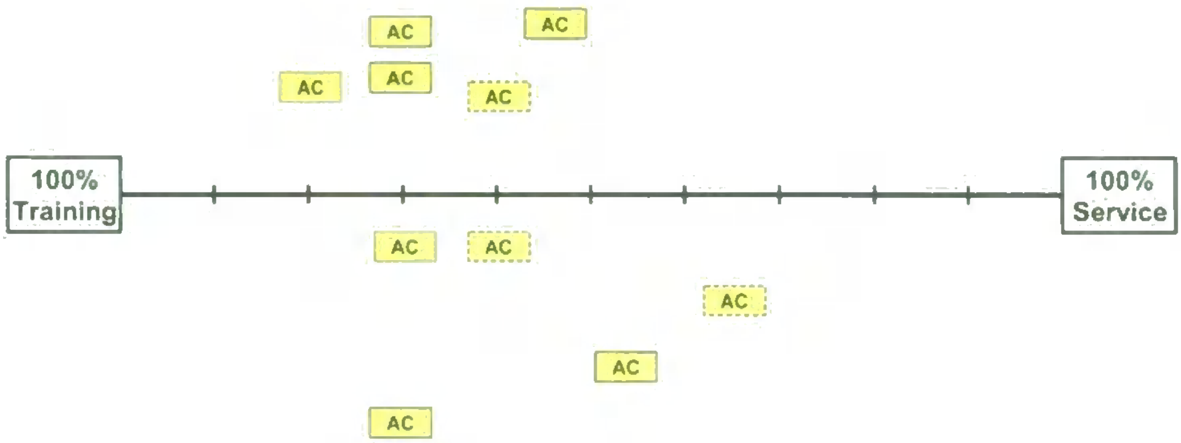


Figure 24 – Board Results for all three focus groups for Attending Clinics

Finally, similarly to operating/ assisting in theatre, clinics are seen to be of a generally educational nature, with some service content as patients are being seen. While not the highest level of consensus, most agree that it leans towards the training end of the continuum.

Additionally, the focus group containing consultants/ educational supervisors expressed the interest to repeat the exercise of placing activities along the training/ service continuum, regarding things should be (i.e. what the training/ service balance in each of the activities ought to be in theory, if there were no other constraints). The results of this can be seen below in figure.

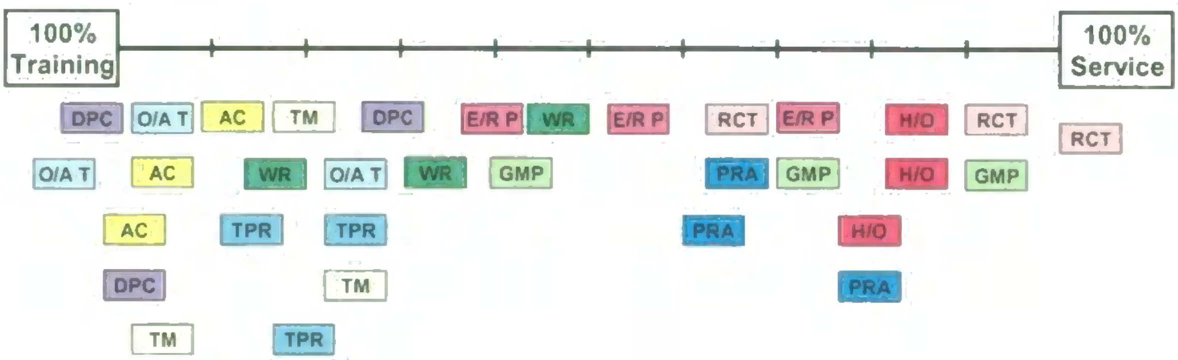


Figure 25 – Board Results as Consultants/ Educational Supervisors perceive the training/ service balance should be, for the eleven SHO activities addressed.

Interestingly, even in this depiction, the consultants did not entirely agree where activities "should" be, especially in the low consensus level activities such as ward round, discussing patients with colleagues and general medical procedures.

A full discussion of these results in the context of what this means for our understanding of the concepts of "training" and "service" can be found in section 5.6.

5.5.2 Themes and Coding Frame of the Focus Groups

In addition to the board outputs, which represented the physical activity which the focus groups were participating in, in order to engage them in the topic and focus the discussion, the transcripts of the groups were analysed for thematic insights into the rationale for the perceptions of the training/ service balance in activities. In short, why were individuals perceiving some activities to be classified as more "training" than "service" (or vice versa)? What factors were influencing their perception?

This section displays the coding frame developed by adopting the described methodology in analysing the focus groups. This coding frame identifies a list of factors affecting what is considered a "training" experience and what is considered a "service" experience, and also how activities may shift along the continuum according to these factors. In addition to these factors, a variety of other themes were addressed in relation to the junior doctor training and the training/ service relationship. These were included in the coding frame, in line with the systematic coding approach adopted.

Nr	Top Level Code	Description	Sub-Code	Description
1	Activities	Activities that SHOs participate in (coded for when they are being discussed)		
			Team Meetings	
			Talking to Patients and Relatives	
			Operating/ Assisting in Theatre	

			Routine Clinical Tasks	
			Patient Related Administration	
			Discussing Patients with Colleagues	
			Handover	
			Attending Clinics	
			Ward Round	
			General Medical Procedures	
			Examining/ Reviewing Patients	
			Presentations	
			Teaching Medical Students	
2	Factors	Factors that have been identified in the focus groups as having an effect on the perception of the training/ service balance in an activity, and where it is seen along the continuum.		
			Specialty/ Type and Nature of Work	Denotes that the type of specialty you work in affects the type of work you do, which will have an impact on how educational you perceive each activity within the specialty.
			Frequency	How often you do something, or how often you have done something.
			Time	How much time is devoted to an activity, or what time of day.
			Number of Patients	Nr of patients relating to

				the activity, which can be seen as a proxy of workload. Nr of Patients is also sometimes referred to as "workload".
			Supervision	The extent to which the SHO is supervised by someone more senior, or alternatively is working on their own (not supervised at all).
			Interaction	This includes the questioning, querying of decisions, discussion of alternatives, reflection on what they're doing.
			Other Commitments	The existence of other commitments
			Purpose and Focus	The purpose and focus of the activity - how it's designed, the content of the discussion, what the intended focus is, etc.
			Trainee	The individual "trainee" - attitude/ motivation / expectations
			Trainer	The individual "trainer" - attitude/ motivation/ expectations
			Experience	How experienced the SHO is, the amount of experience they have and where they are in their career.
			Relevant Knowledge	Relevance - having relevant knowledge, incl. knowledge of the patient
			Team Composition	How many of each grade there are in the specialty team, their experience,

				and in particular the existence of a PRHO in the team.
			Activity Type	Whether the activity or skill is of a manual type or to do with people.
			Complexity	Complexity of the task/ nature of the task/ broadness
			Competency	How competent in the activity they are - are they competent/ able to do something?
3	Skills	The types of skills that SHOs are acquiring during their training		
			Communication	Communication and listening skills
			Clinical judgement and decision making	Clinical judgement and decision making skills
			Presentation	Presentation Skills
			Identifying the seriously ill	Being able to identify when someone is genuinely seriously ill and when not
			Prioritisation	Learning to and being able to prioritise tasks and needs
			Confidence	
			Teaching	Skills in knowing how to teach
			Managing a Team	Knowing how to manage a team of people
4	Ways of Learning	Highlights the different ways that one can learn.		
			Learning by Doing	
			Demonstration	Learning by having someone demonstrate/ show you how it's done.
			Observation	Learning by observing

				others participating in an activity
			Repetition	Learning by repeatedly doing something over and over again.
			Discussion with Colleagues	Learning by discussing cases with colleagues
			Being taught	Learning by being taught by someone else
			From mistakes	Learning from mistakes (own and other)
			Teaching others	Learning by teaching others
5	Relationship between Service and Training	Explores the relationship between Service and Training, in particular *how* the two seem to be related		
			Conflict between	Codes for when a conflict between training and service is identified.
			Links between	Codes for when links between service and training are addressed, in how interrelated they are.
			Priority	Codes for when one is seen as more important than the other, regarding service and training.
6	Roles and Relationships	Describes the roles of the various team members, as highlighted regarding this discussion and the relationships SHOs have with others.		
			Role of PRHO	
			Role of SHO	
			Role of SpR	
			Other team roles	

7	Continuum	Codes when specific places on the continuum are being talked about, and when people are talking about their specific perceptions of activities on the continuum.		
8	Facets of Time	Different aspects of time addressed in the training/ service debate.		
			Not enough time	
			Waste of Time	
			Protected Time	
			Saving Time	
9	External Changes	Changes that are going on that are beyond immediate control, such as changes to SHO training through Modernising Medical Careers		
10	Ideal and Actual	When differences between the ideal and actual practice are identified, i.e. between what things "should" or "ought" to be and what they actually are.		
11	Sources of learning	The different people that SHOs can learn from		
12	Appropriateness of Training	Codes for the issue of whether a training element is even appropriate or desirable in a given activity, or whether it		

		should be "just service".		
13	Expectations of Training	SHO expectations of training and appreciation of when they are "training" or "learning".		
14	Consensus	When the level of agreement between focus group participants is being highlighted.		
15	Organisational Inefficiencies	Codes for all the inefficiencies in the working lives of SHOs that have come up in the Training/ Service debate		
16	Cultural Changes	Codes for perceived changes in the SHO culture that have been identified (attitudes, experience, future)		
17	Career Progression	Codes for when career progression is addressed.		
18	Working Patterns	Codes for references to the working patterns of doctors - shifts and hours, etc.		
19	Learning/ Training/ Experience	Codes for discussions about the difference between these		
20	Mandatory	Something has to be done, is necessary service		

Table 11 – The Coding Frame developed in the analysis of the Focus Groups (as taken from N6 software).

As can be seen from the coding frame, an extensive list of themes were raised, above and beyond the factors affecting the training/ service balance perceptions that were specifically addressed in the focus groups. Part of the reason for the codes being so encompassing is the systematic, data led approach adopted in the analysis of the focus group transcripts. Moreover though is the *interrelation of issues* in postgraduate medical education with issues in working environment, working patterns, team working, service commitments and the wider hospital system. This further demonstrates the need for a systems approach when modelling and analysing the working and education system of junior doctors.

Observed Patterns

From searching the coded transcripts and analysing the data using qualitative analysis software, the following patterns were observed:

1. In investigating the intersection of codes for the different activities and the factors identified, the three most coded factors affecting the balance perception of the activities discussed were: *supervision*, *interaction*, and *purpose/ focus of the activity*, both in terms of number of text units coded and the number of documents these occurred in (they appeared across all focus groups). This finding is not surprising, as it confirms expectations that the most obvious factors affecting the extent to which an activity is "training" is if there is supervision, interactive questioning, and if it has been designated or designed as a "training experience."

While not a surprising finding, it is nevertheless a very important finding, as it helps work towards a clarification of the ill-defined concept of "training".

2. Almost all of the identified factors (12 out of the 16 factors) were addressed by all three focus groups, indicating a high level of consensus across the participant groups, except for:

    (i) The motivation and attitude of the trainee – this was only addressed by the consultant/ educational supervisor and tutor groups. This is rather unsurprising, as the more senior groups will be able to observe the variation in trainees and how this affects the extent to which activities become training-focused, more so than SHOs amongst themselves. Junior doctors also may have a lack of insight into their own motivation and attitudes as compared to others observing their behaviour.

    (ii) Activity Type- only the SHO group identified that it makes a difference whether the activity is a manual skill or an activity involving people.

    (iii) Complexity and Competency – these two were identified by the SHO and the tutor groups, but not by the consultants.

Points (ii) and (iii) could indicate either that SHOs have more insight into what affects their perceptions of the training/ service balance of activities (which makes logical sense), or they could have identified these additional factors more so than the consultant groups, simply because there were more participants in their focus group, which sparks more discussion. Limited conclusions should be drawn from this, as it is most likely that these factors were simply not raised by coincidence during the limited time spent with the sample of consultants.

3. Although identifying ways of learning was not an explicit aim of the focus groups, it dominated some of the discussions around the training/ service balance for SHOs. It was most interesting that of the eight identified ways that SHOs can learn in their jobs (i.e. learning by doing, demonstration, observation, repetition, discussion with colleagues, being taught, from mistakes and teaching others – see table), SHOs only identified and referred to two ways of learning: being taught and teaching others. This is strongly indicative of the connotations that "training" carries with it, and the confusion of "training" and "teaching". If SHOs perceive that teaching is the only method of knowledge delivery, then this may help explain why the perceptions of the balance have moved towards service as a whole, as the amount of time they spend with named "teaching" consultants decreases through the changes in working patterns and increased demands on the health service.

It must be noted that as only three focus groups were held, it is difficult to thoroughly evaluate any identified patterns, to be able to generalise. However, the data can be used (as above) to be indicative of possible wider trends or help provide examples of existing suspected trends.

5.5.3 Language

While discourse analysis was not the explicit aim of the focus groups, analysis of the transcripts revealed some valuable insights into the language that is used regarding SHO "training" and "service". The use of language can be very important, as it bears connotations and can thus very realistically influence perceptions.

During the analysis of transcripts it became evident that the terminology used around postgraduate medical education and junior doctors centred on a few key words (and variations thereof). These include: training, teaching, learning, education, service, business and job.

The use of "training" and "service" is perhaps the most ingrained in the culture, and accordingly, its prevalence in the focus groups concerned with the training/ service balance activities is not surprising. "Training" and "Service" appeared continually in all three transcripts, with "Training" occurring in approx. 8% of all text units and "Service" in approx. 5% of all text units.

Similarly, language that is used, relating to "training" and "service" is used in all three focus groups: "job", "learning", "teaching" and "education" are all used continually to varying degrees. More interestingly is the appearance of "business" in place of service. This appeared in both the SHO and the tutor focus groups.

In the SHO focus group, it is used together with "service" when referring to how team meetings can be run:

> "And it depends how the team meeting is run as well, really. I mean, I'm going to go to an X-ray meeting in quarter of an hour and it'll be very much consultant led: discussions between consultants and we sit in the back and just present a history. It's very **business service**, but again a training opportunity missed."

In the Tutor group it is used interchangeably and synonymously with "service". Referring to Ward Rounds on tutor said, "I suppose also they can divide up into business rounds and teaching rounds".

Further, "business" is referred to more than once in relation to team meetings, as is the case above:

> "Yeah. Our team meetings are, depends what you mean by team meetings, but team meetings have a business and a training element to them, for everyone."
>
> "So, it's not purely business. It shouldn't be purely business. But I think they should be, and they can be made more training oriented, but of course, there is always the time commitment as well.

Here, business is used as the other end of the spectrum to training.

While the non-use of "business" in the consultant focus group may or may not be indicative of standing or behaviour, the existence and use of "business" both together and instead of "service" must be noted. This may be everyday language creeping into health professional's terminology, or may be symptomatic of the increasing running of hospitals as "businesses" with an eye on targets and the bottom line. Further, it could be indicative of the cross-breeding of knowledge and the increasing employment of traditional management techniques and/ or management literature to the health service. Further discourse analysis would be necessary to explore this in detail.

5.6 Discussion

Having presented the results from the quantitative and qualitative data collection via questionnaires and focus groups, it is important for me to discuss and summarise what this tells us in terms of clarifying the concepts of "training" and "service". This is at the crux of the organisational problem and understanding this allows us to move towards building the model depicting how junior doctor activities relate to these concepts (the "micro level" model).

5.6.1 Factors affecting the training/ service balance of an activity – focus group findings

The qualitative data collected during the three focus groups, yielded a list of factors that affect the training/ service balance of SHO activities, both at an individual level and on aggregate. The meaning of these and their impacts are discussed in the sections below. (Note: these factors are not any particular sequence, and order does not represent importance or level of impact).

Time

Time was identified as a crucial factor. It is generally assumed that an activity with a "training" focus takes more time than if it is "service" focused. Consultants expressed the concern that it was not only SHO time, but also more of their time. Service pressures, relating to the number of patients that need to be seen in clinics, ward rounds or theatres, meant that there is less time to "train". As one SHO said:

"It's like ward rounds. If you've got an interested consultant and 15 patients to go round either in a morning or an afternoon, then yes, you can talk about them and, obviously we're looking at the patient's care, but they [the consultants] do explain why they're doing things, and if you've got questions as well. If you've got 70 patients on a post-take ward round that's supposed to be done in two hours then, you know, you barely can do the service commitment, let alone anything else."

Type and nature of work

This factor was addressed by all three focus groups. Repeatedly, variations in the practice of activities, such as outpatient clinics were addressed when participants explained why they had placed particular activities in their places along the continuum.

The specialty factor was addressed mainly in the type of work to be done. For example, the nature of work in ENT was contrasted to other specialties, in relation to two activities: Attending Clinics and Talking to Patients and Relatives. With respect to Attending Clinics, this was seen to be high towards the training end by one participant in the consultant focus group because:

"Ear, Nose and Throat Surgery is about 70% outpatients and 30% inpatient, so they're bound to spend more time in outpatient clinics, where the number of patients are limited. And they are encouraged to come and ask."

Notably, here a number of factors explain his placement of Attending Clinics: nature of work, time, number of patients and interaction (more about these in other sections.)

While the nature of the work was seen to be conducive to training regarding one activity, it meant that at the same time, it made other activities more service oriented. For example: talking to patients and relatives:

"...ENT surgery is a high-volume, short-stay thing – there's not much to talk about. They come in, they have an operation, and go home the same day or the next morning. But if you have somebody with malignant bowel disease or breast cancer or something, the scenario is rather different."

One of the SHOs, confirms the role that the specialty and nature of work plays in talking to patients and relatives:

"It depends on the conversations you're having. There are conversations with relatives which are 'Yes, you will have an operation and it will be as soon as we can get it done' and you don't get anything from that. It's service. Just in the job I'm doing at the moment, when I'm talking to patients and relatives, I tend to be breaking bad news, so I feel I learn quite a lot from doing that, in the way of communication skills, in a way that you might not if you were talking about... [something else]."

Additionally, participants often explained the placement of their activities on the board, by referring to the variance in the way specialties are run:

"But again, this is where I am probably slightly higher than you because of the way in which [the referred specialty] operates in relations to other specialities."

Thus, as the nature and type of work varies tremendously by specialty, so do the training/ service balances of some activities performed in different specialties. While this is an acknowledged fact, this should not universally affect all activities. For example, SHO teaching, appraisals or presentations would be cases, where the type of work should not affect the training/ service balance perception. Interestingly, while the factor was labelled as nature of work or specialty, it is noticeable that this is manifested in other factors: number of patients, complexity of work, time taken, which are all identified below.

Frequency

This was a factor that was originally hypothesised to influence the training/ service balance perception of activities, the rationale being that the more frequently someone participants in an activity, the more likely they are to perceive it as "service".

Frequency, indeed was addressed by all three focus groups, as influencing whether an activity was "training" or "service". However, participants highlighted this in relation to gaining experience and competence. Activities that the SHO hadn't done many times, and thus were not very experienced in, were more "training", versus the ones in which sufficient experience or competence had been achieved, which are seen as "service". Especially, if the activity is performed frequently even after competence has been achieved, then this is seen as "service." For example, when referring to routine clinical tasks, one SHO said:

"They need to be done once and learnt and be able to retain it [the skill] and to be able to do it every so often...taking blood a couple of times, not something that needs to be done every day."

This was confirmed by another SHO in relation to general medical procedures:

"Just talking about practical procedures then you need to get to grips with taking blood and that's very important initially. And then once you've grasped that skill, all you need to do is just do enough to keep it maintained. I think that's where the frequency applies."

These references to frequency and gaining experience are echoed by one of the tutors:

"I mean the major thing that brings it [the activity] up into training is how used to doing it you are."

So, certainly one aspect of frequency as a factor affecting the training/ service balance is not so much how much the SHO performs the activity in general, but more importantly where this is in relation to their experience and learning curves. If this is insufficiently matched, then SHOs can perceive a problem with frequency in relation to their training. Some of the surgical SHO comments have been:

"Say, if you take a registrar that become an orthopaedics registrar two years ago, walk in having done, you know, 90 [specialty specific] operations before – they get on with it. Whereas I'm about –well not about to be a registrar because I have a few exams to do – but potentially my next orthopaedic job, and I'm going to arrive going 'ooh, I've done 4 of these.' "

"Another thing that [another SHO] said about surgery – the general surgery job – is the cancer two week waiting list means that quite often the operations that are SHO level, the sort of smaller when you're first beginning to learn to operate thing, they're the ones that often get cancelled because the consultant has to make sure that everybody who has a two week wait goes through. So that's affected the availability."

Particularly, in the last comment, it is visible that frequency is not necessarily only affected by the hours worked, but also by other pressures in the system. So, while the frequency that an activity is participated in has been addressed as a factor which affects the extent to which it is perceived as "training" or "service", it is deeper in that it is in relation to experience and where the individual is on their learning curve. Further, the frequency in which someone participates in an activity is determined not only by the specialty they work in and the hours they work, but other pressures and factors in the system.

Number of Patients

The number of patients to be seen, reviewed or treated during an activity, was felt to influence the extent to which an activity was perceived as "training" or "service". This is mainly because the number of patients is seen as a proxy to workload, and the more work there is to be done, the less time there is per case to be dedicated to "training".

"If you've got a clinic which, because of service requirements, is very heavily booked, you don't have the luxury to sit along the juniors and discuss cases."

Supervision

As identified in the questionnaires, supervision was seen as an important factor. This is not surprising, as the mere word "training" implies that there is a trainer present to provide or deliver the training. Consultants said that an activity becomes more training focused, by

"Doing it under supervision. Or having it demonstrated to them [the SHOs]. Them feeding back to the consultants what they found, how they found it, and getting them to demonstrate it to them. All that sort of thing."

SHOs identified supervision as very important too. However, they also appreciated the significance of not being supervised in their "training".

"Or if there isn't supervision, you are training yourself because you've been there with the responsibility of dealing with the patient yourself, which is important too."

So, while supervision affects the training/ service balance of an activity, this is likely to be in relation to where the SHO is on their learning curve. In the early stages, supervision is needed, but similarly, lack of it is important later on.

Interaction

Interaction, and particularly the interactive questioning of decisions and alternatives in clinical decision-making and judgement, was universally seen as important for training. When this is missing in an activity, then it is seen as service-focused. Handover, was the most commonly cited example of this: if there was questioning of decision making during handover, then this would place the activity towards the training end of the continuum. If it is simply a case of handing over jobs and to-do-lists, it is more service-oriented.

Other Commitments

While not seen as a major factor, it was repeatedly highlighted by SHOs, consultants and tutors that other pressing matters, commitments and agendas may make an activity more service focused at times. Specific example of these other commitments were not always given, but rather generically labelled "other pressing agendas" or "other things they want to do".

Purpose and Focus

The purpose and focus of a specific activity also was seen to have a bearing on where it was placed along the continuum, in particular regarding ward rounds and team meetings. Whether the activity was run as a "service" ward round or meeting or a "training" one, with an educational emphasis, naturally has a bearing on the perceived training/ service perception.

The "Trainee" and the "Trainer"

The consultant and tutor focus groups identified that there is a significant variation in the motivation, attitudes and expectations amongst individual trainees, which would affect their perceptions of the training/ service balance in SHO activities. In addition to recognising that some are more "keen" than others, as a whole, they felt that trainees expected training to be "delivered" to them. Unsurprisingly, the SHOs did not identify this amongst themselves. One of the tutors highlighted the disparity in trainee and trainer expectations:

"Are we in a situation at the moment where the trainees are expecting to be trained and the trainers are expecting the trainees to learn and therefore the two are a distance apart?"

Unlike the trainee factor, all three focus groups identified that there is a variance in the attitudes, motivation and expectation of the "trainers" (i.e. the consultants), and that this had an impact on the training/ service balance of an activity at a given time. As one participant summarised it:

"I would think that the two factors as to which end things come [on the continuum] depends entirely on the personalities of the SHO and the person they're working with. Some doctors will come, do the work and disappear, that's it. That's all they do. There are other people who take an interest in juniors. And vice versa, there are juniors who are interested in their seniors. And they engage in exchange in information. I think it's largely a reflection on people, to a degree."

Experience and Competence

How experienced an SHO is, was thought to have an influence on their training/ service balance perception: the more experienced someone became, the more the activities would creep down towards the service end. The issue of experience is closely linked to competence. It was felt that until competence in an activity or task had been achieved, it would be perceived towards the training end of the continuum, after which it would become service related. However, this aspect was more relevant for manual skills and procedures that need to be practiced, rather than for activities such as team meetings, ward rounds or discussing patients. Also, the complexity of an activity is relevant: competence being achieved with relatively little experience early on in simpler activities, becoming "service" quickly, as opposed to more complex ones that are at the training end of the continuum for much longer.

5.7 Discussion and Interim Conclusions

In questioning the status quo that all SHO activities are both completely training and service, and inextricably linked, this work has researched the perception of SHOs of which activities are "service" and "training" and the qualities of an activity that leads them to classify it in the way they do.

As is easily seen from figure 8 (training/service continuum), there are trends in the training/ service perceptions of activities and the frequency SHOs perform them and whether they are supervised. It is not surprising that these two factors explain 70% of the variation in perceptions of activities, when the lack of consensus amongst SHOs is accommodated for. This is largely a symptom of the traditional model of postgraduate medical education: being "trained" by repeatedly performing activities under the supervision of senior staff. However, it is evident from this research that these are not the only two qualities that lead medical staff to classify activities into "training" and "service". The training/ service balance perception of activities can be affected by a number of other factors such as time, number of patients (workload), type and nature of work in the specialty, the individual trainee and trainers motivation and attitudes, interaction, purpose and focus of the activity, other commitments, experience and competence. These all affect the execution and practice of activities, which directly influences how they are perceived along the training/ service continuum. Moreover, these factors themselves are intricately related with each other, compounding the complexity of the situation.

This indicates that for junior doctors it does not suffice to say that working many hours under supervision is the only way of providing postgraduate medical education. The "system" is more complex, and it is not relevant to continue assuming that everything SHOs do is both "all training" and "all service". As this work has shown, the balance between the two varies amongst activities, with a number of factors contributing to this perceived balance. This has important implications for reducing junior doctor hours: there is more impacting on training and service than just simply the number of hours worked, and all these factors need to be considered in devising solutions. It has also become apparent from this work that underpinning solutions to the training/service/hours conundrum is a discussion about learning curves and competence, both at individual and aggregate level. The training/ service balance in the practice of activities, and the factors impacting on it are highly related to where the SHO is on the learning curve regarding that activity and whether they are competent in performing it, particularly regarding more practical or manual skills. While it needs to be acknowledged that there is always something new to be learnt from an experience, as SHOs approach the flatter end of the learning curve, the activity will inevitably be perceived as more service-focused, irrespective of the number of patients, time available, interaction with senior staff or any of the other identified factors.

Therefore, perhaps some of the solutions to reconciling the impacts on training and service of reducing junior doctors hours lies in questioning how to encourage junior doctors to move along the learning curve and becoming competent more efficiently. This would not only combat some of the perceived impacts that reduced hours have had on training, but also maintain service provision, as junior doctors would be providing more of a service focus in their activities earlier on, as they are reaching the flatter ends of their learning curves more quickly. More work in this area is needed.

Taking these results further into the wider research agenda, there are now relative measures of training and service percentages for each of the activities that SHOs participate in, with a number of softer factors that affect this balance. For this information to be used purposefully for analysis in a model of the system, it is necessary to find out how much time SHOs spend in each of these activities, in order to assess what the balance looks like for SHOs as a whole.

6. How is Junior Doctor Time Spent?

In an attempt to understand in more detail the balance between training and service for junior doctors under the EWTD, questionnaires and focus groups were used to develop the training/ service continuum, which yielded perceived training/ service percentages for SHO activities. While this in itself is significant progress towards building an understanding into the relationship between training and service, it lacks quantification in terms of time. If "training" and "service" components can be quantified within the activities that they spend their time on, how much of their total time is spent "in training" and "in service"? Therefore, the purpose of this stage of the research is to understand the balance in junior doctor time looks like in reality: is it close to the assumed 50% training/ 50% service that is represented in the funding for these SHO jobs and by educational agreements with the authorities or is the proportion skewed to the service end, as outlined in Liam Donaldson's *Unfinished Business* which calls for the restructuring of training in the SHO grade?

To identify how much time SHOs spend "in training" and "in service", it is necessary to apply the derived percentages of each of the activities to time-use data, which illustrates how much time SHOs spend on each of the defined 28 activities. However, as with all research it is necessary that the data collection and analysis methods are fit for purpose. To clarify the purpose: time use data is required here to understand in more detail the balance between training and service for SHOs in reality, given the percentages of training and service in activities, as determined by earlier part of research. Given that junior doctors perceive activities that they participate in to be varying in educational and service content, how does this translate to how they spend their time on a daily basis? For this, a breakdown of time spent into these activities is required.

6.1 Data Collection Methods

Medical Staff time use data is generally not readily available. NHS junior doctors do not need to keep time sheets of the content of their day, as many other professionals with billed clients need to do (e.g. accountants and lawyers). Since the introduction of the New Deal and the new junior doctor contract in 2001, junior doctors have had to keep time sheets of start times, end times and breaks in their duty for two weeks twice a year, to monitor the hours they work. However, these time sheets reveal no information about the types of duties they partake in during their time at work.

There are fundamentally two ways of collecting time-use data: it is generally collected by either self-completed diaries or logs, which can be either paper-based or electronic, (e.g. using PDAs or bar-code readers) or by employing observers (so-called "shadowers") to observe activity and time use. Either of these methods can be used to collect either structured or unstructured time use data (i.e. using a pre-defined list of activities or not).

Past efforts at looking at how junior doctor time is spent for either workload analyses or studies of out of hours activity and appropriateness have included both these data collection methods and have included both structured and unstructured approaches.

Most of the research on how junior doctor time is spent has stemmed from the need to look at out-of-hours activity in order to meet New Deal hours regulations or to assess the appropriateness of the out-of-hours activity for the junior doctor both for their experience and training and a patient safety point of view, or in order to find efficiencies in the hospital system. In reviewing these past studies it is clear that this type of research relies heavily on sampling or is specific to a very small set of people, where they are for example trying to improve a specific rota in a department. (McKee, Priest et al. 1991; McKee, Priest et al. 1992; Read, Draycott et al. 1998; Kelty, Duffy et al. 1999)

Some researchers have approached the analysis of workload and the way junior doctors spend their time in a very positivistic way, seeking efficiencies to be gained in the system, by using theatre registers and emergency theatre lists to collect activity data and putting considerable thought into how representative the period of study was and how valid and generalisable the results were (McKee, Priest et al. 1991; Kelty, Duffy et al. 1999). This approach is appropriate when looking at operational management issues such as the optimum use of manpower or theatre usage in hospitals at various periods, and is good for looking at other such macro-level matters of hospital management. However, when considering detailed junior doctor time use and how this fits into the proportion of the individuals' time spent training and service, this type of data does not supply the sufficient detail needed. Other projects have relied on data collected either by self completion of diaries (Read, Draycott et al. 1998) or observation.(Leslie, Williams et al. 1990). Turnbull et al (1990) even combined these by asking general surgical trainees to self-record activities in pocket book sized diaries, and completing separate forms about each bleep call they received, and also asking students to shadow them and complete the forms for them during periods when they were too busy.(Turnbull, M. et al. 1990) Some past efforts have even included combining the two, such as McKee et al (1992) who used both routine records and diaries to evaluate junior doctor out-of-hours activities.

In deciding on the data collection methods of time use data, there are two important decisions that need to be made: does the individual keep their own records of how they spend their time or should they be observed, and should the data be recorded in a structured (e.g. by using a predefined list of possible activities) or in an unstructured way. There are naturally advantages and disadvantages of each of these methods of data collection, and these have to be weighed up in consideration of the purpose of the data collection and the research phenomenology.

In deciding whether the data should be collected through self-completion or observation, there are three important factors to consider: time, accuracy and cost. Junior doctors are generally very busy people who not only would not have the time to keep their own records (assuming that they had sufficient inclination to do so, which is another matter which would require significant effort on the part of the researcher to ensure that this is the case) and if they were asked to do this anyway, would probably not have the time to capture enough detail to allow for accurate analysis. Thus self-completion is relatively cheap, but at the cost of the accuracy of data. Observation (or "shadowing") entails the recruitment and training of observers, which is significantly more costly, but would allow for more accurate capturing of times spent in activities, as the observers sole purpose is to act as a "shadow" to the doctor, and capture everything they are doing and for how long, along with possible other observations. Thus accuracy of data is likely to increase, but so does the cost of the data collection.

These considerations were deliberated in designing this data collection. Fortunately, funding was available from the South West Action Team as part of the Medical Workforce Skills Mix Analysis project in July 2003, which was accessible to this research to employ a number of observers to shadow SHOs on-call at Derriford Hospital. At the same time, the Trust had been experiencing significant problems in past efforts in getting trainees to complete time-use diaries, with the main grievance being that they did not have the time to do so. Thus, it was decided to use observation to collect data on SHO time use.

This means that very accurate data could be collected for a number of doctors on-call. Further collecting data through observation means it avoided some of the problems that would have arisen through self-collection of data such as the problems of omission, memory and the gap between stated behaviour and actual behaviour (Bryman 2001). However, the social desirability effect, where participants may behave in ways, which they feel they are expected to, may not be entirely overcome as for the relatively brief shadowing period, junior doctors may distort their "business" to suit their interests in partaking in the study.

A key point in the design of this data collection is whether the observation should be structured or unstructured. Structured observation, also referred to as systematic observation *"is a technique in which the researcher employs explicitly formulated rules for the observation and recording of behaviour. The rules inform observers about what they should look for and how they should record behaviour. Each person who is part of the research is observed for a predetermined period of time using the same rules."*(Bryman 2001)

A distinct advantage of structured observation is that increases consistency in the data collection between observers and due to the existence of an observation schedule, it allows for the aggregation of data across the participants' observation data. This means that a number of doctors could be a shadowed by a number of different people for a predetermined period of time using the same rules, and the data collected from each of these could be used together.

The SHO on-call doctors in eight specialties were shadowed for 24 hours (or a proportion thereof where the entire period was not possible, due to the doctor going home). The specialties selected were: general medicine, general surgery, obstetrics and gynaecology, orthopaedics, cardiothoracics, anaesthetics, maxillofacial surgery and ENT. These were chosen as these specialties represented the majority of on-call specialty groupings, each with their own individual rota. Of course, the more specialties that could have been included the better, but given budgetary restraints, it was only possible to shadow 8 on-call periods for 24 hours. Consultation with operational management at the Trust revealed a preference to shadow a breadth of specialties rather than one specialty in depth. This also suited the nature of the overall research paradigm, as this research considers SHOs in general, not specific to one area, and wanted to capture all generic activity across all areas to understand allow the quantification of the concepts of "training" and "service". As the activities developed in the training/ service continuum included both medical and surgical activities, as well as more general activities, it was important that these areas were included in the participant group.

Observers were recruited by an internal Trust advertisement. This advertisement stated the purpose of the study and the rates of pay, which were:

£7.50 per hour (Mon – Fri 9am - 5pm)

£12.50 per hour (Mon – Fri 5pm – 9am

£15.00 per hour (Sat 9am – Mon 9am)

A specific week in Jul y 2003 was chosen during which all shadowing would take place. Observers volunteered for specific shifts within the shadowing period (July 14 – July 20, 2003). Observers did not need to necessarily have a medical background, but must be familiar to the hospital system and have experience of junior doctor tasks, so that they would be able to recognise what they saw. The recruited observers were of a variety of backgrounds, which included medical students, medical secretaries, nurses and managers. Each observer was trained during a briefing as to the purpose of the task and issued detailed instructions and data collection forms (copies of which can be found in the Appendix). This was also the opportunity for them to ask questions. During the shadowing period they also had emergency contact numbers should any problems arise or they had any further questions.

The doctors that were on-call during the shadowing period were contacted to seek their permission to be observed. None of them refused this request. Most SHOs are familiar with being shadowed by medical student and are themselves involved in a number of research projects and audit at any given time for their career advancement and so are familiar with requests to partake in research projects. Additionally many had the training/ service/ hours issue at heart which made them even more interested in participating in the research. However, as a precaution, observers were informed that should the doctor request for them to stop at anytime that they should follow these instructions. Also, they were instructed not to record any patient-specific data in order to conform to the data protection act and to allow for patient privacy, if requested.

Observers were asked to record time and motion data (i.e. for how long junior doctors were participating in what activities) along with any other observations. However, they were not given a discrete activity list. There were a number of reasons for this. Firstly, this would allow the observers the opportunity to capture everything they saw, and not stick to a pre-defined list. This would act as a "check-up" and validation on the training/ service continuum work. Secondly, it was not felt that the observers may be sufficiently skilled and knowledgeable to categorise what they saw beyond observation. It was better for them to capture everything they saw and their notes be categorised later than possibly introducing elements of error from the outset. If they had time, the observers were encouraged to make additional notes of their observations of the junior doctor working life and system in general. It was felt that these may be useful in understanding the context later.

During the shadowing period, no major problems were encountered. Each observer was met and introduced to the doctor at the start of the shift and observers handed over their notes between observation periods. The results were collected immediately at the end of each shadowing period. Observers were debriefed the following day.

6.2 Data Analysis Methods

The time use data from the shadowing notes was manually categorised into the list of 28 activities that was used in arriving at the training/ service percentages in the training/ service continuum work. Activities that were not represented in the list such as walking, time spent in the doctors' mess, eating, waiting and others were classified as "time not accounted for". As this time that was not accounted for in any particular direct activity which had any educational value as perceived by the junior doctors and consultants, yet it was time during which they had to be available for work at the hospital, it would eventually contribute to time "in service".

The categorised time-use data was entered onto spreadsheets in minutes. Training/ service percentages for each activity were applied to how much total time was spent performing that activity in order to arrive at how much time was spent "in training". It was decided to use the median training/ service percentage for each activity as this was considered the best estimate to the "average" from the training/ service work. This means that if 10 minutes were spent in an activity that was considered to be 70% service and 30% training, then this equates to 7 minutes service and 3 minutes training.

The results of this analysis are shown in table 12 in percentage form. The first column lists the 28 SHO activities as identified in the training/ service continuum work and the observational data has been categorised into these. Alongside is the identified median training percentage as decided by the SHOs. (By deduction, 100 - median training percentage would show the median service percentage). Next to each activity is the percentage of time in the 24-hour shadowing period spent participating in the activity, by specialty. This gives a total time spent in the identified activities by specialty and a percentage of time not accounted for. The bottom two rows shows the percentage of time spent "in training" when both the "empty time" (i.e. the time not accounted for in any particular activity) is included and excluded. This was derived by applying the median training percentage of each activity to the number of minutes spent performing the activity and divided by the total shadowed activity (and respectively including or excluding the "empty time").

Table 12 – Results from applying training/ service percentages to time use data

Percentage SHO Time Spent on Activities (from shadowing data)										
Activity Name	**Perceived Training Percentage (Median)**	**Specialty**								
		Gynaecology	Orthopaedics	Cardiothoracics	Anaesthetics	Maxillofacial Surgery	ENT	General Medicine	General Surgery	**Average**
Appraisals	90.00	0%	0%	0%	0%	0%	2%	0%	0%	0%
Assisting General Medical Procedures	70.00	0%	0%	0%	0%	0%	0%	2%	0%	0%
Assisting in Theatre	70.00	0%	0%	8%	36%	9%	0%	0%	0%	7%
Attending Clinics	80.00	0%	5%	7%	0%	0%	3%	0%	11%	3%
Audit Activities	70.00	0%	0%	0%	0%	0%	0%	0%	0%	0%
Clerking Admissions	30.00	0%	0%	0%	0%	0%	1%	2%	4%	1%
Collating Results	20.00	0%	2%	2%	2%	2%	2%	3%	2%	2%
Discussing patients with colleagues (incl. GP)	50.00	10%	14%	2%	4%	5%	2%	9%	6%	6%
Examining/ Reviewing Patient	50.00	7%	6%	3%	1%	6%	2%	14%	10%	6%
Formal SHO Teaching	100.00	0%	2%	0%	0%	0%	2%	0%	0%	1%
Formal Team Meetings	70.00	0%	0%	0%	0%	0%	0%	0%	0%	0%

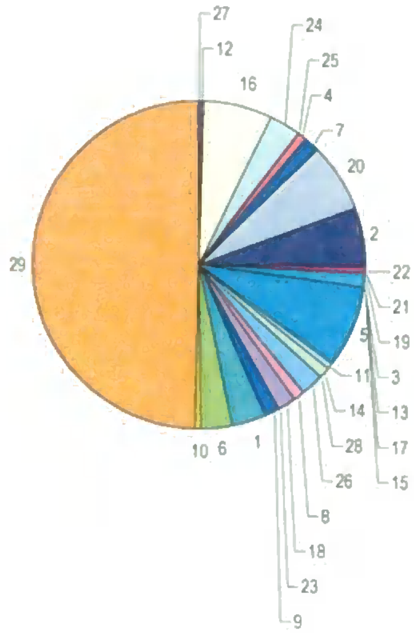
Handover to next SHO (or cover)	20.00	1%	0%	1%	4%	0%	1%	1%	1%	1%
Medical History Taking	50.00	0%	0%	0%	0%	0%	0%	0%	0%	0%
Observing General Medical Procedures	80.00	0%	0%	0%	0%	0%	0%	0%	0%	0%
Observing in Theatre	80.00	0%	0%	0%	0%	0%	0%	0%	0%	0%
Operating in Theatre	80.00	0%	0%	0%	0%	1%	0%	0%	0%	0%
Patient Related Administration	10.00	9%	9%	4%	5%	8%	8%	12%	8%	8%
Performing General Medical Procedures	70.00	0%	0%	0%	4%	1%	0%	0%	0%	1%
Preparing for Procedures or Theatre	30.00	1%	0%	1%	5%	1%	0%	0%	0%	1%
Presentations	80.00	0%	0%	0%	0%	0%	1%	0%	0%	0%
Reading Journals/ Research/ Private Study	90.00	0%	1%	7%	0%	0%	8%	0%	0%	2%
Taking Blood/ECGs/ Cannulation/ Catheterisation	10.00	2%	2%	0%	0%	1%	2%	0%	2%	1%
Talking to Patients and Relatives	40.00	0%	2%	0%	7%	2%	0%	2%	1%	2%
Teaching Medical Students/ Other	80.00	0%	0%	0%	0%	0%	0%	0%	0%	0%
Urgent or Emergency Assessment and	60.00	1%	1%	0%	2%	1%	1%	3%	2%	1%

Management of Patient										
Ward Round	50.00	3%	3%	2%	0%	0%	3%	6%	10%	3%
Writing Patient Notes	20.00	3%	3%	1%	0%	4%	0%	9%	5%	3%
Writing Prescriptions	10.00	1%	1%	0%	0%	0%	0%	0%	0%	0%
Total Time spent on activities (%)		38%	52%	37%	71%	42%	36%	63%	63%	**50%**
% Time not accounted for		62%	48%	63%	29%	58%	64%	37%	37%	**50%**
Total % Time spent "training" (incl. Time not accounted for)		13%	23%	22%	38%	17%	20%	21%	28%	**23%**
Total % Time spent "training" (excl. Time not accounted for)		34%	44%	59%	54%	41%	54%	34%	44%	**45%**

6.3 Results and Discussion

On first glance, it appears that according to the training/ service percentages for the activities and the data used, **45%** of SHO time is spent "in training" if the time that is not accounted for (i.e. time spent doing other sundry activities such as walking, waiting, etc.) is not included. However, if this time is included in the total time then the average time spent "in training" drops to **23%** (meaning that on the contrary, 76% of SHO time is spent providing "service").

Figure 26 - SHO Time Spent in Activities



1 Ward Round
2 Examining/ Reviewing Patient
3 Medical History Taking
4 Clerking Admissions
5 Patient Related Administration
6 Writing Patient Notes
7 Collating Results
8 Taking Blood/ ECGs/ Cannulation/ Catheterisation
9 Urgent or Emergency Assessment and Management of Patient
10 Writing Prescriptions
11 Performing General Medical Procedures
12 Assisting General Medical Procedures
13 Observing General Medical Procedures
14 Preparing for Procedures or Theatre
15 Operating in Theatre
16 Assisting in Theatre
17 Observing in Theatre
18 Talking to Patients and Relatives
19 Handover to next SHO (or cover)
20 Discussing patients with colleagues (incl. GP)
21 Formal Team Meetings
22 Formal SHO Teaching
23 Teaching Medical Students/ Other
24 Attending Clinics
25 Audit Activities
26 Reading Journals/ Research/ Private Study
27 Appraisals
28 Presentations
29 Empty time

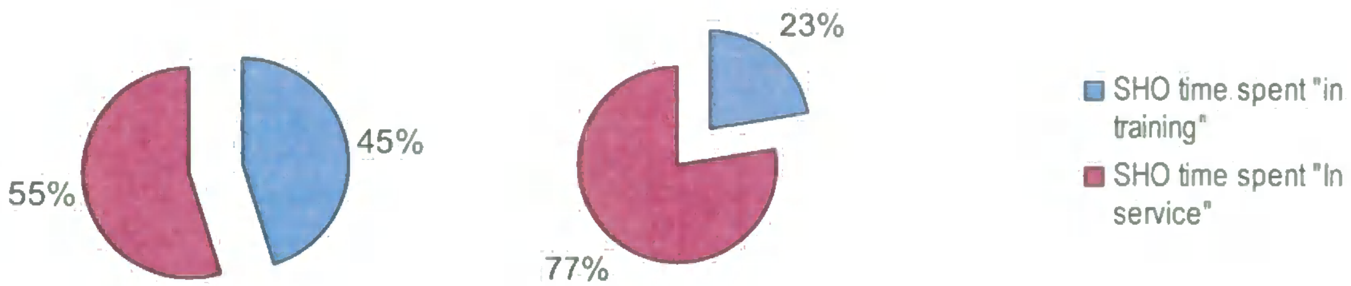


Figure 27 – Percentage of time spent in training and service, excluding and including 'empty' time

As can be seen from the pie chart of time spent in activities, by far the most amount of time is time that is not accounted for by not being spent in junior doctor activities. By specialty this time varies from 29% to 64%, which would indicative variance in the level of business between specialties across the 24-hour period with an average of 50%. There is also variance in the proportion of time spent in the individual activities in the specialty, which is partly down to the nature of the specialty (e.g. one would not expect medical SHOs to be engaging in theatre activities) and partly due to the sampling. However, there is consistency in the data in that across all specialties the majority of SHO time is spent in patient related activities, either examining/ reviewing patients, discussing them, completing their related administration or executing their treatment.

There are number of matters for discussion in this analysis, mostly coming from the quality and accuracy of the time-use data.

Firstly is the issue of unaccounted time, which has been called "empty" time. As this time does not fall within the activities identified, it has to be assumed that all this time such as walking between wards and time spent in the doctors mess is spent "in service". The rationale for this is that even though it is not time that the SHOs are directly providing a service to patients, they are 'on-call', physically present to provide a service at any time, and so one would have to assume that even while they are eating, sleeping, watching TV in the doctors mess or even walking between wards, that they are "in service". Whether they are learning during this "empty" time, is another matter, but this couldn't be identified to that level of detail from the information provided. However, during this time, they were not participating in a previously identified learning experience, and therefore the time must be categorically seen as "service". Interestingly, on average only 50% of the time is accounted for, so there is a relatively high average percentage of time not directly involved in SHO activities. This is partly to do with some of this validly being sleep and eating breaks, but also represents some of the inefficiencies in the system, such as time spent waiting or walking to outlying patients. Moreover, it represents the "just-in-case" management of junior doctor time versus the "just-in-time" principle, which one could introduce, allowing junior doctors to be on-call from a place other than the hospital, within reasonable distance.

There is a high variance in both the time accounted for and the resulting percentage of time spent "in training" across the specialties. There are a number of reasons for this. Most importantly, these shadowing episodes were only done for one SHO post for each of the highlighted specialties, for 24 hours. So if that doctor happened to be appraised, or spend most of the day in theatre or clinic then the balance for them swings towards the training end. Also, if there is a proportionately higher amount of unaccounted for time, then this will affect the overall percentage towards the service end (if this time is included). There is also huge variance in the quality of the shadowing data between shadowers: some shadowers were more detailed in their observations than others, making the manual tabulation clearer. Manually translating the shadowing notes into time spent tables also involved a lot of subjectivity, especially when categorising observations that were unclear (e.g. was time with the patient categorised under examining/ reviewing patient, medical history taking or talking with patients and relatives?)

Also, it was difficult to assign time to activities that were seemingly done at the same time, such as talking to colleagues while writing patient notes, filling out forms while waiting for switchboard to answer on the phone or examining a patient while discussing the patient with other staff. Multi-tasking is difficult to accommodate in linear analysis such as this. However, in the real world of busy people, multi-tasking is not only common it is essential. The tasks in this analysis are not always mutually exclusive, yet from the time allocated to them, it appears as if they were. This is partly a result of the time/ motion type narrative study where shadowers were allocating times to activities, when it is hard to capture everything that is going on at the same time with accurate timings. This is why in future training/ service/ time research, it is important to give multitasking (and the possibility of the total time adding up to more than 100%) special consideration in the design of the study and its analysis.

Of course, another aspect that cannot be accommodated in this analysis is the execution of the activities. The specialties that yielded relatively higher percentages of time spent "in training" had significant time spent in activities such as attending clinics or assisting in theatre (which are perceived to contain a high training element). However, there is no guarantee from the shadowing data that this is how they were executed.

