Methods for identifying and measuring the performance impacts of work environment changes

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Structured abstract

Purpose – New working practices and work environments present the potential to improve both the productivity and the wellbeing of knowledge workers, and more widely, the performance of organisations and the wider society. The flexibility offered by information and communication technology (ICT) has influenced changes in the physical environment where activity-based offices are becoming the standard. Research offers some evidence on the impacts of work environment changes, but studies examining methods that could be useful in capturing the overall impacts and how to measure them are lacking. The purpose of this paper is to introduce and evaluate methods for analysing the impacts of work environment changes.

Design – This paper concludes research of the last five years and includes data from several organisations. The paper presents and empirically demonstrates the application of three complementary ways to analyse the impacts of knowledge work redesigns. The methods include: 1) interview framework for modelling the potential of NWoW; 2) questionnaire tool for measuring the subjective knowledge work performance in the NWoW context; and 3) multidimensional performance measurement for measuring the performance impacts at the organisational level.

Findings – This paper presents a framework for identifying the productivity potential and measuring the impacts of work environment changes. The paper introduces the empirical examples of three different methods for analysing the impacts of NWoW and discusses the usefulness and challenges of the methods. The results also support the idea of a measurement process and confirm that it suits NWoW context.

Practical implications – The three methods explored in this study can be used in organizations for planning and measuring work environment changes. The paper presents a comprehensive approach to work environment which could help managers to identify and improve the critical points of knowledge work.

Originality – Changes in the work environment are huge for knowledge workers, but it is still unclear whether their effects on performance are negative or positive. The value of this paper is that it applies traditional measurement methods to new ways of working contexts, and analyses how these could be used in research and management.

Keywords – Knowledge work, performance, productivity, work environment, work practices, measurement

Paper type – Research paper

1 Introduction

The knowledge-intensive nature of work and the continuously developing possibilities provided by ICT create new ways of working (NWoW). An emerging bundle of flexible and mobile work practices have recently been introduced in the literature (e.g., Bosch-Sijtsema et al., 2009; Gorgievski et al., 2010; Peters et al., 2014; Van der Voordt, 2004a). The main idea is to provide more flexibility and autonomy and allow workers to decide when, where and how their work gets done. Thus, workers can choose the most suitable place and tools based on the task at hand. For example, conventional offices are

turning into activity-based workplaces to support both concentration and collaboration (Appel-Meulenbroek et al., 2015a; De Paoli et al., 2013; Halford, 2005), and some of the tasks can be done at multiple locations, such as the home, coffee shops and hubs (e.g., Koroma et al., 2014). Some aspects of e-mail interactions have moved to instant messaging and social collaboration tools, and meetings are being held via videoconferencing tools to minimise travelling. Moreover, flexible work policies and trust-based managerial principles have been introduced to support autonomy, progress and the work-life balance (Perlow & Kelly, 2014; Peters et al., 2014).

Redesigning knowledge work practices and the work environment presents the potential to improve both the productivity and the wellbeing of knowledge workers, and more widely, the business performance of knowledge-intensive organisations and also the wider society. These kinds of changes may have implications, for example, on employee motivation or, from the real estate and facility management perspectives, to office space requirements and workplace services. However, measuring knowledge work performance and the impacts of work environment changes is challenging (Davenport, 2008; Laihonen et al., 2012; Ramirez & Nembhard, 2004). Only a few specific studies exist concerning the measurement of impacts of work environment or work practice changes on knowledge work and organisational performance (Riratanaphong & van der Voordt, 2015). A study by Laihonen et al. (2012) specifically explored the measurement of impacts of NWoW and developed some conceptual measurement solutions. Nevertheless, empirical experience on applying these measurements in practice is lacking. The purpose of this study is to fill this gap with practical solutions.

