6 Workplace innovation in the digital era: a role for SMART work design

Sharon Kaye Parker and Alexandra A. Boeing[1]

Digital technologies are catalysing a new age of automation, enabling global connections, and changing the way organisations and their employees accomplish their work. During COVID-19, the implementation of digital technologies was accelerated as organisations have had to conduct more of their business online, and as large numbers of people were required to work from home. Digital technologies have allowed people to move freely within and across organisations (Boudreau et al., 2015, p. 11), have promoted flexible working arrangements and virtual teaming, and have eliminated the need for much of the dangerous work historically performed by humans (Parker & Knight, 2021).

However, whilst there is no doubt that digital technologies bring opportunities for work and society, new technologies also can result in low-quality jobs (Parker & Grote, 2019). Digital initiatives can also lead to system inefficiencies and wasted resources (Baxter & Sommerville, 2011). For example, as many as 70% of digital initiatives fail to achieve their objectives because of insufficient attention to cultural, leadership, and social aspects of work (see Tabrizi et al., 2019). Thus, one cannot "assume" that the introduction of digital technologies will generate quality work for people in which the technology augments human performance, nor can productivity benefits be taken for granted.

In this chapter, we assert that organisations need to proactively and intentionally consider the design of work to harness the benefits of technology for people and productivity. We focus on the role of work design in improving the impact of digital technology because it appears unlikely that automation/AI will replace human workers in most occupations in the near future (Brynjolfsson

[1] We acknowledge funding support received from the Australian Research Council, FL160100033, for the first author.

et al., 2018). Barriers to whole-job automation include the technical challenges of automating 'uniquely humans' skills, such as: creativity or empathy; the costs of developing and deploying hardware and software for automation; and regulatory and social issues such as the degree to which machines are acceptable in a certain setting. However, whilst only about 5% of all occupations are likely to be automated entirely, "about 60 per cent of all occupations have at least 30 per cent of constituent activities that could be automated" (Manyika et al., 2017, p. 4). In other words, for many occupations and jobs, the current risk of digital technologies appears to be the disruption of, rather than the elimination of, human work. This gives rise to the challenge of how to organise the work between the human and digital agents in a way that can facilitate work performance and enhance employee wellbeing. Work design questions such as which tasks are allocated to machines and which to people, and who should be in control, come to the fore.

In the light of the centrality of work design, our goal in this chapter is to introduce the SMART model of work design as a basis for establishing a fundamental set of human-centred criteria that can facilitate both meaningful work and productive employee performance in the context of digitalisation. We propose SMART work criteria as a way to support workplace innovation (WPI), which is defined as:

> an integral set of participative mechanisms for interventions relating structural (e.g., organisational design) and cultural aspects (e.g., leadership, coordination and organisational behaviour) of the organisation and its people with the objective to simultaneously improve the conditions for the performance (i.e., productivity, innovation, quality) and quality of working life (i.e., wellbeing at work, competence development, employee engagement). (Oeij & Dhondt, 2017, p. 66)

In other words, the SMART work design model can support the achievement of both performance and quality of working life (which is central to the definition of WPI), and it can do so in part by improving technical design and implementation, thus going beyond the traditional non-technical focus of workplace innovation (Pot, 2011).

In what follows, we first outline the SMART model. We then propose that a work design lens can serve not only as a tool for non-technological innovation but also to improve the design, tailoring, and integration of digital technology into organisations in a way that is congruent with WPI goals. Finally, we conclude with some observations about the link between WPI, technology and work design.

SMART work design: an overview

Work design, a long-established topic in applied psychology and management literature (Hackman & Oldham, 1976), refers to the nature and organisation of employees' tasks, roles, responsibilities, and relationships, such as who makes which decisions, what jobs are included in a team, and how many diverse tasks are allocated to an individual job (Parker, 2014). For example, a self-managing team is a form of work design in which the team has a high level of autonomy to make day-to-day work decisions, and job rotation is a form of work design in which an individual swaps from one set of tasks to a different set of tasks on a regular basis.

Although the design of work systems is a topic that involves consideration of multiple parameters at multiple levels – such as detailed consideration of physical, cognitive, or engineering aspects – our focus is on individuals' psychological and social experience of work, including whether their work is motivating, promotes wellbeing, reduces strain, and fosters growth and learning (which may be termed 'psychosocial aspects', or, when lacking or negative, 'psychosocial risks'). The most common approach to understanding which psychosocial aspects of work are important has been to assess and analyse key individual perceptions about 'work characteristics' and then to model their impact on outcomes. For example, a meta-analysis by Humphrey et al. (2007) showed the importance of motivational work characteristics (e.g., job autonomy), knowledge work characteristics (e.g., problem-solving demands), social work characteristics (e.g., social contact), and physical work characteristics (e.g., work conditions) in shaping employees' motivation and wellbeing.

