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The European Journal of Workplace Innovation (EJWI) is an open-access, net-based, peer reviewed and English-language journal. The Journal invites research-based empirical, theoretical or synoptic articles focusing on innovation and workplace development. The aim of the journal is:
To develop insights into workplace innovation
Provide case studies from Europe as well as comparative studies from other continents
Develop and present new theories in the field of workplace innovation
To increase international publication within the field
To become an important publication channel for workplace innovation researches as well as the international research community.

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EUROPEAN JOURNAL OF WORKPLACE INNOVATION

Editorial

Hans Christian Garmann Johnsen
Richard Ennals

The European Journal of Workplace Innovation has achieved new maturity and sustainability since it was founded in 2015. There is a new agreement with the European Workplace Innovation Network (EUWIN). The journal website at ejwi.eu has been updated. The blind peer review process has been improved. The journal is now supported by two new editorial assistants, based at the University of Agder. Preparations have been made for an ongoing programme of General Issues, complemented by Special Issues, with international guest editors.

Workplace Innovation has gained in prominence in recent debates, with the realisation that it can take many different forms across developed and developing countries. A new vocabulary and literature have developed to help us to learn from the increased range of differences.

All of the papers in this issue address challenges related to methodology, some at a conceptual level, and some specifically addressing how to research and measure the output of workplace innovation initiatives.

• Dessers et. al (Belgium) argue for a multidisciplinary and multimethodological approach.

• Pomares (Spain) presents a framework to integrate a system level and an actor level approach to innovation.

• Korhonen et.al (Finland) present a framework for evaluating learning.

• Kibowski et. al (UK) present arguments for new measures of workplace innovation.

• Köksal (Turkey) presents a framework for identifying workplace innovation at academic staff level in universities.

• Sousa et. al (Portugal) present a framework for organisational mindfulness as part of problem solving in organisations.

• Parker and Davis (UK) use literature review in order to identify key dimensions for explaining innovation outcomes of merger and acquisitions.

This issue includes a short and highly topical discussion paper from Richard Ennals (UK), "Coping with the Future: The Brexit Kodak Moment". The Brexit saga continues!
In addition, Ennals has reviewed “Quality Beyond Borders”, by David Hutchins (UK). Dhondt and von Hootegem (Belgium) have provided a news update on the work of EUWIN, which is active in 30 countries. Baburoglu (Turkey) introduces a new Industrial PhD programme at Sabanci University in Turkey, based on Action Research, which will start in autumn 2020.

All in all, these papers give a fascinating view of the spectrum of challenges facing social science research related to investigating real time factors for explaining innovation.

Our editorial reflection is that

A) These discussions are important. We need a constant debate on research design, and also better methodologies to investigate real time issues. The field of innovation is often characterised by either overall data-based arguments with few references to real life, conceptual discussion without an empirical base, or case studies that lack reference to more general themes. Good and solid empirical research is needed.

B) Part of the problem of making solid and relevant empirical research is to refer to some of the fundamental epistemological issues raised by social sciences on real life social events. Thus, over time, this journal should also address this aspect of the discussion.

Dessers et al argue for a multimethod research programme, related to identifying the impact on work organisation of new technology. The paper gives a good overview of the technologies that will come as a consequence of Industry 4.0. Seven research questions are identified, and the argument is that multidisciplinary, multimethod and multi stakeholder perspectives are needed. The argument is transparent and clearly stated.

Pomares addresses the relation between regional innovation policy and workplace innovation. The paper has two parts, one a general review of the literature on Regional Innovation Systems and Workplace Innovation, and one part presenting innovation programmes in the Basque country.

Korhonen et al present results from a study of how vocational student teachers develop a transparent portfolio of competence development such as an e-portfolio, within a concept called personal learning environment. A framework for research based on five dimensions and three levels of environments is presented. Findings related to the challenges of implementing these new technologies are discussed. The paper gives interesting insights into the implementation of IT technology, as well as learning processes.

Kibowski at al discuss the challenges of measuring workplace innovation. The paper briefly outlines key elements of workplace innovation. These are identified as organisation, structure, learning and partners. Following that, the paper presents results from a statistical analysis of a survey of 855 people in three organisations. The analysis confirms that the four factors are positively related to Workplace Innovation. However, the paper acknowledges the shortcoming of these kinds of surveys, which are important for further research.

Köksal argues for the need for Workplace Innovation among administrative staff at universities. The data comes from Turkey, and the study goes deep into identifying what kind of issues are important for enhanced Workplace Innovation in the organisation. The method is qualitative, and the finding is highly contextual. However, there are insights about the need to take seriously useful local discussions of participation.

Soares et al present findings from a single case of decision-making processes. The issue is access to knowledge and tools as enablers in problem solving and decision making. A key concept is organisational mindfulness. The argument in the paper emphasises the need for reflection at both an individual and collective level in problem-solving and decision making.

Parker and Davis present a literature review of research into challenges related to utilising competences in merger and acquisition processes. A model for dynamic capabilities is presented, and the literature and theory review are organised along the dimensions of the model. Based on this, the paper presents a four-dimensional structure of clustering insights from studies of merger and acquisitions. The purpose of the review is to identify areas for further research.

The purpose of the European Journal of Workplace Innovation is to support further research, dissemination and debate, providing a forum for dialogue involving researchers and practitioners. EJWI is published in Europe but welcomes papers from around the world.

EUROPEAN JOURNAL OF WORKPLACE INNOVATION

Towards a Multidisciplinary Research Framework for studying the Digital Transformation of Industry

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J. De Schutter, L. Pintelon W. Decré,
W. Van Bockhaven, W. Coreynen,
M. De Looze, G. Van Hootegem

Abstract

The manufacturing industry is increasingly regarded as an essential ingredient of an ecosystem of production of goods and services. Key enabling technologies are considered to be the motors behind the ongoing digital transformation of industry. Given that there are still a number of open questions that need to be addressed in order to develop successful strategies for further implementation of these technologies, and to understand how workplace innovation plays a role in the digital transformation of industry, this paper seeks to design a comprehensive research approach and explains how this approach is applied in the PARADIGMS 4.0 research project on the digital transformation of industry in the region of Flanders, Belgium. Based on the identification of current knowledge gaps, research questions are defined on the topics of technology and work organisation, skills and participation, organisational and regional strategies, and labour market impact. A multi-level, multi-disciplinary, multi-method and multi-stakeholder research design was developed in order to study these topics in an integrated way. While this innovative comprehensiveness is seen as a major strength, it is acknowledged that the research design comes with certain risks that need to be tackled.

Keywords: Industry 4.0, work organisation, regional strategy, skills, worker participation, job market

Acknowledgements
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Introduction

The fourth industrial revolution is characterised by a blurring of distinctions between physical, digital, and biological spheres, as major technological advances are having a profound impact on economies, businesses, and the personal lives of people throughout the world (Schwab 2018). Some of the technological forces in this transition include the development of big data, algorithmic management, 3D printing, quantum computing, smart robots, artificial intelligence, the internet of things, nanotechnology, biotechnology and alternative forms of energy technology (O'Reilly, Ranft, and Neufeind 2018). These key enabling technologies are regarded as the motors behind the ongoing digital transformation of industry.

In Europe, a growing awareness can be noticed that the manufacturing industry is an essential pillar for job growth and prosperity. Strengthening Europe's industrial base and getting manufacturing industry back to Europe has been a key topic for both business and government in recent years. Faced with strong competition from emerging economies, combined with massive outsourcing and offshoring of industrial activity during the 1990s and early 2000s, recent policy and business initiatives have been launched to 'reshore' and 'inshore' activities that were previously offshored. The 'strong industrial base' argument in essence holds that the manufacturing industry itself is important, in the EU responsible for 30 million jobs directly, and twice as many indirectly, 80% of total EU export and 80% of private R&D expenditure (European Commission 2014), but it also forms a strong basis for the service economy (Vendrell-Herrero and Wilson 2017) and as such makes higher contributions to the economy than would be expected based on its size, i.e. its production value and (declining) employment.

Also in the region of Flanders (Belgium), manufacturing industries are considered essential for employment in services, as was stated in a recent position paper from the Class of Technical Sciences of the Royal Flemish Academy of Belgium for Sciences and the Arts (Van Brussel et al. 2016). The manufacturing industry is increasingly regarded as an essential ingredient of an ecosystem of production of goods and services. The, perhaps most important, reason behind the manufacturing renaissance is the introduction and application of the said key enabling technologies. Based on a series of consultations and a stakeholder conference in 2016, the Flemish Government made a concept note (EWI 2017), in implementation of its long-term strategy 'Vision 2050' (Vlaamse Overheid 2015), which stressed the urgent need for coordinated action and the development of a long term vision on Industry 4.0. In support of 'Vision 2050', a report (Sels, Vansteenkiste, and Knipprath 2017) on labour market forecasts was published, with an important section on technology, jobs and 21st century skills. These documents show the high relevance of the Industry 4.0 related challenges in Flanders. However, there are still a number of open questions with regard to Industry 4.0 that will need to be addressed in order to develop successful strategies for further implementation. In this respect, Howald et al. (2017) propose that workplace innovation should be given a more central place in the process of digitalisation, emphasising the close relationship between organisational performance (labour productivity, innovation capabilities) and better jobs (competence development, wellbeing at work). The authors state that the concept of workplace innovation covers the main elements of a human related perspective for developing work in a digitalised world that aims for comprehensive utilisation of the potentials of human labour as a condition for ensuring innovative ability. Deuse et al. (2011) emphasize that the success of the proclaimed fourth industrial revolution depends crucially on whether it is sustainably anchored in the organisation and implemented in a targeted way. Accordingly, human and technological aspects should be adapted to and aligned with the organisation's structures and processes.

The Paradigms 4.0 research consortium (Dhondt et al. 2018) took up the gauntlet and received funding from the regional Research Foundation - Flanders (FWO) for designing and implementing an extensive study on the digital transformation of industry.

This paper consists of six parts of which this introduction was the first. Based on the identification of current knowledge gaps in the second part, we will define scientific objectives and the related research

questions in the third part. The fourth part describes the requirements for the research design, which is presented in the fifth part, after which we will further discuss this research design in the sixth part.

1. State of the Art

Industry 4.0 builds on the state-of-the-art research which acknowledges that Industry 4.0 technologies will have a deep and disruptive impact on society. However, there is an increasing number of contradicting studies about the exact impact, especially with regards to quality of working life, organisational performance and employment relationships. It is yet unclear how Industry 4.0 technology could foster societal aims, while at the same time cradle high performance organisations.

1.1 Technology and the labour market

Fast technological developments generate opportunities and threats for manufacturing industries to innovate. Industry 4.0 technologies are considered to be disruptive for labour markets and organisations (Brynjolfsson and McAfee 2015; Frey and Osborne 2013). This 'disruption' perspective is still the standard way of thinking about the effects of technological change on labour markets (Pfeiffer 2016). However, within this perspective, the expectations about the technological developments tend to be overly optimistic as far as the possible applications of new technologies is concerned. At the same time, expectations with regard to the direct, linear impact of technological developments on labour markets could be labelled as overly pessimistic. Kurzweil's Singularity point is still far away, and Moravec's paradox stating that 'tasks that are trivial for men are difficult for robots and vice versa' is likely to remain valid for a long time (Van Brussel et al. 2016). It must be clear that the panic messages in the popular media about 'the invasion of the robots' and its impact on employment and on the potential and limitations of the emerging technologies are often exaggerated and deserve some reservation. But the 'disruption' perspective also leads to misdirected actions in policy agendas such as employers demanding an immediate change of the educational system. A 'high road' smart industrial specialisation strategy (as explained in the next section) does not only rely on technology, but also on the availability of the appropriate skills in the labour market and in the companies. The model of Frey and Osborne (2013) predicted that about 47 percent of total US employment is at high risk for full digitisation. A Belgian replication study estimated 39 percent at risk (HRW 2016). However, this model assumes that whole occupations rather than specific tasks are being replaced by technology. Arntz et al. (2016) argue that this approach leads to an overestimation of technology impacts, as even high-risk occupations often still contain a substantial share of tasks that are hard to digitize. Their analysis accounts for the heterogeneity of workers' tasks within occupations and leads to loss of 9% of total employment due to technology across 21 OECD countries. Huang and Rust (2018) argue that Artificial Intelligence job replacement occurs fundamentally at the task level, rather than the job level. It seems that digitisation is unlikely to destroy large numbers of jobs, although it is found to lead to less opportunity for low-qualified workers. More precise concepts and statistics are needed in order to assess the labour market impact of Industry 4.0 technologies.

1.2 Strategies within entrepreneurial ecosystems

Industry 4.0 is often part of 'smart specialisation' strategies which regions and countries develop in order to help restructure their economies. Smart specialisation is an innovative approach, promoted by the European Union, that aims to boost growth and jobs, by enabling each region to identify and develop its own competitive advantages (hence 'specialisation'). The term 'smart' in smart specialisation points at the intricate process of 'entrepreneurial discovery' through which regions seek to specialize (Foray 2016). Specifically, with regard to Industry 4.0, we use the term Smart Industrial Specialisation (SIS). Based on a comparative analysis of five West-European countries who were able

to increase their industrial production capacity between 2001 and 2011, Tshidimba and Costers (2015) identified to two contrasting paths: The Netherlands and Ireland followed a strategy which was largely based on lowering costs (in terms of labour costs, taxes, commodity prices), while Germany, Austria and Sweden based their strategy on their ability to differentiate in order to stay competitive. These countries specialize by investing more in innovation, compared to other countries, and by focusing research and development activities on the industrial sector. This distinction matches the low and high road to industrialisation, where the low road is based on cheap labour, and the high road stresses innovation (Sengenberger, Loveman, and Piore 1990). The promise of a high road strategy is lower unemployment and better, higher paid jobs. In the scientific debate about such strategies, the role of 'ecosystems' is often stressed, which are defined as the strategic interplay of academia, industry and government. The concept of 'entrepreneurial innovation ecosystems' gradually replaces prior thinking about ecosystems, which was strongly focussed on the transfer from knowledge partners towards companies. In an entrepreneurial innovation ecosystem approach, an interdependent set of actors is governed in such a way that it enables entrepreneurial action. This approach may speak directly to practitioners, but its causal depth and evidence base is still rather limited (Stam 2015). The theoretical foundation for such entrepreneurial innovation ecosystems requires more in-depth investigation.

1.3 Design space in new technology

The relationship between operator and robot has changed drastically over the years. The type of current human-robot interaction can be categorized as *supportive*, *collaborative*, or *cooperative* (Siciliano and Khatib 2016), ranging from no (intended) physical contact to continuous interaction. The comprehensive digitisation and integration of production and planning along the value chain will also change work organisation, yet forecasts are contradictory. The, for human workers, pessimistic perspective predicts more employee surveillance, more standardized and short-cycle work, poorer quality of working life, and worse working conditions. The key question is to what extent the integration of production data along the value chain will imply a centralisation of control and planning, and hence a decrease of autonomy at the level of working units (Lall et al. 2016). The optimistic perspective emphasizes the opportunities of digital technologies (such as decentralized programming facilities and augmented reality) and robotization (such as exoskeletons and collaborative robots) to enable innovative work organisation models based on teamwork, and to empower operators with decentralized planning, control and fine-tuning (Ittermann, Niehaus, and Hirsch-Kreinse 2015). In current applications and research, the role of the human operator is often defined from the perspective of technological optimisation processes. This implies that tasks of human operators (and teams) are guided by software which is pre-programmed by system developers. The new generation of robots and Cognitive Operator Support Systems (COSS) require optimisation processes where the constraints are more complex: with greater geometrical uncertainties, with a larger task variability, and with more interaction between the operator and the machine (Reardon et al. 2015). As a result of this increased complexity of constraints and optimisation processes, the awareness is rising that pre-programmed software to guide tasks is no longer possible and that software needs to enable operators to define or modify the constraints (Pan et al. 2010). The question remains how and to what extent robots and work processes can jointly be designed in such a way that operators, as part of autonomous teams, have adequate decision authority.

1.4 Robots, humans and safety

High technology systems hold the lure of preventing all accidents from happening and creating inherent safe work situations (Parmiggiani et al. 2014). Next to the mechanical autonomy, new robotic systems operate with different sensor systems, actuators and learning systems that help the system identify its environment and act upon it. This approach leads, however, to complicated design choices: how much energy should be diverted to securing a safe working environment, for instance to avoid collision with operators? Such design choices impact the performance of the robot. A 'risk-free' robot

will probably not be able to deal with heavy loads, or to operate at the high speed that is needed for high productivity. Interestingly, the design choices which are usually made in practice, are mainly technology-driven: actual solutions typically do not include a role for the operator, because of the availability of technological safety options. Such safety approaches which, by design, do not allow the operator to make safety decisions, may be hard to integrate in 'high road' Industry 4.0 applications. The question is which safety approach could lead to inherent safe working conditions, by not only relying on technology. Is a new, more operator-centred approach to robotic systems possible, based on broader occupational safety and health (OS&H) approaches, such as traditional safety management (focused on accident prevention), Reason's Swiss Cheese Model (1997), and new approaches such as systems thinking (Leveson 2011) and the Zero Accident Vision, which requires participation by all people engaged in the organisation (Zwetsloot et al. 2017)?

1.5 The skills debate

Pfeiffer (2016) argues that the main weakness of many studies, such as the one by Frey and Osbourne (2013), is the distinction between routine and non-routine tasks. She proposes an index based on 'labouring capacity' to describe digitisation-resistant components of human work, which is understood as a multidimensional interplay of complex challenges in specific situations, together with the action dimensions that are necessary for adequately responding to these challenges. However, the skills debate is currently mainly focused on the distinction between task- or occupation-based approaches (see Section 2.1) for assessing technology impacts on labour markets and skills. Progress is stalling because a thorough analysis of the connection between both approaches is still missing. On top of this discussion, the European Commission and the employers' associations (e.g. European Commission 2016) are now insisting on the development of 'T-shaped skills', which combine deep skills in a specialized area (the vertical axis of the T) with broad competences for collaboration across disciplines (the horizontal axis of the T). It is obvious that the vertical, occupation-related skills are a primary condition for success in many occupations, and that generic, horizontal skills cannot compensate for the lack of occupation-specific competencies. However, indications are that, on average, Industry 4.0 requires employees with a higher educational level than before. Another issue connected to the discussion on T-shaped skills, is that the changing skill needs also require company policies to adapt, in order to enable employees to expand their skillset during their working career. Dhondt and van Hootegem (2015) argue that team-based environments are needed in order to integrate a great number of individuals with overlapping high-tech skill profiles (Dhondt & Van Hootegem, 2015). Fragmenting work across many different, specialized tasks hampers the development of T-shaped organisations (Wladawsky-Berger 2015). In short, there is abundant room for further progress in determining the relation between Industry 4.0 technological developments, employee skills and organisation design.

1.6 Worker participation in Industry 4.0

Implementing Industry4.0 technologies is likely to have a deep impact on the role of workers within a company and within work processes, on the way they are able to participate in the design and execution of labour processes, and even forms of participation at the company level may change. It is yet unclear what potential opportunities, drivers, hindrances and benefits could be of different forms of worker participation in deep transformations such as projected in the Industry 4.0 visions. How can worker participation become a cornerstone in the shaping of technology, labour processes and workplaces, in order to foster beneficial outcomes for society as a whole, and for workers in particular? Three forms of participation can be distinguished. (1) Direct participation in the work processes relates to the concept of 'employee innovative behavior', when employees actively think about how to change, optimize and innovate the work and business performance (De Spiegelaere, Van Gyes, and Van Hootegem 2014). This connects to the entrepreneurial ecosystems approach (see Section 2.2) as well as to the skills of workers and work organisation design (see Section 2.5). (2)

Organisational-level decision latitude is defined as shop-floor consultancy on process improvements, division of labour, targets, etc. (Dhondt, Pot, and Kraan 2014). The High Performance Work Systems perspective argues that both innovative employee behaviour and organisation-level decision latitude depend on organisational structures that provide employees with the abilities, motivation and opportunities for such behaviour (Appelbaum et al. 2000). While the determinants of the abilities and motivations are usually dependent on job characteristics, the opportunities are more likely to be dependent on organisational level variables (Oeij et al. 2015). (3) Representative participation refers to participation by elected worker representatives. Representative participation can influence innovation outcomes both positively and negatively, for example when union bargaining simultaneously leads to lower Research and Development expenditure, due to higher wages, and to stronger innovative capacity, due to higher employee trust and group level dynamics, as well as to employee support for the introduction of new forms of work organisation induced by Industry 4.0 and for investment in training (Van den Berg, Grift, and Van Witteloostuijn 2011). Overall, there is a lack of scientific clarity on the precise relation between direct and representative employee participation, job characteristics and innovative employee behavior. A more rigorous specification of the – likely indirect – pathways through which employee participation influences innovation outcomes was explored by Hermans and Ramioul (2015). However, to date, these pathways lack empirical testing.

1.7 Integration

Industry 4.0 technology is an important trigger for disrupting changes, but from the overview of a number of important Industry 4.0 building blocks in the previous sections, it must be clear that there are several mediating variables. On top of the indicated research gaps, a yet unanswered question is how to combine and integrate these different building blocks in order to enable a 'high road' digital transformation of industry.

2. Research Questions

Based on the overview in the previous part of this paper, we identified four research objectives which were translated into seven research questions. In the next part we will describe the requirements for a research design which allows to study these research questions, in order to realize the four objectives.

2.1 Technology and work organisation

The first objective (O1) is to improve scientific knowledge on the relation between Industry 4.0 technologies and the organisation of work. Two research questions were formulated.

> *RQ1 - Which human-technology interfaces foster optimized quality of working life and increased performance?*
>
> *RQ2 - What occupational health and safety approaches contribute to digitized workplaces that generate safe, productive and healthy jobs?*

2.2 Technology, skills and participation

The second objective (O2) is to improve scientific knowledge on skills and participation as key dimensions of the employment relationship in Industry 4.0 work environments. Two research questions were formulated.

RQ3 - What skills are required for Industry 4.0 manufacturing environments?

RQ4 - What social partnerships may enable forms of participation which contribute to technological innovations that foster synergies between quality of working life and organisational performance?

2.3 Organisational and regional strategies

The third objective (SO3) is to develop a comprehensive conceptual framework of factors supporting quality of working life and organisational performance in Industry 4.0 work environments, by integrating the separate building blocks, thus laying foundations for organisational and regional high road strategies towards Smart Industrial Specialisation. Two research questions were formulated.

RQ5 What is the combined impact of technology, work organisation, skills, and participation, on quality of working life and organisational performance?

RQ6 What organisational and regional strategies contribute to the development of 'high road' Industry 4.0 manufacturing environments?

2.4 Labour market impact

The fourth objective (SO4) is to develop innovative methods for measuring the labour market impact of technological innovations. One research question was formulated.

RQ7 What is the labour market impact of technological innovations in terms of organisations, occupations, and tasks?

3. Requirements for the research design

While the previous part consisted of the formulation of research objectives and research questions, we now formulate four requirements for a research design which would allow to study these research questions and explain how these requirements were met. Firstly, the research design needs to encompass multiple levels, from individual jobs to innovation ecosystems, and it should enable an analysis of the linkage between these levels. Secondly, due to the variety of aspects covered by the research questions, a carefully selected group of academic disciplines needs to be involved in the design of the research, as well as in the further empirical and analytical work. Thirdly, because of the differences in level of analysis and disciplinary focus between the seven research questions, the research design should allow separate sets of methods to be used for each research question. Fourthly, the (potential) fields of application of Industry 4.0 technologies encompass a multitude of stakeholders. The research design therefore needs to cover the involvement of a network of motivated stakeholders. In short, a multi-level, multi-disciplinary, multi-method and multi-stakeholder research design is needed.

3.1 Multilevel

Table 1 presents an overview of the main topics per research question (RQ) and the respective level(s) of analysis. Industry 4.0 is studied from the micro level of workers and human-technology interfaces, over the meso level of teams and organisations, to the macro level of ecosystems and labour markets.

Most of the research questions focus on more than one level (including the interconnection between them). Especially RQ5 explicitly focusses on a cross-level integration of Industry 4.0 building blocks in terms of quality of working life (micro) and organisational performance (meso), and RQ6 builds further on the RQ5 insights in order to develop organisational (meso) and regional (macro) strategies.

Table 1 Overview of the main topics per research question and the respective level(s) of analysis.

RQ	Main topics	Level(s) of analysis
1	Human-technology interfaces	Micro
2	Occupational health and safety approaches	Micro – Meso
3	Skills	Micro – Meso – Macro
4	Participation	Micro – Meso
5	Combined impact on quality of working life and organisational performance	Micro – Meso
6	Organisational and regional strategies	Meso – Macro
7	Labour market impact	Macro

3.2 Multidisciplinary

The research questions ask for an interdisciplinary approach and close collaboration between engineers and social scientists. The research team therefore includes mechanical engineers, experts in robotics and safety at work, and social scientists specialized in work organisation, job design, quality of working life, occupational health and safety, worker participation, and business and regional strategies Each research question will be studied by a tailored combination of researchers from different disciplines.

3.3 Multi-method

Mixed methods research is usually defined as the use of quantitative and qualitative methods in a single study or series of studies. Although the research design that is presented in Section 5 involves the use of quantitative and qualitative methods, we prefer to use the term multi-method (Dessers et al. 2014). While the term mixed method primarily stresses the connection and combination of several different types of data collection to answer a specific research question, multi-method here refers mainly to the fact that each of the seven research questions will demand specific methods. The research questions refer to different levels of analysis, and their disciplinary focus differs as well. For that reason, no one-size-fits-all method could cover all seven research questions. It is expected to be more effective to choose the right tool for the job at hand. As will be explained in Part 5, the most appropriate and feasible research methods are applied for answering the different research questions, including conceptual studies, descriptive case studies, feasibility studies, impact studies, surveys, focus groups, Delphi studies and desk research.

3.4 Multi-stakeholder

Politicians and industrial sector representatives have clearly expressed the need for Industry 4.0 strategies in the light of the digital transformation of industry (EWI 2017). Although studying the research questions primarily requires a fundamental research approach, eventually the acquired insights and knowledge should evidently enable strategic improvements in practice. Active efforts are taken to achieve the effective transfer, the exploitation and the utilisation of the research results. This research was therefore developed through an intensive preparatory process, which resulted in a strong network of motivated stakeholders (Dhondt et al. 2018). We included a total of 16 valorisation partners in the research who confirmed their participation by a letter of intent. These partners come from following stakeholder groups: companies in the manufacturing industry (count: 6); social partners (4); knowledge and education organisations (3); and policy and support institutions and networks (3). All of them have evidently agreed to be part of the project board, to give support to the implementation of the research, to evaluate research results and, even more important, to support the valorisation of the research results. A valorisation trajectory will run parallel to the execution of the research. This approach is based on the concept of 'concurrent engineering', and implies that fundamental research, valorisation and application of the research results are not considered to be sequential phases. Instead, a series of research-valorisation-application-loops will be organized throughout the research project runtime, based on het future search methodology (Weisbord 1992), which is a meeting technique that helps people to use their capability for action.

4. Research Design

Now that the requirements are dealt with, we will present the actual research design. A multi-method approach was developed in order (1) to prepare the studies and to integrate existing information into concepts and frameworks by using conceptual studies, by means of literature review, desk research, and expert discussions; (2) to collect in-depth insights about technological applications, by means of descriptive analyses of workplaces, feasibility studies to test new ideas, and impact studies to analyse results of new designs; (3) to understand strategies of actors in workplaces and organisations by means of focus groups, Delphi studies, and desk research; (4) to identify and understand strategies of stakeholders groups with regard to the labour market, by means of stakeholder meetings, focus groups and Delphi studies; and (5) to create external validity of the collected data, by means of surveys and multi-variate statistics.

In our research design, the in-depth study of Industry 4.0 technologies and the related human-machine interactions take a central place, which enables us to identify alternative human-technology interfaces and organisational designs, and to study their impact on quality of working life, required skills, organisational performance, and possible health and safety risks for workers. Investigating the relationship between technology and work organisation helps to understand the malleability of technology from the perspective of quality of working life and organisational performance. A set of eight case studies covering typical Industry 4.0 technology applications will produce basic data for the joint study of multiple research questions. We selected four types of Industry 4.0 technologies and strive to study two cases of each type. (1) *Autonomous robots,* which evidently do not require human-machine interaction during operation, yet they do require maintenance, logistical and supportive activities; (2) *Interactive robots*, often referred to as collaborative robots or 'cobots'; (3) *Wearables,* including exoskeletons. The development of these systems has just started. We hope to identify cases where wearables are used in a production environment, and if not, we plan to study wearables in an experimental lab setting; (4) *Cognitive Operator Support Systems*, which help operators in conducting their activities. Such systems are now starting to get implemented.

Studying cases of these four industrial applications of Industry 4.0 technologies will allow to generate information about the malleability of these technologies in terms of improved quality of working life and organisational performance (RQ1); about the possibilities for healthier and safer work

environments (RQ2); about the required skills for working in these settings (RQ3); and about pathways for adequate participation (RQ4).

We apply a case study-based design in order to obtain indications on how technology and work organisation related decisions are made in real-life situations. This requires case studies of companies in which technology is being (re)developed; in which decisions concerning implementation are made; in which data can be gathered on desired changes from everyone involved in the production process; in which the feasibility of these desired changes can be investigated; and in which the impact of alternative production set-ups can be measured. Two types of case studies will be needed: (1) Impact studies, which should allow us to better understand which technological and organisational choices were made, and what the possible impacts are of the current set-ups for quality of working life and organisational performance; (2) Feasibility studies in real-life settings and/or design experiments in a lab environment, to explore the possibilities for granting discretionary power to human operators and their teams, for changing and controlling technology applications. These studies should help us understand to what extent and how it could be feasible to adapt technological and organisational dimensions in such a way that quality of working life and organisational performance is fostered.

Both within-case and cross-case analyses will be performed. In combination with literature reviews will these cases provide the building blocks for an integrated scientific approach of the relationship in Industry 4.0 working environments between technology, work organisation, skills and participation on the one hand, and quality of working life and organisational performance on the other hand (RQ5). In a final step, these results will be linked to possible organisational and regional smart specialisation strategies (RQ6). Industry 4.0 stakeholders will be involved to explore the content, validity, and possible deployment of different strategies.

