

SMART Work Design and Modern Sociotechnical Theory

A marriage made in heaven?

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Abstract

Organisation designers responsible for organisational change and the introduction of new digital technologies may share an interest in ensuring good quality of work but often choose different angles. Some of them, likely with an HR background typically emphasise the importance of human needs and job satisfaction when it comes to work design. Others, like organisation designers with an operations management background, might focus more on the division of labour, work processes, and sociotechnical design aspects. Some organisation designers may highlight strategic and organisational choices as prerequisites for work quality, whereas others concentrate on person-environment-fit approaches.

However, to ensure a good quality of work in the digital era, it is much more helpful if organisation designers apply a common lens. Recently, we have observed a convergence in the field of organisational and work sciences with the development of the SMART work design model; this approach integrates individual, team, and organisational elements, linking human needs, job characteristics, and organisational conditions. Previously, researchers in Europe had already connected sociotechnical design thinking to organisational design principles for production layouts and work quality criteria, particularly characteristic of the modern sociotechnical approach (MST) of the Low Countries.

This conceptual and essayistic article aims to spark a discussion on how elements of the SMART work design approach and MST can be integrated into a comprehensive approach where organisation designers can collaborate with a common language. The article argues that the WEBA tool, a method to analyse jobs from both a human needs and organisational design perspective, can serve as a bridge in this context.

Key words: work design; modern sociotechnology; quality of work; organisational design; job design

1. Introduction

The research question of this article is: How can we ensure good quality of work in digital times? In the policy debate, human centricity has become an important goal. Human centricity implies placing the well-being of the industry worker at the centre of the production process (Breque et al., 2020). Worker well-being comes with active jobs in which people have learning opportunities and limited stress risks (Karasek & Theorell, 1990). However, the presence of active jobs, with decision latitude to compensate for high job demands, is not self-evident in these times of digitalisation, like Big Data, artificial intelligence, machine learning, deep learning and algorithms. Parker and Grote (2020: 1173-1174) point out that "(...) the digital era we are in involves extensive technologies that not only change how people do things but also how work is coordinated and controlled (...). Altogether, the collective changes, referred to by Brougham and Haar (2018) as Smart Technology, Artificial Intelligence, Robotics, and Algorithms (STARA), are reshaping the information workers have access to (e.g., real-time data), where people work (e.g., co-working spaces), collaboration patterns (e.g., increasing interaction with robots), and, most fundamentally, people's work designs." How can we ensure good quality of work, as in active jobs, in digital times? Is the SMART work design approach the right answer?

Parker and Grote (2020) propose a central role for work design in understanding the effects of digital technologies. They contend that new technologies can positively and negatively affect job resources (autonomy/control, skill use, job feedback, relational aspects) and job demands (e.g., performance monitoring), with consequences for employee well-being, safety, and performance. They subsequently identify four intervention strategies: "First, work design choices need to be proactively considered during technology implementation, consistent with the sociotechnical systems principle of joint optimisation. Second, human-centered design principles should be explicitly considered in the design and procurement of new technologies. Third, organisationally oriented intervention strategies need to be supported by macro-level policies. Fourth, there is a need to go beyond a focus on upskilling employees to help them adapt to technology change, to also focus on training employees, as well as other stakeholders, in work design and related topics" (Parker & Grote, 2020: 1171).

What is the SMART work design model, and how does it work in practice?

Before addressing that question, we will provide the structure of this article. After explaining the SMART work design model, we discuss its relationship with modern sociotechnical thinking (MST). We conclude that both can be combined in theory but may result in a rather complex method for practitioners to use. We therefore propose a method called WEBA that helps to analyse jobs from both the perspective of the 'psychological' SMART model, based on human needs, and the 'organisational' MST approach, based on operations management. This WEBA method is relatively easy to apply; it goes beyond psychological needs and includes organisations' performance. We hope that the article serves to improve both the quality of work of people and the business performance of organisations, and that it offers a language

that all organisation designers, irrespective of their disciplinary background, can use in practice.

2. SMART work design model

Work design 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 & Boeing, 2023: 93). Their focus on the design of work systems 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 (Parker & Boeing, 2023), such as employees' motivation, wellbeing and job satisfaction.

Parker & Knight (2023) propose the SMART work design model, which identifies five higher-order categories of work characteristics, including stimulating work characteristics (task variety, skill variety, information processing requirements, and problem-solving requirements), mastery work characteristics (job feedback, feedback from others, and role clarity), autonomous (or agency) work characteristics (decision-making autonomy, timing autonomy, and method autonomy), relational work characteristics (social support, task significance, and beneficiary contact), and tolerable work characteristics (low levels of: role overload, work-home conflict, and role conflict). They tested this structure through higher-order confirmatory factor analysis, followed by validity tests linking the factors to the theoretically relevant outcomes of job satisfaction and performance.

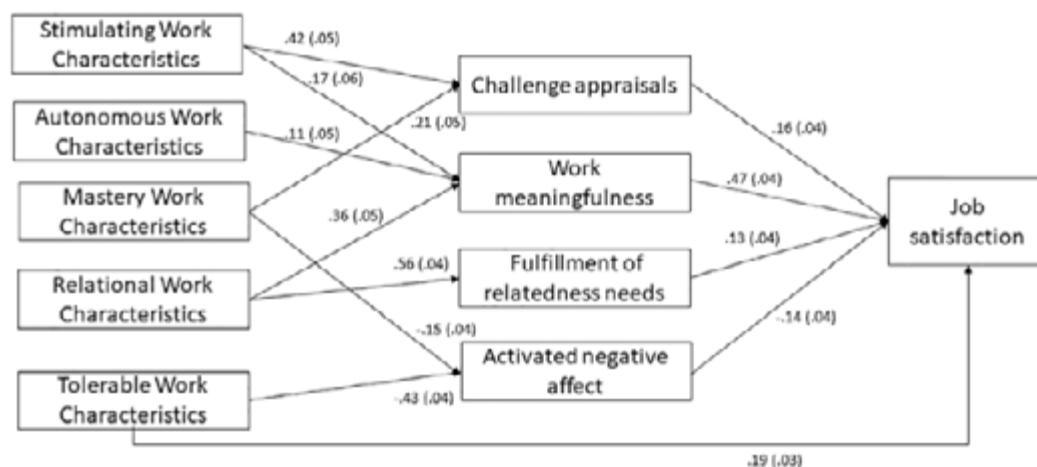
The third row of Table 1 is concerned with a link to organising conditions of the mentioned SMART higher-order factors and human needs. This is where sociotechnical thinking comes in. The Lowlands variant of 'modern sociotechnical systems design' (MST) has developed rules to design organisational conditions that can guarantee excellent organisational and job performance and holds the assumption that this will result in high job satisfaction (De Sitter et al., 1997) , although these sociotechnical researchers state that job design is more fundamental for meaningful work than the job experience of persons, which is a merely a consequence of the quality of work and not a cause of it. We return to this later.

