2024-01-01

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Published in:
The De Gruyter Handbook of Automated Futures

Publication date:
2024

Document version:
Peer reviewed version

Chapter 21

Co-making and Prototyping Community Housing Futures

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Abstract: An emerging area of research on automated futures is that of digital equity—how to innovate and develop digital products, services, and experiences which promote equality of access, and align with the lived experiences of communities they are expected to benefit. In this chapter, we outline a research project focused on the adoption of digital fabrication technologies by a rural community in Bridport, United Kingdom. Their challenge is that of housing futures not only in terms of stock demand, but more broadly in terms of sustainable forms of housing construction (i.e., modern methods of construction) using local materials and skills. The chapter navigates a complex set of interrelations between issues of land and place, skills, material flows, and technologies. After expectations are unmet by government top-down growth and industrial strategies, we frame collective design practices of prototyping and making as a way to exchange, prompt, and visualise housing futures through our Living Lab in Denhay Farm—a space for testing out housing building elements, material opportunities, and early local material supply chains. Through a place-based approach contextualised by marginalised rural and coastal communities, we reflect and introduce expressions of technology adoption and co-production as vehicles to potentially address specific problems of housing procurement and construction, and more broadly as mechanisms to facilitate inclusion, access, knowledge mobilisation, and research impact.

Keywords: participatory design; modern methods of construction; automation-in-place; housing futures; rural coastal communities

1. Introduction

Over the last few years, the United Kingdom (UK) has renewed its focus in rural coastal communities. These are typically marginalised areas, former industrial powerhouses now deprived from access to services and problematic health, educational, and socio-economic outcomes. This contrasts with governmental top-down 'industrial strategies' and 'levelling up' policies unable to rebuild the fabric of infrastructures required to reverse their decline. At policy level, there is increased awareness through evidence reports (Ministry of Housing Communities & Local Government, 2021), health policy (Whitty, 2021), digital inequity (The British Academy, 2022), or the

new Strategic Delivery Plan by UK Research & Innovation, which stresses 'world class places' as a key driver of upcoming funding rounds across all research councils (2022). In relation to digital inequity in rural coastal communities, the latest UK House of Lords report on seaside towns (2019) and its government response outline digital connectivity, education, skills and employment, and housing wellbeing and built environment as key strategic areas of development. Concurrently, the latest report from The British Academy (2022) on digital inequality suggests a more relational approach calling to address digital poverty beyond improving access, but instead by actively empowering people and places to benefit from digital access and to consider more comprehensive supply chain stakeholders through local resources and intermediaries, and the public sector.

This research stems from a collaboration with Wessex Community Assets (WCA), a community benefit society in Bridport, a coastal town in Dorset, UK (Figure 21.1). WCA is part of Raise the Roof, a coalition of creative, community, and civic organisations aiming to deliver affordable and environmentally friendly community housing. WCA was a pioneer in the development of Community Land Trusts in the UK, and has developed one of the largest enabling services for community-led housing including nearly 40 community land trusts providing affordable homes for rent or shared ownership in partnership with housing associations. Our work is then contextualised by a networked community with existing knowledge mobilisation strategies, reach to local civic institutions, and influence on local decision-making processes working collectively towards local development (Gibson-Graham, 2008). On the production of community housing, WCA is working with material suppliers (local foresters and hemp farmers) to stimulate and uncover new, local, and low-carbon supply chains for local housing construction, building upon Bridport's industrial and material cultural legacies. Additionally, WCA is developing support mechanisms and social infrastructures (such as local skills initiatives) to achieve their housing goals. These include training programmes, the development of local fabrication and making facilities, and the introduction of digital design and fabrication technologies within their local workforce to develop and retain high-value skills and jobs—a new, place-based community economy (Roelvink, 2020).

Figure 21.1. Aerial photograph of Bridport and surrounding area. Source: EDINA Digimaps, 2023.