The relationship between technology and the labour market is given a separate place in the research design (RQ7). A literature review will produce a detailed state-of-the-art, which forms the starting point for exploring the conceptual and methodological challenges. We plan to apply the approach developed by Akçomak et al. (2011) to Flemish survey data, and in cooperation with Flemish research and governmental institutes, which will be deploying labour market surveys during the research period, we aim to investigate the possibility to include our new approach in these surveys.

A more detailed overview of the different tasks that will be performed for studying each of the research questions, and of the main methods that will be used, is given in Table 2.

Table 2. Overview of research objectives, research questions, tasks and main methods

RO	RQ	Task	Method
RO1 - Technology and Work Organisation			
	RQ1 - Which human-technology interfaces foster optimized quality of working life and increased performance?		
		Study of alternative technological design options in human-machine interaction that optimize job quality and performance for operators and teams	Literature review Case study
		Evaluation and impact study of the opportunities of the alternative technological design options for autonomy, learning and cooperation of operators and teams	Case study Focus group
		Design of human-machine interface templates and definition of conditions for implementation	Conceptual study Design
	RQ2 - What occupational health and safety approaches contribute to digitized workplaces that generate safe, productive and healthy jobs?		
		Analysis of Industry 4.0 job characteristics and assessment of Occupational Safety & Health implications	Desk research Interview Case study
		Development and testing of an adapted Occupational Safety & Health approach for Industry 4.0	Design Case study
RO2 - Technology, skills and participation			
	RQ3 - What skills are required for Industry 4.0 manufacturing environments?		
		Assessment of the skills debate	Conceptual study Desk research Literature review
		Analysis of T-shaped skills structures in the cases	Case study Design Focus group
		Assessment of T-shaped skills structures in other high-tech environments	Case study
		Integration of skills structures at team and organisation level	Literature review Case study
		Connection of micro and meso to macro: the supporting skills ecosystem	Indicator

	development Statistics Focus group
RQ4 - What social partnerships may enable forms of participation which contribute to technological innovations that foster synergies between quality of working life and organisational performance?	
Theoretical integration and development of conceptual model	Literature review Conceptual study
Test of conceptual model in organisations	Case study Interview
Analysis of forms of participation in innovation in organisations	Survey
Assessment of the feasibility of, and requirements for, new social partnerships in Industry 4.0	Delphi study
SO3 - Organisational and regional strategies	
RQ5 - What is the combined impact of technology, work organisation, skills, and participation, on quality of working life and organisational performance?	
Integration of the Industry 4.0 building blocks	Literature review Case studies Conceptual study
RQ6 - What organisational and regional strategies contribute to the development of 'high road' Industry 4.0 manufacturing environments?	
Identification of possible 'high road' strategies for Industry 4.0 based business models	Desk research Conceptual study Focus group Delphi study
Identification of organisational capabilities for 'high road' Industry 4.0 strategies	Case study Expert panel Survey
Development of a maturity model for interactive robot implementation into new value creation and capturing strategies	Survey Desk research Content analysis

Identification of ecosystem development opportunities and requirements	Conceptual study Expert panel
SO4 - Labor market impact	
RQ7 - What is the labor market impact of technological innovations in terms of organisations, occupations, and tasks?	
Development of a framework for classifying skills, tasks and occupations	Literature review Conceptual study
Test of the framework	Statistics

5. Discussion

The research design that is presented in this paper aims to take the multifacetedness of Industry 4.0 developments into account, and involves multiple levels of analysis, multiple disciplines, multiple methods and multiple stakeholders. This innovative comprehensiveness is the major strength of the research design and is in line with current challenges of Industry 4.0 developments, as explained in Part 2 of this paper. However, we acknowledge that this ambitious design comes with certain risks, which need to be addressed. (1) The involvement of multiple research groups carries the risk that a failure to deliver by one of the research groups (for instance, because of staff turnover) might endanger the entire project. We addressed this issue by designing the research in a modular way, in which the research activities which are performed to answer the various research questions, are only loosely coupled. In such a way, a possible problematic execution of a specific research activity is not likely to have much impact on the other research activities. (2) The use of multiple methods at various levels of analysis may risk leading to fragmented results. For that reason, we formulated a separate research question (RQ5) especially for integrating the results from the study of RQ1, RQ2, RQ3, and RQ4, in order to assess the combined impact of technology, work organisation, skills, and participation, on quality of working life and organisational performance. This integration of insights is then further used as input for studying the research question on organisational and regional strategies (RQ6). As indicated, RQ7, on the relationship between technology and the labour market, was given a separate place in the research design. (3) The valorisation of the research results strongly depends on the commitment of the stakeholders and their willingness to use the research results. This important consideration has led us to give our stakeholders more grip on the project and results than usually is the case in similar projects. As we explained, 16 stakeholders are part of the project board and were thus given the power to influence all major decisions and deliverables of the project. A valorisation trajectory will run parallel to the execution of the research, in order to engage a broad group of stakeholders from industry, social partners, knowledge and education organisations, and policy and support institutions, from the very start of the project.

While it cannot be denied that it will be a challenge to bring this ambitious project to a good end, we believe that, by developing a robust and feasible research design, we provided the project with a strong framework for tackling the research questions, and ultimately, for contributing to a ‘high road’ digital transformation of industry, in Flanders and beyond. This ‘high road’ will need to be built on workplace innovation thinking.

References

Akçomak, I. Semih, Lex Borghans, and Bas ter Weel. 2011. "Measuring and Interpreting Trends in the Division of Labour in the Netherlands." *Economist* 159 (4): 435–82. doi:10.1007/s10645-011-9168-3.

Appelbaum, Eileen, Thomas Bailey, Peter Berg, and Arne L. Kalleberg. 2000. *Manufacturing Advantage. Why High Performance Work Systems Pay Off*. Ithaka: Cornell University Press.

Arntz, Melanie, Terry Gregory, and Ulrich Zierahn. 2016. "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis." *OECD Social, Employment and Migration Working Papers* 2 (189): 47–54. doi:10.1787/5jlz9h56dvq7-en.

Berg, Annette Van den, Yolanda Grift, and Arjen Van Witteloostuijn. 2011. "Works Councils and Organizational Performance." *Journal of Labor Research* 32 (2): 136–56. doi:10.1007/s12122-011-9105-x.

Brussel, Hendrik Van, Joris De Schutter, Herman Bruyninckx, De Man Hugo, Ludo Gelders, Hubert Van Belle, Bram Vanderborght, Joos Vandewalle, Robert Gobin, and Willy Van Overschée. 2016. "Naar Een Inclusieve Robotsamenleving Robotisering, Automatisering En Werkgelegenheid." *KVAB Standpunten*, no. 46: 1–53. http://www.kvab.be/en/standpunten/automation-and-robotisation.

Brynjolfsson, Erik, and Andrew McAfee. 2015. *The Second Machine Age - Work, Progress, and Prosperity in a Time of Brilliant Technologies*. New York - London: W.W.Norton.

Dessers, Ezra, Hubertus J. M. Vrijhoef, Lieven Annemans, Bart Cambré, Steven Dhondt, Johan Hellings, Koen Hermans, et al. 2014. "Towards a Comprehensive Research Design for Studying Integrated Care." *International Journal of Care Coordination* 17 (3–4): 105–15.

Deuse, Jochen, Kirsten Weisner, André Hengstebeck, and Felix Busch. 2011. "Gestaltung von Produktionssystemen Im Kontext von Industrie 4.0." In *Zukunft Der Arbeit*, edited by Erika Zoike, Sven Bungard, Verena Ganske, Franz-Josef Grothaus, Dagmar Hertle, Christian Tewes, Andrea Trümmer, and Karin Kliner, 43–49. Bundesministerium für Wirtschaft und Energie.

Dhondt, Steven, and Geert Van Hootegem. 2015. "Reshaping Workplaces: Workplace Innovation as Designed by Scientists and Practitioners." *European Journal of Workplace Innovation* 1 (1): 17–24.

Dhondt, Steven, Frank Delano Pot, and Karolus O. Kraan. 2014. "The Importance of Organizational Level Decision Latitude for Well-Being and Organizational Commitment." *Team Performance Management* 20: 307–27. doi:10.1108/TPM-03-2014-0025.

Dhondt, Steven, Monique Ramioul, Ezra Dessers, Joris De Schutter, Liliane Pintelon, Wilm Decr, Paul Matthyssens, Wouter Van Bockhaven, Wim Coreynen, and Geert Van Hootegem. 2018. *PARADIGMS 4.0. Building Blocks for a High Road Digital Transformation of Industry. Research and Valorisation Plan*. Leuven: Paradigms 4.0.

European Commission. 2014. "Advancing Manufacturing - Advancing Europe. Report of the Task Force on Advanced Manufacturing for Clean Production (EU)." Brussels. https://ec.europa.eu/digital-agenda/en/news/advancing-manufacturing-advancing-europe-report-task-force-advanced-manufacturing-clean.

———. 2016. "A New Skills Agenda for Europe." Brussels.

EWI. 2017. "Startnota Transitie 'De Sprong Maken Naar Industrie 4.0''.'" Brussels.

Foray, Dominique. 2016. "On the Policy Space of Smart Specialization Strategies." *European Planning Studies* 24 (8). Taylor & Francis: 1428–37. doi:10.1080/09654313.2016.1176126.

Frey, C B, and M A Osborne. 2013. *The Future of Employment. How Susceptible Are Jobs to*

Computerization? Oxford: Oxford Martin School.

Hermans, Maarten, and Monique Ramioul. 2015. "Pathways between Representative Employee Participation and Innovation: A Literature Review." In *European Academy of Management Conference*. Warsaw.

Howaldt, Jürgen, Ralf Kopp, and Jürgen Schultze. 2017. "Why Industrie 4.0 Needs Workplace Innovation - A Critical Essay About the German Debate on Advanced Manufacturing." In *Workplace Innovation. Theory, Research and Practice*, 45–61. Springer International.

HRW. 2016. "Verslag 2016. Digitale Economie En Arbeidsmarkt." Brussel.

Huang, Ming Hui, and Roland T. Rust. 2018. "Artificial Intelligence in Service." *Journal of Service Research* 21 (2): 155–72. doi:10.1177/1094670517752459.

Ittermann, Peter, Jonathan Niehaus, and Hartmut Hirsch-Kreinse. 2015. *Arbeiten in Der Industrie 4.0: Trendbestimmungen Und Arbeitspolitische Handlungsfelder*. Düsseldorf: Hans-Böckler-Stiftung.

Lall, Marta Therese, Eva Amdahl Seim, Hans Yngvar Torvatn, and Gaute A. Johansen Knutstad. 2016. "Flow of Information for Autonomous Operators in Industry 4.0 Factories." In *5h World Confernce on Production and Operations Management P&OM Habana 2016 - 05.09.2016 - 09.09.2016*. Havana.

Leveson, Nancy G. 2011. *Engineering a Safer World: Systems Thinking Applied to Safety*. *Vasa*. Cambridge, USA: MIT Press. doi:10.1017/CBO9781107415324.004.

O'Reilly, Jacqueline, Florian Ranft, and Max Neufeind. 2018. "Introduction. Identifying the Challenges for Work in the Digital Age." In *Work in the Digital Age. Challenges of the Fourth Industrial Revolution*, edited by Max Neufeind, Jacqueline O'Reilly, and Florian Ranft, 1–23. London: Rowman & Littlefield.

Oeij, Peter, Rita Žiauberytė-Jakštienė, Steven Dhondt, Antonio Corral, Peter Totterdill, and Paul Preenen. 2015. *Workplace Innovation in European Companies*. Dublin: Eurofound. doi:10.2806/543283.

Pan, Zengxi, Joseph Polden, Nathan Larkin, Stephen Van Duin, and John Norrish. 2010. "Recent Progress on Programming Methods for Industrial Robots." *Joint 41st International Symposium on Robotics and 6th German Conference on Robotics 2010, ISR/ROBOTIK 2010* 1: 619–26. doi:10.1016/j.rcim.2011.08.004.

Parmiggiani, Alberto, Marco Randazzo, Lorenzo Natale, and Giorgio Metta. 2014. "An Alternative Approach to Robot Safety." *IEEE International Conference on Intelligent Robots and Systems*, no. Iros: 484–89. doi:10.1109/IROS.2014.6942603.

Pfeiffer, Sabine. 2016. "Robots, Industry 4.0 and Humans, or Why Assembly Work Is More than Routine Work." *Societies* 6 (2): 16. doi:10.3390/soc6020016.

Reardon, Christopher, Huan Tan, Balajee Kannan, and Lynn Derose. 2015. "Towards Safe Robot-Human Collaboration Systems Using Human Pose Detection." *IEEE Conference on Technologies for Practical Robot Applications, TePRA* 2015–Augus: 4–9. doi:10.1109/TePRA.2015.7219658.

Reason, James. 1997. *Managing the Risks of Organizational Accidents*. London: Routledge.

Schwab, Klaus. 2018. *Shaping the Fourth Industrial Revolution*. Geneva: World Economic Forum.

Sels, Luc, Sarah Vansteenkiste, and Heidi Knipprath. 2017. *Toekomstverkenningen Arbeidsmarkt 2050 (Werk.Rapport 2017 Nr.1)*. Leuven: Steunpunt Werk, HIVA - KU Leuven.

Sengenberger, W, G W Loveman, and M J Piore, eds. 1990. *The Re-Emergence of Small Enterprises: Industrial Restructuring in Industrialized Countries*. Geneva: International Institute for Labour

Studies.

Siciliano, Bruno, and Oussama Khatib, eds. 2016. *Springer Handbook of Robotics*. Springer International.

Spiegelaere, Stan De, Guy Van Gyes, and Geert Van Hootegem. 2014. "Labour Flexibility and Innovation, Complementary or Concurrent Strategies? A Review of the Literature." *Economic and Industrial Democracy* 35 (4): 653–66. doi:10.1177/0143831X13492831.

Stam, Erik. 2015. "Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique." *European Planning Studies* 23 (9): 1759–69. doi:10.1080/09654313.2015.1061484.

Tshidimba, Didier, and Nicolas Costers. 2015. "Maak u Klaar Voor de Volgende Industriële Revolutie." *Vokawijzer*, no. 38: 35.

Vendrell-Herrero, Ferran, and James R. Wilson. 2017. "Servitization for Territorial Competitiveness: Taxonomy and Research Agenda." *Competitiveness Review* 27 (1): 2–11. doi:10.1108/cr-02-2016-0005.

Vlaamse Overheid. 2015. "Visie 2050: Een Langetermijnvisie Voor Vlaanderen." *Visie2050*. Brussels. doi:10.1017/CBO9781107415324.004.

Weisbord, Marvin Ross. 1992. *Discovering Common Ground*. San Francisco: Berrett-Koehler Publishers.

Wladawsky-Berger, Irving. 2015. "The Rise of the T-Shaped Organization." http://blog.irvingwb.com/blog/2015/12/the-rise-of-the-t-shaped-organization.html.

Zwetsloot, Gerard I.J.M., Pete Kines, Jean Luc Wybo, Riikka Ruotsala, Linda Drupsteen, and Robert A. Bezemer. 2017. "Zero Accident Vision Based Strategies in Organisations: Innovative Perspectives." *Safety Science* 91. Elsevier Ltd: 260–68. doi:10.1016/j.ssci.2016.08.016.

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Revising workers participation in regional innovation systems: a study of workplace innovation programmes in the Basque Country.

Egoitz Pomares

Abstract

The article analyses two workplace innovation programmes from the perspective of regional innovation systems and the design of public policies. In this sense, the programmes are described as political tools that are part of the Science, Innovation and Technology Plan 2020 of the Basque Autonomous Community. The regional perspective and the participation of workers are key matters that acquire relevance within the framework of European smart specialisation policies, as well as for regional development and cohesion.

Keywords: Workplace innovation, programmes, regional innovation system, innovation policy

Introduction

Regions are considered to be decisive for economic growth and social cohesion in the EU. Regional ecosystems are strategic spheres of production capacity and the creation of quality employment. Since the early 1990s, the popularity of the concept of regional innovation (Asheim & Gertler 2005) leads us to consider the region as an adequate scale for the support of innovation-based learning economies Doloreux & Parto 2005). Since 2014 the *Smart Specialisation Strategies*, in particular those that focus on SMEs, are the central core of the EU's regional policy (European Commission, 2012).

Workplace Innovation is a concept with a track record in European politics (Pot et al. 2016). Directly related to the participation of workers due to its origins in sociotechnical systems (STS), the term has been reflected in public policies in the form of tools or programmes that date back to the 1960s.

Today, the participation of workers and promotion by means of programmes have acquired certain relevance in the search for solutions for the simultaneous improvement of productivity and the quality of jobs. Aspects that are directly related to the regional sphere. Given the importance of innovation and micro-factors, regions have become essential spaces for building competitive advantages and, therefore, for the development of territorial strategies (Navarro 2015).

The Basque Country is a good case, due to its high level of political autonomy (Cooke & Morgan 1998), its innovation system (Cooke et al. 2000) and the positive external assessments (OECD 2011; Morgan 2013). As a result, the article presents two programmes to foster the participation of workers in the Basque Country. The article is organised as follows; the first section defines the theoretical framework based on the regional innovation systems and policies. The second section contains different perspectives on the participation of workers in innovation policies. The third section revises the instruments for the design of these types of policies. The fourth section describes the Basque Country's innovation system and the two Participation Programmes. The article concludes with a discussion section, and conclusions and considerations about the orientation and design of these policies within the regional context.

Innovation within the regional context.

The theory of Systems of Innovation (SI) (Freeman 1987; Lundvall 1992) has had a huge influence on the design of policies (OECD 2005, 2011). Based on this theory, innovation is a non-linear interactive process, in which stakeholders interact with a variety of other organisations and institutions. This process is characterised by reciprocity and feedback mechanisms that determine the success of the innovation. Within this theoretical framework regions are considered as important bases of political, economic and social coordination (Lundvall & Borrás 1997: 39), a matter that has acquired relevance in the theoretical, empirical and political field (Asheim et al. 2011).

An approach based on a regional innovation system (RIS) is a strategic instrument for the analysis and implementation of regional innovation policies (Asheim 2007) to the extent that it responds to specific features, challenges and needs in each region (Tödtling & Trippl 2005; Tödtling et al. 2013; Asheim et al. 2013). The RIS has been conceptualised in a limited sense and in a broad sense (Lundvall 1992; Asheim & Gertler 2005). The limited definition mainly includes the R&D functions of universities and research institutes in a top-down model of scientific and technological policies, while the broad definition includes the entire range of organisations of the region's learning and innovation system (Asheim & Gertler 2005).

Similarly, innovation policies can also be classified in a strict or broad sense (see Edquist 1997, 2001; Edquist et al. 2009; Schienstock & Hämäläinen 2001). Traditionally, the goal of the innovation policy has been the development and dissemination of technology, mainly through the production of new products or processes (Lundvall 1992). While according to the strict vision, the policy must have a

fundamentally technological component and is determined from the top down, in a broad innovation policy the process is observed by the interaction that arises from the collaboration between different stakeholders as it adds a variety of sources of knowledge and interactions in organisational processes (Edquist et al. 2009). This means acquiring a conception that transcends R&D policies and technological innovation towards aspects such as organisational learning and innovation (Cooke et al. 2000, Asheim et al. 2003; Lundvall 2004). In other words, an innovation policy with such a broad foundation concurs with the perspective of the innovation system that defines it as an interactive learning system focused on the creation of, among others, social innovations[1] (Lorenz & Lundvall 2006).

The two conceptions of the policy are related to the different forms of innovation (Jensen et al. 2007). The forms of innovation show the differences of the learning and innovation processes in that they indicate the main ways in which companies organise and produce innovations and learning. While the STI (*science, technology & innovation*) form of innovation is of a restrictive nature (offer) and is based on a strategy marked by a scientific drive with a clear technological vocation, the DUI (*doing, using, interacting*) form is market-oriented (demand) and focuses on the development of organisational skills and innovations (Jensen et al. 2007). This is why the limited version of the RIS concurs with the STI innovation form, while the broader definition is associated with the DUI form (Lundvall 2008). However, studies point out the fact that the companies which combine the DUI and STI innovation forms are generally more innovative than companies that focus on just one of the forms (Jensen et al. 2007: 685).

Within this framework, the government is considered to be a core stakeholder (e.g. Borrás & Edquist 2013; Woolthuis et al. 2005). Traditionally, government action has been aimed at solving the market's deficiencies, limiting the action and intervention of public policies for the creation of incentives in R&D (e.g. see Kline & Rosenberg 2010; Metcalfe & Hughes 1993). The (neoclassical) approach downplays the importance of the specific institutional framework in which the innovation is carried out. Starting with the interactions between stakeholders and institutions, the theory of SI has identified others as a starting point in the design of regional innovation policies (Tödtling & Trippl 2005).

According to certain studies (Edquist 2001; Borrás et al. 2009; Chaminade & Edquist 2006) innovation policies must be designed to respond to specific problems, which correspond to the deficiencies of the innovation system. These problems have been classified into two types; as errors in the interaction of the system's components or as errors derived from the operation of the system (Woolthuis et al. 2005; Chaminade & Edquist 2006). In this article we will focus on matters related to the former.

The approach of the broad innovation policy (see Edquist et al. 2009) involves, in addition to the technological focus, the inclusion of other innovations. In line with these arguments Piirainen & Koski (2003; 2004: 320-322) identify three approaches in innovation policies; the traditional approach, the reduced systemic approach and the broad systemic approach. Based on this classification, differences in five aspects of the innovation policies are established. These aspects include features that range from the policy's objectives, the national/regional competitive base, the innovations pursued or desired, the justification for the public intervention and the activities associated with the innovation. This approach can be summarised as follows:

- The objective of the *traditional innovation policy* is to generate economic growth via the promotion of technological advances and support for linear scientific policies.

[1] Social innovations have been conceptualised in the literature as "organisational innovation" (Hage 1999; Lam 2004), "workplace innovation" (Totterdill 2010; Pot 2011), and "social innovation at the workplace " Eeckelaert et al. 2012). A broader study on the concept can be found in *Workplace innovation: Theory, research and practice* (Oeij et al. 2017)

- The objective of the *narrow systemic innovation policy* includes aspects related to the dissemination of technology, considering innovation due to its interactive nature.
- The *broad systemic innovation policy* bases the justification of the intervention on the weaknesses and deficiencies of the system, meaning that its objective is to promote aspects such as innovation, growth, cohesion and social well-being.

Similarly, it has been argued that (technological and industrial) policies should be designed broadly to take into account the social context, as the learning process is conceptualised as "an interactive and socially integrated process" (Lundvall 1999: 20).

The change from a narrow innovation policy to a broader one is a change in many aspects. The examples of how to integrate the users in the innovation processes by means of innovation policies are therefore scarce. Some of them can be found in public programmes and policies oriented towards the promotion of participation; in particular models characterised as divergent from traditional designs (Arnkil 2004; Arnkil et al. 2010), such as the case of Finland, where the government's role in the development of the workplace and in the innovation policy has been stronger than in other European countries (Alasoini 2016: 69).

Participation in the context of innovation policies.

In a scenario dominated by robotisation, automation and digitalisation, innovation policies in a broad sense must, in addition, facilitate the adaptation of workers by generating a collective learning process in an inclusive and participatory manner. This would be based on an interactive or recursive innovation model, including a relatively large number of workplaces, R&D units and other stakeholders in a permanent interaction with a long-term view (Alasoini 2006).

In general terms, the participation of workers has been conceptualised from two perspectives. The first refers to an integrating vision, the main argument for which is found in the effects of participation on efficiency. This approach is understood as a tool, a style and management technique used to persuade workers who participate in the achievement of the company's objectives and goals. The second corresponds to a critical paradigm of the Taylorist organisation of work, and seeks a balanced decision-making power between work and capital (industrial democracy) (Lahera 2004).

The participation of workers mainly comes in two forms; direct participation and indirect participation (carried out by means of representatives). The combination of both forms of participation has been conceptualised as the *employee voice* (Boxall & Purcell 2011).

Despite the importance of the traditional forms of representative and direct participation, the participation of workers in processes and in decision-making that is strategic for the organisation is decisive, in particular within the context of rapid technological change, as a method to create novel solutions (Alasoini 2012: 262). Aside from the differences between one form and the other, the term participation is understood here in a broad sense; in other words, as the different institutions and organisations, forms, levels and mechanisms by which employees directly and/or through representatives can influence matters related to the organisation of work and which have an impact on the operation and decision-making of a company.

Pot (2011) defines this type of participation as “new and combined interventions in the fields of work organisation, human resource management and supportive technologies”. In this sense, there is a large amount of academic literature that classifies the new forms of workplaces identified as “innovative, high-performance, new, or flexible” (Bauer 2004). Despite the differences in the terms, the transformation from a hierarchical type of organisational culture to more flexible structures and horizontal relationships of power are at the core of the concept of workplace innovation. However, Alasoini stresses that "the concept is not limited to the adoption of a ready-made set of ‘high-

performance' work practices, but refers to collaboratively constructed changes in a company´s organisational and management practices that lead to simultaneous improvements in productivity (e.g. work productivity, product quality, process flow) and quality of working life (e.g. opportunities for development and the influence of employees on the work, employee well-being) and that also supports other types of innovation" (Alasoini 2011: 25).

Alasoini argues that in the industrial relations-based policy and in the science and technology-oriented innovation policy, the participation of workers has been approached as a method for the adoption of new solutions developed jointly by the management and external experts (Alasoini 2011). The broad participation of employees in innovation activities within companies must be backed by management processes and practices that are based on management principles different to those used in the Taylorist work organisation model (Alasoni 2012; Cressey et al. 2013). The author argues that limiting participation to the adoption of specific management and organisation practices can be considered as corrective measures for problems derived from technological change, production and organisation models (Alasoini 2004, 2005; Alasoini et al. 2005).

Table 1: different policy rationales on participation

	Industrial relations-based workplace development policy	**Science and technology-oriented innovation policy**	**Broad-based innovation policy**
Forms of participation	Direct and representative participation	Direct and representative participation	*Workplace Innovation*
Typical objects of participation	Work tasks, work organisation and working conditions	New products and processes	New products, services, processes, business models, work organisation, etc.
Rationale of participation	Employees have the right to participate through delegation, consultation, hearing or having access to relevant information. Collaboration between management and employees improves the quality and novelty value of new solutions.	Participation helps overcome employee resistance to the adoption of new solutions. Adapt solutions, developed jointly by management and experts, to better suit local conditions by giving employees an opportunity to implement small adjustments.	Participation is a key success factor in complex environments where networking, fast renewal and innovation are central competitive factors. Generates collective learning and reinforces a sense of inclusiveness among employees in connection with rapid changes.

Source: Alasoini 2013.

Alternatively to this perspective, the participation of workers from the viewpoint of a broad policy surpasses the traditional vision of industrial relations and the activity of technology-oriented innovation, incorporating workers as key factors of the competitiveness of organisations and including workers in innovation activities as a factor that supports the quality of work, respectively (Alasoini

2012: 256). From this approach Alasoini (2016: 99) argues that the strategies of the programmes must include 1) elements that help to improve productivity and QWL simultaneously at a micro (e.g. local and regional organisations) and macro levels (e.g. the regional level), and, 2) elements that facilitate the construction of bridges between the micro and macro levels.

From the perspective of regional development, Totterdill (1999: 28) argues that a workplace innovation-based competitiveness model involves an alternative approach with respect to participation and the organisation of work. Thus the importance of regions lies in their ability to act as focal points, therefore, of their capacity to unblock their own innovation resources. This aligns with the concept of regional innovation ecosystems (Isenberg 2010; Stam 2015) that focus on the creation of a production system. This perspective would lead to solutions to problems, which are partly subject to limitations related to the participation of workers in processes of change and innovation and the ways in which work is organised. Limitations that have to do, at least partly, with the lack of coalitions for learning-oriented cooperation (Ennals & Gustavsen 1999) and which affect the regional sphere (Fricke & Totterdill 2004). Here, the regional system is considered to be "the intellectual framework to guide public action" (Coenen & Asheim 2006).

As a result, the links between the organisation of work and the dynamics of innovation at a company level (and other sectoral, regional and national innovation systems) can influence the improvement of the innovation capacities of workers (Fricke 1983) and the transformation of ideas into new products and processes (Arundel et al. 2007) through workplace innovation.

Policies, Programmes and Public intervention.

A form of public intervention for the generation of workplace innovation is carried out by means of designing public policies. Specifically, through "a set of techniques by which governmental authorities wield their power in attempting to ensure support and effect or prevent social change", also called instruments (Vedung 1998: 2). In general, the instruments are divided into three groups; as regulations, economic transfers and soft instruments (e.g. Borrás & Edquist 2013). Soft instruments our distinguished from the others due to their voluntary and non-coercive nature, where public and private stakeholders establish forms of cooperation that are not strongly hierarchical and where there is a mutual exchange of information (Borras & Edquist 2013: 1516). This is why the instruments are recurrent, due to their usefulness when the diversity of stakeholders and the complexity of the intervention subjects is high (Trubek & Trubek 2005), or to guide learning processes and experimentation in the design and implementation of public policies.

In Europe, as regards participation, public intervention has not always led to legislative reforms, but rather to soft forms of regulation (Forsyth et al. 2006; Trubek & Trubek 2005; Alasoini 2008; Alasoini et al. 2017). Thus, a programme is ideally identified as a soft instrument of political intervention. From an institutional perspective, programmes are understood as an activity with a set duration (Alasoini 2011: 30). This means orienting research towards the institutional separation (Alasoini 2008) between jobs and the innovation policy.

Conceptually, programmes are characterised by 1) simultaneously gathering a broad range of organisations within a defined time frame, 2) the agreement on the content of the framework between the workers, the employees and other stakeholders (social agents, research, education, government). And 3) that the participants in the programme are committed to the exchange of information and cooperation (interaction) (Alasoini 2008: 63).
The programmes, as instruments to obtain workplace innovation, can be considered as production systems and development systems. In their ideal form, the programmes must be capable of renewing

themselves (learning from the programme) and of contributing towards improving the activities of the programme within a broader context (learning of policies) (Alasoini 2016: 53). As a production system, a programme must produce results in productivity and QWL at micro and macro levels (Alasoini 2016: 83-84), while, as a development system, a programme must generates learning at the level of programmes and at the level of public policy. From this approach, Programmes as the instruments of public policies have raised interest, in particular in relation to the impacts of technological change derived from digitalisation, robotisation and the automation of work processes and the way these challenges are tackled through the modernisation of socio-economic institutions (Pérez 2004; Freeman & Perez 1988) and the role of the Public Administration (Mazzucato 2014).