Further Observations

As observers were encouraged to include additional notes in their time and motion studies, it is worth highlighting some of the most common observations that arose from the review of the notes in conducting the quantitative analysis above:

1. The main way of contacting junior doctors in the hospital is through bleeps, which require them to respond by finding a phone and calling the telephone number that has shown on their bleep. Apart from a specific "crash bleep" which is carried specifically for cardiac arrest cases, there is no way for the junior doctor to know who is contacting them (unless they recognise the number) or to know how urgent the call is. This makes prioritisation of tasks and time very difficult and apart from a general structure to the day, the way they spend their time can be very unprioritised and unstructured, depending on the bleeps they receive. The observers in general found quite a number of erroneous bleeps, where the wrong junior doctor had been contacted. It is not known why, but this may be worth investigating as a source of wasted time. It was also astonishing how often activities, in particular those that are perceived as educational such as ward rounds, journal clubs, teaching sessions and clinics, are interrupted by bleeps. This can lead to a doctor being away from the original activity for approximately 5 minutes per bleep, which leads to a lack of continuity in the original activity.

2. In bleeping other doctors and staff, junior doctors can often spend a few minutes per call waiting for switchboard to answer to direct their bleeps.

3. In each patient episode, the proportion of time spent actually with the patient compared to the time spent on the subsequent administration is relatively small, often a 2 minute conversation with a patient results in 10 minutes worth of form filling, requesting tests and writing in patient notes, all of which are paper-based. These are areas which could be looked at making more efficient or distributing tasks to other members of the team.

These observations are not necessarily unique to Derriford Hospital. Turnbull et al (1990) in their study found that "despite a heavy clinical responsibility, the two medical senior house officers spent over half of their working time on non-clinical duties" and "12% of their working time on call on the telephone" (Turnbull, M. et al. 1990: 1192).

Conclusions

For the above-discussed reasons, it is difficult to generalise from this data. However, as stated, this was not the purpose of the data collection and analysis. From this data, it is possible to gain an understanding of the quantified reality of the training/ service balance and in particular gain a "snapshot" of time spent "in training" and "in service". For the shadowing data collected at PHNT in July 2003, and the training/ service percentages arrived at for SHO activities, the average amount of time spent "in training" for SHOs is 23% if all time is included and 45% if "empty" time is excluded. The validity and reliability of these results could be greatly enhanced by more accurate and detailed data, which would come at a financial and resource cost. Interestingly, the 23% figure is similar to the current assumptions made amongst clinicians regarding SHO training, and the 45% is close the target amount of time that SHOs *should* spend “in training” (according to funding splits and MMC guidelines). This shows how much statistics and conclusions from them can be “massaged” to suit, if accurate data is not collected.

The results of this work carry with them the following implications:

1. There appears to be a relatively large proportion of “slack” in the system (almost 50%): time that could be either reduced (perhaps questioning the need for a doctor to be on duty) or put to better use. Perhaps some of this “empty” time could be spent educationally, either in personal study or skills labs. While no one is (nor should be) 100% productive, the slack identified above is significant.

2. A relatively high proportion of aggregate time is spent on tasks such as patient related administration and routine non-complex clinical tasks that could either be made more efficient or in part be supplemented by other members of the team (e.g. doctors' support workers) thus freeing up more time for service and education.

As only a snapshot was used, it would not be advantageous to generalise from this data to feed into the model that is being built of the junior doctor hours, training and service system. Instead it is necessary to use this data as a starting point for discussion with clinicians about assumptions of typical durations/ frequencies of activities for the model, and looking at possible scenarios to simulate once a model of the system has been agreed.

7. The Training/ Service Balance Model

Having explored junior doctor activities, what training/ service balance each carries and the reasons for this, and how this looks for typical junior doctor time, it is now possible to build a tabular model of this at operational level with which some "what if" scenarios can be explored (i.e. the impacts on training/service balance of changes in working and training practices).

7.1 The Principle

During the course of the process of developing a model of the system (see chapter on the system dynamics modelling process) it was identified that it was necessary to capture both the granularity of the details of what junior doctors do, how they spend their time, and how this relates to the training and service, while being able to model the impacts this has on wider strategic issues such as training and service levels and quality as a whole in the system.

7.2 The Development of the Model

Given that at this stage in the research there was data on what activities junior doctors participate in and the relative perceived measures of training and service content in each, it was possible to calculate a general training/ service balance for the SHOs as a whole (as in the previous chapter).

This was done by taking the information gathered from the questionnaire data collection on the training/ service continuum and summarising it in a spreadsheet (i.e. the training/ service balances for each activity).

To take this one step further, this research has identified that the two of the key factors in determining the perceived training/ service balance in an activity, are whether the activity is supervised and how frequently it is participated in (see regression results in section 7.4.2)

In creating the training/ service continuum, a median training/ service percentage for each activity was calculated. Additionally, upper and lower quartile percentages were calculated for each activity.

In considering these results, the model stakeholders and in effect "problem owners" identified that actually, whether an activity was supervised was the overriding factor as to how much it is perceived as training. Again, as described earlier, this mimics the connotations that come with the word "training" as opposed to education or learning.

Given this fundamental assumption in the system, it was assumed that if an activity was supervised, then its training/ service balance would be seen to be at the upper quartile of the training percentage. On the contrary, if it wasn't supervised then it would be seen as containing less of a training element (i.e. towards the lower quartile of the training percentage, and thus at the upper quartile of the service percentage).

This fundamental assumption by the research problem owners allowed the creation of a spreadsheet model containing the list of activities, whether they were supervised and how frequently they were undertaken, along with the derived training/ service percentages.

To complete the information required for this training/ service balance model in the activities, it was necessary to also supply the information on how long each activity typically takes. This information was derived from the observational data collected in the shadowing in 2003 (see chapter 5) and validated by consulting a sample of senior medical staff with typical times for each activity.

From this information, it was possible to calculate a contribution to training and service for each activity. This was done by checking if the activity is supervised in the scenario. If so, the upper quartile training percentage was used and multiplied by the amount of time spent in the activity in a week, and divided by the total number of hours. Similar calculations were applied to derive the service contribution of each scenario.

7.3 The Training/ Service Balance Model

Table 13 show the baseline results of this spreadsheet model for current typical time usage. (An enlarged version of this can be found in Appendix II).

Activity Number	Activity	Likely to be supervised?	Median Frequency (per 6 months)	Median Frequency per week	Median T	Lower Quartile T	Upper Quartile T	Median S	Lower Quartile S	Upper Quartile S	Average Time per Activity (mins)	Average Time per Activity (hrs)	Scenario Supervision	Scenario Frequency (per week)	Contribution to Training Index*	Contribution to Service Index**	Supervised Time
1	Ward Rounds	Y	130	5.00	60	30	75	50	30	75	120	2.00	Y	5.00	0.120	0.004	1
2	Examining/ Reviewing Patient	N	260	20.00	50	30	75	50	30	75	15	0.25	N	10.00	0.013	0.021	
3	Medical History Taking	N	260	10.00	50	30	75	50	30	75	20	0.33	N	10.00	0.016	0.042	
4	Clerking Admissions	N	130	10.00	30	25	60	70	40	80	30	0.50	N	5.00	0.009	0.036	
5	Patient Related Administration	N	260	25.00	10	0	20	80	60	100	5	0.08	N	10.00	0.000	0.015	
6	Writing Patient Notes	N	390	30.00	20	10	50	80	50	90	5	0.08	N	10.00	0.001	0.013	
7	Collating Results	N	260	30.00	20	10	50	80	50	90	10	0.17	N	14.00	0.003	0.027	
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N	390	30.00	0	0	40	100	60	100	10	0.17	N	15.00	0.000	0.036	
9	Urgent or Emergency Assessment and Management of Patient	Y	130	5.00	60	50	80	40	20	50	20	0.33	Y	5.00	0.024	0.006	
10	Writing Prescriptions	N	390	30.00	10	0	30	90	70	100	5	0.08	N	14.00	0.000	0.018	
11	Performing General Medical Procedures	Y	26	2.00	70	50	90	30	10	90	30	0.50	Y	1.00	0.000	0.001	
12	Assisting General Medical Procedures	Y	13	0.50	75	50	90	30	10	50	30	0.50	Y	0.50	0.004	0.006	
13	Observing General Medical Procedures	Y	13	0.50	60	50	80	20	10	50	30	0.50	Y	0.50	0.004	0.006	
14	Preparing for Procedures or Theatre	N	26	1.00	30	10	60	70	40	90	20	0.33	N	1.00	0.001	0.006	
15	Operating in Theatre	Y	26	1.00	80	60	90	20	10	40	120	2.00	Y	1.00	0.032	0.004	
16	Assisting in Theatre	Y	26	1.00	75	50	90	30	10	50	120	2.00	Y	1.00	0.032	0.004	
17	Observing in Theatre	Y	26	1.00	80	50	90	30	10	50	120	2.00	Y	1.00	0.032	0.004	
18	Talking to Patients and Relatives	N	260	20.00	40	20	60	80	40	80	10	0.17	N	10.00	0.006	0.024	
19	Handover to next JD (or cover)	N	130	5.00	20	10	40	60	80	90	5	0.08	N	5.00	0.001	0.007	
20	Discussing patients with colleagues (incl. GP)	Y	130	5.00	60	30	90	50	20	75	10	0.17	Y	5.00	0.012	0.003	
21	Formal Team Meetings	Y	26	1.00	70	50	90	30	10	50	90	1.50	Y	1.00	0.024	0.003	
22	Formal Teaching	Y	26	1.00	100	80	100	0	0	10	120	2.00	Y	1.00	0.036	0.000	
23	Teaching Medical Students/ Others	N	6	5.00	60	50	80	20	20	50	15	0.25	N	0.25	0.001	0.001	
24	Attending Clinics	Y	26	1.00	80	60	90	20	10	40	240	4.00	Y	1.00	0.064	0.007	
25	Audit Activities	Y	2.5	0.10	75	60	80	30	20	50	210	3.50	Y	0.10	0.006	0.001	
26	Reading Journals/ Research/ Private Study	N	26	1.00	90	80	100	10	0	20	30	0.50	N	1.00	0.007	0.002	
27	Appraisals	Y	2.5	0.10	90	70	100	10	0	30	30	0.50	Y	0.10	0.001	0.000	
28	Presentations	Y	2.5	0.10	80	70	100	20	0	30	40	0.67	Y	0.10	0.001	0.000	
	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]		[illegible]				[illegible]	[illegible]	[illegible]	
													Total Weekly Hrs	44.59	0.464	0.536	[illegible]

Table 13 – Baseline results of the training/service balance model

The baseline scenario, developed from the information gathered from the work on the training/ service continuum and how junior doctor time is spent, yields results that 44.59 of the 56 hours that junior doctors are contracted to work are theoretically taken up with the identified activities. With the expected patterns of supervision and frequency, the scenario yields a 46.4% time spent "training" and consequently 53.6% in "service" when considering the empty or "dead time" (excuse the choice of words!) as service based. Additionally, just over 27 hours in the week are supervised.

7.4 Sensitivity Analysis

Analysis of the junior doctor activities' sensitivity to changes in supervision, frequency and time per activity has yielded the following results.

The activity that would yield the most overall benefit from being supervised, in terms of training/ service balance is Medical History Taking (followed by similar activities such as Examining Patients and Clerking Admissions). The reason for this is the sheer frequency, volume and time that junior doctors participate in these activities.

Ward Rounds and Clinics would have the most detrimental impact on training balance if not supervised. This is largely due to the wide range in perceived balance of these activities.

Attending Clinics and Formal Teaching (followed by Ward Rounds and Theatre participation) are the activities in which increases in frequency have the greatest impact on training percentage. Similarly, an increase in time per activity in Attending Clinics and Ward Rounds has the greatest positive impact on training balance.

There is a high level of co-dependency between training percentage of an activity, supervision, frequency and time per episode, making individual sensitivity analysis less indicative. A proxy that can be used for the overall training "value" of an activity is the contribution index, combining all these factors. Analysis of the contributions to training and service showed that the activities contributing relatively highly to perceived training are: Ward Rounds, Attending Clinics, Formal Teaching and Theatre participation. Similarly, the activities that contribute relatively highly to perceived service are: Clerking Admissions, Medical History Taking, Examining/ Reviewing Patients and Talking to Patients and Relatives.

These results are not contrary to expectations. In general, the magnitude of impact of a single change in the execution of an activity on its own was not very high. The highest impact of a single change would be an increase in the number of clinics attended by 1 per week, which would see the training balance rise from 46.4% to 52.8%. The most detrimental single change would be if ward rounds are not supervised, which would reduce the perceived training balance to 39.2%.

N.B. Sensitivity Analysis is conducted under the proviso that all else stays the same.							
			Base Line				
			0.464				
Activity Number	**Activity**	**Change in Supervision**	**Effect on Training Percentage**	**Effect of Increase of Frequency by 1 time per week**	**Effect of Increasing time per activity by 10%**	**Contribution to Training Index**	**Contribution to Service Index**
1	Ward Round	Y to N	-0.072	0.025	0.012	0.125	0.054
2	Examining/ Reviewing Patient	N to Y	0.018	0.001	0.001	0.013	0.031
3	Medical History Taking	N to Y	0.024	0.002	0.002	0.018	0.042
4	Clerking Admissions	N to Y	0.018	0.002	0.001	0.009	0.036
5	Patient Related Administration	N to Y	0.003	0	0	0.000	0.015
6	Writing Patient Notes	N to Y	0.006	0	0	0.001	0.013
7	Collating Results	N to Y	0.012	0	0	0.003	0.027
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N to Y	0.012	0	0	0.000	0.030
9	Urgent or Emergency Assessment and Management of Patient	Y to N	-0.009	0.004	0.002	0.024	0.006
10	Writing Prescriptions	N to Y	0.004	0	0	0.000	0.015
11	Performing General Medical Procedures	Y to N	-0.004	0.008	0.001	0.008	0.001
12	Assisting General Medical Procedures	Y to N	-0.002	0.008	0	0.004	0.000
13	Observing General Medical Procedures	Y to N	-0.002	0.008	0	0.004	0.000
14	Preparing for Procedures or Theatre	N to Y	0.003	0	0	0.001	0.005
15	Operating in Theatre	Y to N	-0.011	0.032	0.003	0.032	0.004
16	Assisting in Theatre	Y to N	-0.015	0.032	0.003	0.032	0.004
17	Observing in Theatre	Y to N	-0.015	0.032	0.003	0.032	0.004
18	Talking to Patients and Relatives	N to Y	0.012	0	0.001	0.006	0.024
19	Handover to next JD (or cover)	N to Y	0.002	0	0	0.001	0.007
20	Discussing patients with colleagues (incl. GP)	Y to N	-0.008	0.002	0.001	0.012	0.003
21	Formal Team Meetings	Y to N	-0.011	0.024	0.002	0.024	0.003
22	Formal Teaching	Y to N	-0.004	0.035	0.004	0.036	0.000
23	Teaching Medical Students/ Others	N to Y	0	0.002	0	0.001	0.001
24	Attending Clinics	Y to N	-0.022	0.064	0.006	0.064	0.007
25	Audit Activities	Y to N	-0.002	0.05	0	0.005	0.001
26	Reading Journals/ Research/ Private Study	N to Y	0.002	0.007	0.001	0.007	0.002
27	Appraisals	Y to N	-0.001	0.009	0	0.001	0.000
28	Presentations	Y to N	-0.001	0.012	0	0.001	0.000
	Dead Time	N to Y	0.256	N/A		0.000	0.203

Table 14 – Sensitivity Analysis

7.5 Identified Scenarios for Modelling

As described in more detail in the chapter on the system dynamics modelling process (chapter 7), the training/ service spreadsheet model took on more importance than initially anticipated. This is because it was used as a link, information feed, and key mechanism of translating changes at operational/ micro level to see impacts at strategic/ macro level.

The problem owners (organisational decision makers) identified 5 scenarios, or areas of decision making, which they would like to know the impact of.

These were:

1. A scenario which entails the increased teaching requirements and assessments that accompany the introduction of Modernising Medical Careers (MMC).

2. A scenario which describes the impacts on activities that would occur from a more proactive approach to learning, seeking the most educational value and opportunities in all activities that junior doctors participated in. (Activities highlighted were identified by the problem stakeholders. These activities would then be perceived as having a training content at the highest end for that activity).

2b. As scenario 2, but instead of increasing the training value of an activity to the highest identified for that activity, it increases it by 10 (on the 0 to 100 scale) where possible, due to the more proactive approach to learning.

3. This scenario assumes that all of the empty or "dead" time is used for educational activities (assumed to be at a value of 100 training/ 0 service), by individuals making better use of their spare time to accommodate learning needs.

3b. This scenario assumes that half of the empty or "dead" time is used for educational activities (assumed to be at a value of 100 training/ 0 service), by individuals making better use of their spare time to accommodate learning needs, as it may not be realistic for individuals to use all of their spare time in their working time for education.

The way the spreadsheet model works is that in identifying a scenario, the problem stakeholders would work out how it would change the micro level activity, in terms of the impact on frequency and supervision of what junior doctors do. This computes a new training/ service percentage, which is fed into the SD model.

In the tables 15 to 19 are the changes to the frequency and supervision of activities for each of the scenarios.

Activity Number	Activity	Likely to be supervised?	Baseline Median Frequency (per 6 months)	Median Training %	Lower Quartile Training %	Upper Quartile Training %	Median Service %	Lower Quartile Service %	Upper Quartile Service %	Average Time per Activity (mins)	Average Time per Activity (hrs)	Is the activity supervised in this Scenario?	Scenario Frequency (per week)	Contribution to Training Index*	Contribution to Service Index**	Supervised Time (hrs)
1	Ward Round	Y	130	50	30	70	50	30	70	120	2.00	Y	5.00	0.125	0.054	10.00
2	Examining/ Reviewing Patient	N	260	50	30	70	50	30	70	15	0.25	N	10.00	0.013	0.031	0.00
3	Medical History Taking	N	260	50	30	70	50	30	70	20	0.33	N	10.00	0.018	0.042	0.00
4	Clerking Admissions	N	130	30	20	60	70	40	80	30	0.50	N	5.00	0.009	0.036	0.00
5	Patient Related Administration	N	260	10	0	20	90	60	100	5	0.08	N	8.00	0.000	0.012	0.00
6	Writing Patient Notes	N	260	20	10	50	80	50	90	5	0.08	N	10.00	0.001	0.013	0.00
7	Collating Results	N	260	20	10	50	80	50	90	10	0.17	N	10.00	0.003	0.027	0.00
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N	260	0	0	40	100	60	100	10	0.17	N	10.00	0.000	0.030	0.00
9	Urgent or Emergency Assessment and Management of Patient	Y	130	60	50	80	40	20	50	20	0.33	Y	5.00	0.024	0.006	1.67
10	Writing Prescriptions	N	260	10	0	30	90	70	100	5	0.08	N	10.00	0.000	0.015	0.00
11	Performing General Medical Procedures	Y	26	70	50	90	30	10	50	30	0.50	Y	0.80	0.006	0.001	0.40
12	Assisting General Medical Procedures	Y	13	70	50	90	30	10	50	30	0.50	Y	0.40	0.003	0.000	0.20
13	Observing General Medical Procedures	Y	13	80	50	90	20	10	50	30	0.50	Y	0.40	0.003	0.000	0.20
14	Preparing for Procedures or Theatre	N	26	30	10	60	70	40	90	20	0.33	N	0.80	0.000	0.004	0.00
15	Operating in Theatre	Y	26	80	60	90	20	10	40	120	2.00	Y	0.80	0.026	0.003	1.60
16	Assisting in Theatre	Y	26	70	50	90	30	10	50	120	2.00	Y	0.80	0.026	0.003	1.60
17	Observing in Theatre	Y	26	80	50	90	20	10	50	120	2.00	Y	0.80	0.026	0.003	1.60
18	Talking to Patients and Relatives	N	260	40	20	60	60	40	80	10	0.17	N	10.00	0.006	0.024	0.00
19	Handover to next JD (or cover)	N	130	20	10	40	80	60	90	30	0.50	N	5.00	0.004	0.040	0.00
20	Discussing patients with colleagues (incl. GP)	Y	130	50	30	80	50	20	70	10	0.17	Y	5.00	0.012	0.003	0.83
21	Formal Team Meetings	Y	26	70	50	90	30	10	50	90	1.50	Y	1.00	0.024	0.003	1.50
22	Formal Teaching	Y	26	100	90	100	0	0	10	240	4.00	Y	1.00	0.071	0.000	4.00
23	Teaching Medical Students/ Others	N	6	80	50	80	20	20	50	15	0.25	N	0.23	0.001	0.001	0.00
24	Attending Clinics	Y	26	80	60	90	20	10	40	240	4.00	Y	1.00	0.064	0.007	4.00
25	Audit Activities	Y	2.5	70	50	80	30	20	50	210	3.50	Y	0.10	0.005	0.001	0.34
26	Reading Journals/ Research/ Private Study	N	26	90	80	100	10	0	20	30	0.50	N	0.00	0.000	0.000	0.00
27	Appraisals/ Assessments	Y	2.5	90	70	100	10	0	30	15	0.25	Y	0.35	0.002	0.000	0.09
28	Presentations	Y	2.5	80	70	100	20	0	30	40	0.67	Y	0.10	0.001	0.000	0.06
	Dead Time	N		0	0	100	100	0	100			N	9.42	0.000	0.168	0.00
												Total Weekly Hrs	46.58	0.474	0.526	28.09

Table 15 – The impacts on activities and the training/ service balance of Scenario 1

Activity Number	Activity	Likely to be supervised?	Baseline Median Frequency (per 6 months)	Median Training %	Lower Quartile Training %	Upper Quartile Training %	Median Service %	Lower Quartile Service %	Upper Quartile Service %	Average Time per Activity (mins)	Average Time per Activity (hrs)	Is the activity supervised in this Scenario?	Highlighted as impacted by learning culture	Scenario Frequency (per week)	Contribution to Training Index*	Contribution to Service Index**	Supervised Time (hrs)
1	Ward Round	Y	130	50	30	70	50	30	70	120	2.00	Y	1.00	5.00	0.125	0.054	10.00
2	Examining/ Reviewing Patient	N	260	50	30	70	50	30	70	15	0.25	N		10.00	0.013	0.031	0.00
3	Medical History Taking	N	260	50	30	70	50	30	70	20	0.33	N		10.00	0.018	0.042	0.00
4	Clerking Admissions	N	130	30	20	60	70	40	80	30	0.50	N		5.00	0.009	0.036	0.00
5	Patient Related Administration	N	260	10	0	20	90	80	100	5	0.08	N		10.00	0.000	0.015	0.00
6	Writing Patient Notes	N	260	20	10	50	80	50	90	5	0.08	N	1.00	10.00	0.007	0.007	0.00
7	Collating Results	N	260	20	10	50	80	50	90	10	0.17	N		10.00	0.003	0.027	0.00
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N	260	0	0	40	100	60	100	10	0.17	N		10.00	0.000	0.030	0.00
9	Urgent or Emergency Assessment and Management of Patient	Y	130	60	50	80	40	20	50	20	0.33	Y	1.00	5.00	0.024	0.008	1.67
10	Writing Prescriptions	N	260	10	0	30	90	70	100	5	0.08	N	1.00	10.00	0.004	0.010	0.00
11	Performing General Medical Procedures	Y	26	70	50	90	30	10	50	30	0.50	Y		1.00	0.008	0.001	0.50
12	Assisting General Medical Procedures	Y	13	70	50	90	30	10	50	30	0.50	Y	1.00	0.50	0.004	0.000	0.25
13	Observing General Medical Procedures	Y	13	80	50	90	20	10	50	30	0.50	Y	1.00	0.50	0.004	0.000	0.25
14	Preparing for Procedures or Theatre	N	26	30	10	60	70	40	90	20	0.33	N		1.00	0.001	0.005	0.00
15	Operating in Theatre	Y	26	80	60	90	20	10	40	120	2.00	Y		1.00	0.032	0.004	2.00
16	Assisting in Theatre	Y	26	70	50	90	30	10	50	120	2.00	Y	1.00	1.00	0.032	0.004	2.00
17	Observing in Theatre	Y	26	80	50	90	20	10	50	120	2.00	Y	1.00	1.00	0.032	0.004	2.00
18	Talking to Patients and Relatives	N	260	40	20	60	60	40	80	10	0.17	N		10.00	0.008	0.024	0.00
19	Handover to next JD (or cover)	N	130	20	10	40	80	60	90	5	0.08	N	1.00	5.00	0.003	0.004	0.00
20	Discussing patients with colleagues (incl. GP)	Y	130	50	30	80	50	20	70	10	0.17	Y	1.00	5.00	0.012	0.003	0.83
21	Formal Team Meetings	Y	26	70	50	90	30	10	50	90	1.50	Y	1.00	1.00	0.024	0.003	1.50
22	Formal Teaching	Y	26	100	90	100	0	0	10	120	2.00	Y	1.00	1.00	0.038	0.000	2.00
23	Teaching Medical Students/ Others	N	6	80	50	80	20	20	50	15	0.25	N	1.00	0.23	0.001	0.000	0.00
24	Attending Clinics	Y	26	80	60	90	20	10	40	240	4.00	Y	1.00	1.00	0.064	0.007	4.00
25	Audit Activities	Y	2.5	70	50	80	30	20	50	210	3.50	Y	1.00	0.10	0.005	0.001	0.34
26	Reading Journals/ Research/ Private Study	N	26	90	80	100	10	0	20	30	0.50	N	1.00	1.00	0.009	0.000	0.00
27	Appraisals	Y	2.5	90	70	100	10	0	30	30	0.50	Y	1.00	0.10	0.001	0.000	0.05
28	Presentations	Y	2.5	80	70	100	20	0	30	40	0.67	Y	1.00	0.10	0.001	0.000	0.06
	Dead Time	N		0	0	100	100	0	100			N		11.41	0.000	0.204	0.00
												Total Weekly Hrs		44.59	0.478	0.522	27.45

Table 16 – The impacts on activities and the training/ service balance of Scenario 2

Activity Number	Activity	Likely to be supervised?	Baseline Median Frequency (per 6 months)	Median Training %	Lower Quartile Training %	Upper Quartile Training %	Median Service %	Lower Quartile Service %	Upper Quartile Service %	Average Time per Activity (mins)	Average Time per Activity (hrs)	Is the activity supervised in this Scenario?	Scenario Frequency (per week)	Scenario Revised Training Percentage	Contribution to Training Index*	Contribution to Service Index**	Supervised Time (hrs)
1	Ward Round	Y	130	50	30	70	50	30	70	120	2.00	Y	5.00	80	0.143	0.036	10.00
2	Examining/ Reviewing Patient	N	260	50	30	70	50	30	70	15	0.25	N	10.00	40	0.018	0.027	0.00
3	Medical History Taking	N	260	50	30	70	50	30	70	20	0.33	N	10.00	40	0.024	0.036	0.00
4	Clerking Admissions	N	130	30	20	60	70	40	80	30	0.50	N	5.00	30	0.013	0.031	0.00
5	Patient Related Administration	N	260	10	0	20	90	80	100	5	0.08	N	10.00	10	0.001	0.013	0.00
6	Writing Patient Notes	N	260	20	10	50	80	50	90	5	0.08	N	10.00	20	0.003	0.012	0.00
7	Collating Results	N	260	20	10	50	80	50	90	10	0.17	N	10.00	20	0.006	0.024	0.00
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N	260	0	0	40	100	60	100	10	0.17	N	10.00	10	0.003	0.027	0.00
9	Urgent or Emergency Assessment and Management of Patient	Y	130	60	50	80	40	20	50	20	0.33	Y	5.00	90	0.027	0.003	1.67
10	Writing Prescriptions	N	260	10	0	30	90	70	100	5	0.08	N	10.00	10	0.001	0.013	0.00
11	Performing General Medical Procedures	Y	26	70	50	90	30	10	50	30	0.50	Y	1.00	100	0.009	0.000	0.50
12	Assisting General Medical Procedures	Y	13	70	50	90	30	10	50	30	0.50	Y	0.50	100	0.004	0.000	0.25
13	Observing General Medical Procedures	Y	13	80	50	90	20	10	50	30	0.50	Y	0.50	100	0.004	0.000	0.25
14	Preparing for Procedures or Theatre	N	26	30	10	60	70	40	90	20	0.33	N	1.00	20	0.001	0.005	0.00
15	Operating in Theatre	Y	26	80	60	90	20	10	40	120	2.00	Y	1.00	100	0.036	0.000	2.00
16	Assisting in Theatre	Y	26	70	50	90	30	10	50	120	2.00	Y	1.00	100	0.036	0.000	2.00
17	Observing in Theatre	Y	26	80	50	90	20	10	50	120	2.00	Y	1.00	100	0.036	0.000	2.00
18	Talking to Patients and Relatives	N	260	40	20	60	60	40	80	10	0.17	N	10.00	30	0.009	0.021	0.00
19	Handover to next JD (or cover)	N	130	20	10	40	60	60	90	5	0.08	N	5.00	20	0.001	0.006	0.00
20	Discussing patients with colleagues (incl. GP)	Y	130	50	30	80	50	20	70	10	0.17	Y	5.00	90	0.013	0.001	0.83
21	Formal Team Meetings	Y	26	70	50	90	30	10	50	90	1.50	Y	1.00	100	0.027	0.000	1.50
22	Formal Teaching	Y	26	100	90	100	0	0	10	120	2.00	Y	1.00	100	0.036	0.000	2.00
23	Teaching Medical Students/ Others	N	6	80	50	80	20	20	50	15	0.25	N	0.23	60	0.001	0.000	0.00
24	Attending Clinics	Y	26	80	60	90	20	10	40	240	4.00	Y	1.00	100	0.071	0.000	4.00
25	Audit Activities	Y	2.5	70	50	80	30	20	50	210	3.50	Y	0.10	90	0.005	0.001	0.34
26	Reading Journals/ Research/ Private Study	N	26	90	80	100	10	0	20	30	0.50	N	1.00	90	0.008	0.001	0.00
27	Appraisals	Y	2.5	90	70	100	10	0	30	30	0.50	Y	0.10	100	0.001	0.000	0.05
28	Presentations	Y	2.5	80	70	100	20	0	30	40	0.67	Y	0.10	100	0.001	0.000	0.06
	Dead Time	N		0	0	100	100	0	100			N	11.41	10	0.020	0.183	0.00
												Total Weekly Hrs	44.59		0.560	0.440	27.45

Table 17 – The impacts on activities and the training/ service balance of Scenario 2b

Activity Number	Activity	Likely to be supervised?	Baseline Median Frequency (per 6 months)	Median Training %	Lower Quartile Training %	Upper Quartile Training %	Median Service %	Lower Quartile Service %	Upper Quartile Service %	Average Time per Activity (mins)	Average Time per Activity (hrs)	Is the activity supervised in this Scenario?	Scenario Frequency (per week)	Contribution to Training Index*	Contribution to Service Index**	Supervised Time (hrs)
1	Ward Round	Y	130	50	30	70	50	30	70	120	2.00	Y	5.00	0.125	0.054	10.00
2	Examining/ Reviewing Patient	N	260	50	30	70	50	30	70	15	0.25	N	10.00	0.013	0.031	0.00
3	Medical History Taking	N	260	50	30	70	50	30	70	20	0.33	N	10.00	0.018	0.042	0.00
4	Clerking Admissions	N	130	30	20	60	70	40	80	30	0.50	N	5.00	0.009	0.036	0.00
5	Patient Related Administration	N	260	10	0	20	90	80	100	5	0.08	N	10.00	0.000	0.015	0.00
6	Writing Patient Notes	N	260	20	10	50	80	50	90	5	0.08	N	10.00	0.001	0.013	0.00
7	Collating Results	N	260	20	10	50	80	50	90	10	0.17	N	10.00	0.003	0.027	0.00
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N	260	0	0	40	100	60	100	10	0.17	N	10.00	0.000	0.030	0.00
9	Urgent or Emergency Assessment and Management of Patient	Y	130	60	50	80	40	20	50	20	0.33	Y	5.00	0.024	0.006	1.67
10	Writing Prescriptions	N	260	10	0	30	90	70	100	5	0.08	N	10.00	0.000	0.015	0.00
11	Performing General Medical Procedures	Y	26	70	50	90	30	10	50	30	0.50	Y	1.00	0.008	0.001	0.50
12	Assisting General Medical Procedures	Y	13	70	50	90	30	10	50	30	0.50	Y	0.50	0.004	0.000	0.25
13	Observing General Medical Procedures	Y	13	80	50	90	20	10	50	30	0.50	Y	0.50	0.004	0.000	0.25
14	Preparing for Procedures or Theatre	N	26	30	10	60	70	40	90	20	0.33	N	1.00	0.001	0.005	0.00
15	Operating in Theatre	Y	26	80	60	90	20	10	40	120	2.00	Y	1.00	0.032	0.004	2.00
16	Assisting in Theatre	Y	26	70	50	90	30	10	50	120	2.00	Y	1.00	0.032	0.004	2.00
17	Observing in Theatre	Y	26	80	50	90	20	10	50	120	2.00	Y	1.00	0.032	0.004	2.00
18	Talking to Patients and Relatives	N	260	40	20	60	60	40	80	10	0.17	N	10.00	0.006	0.024	0.00
19	Handover to next JD (or cover)	N	130	20	10	40	80	60	90	5	0.08	N	5.00	0.001	0.007	0.00
20	Discussing patients with colleagues (incl. GP)	Y	130	50	30	80	50	20	70	10	0.17	Y	5.00	0.012	0.003	0.83
21	Formal Team Meetings	Y	26	70	50	90	30	10	50	90	1.50	Y	1.00	0.024	0.003	1.50
22	Formal Teaching	Y	26	100	90	100	0	0	10	120	2.00	Y	1.00	0.036	0.000	2.00
23	Teaching Medical Students/ Others	N	6	80	50	80	20	20	50	15	0.25	N	0.23	0.001	0.001	0.00
24	Attending Clinics	Y	26	80	60	90	20	10	40	240	4.00	Y	1.00	0.064	0.007	4.00
25	Audit Activities	Y	2.5	70	50	80	30	20	50	210	3.50	Y	0.10	0.005	0.001	0.34
26	Reading Journals/ Research/ Private Study	N	26	90	80	100	10	0	20	30	0.50	N	1.00	0.007	0.002	0.00
27	Appraisals	Y	2.5	90	70	100	10	0	30	30	0.50	Y	0.10	0.001	0.000	0.05
28	Presentations	Y	2.5	80	70	100	20	0	30	40	0.67	Y	0.10	0.001	0.000	0.06
	Dead Time	N		0	0	100	100	0	100		1.00	N	11.41	0.204	0.000	0.00
												Total Weekly Hrs	44.59	0.667	0.333	27.45

Table 18 – The impacts on activities and the training/ service balance of Scenario 3

Activity Number	Activity	Likely to be supervised?	Baseline Median Frequency (per 6 months)	Median Training %	Lower Quartile Training %	Upper Quartile Training %	Median Service %	Lower Quartile Service %	Upper Quartile Service %	Average Time per Activity (mins)	Average Time per Activity (hrs)	Is the activity supervised in this Scenario?	Scenario Frequency (per week)	Contribution to Training Index*	Contribution to Service Index**	Supervised Time (hrs)
1	Ward Round	Y	130	50	30	70	50	30	70	120	2.00	Y	5.00	0.125	0.054	10.00
2	Examining/ Reviewing Patient	N	260	50	30	70	50	30	70	15	0.25	N	10.00	0.013	0.031	0.00
3	Medical History Taking	N	260	50	30	70	50	30	70	20	0.33	N	10.00	0.018	0.042	0.00
4	Clerking Admissions	N	130	30	20	60	70	40	80	30	0.50	N	5.00	0.009	0.038	0.00
5	Patient Related Administration	N	260	10	0	20	90	80	100	5	0.08	N	10.00	0.000	0.015	0.00
6	Writing Patient Notes	N	260	20	10	50	80	50	90	5	0.08	N	10.00	0.001	0.013	0.00
7	Collating Results	N	260	20	10	50	80	50	90	10	0.17	N	10.00	0.003	0.027	0.00
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N	260	0	0	40	100	60	100	10	0.17	N	10.00	0.000	0.030	0.00
9	Urgent or Emergency Assessment and Management of Patient	Y	130	60	50	80	40	20	50	20	0.33	Y	5.00	0.024	0.006	1.67
10	Writing Prescriptions	N	260	10	0	30	90	70	100	5	0.08	N	10.00	0.000	0.015	0.00
11	Performing General Medical Procedures	Y	26	70	50	90	30	10	50	30	0.50	Y	1.00	0.008	0.001	0.50
12	Assisting General Medical Procedures	Y	13	70	50	90	30	10	50	30	0.50	Y	0.50	0.004	0.000	0.25
13	Observing General Medical Procedures	Y	13	80	50	90	20	10	50	30	0.50	Y	0.50	0.004	0.000	0.25
14	Preparing for Procedures or Theatre	N	26	30	10	60	70	40	90	20	0.33	N	1.00	0.001	0.005	0.00
15	Operating in Theatre	Y	26	80	60	90	20	10	40	120	2.00	Y	1.00	0.032	0.004	2.00
16	Assisting in Theatre	Y	26	70	50	90	30	10	50	120	2.00	Y	1.00	0.032	0.004	2.00
17	Observing in Theatre	Y	26	80	50	90	20	10	50	120	2.00	Y	1.00	0.032	0.004	2.00
18	Talking to Patients and Relatives	N	260	40	20	60	60	40	80	10	0.17	N	10.00	0.006	0.024	0.00
19	Handover to next JD (or cover)	N	130	20	10	40	80	60	90	5	0.08	N	5.00	0.001	0.007	0.00
20	Discussing patients with colleagues (incl. GP)	Y	130	50	30	80	50	20	70	10	0.17	Y	5.00	0.012	0.003	0.83
21	Formal Team Meetings	Y	26	70	50	90	30	10	50	90	1.50	Y	1.00	0.024	0.003	1.50
22	Formal Teaching	Y	26	100	90	100	0	0	10	120	2.00	Y	1.00	0.036	0.000	2.00
23	Teaching Medical Students/ Others	N	6	80	50	80	20	20	50	15	0.25	N	0.23	0.001	0.001	0.00
24	Attending Clinics	Y	26	80	60	90	20	10	40	240	4.00	Y	1.00	0.064	0.007	4.00
25	Audit Activities	Y	2.5	70	50	80	30	20	50	210	3.50	Y	0.10	0.005	0.001	0.34
26	Reading Journals/ Research/ Private Study	N	26	90	80	100	10	0	20	30	0.50	N	1.00	0.007	0.002	0.00
27	Appraisals	Y	2.5	90	70	100	10	0	30	30	0.50	Y	0.10	0.001	0.000	0.05
28	Presentations	Y	2.5	80	70	100	20	0	30	40	0.67	Y	0.10	0.001	0.000	0.06
		N		0	0	100	100	0	100		1.00	N	5.71	0.102	0.000	0.00
	Dead Time	N		0	0	100	100	0	100		1.00	N	5.71	0.000	0.102	0.00
												Total Weekly Hrs	44.59	0.566	0.434	27.45

Table 19 – The impacts on activities and the training/ service balance of Scenario 3b

Table 20 shows a summary of the impact on overall training/ service balance of the various scenarios.

Summary of Training/ Service Impacts of Scenarios						
Scenario	Description	Training Index	Service Index	Supervision	Total Hours accounted for in the week	Empty Time (time not accounted for by activities)
		(% Time spent in Training)	(% Time spent in Training)	(hrs per week)	(hrs per week)	(hrs per week)
Base	Entails the frequency, time and supervision of junior doctor activities as they are currently typically executed.	0.46	0.54	27.45	44.59	11.41
1	Entails the changes to activity frequencies and times anticipated by the introduction of increased structured teaching under MMC	0.47	0.53	28.09	46.58	9.42
2	Entails the impacts on activities that would occur from a more proactive approach to seeking learning opportunities on behalf of the individual junior doctor. Certain activities were identified as being affected, which increases their perceived training percentage	0.48	0.52	27.45	44.59	11.41
2b	Entails the impacts on activities that would occur from a more proactive approach to seeking learning opportunities on behalf of the individual junior doctor. The assumption made was that this would increase the perceived training percentage by 10 for each	0.56	0.44	27.45	44.59	11.41
3	Assumes all of the "empty" or dead time is used for educational activities (assumed at a value of 100 training/ 0 service), by individuals making better use of their time to accommodate learning needs	0.67	0.33	27.45	56	0
3b	Assumes half of the "empty" or dead time is used for educational activities (assumed at a value of 100 training/ 0 service) by individuals making better use of their time to accommodate learning needs	0.57	0.43	27.45	50.29	5.71

Table 20 – Summary of the impact of scenarios on overall training/service balance

Observations:

(i) The baseline scenario (current practice) appears to suggest that the training/ service split is approximately 50/50, with a slight lean towards service. Approximately 80% of total time is accounted for by working and training related activities, and 20% empty time, which is in line with what one would expect in typical time usage of professional groups.

The baseline scenario also anticipates that 49% of junior doctor time would be spent under supervision by a more senior member of staff.

(ii) Anticipated changes by the introduction of more structured teaching and appraisal mechanisms under Modernising Medical Careers appear to have relatively little impact. It increases the training index slightly (by 0.01) and consequently reduced the service index by the same amount and increases the supervision needs by less than half an hour a week per doctor (i.e. approx. 2.5% increase). Assuming the total amount of hours worked remains unchanged, it increases the amount of time accounted for by activities by 2 hours, meaning there is less "empty" time available.

(iii) A more proactive approach to education and seeking the most of every learning opportunity will have impacts on the perceived training and service indices, but not on total hours of supervision needed nor total hours spent in activities or empty time. This is because it only changes the perceived educational value derived from an activity, not the frequency it is engaged in nor whether an activity is supervised. One could argue that there would be an increase in the amount of some of the activities (such as private study, research, journal reading, etc) under scenario 3 (making best use of empty time), but this is accounted for in allocating this better use of time a training index of 100.

(iv) The most significant impact on the training/ service balance with no change to supervision needs was making use of all empty time in an educational way (scenario 3). While this is not feasible in reality – there will always need to be slack in a working life system – the amended version of this scenario (3b) where 50% of empty time is used for entirely self-directed educational purposes, has a significant impact on the training/ service balance, while having no impact on supervision needs.

(v) It appears that in these scenarios to date, the ones that have most beneficial impact on the perceived training/ service balance with minimum impact on supervision needs (and thus have a greater impact on service provided by more senior colleagues) are options that involve changes in the junior doctors' use of "empty" time as well as culture/ attitudinal changes.

8. Modelling the Dynamics of the System

We have now arrived at a point in this story where we have identified what junior doctors spend their time on and how they perceive these activities to be educationally or service focused. In a sense we have "defined" what is understood by the concepts of "training" and "service" for junior doctors in their daily working lives. By applying relative percentages to this balance and multiplying it by the amount of time spent on these tasks (from the time analysis data), it was possible to build a picture of what the relationship between training and service is like at an individual's (micro) level. Further, it was even possible to model different scenarios based on the assumptions made about that relationship.

However, how does the micro-level detail relate to the bigger picture? How are the concepts of training and service at micro level related to the functioning of the system and the wider stakeholders? During the focus groups run in the work around the training/ service continuum, and the time analysis of junior doctors, a number of issues were identified about the way this is impacting the other staff groups (i.e. consultants and specialist registrars and the service they provide).

It is clear that the relationship between training and service needs to be explored in a wider systemic context to understand and learn about the way in which the system works, how its elements are assumed to be related and what this means for our learning of education and service for professional groups in a resource-limited context. Ultimately, this will aid organisational learning and decision-making for the problem owners within this organisational context.

It is undoubtedly a complex system that we are dealing with, and in understanding this system and its behaviour, it is proposed to build a model of it that allows us to understand the relationship between "training" and "service" not only at a micro level but also at a systemic level. Furthermore, in doing so, the concepts are further explored, and learning and understanding about the system is derived from the process.

It is proposed that dynamic modelling, and in particular a systems dynamics modelling approach, is adopted to show how the concepts of training and service for the professional group under study are linked at systems (macro) level. The unique purpose of this model is also to explore the links between the granular detail in the individual's perception of the relationship between training and service in their daily working tasks and lives to the bigger picture and system in which they operate.

This chapter outlines the systems dynamics approach in theory and identifies the modelling process adopted, followed by a description of the model that was arrived at as an outcome (and possibly by-product) of the learning process that the stakeholders undertook in understanding and exploring the system. Discussions around the validity of the model and its representation of reality and how this adds to our understanding of the training/ service relationship are presented, which lead to key contributions to the existing body of knowledge in this field.

8.1 The Systems Dynamics Approach

What is a system? Forrester (1968) defines it as: "a grouping of parts that operate together for a common purpose". What is the system under study here, and is it one? This research examines the professional development of a group of people so that they can provide a service to their clients and stakeholders, which in turn aids their development (i.e. the personal and professional development of junior doctors so that they can treat patients more effectively – the ultimate purpose of the system – but in doing so this aids their development). This clearly is a situation where there are parts (doctors of different levels of experience being educated and providing a service) that are operating together for a common purpose.

However, in clarifying what the system under study is, it is necessary to have some discussion around system boundaries. This research uses the junior doctors at Plymouth Hospitals NHS Trust as a case study or example of a problem that prevails across professional groups, where the need for education and service provision are often complimentary and at odds at the same time, and all have to be conducted in confined resources (be it time, money, availability of opportunities, etc.) For the purpose of this research, it is also limiting the study to medical staff (i.e. junior doctors and consultants) as the traditional model of postgraduate medical education indicates that these are the ones involved in education and service provision, although this research and the understanding and learning gained from it may well question this status quo.

If it is accepted that this is indeed a system and that one way of understanding it and the elements within is to model it, then it is necessary to explore what is meant by a model and why we need to model the system or situation at all in order to understand it.

According to Forrester, "our mental processes use concepts which we manipulate into arrangements. These concepts are not, in fact, the real system that they represent. The mental concepts are abstractions based on our experience. This experience has been filtered and modified by our individual perception and organisation processes to produce our mental models that represent the world around us." (Forrester, 1961)

There are several problems with the mental models that we carry in our heads that represent our understanding of concepts and systems: they are ill defined, the content of them keeps changing as our experiences change, our assumptions are not clearly identified, and they are not easy to communicate to others – the "ill defined and nebulous nature of the intuitive mental process is hard to put into words". The process of transforming these mental models into explicit statements in the form of flow diagrams and equations helps alleviate these problems. In a sense, it helps us to explore our understanding of the system and the concepts within it in a more open, explicit manner, exposing the assumptions they are based on. In particular with such nebulous concepts such as "training" and "service", which we all seem to have our own understanding of, what they are, how they are related and what our perception of their relationship is.

Systems Dynamics was developed at MIT in the post-war era of the 1950s, primarily by Jay W. Forrester. He amalgamated concepts from control engineering (feedback and self-regulation) cybernetics (information and its role in systems) and organisational theory to develop a guiding philosophy a way of representing and simulating "complex, nonlinear, multi-loop feedback systems. (Meadows 1980).

Jay Forrester originally defined Industrial dynamics in the following way:

"Industrial dynamics is the investigation of the information-feedback character of industrial systems and the use of models for the design of improved organizational form and guiding policy".

Thus, system dynamics relies on the analysis of the system, which involves the concept of causal feedback loops, and the use of a formal model to portray the structure, to aid understanding of it and thus inform policy decisions.

While Forrester initially applied his techniques to more typical management problems at the time, such as inventory fluctuations, instability of labour force and falling market shares (Forrester, 1961), it has grown to be used in a very wide variety of problems at all levels and industries, in some shape or form.

Born from Forrester's *Industrial Dynamics*, system dynamics (sometimes referred to as business dynamics) is an approach for studying managed systems. The basic principle lies in the assumptions that there is feedback in systems and that a system's behaviour is directly related to its structure. By representing the structure of a system, be it a physical or social system, with a series of connected stocks and flows with identified relationships, it is possible to concretely model and simulate system behaviour. System dynamics enables not only the understanding of a systems elements and how they are related and influence behaviour, but once the structure of the model has been accepted, it also allows simulation and prediction of future trends and behaviours in the system. However, while the iconography of system dynamics models are formalised and standardised, there is a wide variety of contexts in which they have been applied, and accordingly a wide variety in approaches adopted in the construction of these models.

Systems Dynamics has been applied in a number of areas in a plethora of industries. Increasingly there has been a vast amount of interest in applying system dynamics for modelling understanding healthcare systems both in the UK and around the world (Cavana, Davies et al. 1999; Royston, Dost et al. 1999; Heffernan, Martin et al. 2004; Hirsch 2004; McDonnell, Heffernan et al. 2004) for example managing waiting lists in Spain and the UK (González-Busto and Garcia 1999; van Ackere and Smith 1999), chronic illness management (Hirsch and Homer 2004), mental health (Smith, Wolstenholme et al. 2004) and patient flow in the NHS (Wolstenholme 1999). It is relatively easy to see how managing the flows of patients and waiting lists would be amenable to systems dynamics modelling in health, in particular when the systems can be easily be defined in stocks and flows. Thus, "hard" health systems with physical movements of people and processes lend themselves easily to the systems dynamics approach as a way of informing healthcare policy.

