**The Quantified Workplace: a study in self tracking, agility and change management**

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**Introduction**

The Head of the World Economic Form has stated that the Fourth Industrial Revolution is ‘characterized by a fusion of technologies that is blurring the line between the physical, digital and biological spheres’ (Schwab, 2016). In what is also known as Industrie 4.0, humans work more intensively with machines in both cognitive and manual workplaces, often in ‘agile’ environments. Agility is a prominent contemporary work design model which is seen to humanise elements of just-in-time (JIT) and lean production. Agility is increasingly introduced not only in software design and development circles where it originated, but in a range of other knowledge work related industries where computerisation and digitalisation are occurring. Agility not only predicts change, it expects it, because technology changes. So workers must adapt and be resilient and technology is seen as a facilitator as well as a measure of individualised change management.[[1]](#endnote-1)

This chapter focuses on a case study of change management around agility principles, where the researched company used wearable and self-tracking technologies (WSTT)[[2]](#endnote-2) to facilitate a company merger and people’s ability to manage change. The company called their experiment the Quantified Workplace study (QWS) and saw the experiment as a chance to create a product, as the company is itself involved in work design consultancy and because of the rapid increase in the use of wearables in workplaces.[[3]](#endnote-3) While self and other-tracking devices are increasingly common in workplaces, from arthouses to warehouses (Moore and Robinson, 2016: 2777), they are normally implemented either for explicit productivity and efficiency monitoring (warehouses) *or* as part of wellness initiatives (white collar and office work) rather than as part of change management. The QWS involved employee use of FitBits track levels of physical activity, RescueTime for calculations of tailored hours of productivity and daily lifelogs for employees’ subjective sense of productivity, well-being and stress. The QWS was designed by the company to identify how productivity can be self-managed in times of transition through self-awareness and healthy lifestyles and wellbeing along the lines of the ‘wellness syndrome’ (Cederstrom and Spicer, 2015) that is now seen in the era of agility.

Below, we provide a necessarily truncated history of scientific management, demonstrating that the use of machines to measure and design work is not itself new, but work design experiments are being significantly updated now with the rise of wearable and computerised tracking devices workplaces and with increasingly invasive working relations with technology, which is based in an uncritical acceptance of *change* in workplaces. Then, the project methods and field work results of QWS are outlined. Our first research enquiry was to find out how employees responded to the use of WSTT in the workplace in the context of merger. The main research question became, how effective and successful was the QWS, according to employees? The analyses from these research questions is then used in the final section of this chapter where we comment on what employees thought could have been done to improve the study and suggestions for best practices. We were not consultants on the project and our own research was separate from the local study

**From scientific management to agility**

Scholars distinguish between different ‘waves’ of managerial ideology in work design alternating between control and consent (Ramsay, 1977). Here we begin with the second ‘wave’ of work design experimentation, scientific management, because this is the era when technology began to take a serious role in work design.[[4]](#footnote-1) Frank Gilbreth developed time-and-motion study as applied to bricklaying, pursuing with his wife Lillian ‘The Quest of the One Best Way’ or the optimal method to lay bricks. Looking at micro-movements and using a series of technological devices, the Gilbreths looked for a way to lay bricks that would result in the least fatigue, soon becoming known for *motion and fatigue* studies. The Gilbreths measured workers’ heart rates using a stethoscope and stopwatch, a foreshadowing of heart rate measures in the construction industry (Hughes, 2015) and contemporary wellness initiatives.  Simultaneously, but at first unknown to the Gilbreths, Taylor asserted that the greatest obstacle to cooperation between workers and management is the ‘ignorance of management as to what really constitutes a proper day’s work for a workman’ (Taylor, 1911/1998: 25) and an inspiration that ideal movements could be measured and replicated to achieve optimal efficiency.  Through experimentation, Taylor sought to demonstrate how, though the elimination of natural and systematic ‘soldiering’, the productivity of a ‘first-class man’ could be significantly improved to the mutual benefit of company and worker, through quantified work. Scientific management’s Principles of Motion Economy, ‘helpful in work design’ (Barnes 1937/1980, 174), were split into three: (1) use of the human body; (2) arrangement of the place and area; and (3) design of tools and equipment. Mental work was separate from manual work. Technology was seen as a pure, neutral measure of output/labour of manual work. Taylor focused on time and measure, prioritising efficiency and productivity, underplaying the physiological dimension in Gilbreth’s work, but both used technologies that in some cases they invented to gain insights about workers’ best practices.