The regional approach in the Basque Country.

The participation of workers has acquired relevance in the political agendas of the Basque Country. Most of the arguments in favour of the participation of workers are currently based on aspects that link the increase in business competitiveness with higher levels of organisational innovation.

An interesting example in the search for solutions are the worker participation programmes promoted by the Government of the Basque Autonomous Community (NUTS2) and the Provincial Government of Gipuzkoa (NUTS3) implemented starting in 2013. Both are included as instruments to support innovation in the STI Plan.

The next section summarises the innovation policy of the Basque Autonomous Community and its evolution and describes the participation-based promotion programmes. According to the aims of this article, the focus is on participation in terms of workplace innovation and leaves out of its scope of analysis other programmes to foster the social economy or co-operativism.

Background

The evolution and track record of the Science, Technology and Innovation policy in the Basque Country dates back to three decades ago, in the 1980s, and is characterised by its continuity (OECD 2011: 42). The institutional configuration of the Basque Autonomous Community, its self-government capacity, the regime of competences transferred from the Spanish central Administration and the characteristic fiscal decentralisation in the provinces it is comprised of, make the region a holistic case study within the framework of regional public policies (Navarro et al. 2013).

The development of the policies and the evolution of the STI System can be structured into three phases. The decade of the 1980s is defined by the constitution of the Government of the Basque Autonomous Community after the end of Franco's regime and focuses on the industrial reconversion of the Basque economy. This phase has its greatest exponent in the creation of technology centres that reaches its highest point with the creation of the Network of STI Agents in 1997.

All this leads to a subsequent phase, focused on improving the efficiency of Basque companies, fostering non-R&D-based diversification and internationalisation in the late 1990s. During this period, known as the combined offer and demand policy, efforts focus on the consolidation and concentration on priorities in technological knowledge and innovation among the main business and social stakeholders.

During the 2000s, the third phase, the system evolves towards an approach of innovation and science-driven industrial diversification, known as the results-oriented policy, whose main objectives were aimed both at the diversification of the business fabric and at achieving results in terms of science, technology and innovation (Valdaliso 2015). During this phase the Basque STI Council was created

(2007), as the body for participation in STI policies, comprised by the Basque Government and the three provincial (sub-regional) administrative institutions.

Innovation strategies and policies in the Basque Country have prioritised an R&D-based technological policy model, with a clear industrial orientation in comparison to other non-R&D-based scientific or innovation models. In general terms, the innovation strategy and policy has been more focused on offer (creation of infrastructures) than on demand (absorption capacity of companies). This results in low levels of organisational innovation. Part of these deficiencies have been associated with the difficulty to create learning spaces in workplaces (Orkestra 2015: 24) and with the governance structure of companies (Navarro 2010a).

The STI Plan

With the arrival of the new plan (PCTI 2020[2]) in 2014, which includes the Smart Specialisation Strategy promoted by the European commission. As such, the Plan focuses on three strategic priorities (Advanced Manufacturing, Energy, Biosciences/Health) that are implemented in six objectives, one of them in particular based on an increase in the number of innovative companies. The objective of the Plan is expressed as follows:

> *"To improve the well-being, sustainable economic growth and employment of Basque society by means of a research and innovation policy based on smart specialisation and on the improvement of the efficiency of the Science, Technology and Innovation System (STI Plan 2020)".*

In the new strategy, business innovation is of a cross-cutting nature. The low levels of technological and non-technological innovation and the failure to achieve the objectives of the previous 2015 Plan contextualise the framework for the instruments to support the innovation ecosystem of the new STI plan in the 2020 horizon. As regards the levels of non-technological innovation, it should be mentioned that the levels, far from improving, fall during the period (2010-2015) of the preceding plan (STI Plan 2020).

The STI Network

From the point of view of the components of the system, the Basque Administration has carried out a policy that has been strongly mediated by the activity of technology centres. But with the adoption of the new plan, the Network of STI agents (2015) has been reorganised, and there is a restructuring of the public expenditure started in 1990. Based on this re-orientation, problems (offer and demand) are identified, such as the lack of specialisation and research capacity and the lack of absorption capacity of companies (Navarro 2010b; Valdaliso 2010). After the change, the Network[3] is structured by 120 organisations that comprise the regional innovation system in three sub-systems; scientific and university (universities and research centres of excellence); technological innovation and development (technology centres, certification and laboratory entities, company R&D units, healthcare R&D units, etc.); and support for innovation (technology parks, intermediaries, etc.).

As for companies, the Basque administration implements an indirect support policy, by means of developing infrastructures (provision of technology), not directly oriented towards the improvement of

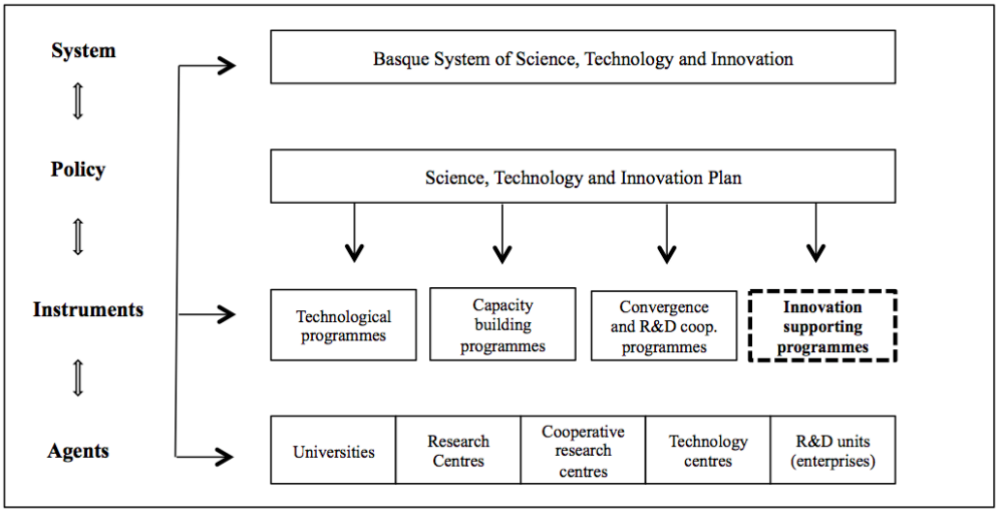
[2] http://www.euskadi.eus/contenidos/informacion/pcti_euskadi_2020/es_def/adjuntos/pcti_libro_en.pdf

[3] According to the assessments carried out (Morgan 2013), the Basque country is considered to be a European region with a high level of institutional thickness (Amin & Thrift 1995).

absorption capacities (Navarro 2010b). The analysis of the economic production fabric for the 2010-2015 period describes a "pattern of innovation oriented towards the development of technological innovation (characterised by high R&D expenditure, innovation oriented towards new products and processes and a significant profile of STI collaborations), of a markedly incremental nature (development of products that only represent a novelty for the company), with the characteristic effects of an operation strategy in the company (that is, it increases the quality of the current product or increases the product range), repetitive over time and concentrated in medium and large companies (with more than 50 workers)" (Orkestra 2017: 78-79).

The instruments (policy mix)

The instruments included in the Plan (see picture 1) range from programmes for technological upskilling, to the generation of skills, the convergence of skills and cooperation in R&D and support for innovation. The main beneficiaries of the instruments are companies (strengthening of technological and innovative skills) and the agents of the Network (reinforcement of scientific and technological skills). The instruments grouped in the above categories consist of support programmes and services for companies, as well as for agents in the R&D value chain.



Picture 1: Policy mix instruments contained in the STI Plan
Source: Basque Government – STI Policy mix instruments.

As pointed out, interest in participation in the design and orientation of the policies is marked by the weakness of the innovative capacity of Basque companies. The analyses carried out associate the lack of adjustment between the innovation input and the impact of the innovation with the lack of adequate organisational models for the exploration and exploitation of knowledge (Orkestra 2017: 78-79).

Within this context, during the 2013-2014 period some participation programmes were launched in the Basque Autonomous Community, defined as support instruments within the policy mix of the STI Plan. The next point describes two approaches; a regional programme (RP) and a sub-regional or provincial level programme (SP) oriented towards the promotion of participation and an increase in business innovation.

The programmes: two approaches to the promotion of participation.

It should be clarified that although the two programmes are included as instruments to support the

policy mix of the STI Plan, the origin and design come from Administrations at different administrative-territorial levels. The regulatory competences for innovation are at an Autonomous Community level; however, the STI Plan is governed by the Basque STI Council, where the government of Gipuzkoa (with a sub-regional scope) participates. On the other hand, even though the SP instrument is incorporated as an instrument to support the plan, its origin is in the territory's social economic development policy (one third of the Autonomous Community). A more detailed analysis of these and other implications, such as multilevel governance, have been developed in some analyses (Pomares 2018; Pomares et al. 2016).

In general terms, the central idea of both programmes consists of expanding the objective of the innovation policy, focusing on positive results derived from technological and non-technological innovations. In both cases, the RP and SP programmes are defined by the use of concepts such as workplace innovation, participation, social innovations, non-technological innovations, organisational process innovations and organisational innovations, in line with those used in other models of European programmes (Business Decisions Limited 2000; Brödner & Latniak 2003; Eeckelaert et al. 2012; Oeij et al. 2017).

A reasoning that underlies both Programmes is that, although they are contextualised within a framework to foster endogenous development and an increase of the levels of business innovation, the issue of the relocation of the decision-making centres of companies is recurrent in the narratives that support participation (in particular participation in the capital or financial participation, also promoted by both programmes by means of deductions or tax incentives).

The Regional Programme (RP) and the Sub-regional Programme (SP).

The Regional Programme (RP) started its activity in 2014 and has its origins in the policies of the Department of Competitiveness (Basque Government) and the business development Agency (SPRI). The programme also includes the participation of the three provincial Administrations that comprise the Basque Country. The geographical scope of this programme is the Basque Autonomous Community and is of a sectoral nature due to its origin in the Industry Plans (2014-2016). This programme limits participation to companies with industrial activities and with 10 employees.

This annual programme is mainly aimed at companies, by financing the preparation of diagnoses, the design of plans and their follow-up in financial participation, management and results projects. The programme establishes a prior diagnosis as a condition, an activity that can be carried out internally or by hiring external experts. This approach has its origin, as has been indicated, in the high percentage of companies with certification systems in advanced management or total quality models (TQM).

Table 2: Objectives of the Programmes

Objectives	Regional Programme (RP)	Sub-regional Programme (SP)
Programme-level	To support the development of competitive improvement activities in companies through actions aimed at the participation of Company workers.	To promote the grounding, continuity and competitiveness of companies through the co-responsible, active and effective participation of all the people in the company.
Generative level	Limited to individual projects; not oriented towards the dissemination of new practices, models, etc...	It considers dissemination and expansion as one of the main activities of the Programme
Workplace level	To improve the capacity of sectoral organisations through the preparation of individual projects based on diagnoses, plans and the implementation of participative organisational models.	To increase the number of organisations with participative models through individual projects in cooperation and/or as a network through R&D, its expansion and dissemination.

Source: own elaboration

The Sub-regional Programme (SP) starts its activity in 2013 and is created by the Department of Economic Promotion (Provincial Government of Gipuzkoa). Its geographical scope is provincial/sub-regional and is based on the territorial socio-economic development policy. Unlike the regional programme, it does not establish sectoral limits over the type of activity or the number of employees, and considers other social, economic, education and production agents as stakeholders. The programme finances R&D activities and projects, in addition to the expansion and dissemination of the resulting experiences.

Table 3: WPI programmes as policy instruments contained in the STI Plan

Name of the instrument	**Innobideak Pertsonak (RP)**	**Participation Programme (SP)**
Scope	Regional (NUTS2)	Sub-regional / Provincial (NUTS3)
Category of the STI Instrument	Support for the business innovation ecosystem	Support for the business innovation ecosystem
Department in charge	Department of Economic Development and Competitiveness - Basque Government.	Department of Economic Promotion - Provincial Government of Gipuzkoa
Origin	Industrialisation Plan 2014-2016	Commitment to the Territory / Commitment to People strategy
Description	To promote the participation of workers in the company to improve competitiveness and social cohesion.	To promote experimentation and intervention in formulas of organisational innovation.
Forms of participation promoted	Participation in Management Participation in Results Participation in Ownership	Participation in Management Participation in results Participation in Ownership
Types of Projects	Individual projects	Individual, in cooperation or in a network
Types of activities	Initial Diagnosis Design of Plans Accompaniment	R&D Projects Diffusion project
Size of Companies	More than 10 workers	No requirements
Participants	Companies (extractive industrial, processing, production, technical services linked to the production processes of the aforementioned and from the field of the information and communication society).	Companies and business associations Trade union organisations STI Network Agents Strategic entities of an educational, economic-social, local and/or regional nature
Types of services provided	Co-financing (50%)	Total financing in R&D projects Partial financing (75%) in expansion and dissemination projects

Source: Basque Government, own elaboration

The main difference between the two programmes is found in the type of project and the types of stakeholders that are eligible. While in the regional sphere the programme finances diagnosis processes, the preparation of plans and monitoring companies mainly from the industrial sector, in the sub-regional sphere the programme promotes R&D projects, the expansion and dissemination of business organisations, and other types of agents of the innovation system. This difference has an impact on the type of activity financed; while at the regional level only individual projects in workplaces are considered, the sub-regional programme extends financing to projects in co-operation with other organisations (social, economic, educational, strategic) and/or companies, as well as for the creation of networks.

Both programmes have their own particular designs and orientations. The RP has a limited scope due to its sectoral nature, limiting participation to individual projects that must follow a diagnosis-based logic, the preparation of plans and their implementation. The participation of education, social or research agents is not possible, and the programme does not establish mechanisms or instruments that make the dissemination of the knowledge generated possible.

With a broad orientation, in that it includes a wide variety of stakeholders (universities, vocational training centres, trade unions, business associations, STI network stakeholders) in the development of individual projects, in co-operation or as a network, the RP guides the activities towards research and the development, dissemination and expansion of the knowledge generated within the framework of the programme.

Discussion

Based on the different approaches to the innovation systems revised, the Basque innovation system can be classified as traditional. The participation of workers as an element to seek innovative solutions to the organisation of work has acquired certain relevance and visibility in the Basque Country starting in the 2010s. However, in the early 1990s, the organisational structure of Basque companies was simple due to the employment size. The evolution and changes in the organisation of work in organisations of the Basque Country has been incentivised, in particular by the ISO certification systems and *European Foundation Quality Management* (EFQM). This evolution took place in particular from 1992 onwards, with the creation of the Basque Foundation for Quality (Euskalit). Starting in 2010, the region is at the lead with the highest number of awarded companies in the European scoreboard. Similarly, it takes place with the proliferation of Corporate Social Responsibility strategies adopted by companies, particularly due to their perception and assessment as an instrument for the improvement of social commitment and relations with employees, which has its impact (Unceta & Gurrutxaga 2005).

The incorporation of new technologies, the higher intensity in R&D and changes in the markets are identified as the main causes among company directives (1996-2001) behind the changes in organisation and management structures, management tools and techniques and the human resource base of companies. In the early 2000s, there is an increase in practices such as ISO 9000 quality management systems, occupational risk prevention plans, diagnosis and training plans, competitor analyses, customer satisfaction surveys, mission and vision definitions, treasury management systems, 5s and continuous improvement (Lahera 2004; Valdaliso 2010; Guler et al. 2002). The type of practices offers an idea of the type of rhetoric and the management style of directives (Barley & Kunda 1992; Abrahamson 1996) used during the period described.

The field studies carried out at machine-tool companies show that the adoption of new forms of work organisation are carried out, mainly, based on regulations and work procedure descriptions designed in technical offices, demonstrating the absence of use of participative forms (carried out directly or by means of representatives) (Lahera 2004).

Although the Basque Country has a tradition, shown through the co-operative experience of Mondragon (MCC) and its broad social capital as a foundation for high levels of co-operation (business to business and business to technology centres), the participation of workers from the perspective of workplace innovation or organisational innovation has barely been studied. Most of the improvements in working conditions have been related to the production capacity model and to collective bargaining.

The Basque Country has been a region rich in negotiation, particularly in the industrial sector. However, recent labour reforms, in particular that of 2012, change this situation; workers covered by an agreement negotiated In the Basque Autonomous Community, after lodging complaints and the non-renewal of the agreement, go on to depend on a state-level agreement or find themselves without the coverage of any agreement at all. According to the Basque Council of Labour Relations[4] (2017) during the 2011-2017 period, state-level agreements have grown in terms of coverage (affected workers) by 20%, while during the same period the agreements recorded in the Basque Autonomous Community fell by 35%. In addition, most of the agreements relinquished from 2013 onwards are particular agreements recorded in the Basque Country (Consejo Vasco de Relaciones Laborales 2017).

As for non-technological innovations (organisational and marketing), the indicators[5] of the *Regional Innovation Scoreboard* 2017 show that the percentage of innovative Basque companies in these fields is still low in the regional European scoreboard. Navarro (2010a) points to evidence about forms of work organisation based on *constrained learning* models (Lorenz & Valeyre 2005), as opposed to the forms based on *discretionary learning*, more typical of the more innovative regions at levels higher than the regional sphere (NUTS 1). Huerta & García (2004), quoted in Navarro 2010a, point to the culture of quality and the inertia of old organisation models as an obstacle for the emergence of new ways of organising work.

Conclusions

As we have seen, one of the weaknesses of the Basque system is in the low levels of organisational innovation. One way to improve the absorption capacity of regional companies could be through programmes to change the governance and control structures of organisations (Navarro 2010a). Establishing the focus of innovation on companies and workers by means of programmes can lead to effects on the creation of institutions to search for solutions capable of generating improvements in the productivity and quality of work, and the creation of bridges among the different knowledge bases available in the region.

Faced with these matters, it seems necessary for the Administration to not only foster and promote them, but also to learn how to develop horizontal and participative public policies with the stakeholders of the innovation system. The programmes represent institutional frameworks which can contribute towards transforming organisational models through public entrepreneurship, insofar as are capable of attracting a critical number of stakeholders and organisations in a research, co-operation, information exchange and regional interaction process (Fricke & Totterdill 2004). It is therefore important to consider the gaps of political knowledge, and to explore in more depth issues such as the design, process and dissemination of workplace innovation;

- Design knowledge refers to the ability to explore the current and future scenarios of

[4] The Basque Council of Labour Relations is a public institution created as a body for permanent dialogue and meetings between the trade union and business confederations and as a consultant body for social and occupational matters for the Basque Government and Parliament. It is participated by the most representative trade unions and business associations.

[5] https://ec.europa.eu/docsroom/documents/24186

companies;
- Process knowledge means helping companies to find adequate ways to implement participative processes of change on the foundation of theories or models of change and development intervention;
- Dissemination knowledge is useful to support the transfer and dissemination of experiences and processes of change and intervention for the benefit of the stakeholders that do not participate in the projects (Alasoini 2011: 30-38).

Understanding the programmes as an institutionalised activity (Alasoini 2011) means building spaces for learning and cooperation that can bring together a critical mass of organisations and stakeholders (Ennals & Gustavsen 1999) as a source for the production of innovations in learning based on the design of instruments and public policies with a social impact (Lundvall 1999).

References

Abrahamson E. (1996). "Management fashion". *Academy of Management Review*, 21(1), 254-285.

Alasoini T. (2004). "The new Finnish workplace development programme (TYKES-FWDP) as an approach to innovation". *Concepts and Transformation*, *9*(3), 279-295.

Alasoini T. (2005)." Learning networks as creators and disseminators of generative ideas". *The Finnish Workplace Development Programme as an expanding activity*, 136.

Alasoini T. (2006). "In search of generative results: a new generation of programmes to develop work organization." *Economic and industrial democracy*, 27(1), 9-37.

Alasoini T. (2008). "Building better programmes: learning networks in the promotion of workplace innovation". *International Journal of Action Research*, 4(1+ 2), 62-89.

Alasoini T. (2011). "Workplace development as part of broad-based innovation policy: Exploiting and exploring three types of knowledge." *Nordic journal of working life studies*, 1(1), 23-43.

Alasoini T. (2012). "A New Model for Workplace Development in Finland. Rethinking Employee Participation and the Quality of Working Life in the Context of Broad-based Innovation Policy". *International Journal of Action Research*, 8(3).

Alasoini T. (2013). "Rethinking employee contribution: A framework for promoting employee-driven innovation". *In Proceedings of the 8th European Conference on Innovation and Entrepreneurship ECIE* (pp. 9-16).

Alasoini T. (2016). *Workplace Development Programmes as Institutional Entrepreneurs-Why They Produce Change and Why They Do Not.* (Doctoral Dissertations, Aalto University, 12/2016)

Alasoini T., Ramstad E. & Rouhiainen N. (Eds.) (2005), *The Finnish Workplace Development Programme as an Expanding Activity. Results, Challenges, Opportunities*, Tykes Reports 47, Ministry of Labour, Helsinki.

Alasoini, T., Ramstad, E. & Totterdill, P. (2017). "National and regional policies to promote and sustain workplace innovation." In *Workplace Innovation* (pp. 27-44). Springer, Cham.

Amin A., & Thrift N. (1995). *Globalization, institutions, and regional development in Europe.* Oxford University Press.

Arnkil R. (2004). "The Finnish workplace development programme: A small giant?". *Concepts and Transformation,* 9(3), 249-278.

Arnkil R., Järvensivu A., Koski P. & Piirainen T. (2010). "Exploring the quadruple helix". *Report of quadruple helix research for the CLIQ project*.

Arundel A., Lorenz E., Lundvall B. Å. & Valeyre A. (2007). "How Europe's economies learn: a comparison of work organization and innovation mode for the EU-15"". *Industrial and corporate change*, 16(6), 1175-1210.

Asheim B. (2007). Differentiated knowledge bases and varieties of regional innovation systems". *Innovation*, 20(3), 223-241.

Asheim B. T., & Gertler M. S. (2005). "The geography of innovation: regional innovation systems". In *The Oxford Handbook of Innovation.* Oxford University Press, Oxford.

Asheim B. T., Smith, H. L. & Oughton C. (2011). "Regional innovation systems: theory, empirics and policy." *Regional studies*, 45(7), 875-891.

Asheim B., Isaksen A., Nauwelaers C. & Tödtling F. (Eds.) (2003). *Regional Innovation Policy For Small–Medium Enterprises*. Edward Elgar, Cheltenham.

Asheim B.T., Bugge M. M., Coenen L. & Herstad S. (2013). "What does evolutionary economic geography bring to the policy table? Reconceptualising regional innovation systems." *Papers in Innovation Studies*, 5.

Barley S. R., & Kunda G. (1992). "Design and devotion: Surges of rational and normative ideologies of control in managerial discourse." *Administrative Science Quarterly*, 363-399.

Bauer T. K. (2004). "High performance workplace practices and job satisfaction: Evidence from Europe". *Institute for the Study of Labor Discussion Paper 1265.*

Borrás S., & Edquist C. (2013). "The choice of innovation policy instruments." *Technological forecasting and social change*, *80*(8), 1513-1522.

Borrás S., Chaminade C. & Edquist C. (2009). "The challenges of globalization: strategic choices for innovation policy. The Innovation Imperative: *National Innovation Strategies in the Global Economy*, 7-23.

Boxall P., & Purcell J. (2011). *Strategy and human resource management.* Macmillan International Higher Education.

Brödner P. & Latniak E. (2003). Sources of innovation and competitiveness: National programmes supporting the development of work organisation." *Concepts and transformation*, 8(2), 179-211.

Business Decisions Limited (2000) *Government Support Programmes for New Forms of Work Organisation: A Report for DG Employment & Social Affairs*. Luxembourg: Office for Official Publications of the European Communities.

Chaminade C. & Edquist C. (2006). "From theory to practice: the use of the systems of innovation approach in innovation policy". *Innovation, science, and institutional change*, 141-160.

Coenen L. & Asheim, B. (2006): "Constructing Advantage at the Northern Edge", in Cooke P. & Piccolug A. (eds.), *Regional Development in the Knowledge Economy,* Routledge, 84-111.

Consejo Vasco de Relaciones Laborales (2018). Situación económica y relaciones laborales en la CAPV 2017. Accedido el 20 de marzo, 2019 en: http://www.crl-lhk.eus/images/infSociolaboral/Anual/Informe_sociolaboral_CRL_2017.pdf

Cooke P., Boekholt P. & Tödtling F. (2000). *The Governance of Innovation in Europe*. Pinter, London.

Cressey P., Totterdill P. & Exton R. (2013). "Workplace social dialogue as a form of' productive reflection". *International Journal of Action Research*, 9(2), 209.

Doloreux D. & Parto S. (2005). Regional innovation systems: Current discourse and unresolved issues. *Technology in society*, 27(2), 133-153.

Edquist C. (1997). *Systems of innovation: Technologies, organisations and institutions*. Pinter, London.

Edquist C. (2001). "The Systems of Innovation Approach and Innovation Policy: An account of the state of the art". In *DRUID conference, Aalborg* (pp. 12-15).

Edquist C., Luukkonen T. & Sotarauta M. (2009). "Broad-based innovation policy", in Evaluation of the Finnish National Innovation System - Full report. (Taloustieto Oy, Helsinki University Print: Helsinki) 11-54

Eeckelaert L., Dhondt S., Oeij P., Pot F. D., Nicolescu G. I., Webster J. & Elsle, D. (2012). *Review of workplace innovation and its relation with occupational safety and health.* Bilbao: European Agency for Safety and Health at Work.

Ennals R., & Gustavsen B. (1999). *Work organization and Europe as a development coalition* (Vol. 7). John Benjamins Publishing.

European Commission. (2012). *Guide to research and innovation strategies for smart specialisations (RIS3)*. Brussels: European Union. May 2012.

Forsyth A., Gahan P. G., Howe J. & Mitchell R. (2006). *Regulating for innovation in workplace production and employment systems: A preliminary discussion of issues and themes.*

Freeman C. (1987). *Technology policy and economic policy: Lessons from Japan*. London: Pinter.

Freeman C. & Perez C. (1988). *Structural crises of adjustment: business cycles. Technical change and economic theory*. London: Pinter.

Fricke W. (1983). "Participatory research and the enhancement of workers' innovative qualifications." *Journal of occupational behaviour*, 73-87.

Fricke W. & Totterdill P. (Eds.). (2004). *Action research in workplace innovation and regional development (Vol. 15).* John Benjamins Publishing.

Gobierno Vasco (2014). Plan de Industrialización 2014-2016. *Gobierno Vasco.—(2013): Plan de Internacionalización Empresarial, 2016*.

Gobierno Vasco (2015). PCTI Euskadi 2020: Una Estrategia de Especialización Inteligente.

Guler I., Guillén M. F. & Macpherson J. M. (2002). "Global competition, institutions, and the diffusion of organizational practices: The international spread of ISO 9000 quality certificates." *Administrative science quarterly*, 47(2), 207-232.

Huerta E. & García C. (2004). *La innovación tecnológica y organizativa en la empresa industrial vasca*. SPRI y Universidad Pública de Navarra.

Isenberg D. J. (2010) "How to start an entrepreneurial revolution", *Harvard Business Review,* 88(6), pp. 41–50.

Jensen M.B., Johnson B., Lorenz E. & Lundvall B.A. (2007) "Forms of knowledge and modes of innovation." *Research Policy* 36, 680-693.

Kline S. J. & Rosenberg N. (2010). "An overview of innovation." In *Studies On Science And The Innovation Process: Selected Works of Nathan Rosenberg* (173-203).

Lahera A. (2005). Enriquecer el factor humano. Paradigmas organizativos y trabajo en grupo, El Viejo Topo, Madrid.

Lahera A. (2004). La participación de los trabajadores en la democracia industrial (Vol.

Lorenz E. & Lundvall B. Å. (Eds.). *(2006). How Europe's economies learn: coordinating competing models.* Oxford University Press.

Lorenz E. & Valeyre A. (2005). "Organisational innovation, human resource management and labour market structure: A comparison of the EU-15." *Journal of industrial relations*, 47(4), 424-442.

Lundvall B. Å., (1999). "Technology policy in the learning economy." *Innovation policy in a global economy*, 19-34.

Lundvall B. Å., (Ed.). *(*1992*). National systems of innovation: Toward a theory of innovation and interactive learning.* London: Printer.

Lundvall B. Å. & Borrás S. (1997). "The globalising learning economy: Implications for innovation policy". Nelson R. R. (Ed.). (1993). *National innovation systems: a comparative analysis*. Oxford University Press.

Lundvall B. Å., 2004. "Why the new economy is a learning economy". *DRUID Working Paper No 04-01*, Department of Business Studies, Aalborg University, Aalborg.

Lundvall B. Å., 2008. National innovation systems – analytical concept and development tool." *Industry and Innovation*, 14(1): 95–119.

Mazzucato M. (2014). Estado emprendedor: mitos del sector público frente al sector privado. Barcelona: RBA.

Metcalfe J. S. & Hughes K. (1993). "Technology policy and innovation systems from an evolutionary perspective". In *The future of UK competitiveness and the role of industrial policy* (p. 226). Policy Studies Institute.

Morgan K. (2013*). Basque Country RIS3: an expert assessment on behalf of DG regional and urban policy*.

Navarro M. (2010a). "Reflexiones sobre el sistema y las políticas de innovación del País Vasco". Working Papers 2010R04, Orkestra - Basque Institute of Competitiveness.

Navarro M. (2010b). Retos para el País Vasco, tras tres décadas de desarrollo del sistema y de las políticas de innovación. EKONOMIAZ. Revista vasca de Economía, 25(03), 136-183.

Navarro M. (2015). Las estrategias territoriales para la transformación productiva. Reflexión desde el caso del País Vasco. Revista Icade. Revista de las Facultades de Derecho y Ciencias Económicas y Empresariales, (96), 75-104.

Navarro M., Valdaliso J. M., Aranguren M. J. & Magro E. (2013). "A holistic approach to regional strategies: The case of the Basque Country." *Science and Public Policy*, 41(4), 532-547.

OECD (2005). *Innovation, Policy and Performance: A cross-country comparison.* OECD, Paris.

OECD (2011). *OECD Reviews of Regional Innovation-Regions and Innovation Policy*. OECD, Paris.