Work environment changes, work practice initiatives and the organisational contexts in which they are implemented vary. Thus, there may be many kinds of related measurement tasks as well. This suggests that there will not be a "one size fits all" type of measurement solution available. Instead, various measurement tools are likely to be needed for different purposes. Therefore, it is useful to study this topic in different contexts. The aim of this paper is to present and empirically demonstrate the application of three complementary ways to analyse the impacts, and to identify the potential of new work environments and more flexible and mobile work practices. Different measurement approaches may be needed due to various organisational contexts and management needs. For example, analysing the productivity potential (ex-ante) is a different management and measurement task compared to evaluating the impacts of a change project (ex-post). Therefore, it is important to have an empirical understanding about the application and usefulness of different measurement approaches in different managerial contexts. This study answers two research questions:
1. How can the productivity potential and goals for work environment changes be identified?
2. How can the impacts of work environment changes on knowledge work be analysed?

2 Measurement approaches for analysing the work environment change process

2.1 The impact of new ways of working

New ways of working demonstrate great potential for improving the business performance of knowledge-intensive organisations (Blok et al., 2012; Ruostela et al., 2015). The performance of knowledge-intensive companies is highly dependent on their ability to provide value to customers through the knowledge and competence possessed by their workers. Various contextual factors may either enable or prevent the successful activities within companies. These contextual factors include the utilisation or adoption of various physical locations, virtual collaborative and mobile tools, as well as various social and organisational practices (e.g., Bosch-Sijtsema et al., 2009; Ruostela & Lönnqvist, 2013). In addition, the individual's way of working can be seen as an important performance driver. If workers are not willing to change their habits or attitudes, fancy offices, tools and policies will not make any improvements. Therefore, to understand the bottlenecks and the potential to improve knowledge work productivity, current ways of working should be analysed, including the underlying attitudes, culture and practices. Then, the objectives and targets for change can be set.

Knowledge work redesign can have many positive impacts on a firm's performance and competitiveness at various levels (e.g., De Paoli et al., 2013; Gibson, 2003; Ruostela et al., 2015; van der Voordt, 2004b). NWoW can have an impact on employees' wellbeing, work motivation, work-life fit and productivity (e.g., Peters et al. 2014; van der Voordt, 2004a, 2004b; van Meel, 2011;). Work

processes can be improved through better planning and eliminating low value work, whereas flexibility, predictability and control improve wellbeing in work and life (Perlow & Kelly, 2014). For example, when work is more flexible in terms of time or location, it can be possible to work at home and save commuting time (Harrison, 2002). Working from home also reduces travel costs and, at the same time, takes into account the sustainability aspect by reducing the carbon footprint caused by commuting (see e.g., Hassanain, 2006). With different kinds of space usage (e.g., hot desking), it is possible to use the organisation's resources and especially space more efficiently and reduce occupancy costs (van der Voordt, 2004b). According to Bradley (2002) and van der Voordt (2004a), these new ways of working may also improve the modern and innovative image of the company from the customers' perspective, and also seem to be more attractive to future employees.

Table 1 summarises the above paragraphs and presents the framework for this study. Knowledge work is analysed from the perspectives of performance drivers and results and outcome. Drivers are divided into organisational level drivers, which are the physical, virtual and social environments, and the personal level driver, which is the individual's work practices. Results and outcomes can also be divided into organisational and personal level impacts, such as productivity, wellbeing at work and customer satisfaction.

Table 1. Framework for identifying productivity potential and measuring impacts of work environment changes.

Perspective	Level	Dimension	References e.g.
Performance drivers	Organisation	Physical environment	Bosch-Sijtsema et al., 2009; Gorgievski et al., 2010
		Virtual environment	Bosch-Sijtsema et al., 2009; Harrison, 2002; Vartiainen and Hyrkkänen, 2010
		Social environment	Bosch-Sijtsema et al., 2009; Vartiainen, 2007
	Knowledge worker	Work practices	Ruostela & Lönnqvist, 2013; Koopmans et al., 2013
Results and outcomes	Organisation	Performance	De Paoli et al., 2013; Gibson, 2003
		Customer value	Ramirez & Nembhard, 2004;
		Sustainability	Hassanain, 2006; Ruostela et al., 2015
	Knowledge worker	Wellbeing at work	Bakker and Demerouti, 2008; Perlow & Kelly, 2014
		Productivity	Peters et al. 2014; van der Voordt, 2004a