Higher-order factor	Definition	Link to organizing conditions	Link to psychological processes	Perceived work characteristics (dimensions)
Stimulating work characteristics	High degree of mental complexity and variety due to the nature and organization of one's work tasks, activities, responsibilities, and relationships.	Horizontal division of labor	Work meaningfulness and challenge appraisal	• Task variety • Skill variety • Problem-solving requirements • Information processing requirements
Autonomous work characteristics	High degree of autonomy, control, and influence over one's work tasks, activities, responsibilities, and relationships.	Vertical division of labor	Work meaningfulness	• Timing autonomy • Method autonomy • Decision-making autonomy
Mastery work characteristics	Work is organized in a way that one can understand what one's tasks, activities, and responsibilities are, how they fit in the system, and how well they are being executed.	Co-ordination and integration via information	Challenge appraisal and lower activated negative affect	• Job feedback • Feedback from others • Role clarity
Relational work characteristics	High degree of support, connection, and the opportunity to positively impact others arising from one's work tasks, activities, responsibilities, and relationships.	Co-ordination and integration via social processes	Work meaningfulness and meeting relational needs	• Task significance • Beneficiary contact • Social support
Tolerable work characteristics	Low degree of costly quantitative demands arising from one's work tasks, activities, responsibilities, and relationships.	Effort required to achieve shared org. goals	Lower activated negative affect	• Low role overload • Low role conflict • Low work-home conflict

Table 1. Higher-order work design factors, including their definition, theorised links to organisational design and psychological processes, and their work characteristics (Parker & Knight, 2023).

By applying structural equation modelling, Parker and Knight (2023) tested the relationships between the five higher-order factors and psychological processes, i.e. psychological human needs and the outcome of job satisfaction. These relationships proved to be significant, and an additional positive direct pathway was found between tolerable work characteristics and job satisfaction. Figure 2 displays the final model.

Figure 2. The final structural equation model shows the usefulness of the higher-order constructs (Parker & Knight, 2023).



How we can understand each higher-order element of the SMART model is explained as follows (Parker & Boeing, 2023: 94-97):

- 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;
- 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 responsibilities are, how they 'fit' in the wider system, and how well they are being executed;
- 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
- 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);
- 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; the effort required should be manageable relative to the person's resources.

3. Technology, digitalisation and SMART work design

Parker and Grote take a proactive stance, which means rejecting "the existing, overly passive perspective focuses on how humans need to adapt to technology, rather than how work designs and technology might be adapted to better meet human competencies, needs, and values" (2020: 1173). This is an important point of view as it reverses the 'person-environment fit' approach into a 'technology-fit' approach, implying that humans should have control over technology. Even with more agentic and automated technical systems, human needs, competencies and values remain crucial. While it is most likely that tasks will be automated, not whole jobs, such that much work will entail an intense interaction between humans and self-learning autonomous technology. Hence, the long-standing principle of joint optimisation of work systems' social and technical components is as important today as it was in the early days of sociotechnical system design (Parker & Grote, 2020). Parker and Grote place work design at the heart of understanding and shaping new technologies based on the body of knowledge on the relationship between work design and individual, team, and organisational outcomes (such as the Job Characteristics Model of Hackman and Oldham, the Job Resources and Demands model of Bakker & Demerouti and the SMART work design model, see Parker, Morgeson, & Johns, 2017).

According to Parker and Boeing (2023), for many occupations and jobs, the current risk of digital technologies appears to be the disruption of, rather than the elimination of, human work – many tasks and activities of jobs could be automated, but not whole jobs. This gives rise to the challenge of organising the work between human and digital agents to 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. The SMART work design model developers contend that it can support the achievement of both performance and quality of working life, and it can do so in part by improving technical design and implementation (Parker & Boeing, 2023). How do the SMART work design proponents apply their approach when introducing new technology?

SMART work design in practice

SMART work designers apply the sociotechnical systems perspective in the sense that joint optimisation of the 'social' and 'technical' components is required. They 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. Their general approach in practice is as follows (Parker & Boeing, 2023: 99; see also Boeing et al., 2020; Hay et al., 2020a and 2020b):

- for each higher-order job characteristic or dimension of SMART, researchers 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 the overview of SMART-related questions about roles, risks, opportunities, and broader issues that can be asked to inform decision-making about new technology implementation in a Table in Parker & Boeing, 2023, pp. 101-107).
- Researchers first identify the overall goal of 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;
- Researchers then identify more specific questions that can be asked to help achieve this goal. They 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, which is noted as a risk to be avoided;
- Finally, researchers identify broader human, cultural, and organisational considerations that might need to be made to support this aspect of work design.

Parker and Boeing posit that the SMART design approach can be applied from the design and commissioning of technology right through to implementation. It can even be considered as early as possible in the process, at the design stage, before the technology is implemented. An example of such a proactive approach comes from a research study of the early-phase design of a military submarine (see Boeing et al., 2020), summarised in the next text box.

"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."

Source: Parker and Boeing, 2023: 99.

While Parker and colleagues are advocates of a proactive stance with the SMART design model, that is preferably starting before the new technology is implemented and to apply the model in (re)designing the wider organisational systems before tackling the redesign of jobs, they experience that it is difficult to dig deeper, because "the reality is that sometimes the level of intervention is the work design of a team or unit" (Parker & Boeing, 2023). Apart from their observation that factors such as the required detailed nature of the methods, a lack of practitioner know-how, and difficulties involved in establishing socially oriented evaluation criteria as potential barriers to wider uptake of sociotechnical approaches (Baxter & Sommerville, 2011), it is indeed a practical barrier if researchers and consultants get no 'rapport' to participate in a root cause analysis (MacDuffie, 1997) and integral (re)design of the broader organisational system (De Sitter et al., 1997).