Introducing the SMART model of work design

One of the challenges that has emerged for understanding work design has been to make sense of many work characteristics that have been shown to promote meaningful and healthy work. The meta-analysis mentioned above, for example, included 14 distinct work characteristics. As work has changed, and as research on the topic of work design has expanded, new work characteristics have been introduced. This proliferation can make it difficult for scholars and practitioners alike to make sense of, and choose from, the many work characteristics.

In the light of this challenge, Parker and Knight (2021) used higher-order structural analytic techniques to show that the diverse work characteristics can be synthesised into five larger categories. This structure has been colloquially

captured via the SMART acronym (see smartworkdesign.com). SMART work design refers to work that an individual experiences as Stimulating (e.g., uses one's skills, has task variety), as supporting Mastery (e.g., provides clarity and feedback), as enabling Agency (e.g., decision-making influence, job autonomy), as fostering Relational aspects (e.g., teamwork, social support), and that has Tolerable demands (e.g., levels of workload & complexity that are manageable). This model has many parallels with the WEBA assessment tool, developed by researchers in the Netherlands to detect risks in jobs for stress or the impairment of learning (Pot et al., 1994; Dhondt & Vaas, 2001). WEBA assesses seven dimensions, each of which relates to some aspect of SMART: 1) Completeness; 2) Non-short-cycled tasks; 3) Degree of complexity (all of which relate to Stimulation); 4) Autonomy in one's work (Agency); 5) Opportunities for contact (Relational); 6) Organisational tasks (relates to Mastery); and 7) Provision of information (relates to Mastery). We describe each higher-order element of the SMART model proposed in this chapter in more depth next.

Stimulating work design

When work is Stimulating, it means that the tasks, activities, and responsibilities within the work role are varied and challenging (e.g., involving problem-solving and active cognitive processing), and that they use and develop the job incumbents' skills (Parker & Knight, 2021). Technological change can affect the extent to which work is stimulating. For example, the commodification of work that has been enabled by "platform-based talent markets within organisations" (such as the 'jobs'-platform Amazon Mechanical Turk) can result in jobs that have narrow tasks, with reduced worker skill use and development (Kittur et al., 2013). On the other hand, because technology often replaces the more routine aspects of work, the introduction of technology can also increase the cognitive complexity and challenge in work.

A great deal of research shows that stimulating work is positive for workers' wellbeing, reflecting theory and evidence that most individuals have a desire to learn and take on new challenges (Ryan & Deci, 2017) and that novelty and stimulation is key to fostering adult development and growth (e.g., Staudinger & Kunzmann, 2005). For example, in a meta-analysis, Humphrey et al. (2007) showed positive relationships between work characteristics such as task variety and skill use with worker job satisfaction.

Mastery-oriented work design

When work supports Mastery, it means the work is organised in such a way that one can understand what one's tasks, activities, relationships, and respon-

sibilities are, how they 'fit' in the wider system, and how well they are being executed (Parker & Knight, 2021). Information flows, coordination mechanisms, feedback from one's supervisor, and technology can all affect Mastery by increasing people's sense of clarity about their roles and responsibilities, as well as feedback about how to improve their job performance. The introduction of technology can both positively and negatively influence Mastery. For example, analyses of the aviation industry have shown that automation can reduce the feedback delivered to workers under normal operating conditions, which reduces their situational awareness and increases the difficulties of resuming operations if manual intervention is required (Norman, 1990). Beane (2019) showed a contemporary example of how robotic technology makes it difficult for trainee surgeons to receive high-quality feedback, resulting in impaired learning.

Mastery work characteristics promote job satisfaction because people have a fundamental desire to be competent at work (Deci & Ryan, 2000). When this need for competence is met, workers feel a positive sense of achievement. Consistent with this reasoning, evidence shows the importance of mastery work characteristics for positive individual outcomes; for example, Humphrey and colleagues (2007) found that job-related feedback was positively related to organisational commitment and job involvement and negatively related to anxiety and stress.

Agentic work design

When work has Agency, it means that workers have a high degree of autonomy, control, and influence over their work tasks, activities, relationships, and responsibilities (Parker & Knight, 2021). Traditional models of work design have highlighted the importance of Agency. The Job Characteristics Model (Hackman & Oldham, 1976) identified job autonomy (or having freedom and the chance for independent decision-making in carrying out one's job) as a key motivational aspect of work. Karasek's (1979) Demand-Control model of strain also identified job control as central.

With regard to digitalisation, technology-enabled work practices can enhance job autonomy by allowing for a wider distribution of information and, thus, localised decision making. Conversely, technology can undermine human agency by eliminating tasks through automation. This can result in humans being taken 'out of the loop', where they lack the necessary situational awareness to take control or accountability in the case where automation fails or is unable to perform (Parker & Grote, 2019).