While scientific management was proselytised as a manager guru’s dream, where science would overcome all irrationalities leading to worker unrest, implementing it into workplaces became rocky when the implications of separating work design from execution was identified by trades unions not with the asserted mutual gains of rising productivity, but with work intensification, deskilling and displacement. The International Association of Machinists gave the first public critical statement on scientific management on 14th April 1911, stating that it embodied ‘drastic measures’ and ‘undemocratic principles’ including ‘elimination of workmen who cannot attain the maximum efficiency’ and the possible elimination of the ‘average man’ (Nadworny, 1955: 58-9). In response to union defiance, Lillian Gilbreth explicitly promoted scientific management as the ideal work design for employees’ health and psychological wellbeing (Gilbreth, 1914), and to improve and train workers (cited in Price, 1989: 6).

Scientific management was superseded by the human relations school where the emphasis shifted from managers controlling workers by removing discretion to the aim to harness worker consent through social interaction, setting the background for the ideals of self-management and preparation for change that is now notable in agility discourses. With the rise of service industries in the 1950s, work design gurus began to ask how knowledge work could be measured and valued. The school of human relations was supplanted in the 1950s by systems rationalism (1955 – 1980). While technology did not play a large role in the Human Relations phase, systems rationalism was made up of groups of scientists who had been called Operations Research Teams during the Second World War and who had been called upon to look for methods for logistical problems using early computers. So while scientific management used technology to measure and track physical movements, these teams began to consider further ways to align work with computerization. These Teams had been so effective during the war that they were asked, to inform industry on ways to apply quantitative methods to management. So while Taylor and the Gilbreths looked for correct practices for work and management, researchers in operations research sought idealised processes and systems of work inspired by computerised processes, introducing a level of abstraction that has not disappeared.

Along these lines, Peter Drucker proposed management by objectives (MBO) based on quantitative systems in 1954, but MBO was not popularised until 1965. Drucker later advocated the integration of *virtue* into managerial vision and assessed the effectiveness of ‘participative management’, indicating that knowledge work should only ever be *guided* rather than *directed*. Management’s introduction of values, employee alignment with management culture and update Drucker’s participative models and reflect the protagonists of what we argue is a current agile work design model. Drucker also warned that a person should not be ‘determined by his technical achievements, in thrall of them, coerced by them’ (1970: 104). Systems Rationalism was supplanted by Organizational Culture and Quality for work design from the 1980s.

We claim that our current phase of work design revolves around ‘agility’. Indeed, work design now prioritises the ideals first put forward by a group of software developers in 2001 who wrote the *Manifesto for Agile Software Development* where specific relationships are reversed. Bureaucracy does not respond to *change* very well, these developers argued, so bureaucratic plans should be replaced by never-ending change preparation and management. The Manifesto (2001) reads:

We are uncovering better ways of developing

software by doing it and helping others do it.

Through this work we have come to value:

Individuals and interactions over processes and tools

Working software over comprehensive documentation

Customer collaboration over contract negotiation

Responding to change over following a plan

That is, while there is value in the items on

the right, we value the items on the left more.

The Manifesto was a call for flexible work practices, paperwork elimination, the ongoing availability of training and retraining, efficiency and a more human-focused workplace. By 2003, most companies had begun to recognise that contemporary work design should be oriented around operational agility or the ‘ability over time to respond quickly and effectively to rapid change and high uncertainty’ (Joroff et al., 2003: 294). The agile model adapts some of Drucker’s arguments for autonomy and worker involvement as well as the efficiency drive of JIT.

Agility is reminiscent of JIT production, which pervaded 1980s debates as did its further extension to the associated application of electronic performance management and surveillance from the 1990s. Sewell and Wilkinson (1992) argued that JIT production constituted a paradigm shift in management away from conventional Taylorism to one of the subordination of worker subjectivity to a ‘managerial panopticon’ that was seen as impossible to resist. The counter-argument was that no such totality of managerial control is possible. Worker resistance is inbuilt into the structure of the employment relationship (Thompson and Ackroyd, 1995).  The ‘assembly-line-in-the-head’ (Taylor and Bain, 1999) analogy of contemporary call-centre work sparked an extension of this debate. Fernie and Metcalf (1998) made the Foucauldian argument that monitoring and feedback technologies embedded in the standard equipment of call centre work create not only the means of disciplinary control over the otherwise subjective aspects of work routine, but most crucially, create a self-disciplinary control emerging once the worker has absorbed the idea that management has the *potential* to eavesdrop on any deviation from the Taylorist work design. The difference now is that this *potential* is a *probable,* as management actively seeks ways to use data generated by WSTT.