The critique of Parker and Boeing (2023: 99) that sociotechnical perspectives are overly vague and hard to put into practice is only partly true. Putting sociotechnical perspectives into practice is indeed a challenge when organisations implement change and technology in a partial manner instead of an integral manner. An organisation is a system whose whole is greater than the sum of its parts. This implies that the renewal of one part, for example, the technology of the mode of production, has consequences for the other parts of the whole, such as work activities carried out in other departments of the organisation. If a client commissions to renew the composition of tasks of teams, and no attention is given to the underlying technological and non-technological structure, one should speak of partial instead of integral organisational change. Upskilling, stress management and time management interventions are examples of partial change. Indeed, a limited assignment is a barrier. Furthermore, one reason for partial commissions is that integral change is a far-stretching, time-consuming, expensive, complex and threatening endeavour with uncertain outcomes. Another reason is that most sociotechnical perspectives and approaches differ quite a lot, as we will outline below.

The SMART work design model and the general body of research in job design and work design have two flaws that are connected to being unable to perform a systemic root cause analysis. The first is that these design approaches lack design rules. An organisational design rule is a prescription for setting up the organisational (production) process, which is based on functional requirements to achieve goals from a systemic, integral perspective. This starts with designing the process from an order to the delivery of the product or services. We do not blame job and work design researchers, as it is simply a matter of subjects belonging to different scientific disciplines, where designing organisations is a subject of operations management. Of course, interdisciplinary and transdisciplinary collaboration would be welcomed to overcome these shortcomings. The second flaw is connected to the first one.

Due to the mentioned 'disciplinary divide' work and organisation researchers with a background in the social sciences (and HR professionals) tend to focus on consequences instead of causes of the design of production processes. While Parker and Grote (2020) are correct to posit that a proactive stance is needed, in practice, the bulk of work and organisational social scientists is restricted to carrying out research, consultancy and design assignments to adapt people to the implemented technology and organisational changes (so-called person-environment fit approaches). As a consequence, addressing the fundamental psychological needs of people in their work is not entirely achievable because these needs are affected by design choices with regard to the production process and their layout by people responsible for operation management. Of course, and again, it would help if work and organisational social scientists and operation management officers would be in a constructive dialogue with each other, for instance, in the case of developing, selecting and implementing new (digital) technology. Even if workers have job resources such as job carving and job crafting opportunities at their disposal (Scopetta et al., 2019), it might be merely scratching the surface if they cannot modify design and technology choices with regard to the production process.

While it may be correct to generally state that sociotechnical perspectives face limitations to guarantee the uptake of human-centred solutions, partly because these also lack fundamental design rules, there is one exception, and that is the Modern Sociotechnology approach (MST).

4. The many faces of sociotechnology

The common notion of sociotechnical approaches is to optimise technology and people in organisations jointly. It criticised a unilateral emphasis on either the technical or the social aspects (Van Eijnatten, 1993). The concept of sociotechnical systems emerged from the Tavistock Institute in London during the 1950s. Researchers such as Eric Trist and Fred Emery studied coal mining operations and observed that optimal organisational performance

resulted from jointly optimising social and technical components. This led to the development of the foundational principles of sociotechnical systems design (STSD), focusing on autonomous work groups and participative work design.

During the 1970s and 1980s, STSD principles were adopted and adapted across various countries. In the Netherlands, professor L.U. De Sitter played a pivotal role in advancing Modern Sociotechnical Design (MST), emphasising integral organisational renewal and the simplification of complex organisations into more adaptable structures. His work highlighted the importance of designing organisations that promote both efficiency and quality of working life. In the United Kingdom, Enid Mumford developed the ETHICS methodology (Effective Technical and Human Implementation of Computer Systems), which integrated ethical considerations into system design, promoting user participation and addressing human needs alongside technical requirements.

The 1990s and 2000s saw a convergence of STSD with systems engineering approaches. Researchers proposed frameworks that integrated work design, information systems, and cognitive systems engineering, aiming to create more holistic and user-centred design methodologies. This integration sought to address the complexities of modern organisational systems and the increasing reliance on information technology (Baxter & Sommerville, 2011). In recent years, 2010s until today, STSD has continued to evolve, addressing emerging challenges such as digital democracy, citizen participation, and the ethical implications of artificial intelligence. For instance, frameworks have been developed to design and evaluate digital platforms that facilitate democratic engagement, ensuring that technological solutions align with societal values and promote inclusive participation (Abdelnour-Nocera et al., 2024). Additionally, the concept of sociotechnical imaginaries has gained prominence, exploring how societies envision and enact futures involving complex interactions between technology and social structures. This perspective emphasises the role of collective imagination in shaping technological development and policy decisions (Jasanoff & Kim, 2009).

Modern Sociotechnical Theory

Modern Sociotechnical Systems Design or Modern Sociotechnical Theory (MST), particularly as developed by De Sitter in the Netherlands, presents a distinctive approach compared to other Sociotechnical Systems Design (STSD) methodologies (Kuipers et al., 2020; Van Eijnatten, 1993)¹.

De Sitter's MST emphasises an integral design methodology that concurrently addresses both the technical and social dimensions of an organisation. This contrasts with traditional STSD approaches, which often treat these aspects separately (Benders et al., 2000). A central tenet of De Sitter's philosophy is transforming complex organisations with simple jobs into simple

¹ This sociotechnical variant of the Low countries is often overlooked, even in sociological overviews of the link between sociotechnical systems thinking and quality of work (e.g. Guest et al., 2022). We think it is because it is 'too technical', as it has a strong relation with operation management. Another reason might be that publications in English are limited.

organisations with complex jobs. This involves designing job roles that are multifaceted and enriching, thereby enhancing employee engagement and reducing the need for extensive hierarchical control mechanisms (De Sitter et al., 1997). MST advocates for the creation of semi-autonomous work groups capable of self-regulation. This approach contrasts with other STSD methodologies that may rely more heavily on centralised control. By fostering self-regulating teams, MST enhances flexibility and responsiveness within the organisation (De Sitter et al., 1997). De Sitter's approach places significant emphasis on involving employees in the design process, ensuring that the resulting organisational structures align with the needs and insights of the workforce. This participative methodology contrasts with approaches observed in other STSD frameworks that, however, do support participation and democratic dialogue, but to a lesser extent, as it regards employee involvement in the design process as crucial (Van Eijnatten, 1993).