Oeij P., Rus D. & Pot F. D. (Eds.). (2017). *Workplace innovation: Theory, research and practice.* Springer.

Orkestra – IVC (2015). Informe de Competitividad del País Vasco 2015. Publicaciones de la Universidad de Deusto, Bilbao.

Orkestra – IVC (2017). Informe de Competitividad del País Vasco 2017. ¿Y mañana?. Publicaciones de la Universidad de Deusto, Bilbao.

Pérez C. (2004). Revoluciones tecnológicas y capital financiero: la dinámica de las grandes burbujas financieras y las épocas de bonanza. Siglo XXI.

Piirainen, T. & Koski P.: "Finnish Workplace Development Programme (TYKE-FWDP) from innovation policy perspective." In Arnkil R., Rissanen P., Pitkänen S., Piirainen T., Koski P., Berg P., Vartiainen M., Gustavsen B., Ekman Philips M., Finne H. & Riegler C.*: The Finnish Workplace Development Programme: a small giant?* Finnish Workplace Development Programme – Ministry of Labour. Helsinki 2003, 26-68..

Piirainen T. & Koski P.: "Integrating workplace development policy and innovation policy: a challenging task. Experiences from and reflections on the Finnish Workplace Development Programme." In Fricke W. & Totterdill P. (eds.): *Action research in workplace innovation and regional development*. John Benjamins. Amsterdam – Philadelphia 2004, 313-331.

Pomares E. (2018). "Alternative Learning Frameworks: Workplace Innovation Programmes and Smart Specialisation Policies in the Basque Country. *International Journal of Action Research*, *14*(2/3), 181-201

Pomares E., Luna Á. & Unceta A. (2016). Patterns of workplace innovation in the Basque Co Eurountry: Challenges and lessons from Gipuzkoa." *European Journal of Workplace Innovation*, *2*(2), 106-127.

Pot F. (2011). "Workplace innovation for better jobs and performance." *International Journal of Productivity and Performance Management,* 60(4), 404-415.

Pot F. D., Totterdill P. & Dhondt S. (2016). *Workplace innovation: European policy and theoretical foundation. World Review of Entrepreneurship, Management and Sustainable Development, 12(1),* 13–32.

Schienstock G. & Hämäläinen T. (2001). *Transformation of the Finnish innovation system: A network approach*. Helsinki: Sitra.

Stam E. (2015). "Entrepreneurial ecosystems and regional policy: a sympathetic critique." *European Planning Studies*, 23(9), 1759-1769.

Tödtling F. & Trippl M. (2005). "One size fits all?: Towards a differentiated regional innovation policy approach." *Research policy*, *34*(8), 1203-1219.

Tödtling F., Asheim B. & Boschma, R. (2013). "Knowledge sourcing, innovation and constructing advantage in regions of Europe*". European Urban and Regional studies, Vol. 20 No. 2*, pp. 161-169.

Totterdill P. (1999). "Workplace innovation as regional development." *Concepts and Transformation*, 4(1), 23-43.

Trubek D. M. & Trubek L. G. (2005). "Hard and soft law in the construction of social Europe: the role of the open method of co-ordination." *European Law Journal,* 11(3), 343-364.

Unceta A. & Gurrutxaga G. (2005). *Responsabilidad Social Corporativa en el País Vasco.* Paradox, Bilbao.

Valdaliso J.M. (2010). Treinta años de cambios en las empresas vascas: un estudio exploratorio y descriptivo. EKONOMIAZ. *Revista vasca de Economía*, 25(03), 194-221.

Valdaliso J.M. (2015). "Capítulo 1. Marco teórico", en Orkestra, Cuadernos del Informe de Competitividad del País Vasco 2015. *Número 3: Sectores y Clústeres.* Bilbao: Publicaciones Deusto.

Vedung E. (1998). "Policy instruments: typologies and theories". In Carrots, Sticks and Sermons: Policy Instruments and Their Evaluation M. L. Bemelmans-Videc, R. C. Rist and E. Vedung (eds). New Brunswick, NJ: Transaction Publishers, 21–58.

Woolthuis R. K., Lankhuizen M. & Gilsing V. (2005)." A system failure framework for innovation policy design." *Technovation,* 25(6), 609-619.

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Identifying Vocational Student Teachers' Competence Using an ePortfolio

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Abstract

The claim of advancing the use of Personal Learning Environments arose from the ideas of an ongoing learning process which lasts throughout a lifetime and informal learning being a meaningful part of the development of an individual's expertise. In order to develop expertise, the following steps are necessary: first, one must explore the competences related to the profession; second, one must discover what these competencies and skills involve; and third, one must reflect on how to master the techniques involved. In addition to this kind of individual process, it is also important nowadays to acknowledge that demonstrating that one has achieved the necessary competences is important information for many audiences, such as workplaces, networks and employers. Nowadays, the most effective way to show one's competence to a wider audience, as well as to review one's skills oneself, is to create a digital record or portfolio (an ePortfolio). However, making an individual's competence transparent in a digital format has proven complicated. This study focuses on exploring vocational student teachers' competence through their ePortfolios, mainly using a theoretical framework of the pedagogical infrastructure design. The study reveals that there is a lot of variation in the quality of ePortfolios and therefore more scaffolding is needed to support student teachers in making their teacher competence visible through ePortfolios. The study advocates both creating a workspace ePortfolio as well as making competence transparent through a showcase ePortfolio.

Keywords: ePortfolio, personal learning environment, teacher competence, scaffolding, VET

Introduction

Personal Learning Environments (PLEs) are increasingly being used in the context of personal development for individual purposes of learning activities and are also expanding outside formal education contexts (Fiedler and Väljataga 2013). Professions are combined with many different competencies, and formal education is not the only way to develop the competence needed in modern professional life. Therefore, it is essential to consider how competence is made transparent and visible in order to demonstrate it to different audiences. One method of accomplishing this is to use a personal portfolio; when a portfolio is assembled in a digital format it is called an ePortfolio.

Neither portfolios nor ePortfolios are new concepts. They have been widely studied from different perspectives, including professional learning design, development planning (Daunert and Price 2014), and technology (Milman and Kilbane 2005). Previous studies have explored ePortfolios as a reflective tool which is seen an essential part of a learning process (Kankaanranta, Grant, and Linnakylä 2007); they are also often understood to serve as a learning diary (Kankaanranta 2007; Viksted 2007; Awouters, Bongaerts and Schrooten 2007). Furthermore, ePortfolios have been studied as a possible means of learning by doing, in other words, the creation of an ePortfolio may be used as a learning process which encompasses ownership, reciprocity, dialogic reflection and focusing on the learning journey (Hughes 2010). However, ePortfolios are not just for learning. Cambridge (2008) wrote that the audience for ePortfolios might be career advisors, employers, personal associations, family members, communities and portfolio owners themselves. He continued that portfolios are used not only for a lifetime learning process generally, but in particular to increase employability. It is meaningful to job-seekers' competence to prospective employers through an ePortfolio, but the ability to create an ePortfolio can be understood as a skill in itself. By representing their skills in an ePortfolio, individuals may better understand not only their professional development but also their needs for further development in the future, as they help narrow the boundaries between education and work (Korhonen et al. 2007). Korhonen et al. (2007) indicated in their study that the most significant issue with portfolios seems to be the integration of formal and informal learning. Reflective writings and tangible artefacts demonstrate an understanding of experiences and tacit knowledge. This study draws on Hughes' (2010) study of using ePortfolios in a learning process which enables learning through making an ePortfolio by focusing on the learning journey and Cambridge's (2008) study of different audiences of ePortfolios to whom competence are shown.

To date, most research on ePortfolios has focused on learning and teacher education; few studies have examined how they make teachers' competence transparent. Teachers' competence is often defined by and based on Shulman's (1986; 1987) studies, which investigated knowledge-based teaching with pedagogical actions. According to Toom (2017, 806), teachers' competencies are nowadays often defined as student teachers' learning outcomes in the teacher education context. She continued that competencies cannot be learned only through formal teacher education—from a longer perspective they must also be acquired in practice in a teaching career. This highlights the need for scaffolding students' professional development so that they continue after one's studies are completed, for example, through maintaining an ePortfolio. Growing competence should also be transparently represented in ePortfolios which explicate a teacher's skills. Wenström, Uusiautti and Määttä (2018) suggested that teachers developing their own expertise in the field of vocational education and training must consider the competence(s) required, explore their existing competences and reflect on how to obtain the required competence(s). According to Wenström et al., (2018) vocational teachers are very enthusiastic when it comes to developing their careers and expanding their work responsibilities. With regard to improving one's performance in the workplace, this requires readiness to engage in professional development continuously throughout one's entire career (Uusiautti 2016). To be able to perceive one's own competence requires making it transparent and visible to oneself as well as to a wider audience. This study explores and suggests how ePortfolios can be harnessed for this purpose.

This study focuses on vocational student teachers' competence presented through their ePortfolios after participating in a vocational teacher education program (60 ECTS). The participants studied for the qualification of vocational teacher in a blended learning program which lasted one and a half years. The curriculum of the vocational teacher education program included vocational pedagogy aspects

such as pedagogical models, teaching methods, learning design, scaffolding, work-based learning, teachers' networking, communication and dialogical skills, digital skills and teaching practices. The study utilized different definitions of teachers' competence to evaluate what kinds of competencies were demonstrated through student teachers' ePortfolios and how they were explicated.

Previous research about ePortfolios

As Hughes (2015) wrote, there is a lot of potential in using ePortfolios in teacher education to demonstrate retention and achievement. According to her study, ePortfolio-based learning supports students' confidence in theoretical studies and in workplace training. According to Struyven, Blieck and De Roeck (2014), in the context of competence-based teacher education, the portfolio has been enhanced as a potential tool for the development and assessment of teaching competencies. In addition, Rico (2017) argued that ePortfolios should be organized around competencies. However, a successful use of ePortfolios in teacher education for learning purposes requires that the ePortfolio process be intentionally integrated in a curriculum design (Lewis 2017). It needs to be framed in a training program in order to attract the needed attention (Imhof and Picard 2009; Rico 2017). In creating and maintaining an ePortfolio a student teacher may achieve an understanding of the competence and practices of the teaching profession; conversely, these skills may also be apparent to others in a teacher's ePortfolio (Berrill and Addison 2010). The criteria for ePortfolios lies in showing individuals' competencies for progressing and planning their career (Lumsden, Meyer, and Garis 2007).

Barrett (2010) stated that an ePortfolio is a collection of evidence which represents a person's learning journey over time. She explained that ePortfolios must be created in two phases. First, students create their own workspace where they can create and save artefacts and important learning materials. Workspaces are not usually directly sufficient to show their owners' competence for wider or public audience and are therefore used as a repository. Second, these repositories are needed when students start organizing their materials and artefacts into a showcase which presents their competence in an edited format to wider audience and even publicly online. As Barret (2010) explained, ePortfolios provide a means of storage (collection), process (collection and reflection), and product (selection/reflection, direction, and presentation). She also pointed out that some of the artefacts may be the same in all levels or they may be edited during levels and stages. Documents of artefacts which present learning outcomes could be attached to reflect what should be ongoing learning processes, not indications of the end of a process (Barret 2010). However, evaluation as a summative assessment of learning needed as the end product of portfolio—that is a showcase (Barret 2010).

In some recent studies, ePortfolios were assessed and explained using certain software designed for official use by an educational institute (Le 2012; Oakley, Pegrum, and Johnston 2013). According to several studies related to the philosophy of Personal Learning Environments (Wheeler 2015, 119; Vuojärvi 2013; Fiedler 2013), ePortfolios need to be chosen by students themselves as a tool to enable a life-long learning process and to promote ownership.

Modern ePortfolios benefit from an appealing visual appearance. It is possible to present material as a combination of text, pictures, photos, videos, figures and so forth, to make individuals' competence transparent in a multifaceted way. Multimodal artefacts and materials are popular nowadays in all kinds of learning processes. Multimodal refers to presenting different means of meaning-making together, such as words with photos, figures with video, and so forth (Jewitt, Bezemer, and O'Halloran 2016). Multimodal portfolios are a natural development for ePortfolios. Because there are a number of web tools which can be used for content creation and sharing and there are discipline-specific differences in the ways in which competence can be made visible, the personal learning environments and ePortfolios are always unique. ePortfolios are a good platform to demonstrate competence. Vocational teachers' competence in the teaching profession is described in the following chapter.

Framing the competence of vocational student teachers

Teaching in vocational education is significant because it contributes to the welfare, maintenance and progress of society (Grollmann 2008). According to Grollmann (2008), specific knowledge is required from vocational teachers which relates to technological developments and the knowledge of specific production processes in professional contexts. Vocational education is often defined as a complex combination of pedagogical content knowledge and teaching actions, substantive competence and situational accomplishment (Oser, Salzmann, and Heinzer 2009). However, Köpsén (2014) stated that the identity of vocational teachers lies in guiding students towards social practices and membership of the society. It seems that there is no general definition of vocational teachers' competence, and therefore in this chapter an overview of teachers' competence in general is presented which also applies to the profession of vocational teaching.

Teachers' competence is a complex combination of knowledge and skills (Toom 2017). Shulman (1986) described the forms of teachers' content knowledge as falling into three categories: a) subject matter content knowledge; b) pedagogical content knowledge; and c) curricular knowledge. Subject matter requires not only an understanding of a subject but also why it is important to students. Pedagogical content knowledge relates to the ability to teach in a comprehensible way which makes it easy to learn a topic—this includes understanding learners' backgrounds, such as group details, individual needs, learning outcomes and values (Shulman 1986). Curriculum knowledge includes the full range of programs designed for teaching, along with instructional materials related to the subject (Shulman 1987). Toom (2017) defined teachers' competence at a general level in four dimensions: theoretical challenges; know-how; practical challenges; and "know-that". According to Toom (2017), teachers' competence should also include general knowledge of theories, educational instructional processes, subject matter, the ability to utilize theories to perceive and structure instructional phenomena, knowledge of pedagogical methods and the ability to apply pedagogical methods and solve problems.

There are several categorizations of teacher competence for the twenty-first century, including technological modernization and globalization (Kerluik et al. 2013). Studies of teachers' digital competence agree that pedagogical skills should be included in discussions of teachers' digital competence (Krumsvik 2014; Tammaro and D'Alessio 2016.). Based on a review study, Ilomäki et al. (2016) stated that there is no overall consensus of the definition of digital competence, but there is a need to find a common ground for using the same concept by different users in educational contexts. They defined digital competence in general as consisting of four elements: (a) technical skills and practices to use digital technologies; (b) the ability to use and apply digital technologies in a meaningful way for working and studying; (c) the ability to understand ethical issues relating to, limitations and challenges, and critical use of various technologies, as well as understanding computational thinking and robotics; and (d) the motivation to participate and engage in digital culture. The researchers emphasized that technology is not "a specific content to be learnt but a didactic approach to be applied" (Ilomäki et al. 2016, 671) in substance and should not be considered too narrowly.

An often-cited theory of teachers' competence is Koehler and Mishra's (2009) Technological Pedagogical Content Knowledge (TPACK) model. Koehler and Mishra (2009) defined content knowledge as subject matter to be learned, pedagogical knowledge as teachers' knowledge of teaching and learning practices, and technology knowledge as rapidly changing digital technology. However, the TPACK model does not define how technical tools are transforming content and pedagogy; neither does it take into consideration teachers' values and epistemic content (Angeli and Valanides 2009) or twenty-first century skills such as collaborating and creative and innovative thinking (Valtonen et al. 2017).

Teachers' digital competence relates to how well they can design learning settings where digital tools are integrated into pedagogical practices. Lakkala and colleagues (Lakkala et al. 2008; Lakkala et al. 2010) defined a so-called pedagogical infrastructure framework which explicates central elements

which teachers should consider, especially when designing collaborative technology-enhanced knowledge-creation pedagogies. They recommended that the central elements be technical, social, epistemological and cognitive structures which should be designed for a learning situation and practices. This framework may be used in evaluating the implementations of technology-enhanced collaborative knowledge practices in education.

When discussing the competence of vocational (student) teachers—or any teachers—managing substance knowledge (epistemological component / subject) is a central competence which cannot be separated in an assessment of pedagogical or digital competencies (Shulman 1987). However, in this study we do not explore substance competence itself; this study is focused on a vocational teacher education program which educates teachers in pedagogical competence. The student teachers are expected to have developed substance competence in their previous studies, such as their master's degree courses.

Two frameworks for evaluating student teachers' ePortfolios are used in this study. Firstly, Ilomäki et al.'s (2016) concept of digital competence was used to evaluate student teachers' digital competence. Secondly, Lakkala et al.'s (2010) pedagogical infrastructure framework was implemented to evaluate student teachers' pedagogical competence.

Aim and research questions

One of the aims of this study was that it explains how vocational students describe their teachers' competence through learning assignments included in their teacher education program. The research was conducted in order to improve the use of ePortfolios in the study process and in presenting one's own competence in a digital format.

This study investigates the pedagogical and technical competence of vocational student teachers by exploring their ePortfolios. In the study program examined, using ePortfolios was a new method for reflection practices and collaborative learning processes, as well as being a repository designed to make individuals' competence transparent. The main aim of the study is to explore and describe the content of ePortfolios of student teachers. In addition, the study investigates how student teachers' competencies are made visible in different forms, such as written texts, photos, figures or videos in their ePortfolios. The research questions are as follows:

1. What kind of artefacts and sections are the ePortfolios composed of?

2. What kind of competence is visible through student teachers' ePortfolios?

    2a. What kind of digital quality ePortfolios represent?

    2b. What kind of content quality ePortfolios represent?

Methodology

Context of the study

In the country under study, vocational education and training consists of three different qualifications: vocational upper secondary qualification, further vocational qualification and specialist vocational qualification. Teachers of these qualifications are advanced professionals in their own disciplines and must continue with vocational teacher studies to have a permanent position in vocational institutes. The vocational teacher studies are also targeted to teachers in universities of applied sciences. Professional teacher studies include 60 ECTS and it takes usually from one to one and a half years to complete them. Most of these students must study part-time as they are already working as teachers or in other positions in educational organizations, or in different professions and positions in companies.

Setting

The study was conducted with two professional student teacher groups in academic years 2013-2014 and 2014-2015. The groups worked in a blended learning setting. The tasks assigned during the study focused on authentic work situations in educational institutes.

During the studies, the lecturer used a digital platform to share learning materials, to assign learning tasks and to scaffold the whole study group. With the first group, the lecturer used a portfolio tool based on the Mahara system. With the second group the teacher used the learning management system (LMS) Moodle. Student teachers were allowed to choose their own ePortfolio platform following a training session about existing digital tools in one of the courses. This pedagogical approach supports the philosophy of Personal Learning Environments in learning processes.

The lecturer instructed the students to produce the following content for their ePortfolios: a learning diary, a project work report, a learning design plan and artefacts. It was also suggested that they produce a personal development plan to include in their ePortfolio. In addition, the participants were guided to include any other important artefacts or materials in their ePortfolios according to their own needs and will.

The lecturer instructed the students to provide artefacts that included text, pictures, figures and even videos as evidence of their competence. During the practical teacher training period, the participants created a very detailed plan of teaching and scaffolding (a learning design) for a chosen educational setting and implemented their plan in practice while completing their teacher training practise. In the end of the studies students made a project related to the development of pedagogical practices or system level development in an education organization and reported it. Digital tools were both an objective, as part of learning to create an ePortfolio, and a way to demonstrate one's own competence through ePortfolio. The lecturer provided technological as well as substance scaffolding.

The Participants

The first group consisted of 8 female and 12 male participants, whose ages varied between 34 and 55 years. The second group consisted of 10 female and 8 male student teachers who were from 34 to 57 years old. The participants represented all disciplines of vocational education, from upper secondary vocational education and training to instructors at universities of applied sciences. For upper secondary vocational education and training, the following disciplines were represented: ICT, Security, Carpentry, Business and Management, Electrical Engineering, Agriculture, Multicultural Studies (for immigrant students), Hairdressing, Logistics, Tourism, Early Childhood Education and Chemistry. The participants who represented universities of Applied Sciences were from disciplines such as ICT, Welfare and Health (dental hygienists, health clinic practitioners, etc), Prison Officers, Automation Engineers (and other engineering programs), Mathematics and Biotechnology.

Data collection

Because the focus of this study is on what kind of competence is shown in ePortfolios, only the material included in the ePortfolios of the participants was used as data. Thirty-six ePortfolios were analysed in total. The participants were informed of the research details, that their participation was voluntary and did not influence the assessment of their performance in the study program. They were also informed that they could leave the study whenever they wanted and that after the study was completed it would be possible to remove reading rights of their ePortfolio from the lecturer (who was also the researcher of this study).

The data (the ePortfolios) were saved and shared with the researcher online based on the tools the participants used, such as the Mahara portfolio tool and social media blog platforms such as Wordpress and Blogger.

Data analysis

The study was conducted using abductive analysis, a process of gathering observations, reading theories extensively, working with observation data and active inquiry combining theory-informed and data-grounded approaches (Tavory & Timmerman, 2014). The first author conducted the analyses, which were then examined and revised several times together with the other two other authors. All three authors agreed on the final categorization.

The study included four phases of analyses: (a) artefacts and sections indicating a general structure of ePortfolios; (b) technical implementation of ePortfolios indicating digital competence; (c) Analysis of learning designs indicating pedagogical competence; and (d) analysis of project work reports indicating pedagogical competence. To answer research question 1, all ePortfolios were first analysed by counting the number of artefacts included a digital format. Artefacts were divided into two categories: single-modal artefacts and multimodal artefacts. Single-modal artefacts include text, photos, figures, video, tables or even links to other online objects and sites. Multimodal artefacts are composed of two or more single-modal artefacts. The analyses were continued by exploring what content sections the participants had included in their ePortfolios. All notable sections of the ePortfolios were listed in an Excel file. Each ePortfolio included one or more sections. All produced artefacts were studied, and it was noticed that learning designs and project work reports had the richest content. Therefore, to answer research question 2, they were chosen to be analysed in a more detailed way.

The quality of participants' digital competence was assessed by studying the way they had used digital tools to create their ePortfolio. This analysis was used to answer research question 2a. The ePortfolios were examined several times and preliminary findings were coded in an Excel file. Three different levels of using digital tools for creating an ePortfolio were found: (a) a minimum level with only a few digital functions of an ePortfolio tool used (Ilomäki et al. [2016], element 1); (b) an average level with digital tools used in a few different ways to build an ePortfolio, such as embedding multimedia, blog, and rss feeds (Ilomäki et al. [2016], elements 1 and 2); and (c) advanced level with several completed multimodal artefacts (Ilomäki et al. [2016], elements 1-4). The definition and elements of digital competence by Ilomäki et al. (2016) were then applied to categorize the findings. Element 1 was seen as the skill to use digital technologies, element 2 as the ability to use and apply digital technologies in a meaningful way, element 3 as the ability to understand the phenomena of digital technologies (such as computational thinking), and element 4 as the motivation to participate and engage in digital culture.

In order to answer research question 2b regarding the content quality of ePortfolios, the learning designs were evaluated based on the framework of pedagogical infrastructure (Lakkala et al. 2010), which includes four components: technical, social, epistemological and cognitive. The participants' pedagogical competence was evaluated by examining how they had created a learning design which took these components into account. A learning design is a detailed plan for building a learning setting for participating students. The technical component was defined as providing appropriate technology as well as technical advice to participants through the learning process; the social component included the nature and combination of individual and collaborative activities designed in the learning tasks; the epistemological component explained the ways of operating with and processing knowledge through the nature of learning assignments; and the cognitive component included the learning assignments which promote students' self-regulative and metacognitive competencies in work.

According to Lakkala et al. (2010), the pedagogical infrastructure framework is helpful in designing support structures in educational settings, but at the same time it takes into account that situations vary and each case depends on the learning goals and intended activities. They also explained that this framework could be used to classify and analyse the pedagogical elements in various educational designs and settings. In the present study, the categories were used to analyse the participants' learning designs in the following ways. The technical component included mentions of both physical and digital learning environments or working spaces. The level was evaluated based on how many different kinds of environments participants mentioned in their learning designs. The social component was evaluated from the descriptions of learning assignments and the levels were defined

based on how individual or collaborative the learning assignments were. The descriptions of learning assignments were also the basis of assessing the epistemological component. The levels were defined based on whether the assignments related mainly to theoretical knowledge, authentic work-related knowledge or creating new knowledge. The cognitive component was also evaluated based on the nature of learning assignments using the following categories: (a) only one type of cognitive support was mentioned; (b) two types of cognitive support were mentioned; or (c) three types of cognitive support were mentioned. The support types were: (a) learning objectives were explained or personalized to students; (b) self-directed learning activities were supported; and (c) self-reflection, self-assessment and/or peer-assessment guided. The cognitive component was also separately assessed according to the ways of scaffolding and feedback mentioned in the learning design. The levels of scaffolding and feedback found in the designs were from light descriptions to constant activities. The exact levels of each component are explained in Table 1.

Table1. Criteria for evaluating the learning designs

Level	Technical component (physical and digital learning environments	Social component (features of learning assignments)	Epistemological component (features of learning assignments)	Cognitive component (1-3 types of support features mentioned in learning assignments)	Cognitive component (scaffolding and feedback)
1	one environment (e.g. classroom and/or laboratory OR one LMS)	only individual or in pairs	repetitive, theoretical considerations	learning objectives explained / scaffolded / personalized to students	very light descriptions
2	several environments: physical (1 or more) AND digital	some collaborative	partly applied, authentic	activities to support self-directed learning	feedback and/or assessment in the end or in the middle
3	several environments and digital tools used in several types of tasks	several and different kinds of collaborative	creating new knowledge	self-reflections and self-assessment and/or peer-assessment	constant

In total each learning design received a score from 1 to 15.

The project work report was a way to evaluate participants' competence in an aspect of practical educational development work in educational institutions as one part of a pedagogical competence. It was used to answer research question 2b regarding pedagogical content quality by analysing the project work reports, which were evaluated by investigating their content and categorizing it as one of the quality levels presented in Table 2 below. The criteria are based on the lecturer's instructions for a project work report. The project work reports were expected to be theory-oriented where theories are applied in practical experiments and had to include a reflection on the conducted experiment.

Table 2. Criteria for evaluating project work reports

Level	Theory	Experiment	Reflection
1	fragmented	loose examples not related to theory	loose or missing
2	partly relevant, partly fragmented	loose examples, but theory oriented	short comments about theory/experiment
3	well structured, relevant	research question/problem defined, practical experiment	experiment reflected theoretically, lessons learned, suggestions for future actions

Finally, all scores for each ePortfolio were calculated. The total scores were as follows:

- Digital level 1–3
- Learning design 1–15
- Project work report 1–9
- The maximum score was 27.

Results

The artefacts and sections of the ePortfolios

The results presented in this chapter answer research question 1 relating to artefacts and sections. A total of 208 single-modal artefacts were found in all ePortfolios. In addition, there were 39 multimodal artefacts that included 120 single-modal artefacts. The numbers of all types of artefacts are introduced in Table 3. The most frequent way to include an artefact in an ePortfolio was an attached appendix in the form of text, created using a word processing application such as Microsoft Word. The second-most-used format was text pages created using an ePortfolio tool. Much less popular formats were text-based artefacts with tables embedded in the ePortfolio and links to objects and sites outside the ePortfolio. Graphic artefacts like photos and videos were present in only a very few ePortfolios.

Table 3. Artefacts created with different web tools

	Single-modal artefact (made with one digital tool)	Single-modal artefacts included in 39 Multimodal artefacts
Text pages created using an ePortfolio web tool	66	34
Text document included as an appendix	72	10
Tables	26	15
Figures	1	25
Photos related to text	11	13
Irrelevant photos	0	10
Videos	2	2
Links outside of the ePortfolio	30	16
Total	208	120

Sections included in the ePortfolios were a learning diary, a project work report, artefacts, a learning design, a personal development plan, a profile and learning materials. One or more sections were found in each of the 36 ePortfolios analysed. The numbers of each type of section found are presented in Figure 1.

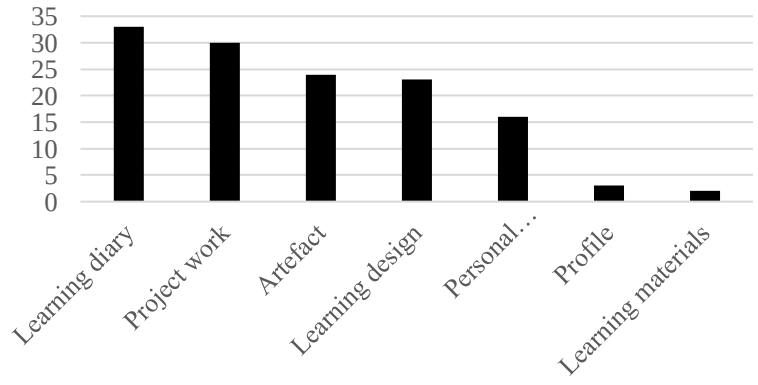

Figure 1. Sections of the portfolios.

The digital quality of the ePortfolios

Research question 2a was answered using the results of how participants used digital tools to create ePortfolios. The use of digital tools to create ePortfolios was categorized into three quality levels. Twenty-one of the 36 portfolios received the lowest score: In these ePortfolios participants used only appendixes which were Word documents or text created using the ePortfolio tool. In 15 ePortfolios the participants used other digital tools and techniques such as like embedded multimedia and blog and rss feeds from outside the ePortfolio as evidence of their ability to integrate information. There was evidence of the highest level of digital competence in seven ePortfolios, demonstrated through the use of multimedia and blog and rss feeds in several ways, which was considered to express a motivation to participate in digital culture.

The quality of ePortfolio content

Research question 2b was answered by analysing the learning designs and project work reports. Of the 36 ePortfolios, 27 featured a learning design to be evaluated, although not all of the designs included all of the expected components. The number of learning designs for each score is presented in Figure 2.