The QWS is a project that embraces agility, but is new in that it incorporates WSTT during corporate transformation. QWS also relies on the *neutrality* of technology (Spencer 2016, 4) to determine idealized subjects (Ruckenstein, 2014). The following sections outline our study of the QWS. Fieldwork reveals how workers responded to intensified technological interventions into the workplace alongside corporate change. Key findings reveal a high rate of disengagement, which interestingly happened alongside participants’ heightened sense of subjective performance, which occurred despite the corporate merger. We finish by providing suggestions, based on the experiences of workers, for improved company initiatives in implementing WSTT into workplaces.

**Quantified Workplace Study**

In 2015, Moore was granted access to speak to QWS participants as part of a grant she led on called *Work, Agility and the Quantified Sel,f* funded by British Academy/Leverhulme small grant scheme. The QWS was proposed and conducted by the smaller work design consultancy company that was being absorbed by a large multinational real estate company with over 20,000 employees internationally. Upon merging, consultants and management from the smaller company set up a year-long local study whereby technological tracking devices were offered to 30 employees to link productivity with wellness. The consultants running the project held a project launch, to which Moore was invited to speak about her research and her independent role as an observer of the QWS. Moore, Piwek and Roper’s agreed role was to conduct independent academic research over the project’s duration (Figure 1). We were granted permission to conduct surveys and interviews with participants and limited access to quantified and self-report data, provided participants consented.

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Figure 1: Timeline of QWS project with the list of all data that was collected during the year-long study. Numbers in brackets indicate a number of participants (n) who gave permission to access their data or participated in the interviews and/or surveys.

***Data collection and method***

A mixed-method observational study design was used with opting-in employees and two streams of data collection contributed to the analysis. The first stream of data took the form of electronic surveys distributed and semi-structured in-depth interviews near the beginning and end of the project, all with nearly all participants. The survey incorporated both open-ended and closed-ended questions including general socio-demographic items, and general information about participants use of tracking technology, productivity, views on data privacy, as well as personal goals set for participation in the QSW study. Semi-structured interviews were in months 3 and 8. 18 employees were interviewed in the first set and 20 in the second. Interviews lasted for 30-60 minutes and were carried out at company offices. All interviews were recorded on a digital audio recorder and professionally transcribed from audio files into a standard text format. Interviews were structured according to following categories: metadata, phenomenon, causal conditions, intervening conditions and consequences. Our research questions were intentionally broad, adopting the grounded theory method (Strauss and Corbin, 1994), starting with ‘what are employees’ responses to the introduction of WSTT at work?’. From transcripts, computer assisted qualitative data analysis was conducted using *NVivo* software for the first set of interviews by coding responses into a range of contextually specific categories.

The second stream available to us was the tracking data collected by the company from participants (Figure 1) including: (1) daily step count (n=17) and average heart rate (n=1) from FitBits devices; (2) average daily time spent on productive and distractive computer-based activities recorded with RescueTime (n =4); (3) data from daily self-reports (n=16) provided by employees who rated their levels of subjective stress, well-being and productivity in response to weekday emails run by the company’s contracted data analyst. Due to very low number agreeing to share RescueTime (n=4) and heart rate (n=1) data, this data was excluded from further analysis.

**Field Work Results I: Effectiveness of study**

To deal with the research question ‘What was the effectiveness of study, according to employees?’ and the related question ‘What specifically about the way this project was set up, had an impact on effectiveness, according to participants?’, researchers asked about perceptions and judgements of the project; difficulties in using technology; and involvement with the project. The first interviews revealed 25 responses with overall positive first impressions, however almost twice that, 41 responses, indicated that employees were critical and had unsure reactions or felt the technology did not meet their expectations (at all/yet). In the final interviews the number of unsure and critical responses dropped to 18, but responses demonstrating difficulties in using the technology itself increased from 13 to 24. Most of the responses in this area from the first interviews had to do with reading results; not knowing whether devices were working accurately; not understanding the technology or not knowing whether one is using the technology accurately.



Figure 2: Frequency of (a) using Fitbits, and (b) completing self-reports for the period between March 2015 and February 2016 shown for each participant separately (each row for separate participant). Bars indicate the use/completion use in specific time period, while gaps indicate the lack of use/completion.