2.2 Measurement challenges and proposed solutions

Measuring the impacts of NWoW and related work environment changes on knowledge work has various challenges. The challenges emanate from the varying content of knowledge work (Davenport, 2008; Greene & Myerson, 2011), the qualitative and intangible nature of knowledge work outputs (Davenport, 2008; Drucker, 1999; Ramirez & Nembhard, 2004), and the difficulty of capturing the impacts on customers (Deakins & Dillon, 2005). Due to the characteristics of knowledge work, the so-called traditional productivity measures (quantitative outputs/quantitative inputs) do not usually fit the requirements of the measurement context. However, certain alternative measurement approaches exist that are better suited. For example, subjective measurements have been considered a potential

way to capture the multidimensional and intangible aspects of knowledge work productivity (Deakins & Dillon, 2005; Drucker, 1999; Ramirez & Nembhard, 2004), as well as measuring employee satisfaction and productivity related to different work environments (e.g., Appel-Meulenbroek et al. 2015b; De Been & Beijer, 2014; Maarleved et al., 2009). Another potential approach is the use of a multidimensional performance measurement system to capture various aspects of performance and work environment changes using both objective and subjective indicators (Jääskeläinen & Lönnqvist, 2010; Riratanaphong & van der Voordt, 2015; Takala et al., 2006).

Typical measurement challenges related to measuring the impacts of organisational change initiatives include the following (Laihonen et al., 2012): identifying which factors are actually impacted (Bailey, 2011); taking into account the fact that impacts may vary depending on the working role (Antikainen et al., 2008) and the organisational level in question (Vuolle, 2010); distinguishing the impact resulting from the change in question in comparison to other factors affecting productivity simultaneously (Kujansivu & Lönnqvist, 2009); and dealing with the time lag between the change and the realisation of the impacts (Davern & Kauffman, 2000). There does not appear to be any generic solution to measure different kinds of organisational impacts. Instead, impacts must be measured on a case-specific basis that allows for examining changes – for example, a before and after comparison.

Based on Bourne et al. (2000), Laihonen et al. (2012) proposed a process model for measuring the impacts of workplace initiatives. This process consists of the following steps: 1) defining the measurement task in question (i.e., what is the purpose of the measurement?); 2) identifying the factors to be measured; 3) planning the actual measurement and choosing the metrics to be used; 4) implementing the measures (the execution of which is based on the choices made during the previous steps); and 5) analysing and reporting the measurement results. As pragmatic measurement solutions, Laihonen et al. (2012) propose, for example, a survey for measuring employees' experienced productivity, interviews, observations and objective indicators. The proposed model and the measures seem to have potential, but their value in this context is still unclear. Thus, the empirical part of the paper uses these as a starting point to search for practical ways to measure workplace initiatives.

3 Research methods and data collection

This paper is based on five years of research projects on knowledge work redesign, including new ways of working and work environment changes. The research projects were carried out in Finland during 2011–2015 and included four organisations. All companies operate in the facility management sector and are interested in knowledge work redesign as a tool for improving their operations, but also as a perspective for developing new services for their customers.

The research can be characterised as action research consisting of a set of three independent studies for developing measurement methods (Table 2). Action research is a pragmatic approach that aims to solve current practical problems while learning from outcomes and expanding scientific knowledge and theory (Baskerville & Myers, 2004; Coughlan & Coghlan, 2002). Action researchers are external helpers who act as facilitators of the change and reflection within an organisation and simultaneously study the process (Baskerville & Myers, 2004; Coughlan & Coghlan, 2002). Therefore, action research can be viewed as a dual cycle process that includes both problem-solving and research interests, differentiating it from pure consultancy (McKay & Marshall, 2001). The companies were at different stages concerning their workplace initiatives, and this had implications on their measurement information needs and on our access to the measurement data. Two of the case organisations had implemented a major workplace initiative including the office layout, tools and practices. Other companies were planning their workplace initiatives or experimenting with smaller scale pilot solutions.