MST prioritises improving the quality of work life by designing jobs that are meaningful and provide opportunities for personal development. This human-centred focus distinguishes it from other approaches that may prioritise efficiency over employee well-being (Benders et al., 2000).

De Sitter's MST combines the mentioned elements to collectively contribute to creating organisations that are both efficient and responsive to the needs of their members. MST of De Sitter bases its design rules on different principles and scope of application compared to other sociotechnical perspectives (Table 3).

Table 3. MST versus other sociotechnical perspectives

Aspect	De Sitter and The Lowlands	Other STSD Perspectives
Scope	Holistic, system-wide redesign	Localised, incremental changes
Simplification	Emphasis on reducing complexity	Focus on optimising existing structures
Work Group Autonomy	Self-regulating, autonomous groups	Hierarchical or semi-autonomous groups
Job Design	Enriched, multi-skilled, and meaningful jobs	Optimised for task efficiency
Coordination	Decentralised through self-regulation	Centralised or semi-centralised
Focus of Optimisation	Social-technical balance with integral renewal	Task and technical system optimisation

In MST, emphasis is placed on the joint optimisation of social and technical systems², but with a strong focus on simplification. De Sitter's rules aim to reduce complexity in organisational structures by designing simple organisations with complex jobs instead of complex organisations with simple jobs.

² MST does not make the distinction between social and technical systems, but posits that both are integrally connected to the functions (activities) that the system as a whole must perform (De Sitter, 1993, 1994).

The primary focus is on integral organisational renewal, where the entire system, including workflows, hierarchies, and technical systems, is redesigned together. Design rules advocate for functional decoupling of complexity, meaning that processes are structured to minimise interdependencies that lead to delays and errors. This results in modularised processes where units or teams are given autonomous control over their tasks, reducing the need for centralised coordination. The design rules promote self-regulating work groups as the foundation of organisational design. Work groups are given the autonomy to manage their tasks, monitor their performance, and make adjustments as needed. This decentralisation fosters adaptability and responsiveness. As criteria for work design, De Sitter's design rules incorporate principles like variance control at the source, meaning potential problems are addressed directly at their point of origin (i.e. autonomy to solve problems at the local level where problems occur and emerge). Job enrichment and multi-skilling (learning opportunities) are encouraged to ensure that employees experience a meaningful quality of work life. The design starts at the organisational level (macro) to identify bottlenecks and inefficiencies and then moves to the micro level (individual jobs and teams). In allocating executive and managing tasks to jobs this macro-to-micro approach is reversed into a micro-to-macro approach³. In other words, MST designs the production process top-down because it needs the complete overview of activities and interdependencies; then it designs the control structure bottom-up to ensure maximum autonomy at the lowest level while minimising unneeded interdependencies to minimise interferences (risks for disruptions and errors).

How does MST distinguish itself from the other sociotechnical variants? Generalising the 'other' sociotechnical perspectives, many approaches focus on joint optimisation, but their design choices are often applied to specific sub-systems or teams rather than at the organisational level. These approaches emphasise incremental changes rather than holistic organisational redesign. Other sociotechnical systems often use design principles focused on task-based modifications, like improving individual tasks or workflows, ensuring alignment with existing hierarchical structures. There is less emphasis on simplifying or reconfiguring the organisational structure as a whole. Or at least not a systemic analysis of the impact of inappropriate organisational design. Other perspectives may not stress the same level of functional decoupling or modularisation as De Sitter's approach. They often work within existing interdependencies rather than restructuring them. In contrast to the self-regulating groups advocated by De Sitter, other STSD frameworks often include more centralised coordination mechanisms or rely on formal managers to integrate activities. Other STSD methodologies, especially those influenced by cognitive systems engineering or IT-driven designs, place significant emphasis on the technical aspects, sometimes at the expense of social dimensions. Approaches tend to focus on optimising technical systems (e.g., software, hardware) and integrating them with human workflows. They are consequently depicted as slightly more technology-centric and slightly less human-centric (De Sitter et al., 1997; Kuipers et al., 2020; Van Eijnatten, 1993).

³ MST also recognises the meso level of departments and units (Kuipers et al, 2020: 222).

Despite the commonalities, sociotechnical practice and sociotechnical theory developed differently depending on the region or continent. In Scandinavia, for example, emphasis has been placed on democratic dialogue between employers and employees in order to arrive at common starting points for organisational innovation. In Australia and America, the focus is mainly on participation in the design process. In the Lowland variants, the theoretical foundation for analysing and designing organisations has undergone thorough development (De Sitter, 1981; 1993; 1994).

The main distinction between MST and the other sociotechnical perspectives is that the first developed detailed design rules based on the mentioned characteristics and more fundamental principles that we will not treat here, as these are available in the textbook of Kuipers, Van Amelsvoort en Kramer (2020). It suffices to outline the main characteristics of the MST design rules and connect these to the SMART work design model. By doing this, we provide professionals who deal with job design and work design with tools to link the psychological needs and their higher-order factors of the SMART model to levers of the design of production processes. We, however, realise that the link between MST and SMART is still an intricate one to work with in practice. Therefore, we suggest an intermediate stage, which is performing a job analysis that connects MST and SMART criteria in an accessible way, and this can be done by applying the WEBA method (Dhondt & Vaas, 2001; Pot et al., 1994).

5. Linking the SMART model to organisational design and integral system characteristics

MST is an open systems approach to designing work processes (the process of producing goods or services) (Kuipers et al., 2020). The design of work processes of organisations follows from strategic choices that organisation members (often management) make. These choices deal with matters such as markets, customers, products, business models, and finance. The mix of those matters results in decisions on how the product can be produced to meet the needs of markets, customers, investors and so on. Thus, we have production criteria for the layout of the work process. The MST approach not only looks at economic values as an input for the design. Human values play a significant role in the MST principle to minimise the division of labour. This principle contributes to the quality of work in terms of meaningful jobs (see footnote 1) by the design of so-called 'complete jobs' (Hacker, 1986 and 2003), in which executive and managing tasks are not split up as in Tayloristic and Bureaucratic organisation designs. This principle allows to consider human-centric values that lead to work criteria that enable the inclusion of well-being-at-work criteria, such as reducing stress risks and enhancing learning and developmental opportunities.