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Figure 3: FitBit step counts and self-reports rating for well-being, productivity and stress, scaled and averaged monthly across all participants for the period of one year with fitted smoothed conditional mean line and standard errors (gray bands).

***Dissatisfaction with technology***

Employees expressed they found the FitBit uncomfortable and too big to sleep in. Nine responses indicated employees had stopped using the technology either for a period or altogether in the first two months. Difficulties with the technology were reflected in employee disengagement with QWS, also observed in average step count data collected with FitBits. Figure 2a shows that employees differed in their frequency of FitBit use – some used it for almost the entire project, while others engaged with it for less than one month or occasionally. The overall FitBit use decreased heavily throughout the project - there was a 30% drop in average steps recorded within the first three months, 50% drop within six months, and 75% drop by the end (Figure 3).

Responses in the first interviews demonstrated skepticism about the validity of the FitBit’s readings as well as hope for more device intelligence:

 A big question for me and for a few others as well, is uh, how reliable the FitBit is.

…this thing [FitBit] might be more intelligent than just recording my data.

***Desire for coaching and issue of gamification***

Large number of employees indicated that they wanted further assistance and coaching. The number of indications demonstrating a desire for coaching increased to 15 in the second set of interviews including such responses as:

I think we all need a coach right now, to give more feedback and feed forward, to know what can we do better and what's the best balance for me and for me it’s different than for another person.

So in the beginning, my behaviour and especially the activity, I was a little influenced by it, but I think at the moment, not anymore. I think it will be when we add the coaching part and the monitoring part of the data.

Some respondents desired a gamified element but others were reticent of competition. Comments included:

 [I am] afraid that some kind of competition will start.

[I] think the only interesting thing is that you can maybe you can set up goals for the group, like climb the mountain.

***Concerns for privacy and use for appraisals***

Five responses indicate employees were concerned that data may be used for performance management in the first set of interviews, which decreased to two in the second set. Three comments indicate concern surrounding the measure of productivity possible by the technology in the first set of interviews, increasing to 21 in the final interviews.

The majority of participants reported to be cautious about the company’s privacy practices: In the first survey, 66% agreed that ‘consumers have lost all control over how personal information is collected and used by companies’; 62% disagreed that ‘most businesses handle the personal information they collect about consumers in a proper and confidential way’; 43% disagreed that ‘existing laws and organizational practices provide a reasonable level of protection for consumer privacy today’.

**Field Work Results II: Subjective performance**

Despite the reticence to the project discussed above, our study revealed that workers’ subjective performance improved. We measured a) self-management, measured by ‘goals’ and ‘motivation’; b) subjective productivity; and c) self-awareness.

***Self-management: goals and motivation***

Both interviews and surveys asked whether participants had set goals and whether the project aided in meeting goals. The initial survey showed they had set up, on aggregate, 13 goals. Only a number of weeks after the survey was completed, five responses indicated employees felt their goals *were* being met. Several did not recall the goals they had set at first, but 17 responses in the final interview indicated that QWS had helped participants meet goals.

The second measure of self-management is ‘motivation’. In the first interviews, 20 responses indicated improved motivation. In the final set, the number was 17. Final responses included:

Yes, it did and on the dashboard you can see how your mood says you was and how stressed you were but also how productive, so I think that’s very interesting and yes, it motivates me, just like I said, to feeling that I was productive.

The whole experiment is quite something, if I tell people about this, I really think, very cool that we’re doing this and yeah, hopefully we’re getting somewhere with it, so… it makes me motivated about having my part in the experiment and it should be a good part and motivated to help and motivated [around] what we’re doing with this project, more about, okay, now I want to see, yeah, what it is really bringing for me.

***Subjective productivity***

Fourteen responses indicated participants felt that their subjective productivity was improving in the first months:

Creativity is not measured in time or in space, it depends on the input you are getting but then again you have got to be creative, so you come up with your own input but it’s not during office hours, so creativity can also be part of I think measuring productivity because you come up with new ideas when you’re talking to people or you are sharing ideas.

Sixteen responses indicated subjective productivity had improved by month 8:

I learned about my feeling of productivity, so productivity has nothing to do with invoices we can send to our clients and before I was thinking, okay, productivity is like just hours I'm working for my clients, but sometimes I feel very productive, just the internal things, so therefore it helps, the way I think about productivity.