To develop these, a partnership was established with the University of Plymouth's School of Art, Design and Architecture. Through a stream of projects funded by UK Research and Innovation, we have delivered fieldwork activity comprising material studies, community workshops, interviews, and 'living lab' spaces enabling local groups of stakeholders to engage with future visions of housing in alignment with local investment plans and longer-term housing projects on existing sites (Figure

21.2). We have scoped the introduction of digital fabrication tools to produce building elements with local materials, and in doing so in embedded and participatory ways, prompting discussion around material supply chains and availability, the needs for local skills and training programmes, and how material provenance derives from multi-sectorial local growth agendas such as regenerative agriculture and sustainable forestry. As a result, we frame the production of housing not only as a matter of manufacturing output, but as a way to stimulate the production of social infrastructures that rebuild collective relations *through* and *with* (Salomon et al., 1991) local beneficiaries and stakeholders—an emerging vision for 'automation-in-place' which responds to local productive needs while concurrently influencing broader development opportunities (such as circular construction) across a broader set of geographies and material flows (such as supply chains of local timber). This is echoed by cognate research interpreting 'infrastructuring' as the creation of 'socio-technical resources that intentionally enable adoption and appropriation beyond the initial scope of the design' (Le Dantec and Salvo, 2013) of, in this case, a house. The 'house' is then not interpreted as an architectural design commission following a client–designer commercial paradigm, but instead as a cross-cutting research space allowing members of the community to envision their future built environments and economies while addressing more contingent and pressing needs for housing stock—a participatory design research space to probe and prototype collective futures often out of reach of marginalised coastal areas. This approach is supported by architectural theorisations of 'the home' which assert that building functions extend beyond a built facility (i.e., a home, a place of learning, a place to gather) into more 'fuzzy' and unstable geographies (Davies, 2020) and their corresponding social and imagined lives. Recent research on the codesign of care home facilities, for instance, identified residents' reflective insights about their current built environments as well as projective, future aspirations for spaces, activities, and social entanglements emerging from the care home (Burke and Veliz Reyes, 2021), reinforced by previous research on 'homeliness' as the space to envision and plan activities outside the physical boundaries of a house (Ewart and Luck, 2015). In this project, community housing opens a window of opportunity to address housing design (however private) as a space for collective production and social entanglements. By experimenting with radical procurement routes that challenge notions of 'ownership' and democratise production, community organisations and activists are moving away from housing as a 'consumption market' (Raco et al., 2022) and instead strategising ways to unlock land for community housing through new community-led delivery frameworks (King et al., 2020), including design for collectiveness, shared ownership, and inclusion (Nguyen and Levasseur, 2023). The house's material constitution, then, becomes key to mediating (instead of separating) conditions of sharedness and ownership, repositioning building production from a construction delivery plan into a more relational, fuzzy, and networked artefact,

embodying socio-cultural and environmental conditions that can facilitate (or neglect) collectiveness—shifting our focus from what the design *is*, to what design *actually does* (Yaneva and Heaphy, 2012).

Figure 21.2. Material experimentation and showcase with hemp/clay mixes in the living lab at Denhay Farm, Bridport. Source: A. Carr, 2023.

1.1. Chapter Structure

Often, we see in design and automation initiatives the issue of fitness—models of increasingly computational creativity and power which are not compatible with localised manufacturing or building practices (Claypool et al., 2021; King et al., 2020), let alone local communities and their capacity to participate and engage with those new, emerging forms of innovation (Community Tech, 2022). We recognise the systemic and complex set of interrelationships at play throughout this project, and yet our concern throughout the chapter is that of fitness: design and productive practices that fit with ambitions for local growth and development, technologies and prototypes that align with need to address local material and employability concerns, and an engaged form of implementation (the living lab) that supports the interests of diverse groups of people involved in the delivery of housing projects. These aims are here presented through (1) the presentation of design practice as a way to engage with communities and promote local development, and (2) its implementation—in this case, our living lab approach in Bridport following action research and participatory design methodological principles. We have—both metaphorically and literally—provided a space for exchange and cocreation around housing, a unique prototyping

setting where local stakeholders can meet, test, and demonstrate building elements and discuss local development issues around housing construction, the fitness and scope for automation technologies 'in place', and material languages and provenance that are directly connected to their local landscape—both physically and socially (Figure 21.3). Digitally cut ash timber, hand mixed hemp/clay insulation material, and timber assemblies became prototypes of building elements and at the same time probes (Sanders and Stappers, 2014) allowing us to get a glimpse into local community organisations, local supply chain dynamics, local economies, and the influence (or lack thereof) of national policies and investment plans. Here, we counter traditional 'professionalised' views of design practice, and expand on the repositioning of design activity within futures and place-based agendas.

Figure 21.3. Timber structure for housing design and experimentation with building elements at Denhay Farm, Bridport. Source: A. Carr, 2023.