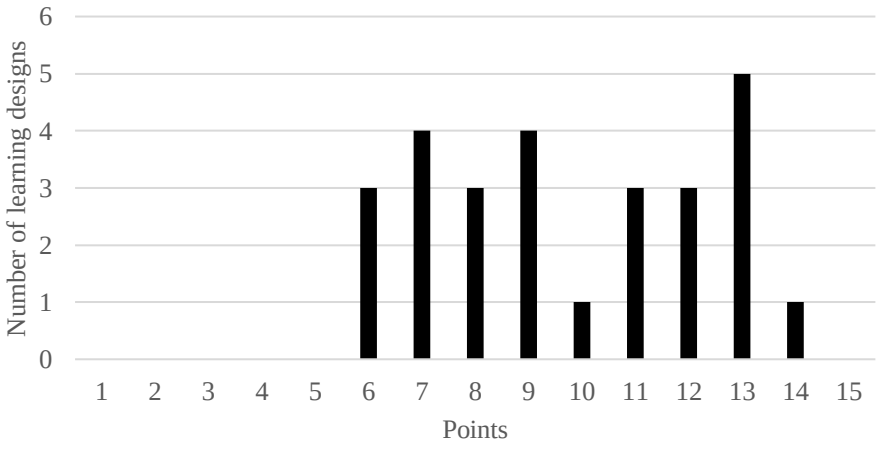

Figure 2. The number of learning designs for each score.

All of the learning designs received scores between 6 and 14, with both the mean and median score being 9. The number of learning designs in each sub-category level of the analysis framework is presented in Table 4. Not all of the components were mentioned in every learning design: Table 4 also indicates the total number of ePortfolios which included them.

Table 4. Number of each component in the three levels

Level	Technical component	Social component	Epistemological component	Cognitive component (support features)	Cognitive component (level of scaffolding)
1	11	11	5	8	3
2	10	4	18	8	3
3	4	12	4	0	19
Total	27	27	27	18	26

It is necessary to consider the fact that 10 of the 36 ePortfolios investigated did not include any kind of learning design.

Project work reports were included in 30 of the 36 examined ePortfolios. The scores received by the project work reports were between 3 and 9. The mean score was 6.6 and the median was 6. The score and number of project work reports are presented in Figure 3.

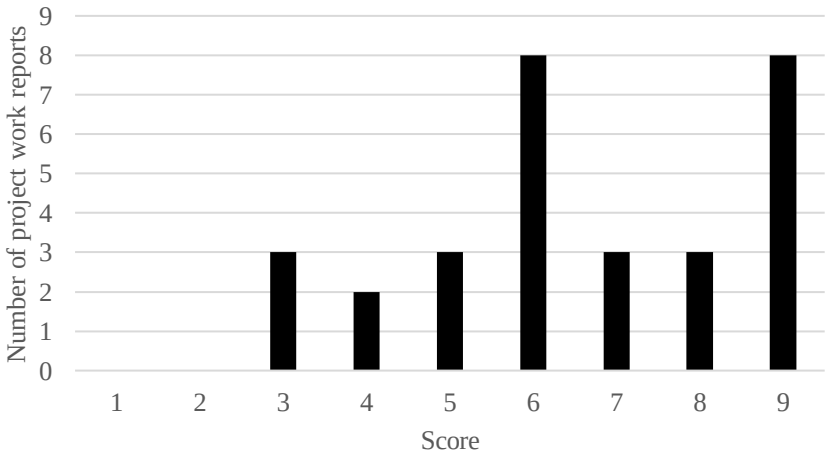

Figure 3. The results of the analysis of project work reports.

Finally, the total score of ePortfolios are presented in Figure 4.

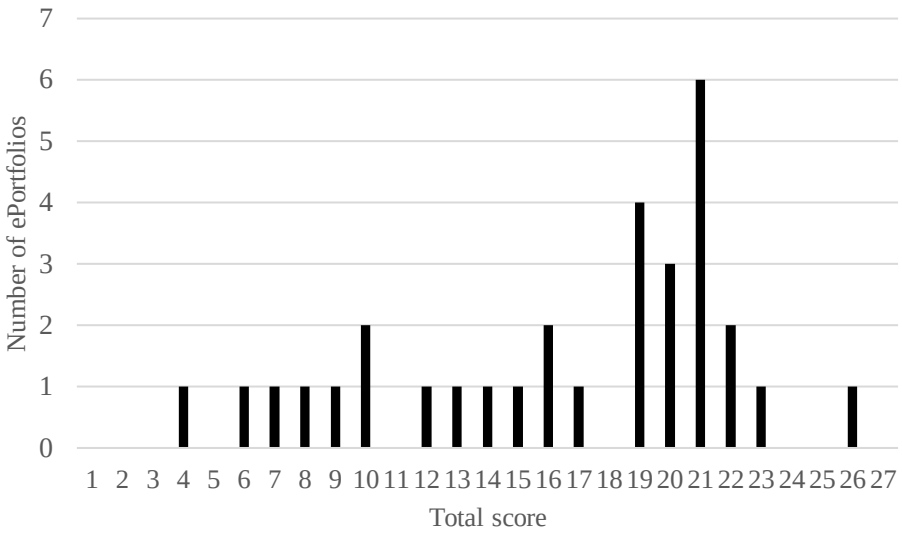

Figure 4. The total score of ePortfolios.

Three ePortfolios were chosen to be presented as examples: (a) the ePortfolio which received the highest score; (b) the ePortfolio from the middle of the range; and (c) the ePortfolio which received a low score but included several artefacts. The cases are described by analyse phases as follows:

The highest-scoring ePortfolio (26 points):

The points were divided in the following way: (a) artefacts and sections indicating a general structure of ePortfolios; (b) the technical implementation of ePortfolios indicating digital competence (3 points); (c) analysing learning designs indicating pedagogical competence (14 points); and (c) analysing project work reports indicating pedagogical competence (9 points).

This participant used the Mahara platform tool to construct an ePortfolio which included a learning diary, project work report, learning design, personal development plan, artefacts and profile information. It comprised several pages which were into sections. From a technical perspective it was constructed using multiple tools and methods, including an embedded blog tool which was used to write a learning diary, a text tool, tables and figures, and profile information in the form of external feeds from two different blogs run by the participant (one professional and one personal). This ePortfolio also included a total of five artefacts, four of which were multimodal: These were created using several web tools, such as combinations of text, photos, figures and tables (11 individual artefacts in total). The learning design represented an advanced product, as it scored 14 points out of 15. The participant included several online applications such as Adobe Connect for online lectures and online collaborative assignments in the learning design. The LMS was used in several learning assignments both individually and collaboratively. Various types of learning assignments, from individual essays to collaborative presentations to peers and to an external client from a company, were mentioned in the learning design. There was also a description of a project where the participant's students evaluated a client's specific practices and created and suggested new processes to the client in order to improve their practices. According to the learning design, the participant explained learning objectives for students and scaffolded activities to supported students in being self-directed. According to the learning design, the assessment and scaffolding of the learning process was constant, as the participant planned to make sure that all groups proceeded with their assignments. The

participant's plan was to conduct an assessment after each learning assignment. The project was related to an online learning process. The participant tested a pedagogical model with students and collected data by interviewing students and by administering a questionnaire. The data were used to answer the research questions, draw conclusions and reflect on lessons learned.

The mid-range ePortfolio (15 points):

Points were divided as follows: (a) artefacts and sections indicating the general structure of an ePortfolio; (b) technical implementation of ePortfolios indicating digital competence (1 point); (c) analysing learning designs indicating pedagogical competence (8 points); and (d) analysing project work reports indicating pedagogical competence (6 points).

The use of digital tools to construct an ePortfolio was considered fundamental to this level. In this category, participant used just two tools to create the ePortfolio: Mahara, to write a learning diary (section), and Blogger presenting other artefacts. The sections linked via Blogger were the project work report, the learning design and some artefacts. Blogger was used only to display text which had been created in Microsoft Word and then copied and pasted. Such text was not edited (e.g. lines and spaces were not fixed). There were no pictures or other visual materials included. The selected ePortfolio included 7 artefacts, none of which was multimodal. According to the learning design, teaching was conducted in a classroom and in LMS. The learning design included descriptions of group assignments as well as individual assignments which required the students to interview professionals in their authentic work situations and made reflections incorporating theory. No self- or peer-assessment tasks were mentioned in the learning design, nor were there any scaffolding activities. The assessment process was described as being in the end of the learning process and comprising an examination. For the project the participant chose a theoretical framework and tested it in practice; she described the theory and practical testing well in her report but neglected to include any reflections.

The lowest scoring ePortfolio (8 points):

Points were divided in the following way: (a) artefacts and sections indicating the general structure of the ePortfolio; (b) technical implementation of ePortfolios indicating digital competence (2 points); (c) analysis of learning designs indicating pedagogical competence (0 points); and (d) analysis of project work reports indicating pedagogical competence (6 points).

The participant used Blogger as the ePortfolio tool. The navigation structure of the ePortfolio followed the structure of the themes of the teacher education program curriculum; however, nearly all of the links the participant used went to objects and pages outside of the ePortfolio—only the learning diary was written with the ePortfolio tool itself. The links led to Google Drive documents which used a text tool. The sections of the ePortfolio included the learning diary, the project work report, and some artefacts. The ePortfolio comprised seven pages, each of which featured a very brief description with links to external sites. In total there were 22 links to sites outside of the ePortfolio. No learning design was presented, and while the project work report did include a theoretical framework it featured only a few loose examples from the participant's own teacher experience. The project work report received in the lowest level.

Discussion

The participants used mainly text-based formats to create their artefacts; very rarely did any of them use more up-to-date digital tools such as videos, photos, figures or tables. Nowadays the topic of digital learning environments is hotly debated in the education field, and there is a need to use modern digital tools to support learning as well as to create content in vocational education and training sector. Student teachers are therefore recommended to test new digital tools during their studies in order to have an impression how such tools may be seen by their own students. To be able to use digital tools in learning processes as well as in their own teaching practices student teachers need more education for digital tools. The results of the ePortfolio project indicate that the participating student teachers were not motivated to engage in the social aspects of digital learning culture (such as forming social groups in different online environments and forums) and they showed no interest in understanding computational thinking. These practices represent a high level of digital competence according to Ilomäki et al. (2016). Technically, the examined ePortfolios were created using several digital tools. The low level of digital competence was explained by Ilomäki et al. (2016) as relying mainly MS word documents as appendices or text written with an ePortfolio tool. According to this definition, the student teachers' ePortfolios did not reflect computational thinking no motivation to participate in digital culture. The reasons for their poor performance may be included a lack of technical skills and a lack of motivation to use time and energy in creating an ePortfolio. The participating student teachers did not seem willing to produce enough content to demonstrate their competence in their ePortfolios even if they were able to.

The sections of the examined ePortfolios addressed well the goals which were set for them related to the curriculum of vocational teacher education. The required sections, such as a learning diary, project work report, and learning design were found in at least some of the ePortfolios. However, none of the examined ePortfolios included all of the sections they were supposed to, and as a result there was content missing from many ePortfolios which should have described the competence of the student teachers. This reveals that more reasoning for creating instructed sections and content related is needed by a lecturer.

Pedagogical competence is crucial in every teacher's work activities and their competence may be highlighted in a learning design which includes a lot of information on learning activities and learners' backgrounds, as well as individual needs and materials related to the subject (Shulman 1987). A learning design created by a student teacher for his or her students should illustrate that teacher's competence, as these are often interpreted through described decisions. The analysis of learning designs based Lakkala et al.'s (2010) Pedagogical Infrastructure Framework revealed that the participating student teachers' pedagogical competence are better than average: Half of the learning designs scored in the highest of the three categories, and it might be said that half of the student teachers demonstrated advanced pedagogical competence by combining technical, epistemological, cognitive and social components in their pedagogical plans (learning designs). However, one-third of the participants failed to include a learning design in their portfolio, meaning that a lot of content which would have demonstrated those participants' pedagogical competence was missing. In general, student teachers participating in the study were able to apply their own professional knowledge in designing their students' lesson plans and incorporate authenticity in the learning process. They performed especially well in this regard. Student teachers' competence in understanding the importance of constant scaffolding and assessment was particularly advanced.

Most of the student teachers expressed their competence in theoretical frameworks and practical experiments well in their project work reports. They were also able to reflect on what they had learned from their experiments and how this knowledge related to theories they used. Almost all of the student teachers included their project work report in their ePortfolio. However, some of the participants needed more scaffolding to express themselves in their project work report. This kind of artefact is possible to attach directly to showcase portfolio as an evidence of ability to develop educational practices in school.

Reviewing the total scores for the ePortfolio revealed that there is a lot of variance among them. Some received very low scores, giving the impression that those student teachers may lack some of the competence necessary to work. At the same time, some ePortfolios were of high quality, indicating high level of competence as well as abilities to explore and present one's own competence creatively and innovatively. The poor quality of other ePortfolios was caused mainly by a lack of a learning design. Pedagogical competence, which was evaluated using the Pedagogical Infrastructure Framework (Lakkala et al. 2010) had the highest possible score of all evaluated sections (15 points). Therefore, the weight of the learning design in evaluating competence demonstrated by the participants through ePortfolios was high. Student teachers who had not placed their learning design in their ePortfolio had to send it via other channels, such as emailing it to the lecturer. These were not included as results in the study. In order to be certain of the level of the student teachers' competence it was necessary that they all share exactly the same investigated sections in their ePortfolios. This result indicates that more scaffolding is needed when deciding what kind of information would describe a pedagogical competence to different audiences.

The ePortfolios were left unfinished, and it seems that insufficient scaffolding was given to student teachers regarding how to create an ePortfolio which can serve as a showcase. Figure 5 illustrates Barret's (2010) vision of balancing the two faces of an ePortfolio. Barret (2010) explained that an ePortfolio has two purposes: it is first a workspace for the learning process and second a showcase which introduces its creator's competence. The process of creating an ePortfolio which was followed in the teacher education course in this study followed Barret's (2010) process of balancing the two faces of an ePortfolio by workspace dimension (marked with grey shading in Figure 5 below). The participants' ePortfolios were workspaces which, as Barret (2010) defined, are intended to be a learning process incorporating reflection and feedback as well as a collection of artefacts constructed according to a lecturer's instructions. However, the participants' ePortfolios did not serve directly as showcases for members of the wider public, such as employers. The scaffolding activities focused on the learning process, and therefore the analysed ePortfolios fulfilled the definition of a workspace. The lighter grey lines, texts, and shaded boxes in Figure 5 illustrate the missing parts of the portfolio process conducted. However, artefacts such as project work reports were in a format which could be attached in showcase portfolio without further modification. The learning designs were partly in a format which could be attached to a showcase portfolio, but most needed to be improved to be more readable and to include a conclusion with reflections first.

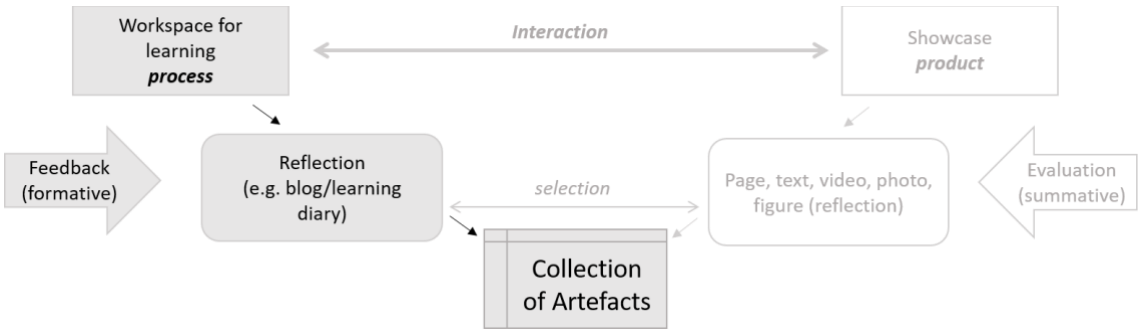

Figure 5. A workspace for the process and a showcase for the product.

Adapted from Barret's (2010) vision of balancing the two faces of ePortfolios.

Conclusions

The results of this study indicate that the scaffolding of ePortfolio processes requires a lot of effort; instructions for how students can make their competence transparent in a digital format must be designed in such a way that a wider audience can see and understand such showcases. A lecturer should plan the process of integrating a curriculum and learning design work as Lewis (2017), Imhof and Picard (2009), and Rico (2017) suggested. Such a process may be based on a theoretical framework such as those used in this study (i.e. the digital competence framework developed by Ilomäki et al. (2016) and pedagogical infrastructure framework presented by Lakkala et al. (2010). Another useful framework for scaffolding ePortfolio processes is Barret's (2010) two faces of ePortfolios (workspace and showcase).

In future research it should be noted that teaching competence cannot be learned only through formal teacher education; rather, they continue to be learned throughout a teacher's career (Toom 2017). Teachers are often willing to develop their own expertise and thereby renew their work practices (Wenström, Uusiautti, and Määttä 2018), but they need support to reach this aim. This raises the question how student teachers' scaffolding processes could be extended after they complete their formal studies in a way that they will also have an effect on their ePortfolio practices in order to demonstrate their competence whenever needed. Making one's competence transparent and visible in an ePortfolio helps one to perceive what further competences might be necessary to continue developing one's expertise to meet the needs of tomorrow's workplaces. This justifies also the use of Personal Learning Environments in learning processes with ePortfolios for ongoing learning purposes after formal education, as Fiedler (2013), Vuojärvi (2013) and Wheeler (2015) suggested.

The evaluation model developed in this study was based on previous research in order to identify student teachers' competence through ePortfolios. In the future this evaluation model can be used systematically as a tool to assess student teachers' (or any teachers') competence critical points which need scaffolding. It is also significant that it highlights student teachers' ability to use and apply digital tools in their daily work as teachers and individuals making their competence transparent in a digital platform.

In the future, it is be important to study student teachers' views on ePortfolios, as these might be relevant to identifying what aspects motivate them to use an ePortfolio in learning processes and in making their competence transparent in a showcase portfolio.

References

Angeli, C. & Valanides, N. (2009). "Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: advances in technological pedagogical content knowledge (TPCK)." C*omputers & Education*, 52(1), 154–168.

Awouters, V., Bongaerts, K. & Schroten, J. (2007). "e-Portfolio as an instrument for assessment and a technique for leaning." In M. Kankaanranta, A. Grant & P. Linnakylä (Eds.), *ePortfolio adding value to lifelong learning*, (pp. 83-106). Jyväskylä: Jyväskylä University Press.

Barrett, H. (2010). "Balancing the two faces of ePortfolios." *Educação, Formação & Tecnologias, 3*(1), 6–14. Retrieved from http://eft.educom.pt/index.php/eft/article/viewFile/161/102

Berrill, D. & Addison, E. (2010). "Repertoires of practice: Re-framing teaching portfolios." *Teaching and Teacher Education, 26*(5), 1178–1185.

Cambridge, D. (2008). "Layering networked and symphonic selves: A critical role for e-portfolios in employability through integrative learning." *Campus-Wide Information Systems*, *25*(4), 244-262.

Daunert, A. & Price, L. (2014). "Discourses on professional learning: On the boundary between learning and working, professional and practice-based learning." In S. Billet, S. Harteis & H. Gruber (eds.), *International handbook of research in professional and practice-based learning* (pp. 231-251). Dordrecht: Springer.

Fiedler, S. (2013). *Emancipating and developing learning activity: systemic intervention and re-instrumentation in higher education*. Doctoral dissertation. University of Turku Centre of Learning Research. Turku, Finland. Retrieved from http://www.doria.fi/handle/10024/77017

Fiedler, S. & Väljataga, T. (2013). "Personal learning environments: A conceptual landscape revisited." *eLearning Papers* 35. Retrieved from https://www.openeducationeuropa.eu/sites/default/files/legacy_files/asset/In-depth_35_2_1.pdf

Grollmann, P. (2008). "The quality of vocational teachers: Teacher education, institutional roles and professional reality." *European Educational Research Journal*, *7*(4), 535–547.

Hughes, J. (2010). "'But it's not just developing like a learner, it's developing as a person': Reflections on e-portfolio-based learning." In R. Harpe, H. Beetham & S. De Feritas (Eds.), *Rethinking learning for a digital age.* New York, NY: Taylor and Francis.

Hughes, J. (2015). "E-portfolio-based learning: A practitioner perspective." *Enhancing Learning in the Social Sciences*, *1*(2), 1–2. https://doi.org/10.11120/elss.2008.01020005

Ilomäki, L., Paavola, S., Lakkala, M. & Kantosalo, A. (2016). "Digital competence—An emergent boundary concept for policy and educational research." *Education and Information Technologies*, *21*, 655–679.

Imhof, M. & Picard, C. (2009). "Views on using portfolio in teacher education." *Teaching and Teacher Education, 25*(1), 149–154.

Jewitt, C., Bezemer, J. & O'Halloran, K. (2016). *Introducing multimodality.* Abingdon: Routledge.

Kankaanranta, M. (2007). "Mapping personal learning paths in higher education with e-portfolios." In M. Kankaanranta, A. Grant & P. Linnakylä (Eds.), *ePortfolio adding value to lifelong learning* (pp. 39-70). Jyväskylä: Jyväskylä University Press.

Kankaanranta, M., Grant, A. & Linnakylä, P. (2007). *ePortfolio adding value to lifelong learning.* Jyväskylä: Jyväskylä University Press.

Kerluik, K., Mishra, P., Fahnoe, C. & Terry, L. (2013). "What knowledge is of most worth." *Journal of Digital Learning in Teacher Education*, *29*: 4. DOI: 10.1080/21532974.2013.10784716

Koehler, M. J., Mishra, P. (2009). "What is technological pedagogical content knowledge?" *Contemporary Issue in Technology and Teacher Education*, *9*(1), 60–70.

Korhonen, V., Kohonen, V., Tolkki, L., Syvänen, A. & Ahonen, M. 2007. "e-portfolios within life-wide professional development." In M. Kankaanranta, A. Grant & P. Linnakylä (Eds.), *e-portfolio adding value to lifelong learning.* Jyväskylä: Institute for Educational Research and Agora Center.

Köpsén, S. (2014). "How vocational teachers describe their vocational teacher identity." *Journal of Vocational Education and Training*, *66*(2), 194–211.

Krumsvik, R. (2014). "Teacher educators' digital competence." *Scandinavian Journal of Education Research*, *58*(3), 269–280.

Lakkala, M., Muukkonen, H., Paavola, S., & Hakkarainen, K. (2008). "Designing pedagogical infrastructures in university courses for technology-enhanced collaborative inquiry." *Research and Practice in Technology Enhanced Learning, 3*(1), 33-64.

Lakkala, M., Ilomäki, L. & Kosonen, K. (2010). "From instructional design to setting up pedagogical infrastructures: designing technology-enhanced knowledge creation." *Technologies and practices for constructing knowledge in online environments: Advancements in learning* (pp.169-185). New York, NY: Information Science Reference.

Le, Q. (2012). "E-portfolio for enhancing graduate research supervision." *Quality Assurance in Education, 20*(1), *54–65.*

Lewis, L. (2017). "ePortfolio as pedagogy: threshold concepts for curriculum design." *E-Learning and Digital Media, 14*(1-2), 72–85.

Lumsden, J., Meyer, K. & Garis, J. (2007). "Development, implementation, and evaluation of an ePortfolio." In M. Kankaanranta, A. Grant & P. Linnakylä (Eds.), *ePortfolio adding value to lifelong learning* (pp. 233–252). Jyväskylä: Jyväskylä University Press.

Oakley, G., Pegrum, M. & Johnston, S. (2013). "Introducing e-portfolios to pre-service teachers as tools for reflection and growth: Lessons learnt." *Asia-Pacific Journal of Teacher Education*, *42*(1), 36–50.

Oser, F., Salzmann, P. & Heinzer, S. (2009). "Measuring the competence-quality of vocational teachers: An advocatory approach." *Empirical Research in Vocational Education and Training*, 1, 65–83.

Milman N.B., & Kilbane C.R. (2005). "Digital teaching portfolios: Catalysts for fostering authentic professional development." *Canadian Journal of Learning and Technology, 31*(3). Retrieved from https://www.cjlt.ca/index.php/cjlt/article/view/26490/19672

Rico, C. (2017). "The ePortfolio: constructing learning in translation technology." *The Interpreter and Translator Trainer, 11*(1), 79–95.

Shulman, L. (1986). "Those who understand: Knowledge growth in teaching author(s)." *Educational Researcher, 15*(2), 4–14.

Shulman, L. (1987). "Knowledge and teaching: Foundations of the new reform." *Harvard Educational Review, 57*(1), 1–21.

Struyven, K., Blieck, Y. & De Roeck, V. (2014). "The electronic portfolio as a tool to develop and assess pre-service student teaching competences: Challenges for quality." *Educational Science*, *43*, 40–54. DOI: 10.1016/j.stueduc.2014.06.001

Tammaro, R., & D'Alessio, A. (2016). "Teacher training and digital competence: A pedagogical recommendation." *International Journal of Digital Literacy and Digital Competence*, *7*(2), 1–10.

Tavory, I., & Timmermans, S. (2014). *Abductive analysis: Theorizing qualitative research*. Chicago, IL: University of Chicago Press.

Toom, A. (2017). "Teachers' professional and pedagogical competencies: A complex divide between teacher work, teacher knowledge and teacher education." In D.J. Cladinin & J. Husu (Eds.), *The SAGE handbook of research on teacher education*, Vol 2. (pp. 803–819). Los Angeles, CA: Sage.

Uusiautti, S. (2016) "Success at work requires hope and the ability to life-long learning." *European Journal of Workplace Innovation*, 2(2), 42–64.

Valtonen, T., Sointu, E., Kukkonen, J., Kontkanen, S., Lambert, M. & Mäkitalo-Siegl, K. (2017). "TPACK updated to measure pre-service teachers' twenty-first century skills." *Australasian Journal of Educational Technology*, *33*(3). DOI: 10.14742/ajet.3518

Wenström, S., Uusiautti, S. & Määttä, K. (2018) "How does the pride theory describe leadership and organization that enhances vocational education teachers' (VET) enthusiasm? An analysis of enthusiastic Finnish VET- teachers' perceptions." *European Journal of workplace innovation*, 4(1),79–94.

Wheeler, S. (2015). *Learning with "e"s: Educational theory and practice in the digital age*. Llandysul: Gomer Press.

Viksted, H. (2007). "e-Portfolios Supporting Development of Teachership." In M. Kankaanranta, A. Grant & P. Linnakylä (Eds.), *ePortfolio adding value to lifelong learning* (pp. 71–82). Jyväskylä: Jyväskylä University Press.

Vuojärvi, H. 2013 *Conceptualising personal and mobile learning environments in higher education* (Doctoral dissertation). University of Lapland. Rovaniemi, Finland. Retrieved from http://lauda.ulapland.fi/handle/10024/61642

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A New Measure of Workplace Innovation

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Abstract

Despite the popularity of Workplace Innovation (WI) and its demonstrable utility for supporting both organisational productivity and employee well-being, there is at present no reliable and valid measure of WI practices for use in research and workplace settings. The aim of this paper is to present the development of a measure of WI climate. The study involved 855 individuals across all levels of three organisations, and a survey of WI practices that was based on four underlying elements: jobs and teams; organisational structures, management and procedures; employee-driven improvement and innovation; and co-created leadership and employee voice. The original list of items was developed in consultation with employers and practitioners. WI was assessed as climate perceptions. A series of analyses were undertaken on the measure, demonstrating good psychometric properties, including consistency of the factor structure, internal reliability, construct validity, and criterion validity. Support for reliability and validity of the new 19-item measure with four elements is presented. Employees who experienced the four elements of WI climate more positively also enjoyed greater work engagement and job satisfaction, outlining criterion validity of the new measure. The availability of a rigorous and reliable measure of WI climate offers a tool for practitioners and researchers tasked with communicating and promoting WI in diverse workplace settings and with diverse groups of stakeholders. We hope that this new measure of WI will stimulate further research on the role of WI in promoting healthy and productive workplaces.

Keywords: workplace innovation, measurement validation, work engagement, job satisfaction

Measuring Workplace Innovation Practices

Workplace innovation (WI) is an area of growing international interest in both government and academia (e.g., Karanika-Murray & Oeij 2017a, 2017b; Gkiontsi & Karanika-Murray 2015; Eeckelaert, Dhondt, Oeij, Pot, Nicolescu, Trifu, & Webster 2012; Exton & Totterdill 2009; OECD 2010; Pot, Totterdill & Dhondt 2016; Totterdill 2015) reflecting growing policy concerns with skills utilisation, productivity, and competitiveness on the one hand, and with workplace health and well-being, on the other. It is this potential for convergence, as opposed to trade-off, between improved performance *and* enhanced quality of working life that lies at the heart of WI (Ramstad 2009, 2014; Dhondt, van Gramberen, Keuken, Pot, Totterdill & Vaas 2011). A growing number of European countries have been developing policy interventions and programme to support companies and their employees in transforming traditional work practices through WI, typically seeking to achieve a convergence between enhanced business performance and quality of working life (Totterdill et al.,2015). At EU policy level the concept of 'social innovation' at work or 'workplace innovation' is an increasingly important pillar in achieving the EU2020 Strategy goals of "smart and inclusive growth" at the organisational level (EESC 2011).

Despite the importance of WI for promoting sustainable employment, well-being, and productivity, there has been limited progress in developing measures of WI, and for valid reasons: first, it is multidimensional as it comprises a range of dimensions or elements, and second, it is as complex to operationalise as to implement. The broad range of WI indicators that have been used makes it difficult to integrate research findings. Nevertheless, as with any area of practice, accurate measurement is important for evaluating WI efforts.

In this paper we present the results of a study designed to validate a measure of WI practices, which were assessed as the participants' climate perceptions. In order to examine the predictive validity of the measure, we also demonstrate how WI can support work engagement and job satisfaction, as indicators of enhanced quality of working life. Next, we describe WI in more detail before we discuss how WI practices can impact work engagement and job satisfaction.

Workplace Innovation Practices

WI is a broad concept that overlaps with organisational and process innovation and draws from a number of disciplines such as HRM, innovation management, and organisational development (Karanika-Murray & Oeij 2017a, 2017b). We adopt the following working definition of WI: "workplace innovations are strategically induced and participatory adopted changes in an organisation's practice of managing, organising and deploying human and non-human resources that lead to simultaneously improved organisational performance and improved quality of working life" (p. 6, Eeckelaert et al. 2012; also see Oeij, Rus & Pot 2017; Pot, Dhondt & Oeij 2012; Ramstad 2009). Similarly, Oeij, Žiauberytė-Jakštienė, Dhondt, Corral, Totterdill and Preenen (2015) define WI as "developed and implemented practice or combination of practices that structurally (structure orientation or a focus on division of labour) and/or culturally (culture orientation or a focus on empowerment) enable employees to participate in organisational change and renewal to improve quality of working life and organisational performance" (p. 8).