Table 2. The studies and measurement approaches examined.

Focus of the study	Measurement approach	Research Methods
Identifying and modelling the potential of work environment changes for improving knowledge	Knowledge work performance framework for identifying factors to be	Thematic interview study within two companies (N = 18)

work productivity	improved and measured	
Developing and testing measurement tools for analysing the level and impacts of the work environment and work practices on knowledge work performance	Subjective measurement tool for quantifying employee experience on the impact of new ways of working on wellbeing and productivity	Constructive research with pilot tests in four organisations (N = 527)
Developing measurement frameworks and metrics for measuring the performance of a knowledge-intensive company through work environment changes	Balanced business performance measurement, subjective and objective measures	Four interviews for identifying the potential impacts. Four iterative measurement development workshops in one company. Analysis of exiting performance metrics in another company.

The aim of the first study was to understand and analyse the potential to improve knowledge work productivity through new work environments and work practices. This helped to identify the main elements of knowledge work performance to be covered by the measurement methods. In total, 18 knowledge workers in various roles were interviewed. All interviews were semi-structured face-to-face interviews. The interviews were recorded with a digital voice recorder and transcribed for further analysis. The transcribed interviews were analysed qualitatively in order to identify important themes. The purpose was to examine the usefulness of interviewing as a subjective method of capturing and modelling individual knowledge workers' views about productivity potential.

The second study was conducted using the constructive research approach to create a managerial construction to solve a practical problem (Kasanen et al., 1993; Labro & Tuomela, 2003). Based on the literature and interviews conducted in the first study, a SmartWoW tool was developed and tested to measure the key elements of knowledge work performance, work environments and flexible work practices. This study covered all of the case companies. After testing the SmartWoW tool in practice, we conducted interviews in each organisation to collect feedback for the solution's applicability.

The third study was a longitudinal case study of a work environment change project carried out in two companies. The aim was to capture the multidimensional performance impacts of an NWoW initiative by measuring the chosen performance indicators before and after the changes. In one of the companies, four key indicators were chosen based on the goals of the project. In the other company, four half-day iterative workshops were organised to develop the measurement framework and key metrics. In constructing the measurement system, we followed the basic principles of balanced performance measurement with three main phases: the design of performance measures, the implementation of performance measures, and the use of performance measures (Bourne et al., 2000; Kaplan & Norton, 1996; Neely et al., 2000). First, key objectives were identified and then performance measures for each objective were designed. After that, the measures were implemented, used and reflected upon. Participants included two facilitators and a group of 5–8 representatives from the various departments within the company. This kind of a facilitated workshop process has proven useful not only in finding useful indicators, but also for committing the key actors to the outcomes of the design process.

The experiences from the three measurement approaches are discussed in the sections below. Each approach is discussed from four perspectives:
1) What is the measurement method like?
2) For which management purposes is the method suitable?
3) How was the measurement method applied?
4) What were the lessons learned?

4 Results: Introducing and analysing three methods for measuring work environment changes

4.1 Interview framework for modelling productivity potential

Interviewing is a potential approach for capturing the intangible and subjective aspects related to the working environment and work practices (Ramirez & Nembhard, 2004). Interviews are not typically considered a measurement, but the process actually fulfils the measurement role as it provides information about the current state in the organisation. In two case companies, it was necessary to obtain an in-depth understanding about individual knowledge workers' productivity and how work environment changes could impact it. Interviewing personnel was chosen as a method for capturing these issues.

The purpose of the interviews was to identify factors related to the work environment and work practices that could be improved. By doing this, the goal of the interviews was to identify the potential for workplace changes to improve knowledge work productivity. In this sense, interviewing works as a kind of *ex-ante* measurement – as a tool for identifying and assessing the potential of workplace initiative. In two companies, nine knowledge workers were interviewed (i.e., 18 in total). Respondents were chosen so that they represented three different working profiles (e.g., fixed, flexible and mobile workers). The interview questions were based on the first version of the Table 1 framework, which focused on two key knowledge work productivity drivers: 1) the impacts of physical, virtual and social work environments on productivity; and 2) the impacts of mobile and flexible work practices on productivity. Both positive and negative impacts were investigated, as well as the ways productivity could be improved.

