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The Hexadecimal Factory - Product and Service Design Work in the Digital Economy

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Abstract. This article explores digital product and service production. Digital production is a sizeable part of the global economy and growing area of employment. People working in the digital economy are employed in many sectors including new ones, such as e-commerce. Their roles are diverse, working conditions varied and in most cases their occupation blends traditional skills such as management with new ones such as software development. This article focuses on creative workers. Working closely with developers, their tasks span envisioning, designing, developing, delivering and maintaining digital deliverables. Preparatory studies were carried out to understand this kind of work more deeply and then to examine the felt nature of creative work in often intense, agile working conditions. Agile was found to have both positive and negative effects on wellbeing. A four-week diary study was then conducted to explore this topic in more detail. The findings helped define how the creative work of designers is integrated within production, the kind of knowledge employed in collaborative, multidisciplinary work and the occupational strains they encounter. These findings are discussed and underpin the article climatic conclusion on evolving Wilcock's framework for occupational health [9] to account for the specific characteristics of creative labour in the current (digital) period of value production and economic cycle.

Keywords: Design, Employment, Occupation, Work, Grounded Theory.

1 Introduction

McKinlay and Smith's critical collection of articles focusing on work and employment in creative industries (2010) is a notable exception to a dearth of studies on creative work in the digital economy. Even then it is primarily concerned with film, theatre and television, rather than the broader digital economy that now spans across almost every nation, market, product and service domain and job. Since 2010, this area of economic activity has grown exponentially. For example, only three years ago around 5.9 million jobs [1] could be attributed to the sector in the US. Bukht and Heeks, [4] contend that generally the digital economy contributes at least 5% of GDP in most developed economies. Research by these economists [5] extends into identifying three important sub-categories of economic activity within the whole.

Firstly, the define a *core digital* sector, that includes a broad category of software development driven value creation. This core sector spans infrastructural platforms, and products and services that underpin a digitalised economy. The second, *digital economy* sector includes innovative products, services and inventions, such as social media, artificial intelligence or remote work practices that are only possible within today's technologically entrenched economics. Finally, the *digitalised economy* encompasses traditional areas of economic activity that have evolved by technological transformation such as e-commerce. Creative workers are employed in all three of these categories. Software development consumes creative labour through the design of user interfaces that manifests technology as useful and usable interactive products and services for consumers. These interfaces in turn provide the means through which consumers take part in their own economic activity.

2 FORMATIVE RESEARCH

Having identified a sizeable area of creative labour within the digital economy, research was undertaken to understand the nature of occupation in this domain more fully. This was done in two stages. First, a number of small studies (see Table 1) were conducted to map out the domain. Findings helped shape a deeper and more targeted diary study that followed and explored emergent themes elicited in the first set of studies. Both stagers of research aimed to address three foundational questions as follows:

What is design work?

What is the impact of this work?

What is the broader context for this work?

Table 1

Study id	Sample	Method	Theme
1	19	Workshop	Designers current project practices
2	40	Survey	Senior designers working practices
3	5	Workshop	In-house design team workflows
4	121	Survey	Designers' attitudes to agile
5	52	Survey	Designers' attitudes to agile
6	14	Survey	Designers' conflicts & beliefs
7	59	Survey	Developers' attitudes to design
8	6	Workshop	Stakeholder's experiences of agile
9	24	Workshop	Design policy stakeholders
10	102	Survey	Stakeholders' attitudes to design
Total	442	N/A	N/A

Data from the first stage of studies was analysed by thematic coding of transcripts, interview notes and verbatims. First, textual data was tabulated and open coded. Over-arching themes were then identified across the study data and in some cases, further

coding used to identify facets and nodes. However, in the final analysis, the main focus was to define key contextual themes within the broad topic of creative work in order to home in on specific areas for further investigation in the follow up study into design as work.

Theme 1 – Designers’ work encompasses production, innovation and facilitation

A consistent finding across the studies is that designers’ primary role is in digital production. This means creating assets for development and working with developers to build digital product and services such as creating wireframes, graphics – even copy and content or page layouts as deliverables. Next, designer’s role maps to the more traditional orientation of supporting innovation through planning out a new or improved digital product or service through blueprint type deliverables. Lastly, designers’ role in facilitating collaboration is a growing part of their daily working practices. The relative growth of facilitation or co-design activities (against the relative decline of individual design work) has been accelerated by the predominance of agile and design thinking. Naturally, non-directly design activities are also part of everyday work and there is general tendency for this to increase proportionally with seniority, especially in seasoned designer’s role in ‘shaping’ projects (estimation and resource planning), ‘client-facing’ activities and sales support including the ubiquitous proposal pitch.