2. Design Practice and Automation "In Place"

2.1. Design for Sustainable Futures

Addressing the green transition from a design research perspective should be a given. Design is, precisely, about future-imagining and future-making. 'Futuring' is however a challenge in rural coastal communities in the UK, often deprived of the means of envisioning futures amid pressing socioeconomic and accessibility challenges. Often the ability to engage with creative solutions still remains out of reach for many, particularly those disenfranchised by the mainstream 'design

economy' (Rosner, 2018). This links into the issue of matching over-arching, homogenous or universal solutions (even those that value creativity) to specific challenges with a specific set of interdependent and nuanced characteristics, and the development of technologies without recognising more differentiated sets of localised priorities and agendas (Shelton et al., 2015). Buchanan characterises 'wicked problems' as a commonality for a diverse range of disciplines and professions that apply design methods within their work (1992). 'Wicked problems' categorises complex, multi-faceted challenges that are difficult to define or solve due to their interconnectedness with social, economic, political, and cultural implications. Unlike 'tame problems'—those with clear goals, well-defined parameters—wicked problems are characterised by their ambiguity and uncertainty, with which there are no standard solutions due to their complexity. The notion that design as a field is capable of dealing with wicked problems has grown in impetus throughout and beyond the field, defining it as a discipline 'capable of scaling to problems of any size and context' (Mareis and Paim, 2021). Others would argue, however, that suggesting design is a universal method capable of dealing with so-called wicked problems is abstract and problematic. The traditional fields of product design and industrial design are neither equipped nor responsible for critically challenging the status quo or managing sustainable change—as fields born within Western culture to serve a predominantly capitalist agenda (Malpass, 2019) 'because product design is thoroughly integrated in capitalist production, it is bereft of an independent critical tradition on which to base an alternative' (Lohmann, 2017). This view of design activity is not only born out of economic lenses, but also historical—in the UK, the Design Council was created in 1944 to 'develop a peacetime economy (…) to boost consumer spending' (McNabola, 2014).

As awareness of climate change and ecological devastation has risen in public minds, so have commercial creative industries sought to appease the demands of consumers, users, and critics. However, many of these attempts are dangerously superficial (Klein, 2014). Perpetuating a state of what Mitropoulos describes as 'change that does not change' (2018), modes of fabricated concession such as green-washing or superficial user consultancy have emerged under the guise of ecological concern, co-design, or community engagement. Design driven by capitalist growth rather than social justice or ecological concern will not serve those who need it most: those without power, privilege, or capital (Malpass, 2019). As stated by Material Cultures (2022), 'our current modus operandi can't support the kinds of futures we envision for ourselves and those to come. As architects, builders, and citizens, we must urgently rethink our relationship to the land and to each other to produce new forms of material practice, culture and economy in solidarity with people and our landscapes'.

In response, emerging voices are looking to more locally available resources and modes of production (Vaughan, 2018), claiming back the power of making things, rather than relying on

problematic capital-driven modes of design practice and global supply chains. The creative economy, more broadly, and design research practices, more specifically, have taken up arms against problematic global systems of extraction, processing, and production (Elzenbaumer, 2021) with design practices looking to challenge the status-quo, such as Speculative Critical Design, Transition Design, and Participatory Design approaches. Value is attributed to the capacity creativity and creative solutions have for making change via alternative and sustainable (both socially, economically and ecologically) visions for the future, supporting the development of resilient productive infrastructures that balance sustainability and social equity. Escobar describes 'design's potential for transitions'; however, to do so, there must be a 'significant reorientation of design' away from the essentialist industrial traditions from which it emerged, in order to fulfil a new, social role (Escobar, 2018). To provide more than superficial (or worse, harmful) design practices, positive change required us to sit with the complex problems and challenging scenarios generating a more robust epistemology of design innovation that deals with complexity at various system scales: the environment, the region, the town, and the lab. This compels designers to generate methods, approaches and strategies that are grown *from* and embedded *within* situated contexts rather than existing as generalised concepts or abstract universalisms.