The interviews provided information on both the actual perceived productivity impacts as well as the productivity potential for further development. Combining different work environments and work practices in the analysis provided a more comprehensive and systematic view on knowledge work productivity. For example, in one of the companies, the factors with the highest potential for improving knowledge work productivity included: 1) more effective use of space (e.g., more team spaces and policies for using the work environment properly); 2) promoting creativity (e.g., by providing employees with creative spaces); and 3) enhancing flexibility (e.g., by focusing more on results and promoting flexibility). It is important to highlight that these development areas are only relevant for this company and that different issues are probably considered relevant for other companies.

The organisations' representatives felt that the interviews gave them good insights into the individuals' views on the impacts and improvement potential of the work environment and practices. One of the organisations reported that they had read the results carefully and used the information for their work environment change plans. Typical features of the interview method seemed particularly applicable in this context. For example, the strengths of interviewing include sensitivity to context (i.e., ability to discover issues that are relevant to the company in question), wide coverage of different aspects of the ways of working, and the ability to capture subjective and qualitative phenomena. Some of the downsides of this approach are those related to subjective measurement techniques in general: interviewing takes resources (both skills and time), and the interpretation of the results always leaves room for criticism. It may also be difficult to examine the improvement of work practices over time.

4.2 Questionnaire for subjective knowledge work performance measurement

Questionnaires are typically used as a method for measuring the experiences of employees and customers. The Smart Ways of Working (SmartWoW) questionnaire was constructed to measure knowledge work performance, and it covers four components from the Table 1 framework related to knowledge work performance. SmartWoW analyses: 1) the contextual factors – physical (7 statements), virtual (7) and social work environment (10); 2) personal ways of working (10) as drivers of knowledge work performance; 3) the experienced wellbeing(8); and 4) productivity (7) of personnel as key work outcomes. Multiple choice statements are scored using a 5-point Likert-scale from 1 = "Disagree" to 5 = "Agree". In addition, one open-ended question is asked concerning ideas for improvement in relation to each of the four main dimensions of the tool. Examples of the statements include the following:

- There is a space for informal interaction at our workplace when needed (physical)
- Workers have access to information regardless of location (virtual)
- Knowledge flows adequately between the key persons at our workplace (social)
- I often telework for carrying out tasks that require uninterrupted concentration (personal)

- I find my work meaningful and having a clear purpose (wellbeing)
- My job mainly includes tasks in which I am able to exploit my knowledge and skills efficiently (productivity).

SmartWoW is a multi-use tool as it serves management in three ways. First, it can be used to identify areas to be developed (ex-ante). Second, when used ex-ante and ex-post as an NWoW initiative, it can be used to determine impacts. Third, with a fixed set of statements, it produces comparable information about different companies, thus providing an opportunity for benchmarking and learning. SmartWoW is very light and takes only 10–15 minutes to answer, which is important for busy knowledge workers. It also works as a communication tool for employees and challenges them to re-think their own work practices.

Since the creation of SmartWoW, one of the organisations has applied it to some of their processes, and 14 organisations and 1,840 knowledge workers have responded to it. Its popularity and systematic use indicate that the tool is valid for practitioners (Kasanen et al., 1993). It is most often used to identify necessary work environment changes before the change is implemented. Open-ended questions have proved to be valuable for identifying specific needs and problems. Example results show how the method can be used in practice. In one case, employees felt that the effectiveness of meeting practices was low (average 2.59) and facilities were not effective (average 3.62). Work environment changes focused especially on these two factors, and in the ex-post measurement, both were significantly improved; meeting practices (from 2.59 to > 2.96) and effectiveness of facilities (from 3.62 to > 3.91).