MST design rules follow a certain sequence, namely to 1] first design the production layout top-down (called production structure), and 2] second, design the logic of combining or dividing managing and operational tasks bottom-up (called management structure). In line with minimising the division of labour, the MST principle aims to locate decision latitude at

the lowest organisational level where problems occur and where autonomous decisions can be made. Once these functional requirements of production and management are determined, as a 3] third step, the design of supporting systems follows, such as (additional) technological systems, information systems, management systems, and human resources systems.

To be clear, technology that is part of the production process is already taken into account in step 1. In the case of a redesign, like introducing new digital technology, a meticulous analysis is made of the functional allocation between humans and machines, taking into account both the interests of the production goals (like effectiveness, efficiency, flexibility and innovativeness) and the interest of employees in terms of quality of work, i.e. active jobs with learning opportunities and limited stress risks. In fact, designing the production structure reckons with the idea that the management structure benefits from a limited division of labour. This means the design process is never entirely linear but iterative. The fact that digital technology is immersive at every level of an organisation and is present in almost all primary and secondary processes requires designers to look at the possible interlinkages with digitalisation (Govers & Van Amelsvoort, 2023).

The sequence of the design is nonetheless crucial. All too often, organisations choose the application of technologies and IT systems that create a division of labour, omitting the quality of work criteria. In such instances, instead of implementing a complementary technology to augment workers in their jobs, technologies can steer and monitor what workers do.

Both sociotechnical researchers on the one hand and work and organisational, and occupational health psychologists on the other – as organisation designers - care about the well-being of people at work, and that is the reason why connecting the SMART work design model and sociotechnical design principles is a groundbreaking opportunity to improve organisational performance and the quality of work simultaneously. Table 4 shows the five factors of the SMART work design model in column 1. Column 2 shows organisational structural design goals, column 3 shows the organisational cultural goals, and finally, integral system characteristics are mentioned in column 4. We emphasise that these goals and characteristics are not similar to functional requirements or criteria for the sociotechnical design rules: these are more complex, abstract and systemic (Christis & Soepenbergh, 2016; Kuipers et al., 2020). While MST does not emphasise organisational culture (column 3), so does workplace innovation. Workplace innovation is partly based on sociotechnical thinking and takes both structural and cultural characteristics into account in its purpose to simultaneously improve business performance and human performance and the quality of work (Oeij & Dhondt, 2017: 66). Workplace innovation aims to connect 'organisational' and 'social innovation', where 'technological innovation' is regarded as part of structural renewal.

SMART model Five factors and organisational conditions	Organisational structural design goals	Organisational cultural design goals	Integral system characteristics
Stimulating work characteristics Horizontal division of labour	• Minimise division of labour • Maximise learning new skills / job enrichment • Technology to augment work	• Opportunity of learning (new skills and on the job learning)	• The organisation as a system must have sufficient control capacity to adequately deal with environmental demands (Law of requisite variety: external variety must be met by internal variety, i.e. internal control options / design active jobs with sufficient decision latitude)
Autonomous work characteristics (Agency) Vertical division of labour	• Decentralisation in division of labour / limited hierarchy / low formalisation • Autonomous teamwork • Artificial Intelligence / Machine Learning as a choice	• Presence of leadership and mentoring to learn new roles / growth in roles • Shared leadership • Options for self-management (self-regulation) and self-selection	• Reduction of structural complexity by reduction of interfaces (simplifying the organisation) • Parallelisation of order variety into homogeneous sub-streams (streamlining the orders) • Combine executive, preparatory, and managing tasks supporting of sub-streams, and allocate such 'whole tasks' (self-regulation) to autonomous groups (segmentation) • Decentralisation of authority whenever possible • Minimise critical specification / minimise monitoring and controlling Artificial Intelligence and Machine Learning
Mastery work characteristics Coordination and integration via information	• Maximise open information about company results and strategy	• Worker participation in organisational change / renewal • Contribute to innovation resulting in technology adoption • Democratic dialogue	• Teamwork implies control-capacity, coordination, collaboration, social support, uses of talents, enrichment, learning opportunities • Functional deconcentration of information (grouping of required information and data) / access to data / augmenting function of (information) systems / explainable Artificial Intelligence
Relational work characteristics Coordination and integration via social processes	• Maximise external control options • Maximise consultation at work / discussion of work progress (participation)	• Cooperation based on human(ist) respect (equality diversity and inclusiveness) / mature employment relationships / labour relations / commitment driven HR system	• Integrate control-cycles to minimise complexity in interactions (nodal network). A control cycle is a coherent 'loop' of import requirements (e.g. tasks and resources) and export requirements (e.g. product quality). Between input and output, the throughput determines how the work process is set up. This throughput (transformation) also regulates how the interactions take place. Think of effective cooperation without bureaucratic red tape.
Tolerable work characteristics Effort required to achieve shared organisational goals	• Maximise internal control options / decision latitude • Workload self-management (e.g. self-rostering)	• Task / assignments based on achievable (non-exploitative) production goals and human well-being • Fair reward system	• Taking into account the psychosocial and physiological boundaries of human functioning (in and outside work)

Table 4: SMART work design model organisational design goals and system characteristics

Parker and Knight (2023) have connected each of the five factors to organisational conditions, which are also mentioned in column 1. They connect stimulating work characteristics related to the horizontal division of labour. This can be associated with the integral system characteristic of developing the organisation as a system that is able to deal with turbulent environments⁴. This aligns with structural goals to minimise the division of labour and the creation of active jobs that enable learning new skills. The work characteristics of autonomy or agency align with integral system characteristics to keep organisations relatively simple, without too many interdependencies that require centralised steering. Instead, the structure should be decentralised with technology that augments people and enables an organisational culture with supporting leadership, shared leadership and much self-regulation. The related organisational condition is a vertical division of labour. Mastery work characteristics are associated with coordination and integration via information. The integral system characteristic related to this is having functionally required information at the lowest levels in the organisation, allowing people to use that information to uptake broad working roles, understand the technology they work with, and contribute to innovation. Relational work characteristics, with coordination and integration via social processes as the organisational condition, can be linked to control cycles as the integral system characteristic. In sociotechnical thinking, complex human relations within teams are preferred over complex interdependencies across teams and departments. Social relating based on intelligent cooperation and functional interhuman support, embedded in active job design, is the desired organisational behaviour enabled by a structure of largely decentralised control options. Finally, tolerable work characteristics, indicating an acceptable effort to achieve shared organisational goals as an organisational condition, can be paired with an integral system characteristic that considers the psychosocial and physiological boundaries of human function. The structural design goal is to maximise control and decision latitude with achievable workloads, allowing for organisational cultural design goals that respect human wellbeing and fair rewards.