2.2. Automation-in-place and Making

Technologies we adopt via modern production and construction methods are, however, not always organised in such a way as to give flexibility to address the growing concerns of the green transition. In 2013, Birtchnell and Urry published a review on digital fabrication focused on the 'personal fabrication' agenda, and its impact on the production and mobilities of objects (2013) with a particular focus on 3D printing (3DP). They stressed the impact of digital (and personal) fabrication in areas such as manufacturing and transport, and speculated on the new mobilities of making and data, a digital/material assemblage (Kitchin, 2021) aggregating technological and ecological consequences of digital fabrication technologies into a new 'geography of (digital) making' (Carr and Gibson, 2016, 2017). The argument here is compelling—data can travel more easily, whereas things do not. Fabrication data can be easily generated and exchanged, and personal fabrication tools such as 3DP can affordably make things closer to us. Lesser needs to transport cargo and consequent environmental benefits (such as reduction of transport carbon footprints) could give way to new economies emerging from local, sustainable, and open access ways to produce things (such as 3DP on demand), positioning 3DP within new disruptive innovation infrastructures and communities of makers—a 'revolution' in waiting. This vision has been, however, only partially met. Digital fabrication technologies require specific sets of protocols and standardised materials for their

implementation hindering collaboration and exchange. For example, sheet materials (such as plywood or OSB panels) used for the production of timber building elements are typically specified, produced, and shipped internationally, disconnected from material and innovation pathways emerging from local landscapes, economic, cultural, and ecological systems (Fure, 2011) and in doing so, limiting the ability for locally available material supply chains. Beyond issues of production, the dominant paradigm of data as a virtual, transferrable, 'everywhere' asset neglects more complex trade-offs between data and its environmental/material manifestations (Taffel, 2021). Recent research has shed light on the environmental impacts of data such as energy demands (Siddik et al., 2021) and resource footprints (Kez et al., 2022), but there is a gap on the analysis of the movement of data and how it relates to the production of objects under 'local' fabrication principles. Geographic approaches to data-in-place such as 'fabcities' (Diez and Posada, 2013; Guallart, 2020) and 'bioregion(ing)' (Thackara, 2019) have attempted to reframe automation futures within more relational, socially, and environmentally aware visions involving issues such as localised making v globalised fabrication, or urban/rural environmental dynamics. However, these reframing efforts are still largely attached to contextually lax principles such as 'globally connected cities', 'regenerative region co-creation', and 'connected communities', with undefined geographies and ecological manifestations.

On responding to this research landscape, then, we recognise the need to contextualise automation-in-place and its differentiation from dominant technological paradigms such as 'smart cities'. Although the dominant view of smart cities often addresses the provision and automation of 'efficiencies' in urban infrastructures and services (e.g., transport networks, street lights, water and energy provision) (Willis, 2019), we identify the impact of automation as part of a process of collectively uncovering relational challenges to achieve local development. Concurrently 'smart city' services and their implementation often imply 'smart citizens', however there is a stream of research documenting how problematic smart cities' implementation often exacerbates issues of inequality, displacement, and marginalisation (Vanolo, 2013) of digitally illiterate groups. Here, instead, our process of research is born out from a condition of marginalisation and digital inequity by inclusively working with disenfranchised community organisations. More importantly, the smart city discourse is closely associated to a condition of urbanity and cities. As mentioned above we have identified that, however, conditions of place are multi-scalar and 'fuzzy', and the implementation of automation-in-place can traverse across a range of geographic conditions of making (Carr and Gibson, 2016) including the living lab facilities and their associated communities of making, the broader town/rural landscape and its local material provenance routes, as well as materials' international supply chains and extractive cartographies. For instance, in our project we have scoped the use of a local timber

supply chain (2 miles from our living lab facility) as opposed to standard digitally-fabricated plywood elements which are largely imported into the UK from China (53%) and Brazil (13%) (Braby, 2023).

3. A Living Lab for Housing Futures

3.1. On Research Methodologies

This project operates through a mixed methods approach, considering the potentials and methods from both Action Research and Participatory Research. For Thiollent (2011), there is a 'rapprochement'—establishment of harmonious relations—of the two methodologies. When utilising the notion of rapprochement as a tool, it is possible to envision the continued development of an open range of participative methodologies rather than requiring the creation of a new, monolithic methodology encompassing the two. 'It is not a matter of demanding a single body of knowledge, with closed borders, because we are dealing with a family of proposals and procedures that have a common democratic will, with participation and cooperation between the parties involved, sharing a vision for social transformation' (Thiollent, 2011: 161). The exchange of the two entwined methodologies provides an open and iterative space for inquiry and discovery led by common cause—social transformation through collaborative and participatory means. Both frameworks offer the opportunity to engage with stakeholders as participants directly and provide a platform to acknowledge and develop different forms of knowledge production and cocreation (Bradbury, 2015).