SmartWoW has proved to be an effective tool for evaluating the maturity or intelligence of the ways of working and how the current practices affect wellbeing and productivity. Based on the interviews, representatives felt that "SmartWoW is good for recognising the problems" and "comparisons to other companies is the most valuable information produced by SmartWoW". SmartWoW limitation is its specific work environment and work practice questions, which could become "outdated" as organisations develop. Thus, adjustments to the questions might be required. The benefit of the after results is that they could be used to identify new targets for development.

4.3 Multidimensional performance measurement of the impacts of work environment changes

The two methods introduced above focus on the work environment and practices from the individual knowledge worker's perspective. Moreover, both approaches are subjective. As one of the aims of workplace initiatives is to create business performance impacts, measuring financial and other company-level phenomena is also necessary. A potential approach for carrying this out is to use a multidimensional performance measurement system, consisting of a set of indicators that are relevant to the objectives of the workplace initiative in question.

In two of the case companies, a multidimensional performance measurement system was developed in order to capture whether the goals of the work environment and work practice changes would be reached. The choice of measures was based on the goals of the project. For example, some of the key objectives and related performance measures are presented in Table 3. One of these companies had more dimensions as their measurement system measures all of the dimensions in the Table 1 framework, such as the length of the meetings and the amount of Microsoft Lync hours.

There are two options for choosing measures. The first is to develop new measures based on the goals of the project. However, developing the measures and gathering the new data may be very labour intensive. The second option is to use existing measures. In this method, it is important to recognise the impacts of work environment changes and which measures those impacts affect. The advantage of this approach is that current and previous data is already collected. Although in our experience with these cases, it can be surprisingly laborious to gather all the data from the organisation's various IT systems. Another benefit of the second method is that it could be used even if the changes are already made, because the beforehand data exist.

In both of the case studies, measurements were carried out before and after the change project in order to capture the changes. In addition to the objective indicators, personnel's views of the impacts of the changes were examined using a questionnaire survey. In the first case study, three months

after the change was completed, the personnel evaluated how the new setting supports their work compared to the previous one. Different aspects, such as operations, flexibility and sustainability, were taken into account in the evaluation process. In the second case study, SmartWoW tool was used one month and 12 months after the change.

The measurement results (Table 3) clearly show improvement in many of the target areas. No doubt, setting clear measurable targets and designing indicators to measure them helped focus the development activities. In addition, the quantitative results appeared to be credible evidence of the value of the NWoW thinking, which is an important issue for a company providing facility management services to its customers.

Table 3. Example measures and results.

Measure	Organisation 1		Organisation 2	
	Before	After	Before	After
Space usage efficiency (NIA)	26 m^2/person	13 m^2/person	22.6 m^2/person	14.9 m^2/person
Occupancy costs (including the rent, repair cost, security, cleaning and electricity)	€7,025/person	€3,570/person	€4,650/person	€3,438/person
Environmental impact	2,650 kg CO_2/person	1,850 kg CO_2/person	690 kg CO_2/person	592 kg CO_2/person

In many ways, the multidimensional measurement system – used before, during and after the change initiative – seems like a very functional approach to measure the impacts of work environment changes. Nevertheless, some downsides can be associated with this approach as well. First, the measurement system focused only on a few concrete elements of business performance (such as space utilisation efficiency), and the impacts of the initiative on knowledge work productivity remained somewhat unclear, although the subjective personnel assessment provided a rough view of it. Second, the measurement system must be tailored according to the needs of the change project. This requires some resources.

5 Strengths and weaknesses of each method

The first purpose of this paper was to determine how to identify the productivity potential and goals for work environment change. Previous literature suggests that it is useful to classify all measures into well-defined categories to measure performance. Section 2.1 presented the framework, which includes all categories that may have an impact on work environment changes. This framework was an important starting point for all these methods as it ensures that everything is taken account. During the studies, three methods were tested and their applicability was evaluated by the case organisations' representatives and the researchers. To identify productivity potential and recognise the most critically needed work environment changes, two methods arose – interviews and survey questionnaire. A multidimensional measurement could trigger the process; for example, if the number of unoccupied desks is high, but the reason for this cannot be explained. In the NWoW context, the interview and survey methods seemed to give identical results in identifying areas in need of improvement. The survey method has one major advantage over interviews as it also offers information about the impacts of the change.