A great deal of research shows that, as theorised, job autonomy predicts outcomes such as worker job satisfaction and wellbeing, and lowered job strain (e.g., Fried & Ferris, 1987; Humphrey et al., 2007). In addition, autonomy also allows people to learn and grow (Parker, 2014) and promotes outcomes such as proactivity and creativity (Parker et al., 2006).

Relational work design

All human beings have a fundamental need to belong (Baumeister & Leary, 1995; Ryan, 1993). Relational work design pertains to this core need: when work is positively designed from a relational perspective, workers experience support from and connection with others, as well as an opportunity to positively impact the lives of others (e.g., end-users). Relational work design, therefore, explicitly focuses on the social and interpersonal context of work (Grant & Parker, 2009). The importance of social support has long been recognised, but more recently, Grant (2007) showed how, when workers understand their impact on others, they are more likely to feel appreciated and valued, leading them to put in more effort and perform more effectively. Relational work design also captures the need to design work in such a way that it takes account of the linkages and interdependencies between tasks, groups, and functions within organisations, such as through 'relational coordination' mechanisms – for example, shared goals (Gittell, 2016) – as well as through appropriate team structures.

The effects of digitalisation and technology on relational aspects of work are varied. On the one hand, social media, for example, can buffer against loneliness for remote workers or homeworkers (Hislop et al., 2015) and enhance connections in distributed workplaces (e.g., Kellogg et al., 2006). However, in the age of COVID-19, society is becoming aware of the difficulties workers can have in establishing bonds, seeking help, and coordinating work in a purely technologically connected environment (e.g. Banerjee & Rai, 2020; Mortensen & Neeley, 2012).

Work design with tolerable demands

Job demands are, by definition, aspects of work that require effort (Demerouti et al., 2001). For example, when one has time pressure, workload, or physical demands, one has to put in the effort. Nevertheless, when the work design is Tolerable, this means that one's level of job demands are not overly taxing or impairing one's ability to carry out non-work roles. In other words, the effort required should be manageable relative to the person's resources (Bakker et al., 2014). When job demands are excessive, they cause distress, such as when

individuals experience levels of role overload that are greater than their time and capability constraints (Rizzo et al., 1970). It is important to note that what demands individuals experience as 'tolerable' is affected by other work characteristics. For example, the job demand-control model (Karasek, 1979) posits that high job demands are more manageable if job control is also high.

On the one hand, technology should reduce demands, since, after all, reducing the need for labour is a key motivation underpinning its implementation. For example, digital technologies are allowing for seamless data integration, such that tasks that previously required a high degree of manual control and cognitive attention are now performed without human intervention (Parasuraman & Mouloua, 2018). However, the ease of information access is also increasing the degree of data volume and complexity, meaning many roles require a higher degree of cognitive complexity to manage. There is also evidence that technology can intensify work. For example, in a review of algorithmic management, Parent-Rocheleau and Parker (2021) showed that these digital systems very often increase work intensity because individuals' work behaviours can be much more tightly monitored.

SMART work design and performance

Above, we have provided evidence and theory linking each category of SMART work design with employee health and wellbeing goals. In addition, when work is designed in ways that make it SMART, it also supports employee performance and can positively impact organisational performance, as elaborated next.

First, the greater motivation of individual workers and teams in the system means they will put in more effort, as well as engage in more 'extra-role' behaviours such as citizenship and be more proactive and creative (e.g., Mahembe & Engelbrecht, 2014). Other studies link work characteristics such as job autonomy with creativity (e.g., Liu et al., 2011) and innovation (e.g., Cai et al., 2013), and yet other studies show links between self-managing teams (or empowered teams) and team performance (e.g., Cohen & Ledford, 1994). Second, there is also evidence that many of the work characteristics in the SMART model link to individual learning (see, for a summary, Parker et al., 2021), which indirectly is important for organisational performance. Third, by creating work that is more self-managing, there are also system benefits. For example, Wall et al. (1992) described the 'quick response mechanism' that arises from allowing workers to solve problems at the source. They argue for the logistical advantages of operator control. In a system where the operator can recognise

and rectify a fault, or make a decision, then action can be prompt and waiting time is eliminated.

Consistent with the idea that SMART work design is good for performance, a systematic analysis of intervention studies, Knight and Parker (2021) provided evidence that work redesigned to have more Stimulating, Mastery, Agency, and Relational elements, tends to result in better performance, with some studies documenting these effects at the team or organisational level.

Using the SMART model when introducing technology

The sociotechnical systems (STS) perspective posits that an inevitable consequence of mixing 'socio' with 'technical' is that the social does not necessarily behave like the technical, people are not machines; paradoxically, as technologies grow more complex and interdependent even the 'technical' can start to exhibit emergence (Walker et al., 2008). As such, optimisation of one component without consideration of the other can have unintended consequences which are actually injurious to the system's performance. To this end, traditional STS theory emphasises that for any sociotechnical system to reach its ultimate performance, joint optimisation of the 'social' and 'technical' components is required. In line with STS principles, WPI also advocates for non-technological innovation to complement and integrate with technological innovation.