In this way, sociotechnical thinking and the SMART design model are highly complementary, with SMART emphasising the fulfilment of psychological human needs at work and sociotechnical thinking connecting the production system, the management system and the information system to active jobs in which operators can fulfil these human needs. The alignment of the two can be realised by translating the organisational conditions (column 3 in Table 1 and column 1 in Table 4) into criteria for human needs and into functional requirements for sociotechnical design⁵. While this is theoretically quite well feasible (Oeij, Dhondt & Vaas, 2024), it is also rather complex and runs the risk of not being used and applied by practitioners. Especially since the ones who design the organisation and its

⁴ Flexible and innovative organisations must deal with turbulent environments that are volatile, uncertain, complex, and ambiguous (Atanassova & Bednar, 2024). Such VUCA environments necessitate that organisation designs deal with that by making organisations less complex (less 'bureaucratic', thus eliminating unneeded interdependencies); the complexity should be designed into the jobs in teams so as to ensure that operators can effectively deal with complex job demands (De Sitter et al., 1997).

⁵ Be aware that the organisational conditions are very similar to Mintzberg's coordinating mechanisms that lead to different organisational configurations: mutual adjustment, direct supervision, standardisation of skills, jobs and outputs / norms (Mintzberg, 1983).

technology and the ones who design jobs and skill people – decision managers, engineers, technicians on the one hand, and HR professionals and people managers on the other -are often not the same functionaries. With regard to the implementation of new technology and digitalisation, the question arises: Who looks at the interests of the quality of work of employees? HR professionals lack broad knowledge of operations management and technology design, while engineers want to make error-free technology and may not understand human needs sufficiently; most managers feel responsible for the business but not always for social aspects. The risks are that the implemented technology is not augmenting but controlling humans, that employees are unwilling to adopt innovations and technology, and that the production process and business performance are suboptimal.

It so happens that there exists a method that can function as an intermediary between MST and SMART, and, what is more, is relatively easy to work with for practitioners, which is called WEBA, an acronym in Dutch that can be translated as Well-being at Work (Dhondt & Vaas, 2001; Pot et al., 1994; Vaas et al., 1995). The method helps practitioners analyse jobs to identify control problems in their work and assess where the options are to eliminate such control problems in the design of the production structure and management structure. The WEBA;

- looks at control problems at work;
- is based on sociotechnical thinking, thus looks at the relation with the production process and workplaces;
- includes conditions of well-being at work, based on the Job-Demand-Control model (Karasek & Theorell, 1990), and conditions for learning and development through 'complete jobs' (Hacker, 1986; 2003).

6. Start with control problems and control options: the WEBA

The description of the SMART work design model and MST beg the question: Where should we start? Redesigning the organisation with MST is no easy task and not a short-term exercise. The application of the SMART philosophy is clearer. A possible objection, however, is that the consequences of problem situations are addressed, but not the structural causes of those problem situations. A more accessible way to connect both perspectives is to apply an approach that immediately puts the axe to the roots, namely, where control problems make it impossible to solve problems in the workplace. Because it causes stress risks and hinders learning and development in the workplace. This often has a cause in how the work is organised and results in employees experiencing *job dissatisfaction*, or worse, absenteeism and *burnout* in the longer term.

The WEBA method to analyse and redesign jobs

The WEBA method can describe how an organisation is designed as a work process, resulting in functions with tasks that include or exclude well-being risks. These risks are a feature of the job and employment situation, regardless of the experience of a person performing the work. However, the absence or presence of risks will impact the perceived fulfilment of human needs in the job performer. It is possible to assess control problems at the level of tasks and functions. A control problem is a disruption in the work process that can be solved with control options (i.e. decision-making space, regulatory authority, autonomy, peer support). A control problem can occur at the task level, for which the job operator may or may not have the control options to solve the disruption (this is the result of a choice in job design and division of labour). If there is a control problem, it means that there is a disruption or an interruption in the performance of a task or job. To solve the disruption, control options (i.e. decision-latitude, autonomy) are needed at the level of this job. It is not about *person-environment fit* but about (internal and external) control options in the job so that it is possible for the job operator to adapt the workload to his physical and psychosocial capacity. The motto is not to adapt the person to the job but to make the job requirements 'adaptable' for (and by) the job performer.

If the control options are lacking and the disruption cannot be resolved at the level of that job, the operator assigned to the job may feel incompetent or stressed. In such cases, it can be established that the task is confronted with an unfavourable 'well-being condition'. We discuss the seven well-being conditions of the WEBA (Dhondt & Vaas, 2001; Pot et al., 1994; Vaas et al., 1995). In doing so, we indicate the relationship with MST and with the SMART work design model (Oeij, Dhondt & Vaas, 2024: 16-17; Parker & Boeing, 2023: 94)⁶:

1. The completeness of a job: a 'complete range of tasks' implies the presence of all options for action (execution, preparation, support and management). This means that the function allows the operator to resolve disturbances (i.e. the result/ *output* is achieved qualitatively and quantitatively) with assigned autonomy and external control possibilities (i.e. some degree of control at both the level of the production structure and the management structure).
-*MST*: this corresponds to the MST design criteria about autonomy over a completed part of the production process (the so-called micro-level of the production structure and control structure);
-*SMART*: this corresponds to the S of Stimulating about task variation, skill variation, problem-solving requirements and information provision; and to the A of autonomy in work.
2. Non-short-cycle time tasks: Short cycle time tasks or short-cycle tasks indicate work that is repetitive, monotonous, and contains (physical/physiological) risks. The task

⁶ Our own assessment deviates slightly from the one by Parker & Boeing, 2023.

does not offer learning opportunities and can cause one-sided physical strain. Such tasks should be limited in a job.