However, the beauty of systems dynamics is that is possible to model softer aspects of problems within a "hard simulation", as has been demonstrated by Holmstrom and Elf (Holmström and Elf 2004) when they use the technique to model staff retention and job satisfaction at a hospital clinic. Similar to this research area Health care managers and providers were "forced to find more efficient and effective ways of producing health care while at the same time improving the quality of patient care" (Holmström and Elf 2004). This is a similar conundrum to the one faced by Plymouth Hospitals NHS Trust in finding more efficient and effective ways of training junior doctors under reduced hours while still maintaining their service standards.

In particular, systems dynamics is useful where problems are (Zock and Rautenberg 2004):

- Ill defined
- Unclear or diffuse in their assumptions
- Difficult to communicate clearly through language
- Not suitable for an inference of the dynamics contained in the respective problem

Introducing system dynamics to the organisational problem allows it to be (Zock and Rautenberg 2004):

- Clearly expressed in terms of structure and assumptions underlying the model
- Easily communicated due to the formal clearness
- Suitable for the inference of the problem dynamics due to the possibility to incorporate a mathematical framework in the formal modelling process.

What is most important to understand is that the model is not necessarily a realistic factual representation of the real world, but a subjective mental representation of the world, as perceived by the problem owners. This aligns itself well with the phenomenological ontology and epistemology of this research, which seeks to construct and understand the world around us as interpreted by the actors in it. This is also a feature of softer problem structuring techniques (such as soft systems methodology or cognitive mapping) used in the operational research domain. The key difference of this approach, which separates it from these approaches, is the identification and measurement of relationships, which allows them to be simulated and explored in more depth, allowing an understanding of the behaviour as a whole over time and under different conditions.

Royston et al (1999) describe how system dynamics has been successfully utilised to help inform policy decisions in the Department of Health in the UK across a wide spectra of organisational problems, including disease screening, assessing public health risks, managing waiting times, developing emergency health and social care, and planning the health care workforce. They clearly identify that there are two different purposes for building system dynamics modelling, namely "solution oriented" and "learning oriented".

Barlas (1996) classifies the purposes of modelling in a slightly different way:

1. Modelling and analysis of a real system in order to improve some undesirable performance pattern
2. Modelling of an existing theory in order to evaluate/ test the theory (taken from Sterman 1985)
3. Modelling for interactive simulation gaming (e.g. management flight simulators)
4. Modelling for learning

It is very clear from both the research phenomenology and the nature of this research problem, that the systems dynamics model that was to be built for Derriford Hospital was one of a learning oriented nature. Barlas (1996) acknowledges that these models support team reasoning and learning, are owned by the policy makers, not technical experts, are built in a group process, and "their primary use is to enhance (organizational) learning" (Barlas, 1996: 201). The purpose of this research is not to build a precise decision support system, allowing detailed man power planning, as this would neither be feasible (due to lack of availability of historical data, especially in the "softer" areas such as the training/ service balance, which first had to be defined) but also not desirable. It was necessary to model the education and service activities and junior doctors within the system to allow greater understanding of the relationships between the various elements in the system, and in particular the relationship between the concepts of service and training (in detail, on aggregate and over time) for professionals in an organisational context.

This in-depth understanding would allow valuable insights into the system, its structure and behaviour to be gained, which in turn would help more effective decision making, and contribute to our understanding of the relationship between these concepts.

Viewing the problem as a system, no matter how elusive, is also in line with the current government's thinking, which "has stressed the importance of taking a 'holistic' approach to improving health and health care and of having 'joined-up policies'." (Royston, Dost et al. 1999)

As Royston et al state:

"We have found no difficulty in weaving system dynamics modelling into the work of the OR group...indeed, for a group in central Government working at a strategic level it has proved a highly appropriate tool. We plan to continue to use system dynamics modelling, in both "hard" and "soft" forms, to support the development and management of policies and programmes in health care and look forward to its continuing success" (Royston, Dost et al. 1999):311

It must be noted that this is not the only modelling tool that could have been applied. One could envisage the same arguments to be made to answering the research question using cognitive mapping or other problem structuring methods. However, this one was selected as a basis for developing, because not only did it fit with the nature of the problem, it allowed the unique ability to employ quantification to be more explicit about the nature of the relationships of seemingly unquantifiable concepts.

8.2 Model Building Process

Having looked at the purpose of the model and what was being attempted by building a model of the system, in particular a systems dynamics model, it is necessary to outline the process that was adopted. Why is it particularly important to this research to describe the process? It is because the purpose of the model was to learn and understand the issues at hand, how the concepts of training and service are related and what consequences this has for the activities of junior doctors and the functioning of the system as a whole. Much of this learning is acquired through the model-building process more so than the outcome of any model evaluation and simulation.

8.2.1 What kind of model and what kind of approach?

As with organisational model building and operational research methods in general, it is not surprising that the approaches taken to building the models and the form which the model takes on (e.g. size, structure, granularity, level of quantification) are linked to the intended purpose and outcome of the modelling process.

There have been many attempts to summarise the stages of the modelling process in operational research methods, and indeed many papers present the process in a scientific manner as the "method" through which a model was arrived at. Sterman (2000) identifies five stages: problem articulation, formulation of a dynamic hypothesis, formulation of a simulation model, testing and policy design and evaluation. Almost all researchers recognise the iterative nature of this process and Sterman (2000) further sees it as "The goal of modelling, and of scientific endeavour more generally, is to build shared understanding that provides insight into the world and helps solve important problems. Modelling is therefore inevitably a process of communication and persuasion among modellers, clients and other affected parties." (Sterman, 2000:850)

While there has been some debate in the system dynamics literature about whether a system dynamics should be qualitative or quantitative, and what the added benefit of quantification is when empirical data is limited (Größler 2004), it could be argued that this is a non-issue. Models need to be fit-for-purpose. If the purpose of the modelling process is to provide accurate simulations and predictions of scenarios for decision makers (such as a decision support system), and the data is available for such a purpose, then a fully quantitative and statistically validated model is an appropriate tool. However, if the object is to understand the system more fully, gain insights into the relationships and feedback in the system to help inform strategic decision making, and in particular when the elements in the system are of an immeasurable type, then there can be a case for remaining at a qualitative level. When the latter is the case, there tends to be a greater focus on the process of model building, as this becomes more important as an outcome. For example, when the process of building a systems dynamics model of a problem is being used to work across professional boundaries and understanding world views to enable people to work better together, then the added value of quantification is not worth the effort (Cavana, Davies et al. 1999).

It is needless to say that this is not a clear-cut area. The domain of this research falls somewhere in between. While the aim of the modelling is one of an understanding and learning nature for both the purposes of the research and the problem owners, it was felt that there was great added benefit and contribution to knowledge to be gained to quantify the relationships, and determine measures, even if they were only relative by nature. This was in line with the approach taken to creating relative balances of training and service in activities, and calculating an overall picture of what the balance looks like in the junior doctor day and week. When considering the question posed by Andreas Größler (Größler 2004):1

"..is it more that model simulation is a nice-to-have add-on to qualitative systems thinking but – in many cases – not really necessary or even misleading; or are systems thinking and simulation naturally tied together and two stages of one single process that only occasionally is stopped after the first qualitative step?"

His conclusion that an attempt at quantification is justified even when empirical data, reinforces the approach in this research. (Größler 2004):14 While it makes validation of the model more difficult and translation of model behaviour to that of real life a struggle, there are valuable insights to be gained from model outputs and their relationships to model assumptions in simulations that allow a greater understanding of the system than qualitative modelling alone. This is why it was decided to build a qualitative systems dynamics model and then attempt to quantify it in order for the problem stakeholders and decision makers to make better informed decisions about the problem area. It also helps to more clearly define the nature of relationships in relation to each other (e.g. whether concepts and their behaviour and influence over each other are positively or negatively related, and what the relative magnitude is). This will mean that validation of the model is attempted in an amended way, and that there will be a limitation on how much of the model behaviour can be directly translated in practice, but the added benefit will outweigh this risk. Details of how model validation was undertaken are referred to later on in this chapter.

As described earlier, system dynamics literature (e.g. Sterman 2000) and operational research more generally all have descriptions of the model building process, largely centred around stages such as problem description, formulation of hypothesis, construction of a model, testing and validation and simulation, with a recognition that the process is iterative, and that the resultant model needs to be fit for purpose. Most of the accounts of system dynamics modelling in health are very scientific, centred around detailed descriptions of the problem and the specifics of the model and its assumptions. This may be possibly because the focus in these is largely on quantitative models, focused on yielding answers to the problem, rather than looking at the process. On the contrary, accounts of the more qualitative models, where learning has been identified as the outcome, focus more on description of the model building process. Accordingly, it will therefore be no surprise that as the purpose of the model in this research lies in understanding the concepts and their relationships, a large part of this chapter is dedicated to the model building process.

It is also possible to comment on the way in which systems dynamics models are reported and documented. Textbooks and publications split the model building process and description thereof neatly into structural model building, parameter estimation, testing and simulation as if these were distinct stages. However, experience finds this not to be the case, and although there is growing acknowledgement in the literature that the model building process is not straightforward in reality, many publications still report it in this manner. While there is now a general recognition and admission amongst experts and practitioners that there is this gap in the literature in describing actual process, and in the recent past there have been some attempt to rectify this and fill this gap (Vennix 1996; Cavana, Davies et al. 1999; van Ackere and Smith 1999; Binder, Vox et al. 2004; Durfee, Mills et al. 2004; Smith, Wolstenholme et al. 2004; Wolstenholme, McKelvie et al. 2004) there are still numerous accounts of system dynamics models and proposed solutions without much regard for process (Heffernan, Martin et al. 2004; Hirsch 2004; McDonnell, Heffernan et al. 2004).

Finally, two more procedural issues that have arisen in systems dynamics are: the client-consultant relationship and involvement and generic versus problem specific models. These are worth considering when elaborating on the model building process. Zock and Rautenberg (2004) refer to the client-consultant relationship as having two modes: the expert mode and participative mode. They characterise the expert mode as having the following characteristics (Zock and Rautenberg 2004):

- The application of a [pre-determined] process

- The application of an expert modelling process scheme that relies heavily on back office modelling work without client modelling
- No clear role model for the involved practitioners and the client
- No established reference to an organisational intervention process model or helping model

It should be clear already to the reader that these are not features of this research's ontology and epistemology, nor the overall research framework. Additionally, the expert mode of model building suffers from disadvantages, which are not acceptable for this research. These include that the results of the modelling process tend to lack client ownership and are therefore often rejected by the problem owners. While some problems and some stakeholders prefer this "doctor-patient" relationship, where the modeller is hired to "find out what is wrong, and recommends how to fix it" (Zock and Rautenberg 2004) the junior doctor system at Derriford and the postgraduate medical education team and management that are involved in this problem are not of this opinion. It is also fundamentally at odds with the constructivist research phenomenology adopted. This is why a participative mode of the model building process was adopted, which employs a much more interactive model construction process and the focus of the SD modeller lies in facilitating the group of stakeholders and their involvement in structuring the problem and in doing so, own it, understand it and gain valuable insights not only from the results but from the process. From the literature, it is clear that the expert mode is now outdated, with many highlighting the need for and importance of client participation (Robinson 1980; Lyneis 1999; Lane, Monefeldt et al. 2003). However, it is worth mentioning that rather than following trends, it is always important to consider the purpose of the modelling, and one can imagine some situations in which the expert mode would be more fit-for-purpose.

Finally, there have been attempts by modellers to create generic models, or templates, which can then be adopted to fit local circumstances. Wolstenholme (1999) in his work on patient flows, argues for the development of a generic model which can then be applied to individual circumstances as a preliminary step. (Wolstenholme 1999):254. Hirsch and Immediato (1999) agree with Senge when they argue that generic structures, or systems archetypes "can be useful tools for understanding and dealing with common management problems." (Hirsch and Immediato 1999):318 They identify 4 generic structures in health care: limits to success, shifting the burden, balancing two boats and accidental adversaries. Again, the use of archetypes depends on the purpose of the model. Within this research phenomenology and the nature of the problem, it is more important to build the model structure from scratch rather than drawing on generic structures. Having said that, this would not necessarily prevent generic observations and structures and insights to be drawn and possibly translated to other hospitals, because even though the specific area under study is junior doctors' hours, training and service, it is symptomatic of a wider prevailing conceptual conflict of balancing organisational and personal development needs in the short and long term within finite resources.

8.2.2 The process that evolved

As alluded to in the earlier section, write-ups of model building processes often make it appear as if the process that was adopted was planned and acted upon in a logical, sequential manner which yielded a valid, accepted model with results for action or implementation. Honest reflection on the research process would reveal that this was not the case in this piece of research.

While it was envisaged that system dynamics could be a good tool for modelling this problem right from the outset in the design for the reasons described earlier, this is just about the only thing that was constant. Once the fundamental parts of the research (i.e. micro level detail), defining junior doctor activities and identifying the relative training/ and service balance in each had been complete, the challenge of building this into a bigger picture, that allowed understanding of the system and its behaviour, was undertaken. Many iterations of the model building process and stages were undertaken, and the model took on various forms. The key challenge in this was determining the level of detail it should include and how to balance the relationship between training and service at micro level (individual and task level detail) and macro level (within the defined system boundaries). Caught up in this struggle was probably also some changing and shifting focus in model purpose (from solution to learning focused) which inevitably can happen over time when involving a group of stakeholders with different ideas, and as more about the "messy problem" is learnt.

Figure 28 represents a summary diagram of the process as it took place. While this could be written up as if it had been planned this way and unfolded, this is actually a pictorial representation of how it occurred. What had been planned was that it would be an iterative process of model development and validation with the problem owners, until the problem owners were happy that it represented the system and that it was exhibiting behaviour, which they could identify in the real world problem. However, it was not possible to jump straight into the SD modelling process, due to a number of reasons. The problem stakeholders were concerned with both the details of what junior doctors did on a daily basis and how they spent their time, and educational and deployment strategies at the same time. Thus, they were trying to tie micro level activity with macro level decisions, which was difficult as these were two different purposes of the same model. Also, they were referring to concepts at micro level, without clear clarification of what these were (hence the need to conduct the research on training/ service balance and activities and time spent as a preliminary) and trying to tie these into macro level concepts of the quality of training and service at the Trust, and the impacts on other staff groups. It often appeared as if they had put all their proverbial eggs in the system dynamics basket! It wasn't until relatively late in the research that it was finally acknowledged that the crux and core of this problem and research area was in understanding the nature of the relationship between training and service and what the systemic impacts of these relationships are.

Through the process described in this section, a two-stage model was arrived at: the first is a spreadsheet model (described in an earlier chapter) capturing the micro level details of junior doctor activities and time spent. This acts as an information feed into the developed and agreed strategic SD model. In order to focus the research, the problem stakeholders concentrated on a set number of scenarios that they wished to pursue the effects of (see Table 20), and these were simulated at micro level. The output of this was fed into the SD model for macro level simulation.

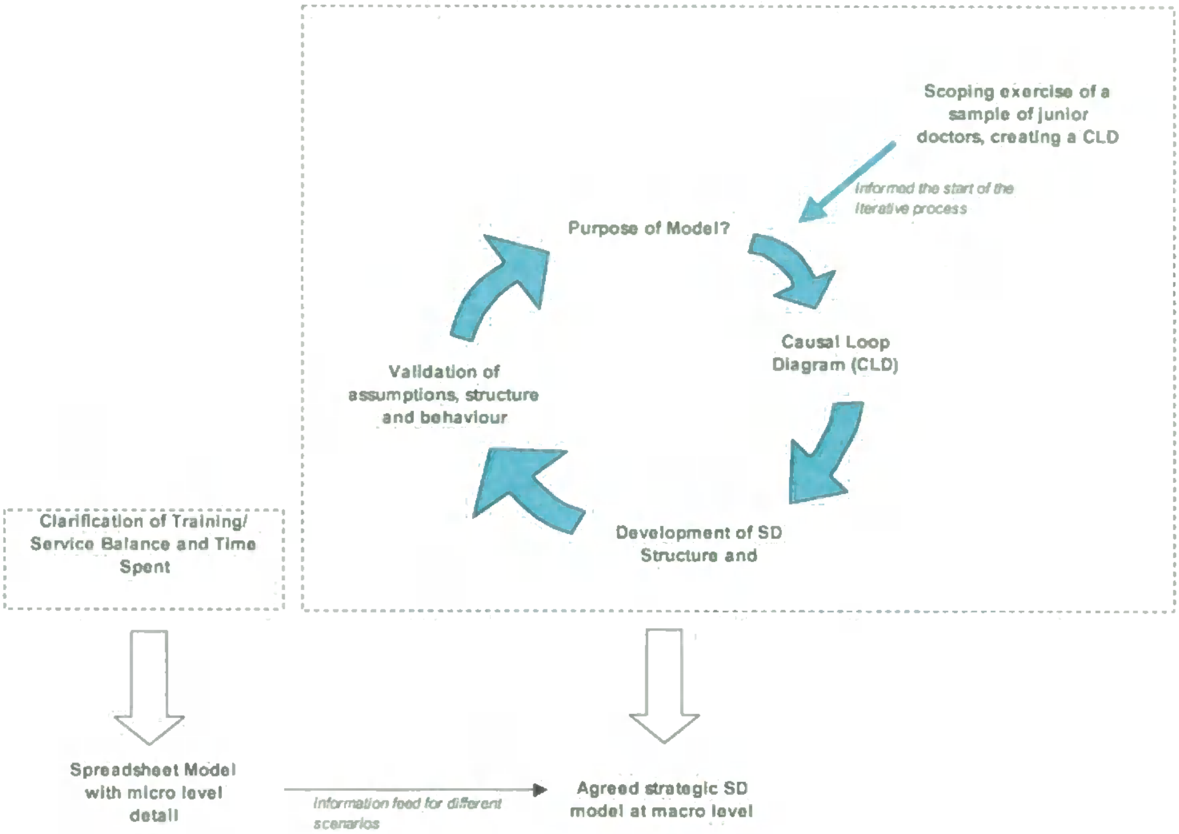


Figure 28 – The modelling process

Taking a step back, it is important to re-emphasise why systems dynamics was chosen as a central tool for analysis for this specific research area. There are two features about problems that typically make them amenable to SD modelling.

Firstly, a system dynamics approach assumes that structure and behaviour of a system are linked, especially that changes in a system's structure would have impacts on the way it behaves. This was already accepted by both senior medical staff and Trust management at all levels. Changes to the junior doctors' hours, especially the movement from on-call to full-shift patterns has had a knock on effect on a wide variety of areas in the lives of the junior doctors, their senior colleagues and the operation of the hospital. This is well documented in the literature, as reviewed.

An early scoping exercise with junior doctors before commencing this formal research, employing cognitive mapping techniques, to identify their perceived impacts of moving from on-call to shift working, resulted in a wide variety of issues in their lives as junior doctors, that had seemingly been caused by a change in structure of the system.

In this scoping exercise, the objective was to identify issues that have arisen from the movement from on-call working (with hours more than allowed by the New Deal) to 56 –hour compliant shift working, as perceived by a sample of junior doctors. The interviewees to be contacted were selected on the following basis: the ones that the rota-coordinator at PHNT had suggested (a total of 5), as they had been here since before 2001 and could thus remember the time before shift working was introduced, along with a further 7 chosen at random from the Staff list (as of Feb. 2003). At a later stage another person was added to the list, because they were at the end of their SHO training and was not yet applying for SpR posts.

An introductory email was sent out to the 12 doctors, explaining the research as a whole and the background to this scoping exercise. In this email, some of their time was requested over the next few days and contact details were given. Unfortunately, only 2 people replied to the email within a few days. (Incidentally, both of these had finished their SHO training, so none of the training SHOs replied to the email).

The two doctors that had replied via email were interviewed (both had been here pre 2001 and both recommended by the rota-coordinator). Subsequently, 2 more SHOs from the 7 were chosen randomly and bleeped. Here the response was immediate and all 3 were seen in 2 days. Bleeping doctors is by far the superior form of contacting them. When they replied to the bleeps, all recalled the email that was sent out and were happy to express their views on the matter.

The interviews were mainly held in the doctor's mess, which is a fairly informal atmosphere (sofas and chairs, over a cup of tea). However, as the interviews were held in the afternoon, it tended to be quiet to allow privacy and expression of opinion. The interviews had a semi-structured/ unstructured nature, where there was a general structure of:

* the interviewer's background
* the interviewee's background
* what was it like to be working/ training on-call?
* what is it like to be working/ training in shifts?
* what are the differences?

While this general structure was adhered to overall, the conversation was not restricted and the interviewees were allowed to express their views on any aspect of the junior doctor role in the current working pattern. Predominant concerns varied by participant, and the interview content and follow-up questions were conducted accordingly.

With the interviewee's consent, notes were taken during the interview. This allowed the capturing of detail and phrases. Here is must be noted that there is inherent bias in note-taking, in that the interviewer will only be capturing what he/she sees as the main points and thus some detail may be lost. However, this problem is inevitable with note-taking. When balanced against the time, effort and potential loss of openness of taping and transcription, it is worth just accepting the bias and bearing it in mind.

The notes of all the interviews were written up. Subsequently, the main issues/ points were put onto individual post-it notes, in order to structure the problem and create a causal map. Again, in structuring the post-it notes (i.e. grouping them and arranging them), the researcher was potentially inflicting some of her views onto the problem. Again, it is hard to avoid this, but with the researcher being as objective as possible (i.e. not a doctor, NHS employee and very new to the NHS at the time – less than 2 months), it was hoped that this effect was kept to a minimum.

The causal map produced is a reflection of how the five people interviewed see the problem. Any cause and effect relationships drawn are simply the way they expressed them. There may be more or alternative relationships, however if these were not observed or expressed by the interviewees then these are not drawn. In effect the causal map is a view of the world as expressed by those 5 interviewees during the relatively short time spent with them.

Upon presentation of this cognitive map to a wider audience within the Trust, including consultants and management, many stakeholders recognised and empathised with these behaviours and knock-on effects of changes in junior doctor working patterns. This confirmed the assumptions that this "problem" indeed was viewed as a system in which behaviour is influenced by structure.

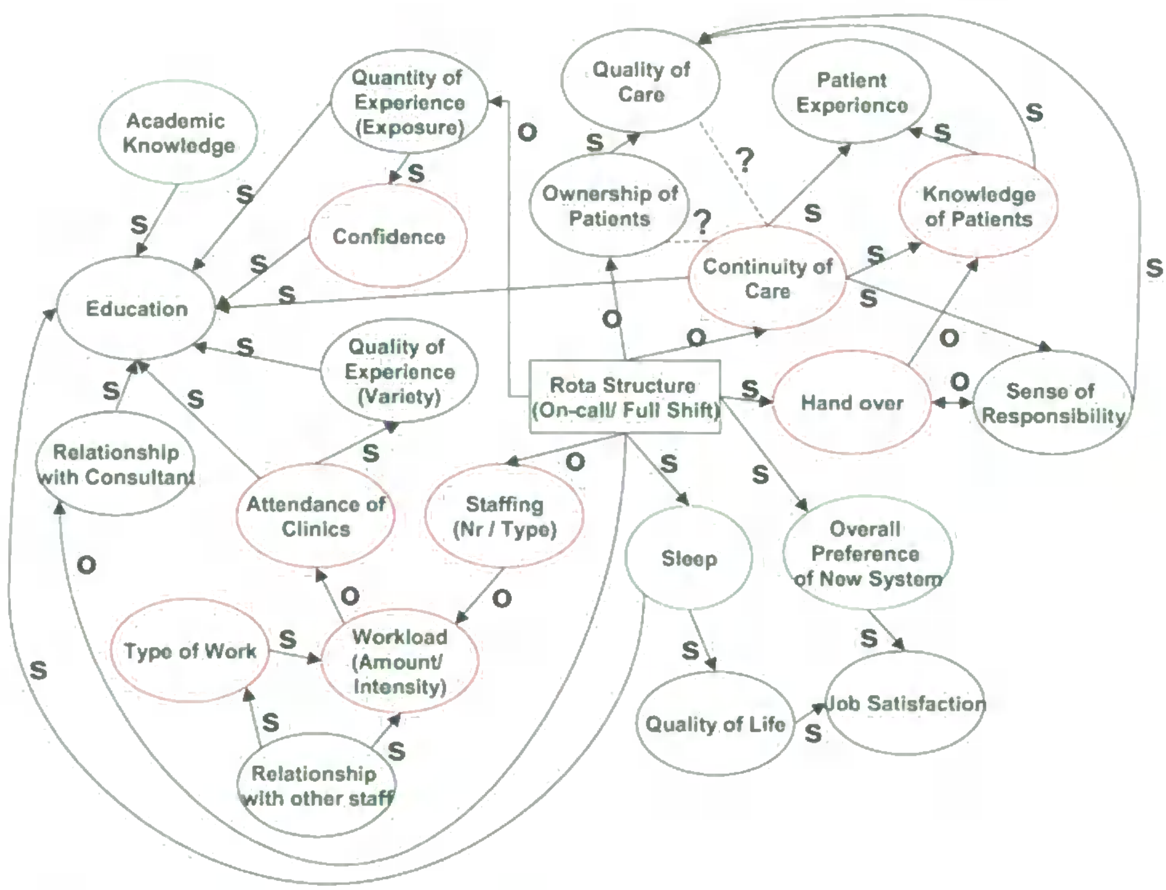


Figure 29 – Cognitive Map of the Knock-on effects of moving from on-call to shift working, as perceived by a sample of junior doctors (includes s/o notation to bring it in line with causal loop diagram notation)
***S** = Relationship is such that changes in one affect the other in the **same** direction (i.e. an increase in one increases the other)*
***O** = Relationship is such that changes in one affect the other in the **opposite** direction (i.e.an increase in one decreases the other)*
Red issues are ones highlighted as concerns or areas that have worsened due to the issue in the box; green issues are ones that appear to have benefited.

Secondly, circular causality in the problem structure clearly has a major influence of system behaviour. What became immediately apparent is that there was an obvious tension between junior doctors acquiring the skills and knowledge in their postgraduate training, while at the same time being required to deliver their medical services to the patients, all within a reduced number of hours.

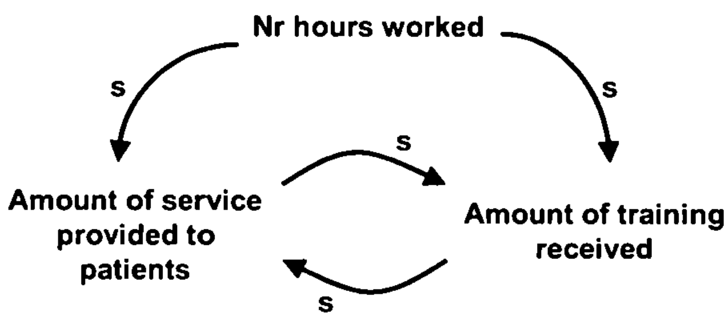


Figure 30 – Diagram of initially assumed relationship between hours, service and training

At first glance, this problem appears to have a reinforcing feedback loop, which is being negatively influenced by the reduction in hours. This is due to the assumed simultaneous relationship between "training" and "service" that prevailed in the medical profession: all hours spent at the hospital were considered both training and service. However, the relationship between the concepts of "service" and "training" do not allow for the feedback loop to be simplified quite like this. This is because while a single term "training" is used in the sector, there are really two major and different kinds of training: the gathering of "experience" which is acquired by providing services to patients, and the learning of something new, either on the "shop floor" or through formal teaching sessions. The latter type of "training" is the type that is often at odds with “service” activities, whereas the former one is the one that can comfortably occur simultaneously.

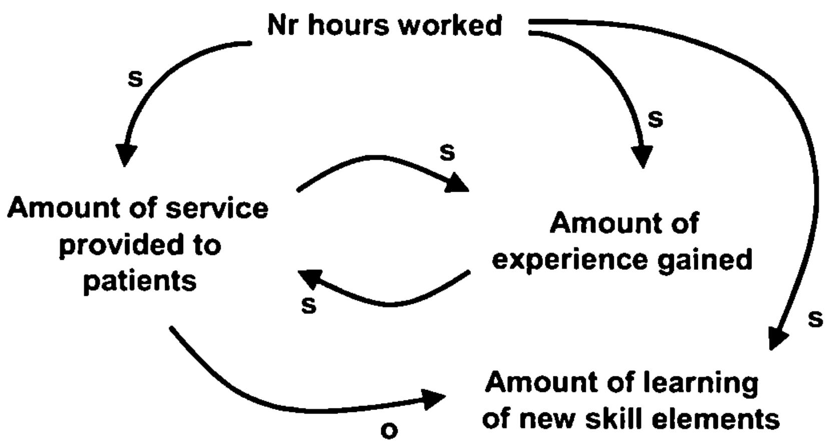


Figure 31 – Diagram of revised assumed relationship between hours, service and training

However as the research evolved, separating out the two elements of “training” still did not allow the problem to be completely captured. While it now showed the reinforcing feedback which was felt to be negatively influenced by the reduction in hours, regarding the conflict between “service” work and new experiences or “taught” sessions, it was difficult to understand the relationship between the “experience” element and the “learning something new” element. Also, this did not capture exactly how the reduction in hours was directly influencing the training and service elements, i.e. tying what junior doctors do at a task level to the other elements in the system. This conflict between micro level and macro level was going to become a distinct problem in the modelling of this problem using system dynamics as the only tool of analysis.

There is clearly a trade-off going on in the training/ service relationship, but it was difficult to specify or pinpoint at the outset because of the elusive nature of the concepts of "training" and "service" in this problem. There was a lack of understanding of these issues, not only for the model builders and project team, but also in the problem stakeholders. While, inherently everyone seemed to know and witness that the reduction of hours was impacting training and service for junior doctors, it was difficult for any particular person to specify the exact relationship. Views of this problem were wrapped up in existing practices and prejudices - or "the way things were"- and it was difficult for people to see beyond this. Additionally, early research revealed that there was further feedback in the system in relation to consultant time and availability, beyond the junior doctor training, service and hours issues, which impacted on the problem. This meant that more work was needed in questioning the status quo with reference to the relationship between "service" and "training", and how these were present in junior doctor activities. This led to the work done on the training service continuum and how junior doctor time is spent (see earlier chapters) before the modelling work could be progressed.

Such structural and dynamic complexity points naturally to SD as the study approach, and Mark Ratnarajah and John Morecroft (2004) similarly chose it in their study of similar issues. However, their study focused on issues relating to morale and the attrition rate of junior doctors due to the EU Working Time Directive within the sector as a whole. While this is an aggregate model dealing with workforce planning issues, as opposed to the operational and strategic decision making aid, balancing training and service requirements within its workforce that this projects is seeking to build, it is confirmation of the successful application of the technique in this area.

Thus, although the scope of the problem had seemed reasonably clear at the outset, it rapidly became clear that definitions, meanings and metrics were not uniformly understood. Secondly, what complicates this situation further, is that there is no fixed individual or set of "problem owners". Different sets of people in the Trust are responsible for the creation of rotas (hours), the provision of clinical education (consultants, clinical and college tutors) and the management of service (clinical directors, management, consultants). With responsibilities spread across such a wide variety and number of people in the trust, it is inevitably difficult to get them all together in one place, working together on "one model". Their views would have to be incorporated, but this cannot be achieved through a usual set up of the client-consultant relationship through one or two key players. This means that more effort than usual was probably going to be needed to negotiate access to people's time, especially in such a pressurised environment, where strategic and long-term decision-making can take a back seat.

The emerging SD model(s)

At the most basic level, this problem is about matching the number of junior doctors as they pass through the training process, senior medical staff and the hours they work, and modelling the impacts of changes in these on the training provided and service delivered. Therefore, the main structure is based on a classic progression model. An 'ageing chain' of junior doctors, and their progression through postgraduate medical education, has been developed, with inflows and outflows at each level depicting the arrival and departure of junior doctors in addition to the internal progression flows. This was deemed the most appropriate starting point, as the physical stocks of "doctors" were easy for the problem stakeholders to relate to, as well as the progression through the system that was most evident. Further, the number of doctors in various grades, and thus their availability for service provision, or supervision in the case of senior medical staff, has been a high profile issue. This represented a tailored, yet fairly generic progression chain, as has been previously employed in human resource models (Sterman, 2000). It was determined that the most appropriate way to show impacts on training and service would be to create two co-flows of training and service, that increase or decrease, depending on (a) the number of junior doctors at each level arriving and leaving the system, and (b) the proportion of their time that was being spent "in training" and "in service" that is calculated in analysis previously mentioned. Thus, more experienced junior doctors, such as those who had been in post for more than 3 years, take proportionately more service hours from the stock when they left (and less training hours) than first year SHOs. There is further scope to feed in sub-models, which calculate the training/service percentage in the time spent, depending on how many of each of the SHO activities were being experienced and whether this is under supervision. (Although, in the version of the model shown in Figure 32 , the training/ service percentages are shown as constants.)

After developing this initial structure with the project team, it quickly became apparent that it had two drawbacks at this stage of the project. Firstly, the level of complexity was growing faster than was necessary for showing the overall feedback relationships and impacts. While separating out each grade of junior doctor, and even sub-grades for the SHO grade, enabled the decision makers to really identify with the model in its representation of the real-life "stocks", it meant that they were focusing on very detailed operational issues too early on, rather than focusing on the bigger picture. Secondly, it was in trying to capture the co-flows of training and service that it became more important to look beyond just the impacts on junior doctors, and their "training" and "service" hours, but to also focus on the consultants and other senior medical staff that were being affected by changes in the junior grade. This is a distinct advantage of building a systemic model: having to think beyond the immediate area of concern. Building in consultant hours and how time was being spent is possible with this model, but again this would raise the level of complexity in the model, as consultants would be supervising several grades of junior doctors, often simultaneously, while providing their own hours of "service", as well as other duties. Defining the impact of lack of supervision on future training/ service percentages was also a challenge in this version of the model.

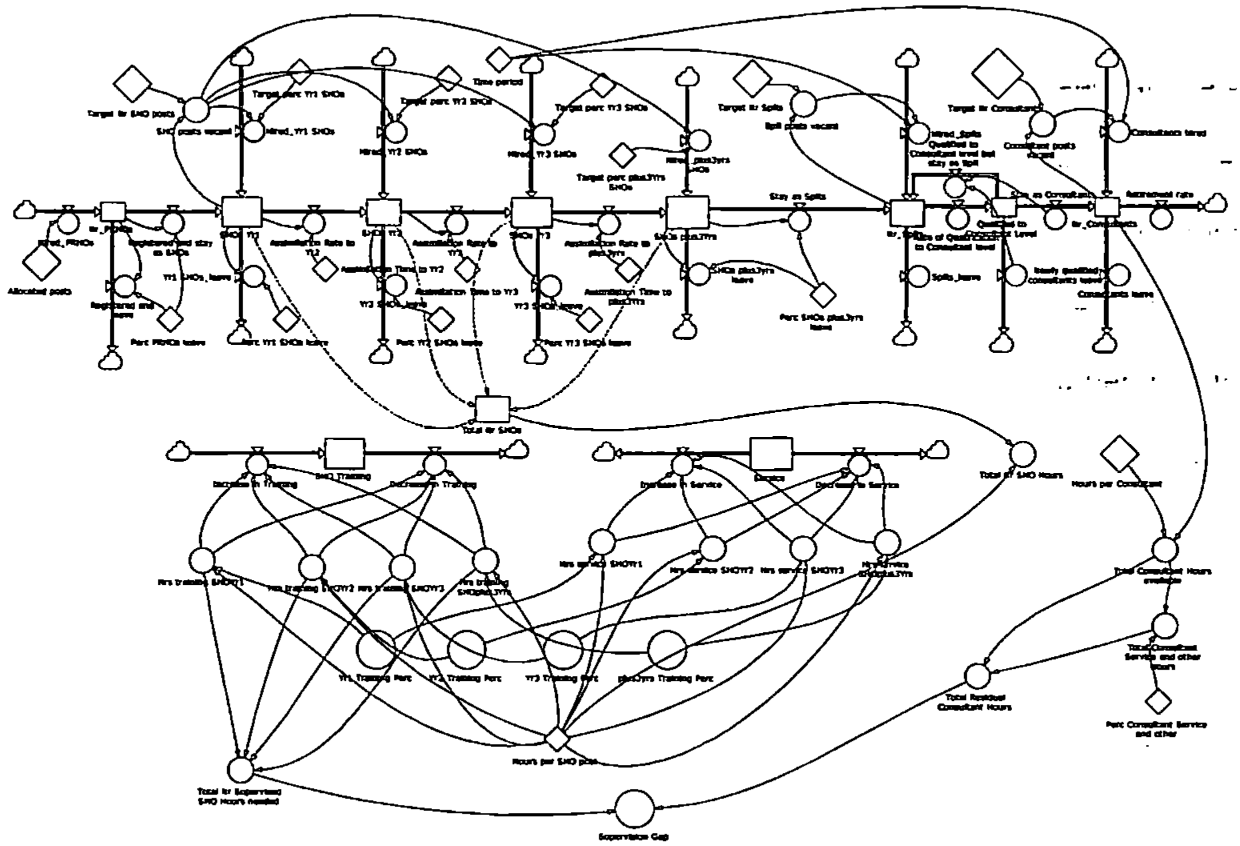


Figure 32 – The initial system dynamics model

It was agreed therefore that while this full progression relationship would ultimately be needed to support decision-making, in order to first enhance understanding of the inter-relationships and their impact on training and service provision and developing a simple insight model should be developed. In order to keep the focus of attention on the whole system, rather than operational detail, a causal loop diagram was developed which summarised all the major feedback loops and relationships. This still reflects some of the more important day-to-day issues (e.g. bleep policies, doctors' assistant roles) but also incorporates qualitative elements (motivation, seeking learning opportunities) that had been raised in the earlier focus groups. The CLD has been accepted as a good representation of the broad system at the aggregate, overview level. (See Figure 33).

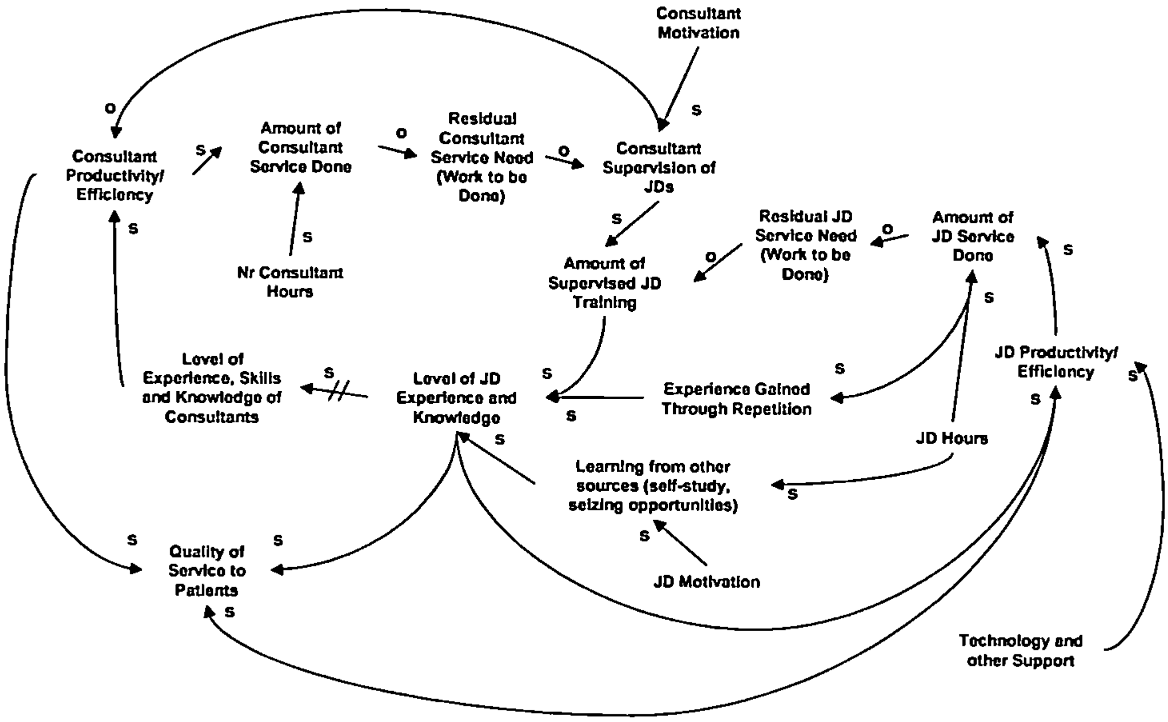


Figure 33 – Causal Loop Diagram of the problem

***S** = Relationship is such that changes in one affect the other in the **same** direction (i.e. an increase in one increases the other)*
***O** = Relationship is such that changes in one affect the other in the **opposite** direction (i.e.an increase in one decreases the other)*
A double line in the arrow shows that the effect is delayed

The causal loop diagram contains four loops: one negative and three positive. It centres on the level of junior doctor experience and knowledge, which is at the heart of the problem. Earlier analysis revealed that one of the major contributors to the level of junior doctor experience and knowledge is the amount of supervised training they receive from senior medical colleagues. Supervision, or the lack thereof due to the EWTD and revised working patterns, has been a much debated issue in this problem. Looking at this issue, and the feedback loop depicted in this area, it clearly shows how the reduction in hours of consultants and the continuing, and even increasing demands on service, impacts on the availability of consultants for junior doctor supervision. The amount of service consultants can provide to patients (be it in the form of clinics, operations, ward rounds, or other activities depending on the specialty) is directly related to the number of hours they work, and their productivity or efficiency. This naturally decreases the residual service (i.e. work that still needs to be done). The less outstanding work there is for consultants to complete, the more likely they are to take the time to spend supervising their junior doctors. This concept is an interesting one - the likelihood of a consultant providing quality supervision really has two factors. Firstly, they need to be available to put in the time. After talking to senior medical staff, it is clear that service to patients is the dominant priority, especially with the national governmental move towards a consultant-led service. However, as became apparent in the focus groups, even if consultants are able to supervise and teach their juniors, a second factor that has to be present is their willingness to do so. Individual attitudes and motivation vary from one doctor to the next – some being keener to train their juniors than others – so the individual's motivation has to be present too. When the consultant is willing and able to supervise and train their junior doctor, this contributes to an increase in the level of junior doctors' experience and knowledge. However, it is universally appreciated that performing a task while simultaneously engaged in training takes more time than simple completing the task. Some of the doctors have estimated that this could reduce their productivity by approximately 30%. Therefore, while supervision increases junior doctors' knowledge, it decreases consultant productivity, which negatively impacts the amount of service they can provide, and thus likelihood of future supervision. However, this supervision is also important, as it increases the junior doctor knowledge, which means they will become more skilled consultants in the long run, which increases long-term consultant productivity/ efficiency. This is clearly a case of two re-enforcing feedback loops, which are acting at odds to each other.

Similarly, on the junior doctor side, the number of hours they work impacts on the amount of service they can provide to patients. The more work they do, the less there is to be done, and the more time they have available to spend with consultants under supervision. This represents the classic tension between service provision and supervision. Depending on how much work there is to do (i.e. number of patients to be seen, forms to be filled, investigations to be chased) they then have the time to spend asking their consultants questions or observing procedures. Working more hours and performing more service means that junior doctors are also increasing their experience through the repetition of activities, which is essential to their level of experience and knowledge. This is one of the areas that is of most concern regarding the reduction in hours - it is feared the junior doctors are simply not getting the same amount of "practice" and are seeing fewer patients and performing fewer operations and procedures.

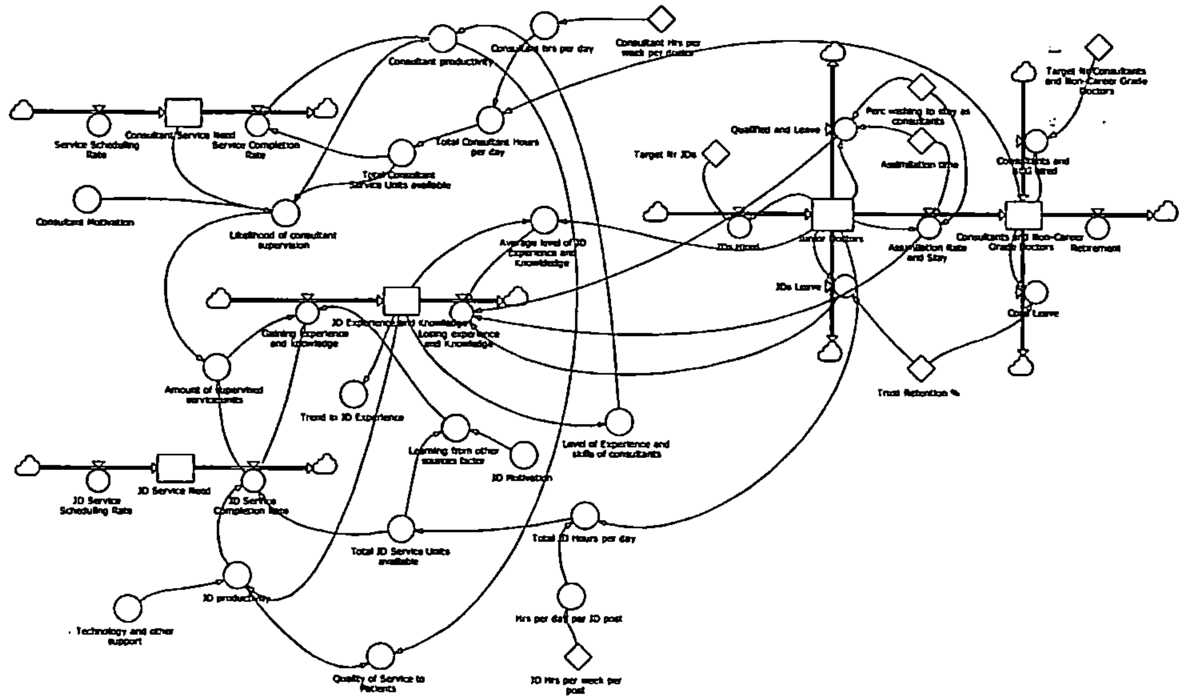
Similar to consultants, junior doctor productivity and efficiency must also be considered. The more efficient and productive junior doctors are the more service they can provide, which has the knock-on beneficial effects on their training, by making best use of their time. There are two things that are perceived to be influencing junior doctor productivity. At an operational level there have been a number of issues that are decreasing the efficiency. These include the ineffective method of communication with doctors via bleeps, which entails someone bleeping the doctor, the doctor having to find a phone and call back, often to find the line engaged, or the wrong doctor being contacted, often for inappropriate reasons. In preliminary investigations and data collection during job shadowing on this project, it was estimated that across the 24-hour day, up to 80% of bleep calls can be for reasons not requiring immediate medical attention of the junior doctor. However, with the current technology in use, it is not possible to differentiate between reasons, nor urgency of contact. Further, as shown in the time-use analysis referred to earlier, it was shown that approximately 20% of junior doctor time is spent on patient related administration and routine clinical tasks (such as ECGs or taking blood). These are tasks that do not require medical education and could easily be performed by a support role. Additional operational issues, such as waiting and chasing results, the number of switchboard staff, ineffective communication with support roles, and lack of support staff, all have surfaced regarding efficient junior doctor working. In the causal loop diagram, these have been summarised as "technology and other support", an increase in which would have a beneficial impact on junior doctor productivity and efficiency, which has positive impacts on junior doctor experience and knowledge. To close this loop, the more experienced and knowledgeable a junior doctor is, the more efficient he will be in providing service, as he will be able to perform procedures, take medical histories and diagnose quicker and more accurately, with less duplication of effort.

Another aspect of the acquisition of junior doctor experience and knowledge is the importance of learning from other sources. In particular, this relates to making the effort to attend teaching sessions, self-directed study and seizing opportunities to learn “on-the-shop floor” when they arise, as opposed to waiting for training to be “delivered”. Again, making the best use of opportunities and experiences to maximize learning and the knowledge to be gained from them is strongly dependent on the individual junior doctors’ attitudes and motivation and this varies hugely from one individual to the next. A change in culture and explicit definition of responsibility for education would be one way to increase the benefits of this.

One final aspect of the problem is the quality of service provided to patients. “Quality” has been poorly defined in the literature to date, and definitions vary from medical outcomes (Gottlieb, Parenti et al. 1991) to qualitative encounters of patient experience (McKee and Black, 1992; Jones et al, 1992). However, in this problem, it has arisen in relation to the impacts of reduced hours working, through the reduced level of junior doctor experience and knowledge, and consultant and junior doctors’ efficiency. The more efficient doctors are, the better the quality of service to patients, as they are not waiting around unnecessarily for tests to be administered, procedures to be carried out or waiting in clinics for appointments. Of course compounding this is the fact that the more experienced the doctors are the better quality of service to patients, not only by increasing efficiency, but also by the reduction in errors and better clinical decision-making.

Overall, there are many interrelated issues at hand in this problem, but the development of this CLD was very helpful in focussing attention on the key issued. Translating this into a stock-flow diagram has resulted in the current version of the insight model shown in Figure 34.

Figure 34 – The revised SD model based on the causal loop diagram



As can be seen, this SD model employs four stock-flow structures, with representation of doctors, consultant service, junior doctor service and junior doctor experience and knowledge, only the last of which is "artificial" in its concepts. The equations behind the model link the number of junior doctors and consultants to the amount of service, by the completion rate (i.e. the rate at which service units are completed: an approximation of productivity). The scheduling rate of consultant and service is set by hospital demand, which can be modified for future simulation runs. Crucial auxiliaries in this are also the number of hours worked, which translate into service units.