STS methods include tools such as cognitive task analyses, functional allocation tools, and scenario forecasting/planning. The objective of such methods is often to make explicit the conditions humans require to perform effectively. For example, the tool KOMPASS (Grote et al., 2000) supports functional allocations between humans and technology, and includes criteria such as 'process transparency', which evaluates the transparency of technical processes for the human operator. In this way, this tool, like others, supports joint sociotechnical optimisation, informing technical design specifications. However, there is evidence to suggest that the uptake of STS and other human-centred design methods is often poor, especially in technologically complex environments (Baxter & Sommerville, 2011; Bloebaum & McGowan, 2012). STS perspectives have been criticised for being overly vague and for being hard to put into practice. To this end, we propose that the SMART work design model can be translated to serve as simple design criteria, which can inform not only non-technological innovation but also technological innovation, and therefore help to inform a useable sociotechnical systems approach.

For each higher-order job characteristic, that is, dimension of SMART, we outline questions that can be asked by end-users (i.e., the employees) but also considered by technology designers, managers, or others commissioning and implementing technology (see Table 6.1). We first identify what the overall goal should be for the work design. For example, in the case of Stimulating, the goal is to design work in which 'workers engage in tasks they find interesting, use and develop their skills'. We then identify more specific questions that can be asked to help achieve this goal. We identify more opportunities or risks that might be created with respect to achieving stimulating work as a result of technology. For example, creating a job that involves a large degree of passive vigilance can be an outcome of technological change (Matthews et al., 2019), so we note this as a risk to be avoided. Finally, we identify broader human, cultural, and organisational considerations that might need to be made to support this aspect of work design. Table 6.1 shows the goal, diagnostic/assessment questions, risks, and opportunities to consider with technology, and broader issues for each of the remaining elements of the SMART model.

These work design elements can be considered from the design and commissioning of technology, right through to implementation. Ideally, SMART work design is considered as early as possible in the process, at the design stage, before the technology is implemented. An example of a proactive approach comes from a research study in which we adopted an STS approach to SMART, to inform the early-phase design of a military submarine (see Boeing et al., 2020). In this project, SMART work criteria were utilised to evaluate the proposed crewing requirements of a future submarine. End-users and those responsible for technological acquisition were involved in the workshops. In the evaluation, SMART criteria were considered alongside factors such as operational capability and the constraints of the proposed technologies. The objective was to evaluate the ability of the proposed crewing requirements to support system performance and meaningful, sustainable work. SMART 'risks' such as skill utilisation in some roles, intolerable demands resulting from significant passive monitoring requirements, and operator fatigue were all highlighted as a result of these analyses. This evaluation ultimately led to alterations to the proposed staffing requirements and further consideration of the submarine's physical layouts and technical specifications.

Ideally, too, a whole work system is considered, alongside technology. De Sitter et al. (1997) argued that "it is useless … to start with job design at the shop floor level" because the degrees of freedom for job design are predetermined by the larger structures within which they are embedded. They advocated (re) designing the wider systems before tackling the redesign of jobs. We agree that this can be the ideal approach. However, the reality is that sometimes

the level of intervention is the work design of a team or unit. Rather than suggesting that redesign at this level is "useless", we suggest it is "constrained". As a case in point, in one organisation in which we conducted research, the introduction of automated train-driving systems created large numbers of workers whose role became extremely unstimulating. At the highest level, the organisation had made the decision that human driving was to be minimised, so there were no opportunities to redesign the work to maintain skill levels by allowing occasional manual driving. Thus, the design approach was far from ideal. Nevertheless, by analysing the train drivers' work design using the SMART model and then involving drivers in a process to come up with ideas for improvements, we were able to come up with recommendations for improvement, such as by rotating drivers to other jobs which involved more interesting tasks.

Conclusions

As transformative technologies become more pervasive in our work ecosystems, it is important to ensure these technologies are designed and implemented with optimal human performance and wellbeing in mind and with the necessary attention to non-technological aspects that enhance digital success. In the light of this radical change, it has been argued that an important role for WPI in the digital age includes enabling the social and organisational system's evolution necessary to support technological innovation to 'stick' (Oeij et al., 2019). In other words, WPI advocates for social and organisational renewal to occur alongside technological innovation in order to achieve the dual outcomes of worker wellbeing and organisational performance.

However, WPI's focus on non-technological innovation limits the ease and likelihood for WPI methods and principles to be applied to technological innovation. As such, like Van Amelsvoort & Van Hootegem (2017), we advocate for an extension to WPI, such that it explicitly incorporates the STS principles of joint 'socio' and 'technical' optimisation. We suggest that this goal can be achieved by focusing on human-centred design criteria, which aim to inform both non-technological and technological innovation. In this chapter, we have introduced the SMART model work design and outlined how it supports the WPI goals of optimised employee performance and wellbeing. Additionally, we have detailed how SMART criteria can be used by both engineers and social scientists to inform both technological and non-technological innovation. We suggest that SMART serves as an example of a WPI tool that can enable innovation to support human performance and wellbeing in the digital age.