2.1 Theme 2 – Agile permeates digital production and shapes creative work

Scrum is ubiquitous and pervades and conditions how designers work and when and what they produce. Here, designers work on ‘missions’ in ‘pods’ through ‘sprints’ of two weeks duration that comprise time-boxed tasks described in ‘tickets’ and ‘stories’, through a ‘backlog’. Teams’ work is constantly refined via ‘grooming’ and ‘sprint planning’ sessions where teams estimate and prioritise tasks through ‘story points’ to deliver an ‘increment’ of working software. Kanban boards are used to progress work during ‘daily Stand-ups’ where a ‘scrum master’ ‘removes impediments’ that might slow team’s ‘velocity’. A number of rituals reinforce agile values and project vision including ‘show and tells’ and ‘hackathons’. Teamwork is enabled by many digital tools and planning aides that help teams to collaborate, progress, produce and manage.

2.2 Theme 3 – Agile has negative and positive impacts on creative work

Designers’ multifaceted role is often challenging in the fast pace of agile delivery as they need to ‘feed’ developers’ assets and sequence their output to parallel production. Creative workers need to continually (re)align to a fixed project vision despite frequent changes (‘pivots’), ‘scope creep’, evolving stakeholder needs, undocumented requirements and constraints that only emerge ‘in sprint’. As a result, rework is often and creatives’ role is regularly limited to low-value ‘production’ work. This is most evident in the tendency for them to be primarily occupied with small, incremental work over rewarding strategic missions. Time pressure often means that ‘cut down’ methods are used instead of comprehensive requirements gathering and design thinking time. Agile can have a negative effect on production value and waste as well as eroding well-being through stress, interpersonal conflict and alienation.

Positive aspects of agile should not be underestimated. These, again, include the benefits of developing agency and comradeship in team work as well as positive flow work experiences [6] of collaborative working at pace. Anecdotally the kind of ‘buzz’ felt in agile pods can be infectious and when work sequencing, vision and resourcing are congruent the progressive aspects of agile are evident and in some ways at odds with more formal and hierarchical ways of working. Björklund & der Marel [3] echoes this positive aspect of agile as helping foster competency, relatedness and meaning.

2.3 Theme 4 – Agile missions deliver micro, macro and transformative value

Agile development delivers three distinctive levels of value by delivering business and consumer innovation that ranges from (transformative) strategic transformations, (macro) middling product or service improvements through to (micro) small tweaks. These three incremental levels of innovation provide scaled levels of value that can be calculated as ‘return on investment’ and ‘business cases’ through to prioritization criteria in sprint planning. In a broader sense, value contribution is also an aspect of the occupational experience of creative workers. Designers gain kudos and satisfaction from high value adding missions but also flourish on a mix of small to large scale work. Middle work which sits between the two extremes and is often the most productively wasteful is the least rewarding. This is possibly due to the often relatively unstructured character of this kind of work compared small discrete tasks or extensive, well-resourced and structured missions necessary for transformational outcomes.

2.4 Theme 5 – Designers are expected to humanise technology

Clients and collaborators (developers) expect and cherish designers, for their influence on innovation as much as their productive value. Designers’ work including a perceived proclivity to humanise technology and an ability engender empathy with customers into technology driven missions is seen as a key differentiating advantage. Designers’ (attributed) progressive prerogative and influence may either be the result or cause of their often-reported dilemmas in regularly encountering ethical challenges. In other words, the value-based role designers are expected to play is a source of conflict for them. The kinds of difficulties faced by designers range from nonmaleficence for consumers, beneficence in applying the right design process, justice in assuring accessibility and autonomy to counterbalance prevailing social, technical and commercial values.

2.5 Formative research conclusions

The first phase of research mapped out the structure of creative work at a general level. The predominance of agile, three levels of innovation spanning tweaks to transformation and designers’ expected role in humanizing technology were strong themes in the data that generally had a negative impact on individual experiences of occupation. The negative effects of working on agile missions derives from the often relentless pace of sprints, the pressure of sequencing and producing deliverables across multiple

workstreams, the commonplace marginalisation of designers within highly technically focused teams, waste through rework and a prevalence of unrewarding task and were some of the reported issues found across the studies. Nevertheless, participants reported positive experiences of work too. They derive satisfaction from collaborative work, develop skill and knowledge-based agency and enjoy the social value of comradeship that underpins scrum. This formative study found that designers' sense of belonging, autonomy and engagement in meaningful activity to be in contradiction to their actual (often limited) role in production. Further and more focused research was undertaken to home in on the experience of creative work at a personal level.