The Doctors

This part of the model depicts a fairly generic progression chain, showing stocks of junior doctors and consultants, who are either hired or leave the Trust, with target numbers of each that is determined by workforce planning groups and funding available. While in reality there are several grades of junior doctors, and it is tempting to reflect this in an ageing chain, it was decided for simplicity and the problems with complexity encountered with the earlier version of the model, to leave this as junior doctors and senior medical staff as the two separate groups. One major assumption that this model version makes is of a "conveyor belt" nature between junior doctors and consultants, in that all those junior doctors who qualify and wish to stay on as consultants do, instead of the competitive nature of interviewing for jobs displayed in reality. This is an acceptable assumption at this stage of the project, the reality of which can be incorporated later.

Consultant and Junior Doctor Service

Stocks of "service" with inflows and outflows named "scheduling rate" and "completion rate" represent the amount of service outstanding for consultants and juniors to partake in. At this stage, this is measured in service units, each unit of service representing 2.5 hours, as this is how consultants have had their contracts and work schedules outlined. Further development of the model could include the move to specify the exact activities outstanding such as clinics, operating list or patient admissions. The advantages of using service units as a reference unit are that they are translatable in to time, are familiar to senior medical staff and can be used as a basis for the creation of the "artificial" units of knowledge and experience for junior doctors. For both, completion rates are calculated as a product of total available service units (derived from number of doctors and hours that they work) and a productivity or efficiency factor, as described in the causal loop diagram. On the consultant side, the residual service need (i.e. the stock of service), along with consultant motivation factor, determines the likelihood of consultant supervision, which is used to calculate the number of supervised junior doctor service units. On the junior doctor side, completion rates are used to calculate supervised service units and contribute to the rate at which experience is gained.

JD Experience and Knowledge

This stock has an inflow, called "gaining experience and knowledge" which is influenced by the number of supervised units, completion rate of junior doctor service and a factor of learning from other sources, which in turn is influenced by junior doctor motivation. It is most applicable to use a factor for the learning from other sources, as the appreciation and effort doctors put into learning what they can from a situation and seizing opportunities applies to everything they do, rather than a set amount of units. In the steady state, the loss of Experience and Knowledge as doctors' progress through and out of the system should be replaced so that the level stays at the desired level.

At that time, these four sets of stocks had been identified, with additional concepts represented by auxiliaries or constants. There are two dummy variables, regarding consultant and junior doctor motivation, which it was decided are either present or not for the time being, but this can be transformed into a factor or scale if the need arises during the validation process.

The beauty of this model is that is shows the problem with all of its implications and its relatively concise set of interrelated variables, comprehensible to the problem stakeholders, while the stock-flow representation, specifying concrete relationships, provides an additional level of insight. The equations behind the model have been derived from information that was gathered in the work on the training/ service balance, used to inform the construction of this model, and thus it gives this work added stance. For example, the junior doctor productivity factor is currently 0.5, as earlier analyses indicated that only 50% of the 24 hour period that junior doctors are available for work are actually spent on junior doctor activities (and the rest was so called "dead time"). Of course, this can be changed if, junior doctor experience and knowledge is increased beyond the current levels, or technology and support mechanism are put into place to facilitate better time use.

While this version of the model now captured the ideas brought about by the more detailed research on the training/ service balance, and junior doctor time, it still did not feel to the problem owners as being entirely fit for purpose. There were still two issues that prevented the model from being agreed and accepted. First of all, the team wanted to be able to clearly identify the links between the granular details of junior doctor activities and the overall impacts (combining of micro and macro level) without making the model too complex, for them as non-experts in the systems dynamics technique, to understand. Secondly, 2005 saw the introduction of the first part of Modernising Medical Careers with the implementation of the F1 grade, to replace the old PRHO grade in August 2005, with the F2 level being implemented in August 2006. The team therefore felt that if the model were to be of much use beyond the immediate term, that the nomenclature of the new postgraduate medical education system should be adopted. It was also felt that there should be an introduction of element of more senior junior doctors supervising those at the start of training, to more realistically reflect reality.

Procedurally, this led to the calling of a focusing meeting, in which the purpose of the model was revisited, clarified and agreed on, from which amendments to the model could be made. The problem area is so complex and the purpose of the model (i.e. the questions that the project team wanted it to be able to answer) kept shifting, as developments in postgraduate medical education changed. Compared to the original research objectives, some of these decisions that they were making, while still related, were out of the realm of the model as it had been developed and more to do with workforce planning and delivery of teaching programmes, than the modelling of the reorganisation of the education and service activities and the impacts this is having.

Thus, a "focusing meeting" was called in September 2005. During the research and model building process, the problem owners had learnt much about the relationship between training and service for junior doctors under the reduced hours framework. To some extent, this had already aided their strategic decision making. However, in terms of purpose of the model (in the iterative process, unfortunately this kept shifting!) it was necessary to hone in on exactly what questions they wanted answering and areas they needed to explore.

It is during this meeting, that the project stakeholders identified the scenarios described in the training/service model chapter and agreed to the concept of a two-stage model, allowing them to see the connection between micro and macro level detail.

After this key "focusing meeting", there were several smaller meetings with individual and small groups of problem stakeholders, including wider presentation, in order to validate model structure and behaviour. However, by specifying exactly what scenarios were being considered for training and service under the EU Working Time Directive at PHNT, it was possible to identify potential areas of impact and start recommending solutions.

Observations on the modelling process

Once modelling began, it became evident that an ideal consulting-context development process that might comprise qualitative analysis, then simple insight model, then a fully detailed model (Lyneis, 1999) would not be appropriate. The first modelling efforts were actually focussed on representing the full detail of the progression or 'hard' elements of the system. This was desirable so that the medical members of the team, who were the direct owners of the problem, could appreciate how the training system would be captured, that it was a true reflection of actual processes rather than a regression-based representation, how the junior doctors would eventually progress to being full doctors - first as registrars then consultants, and finally how the consultant level interfaces back with the other grades through their training supervision roles. This is consistent with an observation by Winch (1990) that in large consulting projects, especially with a disparate client group, a sub-optimal modelling approach is often needed, and models may have to be over-engineered to gain buy-in from all. This model (or model sector) is now largely complete and does reflect both the progression of internal candidates as well as the recruitment of external doctors, including those at SHO level, to maintain staffing establishments. The modelling process has also helped the team better understand the interactions with tricky but important detail, like doctors who are technically qualified to proceed to higher grades, but who stay at lower levels either while awaiting internal or external vacancies, but also to reflect what is evident a growing trend of some doctors wanting to stay in more junior posts for lifestyle and/or personal reasons. In terms of gaining maximum output in terms of both training and service in a progressively constrained system, use of these mechanisms are likely to become more important in doctor resource management at the hospital.

The second modelling phase effectively reverted to the insight phase. By mutual agreement it was felt that rather than continue progressively add layers and layers of detail onto the progression sub-model, it would be preferable to first get a better appreciation of the interaction between the 'hard' part of the system (doctor progression) with the less tangible elements including experience, efficiency, quality, and junior doctors' tendency to seek self-directed learning opportunities. This involved integrating difficult concepts and drawing a simple CLD before attempting to create stock-flow structures was found the most effective route.

Finally, in order to overcome the challenge of capturing micro level detail within a strategic framework, the two-stage model was conceived. This was truly fit for purpose, which is what modelling is all about at the end of the day. This will aid operational decision making in addition to informing more strategic and longer-term concerns.

8.3 A Model of the System

At the risk of negating earlier critiques of researchers that isolate the model description from that of the process, having spent the earlier sections narrating how the final model was arrived at, it is worth exploring the model structure, to enable exploration and depiction of the identified relationships and characteristics of the concepts.

8.3.1 Description of the Model

To help put the model into the right context when describing its structure, and the identified relationships, it is worth reminding ourselves of the purpose of its construction.

Purpose of the model

The purpose of the model is to model the relative impacts at macro level that occur due to changes in the junior doctor system, identified as scenarios by the project stakeholder group. These scenarios are interpreted by identifying what the changes are at micro level (i.e. through the spreadsheet model), which works out a training and service factor. This factor is fed into the macro-level strategic systems dynamics model and simulated.

It is necessary to reiterate that in keeping with the ontology and epistemology of this research and the identified research questions that the purpose of the modelling is not precise prediction, or acting as a decision support system, but rather to understand the system – its structure and likely behaviour in order to aid strategic decision-making.

Model Structure and Assumed Relationships

The model begins on 01/01/05. The reason this time period is two-fold:

1. The majority of data for the purpose of the model was collected in the period July 2003 to December 2004. The model was to help with decisions that the Trust had to make facing the new cohort of doctors that would enter their training programme in August 2005. This coincided with the introduction of foundation training to replace the Pre-registration House Officer year and first year of the Senior House Officer Grade. The run through specialist training grade (labelled RTTG in the model) was implemented in August 2007.

2. This is the time period when the New Deal and EWTD time regulations are already in force. At this point, doctors should not be working more than 56 hours per week according to the New Deal and 58 hours per week according to the EWTD with appropriate rest breaks. As it is appreciated that until services are reconfigured and more efficient working practices are developed, as well as the trainees desires to work the maximum hours allowed in order to maximise the amount of training experiences they are exposed to, the hours worked by all trainees is 56 hours per week.

The overall SD model is depicted in stock-and-flow diagrams as in figure 35 below:

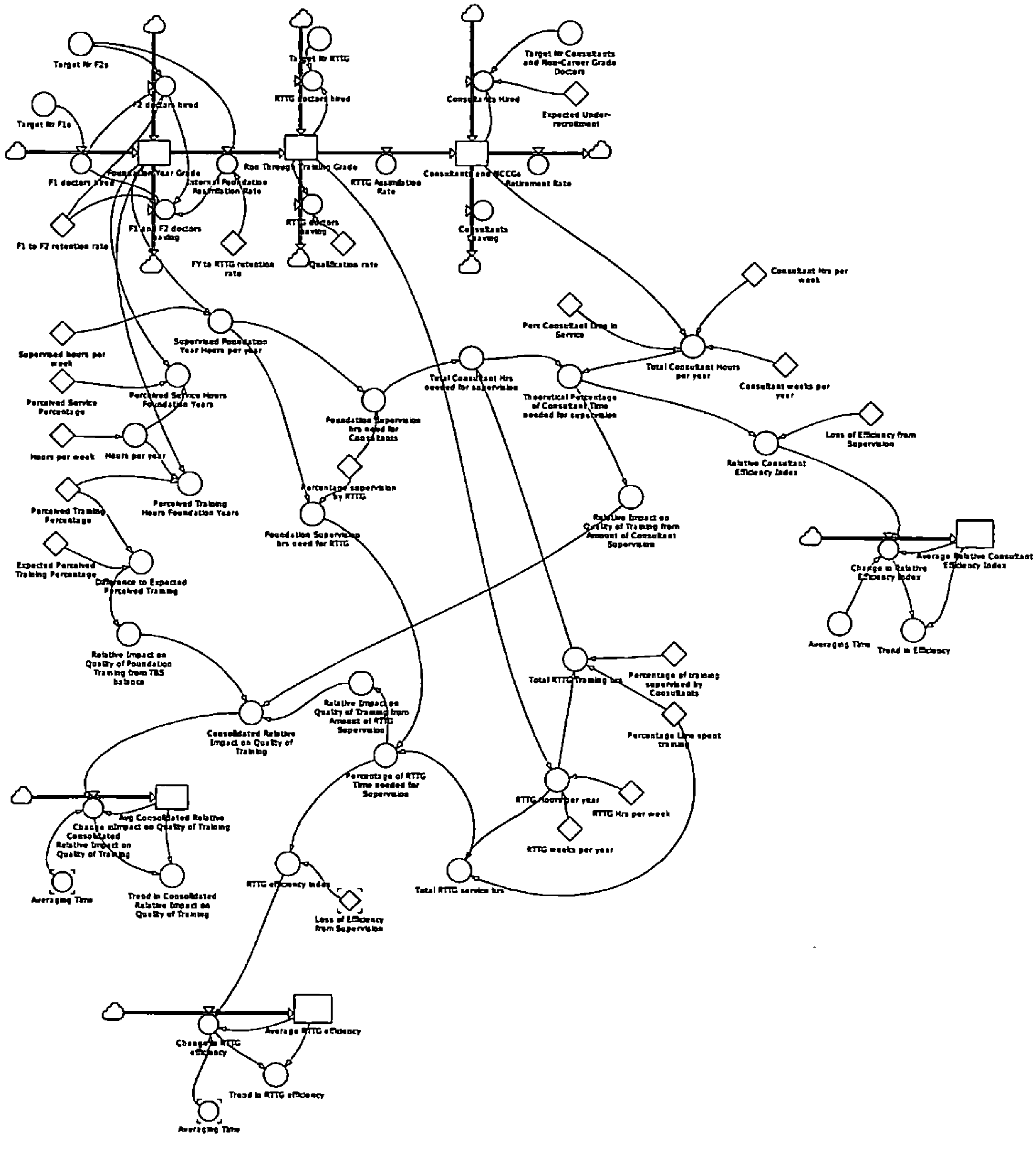


Figure 35 – The model of the system

The top part of the model represents the progression of junior doctors through the new system under MMC: from the foundation year grade to the run through training grade and then to the Consultant or Non-consultant career grade (NCCG). Figure 36 below shows this part of the model. This 'ageing chain' of cohorts of junior doctors is not surprisingly featured in earlier versions and iterations of the model, as it is the most easily identifiable part of the system to most stakeholders, as it represents "physical" stocks and flows of people through the system.

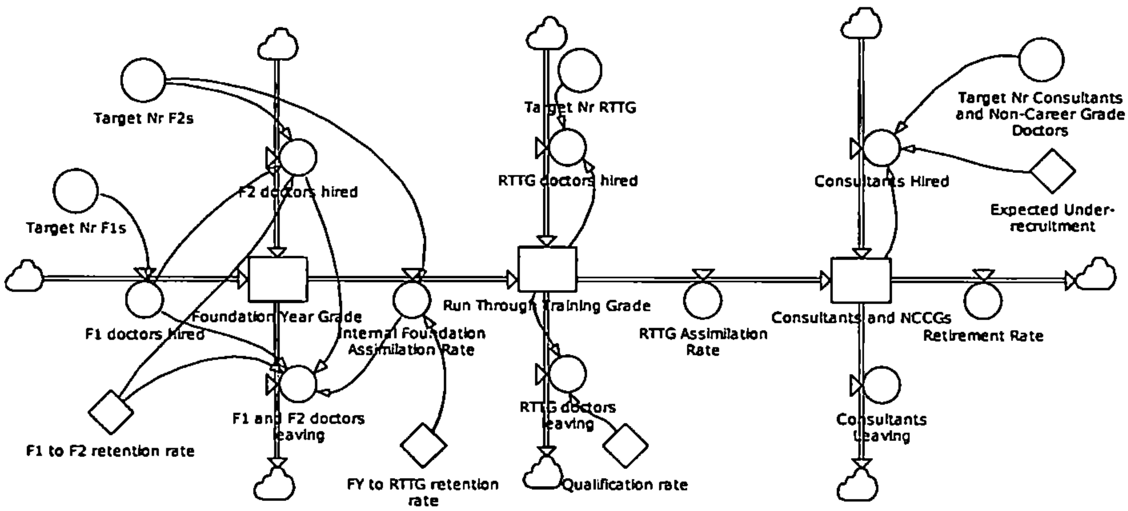


Figure 36 – The junior doctor progression section of the model

Target number of F1 doctors:

Due to the expanding number of medical students graduating in the next few years, the Trust has an agreement with the respective South West Peninsula and MOD Deaneries on the number of F1 (former PRHO) doctors it will take to train for full GMC registration. The expected number of doctors is known up until the August 2008. After 2008, there is reason to believe that this expansion is due to continue at an average rate of 6 doctors per year. Therefore, the target number of F1 doctors is a known 43, 49, 58, and 63 doctors for August 2005, 2006, 2007 and 2008 respectively and is projected at an increase of 6 doctors per year after that for the 9-year simulation period.

Nr F1 doctors hired:

The rate of F1 doctors hired is equal to the target number of F1 doctors per year. This is because at this level, vacancies are always filled. Even if there are exam failures in the expected 5th year medical students graduating from medical school, these vacancies are filled with locum appointments.

Target number of F2 doctors:

Implementation of the second year of foundation training does not happen until 2006 when the first cohort of F1 doctors moves on through the system. Therefore, the target number in 2005 is 0. In 2006, 69 F2 jobs have been created from former SHO posts. The year after that, this number is slightly reduced to 60, as more posts are needed to allow for the implementation of specialist training in 2007. Beyond this, it is assumed that F2 posts are expanded to accommodate the respective previous years' F1 doctors.

It must be noted that at the moment, it is assumed that the Trust can accommodate this expansion in the junior doctor workforce, induced by the expansion in the number of medical graduates, which the government had introduced at the end of the 20th Century to meet the growing demands of the NHS. Events in 2006 led to operational changes, such as ward and bed closures, which may actually see a reduction in the number of junior doctors required. If the trends change, it is relatively simple to relax the projected workforce numbers in the model.

Nr F2 doctors hired:

The rate of F2 doctors hired is equal to the target number of F2 doctors per year. This is because at this level, vacancies are always filled. As the service requirements, in particular ward work and junior doctor rotas, rely heavily on this grade and there is always an abundance of applicants, it can be assumed that there is no permanent under-recruitment.

The number of F2s hired is determined by the target number of F2s per year, minus the number of F1s retained (i.e. those that stay on for their F2 year).

Subsequently the equation in the model is as follows:

('Target Nr F2s'/1<<yr>>)-('F1 doctors hired' x 'F1 to F2 retention rate')

Foundation Year Grade

This stock in the model represents the number of foundation doctors (F1 and F2) in the hospital at any one time. Although in practice the doctors move in cohorts annually, this stock is calculated more frequently, as dictated by the time step. The inflows to the Foundation Year Grade consist of the number of F1 and F2 doctors hired. The outflows are the number of F1 and F2 doctors that leave the trust and the number of F2 doctors that stay on at the Trust for their run-through specialist training.

F1 and F2 doctors leaving

The number of F1 and F2 doctors leaving the Trust is calculated by:

('F1 doctors hired' x (1-'F1 to F2 retention rate'))+('F2 doctors hired'-'Internal Foundation Assimilation Rate')

This means that the number of foundation doctors leaving the Trust are those that are hired at F1 level and do not stay for their F2 year as well as those F2 doctors that do not proceed on to their specialist training at the Trust.

F1 to F2 retention rate

Based on experience at the Trust, the postgraduate education team have estimated that approximately 30% of F1 doctors will choose to stay at the Trust to complete their F2 year. A small number of F1 doctors (5 doctors in 2005 and 7 doctors in 2006) are required to stay in Plymouth for their F2 year, as they are MOD doctors. The MOD Deanery have made it mandatory for their trainees to complete the entire foundation programme (F1 and F2) in one Trust. This fact has been factored into the estimated retention rate.

Additionally, this retention rate is likely to increase. August 2007 will see the PMS output its first students to the F1 year in Trusts in the Peninsula. Initial observations by the medical school have indicated that these students will already have commitments and lifestyle choices mean that they are likely to wish to stay in the Peninsula for at least their first two years of postgraduate medical education. Until evidence of this becomes more concrete, a 30% retention rate will be assumed for the foreseeable future. It is relatively simple to revise this estimate, should this become necessary.

Internal Foundation Assimilation Rate

This variable represents the number of foundation trainees that choose to stay on at the Trust to complete their specialist training. It is calculated by:

('Target Nr F2s'/1<<yr>>) x 'FY to RTTG retention rate'

In effect, this calculates the number of F2 doctors that flow out from the foundation grade into the run through training grade, as governed by the foundation to run through training grade retention rate.

FY to RTTG retention rate

The factors that influence this retention rate are largely the reputation of the Trust as an education provider, attraction of the geographical location, and pre-existing commitments (e.g. house purchases, family commitments) in the area. As with the F1 to F2 retention rate, these are likely to change as junior doctors are increasingly making lifestyle choices earlier on and making work-life balance issues a higher priority and the output of PMS students in the area, of which in particular the first cohort is of a more mature nature with existing commitments in the area.

However, it is assumed that based on past experience, this figure is as high as 60%. Again, this is an assumption that is fairly easy to relax and change, and indeed its sensitivity is worth investigating to see if it has large impacts on the system and if it does, to see what contributes to this retention rate and whether more effort should be put into increasing the retention rate at the Trust.

On a more general note, one would like to believe that the quality of training at the Trust would have an impact on the retention rates between grades of doctor, as the Trust would become more attractive as an employer. While the model does include quality of training, this is in the form of a relative impact on quality of training due to supervision, rather than a measure of quality itself (if such a thing is quantifiable in its entirety). Therefore, while there may be some links, it is not appropriate to link the relative impact on quality of training to any of the retention rates.

Run Through Training Grade

This stock in the model represents the number of run through training grade (equivalent to the old SpR grade) in the hospital at any one time. Although in practice the doctors move in cohorts annually, this stock is calculated more frequently, as dictated by the time step. The inflows to the Run Through Training Grade (RTTG) consist of the Foundation doctors assimilating to the grade and staying at the trust, and the number of RTTG hired from outside. The outflows are the number RTTG that leave the trust and the number of RTTG that stay on and are successful in being hired as consultants.

RTTG doctors hired

The rate of RTTG doctors hired is equal to the target number of RTTG doctors per year. This is because at this level, vacancies are always filled. Similar to the foundation year grade, as the service requirements, in particular ward work and junior doctor rotas, rely heavily on this grade and there is always an abundance of applicants, it can be assumed that there is no permanent under-recruitment.

The number of RTTG hired is determined by the target number of RTTG per year and the current stock of RTTG. This target starts at 327 and increases by between 3 – 7 doctors per year, depending on the predictions by the project stakeholders. It was assumed that there is likely to be an increase in the RTTG grade to accommodate the growing number of junior doctors coming through the system and the increased service needs.

RTTG doctors leaving

Once hired to a run-through programme, trainees are committed to complete this. In only very rare circumstances would a RTTG trainee leave the Trust, unless they were allowed an inter-deanery transfer to another location (only in exceptional circumstances) or they left medicine altogether (a hopefully even rarer circumstance). Thus it is assumed only those that have completed their training programme and qualify will leave the Trust's RTTG grade. As the average length of the RTTG programmes are 5 years, and they are designed to have an equal number of trainees in each grade, the RTTG qualification rate that leaves the trust is assumed at 20%.

RTTG Assimilation rate

Based on historical data and experience at the Trust, it is assumed that approximately 2 doctors per year will be hired to become consultants or non-consultant career grade doctors at the Trust (i.e. associate specialists or staff grades). At this stage, it was felt that there was no reason for this to be any different in the foreseeable future.

Consultants and NCCGS

This stock in the model represents the number of consultants and non-consultant career grades (i.e. associate specialists and staff grade doctors) in the hospital at any one time. The inflows to the Consultant and NCCGs consist of the number of RTTG grade doctors that are hired to that grade and the number of consultants hired. The outflows are the number of consultants and NCCGs that retire, or that leave the Trust to seek employment elsewhere.

Consultants Hired

The number of consultants hired each year is dictated by the target number as compared to the current stock and the expected under-recruitment. Historically, at any one point in time there are approximately 5 consultant and NCCG vacancies. There are a number of reasons for this beyond the remit of this research, but this needs to be included. Additionally, the target number is set to increase by approximately 6-8 doctors per year. The trust has seen a huge consultant expansion in recent years to just under 300 consultants, and while the rate of growth in the target has slowed, it is still expected to steadily increase as the NHS moves to a consultant delivered service and the service requirements increase. What is not yet established is what the balance between consultants (i.e. those on the specialist register) and associate specialists and staff grade doctors in the entire grade of senior medical staff will be.

Consultants Leaving

Based on limited historical data held by medical staffing and experience of Trust management, generally 15 consultants and NCCGs leave the Trust to take up employment elsewhere. While this may seem a lot, it represents a 5% turnover in the grade.

Retirement Rate

Based on historical data, approximately 5 doctors per year retire from medicine altogether. While this will largely depend on the age make-up of the consultant and NCCG grade, it is not anticipated that this figure will change too much from the estimate.

Supervision Needs

In keeping with the causal loop diagram of the system that was developed, this progression of stocks and flows of the "physical" part of the systems model is tied to a number of other areas which are explained below.

Below is the part of the model that calculates the supervision needs of the foundation grade doctors.

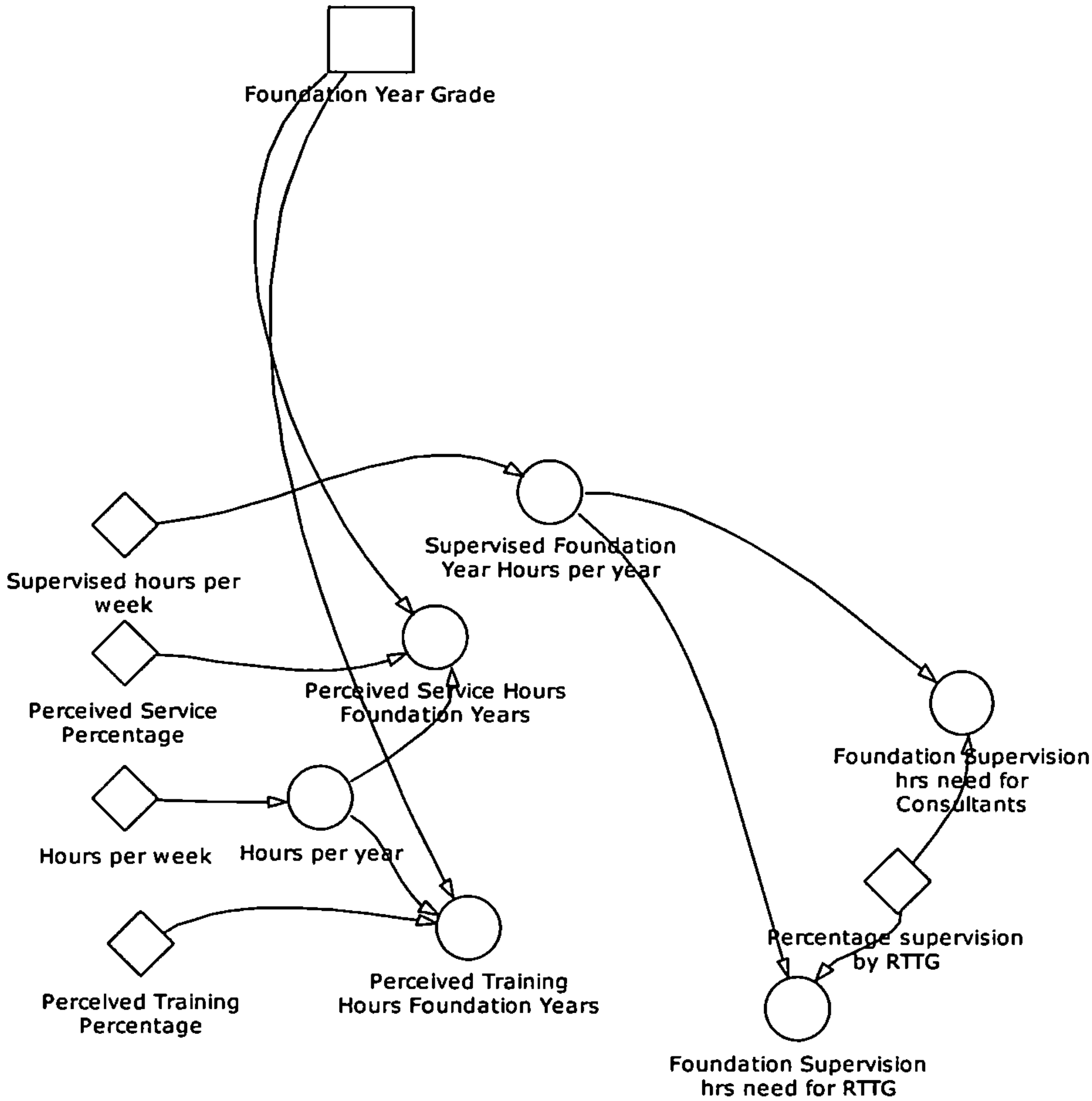


Figure 37 – Supervision needs section of the model for foundation doctors

This is where the information feed occurs in this two-stage model from the micro-level spreadsheet model. The output of the spreadsheet model is 3 key figures: the amount of supervised hours per week from the scenario to be modelled, the perceived service percentage and the perceived training percentage. Additionally, the number of hours per week that junior doctors are allowed to work per week (currently 56 hours per week under the New Deal and EWTD) is needed.

The number of hours of work per year is calculated by multiplying the number of hours per week by 43 weeks in the year. This is because junior doctors are entitled to study leave and annual leave, which reduce the actual number of working weeks in a year to 43.

The perceived total hours of service and training for foundation doctors are calculated, as well as the total number of supervised hours per year required for the foundation doctors. This represents the supervision requirement of the foundation years doctors.

Now, it is appreciated that not all supervision for doctors in the foundation grade doctors comes from consultants. In fact, in practice, it is estimated that approximately 70% of supervision for the F1 and F2 doctors is provided by more senior junior doctors (i.e. those in run through specialist training). Thus, the supervision need is calculated for consultants and for the RTTG doctors on this basis.

Having established the supervision demand on consultants in the scenario for foundation doctors, the model also takes into consideration the supervision needs of the RTTG doctors, which is solely provided by the consultants and NCCGs.

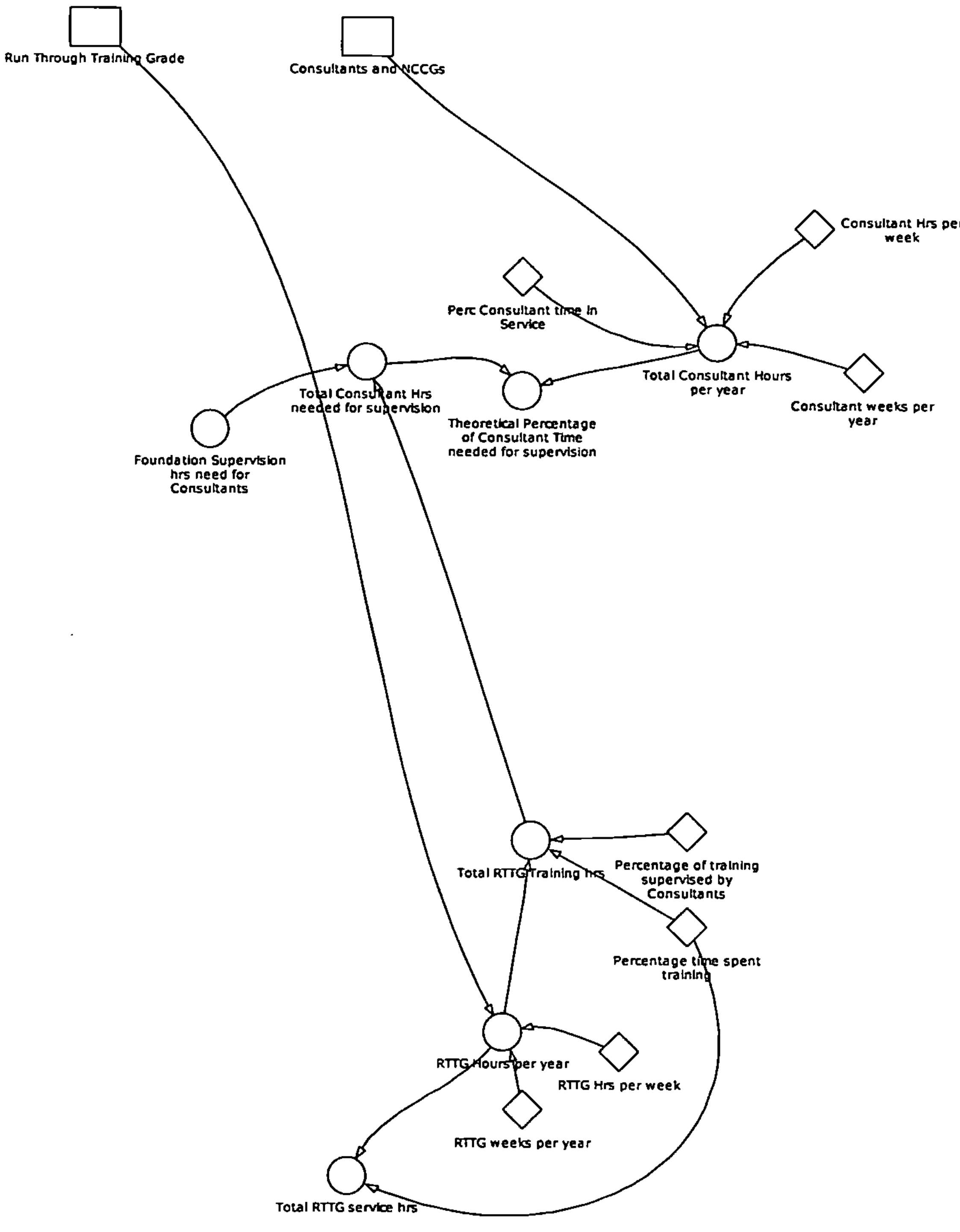


Figure 38 – Supervision needs section of the model for RTTG doctors

The RTTG doctors all work 56 hours per week too for 43 weeks per year. This, combined with how many there are, calculates the total number of RTTG hours of work per year. The total RTTG training hours represents how many of their hours need to be supervised by consultants. This is derived from the amount of time spent "in training", which is currently assumed at 50% and the amount of that time that is supervised by consultants, which is also assumed at 50%. Unfortunately, the micro level analysis that was conducted for the lower level of junior doctor, was not done for this level and so the assumptions are having to be made about proportions of time for this grade. These assumptions are based on both the curriculum and operational framework for the grade and experience of the project stakeholders.

Taking the total RTTG training hours and the foundation doctors supervision need for consultants together, yields a total supervision need for consultants. When compared to the total number of consultant hours available (which is calculated using the number of consultants, their total hours and percentage of time in service, which is currently assumed to be 100%, although there would be arguments for their learning needs on the job too), this gives a percentage of consultant time needed for supervision. At the start of the simulation with the baseline scenario, this is approximately 30%.

Consultant Efficiency

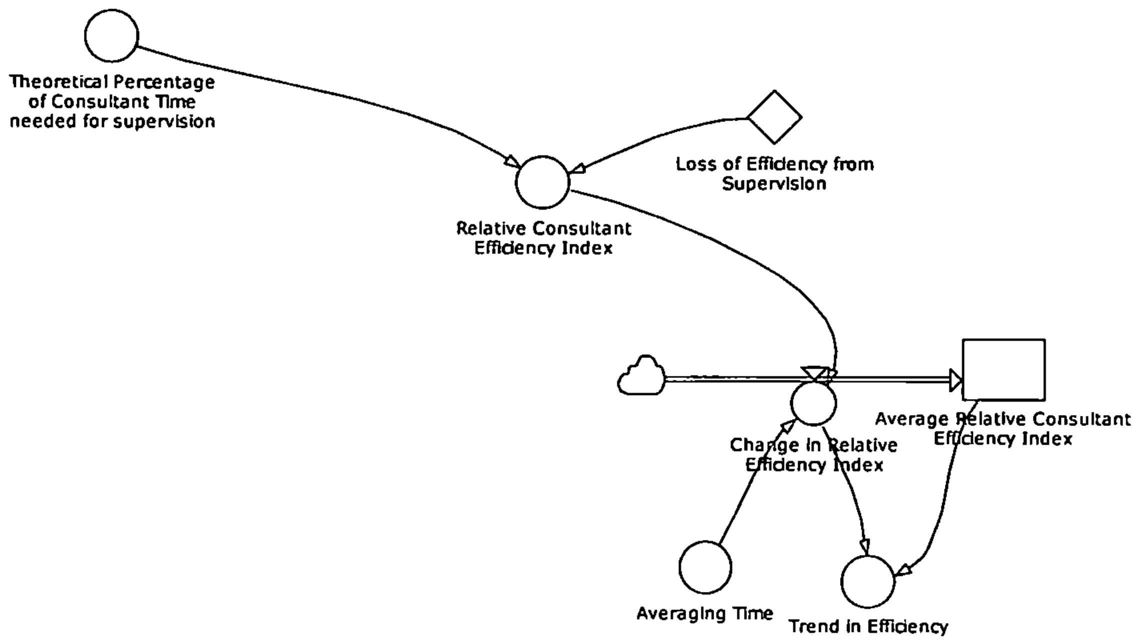


Figure 39 – Consultant efficiency section of the model

As one of the concerns of Trust has been what the impact of all these changes will be on consultants' ability to provide service, this is incorporated by a relative consultant efficiency index. It is widely recognised in the profession that conducting a procedure or operation while supervising a junior doctor means that it takes approximately 30% longer (based on the amount of cases that are scheduled on designated "training" operating lists compared to ones focused on service). This is represented as the loss of efficiency from supervision. This, combined with the theoretical percentage of consultant time needed for supervision, is used to calculate a relative consultant efficiency index. It should be noted that this is a relative index and is used for comparison, and does not mean that a figure of say 0.8 means that the consultants are 80% efficient. Using a standard averaging technique in system dynamics with rates and constants, an average relative consultant efficiency index is calculated.

RTTG Efficiency

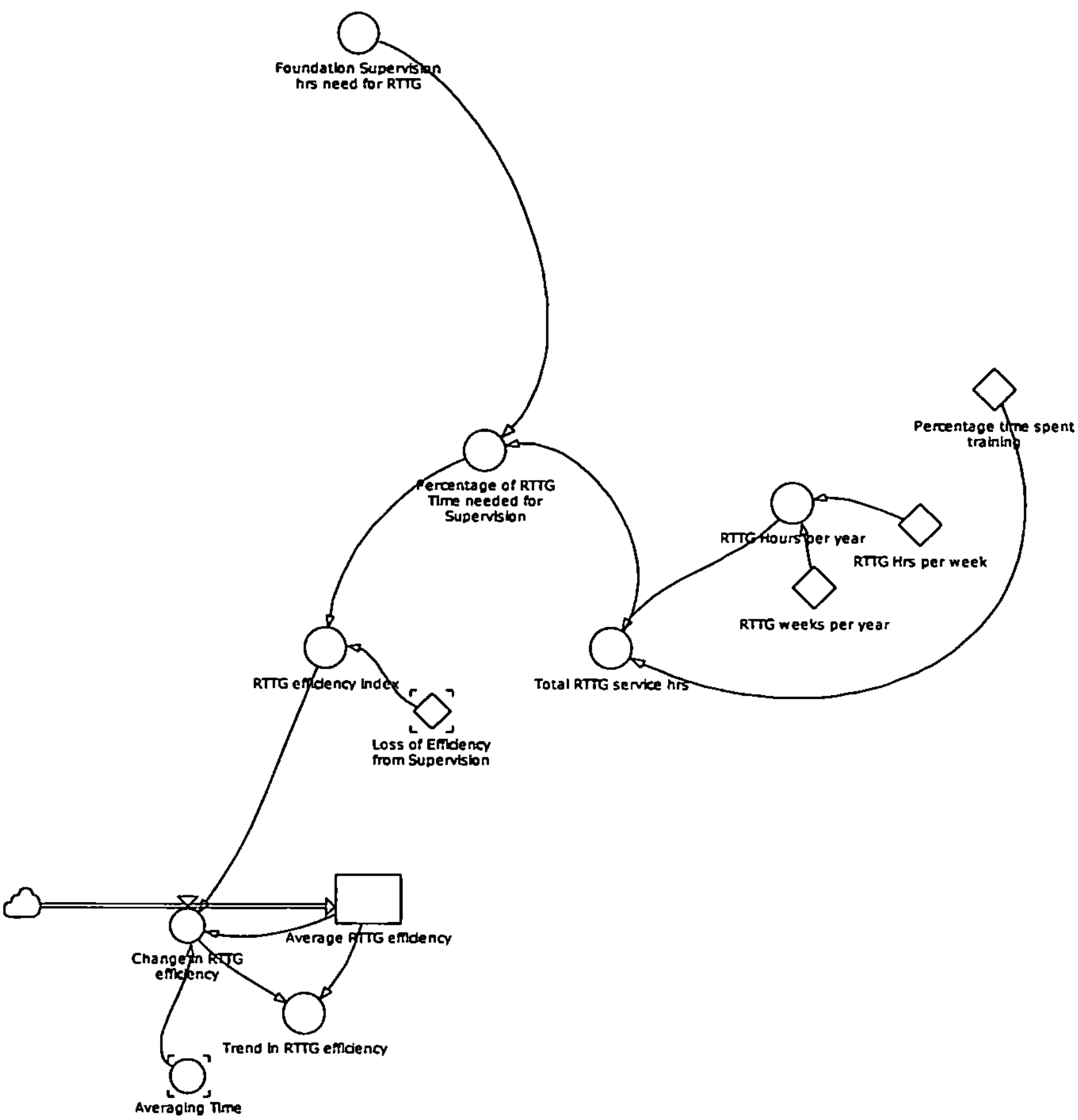


Figure 40 – RTTG efficiency section of the model

Similarly to the consultant grade, the RTTG grade will experience an impact on their efficiency in being able to do the job and provide a service to their patients, while supervising the foundation years doctors. Again, a relative RTTG efficiency index was created, which would be impacted in the same way (i.e. 30% loss of efficiency from supervision) depending on the percentage of their time needed for supervision.

Impact on Quality of Training

It must be said at this stage that in no way is this model attempting to define the quality of training, as this would be a separate piece of research altogether. However, the relative impact on the quality of training for foundation doctors due to hours and service and relationships with more senior doctors is portrayed by contrasting the scenario with the expected norm.

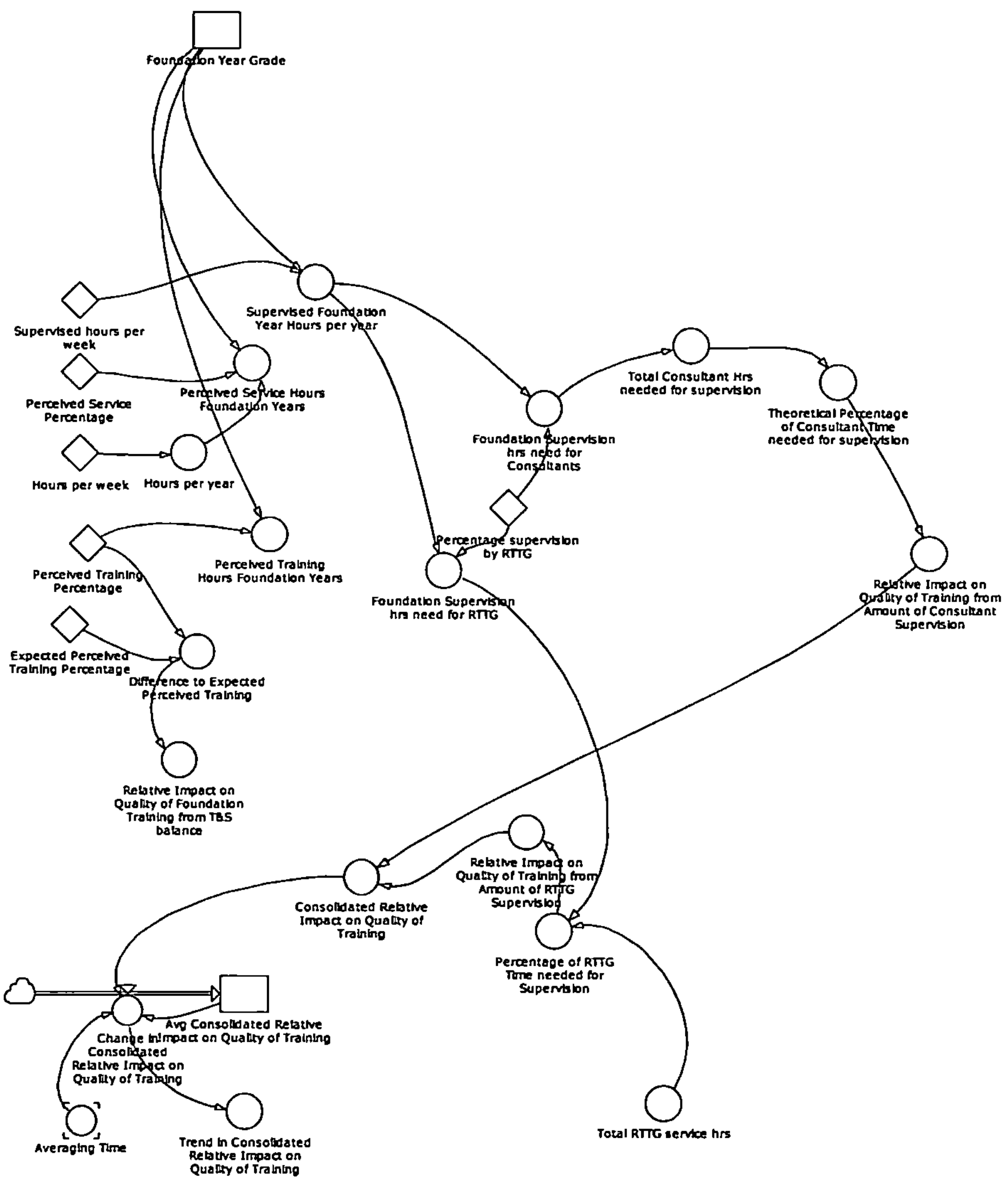


Figure 41 – Quality of Training section of the model

The crucial assumption in this part of the model is the relationship between the percentage time of consultant supervision and the relative impact on the quality of training from the amount of consultant supervision. In general, foundation doctors see supervision as the major factor in their perception of the quality of their training. Whether this is true or not is another debate, but it does influence the perceived quality of training. When foundation doctors see little consultant presence during their working day, they do not perceive to have received much or high quality training. (As identified during the earlier work in the focus groups). Also, it was identified by consultants that the more trainees (and therefore total hours) they are expected to supervise, the lower the quality their supervision is that they can provide to meet the demand, as they can't devote as much attention to quality as they otherwise could.

Much work as gone into getting the problem stakeholders to identify what this relationship looks like, and although it was quickly appreciated that this was a negatively correlated one, they identified after some thought that it is actually a S-shaped curve.

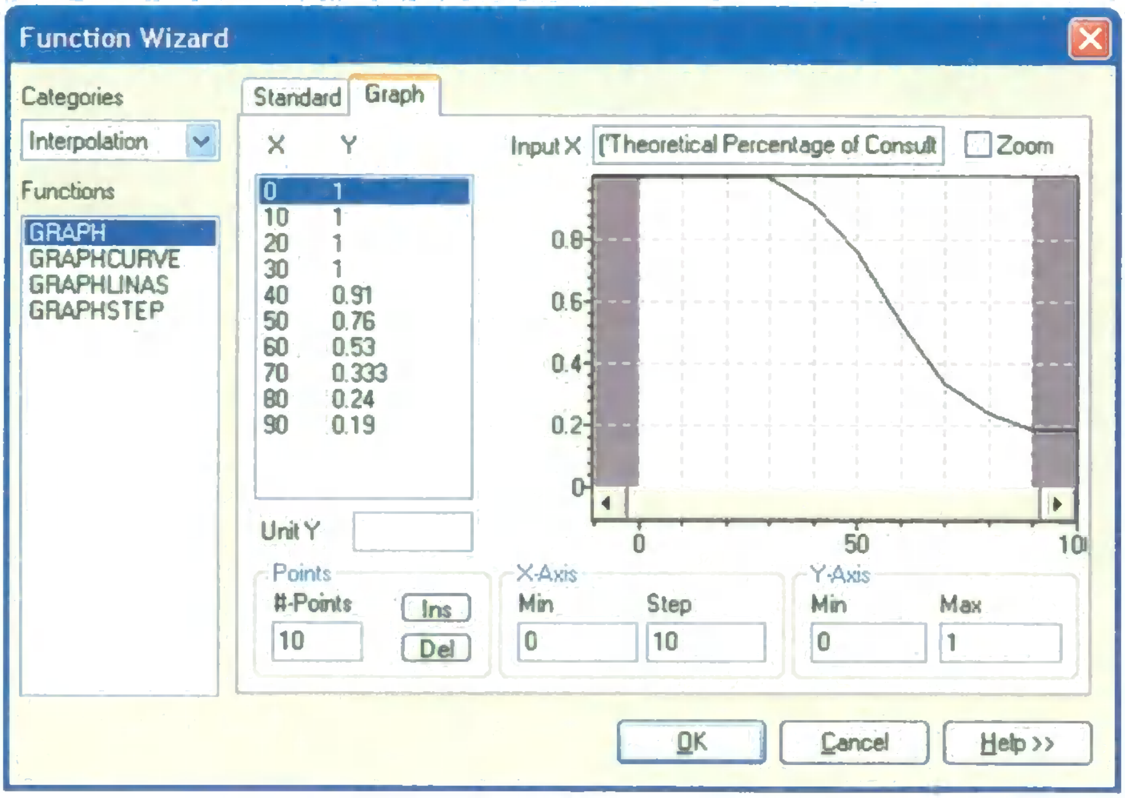


Figure 42 The assumed relationship between the theoretical percentage of consultant time needed for supervision (X-axis) and the relative impact this has on the perceived quality of training from the amount of consultant supervision (Y axis)

Similarly, this same impact is felt from supervision from the RTTG grade.