Action Research can be considered as a 'family of approaches' with differing orientations that all share characteristics that involve, empower, and improve participants and their social context (Bradbury, 2015). In this way, action research does not seek to become a strict methodological framework but, instead, a mode of flexible inquiry that is context-bound and participative. Cycles of action research—observation, action, reflection—are open and iterative, enabling a living and emergent research design that can change and negotiate with practical issues as they arise, supporting the capacity for research to adapt to context as required, both by researchers and participants—utilising action research as a tool to make visible the learning processes from practice. In doing so, design research outputs and outcomes become shareable and accessible, working through projects with the context through negotiation and acknowledging what mediates activity (materials, technology, social norms, infrastructural barriers)—embodying an attitude of *making-with* (Haraway, 2016) rather than *on* or *for* (Bradbury, 2015) individuals and the research context. For some, 'participatory design' refers to a discipline, whilst for others it refers to the Scandinavian precursory approaches developed in the 1970s and 1980s (Krogh and Koskinen, 2020) which have since been adopted and adapted into new forms such as 'codesign'. Participatory approaches aim to

facilitate designers, practitioners, researchers, and non-design professionals' capacity to address present-day issues through collaborative and democratic means (Figure 21.4). Collaboration contributes to a mode of research and design activity that seeks to produce work capable of the sum of its parts, and in doing so, blurring of traditional divisions between user and designer creating a democratic space for dialogue and decision-making that values all opinions, ideas, and lived experiences equally (Matthews et al., 2022; Sanders and Stappers, 2008). In bringing together the creativity and situated knowledge of those with relevant lived experience and expertise into the design process, participatory work can provide insight otherwise unavailable (Matthews et al., 2022).

Figure 21.4. Codesign workshop participants in Denhay Farm, Bridport. Source: T. Crabtree, 2023.

3.2. Participation and Design in Residence

Participatory approaches to design research and design practice that attempt to reframe the 'stakeholder as partner' and 'participant as collaborator' are driven by the democratic principle that people should have the right to be involved in decisions that affect them. Stakeholders, in this sense, both have the capacity to affect change and are affected by decisions made within the process of a design project. Ehn (1993) characterises the democratic right to be involved in decision-making as the political and technical aspects of participatory design. Devisch, Huybrechts and Ridder (2019) stress the importance of the 'political nature of participation' due to its implications for making visible the needs and aspirations of marginalised groups. If we consider this through Arnstein's Ladder of Citizen Participation (1969), participatory design should seek to work towards 'the

redistribution of power that enables the have-not citizens, presently excluded from the political and economic processes, to be deliberately included in the future'.

In Bridport, our network of participants includes marginalised groups, end users of community and affordable housing, housing community groups (such as Wessex Community Assets), and the local town council. A recurring concern is the notion of 'usual suspects'—individuals in the community who have an engaged mindset and often attend events like open days, workshops, and council meetings. These individuals are valuable and active members of the community. However, they tend not to be the individuals most in need of housing, or other of social issues related to accessibility to resources, transport, skills training, or affected by digital inequity—for example, young families struggling to afford housing. Here, it has become clear that usual research recruitment and access approaches need to be revisited, and instead generate trust and embeddedness within local groups to promote participation and mobilise knowledge and experiences from users otherwise not engaged with on-site research activity, moving beyond superficial, low-impact models of design consultancy towards a system that enables communities to work with each other toward shared goals and meaningful change.

Design research 'in residence' responds to the place-based nature of the enquiry, following a tradition of research-in-residence in the University of Plymouth's Centre for Coastal Communities (Gradinger et al., 2019) and their work on codesign technologies for ageing users (see for instance Bradwell et al., 2023), advocating for more embedded research facilitating knowledge coproduction and mobilisation. Here, we don't see a residential approach exclusively to gain access to communities and stimulate participation, but more ambitiously as a pathway to impact by directly designing with end users rather than waiting for research results to 'find their way' into the community. We expect this approach to additionally impact on interrelated issues such as development of local skills and capacity building, and influencing local policy and community housing delivery frameworks. In the specific context of Bridport, this approach has been funded through the Arts and Humanities Research Council in response to a national research programme that places design research ('design exchange partnerships') as an instrumental mechanism to connect academic expertise with rural and coastal communities acknowledging place-based conditions of fieldwork, development, and creative practices (Madgin and Robson, 2023).