3 SUMMATIVE RESEARCH

Participants were recruited through social media platforms. This involved contacting people whose described themselves on their profile as working 'designer's. A variety of tenure and sectors was sought, and participants took an initial online screening questionnaire to check profile matching, gain their informed consent and to give background information about the study. Forty-two subjects were selected down from the initial cohort to complete diary tasks over four weeks. Participants were aged between twenty-five and forty-four (82%), most were female (62%) and the majority were based in the UK (59%). Digital diaries were used to collect data. Each participant was given a unique and secure workspace that provided activity descriptions and space for data entry in the form of interactive tables, pages and forms, depending on the task at hand. Diary entries were prompted through a series of written tasks, exercises and activities given by the moderator to participants via email and described in the weekly task descriptions that follow. The studies produced a large amount of data. Analysis involved tabulation and coding individual diary entries into a consolidate data set. The narrative data from study a was tabulated so that each individual utterance could be analysed. Then open coding was applied by scoring related content to codes. As coding progressed, themes emerged that were then named and through a recursive process a taxonomy emerged structured around primary themes that contained facets that comprised a collection of nodes. Wherever possible frequency scores were calculated as percentages for each level of the taxonomy.

3.1 Narrative Inquiry Research and Reflexive Diary Study

In the first activity, participants co-authored a five-act narrative about a typical mission which provided transcript data for qualitative coding into underlying themes, facets and nodes within the data set. Participants online, collaborative story-writing activity developed a 'Practitioners' Tale'. This described their everyday working week in a typical client project as a group of designers. This activity involved participants creating a set of characters on the first day. The moderator provided scaffolding around this activity that included mandating that wherever possible, the language, terms and colloquial language of work was used. Lastly, within the writing activity, participants were asked to describe episodes of harmony and friction within the action in order to draw out occupation experience and balance factors. The structure and sequencing supported the

activity well and prompts ensured participants were engaged over the whole week and that emergent findings could be probed within the study. The collaborative story telling provided rich data on the felt experience of creative work. Here, the cohort could express their occupational experiences as a group, reflect on past experiences, share them with the cohort and perhaps therapeutically use the activity to communicate the daily tribulations of work in a safe environment with the other designers taking part.

The result was a co-authored narrative containing 584 entries totalling 6052 words including native phrases and words such as ‘Sheep dip (Client speak/jargon for initial meeting/workshop)’. Three main characters (Designer, Engineer and Manager) were described in some detail as well as brief descriptions of the supporting and minor characters. The acts provided structure to a typical mission starting with ‘*Act 1 - Counting down...*’ which detailed the preparatory work needed to ensure sprints run to full velocity and the high expectations and hope felt at the beginning of mission. The narrative then moved to the second act (‘Time is tight’) where the pressure of working at pace, a lack of structure creates tension, compromise and stress. The story then moves to ‘*Act 3 - Fight for Power*’ where conflict erupts and the overall goal of the mission is called into question through the commonplace changes of direction, rework and wasted production effort. In ‘*Touchdown*’ a critical path emerges and alignment occurs briefly to deliver the ‘increment’. Finally, in ‘*Act 5 - Wrapping up...*’ team members recover for the next mission, reconvene with their peers and reflect on the work done. In this closing piece, there is a strong sense of achievement and the team overcoming impossible odds to produce value over and above what was deemed possible. There a complimentary and emphatic sense of the importance of comradeship and celebrating the success of the team.

The narrative was provided a corpus within which thematic coding could be conducted. Provisional themes, codes and facets were developed and then tested until a stable set of themes were identified and stable through to the final analysis. The three themes were iteratively developed from open coding the data and then closed coding to Wilcock’s [10] occupational framework of being, doing, belonging and becoming. The framework was used to guide the direction of analysis that provided a good fit to the emergent themes and also related to the domain level topic of occupation. The full corpus was then copied to three spreadsheet tabs that corresponded to each of the themes and framework constructs. Each tabs’ content was then reviewed and extraneous data (e.g., relating to product owners or clients that are outside of the scope of this research) removed in order to make coding easier and accurate. Each theme was then recursively coded to identify facets and nodes and where possible these were quantified by frequency in order to show the relative weighting of each element in the narrative.