The basic premise for WI is that neither set of policy goals (skills utilisation, productivity and competitiveness, on the one hand, and workplace health and well-being, on the other) can be fully achieved by traditional policy levers such as macro-economic manipulation, skills supply, or health and safety regulation (UKCES 2009). Likewise, at enterprise level there is only limited return on investment in technology (Brödner & Latniak 2002) or skills development (CEDEFOP 2015) when, for example, the tacit knowledge of employees, skills utilisation and workforce creativity are overlooked (UKCES 2009).

The interplay between workplace practices and participative process is central for WI and its dual aim of promoting productivity and quality of working life. WI involves the implementation of practices that are adopted with the aim to induce change towards a defined end and encourage learning from diverse sources (Pot, Totterdill & Dhondt 2016) but is also an inherently social process, which relies on building skills and competence through participation (Totterdill 2015). Rather than attempting to develop a comprehensive measure of these different aspects of WI (practices and processes) and its dual outcomes (productivity and quality of working life), we focus on the practices that can support WI and assess them as the employees' perceptions of workplace climate for WI.

Four Dimensions of WI Practices

A range of workplace practices have been implicated in successfully developing WI in organizations. WI is fuelled by open dialogue, knowledge sharing, experimentation, and learning in which diverse stakeholders including employees, trade unions, managers, and customers are given a voice in the creation of new models of collaboration and new social relationships (Dhondt, van Gramberen, Keuken, Pot, Totterdill, & Vaas 2011; Totterdill 2015). WI seeks to build bridges between the strategic knowledge of the leaders, the operational tacit knowledge of frontline employees, and the organisational design knowledge of experts. It seeks to engage all stakeholders in dialogue in which the force of the better argument prevails (Gustavsen 1992).

WI can take diverse forms, according to a review of 120 case studies across ten European countries (Totterdill, Dhondt & Milsome 2002), but "above all [it] is characterised by the search for 'win-win' solutions: enhancing organisational performance and job satisfaction by developing and using employee competencies and creative potential to the maximum extent" (p. 3, Totterdill et al. 2002). Totterdill et al. (2002) discussed that these factors in the work environment include empowering job design; self-organised team working; structured opportunities for reflection, learning and improvement; high involvement innovation practices; the encouragement of entrepreneurial behaviour at all levels of the organisation; and employee representation in strategic decision-making. Similarly, the Netherlands Centre for Social Innovation (NCSI) specifies work organisation, labour relations, and network relations as the key drivers of organisational performance and utilisation of human resources. In addition, the Netherlands Employer Work Survey (NEWS) uses a construct of WI that includes the following: strategic orientation, flexible work, smart organising, and product-market improvement (Eeckelaert et al. 2012).

Based on a review of over one hundred articles and a similar number of case studies, the broad range of practices relevant to WI can be summarized into four groups of practices (Totterdill 2015) or *four elements*: (1) jobs and teams (organisation), (2) organisational structures, management and procedures (structure), (3) employee-driven improvement and innovation (learning), and (4) co-created leadership and employee voice (partnership). In combination, these ingredients enable convergence between high levels of economic performance and high quality of working life. The combination of WI practices at every level creates a tangible effect in workplaces that is often described in terms of improved engagement and a cultural transformation (so-called *fifth element;* Totterdill 2015) with resulting benefits for performance and working life, which can only take place when the other four elements combine.

Because of the importance of the interdependence between the four elements, it is also important that WI is examined in a comprehensive way, since "a reduction of WI to fragmented practices or general questions on organizational change is likely to lead to neglecting the specific characteristics and potential of WI" (EIS report 2014). Policies and practices that are internally consistent and combine different forms of representative and direct participation, can help to achieve superior outcomes for organizations and their employees compared to individual measures (Lado & Wilson 1994; Huselid, Jackson, & Schuler 1997; Teague 2005). Studies of failed WI initiatives show that partial change can undermine the introduction of empowering working practices (Business Decisions Ltd 2002). More

information on the framework can be found at the EUWIN Knowledge Bank (http://uk.ukwon.eu/the-fifth-element-new).

Next, we outline each of the four groups of WI practices or elements. We describe these four elements as WI-enabling practices. For additional information and detail on these practices the reader is referred to Totterdill (2015).

The First Element of WI Practices: Jobs and Teams (Organisation)

The evidence for the benefits of a range of job design features for "simultaneously improved organisational performance and improved quality of working life" (p. 6, Eeckelaert et al. 2012) is strong and consistent (Oeij, Rus, & Pot 2017; Pot, Dhondt & Oeij 2012; Ramstad 2009). Building workplaces in which employees can develop and deploy their competencies and achieve their potential begins with job design. A number of features ought to be present, in tandem, according to standards of job design developed in The Netherlands in the 1990s. These standards include: the ability to assume responsibility for day-to-day decisions about work through co-operation or communication with others; the existence of systematic opportunities for problem-solving through horizontal contact with peers; the ability to adapt work execution to changing demands, circumstances or opportunities; demonstrable opportunities for analysis, problem-solving and innovation; frequent horizontal and vertical contact to support problem-solving, learning and innovation; and distributed intelligence throughout the organization ensuring that knowledge and expertise are widely shared or readily accessible by employees (Karasek & Theorell 1991; Shantz, Alfes, K., Truss, C., & Soane 2013). The job design literature provides support for the benefits of these features on managing the job demands, avoiding psychological stress and disengagement associated with repetitive and disempowering work (Bakker & Demerouti 2007; Morgeson & Humphrey 2006; Shantz et al. 2013; Truss et al. 2013), engaging better and being better motivated (Christian et al. 2011; Fried & Ferris 1987; Hackman & Oldham 1980; Humphrey, Nahrgang, & Morgeson 2007), and acquiring transferable skills, increasing adaptability and resilience within the organisation and employability outside it (CEDEFOP 2015).

Effective job design must develop in synchrony with team working, one of the defining characteristics of WI, with roots in European thinking about management and organisation dating back to the work of the Tavistock Institute in the 1940s and 50s. Empowered and self-managed teams are more productive and provide better customer service (Totterdill, Dhondt & Milsome 2002; West 2012). A survey of European 6000 workplaces showed that amongst firms which implemented semi-autonomous teams, 68% reported reductions in costs, 87% reduced throughput times, 98% improved products and services, and 85% increased sales (Walker 1997).

However, while team working may refer to a general "sense of community", or a limited enlargement of jobs to enhance organisational flexibility, *empowered* team working will involve a radical re-appraisal of jobs, systems and procedures throughout the whole organisation (West & Lyubovnikova 2012). All team members must have the potential for a high level of reflexivity unconstrained by internal demarcations and privileges (Gustavsen 1992).

Teams in which the specific knowledge and expertise of each team member are valued and make a tangible contribution to product and WI meet important criteria for convergence between enhanced productivity and enhanced quality of working life. Yet convergence is only possible and sustainable when structures, systems, industrial relations and leadership are fully aligned with the empowerment of employees in their day-to-day jobs (Boxall & Purcell 2003; Buchanan & Preston 1992; Teague 2005). These interdependencies are explored further in the other three elements.

The Second Element: Organisational Structures, Management and Procedures (Structure)

Organisational walls and ceilings that allocate people to departments, divisions, grades and professions can create silos that put barriers in the way of doing a good job. Different groups within an organisation should intertwine in ways that help everyone understand other people's jobs, professions, specialisms, priorities, problems and vision. Systems and procedures that govern decision-making, resource allocation and standard operating procedures must also be aligned with commitment to empowerment and trust. Truly innovative workplaces demonstrate a consistent approach through corporate policy from reward systems and performance appraisal to flexible working and budget devolution.

The Third Element: Employee-Driven Improvement and Innovation (Learning)

Research and technology-led activity accounts for only 25% of innovation; the remaining 75% of successful innovation is generated by changing managerial, organisational and work practices (Jansen, Volberda, & van den Bosch 2009; Volberda et al. 2011). Such innovation is strongly associated with "active work situations": workplaces and jobs in which workers have sufficient autonomy to control their work demands coupled to discretionary capacity for learning and problem-solving (Parent-Thirion, Vermeylen, & Houten 2012; Tidd & Bessant 2009).

The Fourth Element: Co-Created Leadership and Employee Voice (Partnership)

Partnership between management, employees and trade unions can take many forms but always requires openness, transparency and two-way communication. Representative partnership structures (such as works councils and management-union partnership forums) on their own may have little direct impact on performance or quality of working life but they can exert a positive influence on the development of activities and practices that do so. Partnership arrangements alongside the previous three Elements leads to improved information sharing, enhanced trust and reduced resistance to change.

Benefits of Workplace Innovation Practices

The benefits of WI have been documented for both individual employees and organisations and in a range of organisational and national contexts. WI has been linked to improved individual level outcomes such as indices of quality of working life (Pot 2011) and improved organisational performance such as reduced absenteeism, enhanced safety performance and safety culture, and better working conditions (Eeckelaert et al. 2012). Furthermore, Van Der Hauw and colleagues (2009) reported higher productivity as a result of implementing WI. Benefits of specific WI practices have also been reported, relating to enhancing the likelihood of securing a full return on investments in training and technology as a result of improvements in performance, innovation, and quality of working life (Totterdill et al. 2002). The combined and cumulative impact of WI practices is likely to enhance motivation, involvement, fulfilment, resilience, ownership and pride in work, all of which characterise high engagement with day-to-day work (MacLeod & Clarke 2009). WI has also been presented as a timely and effective response to the economic and demographic challenges brought about by the ageing workforce (Gkiontsi & Karanika-Murray 2015).

For the purposes of developing and validating the measure of WI practices, we focus on two indicators of quality of working life as outcomes of WI practices: work engagement and job satisfaction. Employee engagement and the development of participative approaches is at the heart of WI. "It is important to see Workplace Innovation not as an end state but as a dynamic, reflexive process in which all stakeholders are continually engaged in reflecting on, learning about and transforming work processes and employment practices in response to both internal and external drivers" (Dortmund/Brussels Position Paper on Workplace Innovation 2012, pp. 2-3). Workplace practices that enable WI by supporting better work organisation can enrich jobs and reduce intensification or labour and provide

the foundations for individuals to achieve a balance between demands and control. Furthermore, WI practices that focus on developing structure and systems can support good working methods and relationships. Similarly, WI practices that support learning and reflection can support competence development, continuous improvement, product and service innovation and efficiency gains (Boud et al. 1985). Finally, WI practices that support the culture and practice of workplace partnership strengthen "employee voice", helping to close the gap between tacit and strategic knowledge within an organisation, enhancing the quality of decision making and implementation while improving employment relations (Purcell & Georgiadis 2007). Together, we can expect that WI practices bolster perceptions of work. Therefore, we can hypothesise that WI practices will be positively linked to work engagement and job satisfaction.

Method

Participants

The overall sample of 855 participants was collected from 3 organizations: 162 participants from organisation A, 60 from organisation B, and 633 participants from organisation C. To develop and test the measure, the overall sample was divided into two: Sample 1 from organisations A and B (222 participants) and Sample 2 from organisation C (633 participants). The means and standard deviations of the overall sample are available on request from the first author.

Measures

Perceptions of *WI practices* were measured using a list of 24 items describing jobs and teams (organisation; items 1-6), organisational structures, management and procedures (structure; items 7-12), employee-driven improvement and innovation (learning; items 13- 17) and co-created leadership and employee voice (partnership; items 18-24). The labels in parentheses are used to identify factors during modelling (see Appendix 1), with items 6, 7, and 10 being reversescored. The item pool was developed in consultation with employers and practitioners to describe the four elements of WI practices and for reflection and a way to encourage consultation among stakeholders (see Totterdill et al. 2015). Since the WI practices are properties of the workplace, we used the referent-shift consensus model (Chan 1998) and the respondents' organisation as the referent for the items, which describes the WI climate in the organisation. Specifically, participants were asked to indicate to what extent they agree with a number of statements regarding the current situation in their organisation on 5-point Likert-style scale (1 = "strongly disagree" to 5 = "strongly agree").

Work engagement was measured with the short version of the Utrecht Work Engagement Scale (Schaufeli, Bakker, & Salanova 2006) which asks participants to indicate how they feel about their work on a 7-point rating scale (0 = "never" to 6 = "always/every day"). The measure consists of three sub-scales: vigour (e.g., "At my work, I feel bursting with energy"), dedication (e.g., "I am enthusiastic about my job"), and absorption in one's work (e.g., "I feel happy when I am working intensely"). *Job satisfaction* was measured by one item ("all in all, I am satisfied with my job"). Respondents were asked to indicate the extent to which they agreed with the statement. Demographic variables (age, gender, educational level, and relationship status) were also assessed.

Statistical analyses

In order to investigate the structural consistency of the four elements, a reliability analysis was performed on sample 1, comparing a one factor model with a 4-factor model. Badly performing items

in terms of internal consistency were highlighted. Badly performing items were defined as items that had an unacceptable level of internal consistency raising Cronbach's alpha (α) value above 0.7 if item deleted. Second, exploratory factor analysis (EFA) was undertaken on sample 1 keeping in mind the identified badly performing items. Third, the competing models resulting from the reliability analyses and the EFA were compared as to their respective fit to the data using confirmatory factor analysis (CFA) on sample 2. Following Hu and Bentler (1999) fit was judged based on the statistics TLI, RMSEA and SRMR, with good fit suggested by TLI ≥ .95, and values RMSEA ≤ .05 or SRMR ≤ .08. Finally, the criterion validity of the final measure was examined by running regression analyses with work engagement and work satisfaction as outcomes of WI. Analyses were carried out in Mplus (version 7.2; Muthén & Muthén 1998-2014).

Results

Descriptives of the item pool

Skewness and excess kurtosis of the 24 items were within the range of -2 to +2. Examination of inter-item correlations indicated that item 4 was weakly correlated with all other items (the highest being 0.16) and was excluded. Items 21 and 22 were highly correlated, r (221) = .822, 95% CI [.77, .86], suggesting the exclusion of one to increase parsimony and minimise the risk of multicollinearity. Based on their face validity, item 21 was excluded. Correlations between items 13 and 14, and items 18 and 19 were high (.725, 95% CI [.66, .78], and .712, 95% CI [.64, .77], respectively) and these items were highlighted for potential exclusion. Finally, inspection of item 9 suggested it may relate to *jobs and teams* rather than *organisational structures, management and procedures*, which was further tested in the CFA models.

Reliability analyses/item analysis

The remaining 22 items (excluding items 4 and 21) had Cronbach's α = .929, 95% CI [.91, .95], on 126 participants of sample 1. Factor one (items 1-3, 5, 6) achieved α = .62, 95% CI [.53, .70] nearing the cut-off of 0.7 suggested by Nunally (1978). Item 9 was included on the basis of better face validity with this factor, raising α to .715, 95% CI [.65, .77]. Elimination of item 6 raised α to .739, 95% CI [.68, .80].

Factor two (items 7-12) had α = 0.742, 95% CI [.68, .80]. Excluding item 7 raised α to 0.780, 95% CI [.73, .83] and excluding item 9 (to be moved to factor 1) placed α above the cut-off at .713, 95% CI [.65, .78].

Items 6 and 7 were highlighted for exclusion owing to them raising their respective factor's α value. Item analysis was carried out to assess their functioning as an item, and the facility index (the sum of all scores/number of participants should not equal 1 or 5) and frequency problems (2 or more response scales aggregate to less than 10% of answers) were also checked. While item 6 passed on both of these, item 7 performed badly. Item 7 scored 4.23 on the facility index, approaching the extreme point of the answering scale of 5. Furthermore, both the aggregation of participants answering as answer scale 1 and 2 (7.4%) and 2 and 3 (8.6%) fell below the cut off of 10%. Therefore, the answer scale for item 7 is not discriminative. Most respondents used the upper two categories (for these items it meant that over 80% of participants disagree or strongly disagree that the flexibility employed by the organisation is harmful to employee's health). For this reason, item 7 was excluded.

For factor three (items 13-17) Cronbach's α was .894, 95% CI [.87, .92]. Keeping in mind the earlier suggestion of items 13 and 14 having a high correlation with each other, alpha values much in excess of .8 indicate potential redundancy of the items of the scale (Bradley 2013). This was also relevant for

the fourth factor (items 18-20 and 22-24) as it had a $\alpha = 0.865$, 95% CI [.86, .91] consistent with the high correlation between items 18 and 19.

Exploratory Factor Analysis

An EFA with principal axis factoring was undertaken on sample 1 in order to examine the dimensionality of the remaining 21 items (4, 7, and 21 excluded).

Bartlett's test of sphericity was significant ($\chi_2 = 1525.4$, $p < .001$), indicating that EFA was appropriate. Multicollinearity was raised as a potential issue as the determinant was 0.000009985 and just below the cut off of 0.00001. Sample sizes of 100-200 are appropriate if communalities are > 0.5 (MacCallum et al. 1999). Although the current sample size for the EFA was 129 and some communalities were < 0.5, the Kaiser-Meyer-Olkin (KMO) statistic was 0.912, suggesting good adequacy of the sample size to determine distinct and reliable factors (Field 2005). Using the Kaiser-Guttman criterion of keeping factors with an eigenvalue > 1 supports the choice for a 4-factor model. Yet, the scree plot did not support this choice indicating a 1-factor solution as more likely. Parallel analysis was undertaken to explore this issue further as it determines eigenvalues that are greater than chance (Wilson & Cooper 2008; Zwick & Velicer 1986). It supported the choice for a 1-factor solution. This constituted model 1 for the CFA.

Confirmatory Factor Analysis

Four models in total (see Table 1 for the specifications) were tested on sample 2 in terms of their fit with the data. The sample consisted of 624 participants from organisation C, reduced from the sample of 633 by 9 who had missing values on all variables. Model 3 was tested due to face validity suggesting that the item content in item 9 was more aligned with factor 1 than 2. Model fit is presented in Table 2.

Table 1. Outline of number of items and factor structure of the models to be tested

	Number of items	Factors: items
Model 1 (EFA)	21	1: all except 4, 7, 21
Model 2 (theoretical)	24	1: 1-6 2: 7-12 3: 13-17 4: 18-24
Model 3 (theory, 3 items excluded: 4 7 21)	21	1: 1 2 3 5 6 2: 8 9 10 11 12 3: 13 14 15 16 17 4: 18 19 20 22 23 24
Model 4 (theory, 3 items excluded, item 9 moved to factor 1)	21	1: 1 2 3 5 6 9 2: 8 10 11 12 3: 13 14 15 16 17 4: 18 19 20 22 23 24

Table 2. Model fit statistics of all four models, with adjustments for models 3 and 4

Model	χ^2 (df)	FP	CFI	TLI	RMSEA (90% CI)	SRMR	AIC	BIC / ssaBIC
1	834.042* (189)	63	0.865	0.850	0.074[a] (0.069-0.079)	0.049	32041.31	32320.77 / 32120.76
2	1147.431* (246)	78	0.837	0.818	0.077[a] (0.072-0.081)	0.049	36574.43	36920.45 / 36672.81
3	646.596* (183)	69	0.903	0.888	0.064[a] (0.058-0.069)	0.041	31865.85	32171.94 / 31952.88
4	644.699* (183)	69	0.903	0.889	0.064[a] (0.058-0.069)	0.043	31863.95	32170.05 / 31950.98

Notes.*all $p \leq .001$; FP = free parameters; [a] Probability that RMSEA $\leq .05$; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ssa = Sample-Size Adjusted; CFI = comparative fit index; TLI = Tucker– Lewis index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardised Root Mean Square Residual.

Both Models 3 and 4 fit the data well. While neither model achieved a non-significant χ^2, it needs to be noted that the χ^2 test of model fit rejects well-fitting models in large samples, as statistical power to detect very small discrepancies between data and model increases (Gerbing & Anderson 1985; Kline 2004). In terms of CFI and TLI, neither model achieved the cut-off of .95, but CFI values were > .90. For both models the RMSEA did not achieve > .05, however the upper confidence interval was < .08. For both models the SRMR is < .08. The modification indices of both models highlighted that items 13 and 14, and items 18 and 19 should include correlated error terms (indicating non-independent errors). This led to the exclusion of items 13 and 18 (as informal inspection of the items suggested they were harder to understand than items 14 and 19). The two models were re-run without 13 and 18 (see Table 3: Models 3a and 4a). Finally, a superordinate factor *Workplace Innovation* was also tested (see Table 3: Model 3a SO and 4a SO).

Table 3. Model fit statistics of models 3 and 4 with adjustments

Model	χ^2 (df)	FP	CFI	TLI	RMSEA (90% CI)	SRMR	AIC	BIC / ssaBIC
3a	366.514* (146)	63	0.942	0.932	0.049[b] (0.043 - 0.056)	0.037	29299.14	29578.62 / 29378.60
4a	366.495* (146)	63	0.942	0.932	0.049[b] (0.043 - 0.056)	0.040	29299.12	29578.60 / 29378.58
3a SO	3953.932* (171)	61	0.937	0.927	0.051[b] (0.045 - 0.057)	0.039	29316.49	29587.10 / 29393.43
4a SO	389.360* (148)	61	0.936	0.926	0.051[b] (0.045 - 0.057)	0.041	29317.99	29588.59 / 29394.93

Notes. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$; n.s. = non-significant; FP = free parameters; [b] Probability that RMSEA > .05; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ssa = Sample-Size Adjusted; CFI = comparative fit index; TLI = Tucker– Lewis index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardised Root Mean Square Residual.

All adjustments to Models 3 and 4 fit the data well. None of the χ^2 values was non-significant but all RMSEA values were < .05 (other than the superordinate models with values of .051), with all upper limits for both models < .08. For all models the TLI and CFI were close to the .95 cut-off suggesting a good fit. The SRMR was below .08, with Model 3a achieving a slightly lower value than Model 4a. Although all models provided statistical fit to the data, Model 4a SO was chosen based on its theoretical underpinnings. Figure 1 presents the standardised loadings.

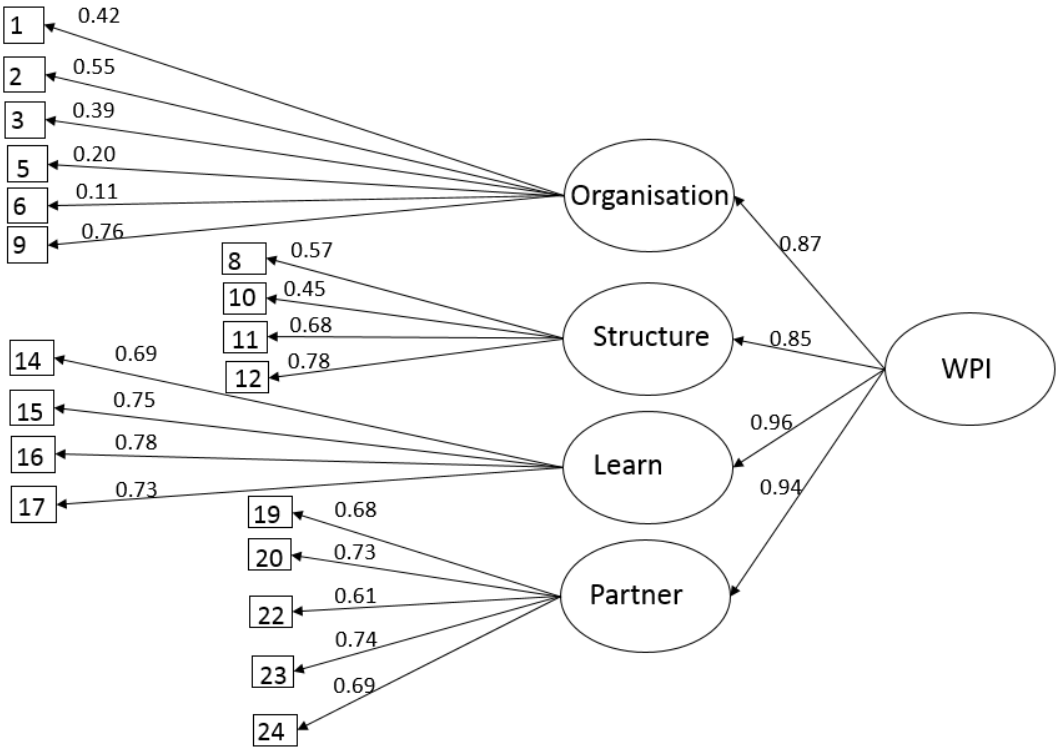

Figure 1. Standardised factor loadings for model 4a SO

Validity analysis

We hypothesized that WI practices would be positively associated with work engagement and job satisfaction, controlling for demographic variables. This was tested using the overall sample (N = 820, with 35 excluded due to missing values). The overall model fit adequately: while the model fit was significant, $\chi_2(308) = 613.3^*$, $p < .00001$, RMSEA and the upper limit of its confidence interval were below .05, RMSEA = .035, 90% CI [.031, .039], while CFI and TLI were both < .95 (.905 and .894 respectively). The weighted root mean square residual was, however, slightly over the cut-off value of < 1 (WRMR = 1.10). The standardised estimates are shown in Figure 2 (only significant paths are shown).

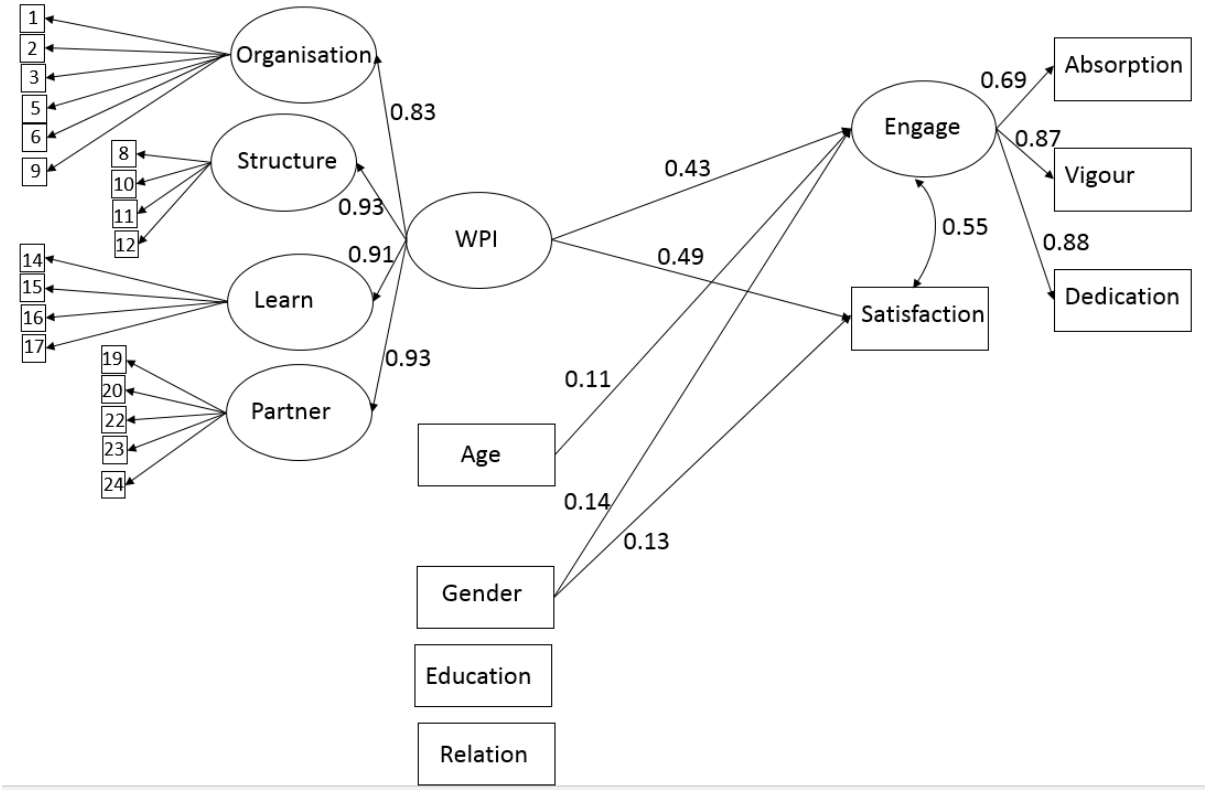

Figure 2. Overall model for the validation of WI with standardised estimates
(Note: Gender was coded as 1 = male, 2 = female

Neither relationship status nor education level were significantly linked to work engagement or job satisfaction. Controlling for the significant effects of age and gender (work engagement and job satisfaction were higher for women), WI positively predicted both work engagement, β = 433, 95% CI [.37, .50], and job satisfaction, β = .487, 95% CI [.41, .57]. Both were also significantly correlated with each other, r = .55, 95% CI [.50, .60]. Appendix 2 shows standardised estimates, standard errors, and p values.

Discussion

The present study reports the evaluation and refinement of a measure for workplace innovation (WI) practices. The measure was based on a model of WI which has been widely used in practice for reflection and as a way to encourage consultation among stakeholders. For the original 24-item version of the measure confirmatory factor analysis indicated poor reliability and no clear factor structure. However, attending to problems with individual items (e.g., removing redundant items and poorly performing items) improved both the reliability of measurements and produced a clearer factor structure. The final model that emerged from a confirmatory factor analysis was based on a 19-item scale had RMSEA, SRMR and TLI fit indices suggesting good to excellent fit. This model included four factors: *jobs and teams* (organization), *structure, management and procedures* (structure), *employee involvement and innovation* (learning), and *shared leadership and voice* (partnership). The refined version of the measure of the WI practices provides reliable assessment of four facets of WI practices. These factors have good face validity and, as expected, are predictive of both work engagement and job satisfaction. This new measure of WI practices therefore has the potential to be an important tool in increasing the reliability of future research on workplace innovation.

While developments in our ability to measure WI practices are important, it is also important to consider the role of such measurement instruments in the context of the broader debate on the nature of WI. WI is not a checklist of practices but is an inherently social process (Dortmund Brussels position paper on WI 2012; Totterdill, Exton, Exton, & Gold 2012) and demanding in terms of an integrated and successful implementation (Karanika-Murray & Oeij 2017a, 2017b). It involves building skills and competence through creative collaboration and participatory practices grounded in continuing reflection, learning and improvement, which sustain the process of innovation in management, work organisation, and the deployment of technologies. The measure presented in this paper is the starting point to identifying the practices that can support true WI by helping practitioners and researchers to provide rigorous evidence for relevant practice and communicating WI to diverse groups of stakeholders with different agendas and understandings (Karanika-Murray & Oeij 2017).