Participants provided daily self-report on their levels of subjective productivity, stress and well-being. The frequency for self-reports was in some cases sparse and irregular (Figure 2b). However, average total ratings was relatively stable with medium-to-high productivity (70% of responses were 3 or higher on 5-point scale), low-to-medium stress (83% of responses were 3 or lower on 5-point scale) and high well-being ratings (78% of responses were 7 or higher on 10-point scale). Figure 3 indicates there were no significant changes in productivity, stress and well-being over the course of the project.

***Self-awareness***

The first interview results demonstrated 25 responses indicated increased self-awareness resulting from the QWS including:

I see when I’m frustrated my heartbeat is higher.

[Participation in the QWS makes me] more conscious of activity, heart rates and wellbeing.

The second interviews revealed 36 responses demonstrating improved self-awareness. One stated:

I think awareness is even more key than total change of behaviour, but that you are more aware of your body and what's the problems for it and that you address that and start to organise your agenda around it, so that’s already a first stage in behavioural change.

**Conclusion: A New Work Design Model?**

There are both possibilities and tensions in the coming era of work design. Here, researchers reflect on employees’ perceptions and employers’ orchestration and running the QWS to provide recommendations for other companies considering integration of an agile work design model that incorporates WSTT.

It is important to note that partway into the project, the Autoriteit Persoonsgegevens sent a letter to the company asking about their precise activities. Questions involved: (1) who saves the data; (2) who delves into the data; (3) how many people are participating; (4) who is using the wearable technology? The local authority indicated that employers should not collect employee data generated by wearable self-tracking devices. Step data should not be gathered by employers. The authority indicated that a third-party developer who sets up employees’ dashboards could be considered to hold sensitive personal data, thus calling into question the legality of a data analyst’s role in the project. These questions required a rethink of the project. In response, the local data analyst designed a Roadblock Privacy Policy which contains a data processor agreement and a research policy.

There is leeway to what appears at first glance to be rather draconian gestures from the local authority in that employers were still permitted to give devices to employees as long as the employer does not have direct access to the data.  Employees would be permitted organise themselves into teams for games and create leader boards and thus share data. Whether a manager may sign up for team games was still not clear (they originally had all participated). A human coach can be designated to employees and employees are permitted to show a coach (who must not be an employer) their personal data in order to work on achieving personally set goals.

Based on research and the local authority’s comments, in conclusion, it is clear that more and better communication is key. Firstly, employees should be provided with training and coaching for the full benefit of involvement in such projects. Secondly, employers should be consult with local authorities *first* to avoid contravention. Thirdly, an employer should communicate clear intentions and practices up front, indicating precisely what is expected from the project and data will/may be used (provided it is permitted) to avoid concern about appraisals and privacy and prevent drop-out.

Improved productivity and efficiency justified scientific management, but where should the line be drawn? Will information on quantified work help employers identify better working practices or will it be used to surreptitiously discriminate and used for appraisals? What future is there for privacy and how much should employers know about employees? As Ajana points out, ‘privacy enables… the ability to set limits on the power of governments and companies’ (2017: 11). As doors are opened for increasing involvement of technology in workplaces, it is vital to consider both the impact it will have on workers, the risks being taken and pursuant ethics. Further research should focus on workers’ experiences resistance to such experiments in the new world of agile, technologically tracked, work design.

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1. Change management in this article refers both to the company’s intended change through the process of corporate merger *and* to individualized expectations for the personal management of change with the help of wearable and self-tracking devices. [↑](#endnote-ref-1)
2. Wearable and self-tracking technologies measure and track activity and performance via accelerometers, Bluetooth, triangulation algorithms and infrared sensors, allowing self-monitoring beyond the enclosure of a specific workplace. Technologies can also be a specific app utilising powerful sensors available on each smartphone. [↑](#endnote-ref-2)
3. In 2015, nearly a fifth (18 per cent) of employees in Europe had access to wearable technology at work (ADP, 2015). Now, 1 in 3 companies provide wearable devices to track activity (Jiff, 2016), save money (Daws, 2016) and improve employees’ health and happiness. [↑](#endnote-ref-3)
4. 1st wave: Industrial Betterment 1870-1900; 2nd wave: scientific management 1900 – 1923; 3rd wave: Human Relations 1925- 1955; 4th wave: Systems Rationalism 1955-1980; 5th wave: Organisational Culture and Quality 1980 – ongoing. (Barley and Kunda, 1992) [↑](#footnote-ref-1)