3.2 Narrative Thematic Findings to Wilcock’s Framework

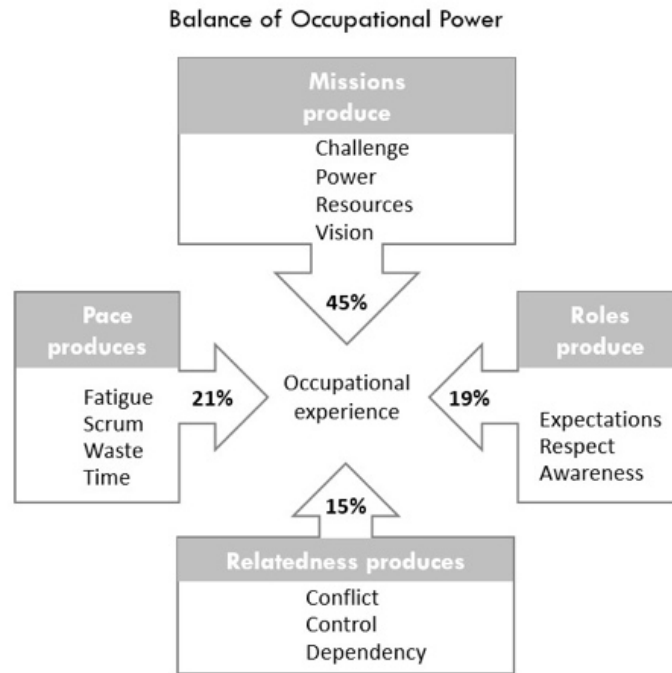
Generally, there was a good fit between all of the data and the framework’s themes of being, doing, belonging and becoming. However, the weighting (the frequency of matching data to each framework element) was surprisingly heterogeneous. Data

relating to the felt nature of occupation (being) made up just half of all the coded data (51%). The second element of doing scored also relatively highly at 36%. This meant that the two primary themes made up nearly ninety percent of the coded data. The dynamic nature of occupation, described in the third facet of the framework, was significantly less frequent at nine percent. Belonging, similarly had low frequency (4%) within the overall set of four coded themes. These overarching findings suggest a general imbalance in designers' occupational experience. This could be understood positively in those designers are highly engaged in their work and that their occupation is deeply connected with who they are as a person in ways that go beyond instrumental notions of work.

Narrative Thematic Findings on Doing

Facets and nodes within the doing theme were relatively easily identifiable as they pertained to the subject doing something or acting on another subject or object. The structural elements of work, identified in the first stage of research, were also found in the second data set, albeit with additional insights into the ratio of different kinds of missions. There was a prevalence of middle work (74%) compared with the distinctively lower frequency of tweak (12%) related and strategic missions (14%) respectively. Occupational balance factor data (see Figure 1) included participants' conception of missions and the negative and positive aspect of work. Facets and nodes were, again, relatively easily identified as they generally related to the outcome of an action or the relationship with another subject. Content relating to the mission theme itself was the highest frequency facet within this theme. Nodes included the type of challenge (unstructured vs. structured), the power relations in teams, the important issue of production waste including resource issues (for example, frequent personnel changes limited knowledge transfer) and touched on the critical topic of (non)convergence on a shared vision within missions. Pace was the second most frequently reported topic. Awareness, expectations and the level of respect other disciplines afforded to designers made up a third role aligned facet within this theme. Content mapping to relatedness (15%) echoed the strong sense of camaraderie seen in the previous research, as well as the more functional collaboration needed in production tasks and the development of team agency. Relatedness also included some surprisingly stringent content including attribution of 'abuse' in pods, as well as similar conditional nodes (good or bad) such as pride. Conflict was reported too within relatedness. Data relating to control and disempowerment (86%) was also an emphatic finding in the data. Nodes within the occupational balance theme shed further light on the felt nature of occupation. This data included insights into the pressure of work itself, lack of structure and certainty, the prevalence of mundane tasks and uneven skills and knowledge across team members. 'Exhaustion', 'burnout', 'panic', 'juggling' and 'rework' are some of the words used in relation to missions in the diary entries. The language and prevailing negative experiences reported by participants give a flavour of the kinds of stresses encountered in creative work in agile development missions within the wider digital economy.