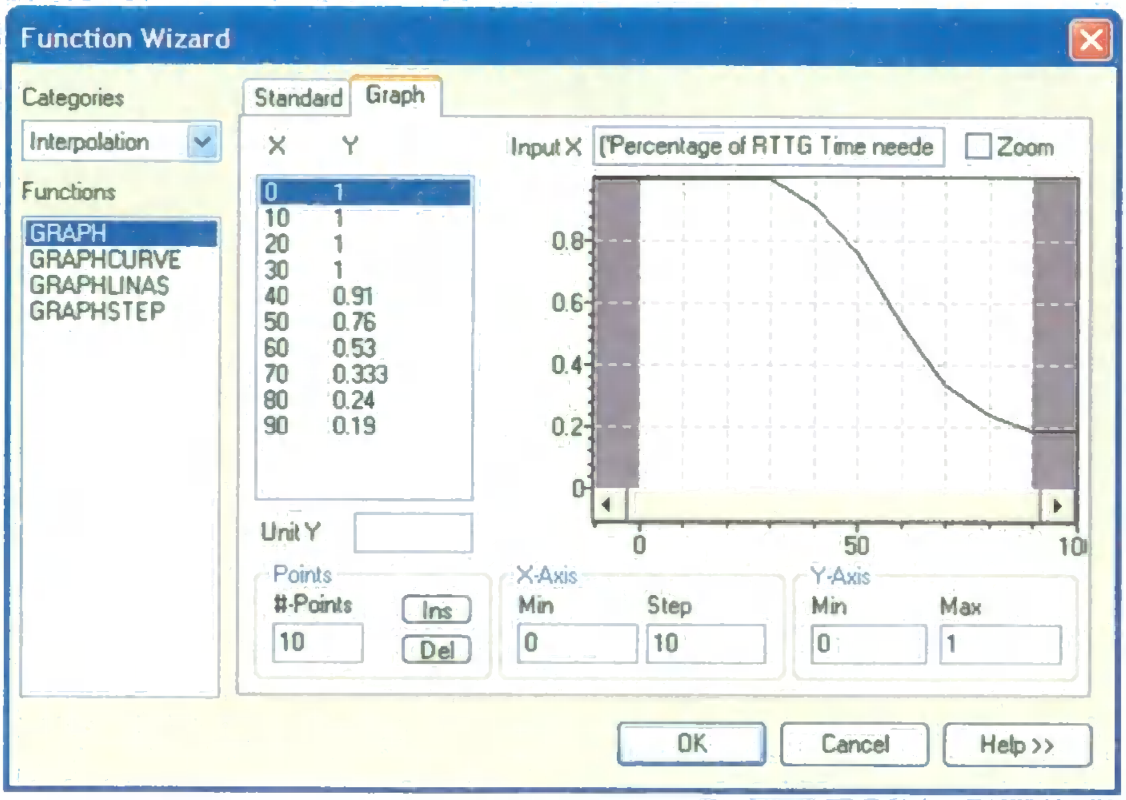


Figure 43 The assumed relationship between the theoretical percentage of RTTG time needed for supervision (X-axis) and the relative impact this has on the perceived quality of training from the amount of RTTG supervision (Y axis)

Thus, the higher the percentage of consultant and RTTG time that would theoretically be needed to provide the supervision, the greater the relative impact on the quality of training that they can provide for each unit of supervision, in order to get it all done.

There is a further relative impact on the quality of training identified in this model and this comes from the difference between the expected training/ service balance and the actual. Foundation doctors expect their time to be split 50/50 between training and service, as this is what they are informed their role is and is also the basis of their funding arrangements (i.e. 50% trust funded, 50% deanery funded).

However, the scenario may calculate a different perceived training balance. Any difference would have an impact (either positive or negative) on the relative perceived quality of training.

This is captured in the model by calculating a difference between actual and expected perceived training balance. The relationship between this difference and the relative impact on the quality of foundation training is shown in the curve below.

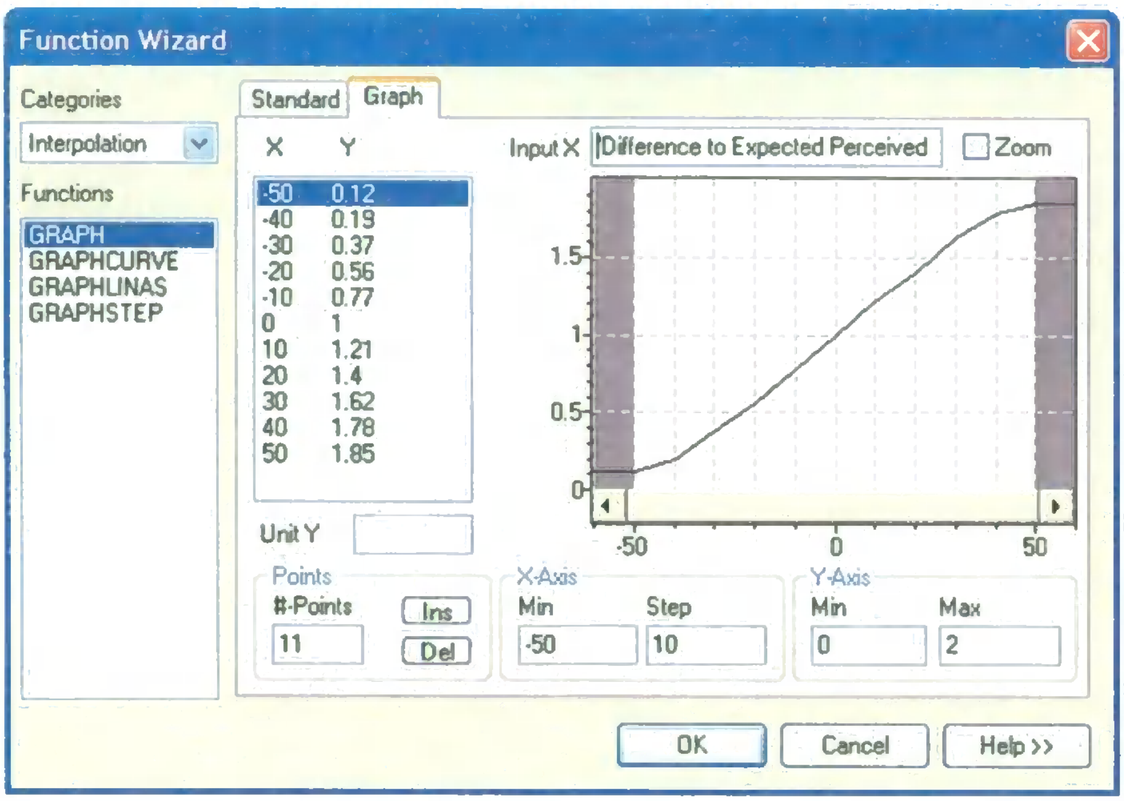


Figure 44 showing the assumed relationship between the difference to expected perceived percentage of training (x axis) and the relative impact this has on the perceived quality of foundation training from this training/ service balance. The more the training percentage is over and above expectation, the higher the relative impact on the perceived quality of training.

So there are three areas in which a relative impact on the quality of training have been identified and calculated.

These are consolidated by addition. Each relative index has a theoretical base of 1, meaning anything less than 1 shows a decline and anything more than 1 an improvement. When adding all three factors, this base is 3. Anything less than 3 in the consolidated relative impact shows a negative relative impact on the quality of training.

As with the efficiency indices, this is averaged out and represented in a stock to show the relative impact on quality of training.

8.4 Model Validity

Validity of results is an important concept in research, and model building in particular, as models are a representation of reality as perceived by its actors. It is therefore important to examine this issue in more detail.

In order to discuss the validity of the model that has been developed, it is worth putting some thought into what validation actually is and what it means. Why do we need to do it and how?

Model validation is inextricably linked to model purpose – so it is very important to be very clear about the model's purpose. What validation is NOT, is testing to prove the model is "right". But rather, validation is done to see if the model is fit for purpose. In light of this, it is worth once again revisiting and re-emphasising the purpose of the model itself and the process of building it. This research explores the meaning of the concepts of training and service for a professional group (i.e. junior doctors) within finite resources (i.e. time restrictions imposed by the EWTD), and further identifies the relationship between the two concepts at an operational day-to-day micro level within the tasks that they perform and also at strategic/ systems level (macro level). In pursuing the building of a model of the system, it is sought to further explore and establish the relationships in the system and the link between the perceived balance between training and service.

In particular, the purpose of building the systems dynamics model was to show how the concepts of training and service for this professional group under study are linked at a macro level to the other elements in the system, in particular the other staff groups and the wider issues around productivity, as identified when the problem was "scoped".

The concepts and relationship of training and service in the activities were explored at micro-level, in the activities that junior doctors participated in, as this was the way in which the problem stakeholders were most easily able to relate to the concepts.

However, in order to "zoom out" and show the relationship between the two at a systems level, linked to the other concepts, it was felt from the initial scoping that a model of the entire system was needed, that captured the complex relationships.

To link the granular detail in the individual's perception of the relationship between training and service at micro level to the bigger picture at macro level, it was decided that one would act as an information feed to the other.

Given that this is the context and purpose for which the model was built, how is it most appropriate to validate it? In order to address this question, it is worth make the effort to clarify what we mean with validation in model building.

Strictly speaking, it is impossible to validate or verify any model, because by definition a model is a limited, simplified representation of the real world (Sterman, 2000). In fact, according to Shrekengost (1985), there are no fully valid models, because all models are something less than the object, or system, being modelled. Sterman (2000: 846) quotes Forrester (1961):

'Any "objective" model-validation procedure rests eventually at some lower level on a judgement or faith that either the procedure or its goals are acceptable without objective proof.'

So actually, in a practical sense we are actually concerned with model usefulness rather than validity. Does the model serve the purpose for which it was intended and is it helpful? (Shrekengost, 1985:1) This is why it is so important to keep the purpose of the model in mind and why it was necessary to re-iterate it at the start of this section.

As such, validation is really a social process, as much as modelling is, and as such validation isn't something that should be done at the end of the model-building process, but rather as part of it. This was the approach taken to validation in this research, which is why there were relatively many iterations in the model-building process, and the time was taken to describe at length the process, including the steps that were seemingly taken "backward". The goal in the model building and validation process was always to build a representation of the system that was fit for purpose.

Having explained this, the systems dynamics literature does list types of "tests" that can be done. These include (Sterman, 2000: 859-861):

1. Boundary Adequacy – Are the important concepts for addressing the problem included in the model?
2. Structure Assessment – Is the model structure consistent with relevant descriptive knowledge of the system? Is the level of aggregation appropriate?
3. Dimensional consistency – Is each equation dimensionally consistent without the use of parameters having no real world meaning?
4. Parameter assessment – Are the parameter values consistent with relevant descriptive and numerical knowledge of the system? Do all parameters have real world counterparts?
5. Extreme conditions
6. Integration error
7. Behaviour reproduction
8. Behaviour anomaly
9. Family member – can the model generate behaviour observed in other instances of the same system?
10. Surprise behaviour – does the model generate previously unobserved or unrecognised behaviour?
11. Sensitivity analysis
12. System improvement – did the modelling process help change the system for the better?

Some of these tests are geared more towards highly quantitative models than others. A number of these tests were performed at various times throughout the modelling process, as deemed appropriate. These were done mainly in conjunction with the problem stakeholders, in assessing structure and parameters, as well as behaviour.

However, this is where it is necessary to re-address the matter of the nature of the model. The mathematical validation and sensitivity tests described by Sterman, amongst others, are particularly geared towards those models that are solution oriented, rather than those for which learning about the problem is the main aim. In this research, where it is the process of building the model that allowed the researcher and the problem owners and stakeholders to learn about the problem, the concepts of training and service and how they are related at both operational and strategic level, conducting statistical validity and validation tests seems somewhat inappropriate.

The main question around model validity lies in the feedback in the system. It will have been noted by the reader that although system dynamics is applied to problems where inherently there is feedback of some sort, and indeed this was identified in the causal loop diagram, the model that was eventually agreed on as a representation of the system seemingly lacks this key feature.

The feedback that is missing in the system dynamics model lies in the link between the relative impact on the quality of training and the delayed effect this would have on future efficiency, depending on the retention rate of the junior doctors as they progressed through the system. Similarly, the effects of the quality of training on the retention rate are not captured.

There are a number of points to comment on here. Not capturing the feedback identified in the qualitative model (i.e. the causal loop diagram) in the quantitative system dynamics model is not a problem. Firstly, and fore mostly, this is because the resultant model is fit for purpose. The causal loop diagram captured all the feedback and this was important because it allowed the problem owners to gain an understanding and learn about the system they operated in.

The two-stage quantitative model that was developed from this was fit for purpose in that it allowed the creation of a link between micro-level operational daily activity, which the problem owners witnessed daily and could influence, to the strategic impacts which they felt they were observing as trends over years. This is the key to this model. This is what it is designed to do and what it does. Adding complexity to the quantitative model at this stage would not make it any more fit for purpose and should be left for future further development and research.

It was also valid to use the SHO activity analysis as the information feed for a model which uses the nomenclature of the new junior doctor grades under MMC. Fundamentally, the role of these junior doctors hasn't changed at an operational level. The foundation year doctors and RTTG will have more structure in their assessments and career progression with pre-determined curricula and competencies, but at micro level they still perform the same roles within the clinical team and the hospital as a whole.

According to Forrester (1968):

"There is nothing in either the physical or social sciences about which we have perfect information. We can never prove that any model is an exact representation of 'reality'. Conversely, among those things of which we are aware, there is nothing of which we know absolutely nothing. So we always deal with information which is of intermediate quality – it is better than nothing and short of perfection. Models are then to be judged, not on an absolute scale that condemns them for failure to be perfect, but on a relative scale that approves them if they succeed in clarifying our knowledge and our insights into systems."

This is a very good way of looking at answering the "why build a model of the system" question – currently the stakeholders have mental models of the "training versus service" problem, which are shaped by their views of the world, their internal assumptions, their interpretations of observations, which are based on their personal experiences (which is in line with the phenomenological paradigm and in principle the epistemology of this research). This is leading to biased and tunnel-visioned decision-making. However, to seek clarity about the concepts in the system and how they are related and to thus enrich our understanding of the situation and what can be learnt from this and how this can improve decision-making and contribute to knowledge as a whole, we need to build a shared model of the system, which seeks to take these concepts and identify their relationships. Of course, it may not be a perfect replication of the real life system (and in keeping with the epistemology of this research, one could argue that there is no such thing), but the criteria on which basis the usefulness of this model will be judged is not if it perfectly replicates the real-life system, nor whether it 'passes' standardised quantitative tests, but rather if it clarifies our knowledge and understanding of the system and enables to stakeholders to build a richer picture of the decision-making arena in which they operate.

Overall, this research approach therefore agrees with Meadows (1980: 36):

"The system dynamics handles the problem of model validity qualitatively and informally. There is no precise, quantitative index to summarize the validity of a systems dynamics model. In fact, system dynamicists do not usually use the term validity. Reference is made to model utility. Is the model sufficiently representative of the real system to answer the question it is designed to answer?"

This model, in particular its unique two-stage model, is fit for purpose. Much care was taken in the design and execution of the model building process and the research design as a whole to ensure that the research was answering the research questions and modelling the junior doctor educational and service activities under the EWTD as perceived by the problem stakeholders.

Given the approach adopted as outlined in the model building process, and the above position on what model validity is and means in this context, it is not surprising that the model validation process adopted in this research was one of iterative consultation with the model stakeholders and owners to ensure that the model was fit for purpose, met the objectives it was set out and that the relationships assumed and reflected in the model structure and the equations supporting it, matched the understanding of the system as held by its decision-makers or "actors". This was done by both individual consultation and in meetings and workshops, and by discussing the results of the scenarios, both throughout the model-building process and at the point at which it was decided that the model was valid enough for the purpose.

How is it known that the model was valid and useful enough to have served a purpose and had an impact on the Trust? Since January 2006, when the researcher left the research project, development of the detail on the model has made limited progress. However, an important legacy was left. In building of the model and evaluating the scenarios, it became clear that the only way that the some of the negative impacts that the changes around the EWTD and MMC were brining about, could only be mitigated against if training and service requirements were planned together and incorporated in the deployment practices and policies. This new ethos and thinking was a significant culture change brought about by this research. In preparing for the introduction of the specialist training programmes under MMC in August 2007, the Trust had to design new programmes and jobs for junior doctors that met both the requirements of the service and the new curriculum. Trust management, seeing the benefits and need for planning these together from the involvement in the model building and the analysis to date as part of this research, decided strategically that these would be designed together operationally to meet the requirements of both. A lot of effort went into ensuring that clinical management and educationalists were both involved and consulted in the design of this major change and consequently Plymouth Hospitals NHS Trust was the first Trust in the South West to have its programmes designed and witnessed one of the lowest levels of operational impacts post change in 2007. The ethos and culture and change in thinking still prevails and there are many examples of how the training programmes have been adapted to ensure that it complements the service aspect of the junior doctor role and that some of the negative impacts of reduced clinical exposure are compensated for to some extent.

8.5 Model Results and Discussion

Now that the reader has arrived at this point of this journey, with a good understanding of the data collection, model building and validation process, it is now possible to explore more results that were arrived at from simulating some of the proposed changes to working and training practices.

8.5.1 Results from the identified scenarios

Before the results from the different simulated scenarios are presented, (the scenarios as identified by the problem owners and presented in an earlier section), it is worth looking at the progression chain and numbers in the model that will not change depending on the training/ service percentage entered from the micro-level model.

Table 21 show the predicted numbers of doctors progressing through the system in the simulations. This will be the same for all scenarios.

Numbers of Doctors

Time	Foundation Year Grade	Run Through Training Grade	Consultants and NCCGs
01 Jan 2005			
01 Jan 2006	48.38	299.15	287
01 Jan 2007	61.72	289.32	285
01 Jan 2008	77.10	305.20	285
01 Jan 2009	94.88	311.60	290
01 Jan 2010	114.23	318.01	295
01 Jan 2011	135.38	325.52	301
01 Jan 2012	158.33	333.30	307
01 Jan 2013	183.08	339.78	314
01 Jan 2014	209.63	346.71	321
01 Jan 2015			

Table 21 – Predicted number of doctors in the system by year

As shown in an earlier chapter, below is a table showing the scenarios and the impact these have had at micro level on the perceived training and service percentages (represented as indices) and the number of supervised hours per week.

Summary of Training/ Service Impacts of Scenarios						
Scenario	Description	Training Index	Service Index	Supervision	Total Hours accounted for in the week	Empty Time (time not accounted for by activities)
		(% Time spent in Training)	(% Time spent in Training)	(hrs per week)	(hrs per week)	(hrs per week)
Base	Entails the frequency, time and supervision of junior doctor activities as they are currently typically executed.	0.46	0.54	27.45	44.59	11.41
1	Entails the changes to activity frequencies and times anticipated by the introduction of increased structured teaching under MMC	0.47	0.53	28.09	46.58	9.42
2	Entails the impacts on activities that would occur from a more proactive approach to seeking learning opportunities on behalf of the individual junior doctor. Certain activities were identified as being affected, which increases their perceived training percentage	0.48	0.52	27.45	44.59	11.41
2b	Entails the impacts on activities that would occur from a more proactive approach to seeking learning opportunities on behalf of the individual junior doctor. The assumption made was that this would increase the perceived training percentage by 10 for each	0.56	0.44	27.45	44.59	11.41
3	Assumes all of the "empty" or dead time is used for educational activities (assumed at a value of 100 training/ 0 service), by individuals making better use of their time to accommodate learning needs	0.67	0.33	27.45	56	0
3b	Assumes half of the "empty" or dead time is used for educational activities (assumed at a value of 100 training/ 0 service) by individuals making better use of their time to accommodate learning needs	0.57	0.43	27.45	50.28	5.71

Table 20 – Summary of the impact of scenarios on overall training/ service balance

As the purpose of the strategic model was looking at the impacts of micro level changes, due to proposals for dealing with the EWTD, at macro level, it was agreed to look at the impacts on:

(i) Efficiency in service provision – for this the proxies of average relative impact on efficiency of consultants and RTTG will be used

(ii) Time for supervision – for this it is worth looking at the theoretical demands for supervision time on the consultant and RTTG

(iii) Training – for this it is worth looking at the average consolidated relative impact on the quality of training and its three components.

Baseline Scenario

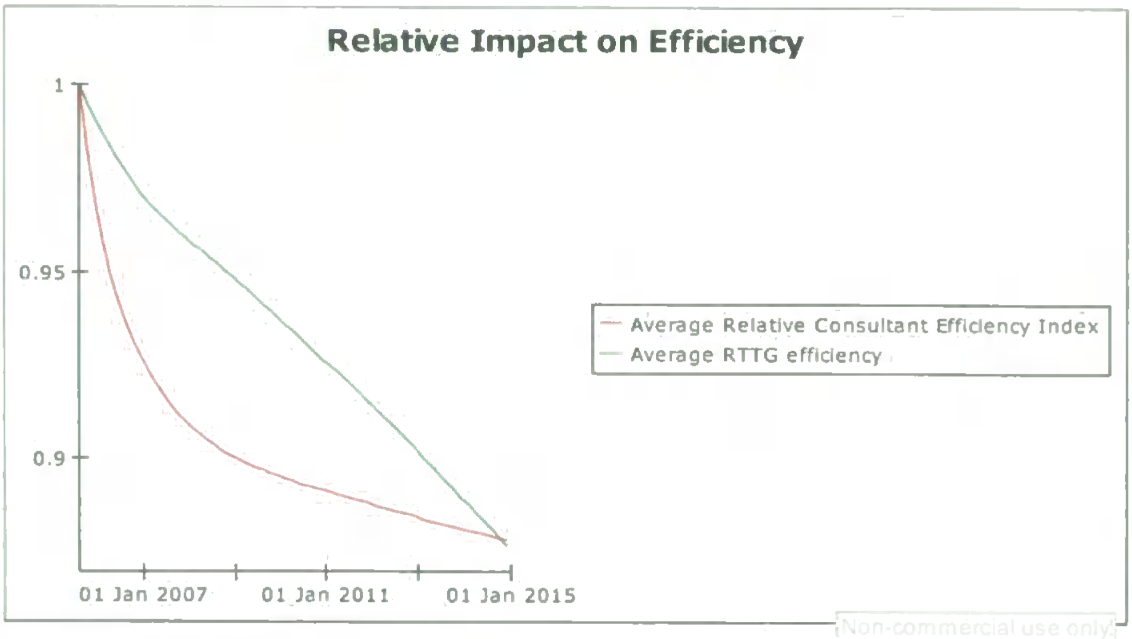


Figure 45 – Relative Impact on Efficiency over time of baseline scenario

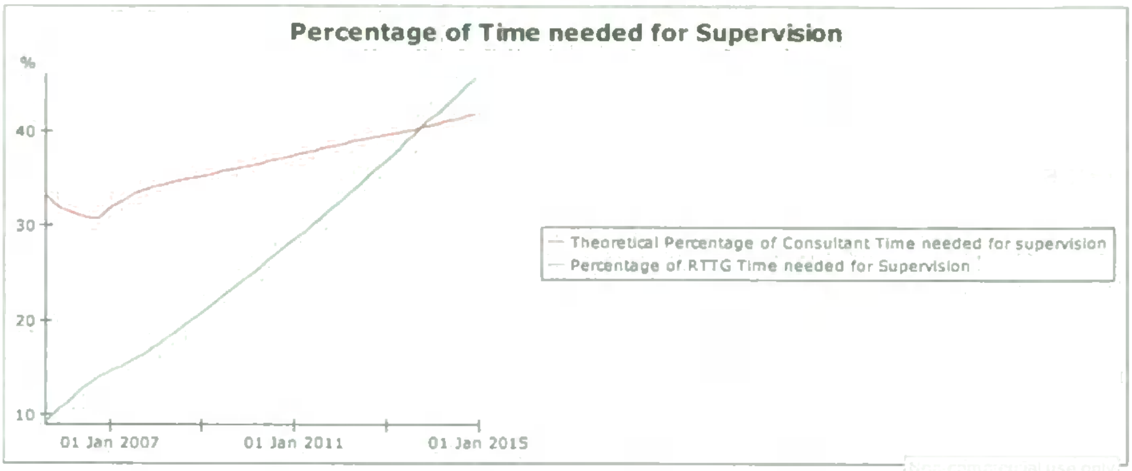


Figure 46 – Percentage of time needed for supervision of baseline scenario

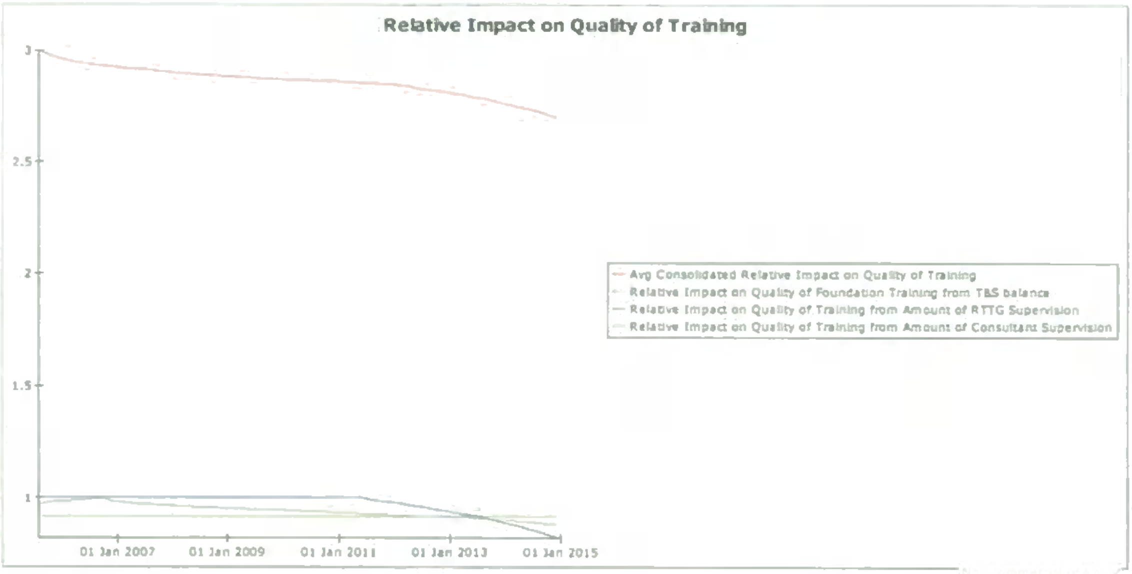


Figure 47 – Relative Impact on Quality of Training of baseline scenario

If things ran the way they are expected to for the next 10 years under the assumptions made in the model both regarding junior and senior doctor numbers and relationships in the system, then there would be an increased demand on supervision (largely fuelled by the increased numbers of foundation doctors) with relative declines in efficiency and on the quality of training.

Below is the table showing the results of the simulation for relative impact on efficiency under each of the scenarios.

Relative Impact on Efficiency												
	Baseline		*1*		*2*		*2b*		*3*		*3b*	
	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG
01-Jan-05												
01-Jan-06	0.96	0.99	0.96	0.99	0.96	0.99	0.96	0.99	0.96	0.99	0.96	0.99
01-Jan-07	0.93	0.97	0.93	0.97	0.93	0.97	0.93	0.97	0.93	0.97	0.93	0.97
01-Jan-08	0.91	0.96	0.91	0.96	0.91	0.96	0.91	0.96	0.91	0.96	0.91	0.96
01-Jan-09	0.9	0.95	0.9	0.95	0.9	0.95	0.9	0.95	0.9	0.95	0.9	0.95
01-Jan-10	0.9	0.94	0.89	0.94	0.9	0.94	0.9	0.94	0.9	0.94	0.9	0.94
01-Jan-11	0.89	0.93	0.89	0.92	0.89	0.93	0.89	0.93	0.89	0.93	0.89	0.93
01-Jan-12	0.89	0.91	0.89	0.91	0.89	0.91	0.89	0.91	0.89	0.91	0.89	0.91
01-Jan-13	0.88	0.9	0.88	0.9	0.88	0.9	0.88	0.9	0.88	0.9	0.88	0.9
01-Jan-14	0.88	0.89	0.88	0.89	0.88	0.89	0.88	0.89	0.88	0.89	0.88	0.89

Table 22 - Results of the simulation runs for each scenario for relative impact on efficiency

As can be seen from the simulation output from each of the scenarios, all scenarios apart from scenario 1 show no difference in the predicted relative impact on efficiency (shown in grey) as compared to the current anticipated decline in the baseline. This is because taking a more proactive approach to learning and better utilisation of spare time for self directed educational opportunities do not change the amount of supervised hours, and thus have a limited differential impact on consultant and RTTG efficiency. However, the introduction of more structured teaching under MMC, while increasing the number of supervised hours slightly, will have no significant different relative impact on efficiency: the endpoint is the same. However, it is to be noted that this is still a decline in efficiency over the years, as the balance in numbers shows an increase in junior doctors not matched by an increase in senior medical staff.

Table 23 shows the results of the simulation for the percentage time required for supervision under each of the scenarios.

Percentage of time needed for supervision												
	Baseline		*1*		*2*		*2b*		*3*		*3b*	
	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG	Consultant	RTTG
01-Jan-05												
01-Jan-06	31.72	11.1	31.79	11.36	31.72	11.1	31.72	11.1	31.72	11.1	31.72	11.1
01-Jan-07	31.81	14.64	31.89	14.98	31.81	14.64	31.81	14.64	31.81	14.64	31.81	14.64
01-Jan-08	34.18	17.34	34.28	17.74	34.18	17.34	34.18	17.34	34.18	17.34	34.18	17.34
01-Jan-09	35.31	20.89	35.43	21.38	35.31	20.89	35.31	20.89	35.31	20.89	35.31	20.89
01-Jan-10	36.34	24.65	36.49	25.22	36.34	24.65	36.34	24.65	36.34	24.65	36.34	24.65
01-Jan-11	37.46	28.54	37.63	29.2	37.46	28.54	37.46	28.54	37.46	28.54	37.46	28.54
01-Jan-12	38.6	32.6	38.8	33.36	38.6	32.6	38.6	32.6	38.6	32.6	38.6	32.6
01-Jan-13	39.65	36.97	39.88	37.84	39.65	36.97	39.65	36.97	39.65	36.97	39.65	36.97
01-Jan-14	40.71	41.49	40.95	42.46	40.71	41.49	40.71	41.49	40.71	41.49	40.71	41.49

Table 23 - Results of the simulation runs for each scenario for the percentage time required for supervision

The baseline scenario shows that an increase in the percentage of time needed for supervision for both consultants and RTTG trainees increases, more so for the RTTG doctors that see a four-fold increase. Similar to the relative impact on efficiency, the scenarios involving more proactive attitudes to learning and making better use of time do not affect this trend. However, the introduction of more structured teaching under MMC does increase the percentages slightly.

Below is the table showing the results of the simulation for the consolidated relative impact on quality of training under each of the scenarios.

Consolidated Relative Impact on Perceived Quality of Training

	Baseline	1	2	2b	3	3b
01-Jan-05						
01-Jan-06	2.96	2.97	2.97	3.04	3.12	3.04
01-Jan-07	2.93	2.94	2.95	3.09	3.26	3.11
01-Jan-08	2.9	2.91	2.93	3.09	3.3	3.11
01-Jan-09	2.88	2.9	2.92	3.09	3.3	3.11
01-Jan-10	2.87	2.88	2.91	3.08	3.29	3.1
01-Jan-11	2.86	2.87	2.9	3.07	3.29	3.09
01-Jan-12	2.85	2.85	2.88	3.05	3.27	3.07
01-Jan-13	2.81	2.82	2.85	3.02	3.24	3.04
01-Jan-14	2.76	2.76	2.8	2.97	3.19	2.99

Table 24 - Results of the simulation runs for each scenario for the consolidated relative impact on training

Finally, the one measure that is affected by all scenarios to some extent or other is the consolidated relative impact on the quality of training. At base line, with current practice, this is predicted to have an overall negative impact, increasingly so over the next 10 years. With the introduction of more structured teaching, this delays the negative impact marginally, but is not avoided. It is only when it is assumed that trainees can seek more learning and educational value out of every activity that they participate in or spend their spare time in a more educationally useful way, in self-directed activities, that the negative impact that comes from increased demands on supervision can be offset by the differences in actual versus expected training balance.

The lessons from this show that inevitably, with the current predictions and assumptions in the system under MMC and the current working time hours and time use, there is going to be an increased demand for supervision for both the RTTG and consultant grade, which will have a relatively negative impact on the quality of training and efficiency in service provision. While the demands on supervision and decline in efficiency cannot be bettered by the scenarios proposed by postgraduate education management, the perceived negative impact on the quality of training can be offset by a change in attitude and culture amongst the foundation trainees. Unfortunately, this is a much more difficult solution to implement. The balance in workforce numbers and construction of micro-level activity largely influence the demands on supervision and efficiency in the model and thus only operational changes in activity levels and fundamental changes in the balance of the medical workforce would significantly alter the future.

8.5.2 Additional Insights and Lessons

Experimentation and simulation with the model has also yielded the following insights into the specifics of the problem at hand:

(i) There will be an increased need for supervision of junior doctors due to projected increase in numbers and the increased amount of structured supervised activities enforced by *Modernising Medical Careers*. On average this is an hour per doctor per week.

(ii) As long as it is assumed that supervision reduces efficiency and amount of service provision on behalf of senior colleagues, meeting the supervision demands of an increased number of trainees participating in more of the structured (and supervised activities) under MMC will have a relatively negative impact on service provision and on relative quality of training provided by senior colleagues.

(iii) However, it is of highest interest for the hospital to maintain relatively high quality of training due to the hypothesised high retention rate both within the foundation years grade (first two years) and between this foundation grade and the run through training grade (the next grade) at Derriford. This is because there is a positive relationship between the quality of training and attractiveness as an employer, as well as future levels of efficiency and quality of service provision.

Analysis has shown that solutions that increase the training/ service *perception balance*, without increasing the number of hours needed for supervision, will have a relatively lower impact on service provision, while compensating for the loss in relative quality of training provided by senior colleagues who are increasingly pushed for time. In particular, this should involve looking at better use of slack time currently observed in the system.

Therefore, to date, work on the model has suggested that there are a certain number of areas of manoeuvrability for senior Trust management to make decisions that may help in the reconciliation of service provision and training standards within the constrained system:

(i) Who provides supervision to junior doctors? Although in practice a large proportion of informal supervision comes from other junior doctors of more senior grades, it may be in the interest of the Trust to emphasise more formally the amount and type of training to be gained from more senior colleagues of the junior doctor grades. This may help meet some of the supervision demands at minimum cost to service provision, due to the greater proportions of this group of staff. In a similar vein, especially lower grades of junior doctors will gain valuable supervision from other more experienced staff groups such as senior nurses and allied health professionals.

(ii) Effect of supervision on efficiency – while this is largely based on the assumptions made, if service is planned to account for this efficiency loss due to meeting training needs, then there may be less of a deviation from the expected level of service. This would require significant long-term changes in planning and would be a challenge within the existing target-oriented framework of NHS governance.

(iii) Alternatively, any technology that may compensate for the reduced efficiency in service provision incurred by supervision may help maintain service levels. The costs of technology assisted working could be investigated against the benefits and savings accrued from an increase in efficiency. (e.g. revised bleep technologies, PDAs for communication and paperwork)

(iv) Better use of empty time for educational purposes – this would increase the training percentage, without necessarily increasing the demands for structured supervision, especially if this time is used for self-directed learning.

In the long run, better quality training for Foundation Years doctors will increase the efficiency in which they are able to provide a service, due to the higher level of skills that they will have acquired. If PHNT is hypothesised to have a relatively high retention rate (as high as 60%) between the foundation years and run-through-training-grade, there is a strong incentive to maintain relatively high quality of training, not only for long term service provision, but also to compensate for increasing demands on junior doctor time to provide supervision to more junior colleagues. This means that an emphasis on meeting all training demands at the crucial foundation stage, while sacrificing some service at this level early on (which could possibly be taken on by other roles or supported by additional means) would benefit career development and service provision at the run-through-training grade and beyond.

Finally, there is currently no provision for the educational value in the participation in service activities. However, unsupervised and independent working can be as important for career and skills development as supervision. If the balance of this is right and appropriate to the skills level of the doctors, the quality of training may further be enhanced. However, this is difficult to model in a quantified model that treats training and service as ends of a continuum.

9. Conclusions

It is indisputable that this research has been a journey down the road less travelled – the discovery into what we mean by training and service for junior doctors under the European Working Time Directive and how the operational day to day activities that they engage in are associated with these concepts, and how this has an effect on the wider operational context and system of healthcare delivery and education, was not an easy one. It entailed a mixed methodology approach, exploring the concepts in qualitative and quantitative ways, adopting a two-step model, with findings that are unique and yet generalisable in a number of ways.

The purpose of the conclusions in this chapter is not to regurgitate the results, discussions or conclusions in the individual sections, as these have been extensively discussed, but rather to pull out all the findings, each important in their own right, and outline how these all together paint the picture that meets the overall aim of this research, identifying key contributions to knowledge and areas for further research. In a sense this is the opportunity to put all the results and discussions to date into a bigger picture.

9.1 Revisiting Key findings and Contribution to Knowledge

In order to focus the conclusions of this research and highlight the key contributions to knowledge that it makes, it is necessary to revisit the main aim of this research:

The aim was **to model the education and service activities of a professional group within an organisational context**, taking junior doctors under the EWTD as the organisational context. Specifically, it sought to clarify the relationship between "training" and "service" at micro level and understand the impacts of changes at this level (i.e. changes to working and training patterns of junior doctors within the reduced-hours context) on the wider system, as perceived by its stakeholders.

More specifically, it sought to understand how what it is junior doctors do relates to "training" and "service", in order to clarify these concepts and the relationship between them, and model the links between this activity at micro level to impacts and relationships in the wider system of medical education and service provision.

In addressing this overall aim, the research sought to answer the following particular sub-questions:

(a) What activities do junior doctors participate in? i.e. what activities do they spend their time on?

(b) How do these activities relate to the concepts of training and service? What is considered to be "training" and what is "service"?

(c) What is junior doctor time being spent on?

(d) Do junior doctors spend more time in service than in training?

(e) What are the measures that are being suggested to help with the problem by the stakeholders within the organisational context?

(f) What are the short and long-term impacts of changes to working and training patterns inspired by the proposed initiatives?

It is these questions that were directly identified from the literature review as being gaps in the body of knowledge that envelops this area. As the reader will have already identified, the answers to these questions have already been discussed in the individual sections and conclusions drawn on each part. It is now time to draw these together to review what insights these have allowed us in our exploration and understanding of what the concepts of "training" and "service" are within this context and how they are related for this professional group, and perhaps draw conclusions to what this means for professions on a wider level.

Much of the knowledge, literature and research to date around junior doctors hours and the EWTD involved discussions around the impacts on the quantity and quality of training and service, including quality of care. From the review of the legislation and the efforts made to date, changes in the working and training practices of junior doctors (regarding rota design, piloting new roles and new ways of working, etc.) are being designed without an understanding of what the impacts are on the key concepts of training and service. This is largely due to a lack of understanding of what these really mean, and more importantly how what it is junior doctors do is related to "training" and "service". This is a key contribution to knowledge of this research.

From the work done with junior doctors, via the questionnaire and focus group studies, and shadowing their time spent, it has been possible to build a much richer understanding of these concepts.

A list of junior doctor activities was identified, and the extent to which these are perceived to be training or service oriented was quantified on a relative scale, the so-called training/service continuum. More importantly, the factors influencing this perception were identified too. It is the combination of knowing how the daily activities relate to training and service and the factors that affect this perception that is a key contribution to knowledge. It shows that there is much more to the relationship than can be seen on the surface.

However, having said that, it is evident from the regression results in Chapter 4, that most of the variation in perception of activities along the training/service continuum can be explained by variation in frequency and supervision. This means that our understanding of what "training" means, or rather what it is perceived to mean, is the presence of a more experienced professional and an activity that is not yet regularly and frequently undertaken.

So overall, what does this research contribute to our understanding of the concepts of "training" and "service"? This research clearly shows that there are trends in the training/ service perceptions of activities and the frequency junior doctors perform them and whether they are supervised. It is not surprising that these two factors explain 70% of the variation in perceptions of activities, when the lack of consensus amongst SHOs is accommodated for. This is largely a symptom of the traditional model of postgraduate medical education: being "trained" by repeatedly performing activities under the supervision of senior staff. However, it is evident from this research that these are not the only two qualities that lead medical staff to classify activities into "training" and "service". The training/ service balance perception of activities can be affected by a number of other factors such as time, number of patients (workload), type and nature of work in the specialty, the individual trainee and trainers motivation and attitudes, interaction, purpose and focus of the activity, other commitments, experience and competence. These all affect the execution and practice of activities, which directly influences how they are perceived along the training/ service continuum. Moreover, these factors themselves are intricately related with each other, compounding the complexity of the situation. This points to a contiguous and contradictory relationship between "training" and "service". However, this research has really been able to take these nebulous concepts and clarify how these can be operationalised and interpreted within the working and training practices of junior doctors.

To further enhance this micro-level detail of the working and training practices, the analysis on time spent, combined with how this is perceived to sit with the concepts of training and service has led to a picture of how time is spent. Within this, it is clear that there is room for exploring how "empty" time is spent, and that as doctors are employed on a "just in case" basis of on-call systems (as outlined in the review of working patterns and legislation early on), there is most room for the reconciliation of the training/service conflict within the reduced hours framework in the use of this "empty" time.

Finally, at operational (micro) level, combining the perceptions of relative levels of training and service within activities and the time spent undertaking these, has allowed the modelling of junior doctor time and what the overall balance is like on aggregate. Further, this has allowed an exploration of changes in [illegible] working and training practices (i.e. the identified scenarios) and sensitivity analysis to understand how changes in different activities would affect the overall picture.

It was clear from the existing body of knowledge and the approaches taken to get there, that this organisational "problem" was a complex system, with seemingly nebulous and elusive concepts that were related to each other in non-linear way.

This warranted not only a new approach to defining and exploring these concepts (training and service) but adopting an existing systemic modelling technique to build a model of, and thereby an understanding of, the system under study.

There is no doubt that the education and service activities within a reduced hours context for this professional group is a complex system, which in the course of this research has been unpicked at micro level and linked the insights gained from this to the bigger strategic picture.

From the five scenarios for simulation, identified by the decision-makers and key stakeholders in this organisational context, and the assumed causal relationships that they perceive within the system, the key lessons to be learnt are that inevitably, the system is likely to be adversely affected by current organisational decisions. However, by understanding the entities in the system and formulating the assumed relationships in the system, it allowed such a detailed understanding of the problem, that clear ways of reducing these impacts were identifiable.

What needs to be emphasised that it is not the resultant model that was the sought after result of this research. Rather, the process of model building was a way of developing this shared understanding of the problem and exploring the relationships between the concepts under study: training, service and hours.

One of the key reflections in this research is the need to move away from the traditional understanding of "training" and what is meant by that and to seek benefits from adopting the view to provide learning experiences and the culture and attitude that goes along with these. Junior doctors and the medical profession in general are still to some extent focused on the "learning as behaviour" mode of individual learning theory, which sees reinforcement (e.g. through verbal instruction or repetition) as a main mode of learning. However, this research clearly demonstrates the benefits of a shift to learning as knowledge construction (CIPD 2002) in which not the expert nor the content is the focus, but the learner and the attitude he or she adopts in constructing knowledge from the context they are put in.

Even legislative concepts are addressed in this research. The distinction between "duty" and "work" and whether training counts as work, which are outlined in the background to this research at length, have been explored through the investigation of time use and the description, perception and deployment of "empty" time.

Methodically speaking, this research has clear contributions to make. As was highlighted in the literature review, most studies into the impacts of reducing hours are evaluation-type research, where a new working pattern or changes to training are introduced to a specialty, unit or group of doctors, and the impacts of these are then evaluated, mainly by questionnaires or interviews, with limited definition of what is meant by the concepts under study, nor any attempt to model the relationships between them, or how operational (micro) level detail links to the wider strategic (macro) level at which decisions are made. This research has taken existing research methods within a phenomenological ontology and combined them in a unique way to not only explore and clarify the concepts under study, but to demonstrate the links between operational level and systems level entities.

The main outputs of this research have been:

- Identification of SHO activities
- Training/ Service Continuum - Key advances into the classification of activities into the concepts of "training" and "service" – really challenging existing notions of the two, and the way they have been treated in the operational EWTD impact literature.
- Identification of factors that affect this perceived balance
- Identification of how junior doctor time is spent

- A spreadsheet model of training/ service balance and impacts of scenarios at micro level
- Impacts of scenarios at macro level
- Key recommendations for decision makers
- A new approach to a prevailing problem

In summary, to date the elusive concepts of "training" and "service" had not been defined, explored nor clarified within this organisational context. Furthermore, it had not been addressed how they relate to the operational detail of what junior doctors do within their hours and how this relates to the wider functioning of the medical workforce within the hospital system. Not only has this gap in knowledge been addressed, but it has been done so by applying existing research methods in a new way, and enabled decision-makers to explore their organisational problem and understand the system, in order to enable richer learning about it and the decisions they make within the context.

The key message is that it is necessary to marry-up the planning of training and service practices and the relationships between the micro level operation detail – what junior doctors do every day on a daily basis, how they perceive their activities – with how the system works as a who, and the impacts this has on education, the service that is provided to patients, and on the rest of the medical workforce.

Training and Service: this research shows that they are entwined and interlinked so much so that with the right attitude, one doesn't and shouldn't exist without the other.

9.2 Reflections on further research

In critiquing this research, perhaps one of its main limitations lies in the assumption that the presence of someone more senior equals supervision of sufficient quality in order for education and learning to take place. This perhaps naïve assumption had to be made in order to conceptualise the system into a model and link the operational detail at micro level to strategic changes at macro level. Whether presence = supervision and what the effect on learning of quality supervision (and indeed what this constitutes) in the clinical setting would be a very insightful piece of research, as it has already been identified that small changes in daily activity can have impacts at an aggregate level.

On a more systems dynamics level, a very useful addition would be to find a way of modelling the feedback that project stakeholders have identified in the "soft" causal loop diagram model, but not captured in their "hard" model, partly because it featured beyond their control, and partly because they felt that additional work on this would not benefit them in their understanding any more than they already had.

Additionally, one practical feature that would be worth including in the model is the phenomenon of simultaneous supervision. In this research, it has been identified that foundation doctors are supervised by more senior junior doctors and consultants, but sometimes consultants supervise both foundation doctors and RTTG trainees at the same time (e.g. on a ward round). And how does this affect the quality of learning for these trainees?

The timing of this research meant that it evolved in a way that could not have been anticipated. The introduction of Modernising Medical Careers during the research has made disentangling the effects of a dynamically changing context very difficult. It would be advantageous to build the model further or perhaps to model it at an aggregate scale to show the collated impacts of changes to hours, education and service provision for a professional group (i.e. junior doctors) which are the ones impacted by all these changes at the same time.

On the note of timing, given that the EWTD is about to enforce a further reduction in hours from 56 to 48 hours in 2009, it would be useful to set up direct comparison or cohort test in some of these conceptual areas now, in order to collect useful data for comparison later.

One can see that there are a number of additional avenues worth pursuing in this research, and when one speaks to both modellers and practitioners alike about this research, it sparks much debate and a great deal of enthusiasm. There are serious long-term implications involved for our health service in balancing workforce numbers, service demand and provision of education.

APPENDICES

APPENDIX I – A copy of the questionnaire used

Thank you for taking the time to answer the following questions about the activities that you as a SHO are involved in. This questionnaire should take approximately 10-15 minutes to complete.

1. How long have you been a SHO?

- ☐ Less than 6 months
- ☐ 6 months to a year
- ☐ 1-2 years
- ☐ 2-3 years
- ☐ 3-4 years
- ☐ More than 4 years

2. For how much longer do you expect to be a SHO?

- ☐ Less than 6 months
- ☐ 6 months to a year
- ☐ 1-2 years
- ☐ 2-3 years
- ☐ 3-4 years
- ☐ More than 4 years

3. Do you know what specialty you eventually want to work in?

- ☐ Yes
- ☐ No

(Continued overleaf)

Below is a list of activities that SHOs are typically involved in (in no particular order). For each of these activities, please choose the appropriate response to the four questions. If there are any tasks that you as a SHO do or activities that you are involved in that are not on the list, please fill these in the spaces provided at the end of the list, and answer the questions for those tasks.

In one part of the table below, you are asked to place each activity along a training-service scale. I appreciate that each activity can be seen as training or service, and most likely will be a combination of both, partly providing a service and partly educational. Please place the activity along the scale according to your perception of to what extent activities are 'training' or 'service'.