3.3. Reconciling Automation with Place-Based Design Research: A Living Lab in Denhay Farm

Human-to-human interaction within Action Research and Participatory Research approaches has been well documented, and methods thoroughly developed to engage participants with positive discussion, ideas, and concept development within design projects and during workshops. Such

methods include the use of probes, toolkits, and prototypes to engage participants with physical making activities (Sanders and Stappers, 2014), context mapping of experiences from practice (Sleeswijk Visser et al., 2005), or speculative artefacts (Ratto, 2011) to name a few. Academic contributions to the field that remain somewhat unexplored and less defined are the 'relations between process, the physicospatial situation and materials' (Lucero et al., 2012). These relations predominantly engage with how design may relate to places. On exploring these material interactions, we have contributed to the creation of a living lab in Denhay Farm, in the rural periphery of Bridport. This is an actual facility in a former dairy barn to facilitate the prototyping of housing building elements with the participation of local stakeholders—farmers, builders, makers, designers, and community housing organisations. Here, two housing prototypes have been built, a tiny house (a towable wooden structure) and a larger timber frame structure able to be filled with different wall building elements to test out panelling and insulation building solutions. Workshops so far have included hemp processing, timber construction of prefabricated panels for walls, and the matching of digitally fabricated components with local building techniques (Figure 21.5).

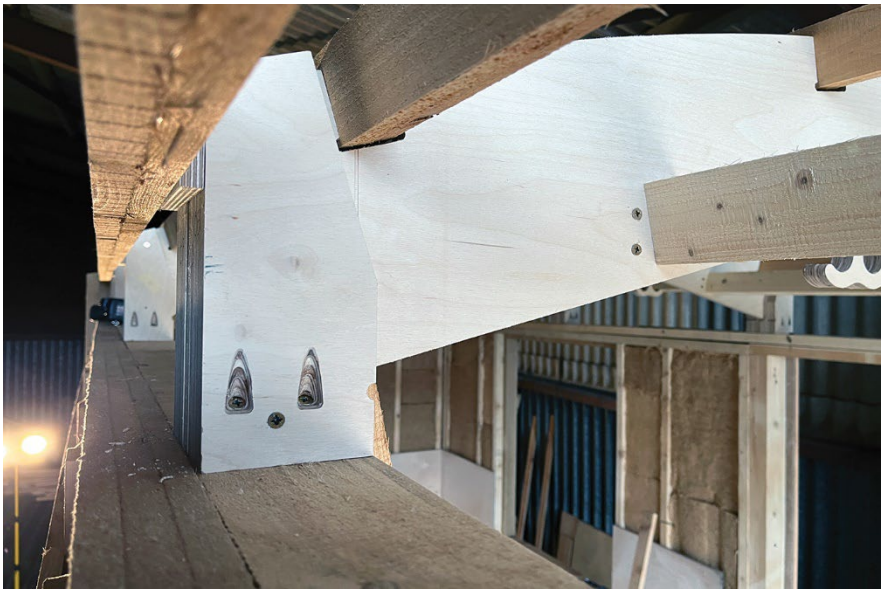

Figure 21.5. Matching of digitally fabricated building components with a locally-built structure for a "tiny house". Source: A. Carr, 2023.

Probing the role of automation within these exchanges proved challenging. As mentioned before, digital production technologies operate within standardised frameworks and struggle to recognise the challenges originated in localised material practices. For instance, a CNC milling machine typically operates under standard sheet material parameters (e.g., plywood of certain thicknesses) instead of locally sawn timber components. While plywood is a stable and more uniform