Figure 1 – Occupational Balance Factors



Narrative Thematic Findings on Knowing

The final theme identified in the data pertained to knowledge. The amount of data relating to this topic was notably higher than the other themes but was less easily identifiable. The data relating to knowing was relatively homogeneous and well-defined within four discrete facets. Ease of coding was helped by most attributed content containing the word 'know' or 'knowing' or where it could be accurately inferred through phrase that involved the subject [knowing] about something or [knowledge] that was needed to act. Unlike the other themes, while the facets and nodes were well-defined there was no related framework, such as Wilcock or even relevant label words that captured the essence of the nodes and was a common term in language. The closest match was found Baumard [2] framework that draws on ancient Greek concepts including Phronesis. However, both the arcane language and the abstract nature of the facets within Baumard's framework, led to a shorthand labeling schema being developed that used colloquial English, including ken and knack. The four elements of this schema were then used to code out facets and nodes, described in Table 2.

Ken connotes a totalising abstract to concrete knowledge capability, attributable through external sources in books and the concretised knowledge and covering the broad body of design knowing and theory. The second, facet 'Chi' can be defined as

knowledge capability built on context, contingent on interaction with others and previous experience. Facets within this theme, include reference to methodologies and nodes relating to cases, patterns, principles and structuring work to standard ways of work. Knowing and learning through doing and reflecting on the work was a strong element too. This node also mapped to scrutiny, judgment and empathy. The third node within the contextual knowing facet concerned knowing about external factors influencing work such as costs and dependencies. This kind of contextual knowing correlates strongly with tenure as experience is gained worldly knowledge increases. However, anecdotally, this can lead to an orthodoxy of working that inhibits doing things differently. Knack, the physical and mental prowess combined into useful practical knowledge capability was the third facet within the theme, although the one with the lowest frequency across all of the nodes. This theme relates to the technical skills needed to do the work and the competency related knowing that employers are most focused on in most cases. Nous, was a strong node in the data. Not only is this kind of cunning ‘practical intelligence’ useful in everyday work but it also correlates to career success independently from educational background or verbal intelligence [8]. The data suggested that this situational, quick-witted kind of knowledge capability is emergent in doing and unlike chi is highly personal and indeed correlates to tenure and developing individual strategies and ways of working. Nodes within this facet included knowing and applying knowledge relating to personal values and ethics, the ability to improvise and break with orthodoxy to get the best out of situation – almost at a level of abstraction that flies in the face of convention, individual drive and guile and the ability to influence others are also strongly attributable to this theme.

Table 2 – Design Knowledge Framework – Theme (T), facets (F) and nodes (Nx)

T	F	N1	N2	N3	N4	N5
Nous	Personality	Curiosity	Pragmatic	Emotion	Empirical	Reflect
71%	Drive	Achieve	Guts	Risk	Own	Juggle
	Strategy	Control	Defer	Plan	Change	Plot
	Influence	Empathise	Listen	Steer	Rapport	Talk
	Intellect	Learn	Diagnose	Explain		
	Approach	Discover	Balance	Scrutinise		
Chi	Practices	Patterns	Principles	Process	Structure	
21%	Context	Quality	Optimise	Value	Estimation	
	Experience	Cases	Education			
	Connect	Collaborate	Facilitate	Consult	Contribute	
Ken 7%		Theory	Abstract	Causality	Clarity	Tradition
Knack 3%	Capability	Expertise	Hands on	Hone	Finish	Document

Thematic Coding Validation

In order to validate the construct further responders kept a reflexive diary for a week and the resulting data helped to assess the knowledge framework. The results also gave good insights into the daily tribulations of design work and importantly enabled mapping coping strategies to the design knowledge capabilities. The results indicated that *Nous* was the most frequently reported, *Chi* was second, *Ken* and *Knack* being the lowest. These findings, and the narrative together suggest a number of knowledge-based strategies for building resilience. Firstly, designers learned to navigate difficult situations using their own capacity and resources. Secondly, that using cases, methods and standards is a strategy to circumvent marginalisation by legitimising their activities based common practices. The low prevalence of theoretical and practical knowledge is notable too. A factor in the low level of tool-related practical knowledge is perhaps contingent on the kind of work designers do today. This tends to be on computers and that, anecdotally the software they tend to use to render visuals, create flows and produce developer ready assets is becoming less complex and more usable with a decreasing need to learn complicated, bespoke design software. Low levels of theoretical knowledge is also not so surprising perhaps, as the other data points to the pressure of work and often low-level production task designers are occupied by. The validation findings, however, suggest a more fundamental and surprising conclusion in connection to Wilcock's framework. In surfacing the importance of knowledge, as both work resource, capability and enabler in occupational balance, the findings suggest that being, doing, becoming and belonging are underpinned by knowledge. This may not be the case in all occupations and perhaps as information workers, designers are particularly dependent on their knowledge capabilities compared to more traditional occupations.