Activity	On average, how often are you likely to be involved in this activity? (Please tick one)								If you *had to* categorise this activity into 'training' or 'service' where would you place it? (Please circle notch on the scale)	Are you likely to participate in this activity in the presence of a more experienced person	If so, who woul this be? (Please tick all that apply)
	More than once a day	Once a day	Once a week	Once a fortnight	Once a month	Once every 2-3 months	Once per SHO job	Never			
Ward Round									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Examining/ Revie Patient									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Medical History ta									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Clerking Admissic									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Patient related administration (ordering tests, bl forms, drug charts TTAs, discharge summaries)									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Writing Patient Nc									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Collating Results									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Taking Blood/ EC Cannulation/ Catherisation									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other

Activity	On average, how often are you likely to be involved in this activity? (Please tick one)								If you *had to* categorise this activity into 'training' or 'service', where would you place it? (Please circle notch on the scale)	Are you likely to participate in this activity in the presence of a more experienced person?	If so, who would this be? (Please tick all that apply)
	More than once a day	Once a day	Once a week	Once a fortnight	Once a month	Once every 2-3 months	Once per SHO job	Never			
Urgent or Emergency assessment and management of patient									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Writing Prescriptions									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Performing General Medical Procedures (e.g. plural taps, putting in lines)									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Assisting General Medical Procedures									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Observing General Medical Procedures									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Preparing for Procedures or Theatre (incl. Staff/ equipment and lists)									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Operating in Theatre									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Assisting in Theatre									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Observing in Theatre									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Talking to patients and relatives									100% Training ——— 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other

Activity	On average, how often are you likely to be involved in this activity? (Please tick one)								If you *had to* categorise this activity into 'training' or 'service', where would you place it? (Please circle notch on the scale)	Are you likely to participate in this activity in the presence of a more experienced person?	If so, who would this be? (Please tick all that apply)
	More than once a day	Once a day	Once a week	Once a fortnight	Once a month	Once every 2-3 months	Once per SHO job	Never			
Handover to next SHO (or cover)									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Discussing patients with colleagues (incl. GP)									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Formal team meetings									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Formal SHO teaching									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Teaching Medical students/ other									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Attending Clinics									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Audit Activities									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Reading Journals/ Research/ Private Study									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Appraisals									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
Presentations									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other
									100% Training — 100% Service	❑ Yes ❑ No	❑ Consultant ❑ SpR ❑ SHO ❑ PRHO ❑ Nurse ❑ Other

Activity	On average, how often are you likely to be involved in this activity? (Please tick one)								If you *had to* categorise this activity into 'training' or 'service', where would you place it? (Please circle notch on the scale)	Are you likely to participate in this activity in the presence of a more experienced person?	If so, who would this be? (Please tick all that apply)
	More than once a day	Once a day	Once a week	Once a fortnight	Once a month	Once every 2-3 months	Once per SHO job	Never			
									100% Training ⊢⊣ 100% Service	❑ Yes ❑ No	❑ Consultant ❑ PRHO ❑ SpR ❑ Nurse ❑ SHO ❑ Other
									100% Training ⊢⊣ 100% Service	❑ Yes ❑ No	❑ Consultant ❑ PRHO ❑ SpR ❑ Nurse ❑ SHO ❑ Other
									100% Training ⊢⊣ 100% Service	❑ Yes ❑ No	❑ Consultant ❑ PRHO ❑ SpR ❑ Nurse ❑ SHO ❑ Other
									100% Training ⊢⊣ 100% Service	❑ Yes ❑ No	❑ Consultant ❑ PRHO ❑ SpR ❑ Nurse ❑ SHO ❑ Other
									100% Training ⊢⊣ 100% Service	❑ Yes ❑ No	❑ Consultant ❑ PRHO ❑ SpR ❑ Nurse ❑ SHO ❑ Other

4. Would you be willing to participate in a focus group at the end of January, classifying activities and exploring the relationship between training and service?

❑ Yes
❑ No

Thank you again for completing this questionnaire. Please return **as soon as possible** to (via internal post or in passing):

Sonja Derrick
Postgraduate Medical Centre
Derriford Hospital
PL6 8DH

If you have any questions please feel free to contact me on ext. 52720 (external: 01752 792 720) or via email on: sonja.derrick@phnt.swest.nhs.uk

Appendix II – Baseline results of the Training/ Service Balance Spreadsheet Model, for current typical time usage.

Activity Number	Activity	Likely to be supervised?	Baseline Median Frequency (per 6 months)	Median Training %	Lower Quartile Training %	Upper Quartile Training %	Median Service %	Lower Quartile Service %	Upper Quartile Service %	Average Time per Activity (mins)	Average Time per Activity (hrs)	Is the activity supervised in this Scenario?	Scenario Frequency (per week)	Contribution to Training Index*	Contribution to Service Index**	Supervised Time
1	Ward Round	Y	130	50	30	70	50	30	70	120	2.00	Y	5.00	0.125	0.054	10.00
2	Examining/ Reviewing Patient	N	260	50	30	70	50	30	70	15	0.25	N	10.00	0.013	0.031	0.00
3	Medical History Taking	N	260	50	30	70	50	30	70	20	0.33	N	10.00	0.018	0.042	0.00
4	Clerking Admissions	N	130	30	20	60	70	40	80	30	0.50	N	5.00	0.009	0.036	0.00
5	Patient Related Administration	N	260	10	0	20	90	80	100	5	0.08	N	10.00	0.000	0.015	0.00
6	Writing Patient Notes	N	260	20	10	50	80	50	90	5	0.08	N	10.00	0.001	0.013	0.00
7	Collating Results	N	260	20	10	50	80	50	90	10	0.17	N	10.00	0.003	0.027	0.00
8	Taking Blood/ ECGs/ Cannulation/ Catheterisation	N	260	0	0	40	100	60	100	10	0.17	N	10.00	0.000	0.030	0.00
9	Urgent or Emergency Assessment and Management of Patient	Y	130	60	50	80	40	20	50	20	0.33	Y	5.00	0.024	0.008	1.67
10	Writing Prescriptions	N	260	10	0	30	90	70	100	5	0.08	N	10.00	0.000	0.015	0.00
11	Performing General Medical Procedures	Y	26	70	50	90	30	10	50	30	0.50	Y	1.00	0.008	0.001	0.50
12	Assisting General Medical Procedures	Y	13	70	50	90	30	10	50	30	0.50	Y	0.50	0.004	0.000	0.25
13	Observing General Medical Procedures	Y	13	80	50	90	20	10	50	30	0.50	Y	0.50	0.004	0.000	0.25
14	Preparing for Procedures or Theatre	N	26	30	10	60	70	40	90	20	0.33	N	1.00	0.001	0.005	0.00
15	Operating in Theatre	Y	26	80	60	90	20	10	40	120	2.00	Y	1.00	0.032	0.004	2.00
16	Assisting in Theatre	Y	26	70	50	90	30	10	50	120	2.00	Y	1.00	0.032	0.004	2.00
17	Observing in Theatre	Y	26	80	50	90	20	10	50	120	2.00	Y	1.00	0.032	0.004	2.00
18	Talking to Patients and Relatives	N	260	40	20	60	60	40	80	10	0.17	N	10.00	0.006	0.024	0.00
19	Handover to next JD (or cover)	N	130	20	10	40	80	60	90	5	0.08	N	5.00	0.001	0.007	0.00
20	Discussing patients with colleagues (incl. GP)	Y	130	50	30	80	50	20	70	10	0.17	Y	5.00	0.012	0.003	0.83
21	Formal Team Meetings	Y	26	70	50	90	30	10	50	90	1.50	Y	1.00	0.024	0.003	1.50
22	Formal Teaching	Y	26	100	90	100	0	0	10	120	2.00	Y	1.00	0.036	0.000	2.00
23	Teaching Medical Students/ Others	N	6	80	50	80	20	20	50	15	0.25	N	0.23	0.001	0.001	0.00
24	Attending Clinics	Y	26	80	60	90	20	10	40	240	4.00	Y	1.00	0.064	0.007	4.00
25	Audit Activities	Y	2.5	70	50	80	30	20	50	210	3.50	Y	0.10	0.005	0.001	0.34
26	Reading Journals/ Research/ Private Study	N	26	90	80	100	10	0	20	30	0.50	N	1.00	0.007	0.002	0.00
27	Appraisals	Y	2.5	90	70	100	10	0	30	30	0.50	Y	0.10	0.001	0.000	0.05
28	Presentations	Y	2.5	80	70	100	20	0	30	40	0.67	Y	0.10	0.001	0.000	0.08
	Dead Time	N		0	0	100	100	0	100			N	11.41	0.000	0.204	0.00
												Total Weekly Hrs	44.59	0.464	0.536	27.45

*(Time in Activity x Training %)/Total Time

**(Time in Activity x Service %)/Total Time

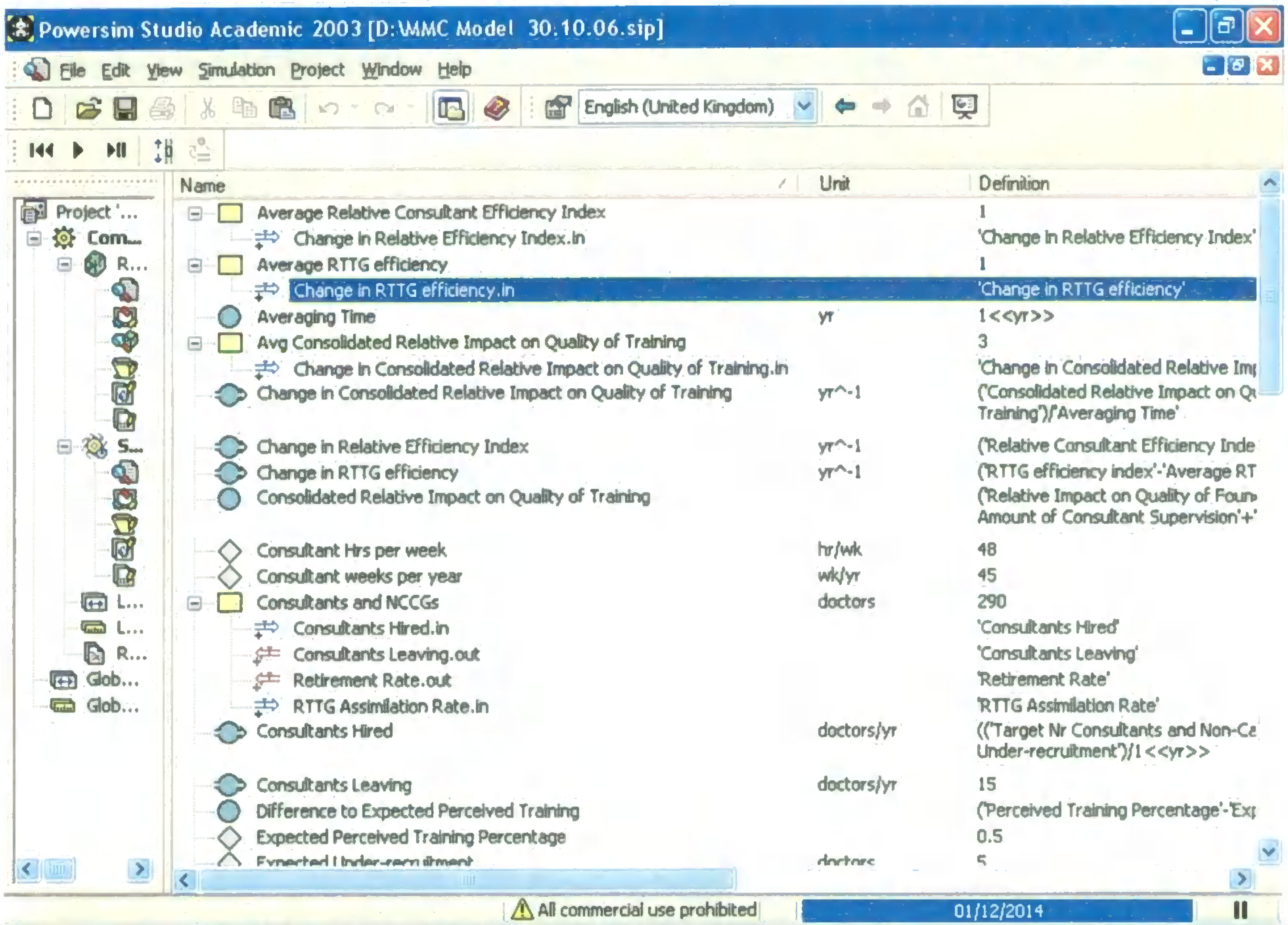
Appendix III – List of Equations in the System Dynamics Model

Name	Type	Unit	Definition (equation) at start of simulation
Average Relative Consultant Efficiency Index	Stock		1
Average RTTG Efficiency	Stock		1
Averaging Time	Calculation	year	1
Avg Consolidated Relative Impact on Quality of Training	Stock		3
Change in Consolidated Relative Impact on Quality of Training	Rate	yr^-1	=('Consolidated Relative Impact on Quality of Training'-'Avg Consolidated Relative Impact on Quality of Training')/'Averaging Time'
Change in Relative Efficiency Index	Rate	yr^-1	=('Relative Consultant Efficency Index'-'Average Relative Consultant Efficiency Index')/'Averaging Time'
Change in RTTG Efficiency	Rate	yr^-1	=('RTTG efficiency index'-'Average RTTG efficiency')/'Averaging Time'
Consolidated Relative Impact on Quality of Training	Calculation		=('Relative Impact on Quality of Foundation Training from T&S balance'+'Relative Impact on Quality of Training from Amount of Consultant Supervision'+'Relative Impact on Quality of Training from Amount of RTTG Supervision'
Consultant Hrs per week	Constant	hr/week	48
Consultant weeks per year	Constant	wk/yr	45
Consultants and NCCGs	Stock	doctors	290
Consultants Hired	Rate	doctors/yr	=(('Target Nr Consultants and Non-Career Grade Doctors'-'Consultants and NCCGs')-'Expected Under-recruitment')/1<<yr>>
Consultants Leaving	Rate	doctors/yr	15
Difference to Expected Perceived Trainig	Calculation		('Perceived Training Percentage'-'Expected Perceived Trailng Percentage') x 100
Expected Perceived Training Percentage	Constant		0.5
Expected Under-recruitment	Constant	doctors	5
F1 and F2 doctors leaving	Rate	doctors/yr	=('F1 doctors hired' x (1-'F1 to F2 retention rate'))+('F2 doctors hired'-'Internal Foundation Assimilation Rate')
F1 doctors hired	Rate	doctors/yr	='Target Nr F1s'/1<<yr>>
F1 to F2 retention rate	Constant		0.3
F2 doctors hired	Rate	doctors/yr	=('Target Nr F2s'/1<<yr..)-('F1 doctors hired x 'F1 to F2 retention rate')

Name	Type	Unit	Definition (equation) at start of simulation
F1 to F2 retention rate	Constant		0.3
F2 doctors hired	Rate	doctors/yr	=('Target Nr F2s'/1<<yr..)-('F1 doctors hired x 'F1 to F2 retention rate')
Foundation Supervision hrs need for Consultants	Calculation	hr/yr	='Supervised Foundation Year Hours per year' x (1-'Percentage supervision by RTTG')
Foundation Supervision hrs need for RTTG	Calculation	hr/yr	Supervised Foundation Year Hours per year' x 'Percentage supervision by RTTG')
Foundation Year Grade	Stock	doctors	43
FY to RTTG retention rate	Constant		0.6
Hours per week	Constant	hr/wk	=(56<<hr>>/(1<<wk>>)
Hours per year	Calculation	hr/yr	=('Hours per week' x 43<<wk>>)/1<<yr>>
Internal Foundation Assimilation Rate	Rate	doctors/yr	=('Target Nr F2s'/1<<yr>>) x 'FY to RTTG retention rate'
Loss of Efficiency from Supervision	Constant	%	30%
Percentage Consultant time in Service	Constant	%	100%
Perceived Service Hours Foundation Years	Calculation	hr/yr	=('Hours per year' x 'Perceived Service Percentage') x ('Foundation Year Grade'/1<<doctors>>)
Perceived Service Percentage	Constant		0.536
Perceived Training Hours Foundation Years	Calculation	hr/yr	=('Hours per year' x 'Perceived Training Percentage') x ('Foundation Year Grade'/1<<doctors>>)
Perceived Training Percentage	Constant		0.464
Percentage of RTTG Time needed for Supervision	Calculation	%	='Foundation Supervision hrs need for RTTG'/'Total RTTG service hrs'
Percentage of training supervised by Consultant	Constant		0.5
Percentage supervision by RTTG	Constant		0.7
Percentage time spent training	Constant		0.5

Name	Type	Unit	Definition (equation) at start of simulation
Qualification rate	Constant		0.2
Relative Consultant Efficiency Index	Calculation		=1-(('Loss of Efficiency from Supervision'/100) x ('Theoretical Percentage of Consultant Time needed for supervison' x 100))
Relative Impact on Quality of Foundation Training from T&S balance	Calculation		=GRAPH('Difference to Expected Perceived Training',-50,10,{0.12,0.19,0.37,0.56,0.77,1,1.21,1.4,1.62,1.78,1.85//Min:0;Max:2//})
Relative Impact on Quality of Training from Amount of Consultant Supervision	Calculation		=GRAPH(('Theoretical Percentage of Consultant Time needed for supervision' x 100),0,10,{1,1,1,1,0.91,0.76,0.53,0.333,0.24,0.19//Min:0;Max:1//})
Relative Impact on Quality of Training from Amount of RTTG Supervision	Calculation		=GRAPH(('Percentage of RTTG Time needed for Supervision' x 100),0,10,{1,1,1,1,0.91,0.76,0.53,0.333,0.24,0.19//Min:0;Max:1//})
Retirement Rate	Rate	doctors/yr	5
RTTG Assimilation Rate	Rate	doctors/yr	2
RTTG doctors hired	Rate	doctors/yr	=('Target Nr RTTG'-'Run Through Training Grade')/1<<yr>>
RTTG doctors leaving	Rate	doctors/yr	=('Qualificaton rate' x 'Run Through Training Grade')/1<<yr>>
RTTG efficiency index	Calculation		=1-(('Loss of Efficiency from Supervision') x 'Percentage of RTTG Time needed for Supervision')
RTTG Hours per year	Calculation	hr/yr	=('RTTG Hrs per week' x 'RTTG weeks per year') x ('Run Through Training Grade'/1<<doctors>>)
RTTG Hrs per week	Constant	hr/wk	56
RTTG weeks per year	Constant	wk/yr	43
Run Through Training Grade	Stock	doctors	320
Supervised Foundation Year Hours per year	Calculation	hr/yr	=((@Supervised hours per wek' x '('Foundation Year Grade'/1<<doctors>>)) x 43<<wk>>)/1<<yr>>
Supervised hours per week	Constant	hr/wk	27.45
Target Nr Consultants and Non-Career Grade Doctors	Calculation	doctors	=GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),1,1,{307,313,319,325,332,338,346,353,360,367}) x 1<<doctors>>
Target Nr F1s	Calculation	doctors	=GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),0,1,{43,49,58,63,69,75,81,87,93,98}) x 1<<doctors>>
Target Nr F2s	Calculation	doctors	=GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),0,1,{0,69,60,60,63,69,75,81,87,93}) x 1<<doctors>>
Target Nr RTTG	Calculation	doctors	=GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),0,1,{327,333,340,347,354,361,365,368,376,383}) x 1<<doctors>>

Name	Type	Unit	Definition (equation) at start of simulation
Theoretical Percentage of Consultant Time needed for supervison	Calculation	%	='Total Consultant Hrs needed for supervision'/'Total Consultant Hours per year'
Total Consultant Hours per year	Calculation	hr/yr	=(('Consultant Hrs per week' x 'Consultant weeks per year') x ('Consultants and NCCGs'/1<<doctors>>)) x 'Perc Consultant time in Service'
Total Consultant Hrs needed for supervision	Calculation	hr/yr	='Foundation Supervision hrs need for Consultants' + 'Total RTTG Training hrs'
Total RTTG service hrs	Calculation	hr/yr	='RTTG Hours per year' x (1-'Percentage time spent training')
Total RTTG Training hrs	Calculation	hr/yr	='RTTG Hours per year' x 'Percentage time spent training' x 'Percentage of training supervised by Consultants'
Trend in Consolidated Relative Impact on Quality of Training	Calculation	yr^-1	='Change in Consolidated Relative Impact on Quality of Training'/'Avg Consolidated Relative Impact on Quality of Training'
Trend in Efficiency	Calculation	yr^-1	='Change in Relative Efficiency Index'/'Average Relative Consultant Efficiency Index'
Trend in RTTG efficiency	Calculation	yr^-1	Change in RTTG efficiency'/'Average RTTG efficiency'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Unit
Definition
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Change in Relative Efficiency Index.in
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Average RTTG efficiency
1
Change in RTTG efficiency.in
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Averaging Time
yr
1<<yr>>
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3
Change in Consolidated Relative Impact on Quality of Training.in
Change in Consolidated Relative Impact on Quality of Training
yr^-1
Change in Relative Efficiency Index
yr^-1
Change in RTTG efficiency
yr^-1
Consolidated Relative Impact on Quality of Training
Consultant Hrs per week
hr/wk
48
Consultant weeks per year
wk/yr
45
Consultants and NCCGs
doctors
290
Consultants Hired.in
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Consultants Leaving.out
'Consultants Leaving'
Retirement Rate.out
'Retirement Rate'
RTTG Assimilation Rate.in
'RTTG Assimilation Rate'
Consultants Hired
doctors/yr
Consultants Leaving
doctors/yr
15
Difference to Expected Perceived Training
Expected Perceived Training Percentage
0.5
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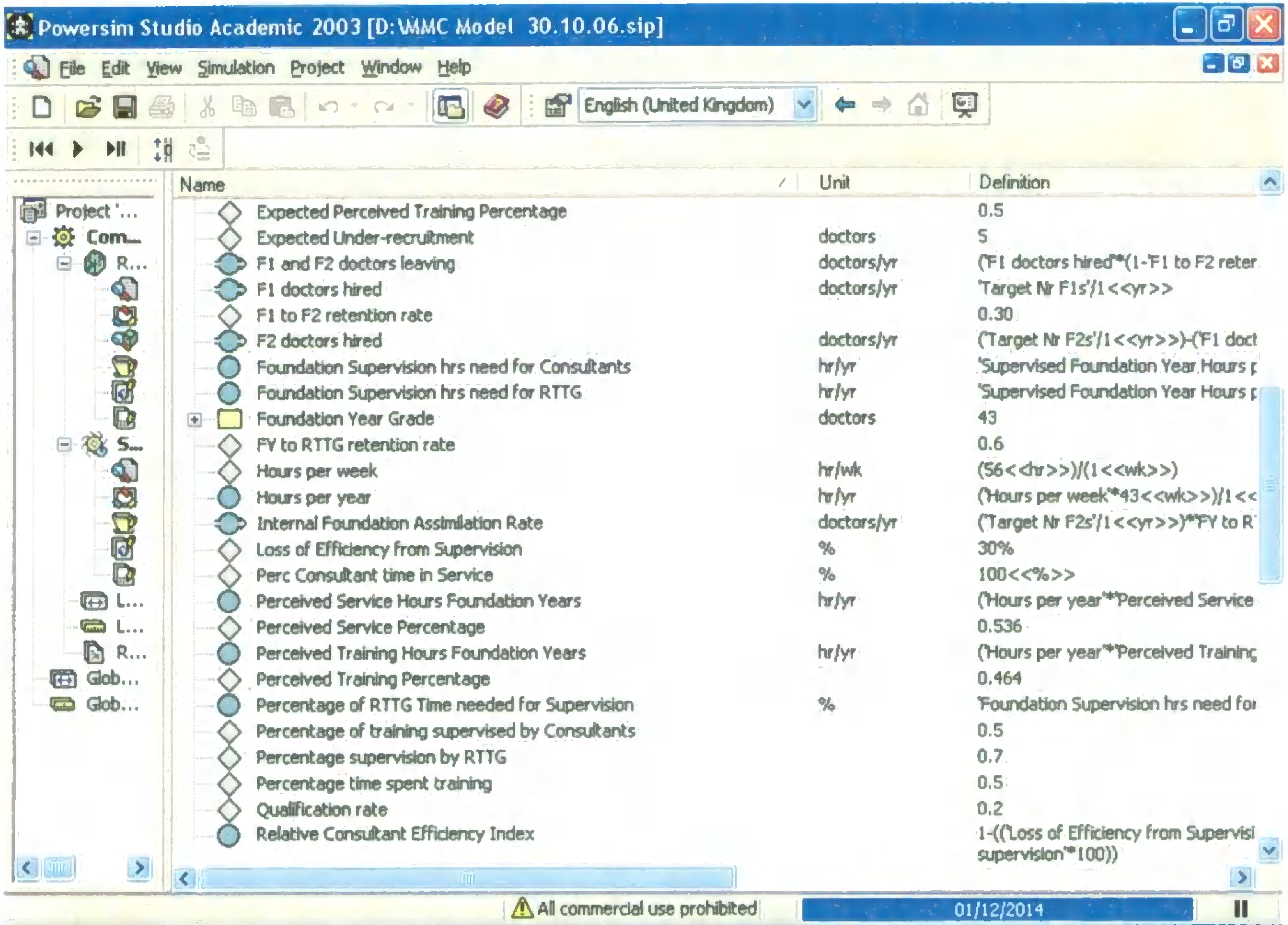
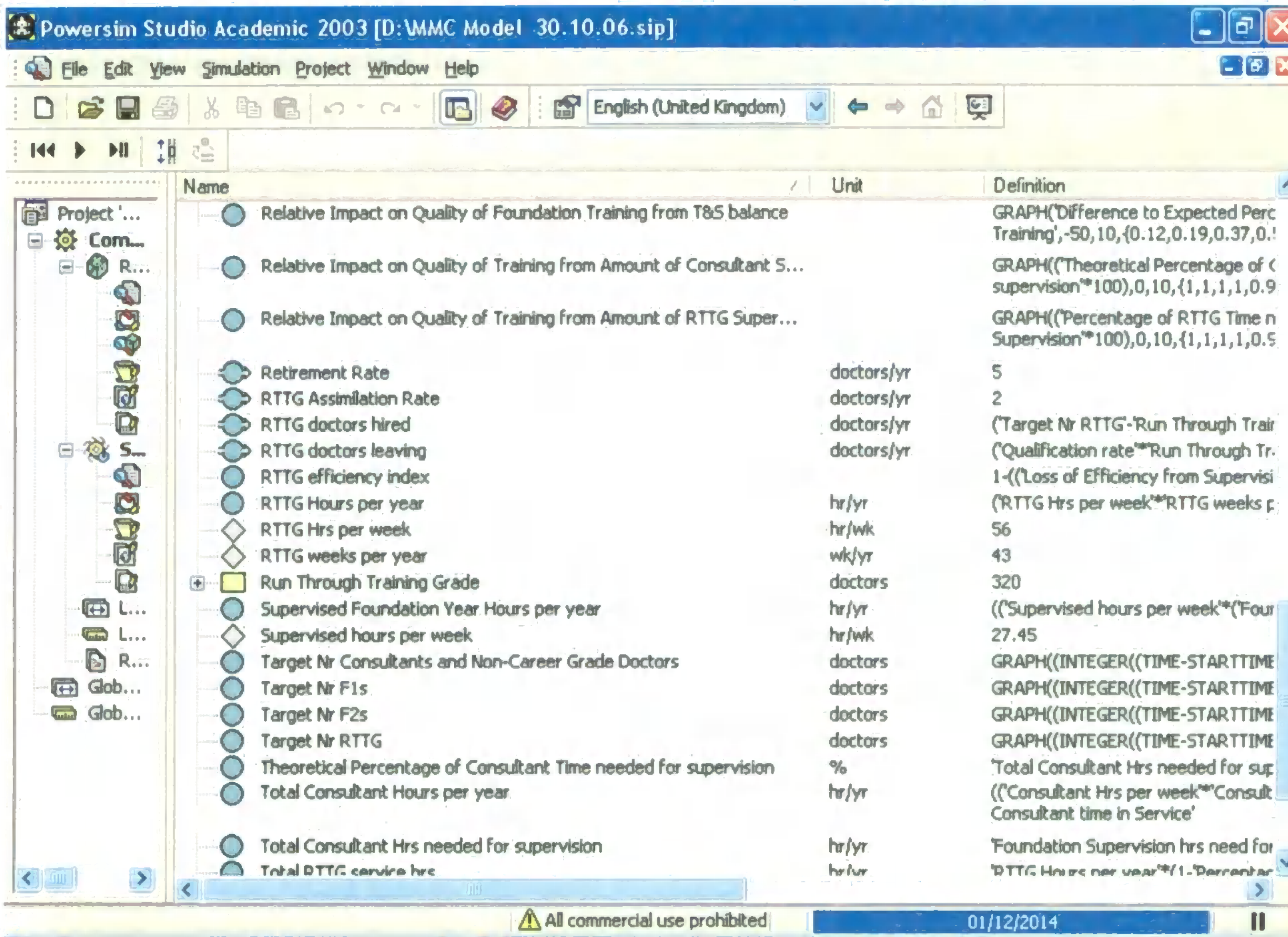


Name	Unit	Definition
Expected Perceived Training Percentage		0.5
Expected Under-recruitment	doctors	5
F1 and F2 doctors leaving	doctors/yr	('F1 doctors hired'*(1-'F1 to F2 reter
F1 doctors hired	doctors/yr	'Target Nr F1s'/1<<yr>>
F1 to F2 retention rate		0.30
F2 doctors hired	doctors/yr	('Target Nr F2s'/1<<yr>>)-('F1 doct
Foundation Supervision hrs need for Consultants	hr/yr	'Supervised Foundation Year Hours p
Foundation Supervision hrs need for RTTG	hr/yr	'Supervised Foundation Year Hours p
Foundation Year Grade	doctors	43
FY to RTTG retention rate		0.6
Hours per week	hr/wk	(56<<hr>>)/(1<<wk>>)
Hours per year	hr/yr	('Hours per week'*43<<wk>>)/1<<
Internal Foundation Assimilation Rate	doctors/yr	('Target Nr F2s'/1<<yr>>)*'FY to R
Loss of Efficiency from Supervision	%	30%
Perc Consultant time in Service	%	100<<%>>
Perceived Service Hours Foundation Years	hr/yr	('Hours per year'*'Perceived Service
Perceived Service Percentage		0.536
Perceived Training Hours Foundation Years	hr/yr	('Hours per year'*'Perceived Training
Perceived Training Percentage		0.464
Percentage of RTTG Time needed for Supervision	%	'Foundation Supervision hrs need for
Percentage of training supervised by Consultants		0.5
Percentage supervision by RTTG		0.7
Percentage time spent training		0.5
Qualification rate		0.2
Relative Consultant Efficiency Index		1-(('Loss of Efficiency from Supervisi supervision'*100))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Unit
Definition
Relative Impact on Quality of Foundation Training from T&S balance
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Relative Impact on Quality of Training from Amount of Consultant S...
GRAPH(('Theoretical Percentage of C supervision'*100),0,10,{1,1,1,1,0.9
Relative Impact on Quality of Training from Amount of RTTG Super...
GRAPH(('Percentage of RTTG Time n Supervision'*100),0,10,{1,1,1,1,0.9
Retirement Rate | doctors/yr | 5
RTTG Assimilation Rate | doctors/yr | 2
RTTG doctors hired | doctors/yr | ('Target Nr RTTG'-'Run Through Trair
RTTG doctors leaving | doctors/yr | ('Qualification rate'*'Run Through Tr.
RTTG efficiency index | | 1-(('Loss of Efficiency from Supervisi
RTTG Hours per year | hr/yr | ('RTTG Hrs per week'*'RTTG weeks p
RTTG Hrs per week | hr/wk | 56
RTTG weeks per year | wk/yr | 43
Run Through Training Grade | doctors | 320
Supervised Foundation Year Hours per year | hr/yr | (('Supervised hours per week'*('Four
Supervised hours per week | hr/wk | 27.45
Target Nr Consultants and Non-Career Grade Doctors | doctors | GRAPH((INTEGER((TIME-STARTTIME
Target Nr F1s | doctors | GRAPH((INTEGER((TIME-STARTTIME
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Target Nr RTTG | doctors | GRAPH((INTEGER((TIME-STARTTIME
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Total Consultant Hours per year | hr/yr | (('Consultant Hrs per week'*'Consult Consultant time in Service'
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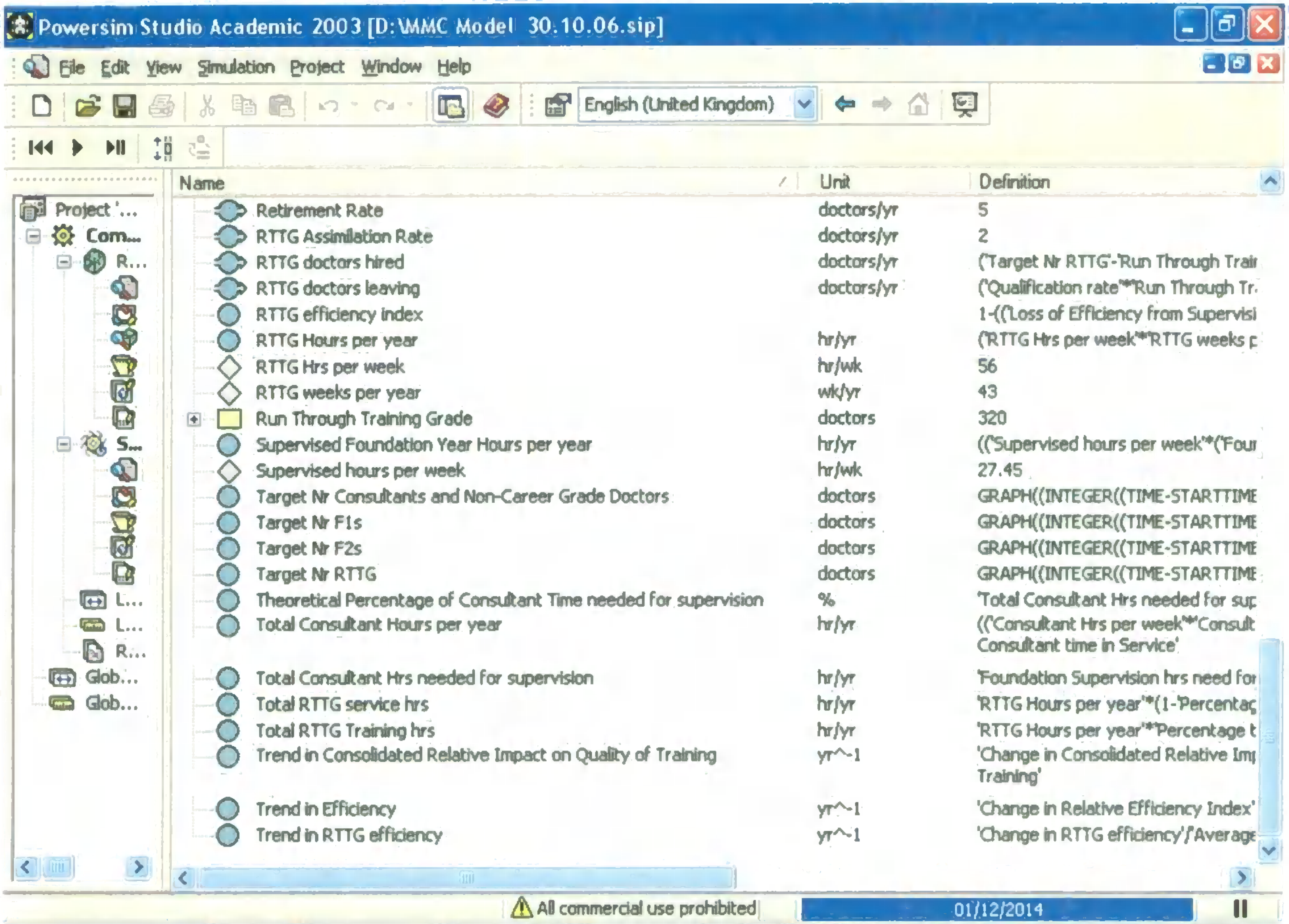
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Name
Unit
Definition
Retirement Rate doctors/yr 5
RTTG Assimilation Rate doctors/yr 2
RTTG doctors hired doctors/yr ('Target Nr RTTG'-'Run Through Trai
RTTG doctors leaving doctors/yr ('Qualification rate'*'Run Through Tr
RTTG efficiency index 1-(('Loss of Efficiency from Supervisi
RTTG Hours per year hr/yr ('RTTG Hrs per week'*'RTTG weeks p
RTTG Hrs per week hr/wk 56
RTTG weeks per year wk/yr 43
Run Through Training Grade doctors 320
Supervised Foundation Year Hours per year hr/yr (('Supervised hours per week'*('Four
Supervised hours per week hr/wk 27.45
Target Nr Consultants and Non-Career Grade Doctors doctors GRAPH((INTEGER((TIME-STARTTIME
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Target Nr RTTG doctors GRAPH((INTEGER((TIME-STARTTIME
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Total Consultant Hours per year hr/yr (('Consultant Hrs per week'*'Consult
Consultant time in Service'
Total Consultant Hrs needed for supervision hr/yr 'Foundation Supervision hrs need for
Total RTTG service hrs hr/yr 'RTTG Hours per year'*(1-'Percentag
Total RTTG Training hrs hr/yr 'RTTG Hours per year'*'Percentage t
Trend in Consolidated Relative Impact on Quality of Training yr^-1 'Change in Consolidated Relative Im
Training'
Trend in Efficiency yr^-1 'Change in Relative Efficiency Index'
Trend in RTTG efficiency yr^-1 'Change in RTTG efficiency'/'Average
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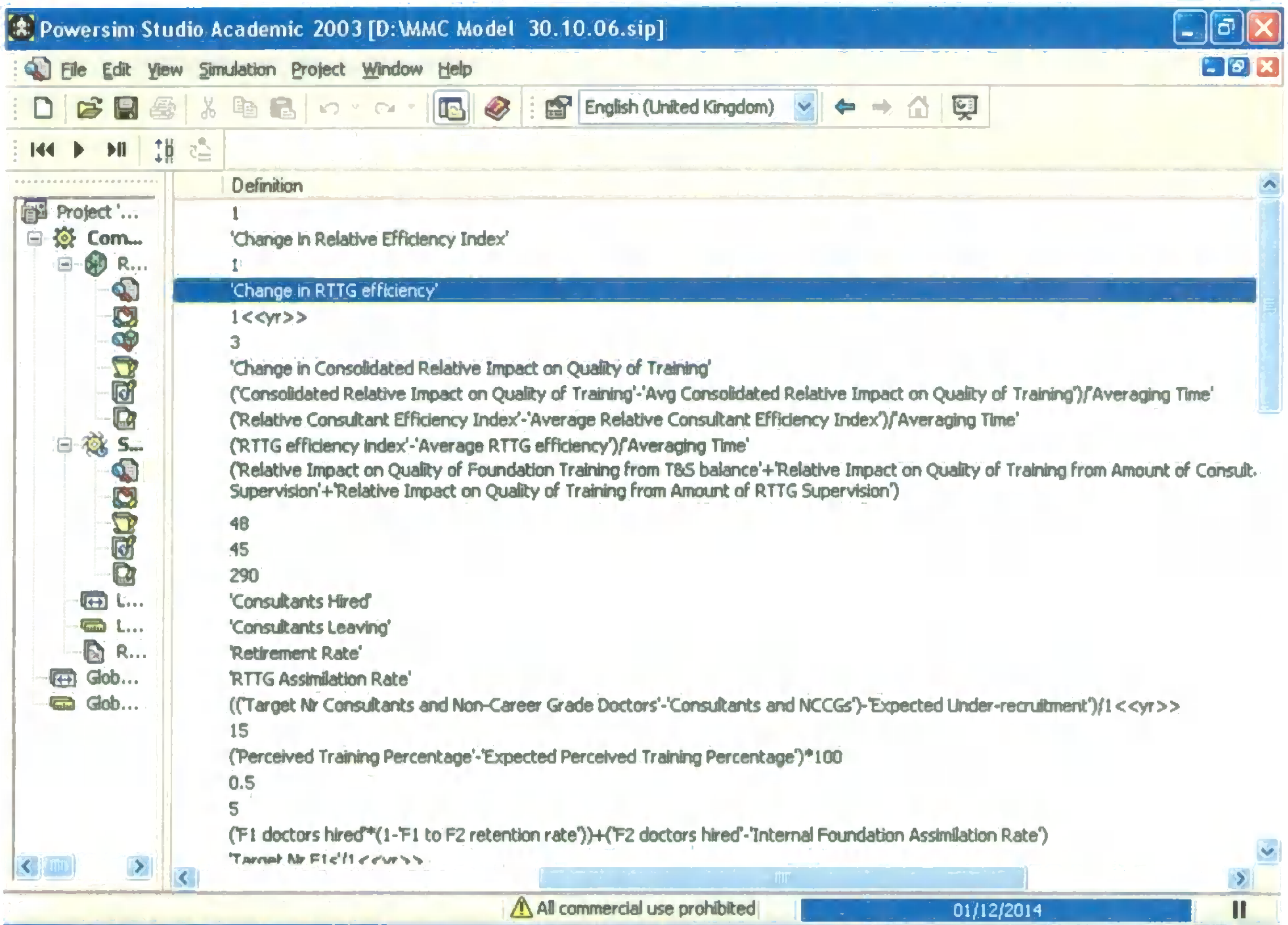
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Definition
1
'Change in Relative Efficiency Index'
1
'Change in RTTG efficiency'
1<<yr>>
3
'Change in Consolidated Relative Impact on Quality of Training'
('Consolidated Relative Impact on Quality of Training'-'Avg Consolidated Relative Impact on Quality of Training')/'Averaging Time'
('Relative Consultant Efficiency Index'-'Average Relative Consultant Efficiency Index')/'Averaging Time'
('RTTG efficiency index'-'Average RTTG efficiency')/'Averaging Time'
('Relative Impact on Quality of Foundation Training from T&S balance'+'Relative Impact on Quality of Training from Amount of Consult. Supervision'+'Relative Impact on Quality of Training from Amount of RTTG Supervision')
48
45
290
'Consultants Hired'
'Consultants Leaving'
'Retirement Rate'
'RTTG Assimilation Rate'
(('Target Nr Consultants and Non-Career Grade Doctors'-'Consultants and NCCGs')-'Expected Under-recruitment')/1<<yr>>
15
('Perceived Training Percentage'-'Expected Perceived Training Percentage')*100
0.5
5
('F1 doctors hired'*(1-'F1 to F2 retention rate'))+('F2 doctors hired'-'Internal Foundation Assimilation Rate')
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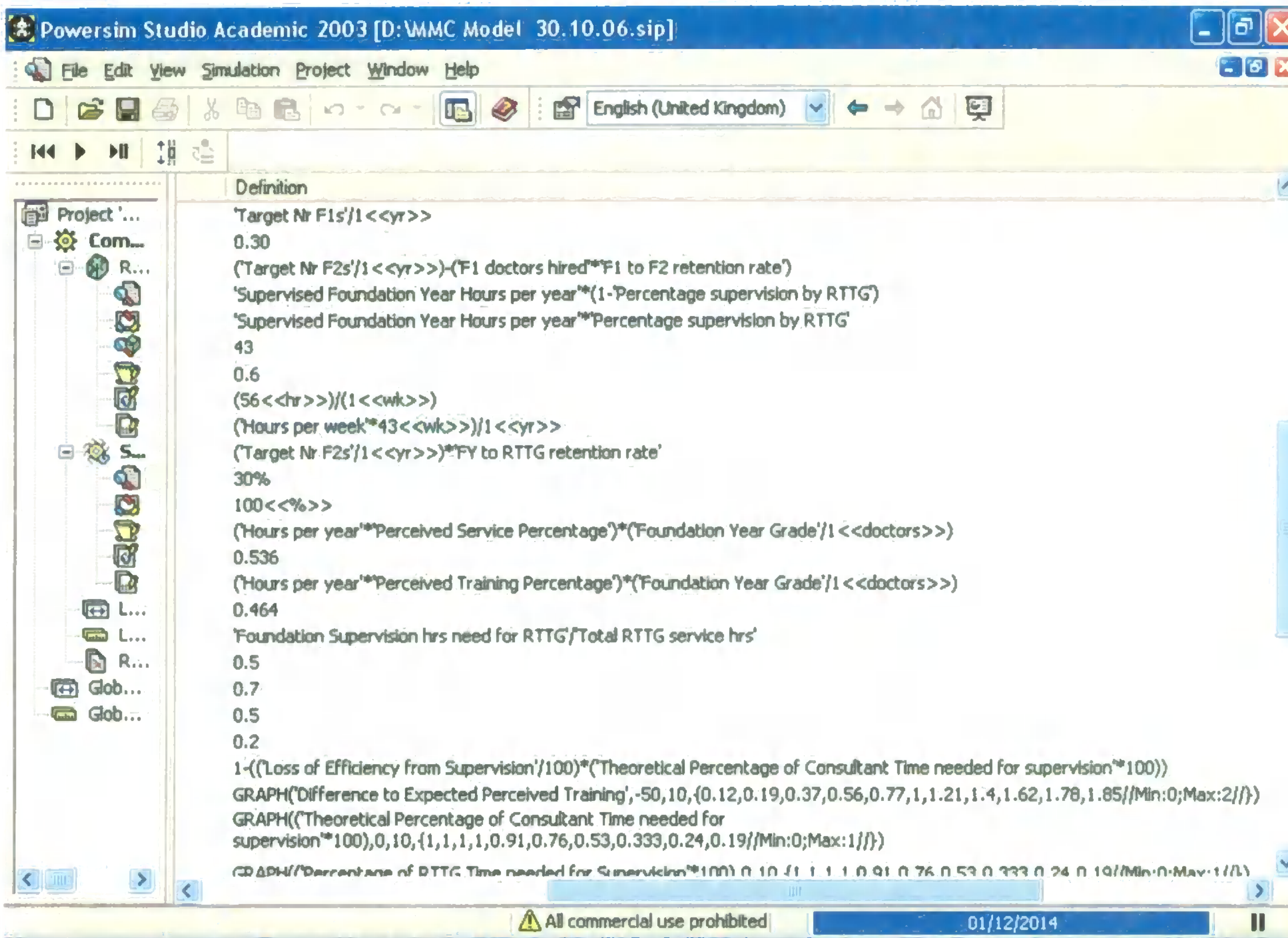
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Definition
'Target Nr F1s'/1<<yr>>
0.30
('Target Nr F2s'/1<<yr>>)-('F1 doctors hired'*'F1 to F2 retention rate')
'Supervised Foundation Year Hours per year'*(1-'Percentage supervision by RTTG')
'Supervised Foundation Year Hours per year'*'Percentage supervision by RTTG'
43
0.6
(56<<hr>>)/(1<<wk>>)
('Hours per week'*43<<wk>>)/1<<yr>>
('Target Nr F2s'/1<<yr>>)*'FY to RTTG retention rate'
30%
100<<%>>
('Hours per year'*'Perceived Service Percentage')*('Foundation Year Grade'/1<<doctors>>)
0.536
('Hours per year'*'Perceived Training Percentage')*('Foundation Year Grade'/1<<doctors>>)
0.464
'Foundation Supervision hrs need for RTTG'/'Total RTTG service hrs'
0.5
0.7
0.5
0.2
1-(('Loss of Efficiency from Supervision'/100)*('Theoretical Percentage of Consultant Time needed for supervision'*100))
GRAPH('Difference to Expected Perceived Training',-50,10,{0.12,0.19,0.37,0.56,0.77,1,1.21,1.4,1.62,1.78,1.85//Min:0;Max:2//})
GRAPH(('Theoretical Percentage of Consultant Time needed for supervision'*100),0,10,{1,1,1,1,0.91,0.76,0.53,0.333,0.24,0.19//Min:0;Max:1//})
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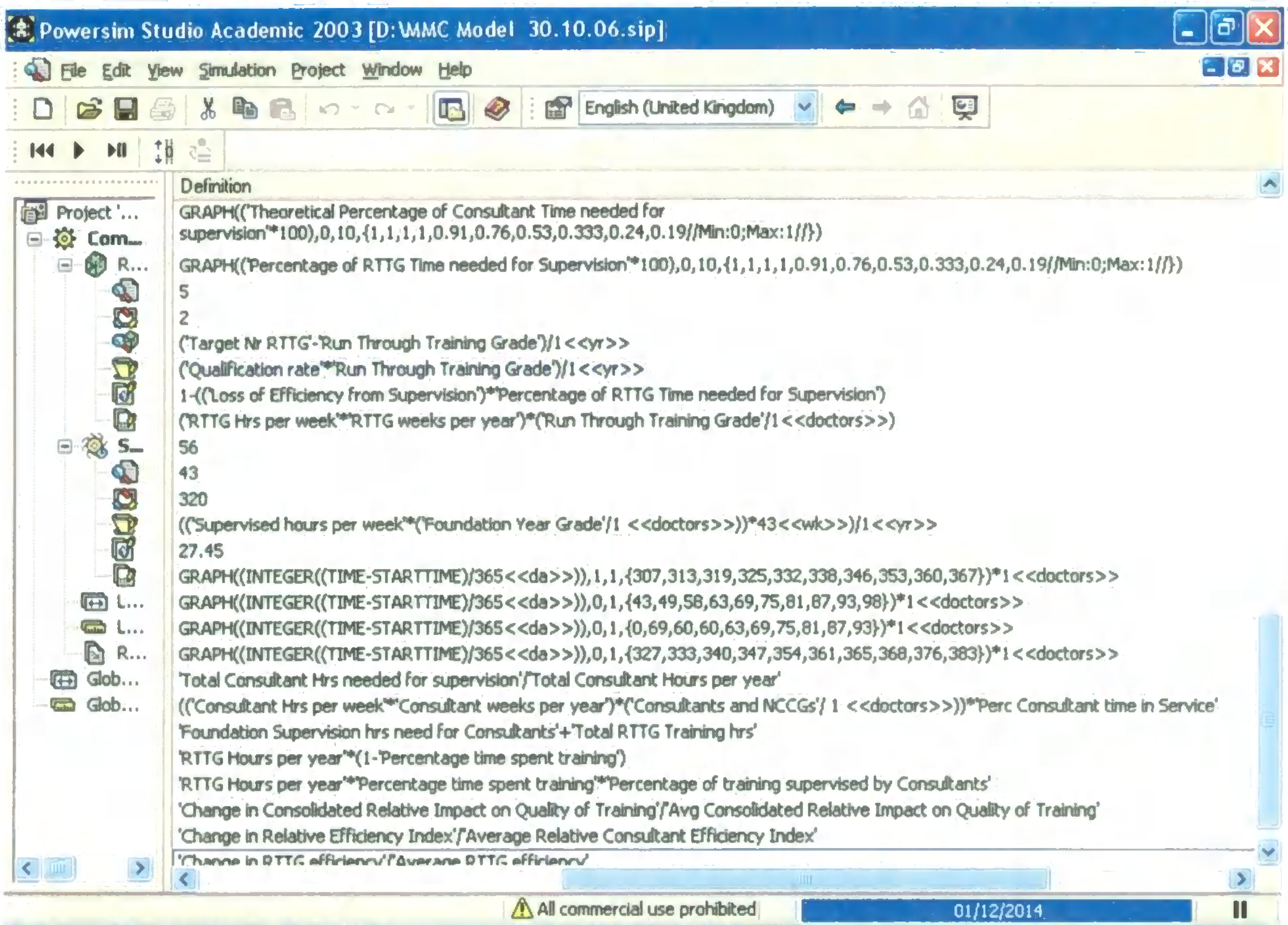
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GRAPH(('Theoretical Percentage of Consultant Time needed for supervision'*100),0,10,{1,1,1,1,0.91,0.76,0.53,0.333,0.24,0.19//Min:0;Max:1//})
GRAPH(('Percentage of RTTG Time needed for Supervision'*100),0,10,{1,1,1,1,0.91,0.76,0.53,0.333,0.24,0.19//Min:0;Max:1//})
5
2
('Target Nr RTTG'-'Run Through Training Grade')/1<<yr>>
('Qualification rate'*'Run Through Training Grade')/1<<yr>>
1-(('Loss of Efficiency from Supervision')*'Percentage of RTTG Time needed for Supervision')
('RTTG Hrs per week'*'RTTG weeks per year')*('Run Through Training Grade'/1<<doctors>>)
56
43
320
(('Supervised hours per week'*('Foundation Year Grade'/1 <<doctors>>))*43<<wk>>)/1<<yr>>
27.45
GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),1,1,{307,313,319,325,332,338,346,353,360,367})*1<<doctors>>
GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),0,1,{43,49,58,63,69,75,81,87,93,98})*1<<doctors>>
GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),0,1,{0,69,60,60,63,69,75,81,87,93})*1<<doctors>>
GRAPH((INTEGER((TIME-STARTTIME)/365<<da>>)),0,1,{327,333,340,347,354,361,365,368,376,383})*1<<doctors>>
'Total Consultant Hrs needed for supervision'/'Total Consultant Hours per year'
(('Consultant Hrs per week'*'Consultant weeks per year')*('Consultants and NCCGs'/ 1 <<doctors>>))*'Perc Consultant time in Service'
'Foundation Supervision hrs need for Consultants'+'Total RTTG Training hrs'
'RTTG Hours per year'*(1-'Percentage time spent training')
'RTTG Hours per year'*'Percentage time spent training'*'Percentage of training supervised by Consultants'
'Change in Consolidated Relative Impact on Quality of Training'/'Avg Consolidated Relative Impact on Quality of Training'
'Change in Relative Efficiency Index'/'Average Relative Consultant Efficiency Index'
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Appendix IV

The training/service continuum: exploring the training/service balance of senior house officer activities

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BACKGROUND The continued reduction in junior doctors' hours in the UK has made it necessary to re-examine traditional assumptions about the synonymous natures of training and service. This paper researches senior house officers' (SHOs) perceptions of 'service' and 'training', with reference to where they place activities along the training/service continuum, and the factors that lead them to classify these activities in the way they do.