Importantly, factors such as the detailed nature of the methods, a lack of practitioner know-how, and difficulties involved in establishing socially oriented evaluation criteria have been cited as potential barriers to wider uptake of sociotechnical approaches (Baxter & Sommerville, 2011; Rus et al., 2019). These challenges are likely to compound in the digital age, with the need to consider more variables within a wider ecosystem. The process of work system redesign needs to be simple and fast in order to 1) support designers and engineers to consider human factors in the design and implementation of technologies; and 2) allow the social and organisational systems to adapt alongside ever-evolving new technologies and business models. We believe that SMART work design criteria are a simple and intuitive means to support the evaluation and design of both technical and social system components by both technologists as well as end-users. In this way, we suggest that SMART criteria can support agile and adaptive work systems, enabling rapid social system evolution and allowing for human-centred criteria to be included in technological design and acquisition decisions. We hope that this approach will help to grow the application of sociotechnical methods to new technology which, despite ongoing demonstrations of the importance of sociotechnical design (McGowan et al., 2013), and positive experiences in demonstrator projects, have not yet been widely adopted (Baxter & Sommerville, 2011).

References

Bakker, A.B., Demerouti, E., & Sanz-Vergel, A.I. (2014) Burnout and work engagement: The JD–R approach. *Annual Review of Organizational Psychology and Organizational Behaviour, 1*(1), 389–411. https://doi.org/10.1146/annurev-orgpsych-031413-091235

Banerjee, D. & Rai, M. (2020) Social isolation in Covid-19: The impact of loneliness. *International Journal of Social Psychiatry, 66*(6), 525–527. https://doi.org/10.1177/0020764020922269

Baumeister, R.F. & Leary, M.R. (1995) The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Baxter, G. & Sommerville, I. (2011) Sociotechnical systems: From design methods to systems engineering. *Interacting with Computers, 23*(1), 4–17. https://doi.org/10.1016/j.intcom.2010.07.003

Beane, M. (2019) Shadow learning: Building robotic surgical skill when approved means fail. *Administrative Science Quarterly, 64*(1), 87–123. https://doi.org/10.1177/0001839217751692

Bloebaum, C.L. & McGowan, A.M.R. (2012) *The design of large-scale complex engineered systems: present challenges and future promise.* In 12th AIAA ATIO Conference and 14th AIAA/ISSMO MA&O Conference, AIAA Paper (No. 2012-5571). https://doi.org/10.2514/6.2012-5571

Boeing, A.A., Jorritsma, K., Griffin, M.A., & Parker, S.K. (2020) Surfacing the social factors early: A sociotechnical approach to the design of a future submarine. *Australian Journal of Management*, *45*(3), 527–545. https:// doi .org/ 10 .1177/ 0312896220920338

Boudreau, J.W., Jesuthasan, R., & Creelman, D. (2015) *Lead the work: Navigating a world beyond employment*. John Wiley & Sons.

Brynjolfsson, E., Mitchell, T., & Rock, D. (2018, May). What can machines learn, and what does it mean for occupations and the economy? *AEA Papers and Proceedings, 108*, 43–47. https://doi.org/10.1257/pandp.20181019

Cai, W., Song, W., & Zhao, S. (2013) An empirical study on the effects of creative personality and job autonomy on individual innovation performance of knowledge workers. *International Business and Management, 6*(2), 24–30. https:// doi .org/ 10 .3968/j.ibm.1923842820130602.1045

Cohen, S.G. & Ledford Jr, G.E. (1994) The effectiveness of self-managing teams: A quasi-experiment. *Human Relations*, *47*(1), 13–43. https:// doi .org/ 10 .1177/ 001872679404700102

Deci, E.L. & Ryan, R.M. (2000) The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268. https://doi .org/10.1207/S15327965PLI1104_01

Demerouti, E., Bakker, A.B., Nachreiner, F., & Schaufeli, W.B. (2001) The job demands-resources model of burnout. *Journal of Applied Psychology*, 86(3), 499–512. https://doi.org/10.1037/0021-9010.86.3.499

De Sitter, L.U., Den Hertog, J.F., & Dankbaar, B. (1997) From complex organizations with simple jobs to simple organizations with complex jobs. *Human Relations*, *50*(5), 497–534. https://doi.org/10.1177/001872679705000503

Dhondt, S. & Vaas, F. (2001) *WEBA Analysis Manual*. Leiden: TNO Work and Employment.