Measuring WI practices at the individual level has inherent limitations. First, these measures – in common with other scales –capture a subjective snapshot of how people view general characteristics of WI practices. This is both a strength (in not tying responses to particular organisation contexts or interventions) and a weakness (in not identifying the practices in question). This limitation can in principle be overcome by combining measurement of WI practices with observation or other qualitative data that captures or documents these practices. Second, individual measures may not fully capture WI at a team or organisation level. It is therefore sensible to consider using WI practices alongside measures at other levels and in combination with team or organisation measures such as climate. Methods also exist to simultaneously model individual and team effects of predictors such as WI practices within the same model (e.g., Enders & Tofighi 2007). Put simply, a single measure such WI practices will not capture everything that researchers mean by the complex concept and process of WI, but nevertheless offers needed progress in capturing key aspects of WI.

Future research on WI is required to assess the potential contribution of WI practices and how best to combine WI practices with other sources of data. For example, in diagnosing the conditions that can lead to actionable solutions, individuals' perceptions of their ideal situation may be as important as their perceptions of the current situation. Present practice sometimes uses a "current minus ideal" combination in which the gap between current and ideal experiences of WI is used to guide interventions (Totterdill 2015). Although a universal benchmark of what is considered good WI can inform general guidance and recommendations, for the measure to be of further practical use it may be useful to take into account the preferences of employees on the ideal situation. The refined WI practices scale we propose here would facilitate such a comparison by ensuring more reliable estimation of the current situation. Additionally, the WI practices scale would also benefit from further evidence of external validity, for example through links to "hard" outcomes such as sickness absenteeism, turnover, early retirement, or performance.

Conclusions

This study offers a succinct, useful, and practical way to assess WI practices. We examined the psychometric properties of a 19-item climate measure and its dimensionality, by employing exploratory and confirmatory factor analyses, and offered evidence for its predictive validity in relation to employee engagement and job satisfaction. Constructing a valid and reliable measure of WI practices is an important first step in the evaluation of WI efforts. We hope that this new WI measure will encourage further research on understanding WI and its role in promoting healthy and productive workplaces.

References

Bakker, A. B., & Demerouti, E. (2007). The job demands-resources model: State of the art. *Journal of managerial psychology, 22*(3), 309-328.

Boud, D., Keogh, R., & Walker, D. (1985). *Reflection: Turning Experience into Learning*. London: Kogan Page.

Boxall, P. and Purcell, J. (2003). *Strategy and Human Resource Management*. Palgrave Macmillan, Basingstoke.

Brödner, P. and Latniak, E. (2002), Sources of innovation and competitiveness: national programmes supporting the development of work organisation. Final Report to DG Employment and Social Affairs, Institute for Work and Technology, Gelsenkirchen.

Buchanan D. A. and Preston, D. (1992) Life in the cell: supervision and teamwork in a "manufacturing systems engineering" environment. *Human Resource Management Journal, 2* (4) 55-80

Business Decisions Limited, 2002. Benchmarking the Competitiveness of the European Animal Health Industry. A Report by Business Decisions Limited for FEDESA. BDL, UK.

CEDEFOP (2015), Skill shortages and gaps in European enterprises. Striking a balance between vocational education and training and the labour market, Luxembourg: Publications Office of the European Union, n.102. Available at: http://www.cedefop.europa.eu/it/publications-andresources/publications/3071

Chan, D. (1998). Functional relations among constructs in the same content domain at different levels of analysis: A typology of composition models. *Journal of Applied Psychology, 83*(2), 234.

Christian, M. S., Garza, A. S., & Slaughter, J. E. (2011). Work engagement: A quantitative review and test of its relations with task and contextual performance. *Personnel Psychology, 64*(1), 89-136.

Dhondt, S., M. van Gramberen, F. Keuken, F. Pot, P. Totterdill & F. Vaas (2011) Workplace innovation, *Social Innovation Europe launch event*. Nottingham: UKWON.

Dortmund Brussels Position Paper on Workplace Innovation (2012). (available at: http://ec.europa.eu/enterprise/policies/innovation/files/dortmund-brusselsposition-paper-workplace-innovation_en.pdf)

Eeckelaert, L., Dhondt, S., Oeij, P., Pot, F., Nicolescu, G.I., Trifu, A. & Webster, J. (2012). *Review of Workplace Innovation and Its Relation with Occupational Safety and Health: Literature Review*. Bilbao, Spain: European Agency for Safety and Health at Work. (available at: https://osha.europa.eu/en/tools-and-publications/publications/reports/workplace-innovation-review).

EESC - European Economic and Social Committee (2011). *Innovative workplaces as a source of productivity and quality jobs*, (SC/034) Brussels.

Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: a new look at an old issue. *Psychological Methods, 12*(2), 121.

EIS (2014) - Exploratory Report on Workplace Innovation. (available at: https://www.zsi.at/object/project/2902/attach/2014_1013_EIS_Workplace_Innovation_EN.pdf)

Exton, R., & Totterdill, P. (2009). Workplace innovation: bridging knowledge and practice. *Ai & Society, 23*(1), 3-15.

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. Sage publications.

Fried, Y., & Ferris, G. R. (1987). The validity of the job characteristics model: A review and meta-analysis. *Personnel Psychology, 40*(2), 287-322.

Gerbing, D. W., & Anderson, J. C. (1985). The effects of sampling error and model characteristics on parameter estimation for maximum likelihood confirmatory factor analysis. *Multivariate Behavioral Research, 20*, 255-271.

Gkiontsi, D., & Karanika-Murray, M. (2016). Dealing with economic and demographic challenges: Workplace innovation practices as a timely and effective response to older workers' needs. *European Journal of Workplace Innovation, 2*(1), 25-42.

Gustavsen, B. (1992), *Dialogue and Development.* Van Gorcum: Assen/Maastricht.

Hackman, J. R., & Oldham, G. R. (1980). *Work redesign.* Reading: Alisson-Wesley.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal, 6*(1), 1-55.

Humphrey, S. E., Nahrgang, J. D., & Morgeson, F. P. (2007). Integrating motivational, social, and contextual work design features: a meta-analytic summary and theoretical extension of the work design literature. *Journal of Applied Psychology, 92*(5), 1332.

Huselid, M. A., Jackson, S. E., & Schuler, R. S. (1997). Technical and strategic human resources management effectiveness as determinants of firm performance. *Academy of Management journal, 40*(1), 171-188.

Jansen, J., Volberda, H., & van den Bosch, F. (2009). Erasmus Concurrentie en Innovatie Monitor 2008-2009 (Erasmus Competition and Innovation Monitor 2008-2009). *Eindrapport (Final Report), Rotterdam School of Management, Rotterdam.*

Karasek, R.A. and Theorell, T., *Healthy work; stress, productivity and the reconstruction of working life.* Basic Books, New York, 1990.

Karanika-Murray, M., & Oeij, P.R.A. (2017a). How can work and organizational psychologists fortify the practice of workplace innovation? In: P.R.A. Oeij, D. Rus, & F. Pot (Eds.), *Workplace Innovation: Theory, Research and Practice*, Heidelberg: Springer Publishing.

Karanika-Murray, M., & Oeij, P.R.A. (2017b). The role of work and organizational psychology for workplace innovation: Fortifying practice. *European Work & Organizational Psychology–In Practice* (special issue on Workplace Innovation). http://www.eawop.org/latest-issue

Kline, R.B. (2004). *Beyond Significance Testing: Reforming Data Analysis Methods in Behavioral Research*. Washington D.C.: American Psychological Association.

Lado, A. A., & Wilson, M. C. (1994). Human resource systems and sustained competitive advantage: A competency-based perspective. *Academy of management review, 19*(4), 699-727.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods, 4*(1), 84.

MacLeod, D., & Clarke N. (2009). *Engaging for Success: Enhancing performance through employee engagement*. London: BIS.

Morgeson, F. P., & Humphrey, S. E. (2008). Job and team design: Toward a more integrative conceptualization of work design. *Research in personnel and human resources management, 27*, 39.

Muthén, L. K., & Muthén, B. O. (1998-2014). *Mplus User's Guide*. Seventh Edition. Los Angeles, CA: Muthén & Muthén.

OECD. Centre for Educational Research and Innovation (CERI). (2010). *Innovative workplaces: making better use of skills within organisations*. OECD, Paris, France.

Oeij, P.R.A., Rus, D., & Pot, P. (2017). *Workplace Innovation: Theory, Research and Practice* (Eds.) Springer.

Oeij, P. R. A., Žiauberytė-Jakštienė, R., Dhondt, S., Corral, A., Totterdill, P., & Preenen, P. (2015). *Workplace Innovation in European companies*. Study commissioned by Eurofound. Luxemburg: Office for Official Publications of the European Communities.

Parent-Thirion, A., Vermeylen, G., & Houten, G. V. (2012). Eurofound (2012), Fifth European Working Conditions Survey. *Publications Office of the European Union, Luxembourg, S*, *158*.

Pot, F.D. (2011). Workplace innovation for better jobs and performance. *International Journal of Productivity and Performance Management, 60* (4), 404-415.

Pot, F., Dhondt, S., & Oeij, P. (2012). Social innovation of work and employment. In *Challenge Social Innovation* (pp. 261-274). Springer Berlin Heidelberg.

Pot, F., Totterdill, P., & Dhondt, S. (2016). Workplace innovation: European policy and theoretical foundation. *World Review of Entrepreneurship, Management and Sustainable Development, 12*(1), 13-32.

Purcell, J., & Georgiadis, K. (2007). Why should employers bother with worker voice?. *What Workers Say: Employee Voice in the Anglo-American Workplace*, 181-197.

Ramstad, E. (2009), Promoting performance and the quality of working life simultaneously. *International Journal of Productivity and Performance Management, 58* (5), 423-436.

Ramstad, E. (2014). Can high-involvement innovation practices improve productivity and quality of working-life simultaneously? Management and employee views on comparisons. *Nordic Journal of Working Life Studies, 4*(4), 25-45.

Shantz, A., Alfes, K., Truss, C., & Soane, E. (2013). The role of employee engagement in the relationship between job design and task performance, citizenship and deviant behaviours. *The International Journal of Human Resource Management, 24*(13), 2608-2627.

Schaufeli, W.B., Bakker, A.B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire. *Educational & Psychological Measurement, 66*(4), 701-716.

Teague, P. (2005) What is Enterprise Partnership? *Organization, 12*(4), 567-589.

Tidd, J. and Bessant, J., (2009), *Managing Innovation: Integrating Technological, Market and Organizational Change*, 4th edition, Chichester: John Wiley and Sons.

Totterdill, P. (2015) Closing the Gap: The Fifth Element and Workplace Innovation. *European Journal of Workplace Innovation, 1*(1). (available at http://journal.uia.no/index.php/EJWI/article/view/166)

Totterdill, P., Dhondt, S., & Milsome, S. (2002). Partners at work. A report to Europe's policy makers and social partners. Report of the Hi-Res Project (The High Road concept as a Resource) funded by DG Research of the European Commission under the Competitive and Sustainable Growth: Accompanying Measures Programme.

Totterdill, P. Exton, R., Exton, O., and Gold, M. (2012). Closing the gap between evidence-based and common practice -Workplace innovation and public policy in Europe. Lifelong Learning in Europe. 4/2012. (available at: http://www.lline.fi/en/article/policy/totterdill/closing-the-gap-between-evidencebased-and-common-practice-workplace-innovation-and-public-policy-in-europe)

Totterdill, P. (2013) Job Design. EUWIN Theme Paper. (available at http://uk.ukwon.eu/_literature_3809/Job_design, accessed 3rd June 2014).

Truss, K., Baron, A., Crawford, D., Debenham, T., Emmott, M., Harding, S., Longman, M., Murray, E., & Totterdill, P. (2013). Job Design and Employee Engagement. (available at: http://engageforsuccess.org/wp-content/uploads/2015/10/Job-Design-and-Employee-Engagement-Katie-Truss-et-al-11.pdf)

UK Commission for Employment and Skills (UKCES) (2009), "About the UK Commission for Employment and Skills", UK Commission for Employment and Skills, London, available at: www.ukces.org.uk/Default.aspx?page=1 (accessed 5 February 2009).

van der Hauw, P. A., Pasaribu, M. N., & van der Zeijden, P. T. (2009). *Slimmer werken: gebruik, mogelijkheden en opbrengsten in de praktijk* [Working smarter: application, opportunities and proceeds in practice]. Zoetermeer: EIM

Volberda, H., Jansen, J., Tempelaar, M., Heij, K. (2011). Monitoren van sociale innovatie: slimmer werken, dynamisch managen en flexibel organiseren. [Monitoring of social innovation: smarter work, dynamic management and flexible organising.] *Tijdschrift voor HRM, 1*, 85-110.

Walker, A. (1997). Combating age barriers in employment: European research report. Eurofound.

West, M. (2012) *Effective Teamwork: Practical Lessons from Organizational Research*. Oxford: Blackwell.

West, M. A., & Lyubovnikova, J. (2012). Real teams or pseudo teams? The changing landscape needs a better map. *Industrial and Organizational Psychology, 5*(1), 25-28.

Wilson, P., & Cooper, C. (2008). Finding the magic number: Methods for determining the number of factors in exploratory factor analysis. *The Psychologist, 21*(10), 866-867.

Zwick, W.R., & Velicer, W.F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin, 99*, 432–442.

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Appendix 1a. The original list of items

Jobs and Teams
1. In [organization] employees decide how they do their jobs
2. In [organization] employees share common tasks and goals and/or work in teams
3. The technology used helps employees do their work
4. Technology determines how the work is done in [organization]
5. Employees have a say in their own working times / working time schedule
6. The flexibility applied in [organization] is harmful to employees' health (Reversed)
9. Taking initiative as an employee is highly supported

Organizational structures, management and procedures
7. [organization] has many layers between top management and the frontline
8. If you need to talk to top management, they are highly accessible
10. Some employees are regularly favoured above others (Reversed)
11. People feel understood and accepted by each other
12. Employees in [organization] feel free to bring up problems and tough issues

Employee-driven improvement and innovation
13. Employees in this [organization] are always searching for fresh, new ways of looking at problems
14. Employees in [organization] cooperate to help develop and apply new ideas
15. There are real attempts to share information throughout the organization
16. [organization] learns from good practice elsewhere as a means of improving the way we do things
17. We regularly take time to figure out ways to improve our organization's work processes

Co-created leadership and employee voice
18. Employees develop and make recommendations on issues that affect our organization's work
19. Employees speak up with ideas for new ways of working or changes in procedures
20. Managers and employees actively discuss decisions about the present and future of [organization]
21. Employee representatives help to ensure that employees' voices are heard
22. Employee representatives work with management to improve working conditions
23. The expertise of frontline employees is considered important in making strategic decisions
24. Management uses informal ways of consulting with employees as well as formal approaches

Appendix 1b. The final measure of Workplace Innovation Practices

Jobs and Teams

1. In [organization] employees decide how they do their jobs
2. In [organization] employees share common tasks and goals and/or work in teams
3. The technology used helps employees do their work
4. Employees have a say in their own working times / working time schedule
5. The flexibility applied in [organization] is harmful to employees' health (Reversed)
6. Taking initiative as an employee is highly supported

Organizational structures, management and procedures

1. If you need to talk to top management, they are highly accessible
2. Some employees are regularly favoured above others (Reversed)
3. People feel understood and accepted by each other
4. Employees in [organization] feel free to bring up problems and tough issues

Employee-driven improvement and innovation

1. Employees in [organization] cooperate to help develop and apply new ideas
2. There are real attempts to share information throughout the organization
3. [organization] learns from good practice elsewhere as a means of improving the way we do things
4. We regularly take time to figure out ways to improve our organization's work processes

Co-created leadership and employee voice

1. Employees speak up with ideas for new ways of working or changes in procedures
2. Managers and employees actively discuss decisions about the present and future of [organization]
3. Employee representatives work with management to improve working conditions
4. The expertise of frontline employees is considered important in making strategic decisions
5. Management uses informal ways of consulting with employees as well as formal approaches

Appendix 2. Standardized estimates, standard errors and p-values for the validation model

	Estimate/S.E.	**P-Value**		**Estimate/S.E.**
Significant structural paths:			**Organization by:**	
WI to Engagement	0.433 / 0.032	0.0001	1	0.478 / 0.032
WI to Satisfaction	0.487 / 0.040	0.0001	2	0.611 / 0.027
Age to Engagement	0.010 /0.004	0.003	3	0.430 / 0.033
Gender to Engagement	0.315 /0.082	0.0001	5	0.338 / 0.036
Gender to satisfaction	0.289 /0.099	0.003	6	0.215 / 0.038
Non-sign. structural paths:			9	0.831 / 0.024
Age to Satisfaction	0.005 /0.004	0.266	**Structure by:**	
Education to Engagement	0.004 /0.061	0.945	8	0.585 / 0.030
Education to Satisfaction	-0.103 / 0.073	0.158	10	0.451 / 0.033
Relationship to Engagement	0.004 / 0.096	0.965	11	0.660 / 0.024
Relationship to Satisfaction	0.154 / 0.115	0.180	12	0.780 / 0.022
			Learn by:	
WI by:			14	0.739 / 0.021
Organization	0.834 /0.023		15	0.723 / 0.022
Structure	0.930 /0.017		16	0.755 / 0.020
Learn	0.906 /0.017		17	0.755 / 0.021
Partner	0.925/0.015		**Partner by:**	
Engagement by:			19	0.720 / 0.022

Absorption	0.694 /0.032	20	0.745 / 0.023
Vigour	0.873 /0.026	22	0.619 / 0.028
Dedication	0.882 /0.026	23	0.720 / 0.024
		24	0.687 / 0.023

Note: "By" denotes measurement model; all other p values $p<0.0001$;

EUROPEAN JOURNAL OF WORKPLACE INNOVATION

The role of universities for workplace innovation: A Turkish case

Hayal Köksal

Abstract

Universities have three essential functions. One is educational and other is about generating knowledge and technology. The last one is related to the bridge between the theory and practice that is being practically engaged to the society that is generally called "Service". In many of them, to educate the citizens and citizen-leaders for the society is a much more important mission then the latter. They do this through their commitment to the transformative power of a liberal arts and sciences education. While focusing on the educational issues of students, university administrators should also take into consideration the training needs of their own administrative personnel, since they are among the fundamental internal customers of the university. Creating an innovative workplace for all is essential at a contemporary university, since it is accepted as one of the role model workplaces within society. This paper emphasises the crucial need and the steps of in-service training programmes for administrative personnel, which contributes to the educational and managerial quality of higher education institutes. As a sample case, an in-service training programme is shared for the training needs of the administrative personnel of a Turkish State University, located in Istanbul, after conducting a detailed needs analysis. Following the response of the sample university to the research findings, the paper concludes with reflections on alternative institutional structures, based on Quality Circles / İmece Circles.

Keywords: University personnel, Programme development, Needs assessment, In service training, innovation, Village Institutions, Quality Circles, İmece Circles

Introduction

Organisations and their human resources, as well as their needs, are constantly changing and both must develop new skills to maintain effective operation. In a period of recession and rapidly changing technology, it is imperative for organisations to create a flexible and adaptable labour force with the competency to use new technology and methods. As Laird (1985) stated, "A training need exists when an employee lacks the knowledge or skill to perform an assigned task satisfactorily."

The training and development of personnel is an issue that has to be faced by every organisation. The amount and quality of training carried out varies enormously from one institution to another. In recent years, the topic of in-service training, along with the concept of human resource management, has attracted more attention of administrators and employers. Several studies have shown that organisations vary greatly in their commitment to training activities. Some of the major corporations see themselves making a continuing investment in their human resources, though some still have the tendency to consider training as an unnecessary expense or waste of time. The latter meets their needs for training in an ad hoc and haphazard way. Training in these organisations is more or less unplanned and unsystematic. The others set about identifying their training needs, then design training activities around this, carry out the training, and finally assess the results of training. Such organisations engage in a systematic approach to the training and development of their employees.

What is the situation of the personnel (employees) working in universities? The main functions of higher education and universities are mainly two-fold. One is education; the other is technology and research, which are delivered to society as services. However, there appears to be a problem. Do universities provide education and training only for students, or for all internal and external customers? In other words, do they ignore one group of inner customers, like administrative employees, while ornamenting the students with modern knowledge? After working more than thirty years at various universities of Turkey, and working with total quality issues at schools, the author wants to focus on the training needs of administrative personnel who work very close to students and instructors in their daily routine. That kind of closeness, and their weak points, affect directly the quality level of faculties. Therefore, one of the main missions of university administration should be providing training for all workers in addition to faculty staff.

Universities as Change Agents and Quality Creators

Universities are an important part of societies. Their existence brings a great change to their surroundings. The university was, without doubt, a social innovation of great magnitude. It made it possible to create a market of wise men, technologists and instructors among the political and ecclesiastical powers. The responsibility of universities is to create, store and transmit knowledge through teaching, investigation and publication. Thus, they act as the change agents of communities. Universities contribute to the development of countries in a traditional way by training professionals, and by being at the centre of the creation and transfer of knowledge per excellence. In many regions, the importance of the university as a motor of development is noteworthy. Its contribution to human capital, technological contribution and cultural change is great (Klann-Delius & Somerville 2001).

The study of university contribution to development is recent. For instance, the following words are heard often for universities; objectives of the Institution, indicators, public sources of finance, private sources of finance, evaluation, quality management, participation, competition, internal competition, collaboration, incentives and control. These terms entered Turkish university life after the Total Quality Management (TQM) application trials into them after 1995. It is important to order that set of words, and to balance those concepts. There are also some contradictions about the current running of universities like; academia

versus bureaucratic staff, public management versus private management, and research versus teaching focused university, etc. Settlement of all these arguments will bring more quality and productivity to universities.

Another surprising contradiction in the proposals of experts concerning the abovementioned quality issues is taking place at the initial step of quality. While determining the customer clusters, they fail to include the university personnel/employees into the training loops (Köksoy 1998:8). Those people, those key factors of the working population of a university, are constantly kept out of the interest and training issues within that universal training agent: the university. It is surprisingly interesting. In order to eliminate the weak sides of the employees, a carefully planned needs assessment is essential. With the development of technology, some responsibilities have shown great change. For instance, typists do not exist in any workplace anymore. Computers are the main vehicle of secretaries. Some new needs appeared because of the changing world. People need to learn how to manage their time, how to deal with workplace conflict and how to manage new risks. All those issues seem to be the in-service training needs of the personnel. In the following section, this issue will be investigated.

Significance of In-Service Training at Universities

In-service training has long been a method for the improvement of instruction in institutions of higher education. Although in-service training has played a significant role in academic life, personnel work has not utilised such activities. Statistics have proven that, the rate of the participants among university employees in in-service training activities, by the distribution of government agencies and establishment groups, is approximately four percent. In 1982, the State Institute of Statistics (DİE, 1992), and The State Personnel Presidency collaborated to reveal statistical data on pre-service and in-service training activities of state establishments and foundations. According to the first publication, called "Statistics on Training in State Institutions", 278,000 people from government agencies and establishments participated in in-service training activities in 1992. Only one percent of the trainees were actual university employees.

Each individual possesses a unique blend of skills and knowledge, personality, interests, and preferences. It is to an institution's advantage to maximise the development and the utilisation of its human resources to ensure employees' satisfaction and productivity. As has been clearly understood, training: especially in-service training of human resources of those working at universities, has been ignored for a long time. The author's University is one of the schools, which has an in-service training department, but it does not contain a well-designed programme. The so-called in-service training sessions are termed as "Monthly Lecturing Sessions" at the beginning of each year, but since they are not based on the needs of the employees, they are not taken into serious consideration by the employees or the administrators.

The establishment of comprehensive programmes in in-service training can contribute effectively towards solving some of the problems facing university administration. In-service training for employees should be directed toward professional upgrading of each staff member as an individual, and the increased competence of the staff (Truill & Gross 1970:68).

Universities are the laboratories for the future. In this role, they are a major and competent leader in society. A systematic approach to training and development should follow a logical sequence of activities, starting with the establishment of a policy and the resources to sustain it, followed by an assessment of training needs, for which appropriate training is provided, and, ending with some form of evaluation and feedback.

In the following study, the author assessed the in-service training needs of the employees working at a Turkish State University according to their perceived needs, and according to the academic and non-academic administrators' point of view. After the "needs assessment phase", an in-service training

programme was proposed, in order to meet the established needs. She chose Marmara University as the target, because she graduated from the Faculty of Education of that university in 1995, she worked as a co-ordinator for it for six years, and she retired from there in 1999. She thinks that she owes that kind of support to her mother workplace. From then on, it will be mentioned as 'the university'.

Problem

As the result of changing technology, organisations are finding it increasingly difficult to fill some of their human resource needs with already trained employees. Out of this situation, they are finding it necessary to do more of their own training, and to develop talent from within the organisation. "In-service training has long been an effective method for the improvement of work to attain the goals of the organisation" Taymaz states (1981:21). Although major industrial organisations spend enormous amounts of effort and money for the training needs of their employees, the in-service training of the personnel working at schools, particularly at universities, has been mostly neglected.

The establishment of a comprehensive programme of in-service training can contribute significantly toward solving some of the problems facing universities, and more specifically in the administrative personnel area. Due to the reasons mentioned above, the Seventh Section of the State Personnel Law, No.657, has defined the regulations of in-service training activities of personnel working for State Establishments and Foundations under the heading of "The Training of State Personnel ". According to the Article 214 of the same Law, "An in-service training programme, which aims at increasing the efficiency of the State Personnel, improving their productivity, and preparing them for higher level positions, is conducted through the regulation prepared by the State Personnel Presidency and the related organisation. Article 215 recommends that each organisation establish a "Training Bureau" for the organisation, which includes the implementation and evaluation of training programmes for the training needs of their staff. The Higher Education Law, No.2547, also has similar rules related to in-service training.

When the situation was analysed at Marmara University, one of the largest universities in Turkey, in accordance with the rules mentioned above, it was understood that no well-planned in-service training programme for the employees (secretaries, typists and other employees) existed, except for a few explanatory sessions about the recent changes in the rules and regulations related to the administration (1994-1997).

The problem, therefore, appears to be twofold;

- The investigation of the in-service training needs of the employees working at the university.
- The establishment of an appropriate programme that would meet the needs of the employees.

Purpose

This study attempted to develop an in-service training programme, after the assessment of the in-service training needs of employees working at the university.

In-service training is a multidimensional phenomenon, with numerous variables such as employees, academic and non-academic administrators, that makes it necessary to take into consideration the perceptions of each position on the determination of their training needs. Additionally, the effects of independent variables such as; age, sex, educational level, work experience and type of job the employee performs will be investigated in order to better establish their training needs. In summary, the aim of that study was to identify the in-service training needs of the employees at the University and to develop an in-service training programme.

Research Questions

The primary focus was on the identification of the in-service training needs of the employees and on the development of a programme, which would help the administrators bring in an over-all solution to the problems. The following questions were examined in the course of this study:

A. Questions and Sub-questions Related to the Needs Assessment:

1. Which in-service training areas and courses are perceived as important for employees by employees, academic administrators, and non-academic administrators?
2. Are there any significant differences in the perceptions of employees, academic administrators and non-academic administrators about the -service training needs of employees?
3. Which training methods do the employees prefer while attending the courses?
4. Is there a consensus among employees, academic administrators and non-academic administrators on the instruction time of the in-service training courses of the employees?

In addition to the above main research questions, the following sub-questions will also be answered:

- Do the perceptions of employees on the areas and courses vary according to *age*?
- Do the perceptions of employees on the areas and courses vary according to *sex*?
- Do the perceptions of employees on the areas and courses vary according to *educational background*?
- Do the perceptions of employees on the areas and courses vary according to *work experience*?
- Do the perceptions of employees on the areas and courses vary according to *type* of *job* performed?

B. Question Related to the Programme Development:

1. What kind of in-service training programme may be developed for the employees of the university in the light of the findings of the "Needs Assessment"?

Method of Data Collection

Selection of the subjects: In that study, two populations were under consideration: *administrators* and *employees*. "The administrators´ group" consisted of academic and non-academic administrators working in different faculties and offices of the university, and they were in close contact with employees. "The employees´ group" consisted of administrative personnel such as secretaries, typists, officials, librarians and custodians. The medical and technical staff were excluded, as the researcher believed that an expert in those fields should assess their needs. Also excluded were those who have been working at the university for less than a year, under the assumption that they had just had "Basic and/or Orientation Training".

Since the purpose of that study was to develop an in-service training programme for the needs of the employees of the university, all the employees, academic, and non-academic administrators: excluding medical, technical and academic staff, were taken as the subjects. The subjects were estimated as 141 academic, 162 non-academic administrators and 680 administrative personnel. Of this overall population, the margin of error was 10% as these questionnaires were not suitable for analysis or were not returned. Thus, the population included 609 administrative personnel, 148 non-academic administrators, and 128 academic administrators.

The "Employees' Group" consisted of five different types of professions: officials (331), secretaries (64), typists (89), librarians (29) and custodians (105). The "Academic Administrators' Group" (128) included the Secretary General, Deans, Assistant Deans, Directors of Institutions and their assistants, Directors of Schools for Advanced Vocational Studies, and their assistants, Heads of Departments, and Heads of Social and Scientific Disciplines. Office Directors, Executive Secretaries to the Faculties and to the Schools for

Advanced Vocational Studies, Section Officers, Accountants, and Chiefs constitute the "Non-academic Administrators' Group" (148).

Instruments: In that study, two sets of questionnaires were utilised for data collection purposes in the "needs assessment" phase. One was used for both groups of the administrators (academic and non-academic), and the other for the employees. The questionnaires, developed by Gedikoğlu in 1989, were modified and adapted by the researcher. First, a broad review of literature and regulations prepared by the related body of government (The In-service Training Department of The State Personnel Presidency) concerning in-service training was examined. Secondly, some corrections and changes were made. After consultation with various experts in the fields of "adult education" and "in-service education" in Istanbul and Ankara, four judges (academics) were asked to check the content and determine the face validity of the questionnaires before a pilot study would be conducted. After having made the recommended changes, the judges agreed that the instruments could serve the purpose, and they suggested that the researcher conduct a pilot study.

Thus, a pilot study was conducted (N=35) in one of the faculties of the university. After the application of "Test-retest" technique, the reliability of the instruments was computed by utilising the reliability sub-programme of SPSS (Nie 1975:58), and it was found to be 0.92, indicating high reliability. The results of the pilot study were also discussed with the experts, and the questionnaires were given their final form.