METHODS Questionnaires were sent to all identified SHOs at Plymouth Hospitals NHS Trust (40% response rate). Three focus groups were held with 5 SHOs, 3 consultants and 2 clinical tutors. Quantitative data derived from the questionnaires were analysed using SPSS. Qualitative data collected in the focus groups was coded with the aid of N6, which facilitated the thematic analysis of transcripts.

RESULTS Analysis of the quantitative data allowed the construction of the training/service continuum diagram. Identified factors affecting the perceived training/service balance of SHO activities included: frequency, time, type and nature of work, number of patients, supervision, interaction, other commitments, purpose and focus of the activity, the individual trainee and trainer, and experience and competence.

DISCUSSION It is no longer appropriate to assume that all junior doctor activities represent either training or service individually: activities are perceived differently along the training/service continuum depending on their execution and their relation to the SHOs' learning curves. Within the reduced hours framework, it is necessary to match this balance to experience, in order for both training and service requirements to be satisfied.

KEYWORDS medical staff, hospital/*education/psychology/statistics & numerical data; *in-service training; *attitude of health personnel; perception; teaching/methods; professional practice/*statistics & numerical data/organisation & administration; workload; Great Britain.

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INTRODUCTION

Historically, excessive hours, including long hours on-call, were integral to the life of a junior doctor, allowing them to soak up knowledge and train alongside other grades in their specialty. Increased recognition of lack of safety for patients and adverse effects on the learning and health of junior doctors led to the introduction of the New Deal Working Hours Regulations and the revised junior doctor contract. Additionally, the European Union Working Time Directive (EU WTD) came into force for junior doctors in the UK in August 2004, requiring a reduction in working hours.[1]

In an effort to reduce hours, there have been significant changes in working patterns, including moving to shift working, increasing the numbers of trust doctors, reducing tiers and increasing cross cover, as well as new ways of working and extended roles piloted by the Department of Health.[2] The

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Overview

What is already known on this subject

Reduced hours and revised working patterns may impact negatively on training, with service provision becoming the priority. 'Training' and 'service' for junior doctors are seen as synonymous.

What this study adds

Senior house officer activities do not represent either training or service individually, but are perceived as lying along a continuum. This study identifies factors that lead SHOs to perceive the balance between activities.

Suggestions for further research

To address the training/service balance within a reduced hours context, it is necessary to match the execution of activities to SHOs' level of experience and develop strategies for encouraging junior doctors to move along their learning curves. Further research might identify ways of achieving this.

implementation of *Modernising Medical Careers*, which aims to restructure and formalise senior house officer (SHO) training[3–5] will bring further changes.

A literature review revealed a significant number of studies into impacts of the EU WTD and its equivalent initiative by the Accreditation Council for Graduate Medical Education in the USA, which reduces resident working weeks to fewer than 80 hours. The research reveals a general concern for potential negative impacts of reduced hours on training and patient care, particularly on the continuity of care,[6] but there are mixed results. Although some use quantified measures of training (e.g. operating hours, patient episodes experienced),[7,8] there is a trend to use junior doctors' and senior medical staff's perceptions and attitudes in evaluating impacts on experiences of training.[9–13] Chung et al. (2004) used both quantified measures of training experiences in conjunction with junior doctors perceptions to evaluate the impacts of reduced hours working on training.[14] However, what is most evident is that the existing research into impacts on training suffers from a lack of clarity about what is meant by 'training': is it classroom teaching, on-the-job experience, learning, or all of these?

Given this lack of direction, it is not surprising that research results on the impacts of shift-working and reduced hours on junior doctor training are inconclusive and contradictory.[15] Some studies comparing shift-working with on-call patterns have found significantly lower training experience and training satisfaction scores for participants,[16,17] while others purport that training standards are maintained[18] or even improved due to better learning and working conditions associated with less tiredness. The literature also refers to adverse impacts on training in relation to loss of continuity of care,[6] and claims that when hours are reduced, there are fewer opportunities for learning,[17,19] experience is diluted[20] and service takes precedence over training.[16,21] Beyond formal studies, there is a significant body of literature that comprises personal commentaries, editorials and anecdotes, and expresses concerns over the potential adverse impacts of reduced hours and shift working on the education and training of junior doctors at all levels.[22–26]

There have been claims that the reduction in working hours is impacting on junior doctor training because fewer hours spent at work are seen to equate with fewer hours spent in training.[16,17] This assumes that all hours spent at the hospital are training hours. Simultaneously, it has been widely recognised that, as SHOs provide the bulk of the service, reducing their hours will impact on service provision. This assumes that all hours are service hours. Which is the case? Is everything that SHOs do simply all training or all service? Are there varying amounts of training and service to be found in what they do? How does the balance between training and service vary across activities? What factors influence this? These questions have not been answered; the synonymous nature of training and service for junior doctors has not been questioned, and there is a lack of definition of the concepts of 'training' and 'service'.

In raising these questions, a training/service continuum was conceived: SHO activities could be placed along a continuum ranging from 100% training (consequentially 0% service) to 100% service (consequentially 0% training).

Using this conceived training/service continuum, this research explored:

1 the perceived training/service balance for each typical SHO activity, and

2 factors affecting perceptions of the training/service balance for SHO activities.

METHODS

Data were collected through questionnaires and focus groups. The 2 sources of information were designed to complement each other.

Questionnaires were used to gauge SHOs' perceptions of the extent to which activities are training- or service-focused, frequency of participation, and the presence of a more experienced person, as their presence may affect the perception of the balance in activities. Simple questions were asked about how long the participant had been an SHO, how long he or she expected to be an SHO and if he or she knew which specialty he or she wanted to work in. This was to assess whether experience and known career goals were variables that affect perceptions of training/service balance. As design and layout were important considerations in ensuring a high response rate, the questionnaire was piloted with a convenience sample of SHOs and senior medical staff. Appendix S1, available online, shows the final questionnaire, which was sent out to all 184 identified SHOs at Plymouth Hospitals NHS Trust.

Focus groups were convened to classify activities along the training/service continuum, allowing comparison with the questionnaire data, and identifying and exploring in more depth the factors that make an activity appear to be either more training- or more service-focused, thereby unpicking the rationale of perceptions and helping to validate the questionnaire data. Three focus groups were held: 1 for SHOs, 1 for consultant/educational supervisors, and 1 for clinical/college tutors.

The organisation and design of the focus groups were important for effective data collection. An upper limit of 10 participants per focus group was set, with an anticipated optimum number of approximately 5 or 6. They each ran for about 1 hour. Participants' chairs were positioned in a semicircle around a board displaying the training/service continuum. In order to make the best use of limited time, participants were briefed beforehand by a letter on the topics. Five SHOs, 3 consultant supervisors and 2 clinical tutors from a variety of surgical and medical specialties participated in 3 focus groups. Whilst the optimum number was not reached, it did not have an adverse effect on the quality of data as the sample size was still fit-for-purpose. The aim was not to seek universally representative and generaliseable data, but to gain insights into the rationale behind the perceptions identified by the questionnaires.

Data collected from the questionnaires were entered into an Access database and analysed in SPSS. The focus groups were taped and the tapes transcribed and analysed using N6, a qualitative analysis software package that facilitated the development of coding frames and thematic analyses of the texts.

RESULTS

Questionnaire results

After reminders, targeting specialties and a second mail-shot, the overall response rate was 40% (74 of 184). Most specialties were represented by at least 1 response; the major specialties had higher response rates. Table 1 shows response rates by specialty.

There was a fairly even and representative distribution of the experience of SHOs measured by how long each of them had been an SHO and how long he or she expected to remain an SHO. Thus, the 40% response rate is acceptable, as the demographics of the sample cover all major specialties and levels of experience.

Table 2 displays the median frequency, supervision (1 = supervision, 0 = none) and perceived training percentage for each activity. The mode and standard deviations are shown for the perceived training percentage. The median is appropriately close to the most frequent response in most cases, but there was a relatively high standard deviation.

Figure 1 shows how the activities are placed along the continuum, depicting the interquartile range (the peak displays the median; the higher and lower ends of the shapes show the 75% and 25% quartiles). This provides an indication of the level of consensus of perceptions of the training/service balance in the activities.

Regressions and correlations showed that just under 70% of variation in training percentage perception could be explained by variations in frequency and supervision across the 28 activities, unsurprisingly. The more frequent the activity, the lower the perceived training focus. As expected, the existence of supervision in an activity increases the perceived training focus.

Table 1 Questionnaire response rates by specialty

Specialty	*n* SHOs identified	Response rate %
Accident & Emergency	16	44
Anaesthetics	18	61
Cardiology	7	57
Cardiothoracic Surgery	8	75
Dermatology	1	100
Diabetes/Endocrinology	5	40
Ear, Nose & Throat	3	67
Gastroenterology	4	0
Haematology	3	0
Health Care of the Elderly	7	57
Intensive Care Unit	4	25
Maxillofacial surgery	5	40
Medicine (other)	7	14
Neurology	6	50
Neurosurgery	6	33
Obstetrics & Gynaecology	12	25
Oncology	5	60
Ophthalmology	6	0
Orthopaedics	13	23
Paediatrics	13	31
Plastic Surgery	5	60
Psychiatry	1	0
Renal	7	43
Respiratory	6	50
Rheumatology	2	0
Surgery	12	42
Urology	2	50
Total	184	40

Focus group results

The qualitative data collected identified factors that affect the training/service balance perception of SHO activities.

Frequency

Frequency was seen as influencing whether an activity was perceived as being training- or service-oriented. Experience and competence were highlighted: activities that SHOs had not performed many times were seen as part of training, whereas those in which sufficient experience or competence had been achieved were seen as representing service. If the frequency of an activity was insufficiently matched with the individual's experience and learning curves, SHOs perceived the balance as problematic.

Time

Time was identified as a crucial factor. It is assumed that a training-focused activity takes more time than an activity that is service-focused. Consultants expressed concern that this involved not only SHO time, but also more of their time. Service pressures, relating to the number of patients who needed to be seen in clinics, ward rounds or theatres, meant there was less time to train. One SHO said:

> 'It's like ward rounds. If you've got an interested consultant and 15 patients to go round either in a morning or an afternoon, then you can talk about them and, obviously we're looking at the patient's care, but they [the consultants] do explain why they're doing things, and if you've got questions as well... If you've got 70 patients on a post-take ward round that's supposed to be done in 2 hours then, you barely can do the service commitment, let alone anything else.'

Type and nature of work

Variations in the practice of activities, such as outpatient clinics, were frequently mentioned as explanations for where activities were placed on the continuum. For example, the nature of work in the ear, nose and throat department was contrasted with that in other specialties in terms of attending clinics and talking to patients and relatives. Attending clinics was seen to be at the training end of the spectrum by 1 participant in the consultant focus group because:

> 'Ear, nose and throat surgery is about 70% outpatients and 30% inpatient, so they're [the SHOs] bound to spend more time in outpatient clinics, where the number of patients is limited. And they are encouraged to come and ask.'

While the nature of the work in an activity was seen to be conducive to training, it simultaneously made other activities more service-oriented. For example, in talking to patients and relatives:

> '...ENT surgery is a high-volume, short-stay thing – there's not much to talk about. They come in, they have an operation, and go home the same day or the next morning. But if you have somebody with malignant bowel disease or breast cancer or something, the scenario is rather different.'

Thus, as the nature and type of work vary tremendously by specialty, so do the training/service balances of activities performed in different specialties. While this is an acknowledged fact, it does not universally affect all activities. For example, SHO teaching, appraisals or presentations represent examples of activities where the type of work did not affect the training/service balance perception.

Table 2 Questionnaire results: descriptive statistics for the frequency, existence of supervision and perceived training percentage of SHO activities

Activity (no)	Frequency (times per SHO post) Median	Supervision Median	Perceived training percentage Median	Mode	Standard deviation
Appraisals (27)	2.50	1	90.00	100.00	22.40
Assisting general medical procedures (12)	13.00	1	70.00	90.00	27.66
Assisting in theatre (16)	26.00	1	70.00	50.00	24.00
Attending clinics (24)	26.00	1	80.00	80.00	21.74
Audit activities (25)	2.50	1	70.00	50.00	22.19
Clerking admissions (4)	130.00	0	30.00	20.00	27.65
Collating results (7)	260.00	0	20.00	0.00	24.53
Discussing patients with colleagues (incl.GP) (20)	130.00	1	50.00	80.00	27.86
Examining/reviewing patient (2)	260.00	0	50.00	60.00	24.40
Formal SHO teaching (22)	26.00	1	100.00	100.00	10.46
Formal team meetings (21)	26.00	1	70.00	50.00	23.39
Handover to next SHO (or cover) (19)	130.00	0	20.00	0.00	23.50
Medical history taking (3)	260.00	0	50.00	50.00	27.47
Observing general medical procedures (13)	13.00	1	80.00	80.00	28.12
Observing in theatre (17)	26.00	1	80.00	90.00	25.41
Operating in theatre (15)	26.00	1	80.00	90.00	24.74
Patient-related administration (5)	260.00	0	10.00	0.00	22.83
Performing general medical procedures (11)	26.00	1	70.00	50.00	22.65
Preparing for procedures or theatre (14)	26.00	0	30.00	0.00	30.38
Presentations (28)	2.50	1	80.00	80.00	18.09
Reading journals/research/private study (26)	26.00	0	90.00	100.00	14.31
Taking blood/ECGs/cannulation/ catheterisation (8)	260.00	0	10.00	0.00	23.56
Talking to patients and relatives (18)	260.00	0	40.00	50.00	24.94
Teaching medical students/other (23)	6.00	0	80.00	80.00	25.02
Urgent or emergency assessment and management of patient (9)	130.00	1	60.00	50.00	24.47
Ward round (1)	130.00	1	50.00	50.00	25.34
Writing patient notes (6)	260.00	0	20.00	10.00	24.24
Writing prescriptions (10)	260.00	0	10.00	10.00	23.87

(No): activity numbers refer to the order activities appear in the questionnaire.

Number of patients

The number of patients reviewed or treated during an activity was felt to influence the extent to which an activity was perceived as being training- or service-oriented, mainly because the number of patients was seen as proxy to workload in that the more work there is, the less time there is for training:

> 'If you've got a clinic which, because of service requirements, is very heavily booked, you don't have the luxury to sit along[side] the juniors and discuss cases.'

Supervision

Supervision, unsurprisingly, was seen as an important factor as the mere word 'training' implies the presence of a trainer. Consultants said that an activity becomes more training-focused by:

> 'Doing it under supervision. Or having it demonstrated to them [the SHOs]. Them feeding back to the consultants what they found, how they found it, and getting them to demonstrate it to them. All that sort of thing.'

SHOs also identified supervision as very important but appreciated the significance of not being supervised in their training:

> 'If there isn't supervision, you are training yourself because you've been there with the responsibility of dealing with the patient yourself, which is important too.'

In the early stages, supervision is needed, but lack of it is important later on for developing confidence.

Interaction

Interaction, particularly the interactive questioning of decisions and alternatives in clinical decision

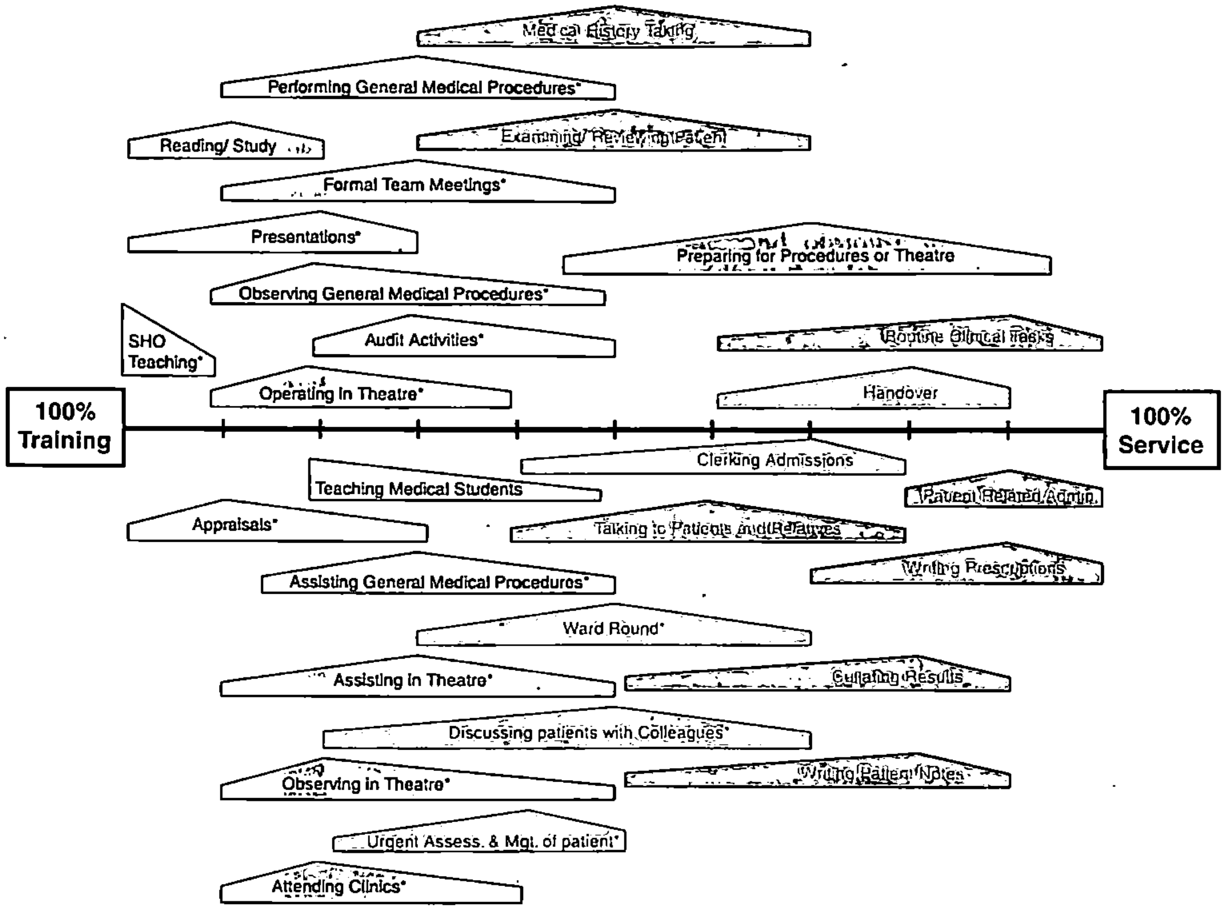

Figure 1 Diagrammatic representation of training/service perceptions of SHO activities. Darker shades represent activities that are performed more frequently. Activities marked with * are likely to be supervised.

making and judgement, was universally seen as important for training. When this was missing in an activity, it was seen as service-focused. Handover was the most commonly cited example: if there was any questioning of decision making, the handover was seen as more training-focused. If the handover procedure simply involved handing over jobs and to-do-lists, it was seen as being more service-oriented.

Other commitments

Other commitments that have to be fulfilled at the same time were mentioned by all groups as a reason for activities to be seen as more service-focused.

Purpose and focus

The purpose and focus of specific activities were seen to affect their execution; this was seen to have a bearing on their place on the continuum, particularly regarding ward rounds and team meetings.

The trainee and the trainer

The consultant and tutor focus groups identified that there is significant variation in motivation, attitudes and expectations among trainees. This affects the training/service balance. They also felt that trainees expected training to be 'delivered' to them. Unsurprisingly, the SHOs did not identify this. One of the tutors highlighted the disparity in trainee and trainer expectations:

> 'Are we in a situation at the moment where the trainees are expecting to be trained and the trainers are expecting the trainees to learn? and therefore the two are a distance apart.'

All focus groups identified a variance in the attitudes, motivation and expectation of the trainers (i.e. the consultants), and perceived that this had an impact on the training/service balance of an activity. As 1 participant summarised:

> 'I would think where things come [on the continuum] depends entirely on the personalities of

the SHO and the person they're working with. Some doctors will come, do the work and disappear, that's it. That's all they do. There are other people who take an interest in juniors. And vice versa, there are juniors who are interested in their seniors. And they engage in exchange in information. I think it's largely a reflection on people.'

Experience and competence

Experience and competence had an influence on the training/service balance perception: the more experienced someone became, the more the activity would be seen as part of service. Similarly, until competence was demonstrated, the same activity would be perceived as lying towards the training end of the continuum, after which it would become service-related. This was particularly relevant for manual skills and procedures. The complexity of an activity was relevant: simple activities require less experience to gain competence, therefore they quickly become service-focused, as opposed to more complex activities, which remain at the training end of the continuum for much longer.

DISCUSSION

This paper has researched which SHO activities are perceived as being service-focused and which training-focused, and the qualities of an activity that lead to its classification.

As Fig. 1 shows, 2 factors – the frequency with which SHOs perform activities and supervision – explain 70% of the variation in perceptions of activities. This is largely a symptom of the traditional model of postgraduate medical education, where the junior is trained by repeatedly performing activities under the supervision of senior staff. However, it is evident from this research that these are not the only qualities that lead to classification under 'training' and 'service'. Other factors include: time; the number of patients (workload); the type and nature of work in the specialty; the individual trainee's and trainer's motivations and attitudes; interaction; the purpose and focus of the activity; other commitments; experience, and competence. These all affect the execution and practice of activities, which directly influences how the activities are perceived along the training/service continuum. Moreover, these factors themselves are intricately related with one another, compounding the complexity of the situation.

This indicates that the notion that working many hours under supervision is the only way of providing postgraduate medical education is too simplistic. The 'system' is more complex, and it is not relevant to continue assuming that everything SHOs do is either 'all training' and 'all service'. As this study has shown, the balance between the 2 varies between activities, with a number of factors contributing to this perceived balance. This has important implications for reducing junior doctor hours: there is more impact on training and service than just simply the number of hours worked, and all these factors need to be considered in devising solutions. It has also become apparent from this work that underpinning solutions to the training/service/hours conundrum is a discussion about learning curves and competence, both at an individual and an aggregate level. The training/service balance in the practice of activities and the factors shaping it are highly related to where the SHO is on the learning curve regarding that activity and whether he or she is competent in performing it, particularly regarding more practical or manual skills. While it needs to be acknowledged that there is always something new to be learnt from an experience, as SHOs approach the flatter end of the learning curve the activity will inevitably be perceived as being more service-focused, irrespective of the number of patients involved, time available, interaction with senior staff or any of the other identified factors.

Therefore, perhaps some of the solutions to reconciling the impacts on training and service of reducing junior doctors' hours lie in questioning how to encourage junior doctors to move along the learning curve and become competent more efficiently. This would not only combat some of the perceived consequences that reduced hours have had on training, but also maintain service provision, as junior doctors would provide more of a service focus in their activities earlier on as they reach the flatter ends of their learning curves more quickly. More work in this area is needed.

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SUPPLEMENTARY MATERIAL

The following supplementary material is available for this article online:

Appendix S1. Questionnaire.

This material is available as part of the online article from http://www.blackwell-synergy.com

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plans that will promote long term sustainable development at the local level. The conceptual model for this research project explores the primary mitigation policy alternatives and depicts the "false sense of security" trap, with endogenous explanations, in a stock and flow feedback structure.

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Evaluating the Impacts of Time-Reduction Legislation on Junior Doctor Training and Service

If junior doctors are to work significantly fewer hours in the future, how can they still receive full training and continue to provide necessary levels of medical service to patients? Historically, excessive hours have been a way of the life for junior doctors worldwide, but New Deal regulations, a revised junior doctor contract, and the EU Working Time Directive are changing this. A project at Derriford Hospital in Plymouth is researching the nature of 'quality and effective training', and constructing SD models to yield insights and eventually support operational decision-making. This has already yielded significant insights for those at Derriford wrestling with this seemingly impossible task, including, the circularity between junior doctor training, consultants' service and their training-supervision role, and the quality of training provided, and the likely importance of recruiting outside the progression process in addressing service imbalances. It also highlights some of the special challenges in projects where there are many stakeholders, political agendas, and a continuously changing environment.

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Usefulness of Probabilistic System Dynamics in Dynamic Decision Making

Most dynamic decision making tasks include assumptions which have a huge uncertainty attached to them. Organizations are inherently complex. The combination of uncertainty and complexity results often in a sub-optimal decision. This paper emphasises on the usage of probabilistic system dynamics (SD). The focus of probabilistic SD is to represent the behaviour of uncertain variables in a realistic manner. The information generated by probabilistic SD could produce "complete" information thereby improving the mental models of decision makers. Many SD models use deterministic values of variables. However, "determinism" is untrue for real business settings. In order to test the effectiveness of probabilistic SD on managerial decision making, this study aims at conducting a series of rigorous and controlled experiments. Specifically it tests the usefulness of (1) system dynamics itself, (2) model validation techniques and (3)

PROCEEDINGS OF THE PLYMOUTH BUSINESS SCHOOL AND SCHOOL OF SOCIOLOGY, POLITICS AND LAW POSTGRADUATE SYMPOSIUM 2006. Compilation © 2006 University of Plymouth, UK

MODELLING THE EDUCATION AND SERVICE ACTIVITIES OF JUNIOR DOCTORS UNDER THE EU WORKING TIME DIRECTIVE

Sonja Derrick

Abstract

If junior doctors are to work significantly fewer hours in the future, how can they still receive full training and continue to provide necessary levels of service to patients? Historically, excessive hours have been a way of the life for junior doctors, but New Deal regulations, a revised junior doctor contract, and the EU Working Time Directive (EU WTD) are changing this. Additionally, postgraduate medical education is undergoing significant changes under Modernising Medical Careers. This research seeks to use system dynamics as a tool to model the impacts of the re-organisation of the education and service activities of a professional group within an organisational context, by taking junior doctor service and training under the EU WTD as the specific example at hand. The necessarily tailored approach taken to developing the model has yielded important insights into the relationship between junior doctor "training" and "service" and how these are related to the activities they participate in during working hours. Valuable knowledge and lessons were also gathered from the model building process itself, which has involved continuous iterations and modifications in describing this social system.

Background

Historically, excessive hours were integral to the life of a junior doctor; long hours on-call, soaking up knowledge and training alongside other grades in their specialty. Increased recognition of lack of safety for patients and adverse effects on learning and health of junior doctors has led to the introduction of the New Deal working hours regulations and the revised junior doctor contract. Additionally, the European Union Working Time Directive (EU WTD) came into force for junior doctors in the UK in August 2004, requiring a reduction in working hours.[1]

Further, postgraduate medical education in the UK is changing under the introduction of *Modernising Medical Careers*, which sees the restructuring of junior doctor grades and formalising of the curriculum and assessment of training. Postgraduate medical career progression until 2005 can be seen in Figure 1a and a simplified diagram of the new grades proposed under Modernising Medical Careers in Figure 1b.

Figure 1a - Postgraduate Medical Career Progression until August 2005

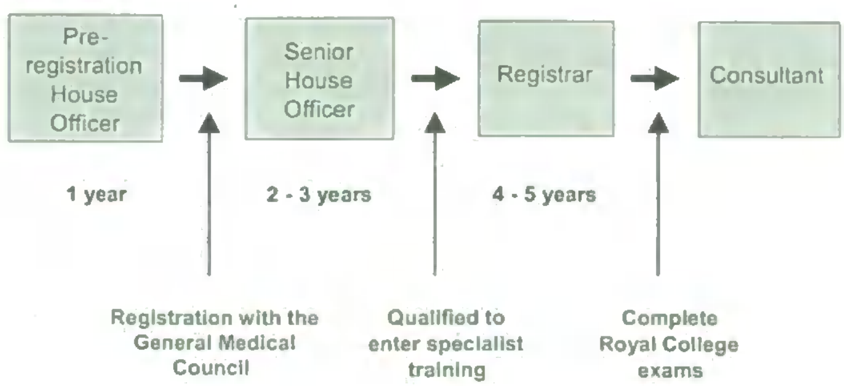


Figure 1b - Simplified Diagram of New Junior Doctor Grades under Modernising Medical Careers

In an effort to reduce hours, Hospital Trusts have had to introduce significant changes in working patterns for junior doctors: moving from on-call to shift working, increasing numbers of service based doctors, reducing tiers and increasing cross cover, as well as new ways of working and extended roles piloted by the Department of Health.[2] The implementation of Modernising Medical Careers, which aims to restructure and formalise postgraduate medical education [3-5] will bring further changes from 2005.

Further, it is also feared that as training becomes more intense and more doctors will have to be trained to fill the service gap, then pressures on consultants' time will also increase. Alongside which, it is not only junior doctors that have to comply with hours regulations, but also senior members. In principle, consultants have always fallen under the 48-hour working week imposed by the EUWTD. However, this issue has become more prominent in the recent negotiations of the new consultant contract, and demands continue to increase as hospital admissions rise and growth of service provision flourishes. Non-compliance is not an option, and failure to train junior medical staff or provide services to patients results in a withdrawal in funding or other financial penalties for NHS Hospital Trusts.

A literature review revealed a significant number of studies into impacts of the EU WTD and its equivalent initiative by the ACGME in the U.S., which reduces resident working weeks to fewer than 80 hours. The research reveals a general concern of potential negative impacts of reduced hours on training and patient care, particularly on the continuity of care [6], but there are mixed results. Although some use quantified measures of training (e.g. operating hours, patient episodes experienced) [7-8], there is a trend to use junior doctors and senior medical staff's perceptions and attitudes in evaluating impacts on experiences of training. [9-13] However, what is most evident is that the existing research of impacts of reduced hours working on "training" suffers from a lack of definition of what is meant with "training": is it classroom teaching, on-the-job experience, learning, or all of the above?

Given this lack of direction, it is not surprising that relevant research results to date are inconclusive and contradictory. [14] While some studies report a significantly lower training experience and training satisfaction scores for participants [15-16] while others purport that either training standards are maintained[17], or even improved due to better learning and working conditions associated with less tiredness. The literature also refers to adverse impacts on training in relation to loss of continuity of care[6] and that when hours are reduced, there are fewer opportunities for learning[16,18], a dilution of experience[19] and "service" takes precedence over "training" [15,20].

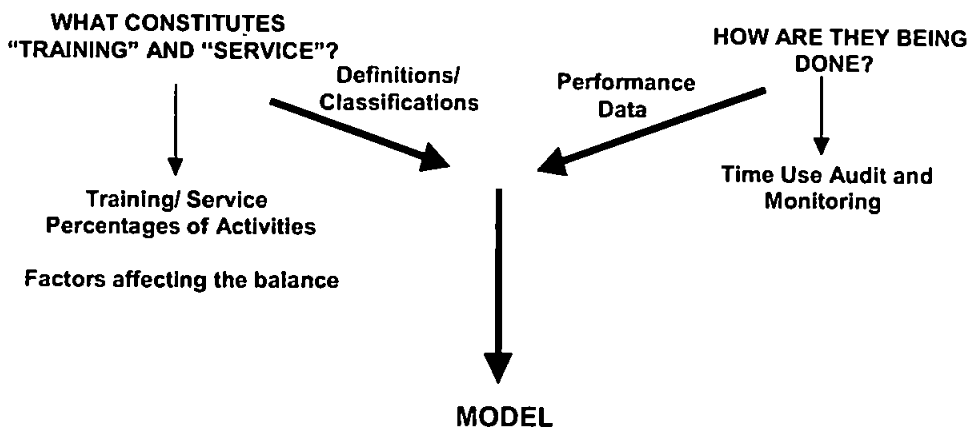
It is immediately apparent this is a "messy problem" beyond simple optimisation. Reducing junior doctors' hours involves changes to working patterns, which have very real causally linked impacts, of both a qualitative and quantitative nature. Further, failure to consider the system as a whole is likely to have short and long-term impacts on: training and experience for junior doctors, finance and service provision for the Trust, patient care, and the development of the current and future workforce. Proposed new ways of working need to be evaluated in light of all the potential consequences, beyond simple compliance and costs.

The Context

Plymouth Hospitals NHS Trust, whose main site is at Derriford Hospital in Plymouth, provides acute and specialist care services to approximately 450,000 people in Southeast Cornwall and Southwest Devon, and covering a population of almost 2 million people for some specialist services. With a budget of approximately £250 million, 1300 beds and the busiest A&E department in the South West of England, it employs approximately 6000 people, including approximately 450 junior doctors and 230 consultants. It is a major employer and provider of health services in the southwest peninsula.

Plymouth Hospitals NHS Trust have been working in partnership with the University of Plymouth to analyse the situation they are facing regarding the reconciliation of training and service needs of junior doctors with the EU WTD. From the outset, it

Figure 2 - The two pronged research approach



Early on in the research, both from the literature review and from conversations with problem owners, it became apparent that there was a lack of data and definition concerning both the concepts of "training" and "service" for junior doctors, how these related to what they did at work, as well as how much of their time is spent in training and service provision. Before the model building process could be initiated, it was necessary to bridge these gaps in knowledge, so that they could be accurately represented in the model of this social system.

The Training/ Service Continuum

As described, it was necessary to scope and clarify the concepts of "training" and "service" and question the status quo of the simultaneous nature of the two that was currently assumed in the profession. In particular, with reference to junior doctors it was important to understand: what constitutes training and service? How are they related? Is this a continuum or binary (either training or service)? How do junior doctor activities fall along the training/ service continuum and what factors affect this balance?

In addressing these questions, data was collected through questionnaires and focus groups. The entire population of Senior House Officers (a grade of junior doctors) at Plymouth Hospitals NHS Trust (PHNT) were targeted with a questionnaire, yielding quantitative data about training/ service balance perceptions and possible independent variables influencing these. Subsequently a sample of SHOs, Consultants and Tutors participated in focus groups, providing qualitative data on just under 70% of variation in training percentage perception could be explained by variations in frequency and supervision across the 28 activities.

Finally, in confirming the experience that there are a wide variety of views on the issues dealt in the training/ service/ hours conundrum, it is apparent that for some activities, there is a much higher level of consensus than others. For example, there is a high level of consensus about the training/ service balance in a SHO teaching session, but a more variable activity in its execution, such as ward round, or discussing patients with colleagues has a high interquartile range of responses, indicating a far lower level of consensus in views.

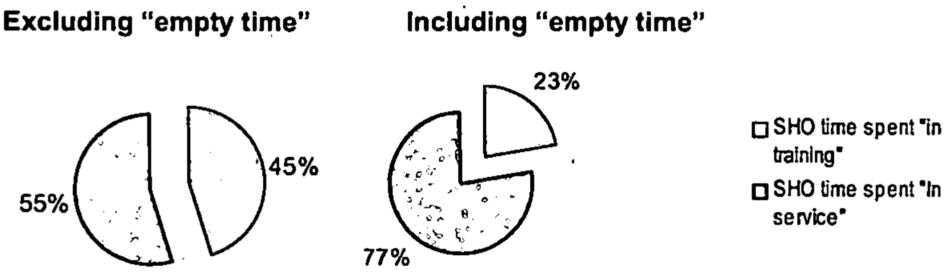
Complementing these results was a list of factors that affect the training/ service balance in the activities, which were arrived at from the focus groups. These included: time available for undertaking the activity, number of patients (workload), type and nature of work in the specialty, the individual trainee and trainers motivation and attitudes, interaction, purpose and focus of the activity, other commitments, experience and competence of the junior doctor. These were all factors regarding the execution of the activities. Some are quantitative features that can be more readily incorporated in the system dynamics model. Others, such as motivation and attitude, are not easily measurable, but this does not make them any less significant. In fact, this problem features a number of "soft issues" that have very definite real and "hard" impacts. This is something system dynamics should be amenable to modelling.

How is junior doctor time spent?

Once it was established what activities junior doctors partake in and how educational or service based these are perceived to be, it was necessary to gauge how much time was spent in these activities, in order to understand what the balance between "training" and "service" is in the working lives of junior doctors. The intention was to incorporate the concept of training/ service balance in the systems model, as its importance to the problem stakeholders had become apparent in early discussions.

Analysis of time-use data, collected at PHNT as part of the Medical Workforce Skills Mix Analysis project in 2003, where time spent undertaking each of the 28 activities was multiplied by the relevant training or service percentage, showed that 45% of SHO time is spent "in training" if the "empty" time (i.e. time spent doing other sundry activities such as walking, waiting, time in the doctors' mess (lounge), etc.) is not accounted for. However, if this time is included then the average time spent "in training" falls to 23% (implying conversely that 76% of SHO time is spent providing service). Detailed results of this time analysis can be found in Derrick et al [22].

Figure 4 - A snapshot of the Training/ Service Balance for SHOs



While there are a number of problems with this analysis, mostly deriving from the quality and accuracy of the time-use data, there are two major issues discovered in the time use analysis:

a. Across the 24-hr period, there appears to be a relatively large proportion of "slack" or "empty time" in the system (almost 50%): time that could be either reduced (perhaps questioning the need for a doctor to be on duty) or put to better use. Perhaps some of this "empty" time could be spent educationally, either in personal study or skills labs. While no one is (nor should be) 100% productive, the slack identified above is significant.

b. A relatively high proportion of aggregate time is spent on tasks such as patient related administration and routine non-complex clinical tasks that could either be made more efficient or in part be supplemented by other members of the team (e.g. doctors' support workers) thus freeing up more time for service and education.

Inevitably, the validity and reliability of these results could be greatly enhanced by more accurate and detailed data, but interestingly, the 23% figure is similar to the current assumptions made by many clinicians regarding junior doctor training, who have been highlighting that the bulk of NHS service is delivered by the SHO grade, and the 45% figure is close to the target amount of time that SHOs *should* spend "in training" (according to funding arrangements and *Modernising Medical Careers* guidelines that propose a 50/50 split). This discrepancy illustrates how statistics and conclusions from studies can be "massaged" to suit, if accurate data is not collected. Although appreciated that this shadowing data is not representative, nor complete, due to the lack of resources, this is the only data of this type currently available for PHNT. It is used here to help provide an indication of the training/ service balance for SHOs, and a good starting point for quantifying some of the relationships in the model, that previously haven't been able to be measured in this way.

Issues arising from the model building process

The model building process that this research underwent is extensively described and discussed elsewhere.[21-22] It involved extensive and iterative consultation with stakeholders to describe and quantify the system, including not only causal loop diagrams at scoping and interim stages, but also at times required steps backwards to move in a new direction for the resultant model to be valuable to the decision makers.

However, in undergoing this iterative process and consulting with senior Trust members, problem owners and decision makers, one of the main directions the model took, that was not anticipated at the outset of the analysis, was that it had also to encompass the consultants and other senior medical staff that were being affected by changes in the junior grade, rather than simply concentrating on the lives of junior doctors in isolation of the human and physical resources that they operate with.

Additionally, a big debate that evolved during model construction was the issue of granularity and the level of detail in the model. Initially, the system dynamics model included a lot of detail regarding the different grades of junior doctors and their progression through the system in order for the problem owners to identify the system in the format that was unfamiliar to them (the iconography of stocks and flows in system dynamics). However, this quickly resulted in participants being distracted from the longer-term and strategic issues regarding the entire system, because they were concentrating on the detail.

In order to keep attention on the whole system, rather than operational detail, the researcher reverted to developing a causal loop diagram (CLD) which summarised all the major feedback loops and relationships. This still reflects some of the more important day-to-day issues (e.g. bleep policies, doctors' assistant roles) but also incorporates qualitative elements (motivation, seeking learning opportunities) that had been raised in the earlier focus groups. The CLD has been valued as a good representation of the broad system at the aggregate, overview level.

amount of service they can provide, moving the burden of service back onto the juniors. Against this, this supervision will increase the junior doctor knowledge, which means they will become more skilled consultants in the long run, which will increases long-term consultant productivity / efficiency. There are similar complex inter-relations in looking at the work-load, training, service and productivity/efficiency of the junior doctors.

Overall, there are many interrelated issues at hand in this problem, but the development of this CLD was very helpful in focussing attention on the key issues. Translating this into a stock-flow diagram, followed by a set of iterative revisions during consultation meetings with problem stakeholders, has resulted in the current version of the insight model shown in Figure 6. (It is appreciated that this is too small for detailed examination, but this is not the purpose of its exposition.) At the time of writing, this is still work-in-progress and is currently being validated, tested and experimented with to ensure the model accurately depicts both system structure and anticipated behaviour.

Several iterations of model building were also needed due to changing circumstances over the 3-year period of research, as the details of *Modernising Medical Careers* were specified, and also when it became clearer to the decision makers what aspects of the system required more attention, some of which they had learnt from participating in the research. In particular when stakeholders were asked to quantify the relationships between elements in the system, it became more certain: what it was in the system that was important to model, how dependent the results were on assumptions made and how little is often known about the system that they are living and breathing in.

The issue of granularity in the problem was eventually resolved by developing two parts to the system dynamics model. The first is a spreadsheet model which lists each of the junior doctor activities, their respective typical frequency in which junior doctors participate in them, whether they are likely to be supervised or not, and the perceived training/ service balance. This captures the operational detail and changes to working and training patterns can be input into this spreadsheet. The output of this is an overall training/ service split (in percentages) and number of supervised hours. This feeds into the second part: the system dynamics model, which allows the calculation of supervision needs and consequent impacts on consultant and more senior junior doctor time, as well as productivity and quality of training (based on assumptions made by the problem stakeholders).

Figure 6 - Stock and Flow Diagram of the System Dynamics Model to date (overleaf)

It is not the intention to extensively discuss the system dynamics model in this paper, especially as the development, testing and validation there-of is still in progress. However, it provides an opportunity to highlight some of the findings and insights into the problem found in the model building process and experimentation to date.

Insights to date

What has already become evident from this research and the analysis and models produced to date is that this is a complex system, where system dynamics can be a valuable analysis and decision-making tool, for strategic and operational planning. Further, it is a system, of both quantitative and qualitative elements, whose interrelationships need to be made explicit, because even seemingly "soft" concepts such as junior doctor experience and knowledge or motivation have very real "hard" impacts on current and future service provision.

Once modelling began, it became evident that an ideal consulting-context development process that might comprise qualitative analysis, then simple insight model, then a fully detailed model[23] would not be appropriate. The first modelling efforts were actually focussed on representing the full detail of the progression or 'hard' elements of the system. This was desirable so that the medical members of the team, who were the direct owners of the problem, could appreciate how the training system would be captured, that it was a true reflection of actual processes, how the junior doctors would eventually progress to being full doctors, and finally how the consultant level interfaces back with the other grades through their training supervision roles. This is consistent with an observation by Winch [24] that in large consulting projects, especially with a disparate client group, a sub-optimal modelling approach is often needed, and models may have to be over-engineered to gain buy-in from all. The modelling process has also helped the team better understand the interactions with tricky but important detail, like doctors who have technically qualified to proceed to higher grades, but who stay at lower levels either while awaiting internal or external vacancies, but also to reflect what is evident a growing trend of some doctors wanting to stay in more junior posts for lifestyle and/or personal reasons. In terms of gaining maximum output in terms of both training and service in a progressively constrained system, use of these mechanisms are likely to become more important in doctor resource management at the hospital.

Experimentation and simulation with the model has also yielded the following insights into the specifics of the problem at hand:

(i) There will be an increased need for supervision of junior doctors due to projected increase in numbers and the increased amount of structured supervised activities enforced by *Modernising Medical Careers*. On average this is an hour per doctor per week.

(ii) As long as it is assumed that supervision reduces efficiency and amount of service provision on behalf of senior colleagues, meeting the supervision demands of an increased number of trainees participating in more of the structured (and supervised activities) under MMC will have a relatively negative impact on service provision and on relative quality of training provided by senior colleagues.

(iii) However, it is of highest interest for the hospital to maintain relatively high quality of training due to the hypothesised high retention rate both within the foundation years grade (first two years) and between this foundation grade and the run through training grade (the next grade) at Derriford. This is because there is a positive relationship between the quality of training and attractiveness as an employer, as well as future levels of efficiency and quality of service provision.

Analysis has shown that solutions that increase the training/ service *perception balance*, without increasing the number of hours needed for supervision, will have a relatively lower impact on service provision, while compensating for the loss in relative quality of training provided by senior colleagues who are increasingly pushed for time. In particular, this should involve looking at better use of slack time currently observed in the system.

Therefore, to date, work on the model has suggested that there are a certain number of areas of manoeuvrability for senior Trust management to make decisions that may help in the reconciliation of service provision and training standards within the constrained system:

(i) Who provides supervision to junior doctors? Although in practice a large proportion of informal supervision comes from other junior doctors of more senior grades, it may be in the interest of the Trust to emphasise more formally the amount and type of training to be gained from more senior colleagues of the junior doctor grades. This may help meet some of the supervision demands at minimum cost to service provision, due to the greater proportions of this group of staff. In a similar vein, especially lower grades of junior doctors will gain valuable supervision from other more experienced staff groups such as senior nurses and allied health professionals.

(ii) Effect of supervision on efficiency - while this is largely based on the assumptions made, if service is planned to account for this efficiency loss due to meeting training needs, then there may be less of a deviation from the expected level of service. This would require significant long-term changes in planning and would be a challenge within the existing target-oriented framework of NHS governance.

(iii) Alternatively, any technology that may compensate for the reduced efficiency in service provision incurred by supervision may help maintain service levels. The costs of technology assisted working could be investigated against the benefits and savings accrued from an increase in efficiency. (e.g. revised bleep technologies, PDAs for communication and paperwork)

(iv) Better use of empty time for educational purposes - this would increase the training percentage, without necessarily increasing the demands for structured supervision, especially if this time is used for self-directed learning.

In the long run, better quality training for Foundation Years doctors will increase the efficiency in which they are able to provide a service, due to the higher level of skills that they will have acquired. If PHNT is hypothesised to have a relatively high retention rate (as high as 60%) between the foundation years and run-through-training-grade, there is a strong incentive to maintain relatively high quality of training, not only for long term service provision, but also to compensate for increasing demands on junior doctor time to provide supervision to more junior colleagues. This means that an emphasis on meeting all training demands at the crucial foundation stage, while sacrificing some service at this level early on (which could possibly be taken on by other roles or supported by additional means) would benefit career development and service provision at the run-through-training grade and beyond.

Finally, there is currently no provision for the educational value in the participation in service activities. However, unsupervised and independent working can be as important for career and skills development as supervision. If the balance of this is right and appropriate to the skills level of the doctors, the quality of training may further be enhanced. However, this is difficult to model in a quantified model that treats training and service as ends of a continuum.