-*MST*: this corresponds to the MST design criteria about the autonomy over a completed part of the production process so that learning opportunities are available;

-*SMART*: this corresponds to the S of Stimulating about task variation, skill variation, problem-solving requirements and information provision;

3. Level of (cognitive) complexity: Within a job, there must be tasks that provide learning opportunities. The combination of high task demands and high autonomy ensures a combination of learning new things and the presence of control to deal with them (e.g. solving a malfunction) without high stress risks. A balanced mix of 'complex' tasks and 'routine' is desirable.

-*MST*: this corresponds to the MST design criteria on the autonomy over a completed part of the production process;

-*SMART*: this corresponds to the S of Stimulating about task variation, skill variation, problem-solving requirements and information provision; and the T of tolerable work brands about low role overload, low role conflict, and low work-home conflict (work-life imbalance).

4. Autonomy: the position must allow forms of autonomy in the execution of the tasks with regard to pace, method, (order) order and (work) place.

-*MST*: this corresponds to the MST design criteria on the autonomy over a completed part of the production process with an absence of stress risks and the presence of learning opportunities;

-*SMART*: this corresponds to the S of Stimulating about task variety, skill variety, problem-solving requirements and information processing; and with the A of autonomy in work; and the T of tolerable works brands about low role overload, low role conflict, and low work-home conflict.

5. Interaction network: the tasks should allow functional and social contacts with other people and the workplace should not be an isolated working environment.

-*MST*: this corresponds to the MST design criteria on teamwork, information provision, and external control capacity;

-*SMART*: this corresponds to the M for Mastery about feedback at work, feedback from others and role clarity, and to the R for Relational about job meaning, contact with beneficiaries, and social support.

6. Organising tasks: the tasks must make it possible, among other things, to organise functional contacts, work consultations and intervision (mutual consultation) and to arrange help and advice (by colleagues, staff, staff and management).

-*MST*: this corresponds to the MST design criteria on full functions, teamwork and external control capacity;

-*SMART*: this corresponds to the R of Relational about task meaning, contact with beneficiaries, and social support, the T of tolerable works brands about low role overload, low role conflict, and low work-home conflict, and the M of Mastery which stress the understanding how work is organised and who is doing which tasks.

7. Information: there must be sufficient information and data available about the goals, the assignment and feedback on the results.

-*MST*: this corresponds to the MST design criteria about the autonomy over a completed part of the production process for which sufficient information must be available;

-*SMART*: this corresponds to the M of Mastery about feedback on work, feedback from others and role clarity.

If these well-being conditions are not met and intended results cannot be achieved, this will not only have consequences for the realisation of the intended goals of the organisation but also for human needs. However, MST is less concerned with human job satisfaction but with the absence of risks in tasks and functions. With the WEBA, the SMART work design model can take advantage of the sociotechnical design approach to identify risks in the organisation's design and jobs to improve the options to optimise human needs and job satisfaction. Equally, the MST can benefit from the relationship with the work of HR professionals to strengthen and validate the usefulness of MST. We think this can support the conversation between organisation designers, such as engineers, technicians and HR professionals. The pleasant feature of the WEBA method is that it can be applied easily by people who have a thorough knowledge of work, organisational processes and organisational behaviour.

Example of a WEBA job analysis: Operator production line

To show the connection between the SMART work design model and sociotechnical design rules, we present an example of a WEBA analysis of a concrete job, the operator on a production line (Vaas, 2023). This was part of research into the health and safety risks of short cycle time labour. Based on an expert assessment of the seven well-being conditions, a 'well-being profile' can be generated (Table 5).

Table 5. Well-being profile of 'operator production line' (Vaas, 2023)

Assessment	Unsatisfactory	Limited satisfactory	Satisfactory
1.Job completeness			
2.Non-short cycle time tasks			
3.Cognitive complexity			
4.Autonomy			
5.Interaction network			
6.Organising tasks			
7.Information			

Overall, the job profile of this operator does not look too bad but can be improved by enhancing cognitive difficulty to improve learning opportunities. To prevent, reduce and preferably structurally eliminate the risks that lead to unsatisfactory scores, the WEBA method – based on sociotechnical design rules- suggests adaptation measures, improvement measures, and restructuring measures (i.e. redesign). Adaptation measures are mainly measures that solve control problems, for example, by clearer work instructions and provision of more or better resources and materials. Note that this is 'only' an adaptation: it reduces the stress risks, but it also reduces the opportunities to learn from solving the problem in case. Improvement measures are aimed at improving task composition and introducing control opportunities as (social) contacts without requiring production-organisational and/or production-technical measures (i.e. restructuring measure): task rotation, task expansion, task enrichment (as examples of improving the horizontal division of labour), work consultation (functional dialogue).

The machine operator in the studied plant rotates across various workstations on the production line. At these workstations, the operator has to carry out preparatory tasks and quality control tasks. As a result, the job contains fewer short-cycle tasks as in the case of isolated workstations. This contributes to the job 'completeness'. Task enrichment here has little effect on cognitive difficulty (i.e. learning opportunities) or functional contacts because most tasks on the line are of an equally low cognitive level, and the workstations are isolated (the operators usually work there in pairs). A useful task enrichment in this job would be to have the machine operators (in rotation) make the daily schedule or introduce self-scheduling.

Introducing work meetings (functional consultation) for all operators on this production line would enable the machine operators to jointly address control issues in areas such as material supply or working conditions. A restructuring measure could be to make all operators on the production line function as a 'task group' or 'autonomous team'. Such a team is responsible for the daily planning and mutual distribution of work, does as much of the preparation, execution and support tasks in the work process as possible, establishes contacts with colleagues inside and outside the department independently when control problems arise, meets regularly for work consultations involving planning and logistics, product and process specifications, materials (i.e. what is processed by the machines), equipment, technology, working conditions, clean policy requirements, etc.