The second purpose of this paper was to examine how to analyse and measure the impacts of work environment changes. The typical approach for measuring impacts is to use objective measures, but the previous literature mentioned in section 2.2 suggests that subjective measures also work fine, and it might be beneficial to use both methods together. From the three methods of this study, we used surveys and multidimensional measurements to measure impacts of work environment changes. The organisation that used both methods felt that the survey gave good results and would be easy to use by any organisation. They were so satisfied that they utilised the SmartWoW tool for some of their customers work environment change processes. This organisation felt that they also needed objective measures because some people at the customer organisation trusted measurable numbers more than subjective evaluations. The weakness of multidimensional measurement is that it requires

significant resources to gather all the information. As researchers, we would have liked to gather information about the same things using both subjective and objective measures, but this presented difficulties. The main difficulty was that the objective information was not available, and when it was, it was still difficult to gather from all of the organisations' information systems. Some similarities could be seen in both results within the same organisation, e.g. subjective feeling that meeting practices have improved and the average length of the meeting in the booking system, but this needs more empirical evidence to be confirmed.

Table 4 concludes the case organisations and the researchers' experiences about the strengths and weaknesses of the three methods of this study. It shows that the general characteristics of interview, survey and objective measurements exist also in the context of NWoW. The reason why those methods work well in this context lies in the theoretical framework (Table 1), which is in the background of all the methods. This ensures that the measurement is comprehensive and that every dimension of knowledge work is observed.

Table 4. Conclusion of the strengths and weaknesses of the methods.

Method	Interview	Questionnaire	Multidimensional performance measurement
Strengths	+ Ability to discuss sensitive topics + Wide coverage of different aspects + Can be used to recognise which factors are impacted + Workers are the experts to evaluate how the changes would impact	+ Covers all dimensions of framework which may reveal if something else is changing at the same time + Covers all the organisational levels + Generalised results + Can be easily re-used	+ Can cover all the dimensions of the framework + Gives objective information + Continuous measurement reveals the impacts during the time
Weaknesses	− Takes resources (skills and time) − Interpretation of results − Difficult to examine the improvement over time − Difficult to define sample − Hard to find less obvious needs	− Employees may respond as they think they should − Subjective evaluation might be biased − Survey structure needs occasional updates as the ways of working change	− Requires information which measures should be used − Focuses only on a few elements of the framework due to available data limitations − Initiative on knowledge work productivity may remain unclear − Tailoring needs resources − Hard to confirm which are the right measures

6 Conclusions

This paper has introduced empirical examples of three different methods used to analyse the impacts of NWoW and discussed the usefulness and challenges of the methods. The methods are based on the framework that includes all the important areas of work environment changes. The methods include: 1) interview framework for modelling the potential of NWoW; 2) questionnaire tool for measuring the subjective knowledge work performance in the NWoW context; and 3) multidimensional performance measurement for measuring the performance impacts at the organisational level. These methods can be used independently, but they also complete each other, depending on the measurement task at hand. For example, interviews and questionnaires can be

used before planning the NWoW initiative to analyse the current practices and level of productivity and to set targets for the NWoW project. These targets can then be used when designing measures for a multidimensional performance framework. Moreover, the scores from the SmartWoW tool can be used as one subjective measure in the performance framework. After the NWoW initiative, the impacts can be captured by conducting the SmartWoW survey again six and 12 months after the changes, and collecting the objective measurement data at the same time.

Measuring the impacts should be seen as a process, and the measurements should be integrated into the NWoW project from the beginning, in order to set the baseline and determine whether the targets have been achieved. By utilising both subjective and objective measures as well as short-term and long-term evaluations, it is possible to capture the overall impacts from the intervention.

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