More detailed results about the scenarios that are being simulated and the results of sensitivity analyses and testing will be published as they become available.

It is clear that system dynamics is a powerful tool for modelling systems, their components, relationships and changes in complex social problems. This paper has set out to highlight some of the ways in which it has been used as a tool amongst other research techniques to analyse and gain understanding into a complex problem faced by hospital trusts in the UK.

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Since then there have been a number of projects and publications which have attempted to shed further light on the intervention process, and others have suggested specific protocols and procedures based on successful projects or sets of similar projects. Probably the most notable of these are the group modelling works of Vennix, Richardson, Andersen and a number of co-workers (see especially Vennix 1999, Vennix, Richardson and Andersen, 1997). They have proposed procedures and protocols of their own, and have introduced and reviewed a range of practices relating to the elicitation of knowledge and the building of models in group contexts.

However, while projects may involve disparate groups within a client, not all situations fall into the definition of group modelling building as assumed by Vennix (1999) as " ... process in which a client group is deeply involved in the process of model construction". For example, in the case to be discussed here, two senior members form the client organisation are on the project team and participate deeply in the project progress, but they are largely the interpreters of the system around them and are the gate-keepers to data gathering, focus group research, and model verification within the wider client community. In this regard, the intervention appears to overlap with the category of *Change Management as Interpreting* (Palmer and Dunford 2002). They characterize this process as involving "...placing managers in the role of creating meaning for other organizational members and helping them to make sense of the differing meanings attached to events."

Other authors have looked to other constructs or processes to try to leverage the effectiveness of interventions in complex situations. In another healthcare application, Liddell and Powell (2004) report the use of a development of the causal loop diagram (CLD) - the Qualitative Politicized Influence Diagram or QPID. This construct specifies particular agents and actors attached to the links in order to structure thinking about the appropriate actions for managing system behaviour. In a study with the New Zealand customs service policy development for dealing with the potential threat of anthrax, Cavana and Mares (2004) describe the integration of critical thinking with the construction of causal loop diagrams. They suggest that critical thinking first be used to help develop rationale for policy, then they explain how premises and arguments can be converted to form a conceptual diagram and subsequently a causal loop diagram, which can be used as the basis for developing actions and implementation of policy. Yet others look to process management. Lyneis (1999) advocates a four-phase process of business structure analysis, development of a small insight-based model, development of a detailed calibrated model, and finally ongoing strategy management system and organizational learning, while Akkermans (2001) looks to inspiration from the East in the development of an approach for facilitating development of intra- and inter-organizational networks called *Renga*, after the classical Japanese style of composing linked verse.

This paper now describes an on-going project with a NHS Trust in the UK looking at the very challenging task of redefining and redesigning training programmes for junior hospital doctors at a large teaching hospital, using SD analysis at the core. The system and operating environments are certainly very complex, and the problem is definitely 'full of difficulties and complications'. But no solution is not an option, and the project team is having to progress the work in a very flexible manner in order to keep the project on track and to involve key stakeholder groups outside the central team as necessary. The paper first describes the background to this *knotty* problem, and then outlines the project progress which appears not to follow a straightforward process – as, for example, with the Lyneis four-phases - and had to backtrack on itself to be effective. The paper closes with some remarks on the especial challenges in these knotty problems, the need for flexibility in project process, and why the process that emerges may seem untraditional and even counter-productive but was necessary.

Working time reductions – *'trying to get a quart into a pint-pot'*

Historically, excessive hours have been an integral part of the life of junior doctors worldwide, with long hours on-call, formal lectures and tuition, and the assumption of an osmosis-like process of acquiring knowledge and training through working for many hours alongside more senior doctors in their specialty. Increased recognition of the lack of safety for patients in this practice, and its adverse effects on learning and the health of junior doctors, has lead to the introduction of the New Deal working hours regulations in the UK and a revised junior doctor contract. This has limited junior doctor hours to 56 hours a week (from infamous figures of 80+ hours) with additional restrictions on duty lengths and rest breaks. Additionally, the European Union Working Time Directive (EUWTD) came into force for junior doctors in the UK in August 2004, also requiring a reduction in working hours to less than 58 hours a week, with further reductions to 48 hours a week currently scheduled by 2009. (Department of Health, National Assembly for Wales, *et al.* 2002).

In the UK, local primary healthcare is provided through non-profit entities called NHS Trusts. Hospitals fall under a Trust's management and the Trust must deliver medical care to patients while providing the training opportunity for junior doctors in their initial practical placements (i.e. immediately after initial medical school training). The term 'Junior Doctor' can apply to all doctors in practice below the grade of Consultant – all these grades are still in the process of acquiring final specialist training and qualification – but this project relates to pre-registration and senior house officers – those in the first three years or so of practice. In an effort to reduce junior doctors' hours, there have been significant changes in working patterns over the last few years. These changes include moving to shift working, an increase in the number of contract doctors, reduced tiers and increased cross-cover, as well as some of the new ways of working and extended roles piloted by the Department of Health (2004a).

Further changes to junior doctor working will be forced by the implementation of *Modernising Medical Careers*, which aims to restructure and formalise Senior House Officer (SHO) training (Department of Health 2002, 2003, 2004b). The typical training/practice career path for hospital doctors in the UK is given in Figure 1. There have been claims that the reduction in working hours is impacting junior doctor training, as fewer hours spent at work are seen to equate with fewer hours spent training (Kapur & House 1998; Carr 2003). Inherently, this assumes that all hours spent at the hospital are "training" hours. Yet at the same time, it has been widely recognised that junior doctors and SHOs in particular, provide the bulk of the service – medical attention and treatments - and that a reduction in their hours will also impact on service provision.

Further, it is also feared that as training becomes more intense and more doctors will have to be trained to fill the service gap, then pressures on consultants' time will also increase. Alongside which, it is not only junior doctors that have to comply with hours regulations, but also senior members. In principle, consultants have always fallen under the 48-hour working week imposed by the EUWTD. However, this has become more acutely apparent in the recent negotiations of the new consultant contract, and demands continue to increase as hospital admissions rise and growth of service provision flourishes. Non-compliance is not an option, and failure to train junior medical staff or provide services to patients can result in a withdrawal in funding or other financial penalties.

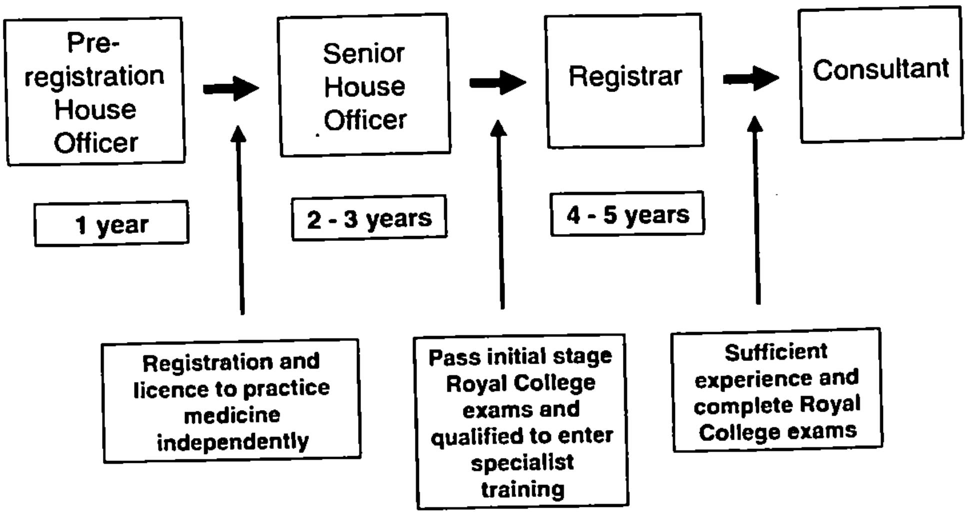

Figure 1 Typical progress of a hospital doctor's career post medical school

This is a *knotty* problem by any definition. Reducing junior doctors' hours involves major changes to working patterns, which have very real knock-on effects to the service they can provide as well as their training. Failure to consider the system as a whole is likely to have short and long-term impacts on training and experience for junior doctors, finance and service provision for the Trust, patient care, and the development of the current and future workforce. Proposed new ways of working need to be evaluated in light of all the potential consequences, beyond simple compliance and costs.

The host organisation and the immediate problem

Plymouth Hospitals NHS Trust, whose main site is at Derriford Hospital in Plymouth, provides acute and specialist care services to approximately 450,000 people in Southeast Cornwall and Southwest Devon, and covers a population of almost 2 million people for some specialist services. With a budget of approximately £250 million, 1300 beds and the busiest A&E department in the South West of England, it employs approximately 6000 people, including approximately 450 junior doctors and 230 consultants. It is a major employer and provider of health services in the southwest peninsula.

The Trust has established a knowledge transfer partnership (KTP) project with the University of Plymouth to analyse this situation. The core team includes a KTP associate who is an employee of the university but located full-time at the hospital, a system dynamicist, two further academics specialising in human resource management and social processes in employment, and two senior doctors holding consultants' posts and with management responsibilities in post-graduate training programmes[1]. From the outset, it was realised that

[1] The authors would like to acknowledge the enthusiasm and contribution of the other teams members – Beryl Badger and Joan Chandler, University of Plymouth Faculty of Social Science and Business, and Jenny Lovett and Tim Nokes, Plymouth NHS Trust – Derriford Hospital. Their specialist knowledge and efforts have driven the expectations of the project and the background research into all aspects of junior doctors' training. This paper however reflects the personal experiences and opinions of the authors in terms of the process of applying of system dynamics approaches, which has been their responsibility.

system dynamics was an appropriate approach for this situation (as did Ratnarajah & Morecroft 2004) and the original project proposal specified this as the core approach in the analysis, The aim was to produce a model or models to be the basis for an evaluation tool for senior Trust management to understand this complex system, and to serve as an aid in their strategic planning and decision making. This will allow not only a thorough comprehension of the situation, but also support decision-making by modelling possible future outcomes of proposed scenarios. In particular, it will show the feedback effects, both long-term and short-term impacts of changes, aiding strategic decision-making in an industry that is often features short-termism in its decision-making, imposed by year-to-year budgets, meeting constantly changing government targets and constant crisis management.

The choice of an adaptive system-dynamics study process

Step 1 – An early scoping process

A significant element of the project was the need to somehow compare whatever new systems are proposed and put in place with historic practice – specifically, would junior doctors receive comparable training to those in the past, how do the new working patterns impact on their lives, and to what extent must a new system reflect the needs of doctors of today rather than those in the past? Very early in the process, therefore, a scoping exercise was undertaken with junior doctors, employing cognitive mapping techniques, to identify their perceived impacts of moving from on-call to shift working. This does indeed appear to be leading to a wide variety of issues in their lives. This scoping diagram (Figure 2) was then used in presentations and discussions with a wider audience within the Trust, including consultants and management, and many stakeholders recognised and empathised with these behaviours and knock-on effects.

A critical issue is that junior doctors must receive the necessary training in terms of knowledge and skills, but at the same time deliver medial care to patients. This are assumed to be simultaneous activities - all hours spent at the hospital were considered both training and service. There is a natural tension in that regimes may require doctors to perform activities that are important for patients, but have limited training content; while conversely, participation in more training activities might reduce the level of service provided below expected levels. Moreover, while a single term "training" is generally used in the sector, there are really two major and different kinds of training: the gathering of "experience" which is acquired during the process of treating patients, and the learning of something new, either on the "shop floor" or through formal teaching sessions. The latter type of "training" is the type that is often at odds with "service" activities, whereas the former one is the one that can comfortably occur simultaneously. It was therefore hypothesised that all activities lay on a continuum where some are essentially all, or nearly all training with minimal service content, while others could be largely categorised as service with some small training content. It was therefore necessary to carry out some very detailed analysis into the range of different activities that junior doctors actually undertake, and the perception in the profession as to where each lay on the continuum. The detailed results of this are reported in Derrick (2004) and Derrick et al. (2005). This process is very close to the Palmer and Dunford (2002) notion of change management as an interpreting process, emphasising the need for creating meaning and helping in making sense of the differing meanings. This also fits with Weick's (2000) sense-making model of organizational change in which he suggests that a central focus is needed on the structuring processes and flows through which organizational work occurs, which leads to seeing " ... organizations as being in an ongoing state of accomplishment and re-accomplishment with organizational routines constantly undergoing adjustments to better fit changing circumstances."

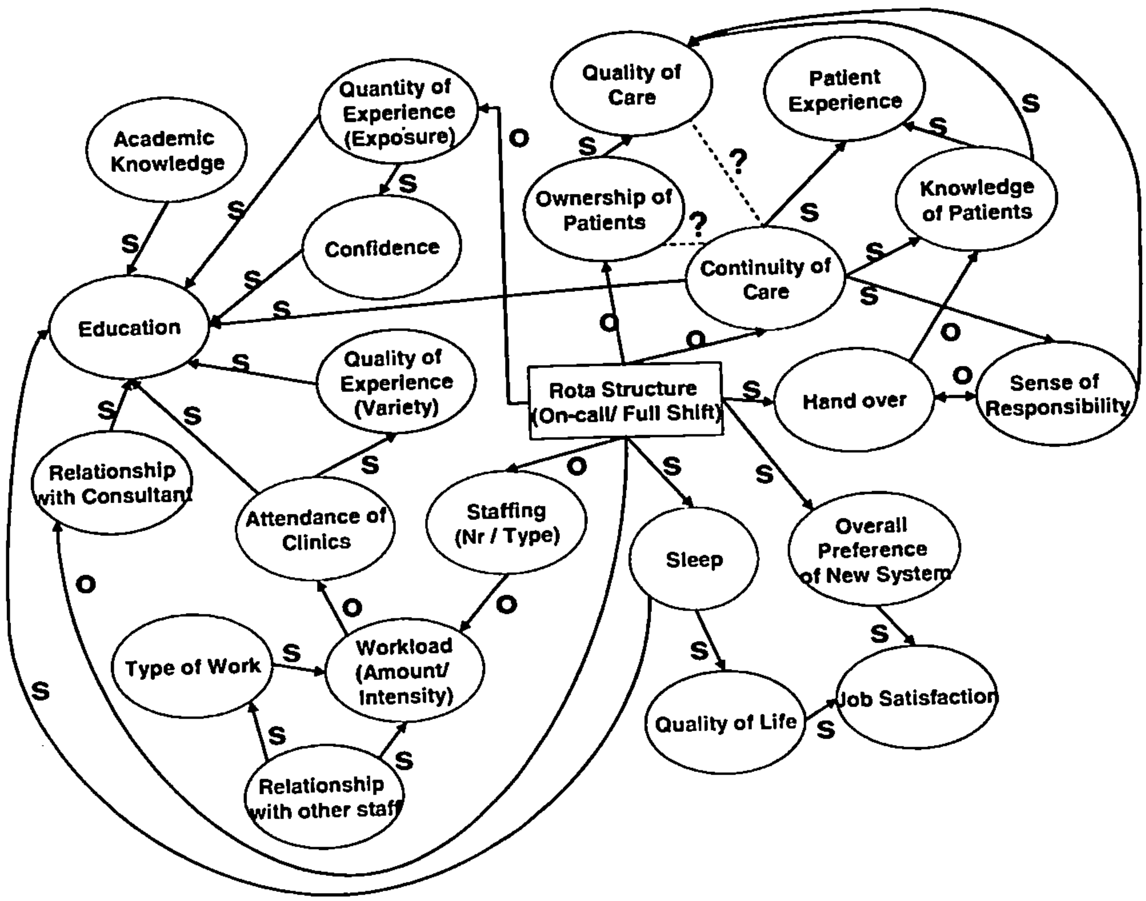

Figure 2 – Scoping diagram – cognitive map capturing junior doctors' perceptions of the impacts of working patterns

It was also necessary to complete an analysis of time-use data, collected at PHNT as part of the Medical Workforce Skills Mix Analysis project in 2003, which showed, *inter alia*, that 45% of SHO time is spent "in training" if the "empty" time (i.e. time spent doing other sundry activities such as walking, waiting, time in the doctors' mess (lounge), etc.) is not accounted for. However, if this time is included then the average time spent "in training" falls to 23% (implying conversely that 76% of SHO time is spent providing service). This did suggested a possible way to increase the efficiency of use of doctors time.

Step 2 - Envisioning the model in terms of the operations on the ground

At the most basic level, this problem is about matching the number of junior doctors as they pass through the training process, senior medical staff and the hours they work, and modelling the impacts of changes in these on the training provided and service delivered. Therefore, the main structure is based on a classic progression model. An 'ageing chain' of junior doctors, and their progression through postgraduate medical education, has been developed, with inflows and outflows at each level depicting the arrival and departure of junior doctors in addition to the internal progression flows. This was deemed the most appropriate starting point, as the physical stocks of "doctors" were easy for the problem relationships and impacts. While separating out each grade of junior doctor, and even sub-grades for the SHO grade, enabled the decision makers to really identify with the model in its representation of the real-life "stocks", it meant that they were focusing on very detailed operational issues too early on, rather than focusing on the bigger picture. This is typical of situations where the 'hard' elements of the system are readily assimilated – a hard model tends to stimulate hard thinking. This is a phenomenon that is also identified in software development by Day (2000), and is blamed for IT tending to over-focus on the technical issues, and he also asserts that there is then a critical need to "moderate the dominance of the engineering metaphor" to ensure that the complexity in "human populated systems" is fully incorporated.

Step 3 - A backward step?

It was in trying to capture the flows of training and service that it became evident that a view beyond just the impacts on junior doctors, and their 'training' and 'service' hours was necessary and that the analysis had also to encompass the consultants and other senior medical staff that were being affected by changes in the junior grade. Building in consultant hours and how time was being spent is possible with this model, but would also raise again the level of complexity in the model, as consultants would be supervising several grades of junior doctors, often simultaneously, while providing their own hours of service, as well as other duties. Defining the impact of lack of supervision on future training / service percentages was also a challenge in this version of the model.

It was agreed therefore that while this full progression relationship would ultimately be needed to support decision-making, in order to first enhance understanding of the inter-relationships and their impact on training and service provision and developing a simple insight model should be developed. In order to keep attention on the whole system, rather than operational detail, the team reverted to developing a causal loop diagram which summarised all the major feedback loops and relationships. This still reflects some of the more important day-to-day issues (e.g. bleep policies, doctors' assistant roles) but also incorporates qualitative elements (motivation, seeking learning opportunities) that had been raised in the earlier focus groups. The CLD has been valued as a good representation of the broad system at the aggregate-overview level. (See Figure 4).

The causal loop diagram contains a dozen or so loops, and centres on the level of junior doctor experience and knowledge, and it helping all stakeholders get to grips with the key loops at the at the heart of the problem. Earlier analysis had revealed that one of the major contributors to the level of junior doctor experience and knowledge is the amount of supervised training they receive from senior medical colleagues. In particular, focus has been turned onto supervision, or the lack thereof due to the EU WTD and revised working patterns. The diagram clarifies how the reduction in hours of consultants and the continuing, and even increasing demands on service, impacts on the availability of consultants for junior doctor supervision. The amount of service consultants can provide to patients (be it in the form of clinics, operations, ward rounds, or other activities depending on the specialty) is directly related to the number of hours they work, and their productivity or efficiency. This naturally decreases the residual service (i.e. work that still needs to be done). The less outstanding work there is for consultants to complete, the more time they have to spend supervising their junior doctors.

Observations and Conclusions

What has already become evident from the work on this project and the models produced to date is that this is a complex system, where system dynamics can be a valuable analysis and decision-making tool, for strategic and operational planning. Further, it is a system of both critical hard and soft elements. The project to date has yielded some very valuable insights into what drives this system and the possible impacts of changes in working practices on junior doctor training. These are discussed more fully elsewhere (Derrick et al. 2005), but include:

- how the division of the content of all junior doctor activities is between training and service is perceived by various system players,
- what contributes to efficiency and effectiveness in the training and supervision regime,
- how the efficient use of doctors' in terms of being diverted by unnecessary bleep-calls was highlighted,
- that the training/service issue at junior doctor level is inseparable from the supervision and service roles of consultants with both immediate and longer-term dynamic implications

However, trying to manage the project within the funding and time window is also complex and the team has had to be very flexible in their project management. It quickly became evident that an ideal consulting-process of the Lyneis sort would not be appropriate. An initial scoping phase was completed to establish vocabularies and the dimensions of junior doctor's professional and personal lives that were expected to be impacted by the change. This cognitive map was used as an interface between the junior doctors and the other system stakeholders. The diagram proved a most effective in the critical team-building and developing phase as a communication medium to help stimulate idea generation (McFadzean & O'Loughlin 2000). The notion of a mental model, let alone a group mental model, does present a number of difficulties regarding completeness, consistency, and whether it is a true consensus model or simply an impression of an analyst or other participant which was not wrong, complete or controversial enough to raise loud objections. However, the authors would agree with the observation of Langan-Fox, *et al.*, (2004) that the effort is worth it.

After extensive background research, the first real modelling efforts were actually focussed on representing the full detail of the progression or 'hard' elements of the system. This was desirable so that the medical members of the team, who were the direct owners of the problem, could appreciate how the training system would be captured, that it was a true reflection of actual processes rather than a regression-based representation, how the junior doctors would eventually progress to being full doctors - first as registrars then consultants, and finally how the consultant level interfaces back with the other grades through their training supervision roles. This is consistent with an observation by Winch (1990) that in large consulting projects, especially with a disparate client group, a sub-optimal modelling approach is often needed, and models may have to be over-engineered in terms of extra detail to gain buy-in from all. This model (or model sector) is now largely complete and does reflect both the progression of internal candidates as well as the recruitment of doctors externally, including those at SHO, to maintain staffing establishments. The modelling process has also helped the team better understand the interactions with tricky but important detail, like doctors who have technically qualified to proceed to higher grades, but who stay at lower levels often while awaiting internal or external vacancies, but also to reflect what is evidently a growing trend of some doctors wanting to stay in more junior posts for lifestyle and/or other personal reasons. In terms of gaining maximum output in terms of both training and service in a progressively constrained system, the use of these mechanisms is likely to become more important in doctor resource management at the hospital.

The second modelling phase effectively reverted to the insight phase. By mutual agreement it was felt that rather than continue progressively adding layers and layers of detail onto the progression sub-model, it would be preferable to first get a better appreciation of the interaction between the 'hard' part of the system (doctor progression) with the less tangible elements including experience, efficiency, quality, and junior doctors' tendency to seek self-directed learning opportunities. This involved integrating difficult concepts and drawing a simple CLD before attempting to create stock-flow structures, was found the most effective route. This is a similar to the reasoning of Liddell & Powell (2004) who used their developed CLD – the QPID – to deal with "hybrid" systems comprising both hard elements and intractable soft elements in a different healthcare situation with but with many parallel elements. However, the next phase in this study is to now go back to the development of stock-flow structures to capture the higher level view of the CLD with a view to creating quantitative sub-sectors for levels of junior doctor knowledge / skill development and service fulfilment both in terms of simple quantities (hours or equivalent hours) and more complex quantity and effectiveness dimensions. Like Mayo *et al.* (2001), the team have also observed the value of the parallel use of a model as a qualitative framework and a quantitative analytic tool, and about effectively communicating the content of large, complex models to non-SD-specialists.

Deborah Campbell in her article evocatively and amusingly titled "The long and winding (and frequently bumpy) road to successful client engagement" listed a number of important lessons for her and her team, of which two are particularly relevant here (Campbell 2001). The first was to try to define explicitly when in the process the client team and analysts "…will be in a state of confusion", how to get out, and to explain why this happens. This, she assures, will prepare client teams for the inevitable bumpy road; and while it might not make the time of confusion any less painful, it will at least reassure everyone that the project is still on the right track. This project probably did not do this as well as it might, though the willingness to break from the traditional modeling route and quickly adopt a new approach, most probably did reassure other stakeholders that the situation was under control A second important lesson was "Let the complexity come". She observed that some system dynamicists may not agree with this, but for her giving team members frequent and early opportunities get their contributions onto the table and into the model is a winning formula. Our experience of quickly going to a detailed operational representation to reassure team members that the system that they know so well will be modeled explicitly and accurately, and then letting a higher level view develop through a further CLD, while also unorthodox, is that this is keeping pace and interest in the model high.

The project has already yielded significant insights and provided valuable support to those wrestling with the seemingly impossible task of maintaining quality and depth in the training of junior doctors at Derriford Hospital while also, and most importantly, delivering required levels of medical service to patients. However, it is also highlighting some of the special challenges of projects where there are a complex operating system, many stakeholders, political agendas, and a continuously changing environment.

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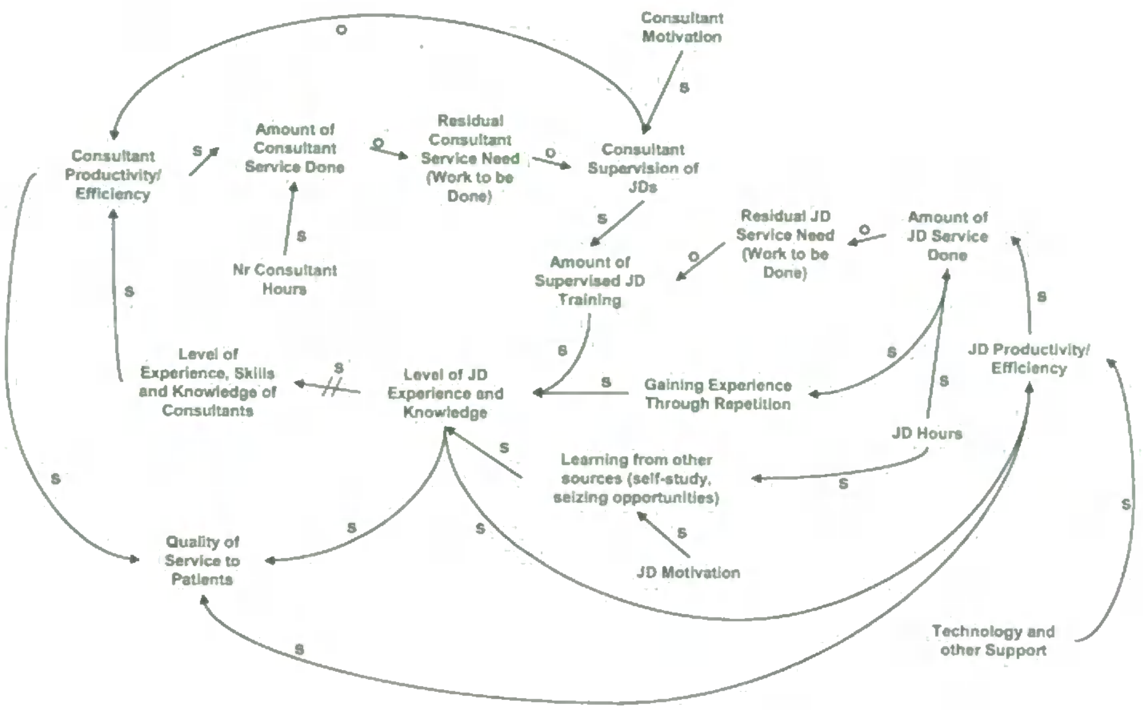
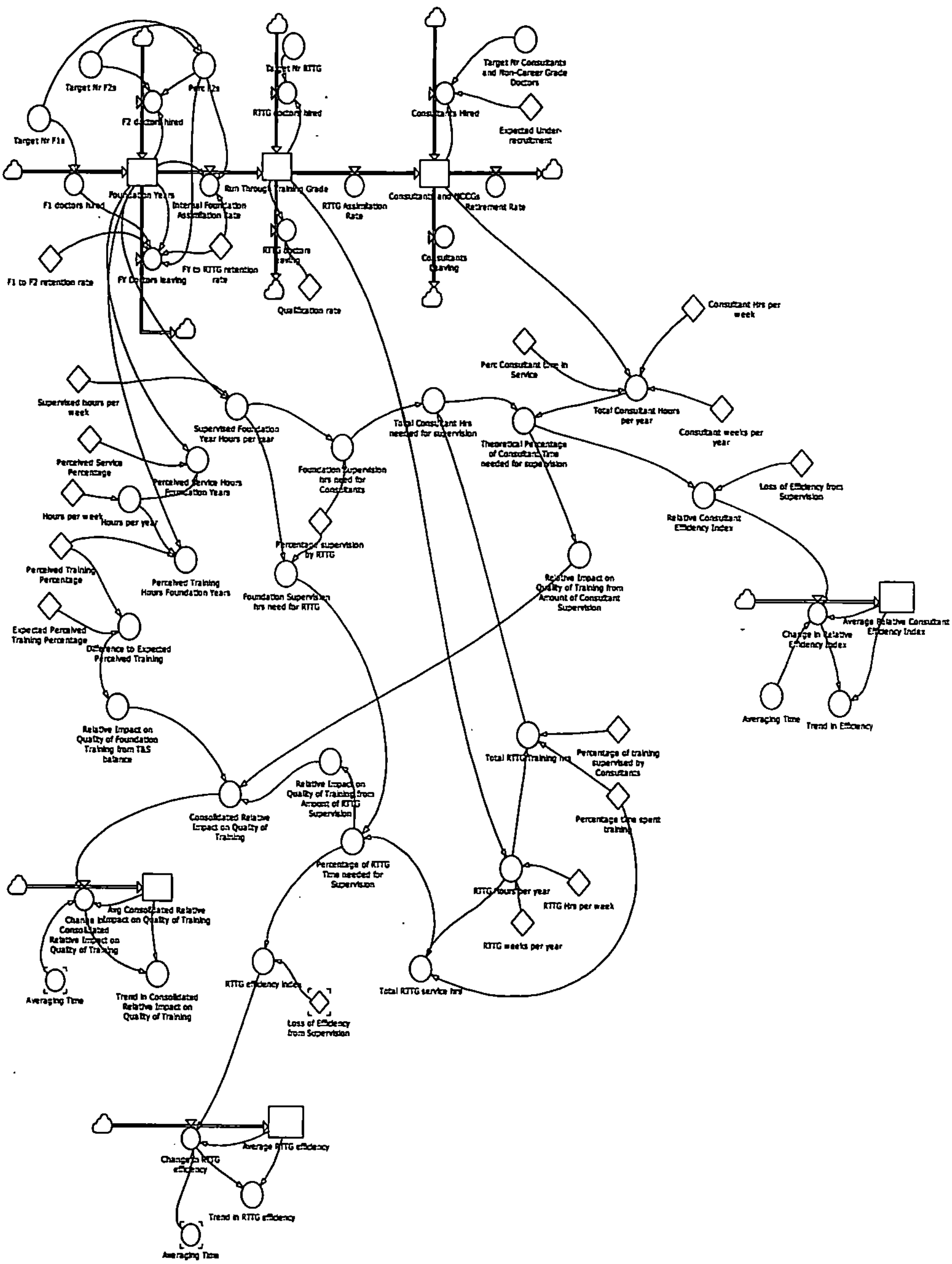
Figure 5 - The causal loop diagram of the system



The causal loop diagram centres on the level of junior doctor experience and knowledge, and it helped all stakeholders get to grips with the key loops at the heart of the problem. Earlier analysis (the training/ service continuum) had revealed that one of the major contributors to the level of junior doctor experience and knowledge is the amount of supervised training they receive from senior medical colleagues. In particular, focus has been turned onto supervision, or the lack thereof due to the EU WTD and revised working patterns. The diagram clarifies how the reduction in hours of consultants and the continuing, and even increasing demands on service, impacts on the availability of consultants for junior doctor supervision. The amount of service consultants can provide to patients (be it in the form of clinics, operations, ward rounds, or other activities depending on the specialty) is directly related to the number of hours they work, and their productivity or efficiency. This naturally decreases the residual service (i.e. work that still needs to be done). The less outstanding work there is for consultants to complete, the more time to spend supervising their junior doctors.

Obviously, in addition to having the time, a second factor that has to be their willingness to do so. Individual attitudes and motivation vary from one doctor to the next. However, it is universally appreciated that performing a task while simultaneously engaged in training takes more time than simple completing the task. Some of the doctors estimated that this could reduce their productivity by approximately 30%. Therefore, while supervision increases junior doctors' knowledge, it decreases consultant productivity, which negatively impacts the


Target Nr F2s
Target Nr F1s
F2 doctors hired
Foundation Years
F1 doctors hired
Internal Foundation Assimilation Rate
F1 to F2 retention rate
FY Doctors leaving
FY to RTTG retention rate
Target Nr RTTG
RTTG doctors hired
Run Through Training Grade
RTTG Assimilation Rate
RTTG doctors leaving
Qualification rate
Target Nr Consultants and Non-Career Grade Doctors
Consultants Hired
Expected Under-recruitment
Consultants and NCCGs
Retirement Rate
Consultants Leaving
Consultant Hrs per week
Perc Consultant time in Service
Total Consultant Hours per year
Consultant weeks per year
Supervised hours per week
Supervised Foundation Year Hours per year
Foundation Supervision hrs need for Consultants
Total Consultant Hrs needed for supervision
Theoretical Percentage of Consultant Time needed for supervision
Loss of Efficiency from Supervision
Relative Consultant Efficiency Index
Perceived Service Percentage
Perceived Service Hours Foundation Years
Hours per week
Hours per year
Percentage supervision by RTTG
Perceived Training Percentage
Perceived Training Hours Foundation Years
Foundation Supervision hrs need for RTTG
Relative Impact on Quality of Training from Amount of Consultant Supervision
Average Relative Consultant Efficiency Index
Change in Relative Efficiency Index
Averaging Time
Trend in Efficiency
Expected Perceived Training Percentage
Difference to Expected Perceived Training
Relative Impact on Quality of Foundation Training from T&S balance
Total RTTG Training hrs
Percentage of training supervised by Consultants
Relative Impact on Quality of Training from Amount of RTTG Supervision
Consolidated Relative Impact on Quality of Training
Percentage time spent training
Percentage of RTTG Time needed for Supervision
RTTG Hours per year
RTTG Hrs per week
Avg Consolidated Relative Impact on Quality of Training
Change in Consolidated Relative Impact on Quality of Training
RTTG weeks per year
Averaging Time
Trend in Consolidated Relative Impact on Quality of Training
RTTG efficiency Index
Total RTTG service hrs
Loss of Efficiency from Supervision
Average RTTG efficiency
Change in RTTG efficiency
Trend in RTTG efficiency
Averaging Time

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Flexible Study Processes in 'Knotty' System Dynamics Projects

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Abstract

System dynamics is generally selected as an analytical approach because it is believed to be particularly good with complex issues. However, sometimes not only is the system complex but so too is the study environment. The SD literature does devote considerable space to study and intervention processes, often suggesting general models, protocols or procedures that have worked in specific applications or a range of similar applications. This paper describes an on-going research project in which a complex system operates within a highly complex environment, major and over-lapping organisational changes, a diverse set of stakeholders both within and outside the team, and difficult political agendas. The project concerns the nature of 'quality and effective training' of junior doctors in the UK against the backdrop of major changes in working hours and conditions driven by national safety concerns and the over-arching requirements of the EU Working Time Directive. The problem is compounded as junior doctors also have to provide substantial levels of service - patient care – at the same time as they are being trained. Early models are already yielding valuable insights for those at a large teaching hospital wrestling with the seemingly impossible task of maintaining levels and quality of both training and service, when junior doctors working hours are practices are being so drastically altered. However, it is also demonstrating that in such high-complexity studies, flexible and adaptive processes are needed to manage the project effectively.

Introduction

The tile refers to 'knotty' problems. The word knotty is defined by Merriam-Webster Online as: "so full of difficulties and complications as to be likely to defy solution", and offers 'Complex' as a synonym. System Dynamicists are very used to the notion of complexity, which we often categorise as structural complexity and dynamic complexity, and believe that the approaches of system dynamics are particularly suited to the study of such systems. But what of situations where not only the system to be studied is complex, but so too is the whole environment within which the study is to be undertaken. The SD literature does include a significant body of work that is devoted largely to the process of undertaking a system-dynamics project or intervention, though Cavaleri & Sterman (1997) argued that little was known then about the efficacy of interventions and evaluating the interventions is even more remote. Vennix (1999) also argues that 'messy' situations, where the problem is ill-defined or where opinions may widely differ, are particularly difficult to handle at least in part because consensus is not always easily achieved.

stakeholders to relate to, as well as the progression through the system that was most evident. Further, the number of doctors in various grades, and thus their availability for service provision, or supervision in the case of senior medical staff, has been a high profile issue. This represented a tailored, yet fairly generic progression chain, as has been previously employed in human resource models (Sterman, 2000). It was determined that the most appropriate way to show impacts on training and service would be to create two co-flows of training and service, that increase or decrease, depending on (a) the number of junior doctors at each level arriving and leaving the system, and (b) the proportion of their time that was being spent "in training" and "in service" that is calculated in analysis previously mentioned. Thus, more experienced junior doctors, such as those who had been in post for more than 3 years, take proportionately more service hours from the stock when they left (and less training hours) than first year SHOs. There is further scope to feed in sub-models, which calculate the training/service percentage in the time spent, depending on how many of each of the SHO activities were being experienced and whether this is under supervision. This first structural model is shown as Figure 3.

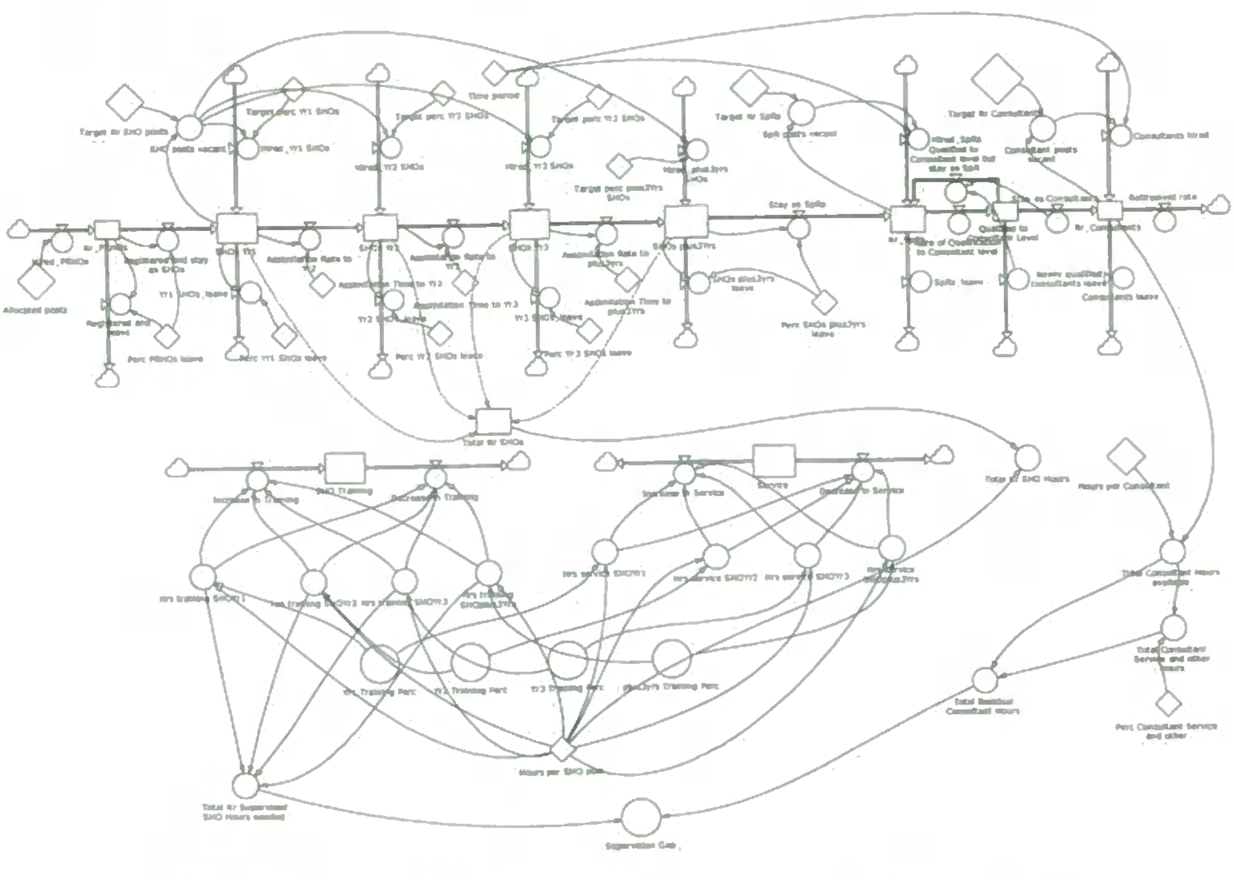

Figure 3 - First model focussing on career progression of doctors

At normal print size, little of the detail of this diagram can be discerned. However, it can be appreciated that the top section represents a very complex single stock-flow structure – the progression of hospital doctors through their career path. More specifically, this is the staffing structure that the Trust must manage in order to maintain its complement of doctors at all grades. The bottom half reflects the interactions between senior and junior doctors through the training processes. After developing this initial structure with the project team, it quickly became apparent that it had two drawbacks at this stage of the project. Firstly, the level of complexity was growing faster than was necessary for showing the overall feedback

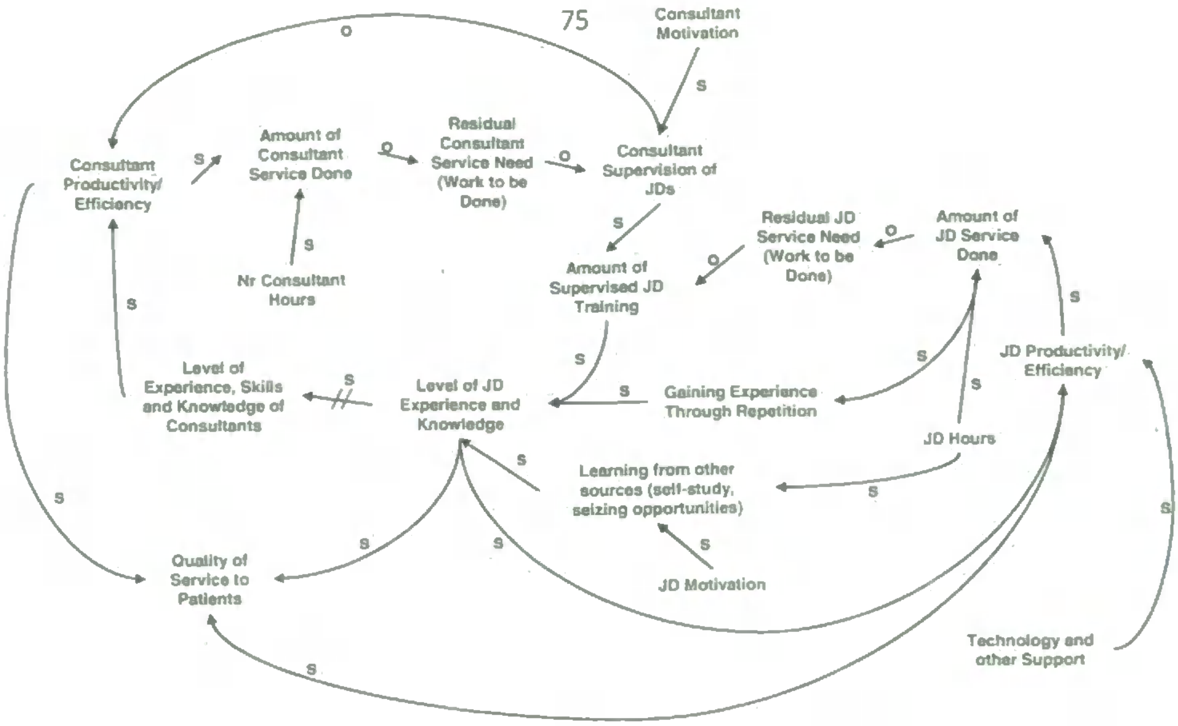

Figure 4 – Causal loop diagram reverting to a broader reflection of the training system

Obviously, in addition to having the time, a second factor has to be their willingness and enthusiasm to give attentive and enthusiastic supervision. Individual attitudes and motivation vary from one doctor to the next. However, it is universally appreciated that performing a task while simultaneously engaged in training takes more time than simple completing the task. Some of the doctors estimated that this could reduce their productivity by approximately 30%. Therefore, while supervision increases junior doctors' knowledge, it decreases consultant productivity, which negatively impacts the amount of service they can provide, moving the burden of service back onto the juniors. Against this, this supervision will increase the junior doctor knowledge, which means they will become more skilled consultants in the long run, which will increases long-term consultant productivity / efficiency. There are similar complex inter-relations in looking at the work-load, training, service and productivity/efficiency of the junior doctors.

One of the factors highlighted here was the inefficient method of communication with doctors via bleeps, which entails someone bleeping the doctor, the doctor having to find a phone and call back, often to find the line engaged, or the wrong doctor being contacted, often for inappropriate reasons. In preliminary investigations and data collection during job shadowing on this project, it was estimated that across the 24-hour day, up to 80% of bleep calls can be for reasons not requiring immediate medical attention of the junior doctor. (This information supported a bid by the hospitals for separate funds to trail a bleep intervention/management system with doctors' assistants.) Another aspect highlighted was the opportunities for learning from other sources. In particular, this relates to making the effort to attend teaching sessions, self-directed study and seizing opportunities to learn "on-the-shop floor" when they arise, as opposed to waiting for training to be "delivered". Again, making the best use of opportunities and experiences to maximize learning and the knowledge to be gained from them is strongly dependent on the individual junior doctors' attitudes and motivation and this varies hugely from one individual to the next. A change in culture and explicit definition of responsibility for education would be one way to increase the benefits of this, as would facilities and non-threatening protocols (London & Smither 1999).

The development of this CLD was most helpful in refocusing attention on the broader system, encompassing all the dimensions that drive the system and must be considered in any solution. Translating this into a stock-flow diagram has now resulted in a simpler insight-type model, shown in Figure 5.

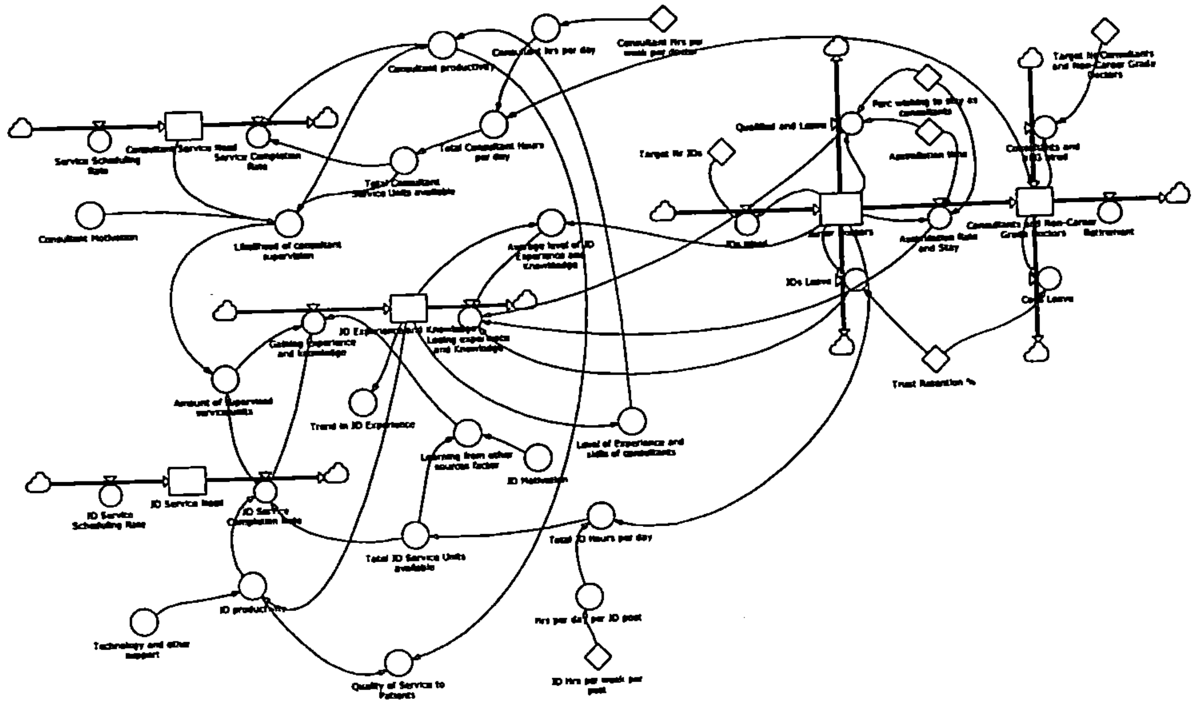

Figure 5 – Insight level model reflecting doctor progression and training/service interactions

As can be seen, this model is much simpler and employs four stock-flow structures, with representations of doctors, consultant service, junior doctor service and junior doctor experience and knowledge. It is particularly notable that the very detailed career progression sector has now been collapsed into a two level sequence – junior doctors and senior doctors (consultant-grade). The fuller representation would be required to support detailed decisions on staffing management, but is not necessary to appreciate the broader issues in training and service. This model is now being calibrated and will be used to simulate the system at this insight level to support a better understand of the training /service conundrum and the macro-level impacts of the working pattern changes.

The attraction of this model is that is shows the entire 'problem' with a relatively concise set of interrelated variables, comprehensible to the problem stakeholders, while the stock-flow representation specifying concrete relationships provides an additional level of insight. The equations behind the model have been derived from the detailed information that was gathered in the background research on junior doctors' activities, time-use, and the training / service continuum, and is thus well-grounded.

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