The formation of a task group /team requires a rearrangement of tasks and competencies, i.e. a change in the production structure and the management structure of the work organisation.

Why should involved agents want to use it? First of all, we think that the time is right. There is growing resistance against economic systems such as shareholder capitalism that does not put much effort into taking into account a fair sharing of the profits, and that benefits few at the cost of the health of workers. Also, outside the world of work, another wind is blowing. European policymakers suggest that technological deterministic Industry 4.0 should make

place for a more human-centric Industry 5.0 which also pays attention to sustainability, circularity and reduction of fossil energy resources (Breque et al., 2021). And thirdly, the threat of 'unexplainable AI' and autonomous technology demands to get back a sense of control and grip on our future (Prunkl, 2024; Rana et al., 2022).

With this in mind, the next step and challenge in connecting SMART and MST is to understand digital technology better and to implement it in a way that continues to ensure opportunities for good quality work in accordance with creating economic welfare and social well-being.

7. Summary and Concluding Observations

The aim of this contribution is to bring organisation designers into conversation about organisational design, technology choices and quality of work. In the first part of this article, the focus was on the relationship between the SMART work design model and the MST. If organisation designers want to apply this combination in practice, it is a complicated exercise, and that inevitably raises questions about its usability. In the second part, we added the WEBA method. In this way, not only does the picture become complete, but there is a guide to make the connection with the design of work organisations and functions based on the desire to improve the quality of work. We want to make the point that the results of a function analysis with the WEBA method lead to insights into control problems. These regulatory problems can be counteracted or eliminated by introducing measures based on MST design rules. It is possible to relate design rules to the five factors of the SMART work design model. No fewer than fifty sociotechnical design rules increase the quality of work from the perspective of MST (see Peeters & Mossink, 1995). We have summarised these elsewhere, establishing the relationship between the design rules and five factors of the SMART working design model (Oeij, Dhondt & Vaas, 2024).

This conceptual article examined how the SMART work design model can be linked to sociotechnical systems thinking to improve the quality of work. The article starts from two perspectives: the design of jobs from psychological human needs and from operational functional requirements of the organisational business goals. The conclusion is that the link is possible, at least in theory. The SMART work design model operationalised human needs in five factors and organisational conditions. The MST translated production requirements into functions that meet welfare conditions for which design rules were formulated. We emphasised that there is an order that we believe produces the best results. First, look at how the work is organised in the production process before interventions are proposed as solutions. Logically, one should first look at the organisation of work from a socio-technical perspective and only then possibly identify improvements for the psychological needs that people have in work from the five-factor model of SMART. Fortunately, the WEBA method offers the opportunity to analyse features and develop redesign recommendations that align with both MST and the SMART working design model.

Our contribution is primarily aimed at supporting organisation designers in developing organisations and functions that promote good organisational performance and good quality of work at the same time. In doing so, the approach is in line with the concept of *workplace innovation*, or social innovation (Oeij & Dhondt, 2017, p. 66; Parker & Boeing, 2023: 92). The next step is to translate our ideas into a concrete action plan with concrete steps.

A limitation of our contribution, therefore, is the lack of empirical testing this new combination of MST and SMART into a single approach. That is to say, the elements about human needs have been researched extensively and the SMART work design model did stand its first tests (Parker & Knight, 2023). Concerning the MST design rules and the WEBA method, there is quite some qualitative research carried out in the Lowlands (the Netherlands and Flanders in Belgium) that supports the viewpoints, but a systematic, quantitative evaluation has not been performed⁷. Nonetheless, there are numerous qualitative case descriptions available⁸. Moreover, there is serious concern that individual-level interventions (read psychological interventions) do not engage with working conditions (read organisational redesign) and that such interventions do not provide additional or appropriate resources in response to job demands (Fleming, 2023).

Secondly, we want to emphasise the importance of collaboration in the scientific field to develop this approach further. There is too little dialogue between different scientific disciplines, such as psychology, sociology, management science, computer and software technology and operations management. That makes sense because they are diverse fields. But where those disciplines come together in the world of work, digitalisation, and business results, there is also a loss. We estimate that at least some convergence of the organisational researchers with individual, group and organisational design expertise would be useful for people who work with new digital technology now and in the future to constrain the risk of harming human interests and align digital technology with human values (Bai & Vahedian, 2023; Christian, 2020; Kretschmer & Khashabi, 2020; Parker & Grote, 2020).

The future of work is one with more digitisation, robotisation, artificial intelligence and *machine learning* (Govers & Van Amelsvoort, 2023; Parker & Grote, 2020; 2022). We have learned that technological advances and their application and implementation tend to neglect the human factor too much. This needs to change; we can put people more at the centre (Breque et al., 2021; Oeij, Lenaerts, Dhondt, Van Dijk et al., 2024). "Industry 5.0 is characterised by going beyond producing goods and services for profit. It shifts the focus from shareholder value to stakeholder value and reinforces the role and the contribution of industry to society. It places the well-being of the worker at the centre of the production process and uses new technologies to provide prosperity beyond jobs and growth while respecting the production limits of the planet" (Breque et al., 2021: p. 14). Human centricity, therefore, as the social hallmark of Industry 5.0, implies taking human interests seriously, which, in sociotechnical terms and in line with the workplace innovation concept, suggests

⁷ However, there is also a survey questionnaire version of the WEBA (called NOVA-WEBA) that has been tested and validated (Kraan et al., 2000) and has been partially included in the Netherlands Working Conditions Survey (NEA, <https://www.cbs.nl/en-gb/our-services/methods/surveys/brief-survey-description/netherlands-working-conditions-survey--nea-->).

⁸ See for example the Knowledge Bank Workplace Innovation (<https://www.workplaceinnovation.org/>).

the presence of a management approach that is not fully top-down and offers at least some room for bottom-up dialogue). To this end, human interests are linked to humanist values in work (as in the quality of working life stream, human relations perspective). Such values are linked to the psychological human needs model (such as in SMART work design). These depend on organisational facilitation that is rooted in the operations design of working processes and production processes, according to the basic rule to keep the division of labour limited and to maximise employee decision latitude. This, then, finally leads to the notion that tools, instruments, software, IT, etc., should, as much as possible, augment and support the work of workers instead of controlling, monitoring and steering workers.

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