Fried, Y. & Ferris, G.R. (1987) The validity of the job characteristics model: A review and meta-analysis. *Personnel Psychology*, *40*(2), 287–322. https://doi.org/ 10.1111/j .1744-6570.1987.tb00605.x

Gittell, J.H. (2016) Rethinking autonomy: Relationships as a source of resilience in a changing healthcare system. *Health Services Research, 51*(5), 1701. https://doi.org/ 10.1111/1475-6773.12578

Grant, A.M. (2007) Relational job design and the motivation to make a prosocial difference. *Academy of Management Review, 32*(2), 393–417. https://doi.org/ 10.5465/ amr.2007.24351328

Grant, A.M. & Parker, S.K. (2009) Redesigning work design theories: The rise of relational and proactive perspectives. *Academy of Management Annals*, *3*(1), 317–375. https://doi.org/10.5465/19416520903047327

Grote, G., Ryser, C., Wäler, T., Windischer, A., & Weik, S. (2000) KOMPASS: A method for complementary function allocation in automated work systems. *International Journal of Human-Computer Studies*, *52*(2), 267–287. https:// doi.org/ 10 .1006/ ijhc .1999.0289

Hackman, J.R. & Oldham, G.R. (1976) Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*(2), 250–279. https:// doi.org/10.1016/0030-5073(76)90016-7

Hislop, D., Axtell, C., Collins, A., Daniels, K., Glover, J., & Niven, K. (2015) Variability in the use of mobile ICTs by homeworkers and its consequences for boundary management and social isolation. *Information and Organization*, 25(4), 222–232. https:// doi.org/10.1016/j.infoandorg.2015.10.001

Humphrey, S.E., Nahrgang, J.D., & Morgeson, F.P. (2007) Integrating motivational, social, and contextual work design features: A meta-analytic summary and theoretical extension of the work design literature. *Journal of Applied Psychology, 92*(5), 1332–1356. https://doi.org/10.1037/0021-9010.92.5.1332

Karasek, R.A. (1979) Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24*(2), 285–308. https://doi.org/10.2307/2392498

Kittur, A., Nickerson, J.V., Bernstein, M., Gerber, E., Shaw, A., Zimmerman, J., Lease, M., & Horton, J. (2013, February)) The future of crowd work. In *Proceedings of the 2013 Conference on Computer-supported Cooperative Work* (pp. 1301–1318). https://doi.org/10.1145/2441776.2441923

Knight, C., & Parker, S.K. (2021) How work redesign interventions affect performance: An evidence-based model from a systematic review. *Human Relations*, *74*(1), 69–104. https://doi.org/10.1177/0018726719865604

Liu, D., Chen, X.P., & Yao, X. (2011) From autonomy to creativity: A multilevel investigation of the mediating role of harmonious passion. *Journal of Applied Psychology*, *96*(2), 294. https://doi.org/10.1037/a0021294

Mahembe, B. & Engelbrecht, A.S. (2014) The relationship between servant leadership, organisational citizenship behaviour and team effectiveness. *SA Journal of Industrial Psychology, 40*(1), 1–10. https://doi.org/10.4102/sajip.v40i1.1107

Manyika, J., Chui, M., & Miremadi, M. (2017) A future that works: AI, automation, employment, and productivity. *McKinsey Global Institute Research*. https://www.jbs.cam.ac.uk/wp-content/uploads/2020/08/170622-slides-manyika.pdf

Matthews, G., Neubauer, C., Saxby, D.J., Wohleber, R.W., & Lin, J. (2019) Dangerous intersections? A review of studies of fatigue and distraction in the automated vehicle. *Accident Analysis & Prevention, 126*, 85–94. https://doi.org/10.1016/j.aap.2018.04.004

McGowan, A.M.R., Daly, S., Baker, W., Papalambros, P., & Seifert, C. (2013) A sociotechnical perspective on interdisciplinary interactions during the development of complex engineered systems. *Procedia Computer Science, 16*, 1142–1151. https://doi.org/10.1016/j.procs.2013.01.120

Mortensen, M. & Neeley, T.B. (2012) Reflected knowledge and trust in global collaboration. *Management Science*, *58*(12), 2207–2224. https://doi.org/10.1287/mnsc.1120.1546

Norman, D.A. (1990) The 'problem' with automation: Inappropriate feedback and interaction, not 'over-automation'. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences*, *327*(1241), 585–593. https://doi.org/10.1098/rstb.1990.0101

Oeij, P. & Dhondt, S. (2017) Theoretical approaches supporting workplace innovation. In Oeij, P., Rus, D. and Pot, F. (eds), *Workplace innovation. Theory, research and practice* (pp. 63–78). Springer. https://doi.org/10.1007/978-3-319-56333-6_5

Oeij, P.R., Dhondt, S., Rus, D., & Van Hootegem, G. (2019) The digital transformation requires workplace innovation: an introduction. *International Journal of Technology Transfer and Commercialisation*, *16*(3), 199–207. https:// www .researchgate .net/ publication/ 332965662 _The _digital _transformation _requires _workplace _innovation_an_introduction

Parasuraman, R. & Mouloua, M. (eds) (2018) *Automation and human performance: Theory and applications*. Routledge.