material, timber has grains, knots, cracks, bends, and warps that require bespoke forms of industrial processing. At the moment of writing, a parallel project is being delivered in partnership with our School of Engineering attempting to use computer vision to automate the identification of defects in local ash and optimise its industrial processing through digital fabrication tools (Figure 21.6). Similarly, local farmers are trialling hemp as a break crop, and scoping the possibilities of reintroducing hemp into the local economy following Bridport's industrial heritage in rope and net manufacturing (English Heritage, 2006). In hemp processing workshops we have tested clay and lime mixes with locally sourced materials, comparing them against industry standards such as hempcrete (a cement-based mix). These materials have specific rheologies and mix ratios, and shrink, crack, and dry in uneven and often unexpected ways. Material flows, lack of localised digital skills, lack of local digital fabrication facilities, and ad hoc supply chains were evidenced through discussion and co-making—solving construction and assembly challenges only discoverable due to the frictions between digital production and local construction techniques. Although technology "solved the problem" of procuring and processing local timber, logistical barriers inherent to working in rural settings resulted in collective forms of engagement with a much more complex context. On reframing automation practices, that demands addressing social dynamics entwinned with socio-material practices (Orlikowski, 2006) to develop multidimensional and sensitive research spaces.

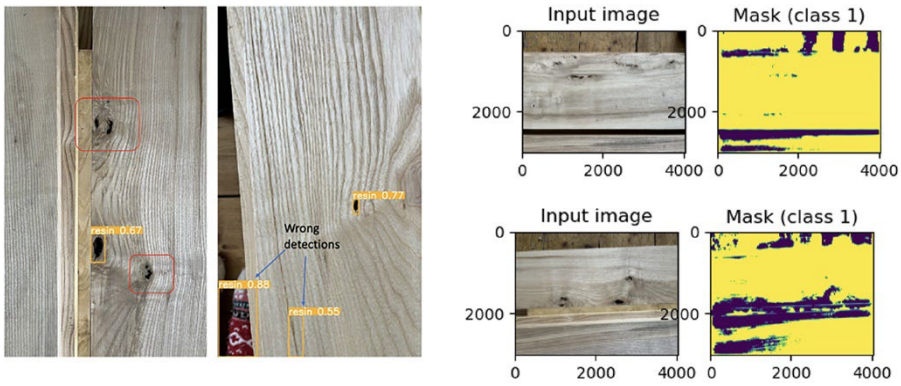

Figure 21.6. Sample of computer vision applications in the detection of timber defects, using object detection (left) and semantic segmentation (right) techniques. Source: D. Selvaratnam, 2023.

4. Discussion

In this chapter we outline how radical and inclusive design practices, and consideration to 'automation-in-place', can make a positive offer based on the creative potentials of Bridport's local communities and organisations' ability to envision their housing futures. By bringing together local

stakeholders with designers 'in residence', we can simultaneously address the needs of areas with significant economic and digital inequity, while also mobilise knowledge and creative impacts from communities rich in its material and industrial legacies (Arts and Humanities Research Council, 2023). In our research we identify housing as a design territory on the overlaps between physical and social infrastructures, a space for cocreation at scale using a mixed methods Action Research / Participatory Research approach. This led us to framing our approach to 'automation' not only as a design and prototyping tool, but instead as a multi-dimensional and multi-scalar research space (Buchanan, 2019) acknowledging not only a technological discourse, but additionally as a driver to develop social (infra)structures that mediate collective change (Vink et al., 2021) and social innovation (van der Bijl-Brouwer and Malcolm, 2020).

Although beyond the remit of this chapter, we do recognise an emergent line of research on the entanglements between data (and data infrastructures) and its localised material and productive manifestations in the production of our built environment, similar to emerging research on the ecological and socially situated impacts of data centres (Brodie, 2020, 2023) or communication infrastructures (Lehuedé, 2022). This will allow for multidisciplinary research involving design, materials science, manufacturing, data science, geography, consumption, and market research identifying ecological and multi-scalar impacts across sectors such as construction, design, human geography, and housing studies, among others. On this basis, we have initiated a new research project in partnership with Open Systems Lab, aimed at developing the data infrastructures necessary to involve local SMEs ecosystems on the production and tracking (via material passports) of timber building elements, uncovering a new data ecology in building supply chains marginalised from 'modern methods of construction' capital investments.

Acknowledgements

This project meets the University of Plymouth's Research Ethics and Integrity Policy, and it has secured ethical approval from the Faculty Research Ethics Committee (Faculty of Arts, Humanities and Business). This work is funded by UK Research and Innovation, projects 'Participatory housing manufacturing' (EPSRC Connected Everything: Accelerating Digital Manufacturing Research Collaboration and Innovation Network Plus grant ref. EP/S036113/1) and 'Building with/for Bridport: A systems thinking methodology for housing codesign in coastal communities' (AHRC Design Exchange Partnerships grant ref. AH/Y00003X/1).

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