3.6 Occupational Diary

The diary study research progressed beyond the narrative inquiry that identified the importance of knowledge to occupation and included a further two weeks of fieldwork. This study produced data on daily design tasks, participants occupational experiences and emotional states. Participants kept a daily diary and were prompted to answer questions on what they were doing, how they felt at specific times, by adding notes and scoring against a set of descriptors. The descriptors were developed from the findings of the first stage of research and were iteratively refined before the occupational diary study in order to gain a good potential fit with agile working experiences. The sixteen emotional descriptors were scored by diary keepers using a ten-point scale (0 being low) during their working day over one week. They could also add their own descriptor if the predefined set was lacking or ill-fitting. This resulted in tabular data that could be quantitatively analysed to measure frequency and fit and was used to refine the set of descriptors for a second week of diary keeping. The second weeks fieldwork followed a similar procedure to the first, except participants were only given the refined set of descriptors to match against in their diaries as the first set had already been refined.

3.7 Thematic Findings on Being

The occupational diary data was coded, and the descriptors paired into eight binary sets of low state to high state such as stressed to calm within an occupational experience framework (see Table 3). Each set was then coded back from the data to derive nine

occupational emotional binaries ranging from congruence to pace. These provide insights to the felt nature of creative work with each binary containing a low state stressor and a positive satisficing high point. The data shows that the occupational experience fluctuates between polarities and are highly personal in how they manifest as positive or negative experiences. In other words, a challenge can be both good and bad for different individuals and situations. The findings are surprising in the relative homogeneity of the data with Pace being the lowest and arousal the highest. How each of the binaries work together and the valence within each set is an interesting topic for further research. Anecdotally from the narrative it would seem that individual difference and personal capacity for work, based on their particular mapping to being and doing states highly determines their occupation experience at any given time. In other words, someone can be positively engaged in challenging task even if they are rushed if they find the activity stimulating. Someone else might find being fully aligned in the purpose of their task with their peers a good thing, while others might strive for more autonomy. However, individuals operate within this framework, were shown to accurately account for designers' occupational experience in the study with little variation from the first set.

Table 3 – Occupational Emotional Descriptors and Occupational Experience Themes

Low-state frequency	Low-state descriptors	High-state descriptors	High-state frequency	Occupational Experience Theme nodes
4.34%	Alienated	Aligned	5.41%	Congruence
3.56%	Bored	Excited	5.49%	Stimulation
7.12%	Calm	Stressed	6.26%	Arousal
6.04%	Constrained	Unconstrained	4.97%	Autonomy
5.67%	Disempowered	Empowered	6.71%	Control
4.56%	Disordered	Ordered	5.60%	Structure
6.12%	Distracted	Engaged	7.67%	Engagement
5.00%	Overstretched	Underused	5.63%	Utilisation
4.97%	Leisurely	Rushed	4.89%	Pace

CONCLUSION

This research has helped to outline the structural foundations of creative work in the digital economy. Two stages of fieldwork were undertaken within an emergent occupational perspective. Formative research helped to identify key constructs with design work in an agile environment. These primarily structural constructs included three levels of design work ranging from the small change tweak type missions through to the strategic. However, this tranche of research gave limited insights into the felt nature of this kind of work. In the summative phase of research, diary studies were used to gain insights into this topic and to evolve Wilcock's occupational framework of being, doing, knowing and belonging. The occupational perspective not only compliments the proximal fields of social practice theory and design research, but also provides

methodological tools and insights into the felt experience of work and perhaps, most importantly the connection between work and well-being [10]. Future work may build on the possibility of using these insights for targeted therapeutic interventions that engender improving generalised and persistent occupational health issues of achieving balance, resilience and empowerment in work. Extending the health potential of design itself and augmenting resilience building with tried and tested design thinking activities is another potential benefit of aligning these two disciplines further. It might be that the very tools and methods used in design practice might compliment the now commonplace use of mental health support in work and help build resilience in all kinds of digital work.

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