Parent-Rocheleau, X. & Parker, S.K. (2021) Algorithms as work designers: How algorithmic management influences the design of jobs. *Human Resource Management Review*. https://doi.org/10./j.hrmr.2021.100838

Parker, S.K. (2014) Beyond motivation: Job and work design for development, health, ambidexterity, and more. *Annual Review of Psychology*, *65*. https://doi.org/10.1146/annurev-psych-010213-115208

Parker, S.K. & Grote, G. (2019) Automation, algorithms, and beyond: Why work design matters more than ever in a digital world. *Applied Psychology*. https:// doi .org/ 10 .1111/apps.12241

Parker, S.K. & Knight, C. (2021). Structuring work design: A higher-order analysis of work characteristics. *Applied Psychology*.

Parker, S.K., Morgeson, F.P., & Johns, G. (2017) One hundred years of work design research: Looking back and looking forward. *Journal of Applied Psychology, 102*(3), 403. https://doi.org/10.1037/apl0000106

Parker, S.K., Wall, T.D., & Cordery, J.L. (2001) Future work design research and practice: Towards an elaborated model of work design. *Journal of Occupational and Organizational Psychology, 74*(4), 413–440. https:// doi .org/ 10 .1348/096317901167460

Parker, S.K., Ward, M.K., & Fisher, G. (2021) Can high-quality jobs help adults learn new tricks? A multi-disciplinary review of work design for cognition. *Academy of Management Annals*. https://doi.org/10.5465/annals.2019.0057

Pot, F. (2011). Workplace innovation for better jobs and performance. *International Journal of Productivity and Performance Management, 60*(4). 404–415. https://doi .org/10.1108/17410401111123562

Rizzo, J.R., House, R.J., & Lirtzman, S.I. (1970) Role conflict and ambiguity in complex organizations. *Administrative Science Quarterly*, 150–163. https://doi.org/10.2307/2391486

Rus, D., Oeij, P.R., Pot, F.D., & Totterdill, P. (2019) Workplace innovation: a review and potential future avenues. *International Journal of Technology Transfer and Commercialisation*, *16*(3), 208–227. https://doi.org/10.1504/IJTTC.2019.099900

Ryan, R.M. (1993) Agency and organisation: Intrinsic motivation, autonomy and the self in psychological development. In J. Jacobs (ed.), *Nebraska Symposium on Motivation: Developmental perspectives on motivation* (Vol. 40, pp. 1–56). University of Nebraska Press.

Ryan, R.M. & Deci, E.L. (2017) *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Publications.

Staudinger, U.M. & Kunzmann, U. (2005) Positive adult personality development: Adjustment and/or growth? *European Psychologist, 10*(4), 320–329. https://doi.org/10.1027/1016-9040.10.4.320

Tabrizi, B., Lam, E., Girard, K., & Irvin, V. (2019) Digital transformation is not about technology. *Harvard Business Review*, *13*(March), 1–6. https://bluecirclemarketing .com/ wp -content/ uploads/ 2019/ 07/ Digital -Transformation -Is -Not -About -Technology.pdf

Van Amelsvoort, P. & Van Hootegem, G. (2017) Towards a total workplace innovation concept based on sociotechnical systems design. In P. Oeij, D. Rus, & F. Pot (eds), *Workplace Innovation* (pp. 281–299). Springer. https://doi.org/10.1007/978-3-319-56333-6_17

Walker, G.H., Stanton, N.A., Salmon, P.M., & Jenkins, D.P. (2008) A review of sociotechnical systems theory: A classic concept for new command and control paradigms. *Theoretical Issues in Ergonomics Science*, 9(6), 479–499. https://doi.org/10.1080/14639220701635470

Wall, T.D., Jackson, P.R., & Davids, K. (1992) Operator work design and robotics system performance: A serendipitous field study. *Journal of Applied Psychology, 77*(3), 353. https://doi.org/10.1037/0021-9010.77.3.353

Table 1.

SMART-related Questions About Roles, Risks, Opportunities and Wider Issues That Can Be Asked To Inform Decision-Making

Work Design Dimension: Overall criteria	**Impact on roles:** *With regard to existing, new, or planned work roles:*	**Technology-related risks and opportunities:** *When designing, commissioning, or implementing digital technologies…*	**Wider people, cultural, and other issues:**
Stimulating: Workers engage in tasks they find interesting, use and develop their skills.	• Can workers engage in a variety of tasks and/or use a variety of skills? • Can people apply their knowledge & skills? • Does the work provide a sense of challenge, interest & meaning? • Does the job have the chance for people to learn new skills?	• Which dull and routine tasks can be automated? • How can the role be constructed so that humans keep learning? • How can a role be created that is not simply one of passive vigilance? • What change to the role is needed to ensure key skills are not being lost over time due to excess automation?	• Is the wider organisation design organised in a way that is conducive to worker variety? (e.g., customer-focused/ product-structure versus functional structure) • What changes are required to training & development systems to upskill workers? • How will workers be supported as they transition to altered work roles? • What are future career paths for workers in the new system? • Which groups of individuals might miss out on opportunities for stimulating work due to the inability to acquire skills?
• **Mastery-oriented**. Workers understand their own and others' responsibilities & they know how they are performing.	• Do workers clearly understand their roles and responsibilities? • Can workers see where the job 'fits' in the wider system? • Have workers got the resources and training they need to do the job and handle challenges? • Do workers get feedback from the job which lets workers know how well they are performing? • Do workers receive feedback from others that lets workers know how well they are performing?	• Have technological systems been designed to provide clear feedback to workers? • Is the basis of algorithmic-generated feedback as transparent as possible? • Can workers intervene to challenge automated feedback?	• How do organisations provide clarity about roles and responsibilities without stifling Agency, such as by focusing on clarity about outcomes/results rather than work methods? • How are traditional HR tools like job descriptions made sufficiently flexible to provide clarity yet also be able to be adapted easily as requirements change? • How can information processes & systems be designed to increase workers' access to information?

Agentic. Workers have day-to-day autonomy over key aspects of their work and influence over the systems within which they operate.	• Can workers decide when they do particular tasks or activities? • Can workers influence decisions that concern them or their job? • Do workers have the freedom to work how they choose? • Can workers take a break when they wish? • Do workers have the flexibility to optimally manage their home demands?	• Is the scheduling of work tasks able to be shaped by humans (rather than being completely dictated by technology) • Does the technology allow humans to control and influence the machines they interact with (rather than creating a sense of helplessness and passivity)? • Has sufficient opportunity for human input been built into automated systems? • When is human judgement important, and does the technology allow for this judgement? • Are people being held accountable for outcomes they have control over (versus being held accountable for machine outputs etc., they cannot properly control?)	• Are workers or worker representatives involved in the design, commissioning, and implementation of technology? • Have leaders been giving training in how to manage in an empowering way that supports worker agency? • Have workers got sufficient training, knowledge, and information to make appropriate decisions? • How is the balance between team and individual autonomy handled?
Relational. Workers have opportunities for connection with, and support, from others and see their work makes a difference to other humans	• Do workers feel supported by their supervisors at work? • Do workers feel supported by their peers and colleagues? • Are workers part of a team or larger entity? • Do workers have the opportunity for social contact and connection with others? • Are workers comfortable asking for help and support from others? • Do workers connect with (or get feedback from) the end-users of the system, that is, the people who benefit from the work? • Is the role designed in such a way that interdependencies are considered (e.g., with a team structure)?	• Do the new physical layouts associated with new technology or other aspects of the way the technology works change opportunities for worker social contact? • Are there direct opportunities for workers to connect with human supervisors if required? • Is technology being used in a way that fosters positive social relationships amongst peers (rather than, for example, pitting workers against each other)? • If remote technology is being used, what opportunities are there sufficient for face-to-face interaction of workers? • Is the technology implemented in a way that takes account of interdependencies between tasks/ functions/ units?	• Do supervisory roles have a clear expectation for providing support to workers and do supervisors receive training on interpersonal aspects of work? • Are teams of workers given training in how to work as a team? • What steps are taken to create a psychologically safe culture? • For organisations with large numbers of remote workers, what steps are taken to reduce isolation and support social connection? • What coordination mechanisms are needed to manage interdependencies>
Tolerable demands. The level of workload, cognitive, physical, emotional, and	• Do workers have work hours that are reasonable (rather than experiencing excessively long shifts	• Does the technology excessively monitor individuals creating surveillance demands?	• What systems exist in the wider organisation to ensure that any mental health risks of

other demands is manageable and does not exceed workers capacity to cope.	or chronic periods of long workloads?) • Do workers have sufficient mental or physical breaks from highly demanding work? • Are the physical demands of the job managed so that they are not excessive or damaging to workers? • Are any emotional demands faced by workers appropriately supported? • Are the vigilance demands reasonable (versus workers being expected to be vigilant for excessively long periods of time without sufficient breaks)? • Are workers exposed to unnecessary physical, mental, or emotional hazards? • What positive aspects of work (e.g., control, support) can increase people's ability to manage demands?	• Does the technology allow individuals to manage their work demands (e.g., to have breaks when required)? • What workload pressures does the technological system create for humans? • Are any safety risks induced by the new technologies?	the work are detected and supported? • Does the organisation allow for individuals differences in coping with demands? • Are there broader systems within the organisation (e.g., managerial targets) that cause unrealistic worker demands?