Each questionnaire consisted of three parts:

1. Demographic characteristics of the respondents,
2. Seventeen in-service training areas and five teaching methods (the teaching method took place only in the questionnaire form of the employees).
3. Nine In-service training courses, and their preferred times; "During Work" or "After Work".

The Employees Questionnaire: The first part of the questionnaire aimed at identifying the demographic characteristics of employees (age, sex, type of job, educational background and work experience). Thus, necessary information would be gathered to draw a profile of the employees, and data would be used to find answers to the sub-questions of the needs assessment part. In the Second Part, the respondents (employees) were asked to identify the extent 17 areas on five-point Likert type questions ranging from a "Very Important" specification" to "Definitely not important". The options were weighed from five to one. They were asked to define the training methods as well. Part 3 included nine courses, and their perceptions of their in-service training needs were asked through a one to five Likert scale as mentioned above. They were also asked to identify the instruction time of the courses.

The Administrators Questionnaire: The first part consisted of only the options concerning the posts of the academic and non-academic administrators. In the Second Part of the questionnaire, the administrators were asked to define the in-service areas related to the jobs of their employees through a one to five Likert scale. The ratio of the options was five to one, as mentioned earlier. The last part was the same as the employees' form.

Method of Data Analysis

In the study, the data related to the in-service training needs and demographic characteristics of the employees of the university were processed at the Computer Centre of the university. The researcher used the following tools to analyse the data:

- the frequency distributions and percentages",
- "t-test" (when independent variables have two categories and dependent variables are continuous),
- "one-way analysis of variance (ANOVA)" (when independent variables have more than two categories and dependent variables are continuous),
- and after ANOVA test, to see where the differences occur; a "Post hoc"- Student-Newman-Keuls test (S.N.K.) of SPSS (Statistical Packages for Social Sciences / .5.0), and
- "chi square test" (when the whole variables are categorical) (Gay1987:420).

In analysing the First Part of the questionnaires, "frequencies and percentages" were used to describe the demographic characteristics of the respondents. The same statistical procedure was applied to find out answers to the questions related to the "Teaching methods of the subject matters" (Question 3), and the "Instruction times of the in-service training courses" (Question 4). Furthermore, in order to test if there were any significant differences in the perceptions of the employees, academic administrators and non-academic administrators on the "Instruction time of the courses", the chi-square test was used.

In determining the degree of importance of the subjects' job specifications and the courses according to the perceptions of three groups of subjects (Question 1); the means, standard deviations and percentages of each item were used. In order to identify if there were any significant differences in the perceptions of the employees, academic administrators and non-academic administrators of employees' in-service training needs (both areas and courses) (Question 2), one-way Analysis of Variance (ANOVA) was used. According to Gay (1981:321), in a study involving three groups, the ANOVA is the appropriate analysis technique.

One-way Analysis of Variance was also used to see the differences between the perceptions of employees concerning age, educational level, work experience and type of job performed (Sub-Questions). In the analysis of variance, an overall *F* test, if significant, simply indicates that there are significant differences somewhere in the data. To test hypotheses, however, more or less controlled and precise statistical tests (Post Hoc) are needed (Kerlinger 1979:232). Thus, the researcher is able to know which differences contribute to the significance. In order to realize this, the Student-Newman-Keuls (S.N.K.) test was used. It is a multiple comparison procedure that arranges the group means from the smallest to largest and sets the ranges that is used to test for a significant difference between means on the basis of a number of steps between the two means being tested.

The t-test was used to test if there were significant differences between the perceptions of the employees concerning *sex* (Sub-Question)**.** The t-test is used to calculate the degree of significance of two means at a selected probability level. The t-test makes adjustments for the fact that the distribution of scores for small samples becomes increasingly different from a normal distribution as sample sizes become increasingly smaller (Gay 1987:428).

Discussion of Results

Demographic Characteristics of the Participants:

Employees: According to the results (1997), the majority of the employees working at the university were young; 54.5 percent of them are between the ages of 30 and 39, with an experience of 6-15 years (58.2%). It was interesting to note that, more than half of the employees were females (56.8%), and nearly half of the employees were high school graduates (55.2%). The other were faculty graduate and elementary school graduates. The majority of the employees were officials (54.3%) performing office work. 17.1 percent were custodians, 14.5 percent are typists and 10.5 percent were secretaries. The remaining 4.6 percent were librarians.

Administrators: Since the employees constituted the focal point of the study, the demographic characteristics of the administrators were not taken into consideration, except for their positions.

The perceptions of the Subjects:

The findings revealed that in general there was some consistency among the perceptions of the groups. For instance, each of the first ten areas took place within the first ten important areas of each party. In rank ordering of the importance of the 17 areas, it was found that the three groups agreed on the first most important area (Improving the Oral and Written Forms of Turkish Effectively and accurately). Employees and academic administrators agreed on the second one (Learning the Administrative Regulations, and their Application) and the third one (Learning the Ways of Maintaining Discipline, Safety and Order at Work). The perceptions of the employees and non-academic administrators showed similarities on the areas 5 (Learning Self-improvement at Work), 9 (Learning How to be Productive and Harmonious in Group Work) and 10 (Improving Oral and Written Communication within the Organisation). Academic and non-academic administrators showed significant differences in all areas, except for the first one.

On the other hand, the perceptions of the subjects concerning the in-service training courses revealed statistically significant similarities on the third, fifth and ninth courses. All the groups placed the "Time Management Course" as the second most important, "Executive Secretary" as the second least important and the "Typing Course" as the least important. Although, employees and non-academic administrators shared the same perceptions on course 4 (Computer) and course 8 (Public Relations), academic administrators demonstrated significant differences.

Teaching Method Preferences of the employees:

The results of the "Frequency Distributions and Percentages" revealed that employees preferred "Lecture" method for nine and " Learning by Practicing" method for seven of the areas. They preferred "Group Work" method only for one area (Learning How to be Productive and Harmonious in Group Work). They did not prefer the other two methods ("Question and Answer" and "Case Study") for any of them.

Perceptions of the Subjects on the Instruction times of the Courses:

The three groups of subjects (academic administrators, non-academic administrators and employees) agreed on six courses to be given after work. These are; "Turkish", "Time Management", "Public Relations", "Foreign Languages", "Executive Secretary" and "Typing" courses. The perceptions of the participants demonstrated significant differences on "Computer", "Behaviour and Appearance" and "Office Management" courses. In general, employees perceived those courses as "During Work" activities, except for the administrators.

The Associations between the Perceptions and Demographic characteristics of the Employees:

In terms of demographic characteristics, employees showed differences in the perceptions of the in-service training needs of themselves. Statistically significant differences were found among the perceptions of the employees on twelve areas and six courses, concerning age. For most of the areas *the younger* employees indicated "more important" in-service training need, whereas, the courses were stressed as the most important needs by *the oldest* group of employees. Those who were between 30 and 39 did not perceive the in-service training as important as the other age groups did. That might reflect that young employees were facing difficulties with their jobs, and their older colleagues were aware of their needs for in-service training.

There were significant differences between the employees' perceptions areas and one course concerning their sexes. *Female* employees perceived those items as more important needs for employees than the *male* employees did. They agreed on the other nine areas and eight courses.

Two-year higher school and university graduates perceived a higher importance in most of the areas and courses than elementary or Jr. High school graduates did. Employees with "higher education level"- especially, those who have degrees- are more aware of the in-service training needs of the employees working for the university.

On the other hand, the results of the statistics revealed that no significant differences were found between the work experiences of the employees and their perceptions about eleven areas and six courses. Level of experience was not found to be a significant variable in their perceptions about those points. For the remaining areas and three courses, the experience-groups shared their feelings. In summary, as they gained more experience, they considered those in-service training needs as having more importance for the employees.

In contrast to work experience, all of the employees with different type of jobs perceived differently the importance of the in-service training. Typists, librarians and secretaries were the ones who perceived most of the areas and in-service training courses as being "Very Important". Officials and custodians perceived none of their areas as important. Officials considered the "Computer Course" as the most important one, and the custodians thought that "Turkish Course" was the most important one. There existed no significant differences among the perceptions of the five job groups of the employees on the "Executive Secretary" and "Behaviour and Appearance" courses.

Programme Development

The improvement of in-service training in organisations and the effectiveness and efficiency of employees, requires careful needs analysis and planning of training design. In other words, the goal of the in-service training programme is to improve the performance and productivity of the present, experienced employees of the University, by decreasing the deficiencies through training in four months' time. This goal sought by in-service training is directly related to the needs of the personnel and basic objectives of the organisation. All employees should receive appropriate opportunities to improve their job performances. In that study, the perceptions of the academic administrators were accepted as the major criterion for the in-service training needs of the employees. However, the perceptions of the other two parties: non-academic administrators and employees, were taken into consideration, to some extent. ın the light of the findings, three in-service training courses were eliminated and six in-service training courses and related seventeen areas appeared to be the in-service training needs of the employees for the university. The programme would be realised through these in-service training courses: "Turkish", "Time Management", "Computer", "Behaviour and Appearance", "Public Relations" and "Office Management ".

For each of those courses, the researcher listed a series of objectives through the needs analyses. The in-service training areas were expressed as the objectives of the programme because they were the expected behaviours of the employees as the result of this in-service training programme. After having completed the in-service training programme, employees of the university would reach the following programme objectives. The employee who finished that programme successfully would be able to:

1. Improve in oral and written forms of Turkish effectively and accurately.
2. Recognise better ways of oral and written communication within the University.
3. Know how to be productive and useful at work.
4. Develop self-improvement at work.
5. Know how to be productive and harmonious in group work.
6. Learn how to be creative and investigative at work.
7. Know how to motivate themselves to work harder.
8. Be familiar with the practical use of innovative technology (e.g. computer and fax).
9. Understand the administrative regulations and their appliance.
10. Interpret the ways maintaining discipline, safety and order at work.
11. Rearrange the relations between the subordinates and superiors in accordance with modern human relations.
12. Comprehend the ways of dealing with disagreements at work.
13. Learn self-evaluation and self-control.
14. Be familiar with the ways of "filing" and styles of "corresponding.
15. Develop good leadership skills.
16. Learn the use and the maintenance of the office equipment.
17. Be familiar with the activities to improve their social, cultural and artistic sides in order to mingle with the other people.

Design of the Programme:

In order to realise those objectives, and match them with the desire of the employees, the above-mentioned five in-service training courses, would be satisfactory. The "Computer Course" was considered as a component of the "Office Management Course" since it was only needed by those who performed office work. On the other hand, the "Public Relations Course" was included in the "Core Course" which holds the obligatory subjects by the Laws, such as; "The Principles of Atatürk", "The History of Turkish Revolution","First Aid" and "Civil Defence". Because "Public Relations" is considered one of the basics of a contemporary organisation. Thus, in order to accomplish the programme goal, in-service training programme would be realised through the following five in-service training courses:

- Turkish
- Time Management
- Behaviour and Appearance
- Office Management
- Core

Those courses were also divided into different segments to meet the differing in-service training needs of the employees who had significantly different characteristics concerning educational background and type of job they performed. Each main course consisted of; a) the course goals and objectives, b) the course content, c) the course Implementation and d) evaluation of the course.

The major elements of the course design generally contain: the participants, the content, the trainers, needed resources, location and facilities, the training methods, scheduling, administration and budgeting and measurement of the trainees' achievement. Each of these elements were clarified in the study. In the

light of the findings, the researcher, including 17 in-service areas, developed a 40-hour-programme and six in-service training courses (See the figure). The necessary additions, which were recommended to be included in any in-service training programme to be conducted in Turkey by the in-service training regulations of the State's Personnel Institution, were applied. The proposed programme, that was based on the results of a needs analysis of all employees and the perceptions of the administrators of the needs of their employees, was designed to respond to the changing professional needs of administrative employees by offering activities to improve their productivity.

Recommendations

On the basis of the findings of that study, the following can be recommended for further studies on in-service training needs of the university personnel:

1. This study only surveyed the employees of Marmara University as a representative of Turkish State Universities. Therefore, for further studies, it may be wise to survey the other universities (state and/or private) by using different techniques, such as; interview or observation in addition to the questionnaire forms of this study to be able to make comparisons among different universities.
2. Universities could have a great role in supplying the training facilities. They could support other institutions and organisations in developing and setting up in-service training programmes. Related professors in the universities could help to develop such training programmes and provide trainers and training aids. Then, it becomes the responsibility of these institutions / organisations to send their educators and administrators to participate in the training programmes and make training a compulsory pre-condition of employment.
3. Many administrators and even educators look upon in-service training as a stepping-stone rather than as a motivator and developing factor. Therefore, the government and the high-level administrators of the organisations should consider in-service training as an important section of the educational system.
4. In this study, the programme was designed only for the administrative employees (typists, secretaries, officials, librarians and custodians). Maybe another study can include other employees such as technical or medical ones.
5. The implementation and evaluation phases of the study may also be investigated more deeply in different studies.

Further studies are recommended to all universities to determine the needs of their customers.

Conclusion

Development and increase of the quality level of a country depends on the quality of universities. They are the main change agents of a community. Quality improvement efforts cannot be partial. Wholeness is necessary. Therefore, if the instruction and administrative issues are the main concerns of any institution, all members should get the advantage of all innovative developments within the institution. This is the main responsibility of top managers. In this research, the main target was the employees, in another one it might be any other working group. If one would like to talk about workplace innovation, it must be open to all customer groups.

The research was conducted by the author as part of a Ph D dissertation. A programme of staff training and development was recommended in 1998, but the University administrators declined to proceed. Even though the author retired from the university in 1999, she continued working at various outstanding Istanbul universities. After 2000, she has focused her studies on alternative institutional structures and Quality Circles (QC). She localised that methodology to Turkish settings and designed a new one called İmece Circles. Following the response of the sample university to the research findings, the paper

concludes with reflections on alternative institutional structures, based on Village Institutions and Quality Circles / İmece Circles.

There has been a long tradition of Village Institutions in Turkey, which were first established by Ataturk, as part of his vision for building a modern Turkey, after the Ottoman Empire and the First World War. This offers an alternative, practically oriented, model of education, including Higher Education and Teacher Education. Arising from this has been recent substantial work in Turkey with Students' Quality Circles, also known in Turkey as İmece Circles. This can also be seen as building on foundations of Quality Circles in Japan, which were then transposed to the context of schools in India, and became the basis for an international movement, concerned with aspects of Total Quality Management, and with a focus on Quality as Empowerment.

In Turkey, Quality issues have gained importance for universities recently. The Higher Education Council has started some training programmes for administrative personnel starting from Deans. That is an initial positive point for all developing countries like Turkey. We may hope to see a re-invention of the modern university, taking account of the role of the university as a knowledge workplace. Many bureaucratic universities, often preoccupied with New Public Management, have neglected the learning and development needs of their own employees, thus damaging the effectiveness of the university as a whole. There are alternative ways forward. The objective should be having qualified and outstanding global universities, instead of having hundreds of low-quality higher education schools. This will bring quality to education.

References

Akyıldız, İ.1994. *A Study of In-service Training Activities in Selected Turkish Industrial Organizations*, Unpublished M.A.Thesis, B.U., Istanbul.

Başaran İ. E., 1966. *Hizmet-içi Eğitim Araştırması (In-Service Training Research)*, MEB Eğitim Birimi Müdürlüğü Yayınları (Ministry of National Education Publications), Ankara.

Bloom B., 1956. *Taxonomy of Educational Objectives-I. The cognitive Domain*, Longman, London.

Bursalıoğlu Z., 1975. *Eğitim Yöneticisinin Yeterlilikleri (Sufficiency of Educational Administrators),* A.Ü.E.F. Publications, No.51, Ankara.

Cole G.A., 1988. *Personnel Management*, DP Publications Ltd., London.

DİE 1992. *Kamu Kurum ve Kuruluşları Hizmet Öncesi ve Hizmet-içi Eğitim İstatistikleri (Statistics of Pre- and In-Service Training Programs of the State Organizations),* T.C. Başbakanlık Devlet İstatistik Enstitüsü (Institute of Statistics of Turkish Prime Minister Office, Ankara.

Gay L.R., 1981. *Educational Research*, Bell and Havel Co., LA.

Gedikoğlu T., 1989. *Gaziantep Üniversitesi İdari personelinin Hizmet-içi Eğitim İhtiyaçları (In-Service Training Program Needs of G.U.)*, Gaziantep.

Karasar N., 1986. *Bilimsel Araştırma Yöntemi (Scientific Research Method)*, Bilim Publications, Ankara.

Klann-Delius G. & Somervill J. 2001. "Opening Talk of the Dean" *(Deans' European Academic Network, Third Annual Conference Proceedings,* Berlin, 8-10 October.

Köksal H., 1997. *A Proposed program for the In-service Training Needs of the Employees Working at M. U.*, Unpublished Ph.D. Dissertation, Gaziantep University, Gaziantep.

Köksoy, M. 1998. *Yükseköğretimde Kalite ve Türk Yükseköğretimi için Öneriler (Suggestions of Quality at Universities and Turkish Higher Education)*, İstanbul Kültür University Publications, No: 2, İstanbul.

Nie N. H., Hull J.H., Jenkins J.G., Steinbrenner K. and Bent D.H. 1975. *Statistical Package for the Social Sciences* (2nd Ed.), Mc Graw - Hill, New York.

Taymaz H., 1981. *Hizmet-içi Eğitim-Kavramlar, İlkeler, Yöntemler (In-Service Training: Concepts Principles Methods),* AÜİEF Publications, No. 94, Ankara.

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Dynamic capabilities:

Their effect on performance mediated by product integration in the highly acquisitive software industry

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Abstract

Building on behavioural theory employing dynamic capabilities, this paper examines how firms create competitive advantage through innovation over time after multiple mergers and acquisitions. Mergers and acquisitions are a way to acquire gaps and prominently missing features and functions; the firm then has only to assimilate them into their portfolio. This research is focused on the acquirer's ability towards obtaining performance from product integration and is set within the context of highly acquisitive software-houses; those organisations involved in the sales and manufacture of business software products. The ability to realign and innovate this will increase performance over the long term.

Keywords: Dynamic capabilities; performance; product integration; software industry; acquisition

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Introduction

According to the Business Software Alliance, BSA (2008), the software sector has enjoyed meteoric growth. In 2007, the software and related services sector experienced a real annual growth rate of 14%, compared with a real annual growth rate of 2% for all US industries, outpacing the rest of the US economy in each year since 2003. The highly acquisitive company which seeks rapid growth and use acquisitions as the means to achieve this, is using a recognised route to growth. Famously, Cisco went from being a small company in the 1990's to being (briefly) the largest market capitalised company in the world (Damodaran 2004). High growth through acquisition is cheap, in part due to accounting rules that allow the acquirer to show the benefits of the acquisition but partially hide the costs of the acquisition. This growth success is reflected in the increase of share prices and marks out the CEO of the firm as a genius (Damodaran 2004). The implication is, for the firm that has grown in this way to remain successful it has to continue on the acquisition path to keep the top-line numbers high. Léger and Quach (2009) agree and imply that in the short term, post-acquisition, the firm can relax with regard to gaining product synergies by combining portfolios: simply making an acquisition increased the financial market value. Léger and Quach (2009) determine that for acquisitions within the software market and the financial markets fail to take the potential synergy of the combined software portfolio into account when valuing the acquirer firm's shares.

As this level of acquisition is not sustainable indefinitely, many of the highly acquisitive software houses, such as SunGard (2010), have latterly attempted to focus on endogenous growth (PwC 2013) from their existing portfolio. This is more generally termed as 'organic growth' in the industry, i.e. growing the business by creating and innovating more with what they already have (Nambisan 2002a). In a press release in May 2009, Cristóbal Conde, SunGard president and chief executive officer, commented:

> *"We are very pleased that we achieved positive organic revenue growth in the quarter in the face of very challenging industry conditions"…'organic revenue grew just under 1% in the quarter'* (SunGard 2009).

This raises the question as to how is it that the BSA (2008) reports that the software industry is growing by such a large margin (14%), but the internal growth of the example acquisitive software house is not? There is a possibility that the software houses are not looking at the revenue growth from increased innovation.

This study will concentrate highly acquisitive software firms and aims to describe, explain and account for the impacts of mergers and acquisitions on the impacts on innovation, in terms of product integration: the reconfiguring and combination of the product portfolios in software firms. With regard to the acquiring firm's endogenous growth, the intent is to explain the relationship between organisational capabilities and the innovation outcome, as well as the innovations' effect on revenue.

1.1 Problem definition

In 2012, software firms completed over $66 billion of mergers and acquisitions (Berkery Noyes 2013). However research suggests that synergies are left unrealised (Barkema & Schijven 2008; Léger & Quach 2009). In addition, the software industry is maturing and mergers and acquisition activity in the industry has intensified (Léger & Quach 2009). In a report from PwC (2014) Rob Fisher, the PwC US technology industry leader notes that:

> *"With software embedded in virtually everything, software and Internet sector [mergers and acquisition] deal activity continues to flourish, offsetting declines in other subsectors."*

For example, some of the largest deals from 2012 were (PwC 2014, p.1):

- Cisco's acquisition of NDS Technologies, a provider of content management software, for $5 billion.
- Dell's $2.4 billion acquisition of Quest Software, developer of application and database utilities.
- The $1.9 billion acquisition by RedPrairie, a developer of logistics management software.
- The acquisition of SunGard Higher Education from SunGard Data Systems by Datatel for $1.8 billion.

Léger and Quach (2009) explain that few businesses achieve the performance levels that were anticipated at the time the decision to undertake the acquisition was made. Much research has explored the mergers and acquisitions process prior to acquisition and argues that strategic fit is key for synergistic opportunities (Barkema & Schijven 2008; Hitt et al. 2009; Pennings, Barkema & Douma 1994). Latterly however, Barkema and Schijven (2008) have revealed that although strategic fit is necessary, it merely creates potential for strategic realisation through effective integration.

As software is a high-technology industry (Nambisan 2002a), the need for novel solutions has been a motivational strategy, enabling firms to extend their resources and capabilities through mergers and acquisitions (Makri, Hitt, & Lane 2010). Again, Makri, Hitt and Lane (2010) find that the pre-acquisition decisions on fit are important, however the level of the fit between the firms has an impact on innovation (creating novel solutions) in other high-tech businesses.

Nambisan (2002a) confirms that high-technology customers place increasing value on cross-product integration. On the other hand, this is challenging for the firm, since integration efforts may cause distraction from the strategic product plans, additionally the potential disruption due to the need for additional development resources and rapid evolution of complementary products. This implies that post-acquisition, in order to satisfy customer needs, the firm must innovate: that is, combine and reconfigure their products to remain competitive and profitable (Teece 2007).

Therefore, after an acquirer selects and then acquires a firm with synergistic potential, it is up to the acquirer to build the organisation in such a way as to facilitate the synergy opportunities, regardless of complexity (Barkema & Schijven 2008). The performance of the acquirer in the financial markets is not impacted by the software compatibility (Léger & Quach 2009), although there is a recognition that software firms are focusing on incorporating past strategic acquisitions, creating disruptive innovation and looking for competitive differentiators (PwC 2013).

Within high technology industries, resources are at the heart of the firm and constitute the largest cost. The resource based view (RBV) of the firm is an influential theory that offers an explanation of assets that can be used in strategic change that achieves competitive advantage (Eisenhardt & Martin 2000; Penrose 2009). This RBV perspective is focused on the internal organisation and thus complements the notion of the emphasis of strategy as positioning within an industry structure. More recently, scholars have extended the RBV of the firm to more dynamic markets, i.e. firms in situations of rapid change as the RBV does not adequately explain how and why some firms have an advantage in change situations (Eisenhardt & Martin, 2000). In these markets, where the competitive landscape is shifting, the dynamic capabilities by which firm managers "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece, Pisano & Shuen, 1997, p.516). To this end, the development of the dynamic capabilities framework sets out to enable business enterprises to create, deploy, and protect the intangible assets that support superior long-run business performance (Teece 2007).

Dynamic capabilities are focused on the businesses that consist of difficult to replicate and trade assets and competencies, such as the high tech software industry. In addition, dynamic capabilities include difficult to replicate enterprise capabilities required to adapt to changing customer and technological opportunities. Incorporating the ability to shape the ecosystem that it occupies, in terms of product development, business model design and implementation (Helfat & Peteraf 2009; Teece 2007).

Whilst the theory has extended the resource based view of the firm, theory concerning dynamic capabilities has had little time to develop, in relative terms and as such has been criticised for having a lack of clarity, as well as a lack of empirical support (Helfat & Peteraf 2009, p.92). Eisenhardt and Martin (2000) use organisational theory to analyse the processes that underpin dynamic capabilities. Helfat and Peteraf (2009) point out that a specific capability can be tested with the same tests as a resource based test in answer to critics.

Dynamic capabilities rest on the firms process that can alter the current position leading to an effect on the firms performance and competetive advantage (Helfat & Peteraf 2009). Teece's (2007) dynamic capabilities model focuses on dynamic capability types, i.e. sensing opportunities, seizing the opportunity and recombination. The dynamic capabilities basic chain of logic (Helfat & Peteraf 2009) in Figure 1 demonstrates that subsequent to investement (seizing) the dynamic capabilities for recombination and reconfiguration can further alter the asset base leading to additional effect on firm performance. This is the fundamental problem to be addressed in this

paper. After mergers and acquisitions, the opportunity sensed and seized by the firm, do the reconfiguration and recombination capabilities lead to increased innovation (product integration) and performance?

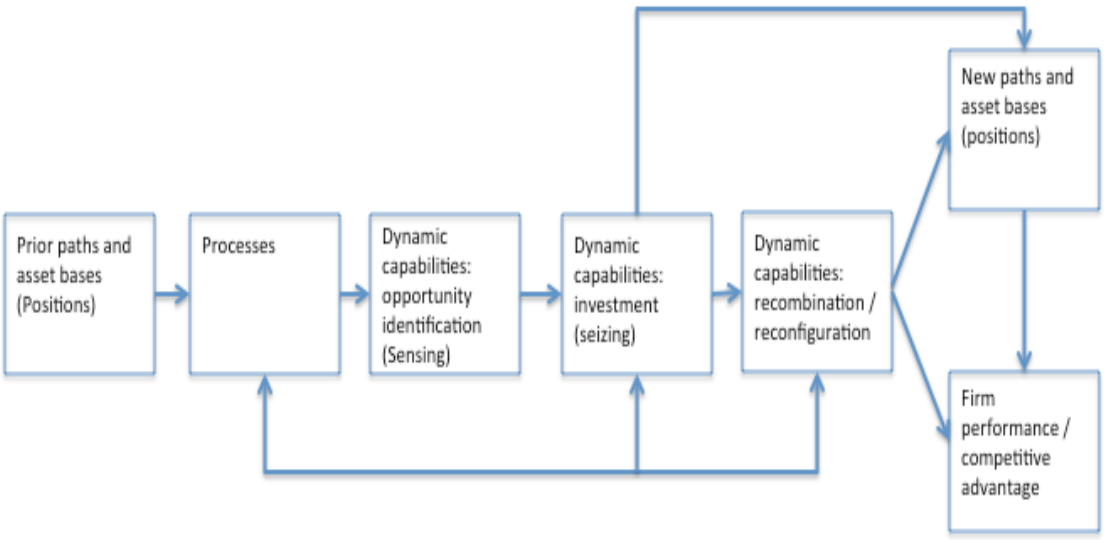

Figure 1: Dynamic Capability chain of logic (Helfat and Peteraf 2009, p.96)

In light of the business problem and the reach of the dynamic capabilities framework, it is therefore reasonable to pursue the factors that determine the product integration innovation success of software products post-acquisition as well as the impact of that innovation on the acquirer's performance. Thus, extending the empirical work utilising this framework and adding to the body of work in strategy process incorporating management decision making, organisation routines and change.

2. Key Theories

2.1 Mergers and acquisitions

This study is concerned with organisation capabilities and behaviours that impact the success or otherwise of product integration, i.e. product innovation, post mergers and acquisition in the software industry. Mergers and acquisitions (M&A) have been a topic of great interest in research regarding financial impacts as well as for organisational and individual behavioural effects (Ager 2011; Ahuja & Katila 2001; Barkema & Schijven 2008). As Ager (2011, p.200) noted in an ethnographic study of Xerox, mergers and acquisitions are difficult to do although "they seem like a good idea." Mergers and acquisitions are undertaken for multiple reasons, e.g. market growth, to gain economies of scale and scope and to acquire competencies (PwC 2013). Domodaran (2004) explains that analysts like companies that engage in mergers and acquisitions, and therefore invest heavily in them. Notwithstanding this, mergers and acquisitions are costly, complex, and risky. Many regard their potential as worth the time and effort, yet, many fail to meet expectations (Barkema & Schijven 2008; Léger & Quach 2009). In the software market, Grant Thornton (2011) reports that mergers and acquisition are extensively adopted. Barkema and Schijven (2008) study the unlocking of potential synergies following mergers and acquisitions and build on a theme within behavioural theory that extends the insights into organisational learning, restructuring and acquisition behaviour. This research seeks to extend the body of existing research in organisation behaviour impact to product innovation following mergers and acquisitions and further, how the performance is mediated by the product innovation.

Post mergers and acquisitions, the most difficult job of the acquirer begins; the creation of value that was expected from the deal through successful integration of the companies' operations (Barkema & Schijven 2008; Gates & Very 2003). Whatever the acquirer's strategy, combining two firms will often constitute a challenging task for management. The acquirer must implement synergies in order to create value while simultaneously managing issues to avoid value leakage (Gates & Very 2003). Barkema and Schijven (2008) agree that, post-acquisition, firms integrate to capture performance.

2.2 Technology Integration

This study is not focused on the integration of the company operations, e.g. HR or accounts. It is concerned with the next stage of integration, involving innovation, resource management and organization capability. Teece (2007) describes these requisite skills as dynamic capabilities and frames this activity stage in terms of the realignment of specific tangible and intangible assets. To this end, the literature review is seeking extant research that explicates the influencing factors of post-acquisition integration in the technology sector. These factors encompass wide ranging organizational influences associated with the decision to maximise value from an acquisition by realigning, integrating the portfolio and creating new product in the technology sector.

The dynamic capabilities framework, as explained by Teece (2007) is particularly relevant to high technology sectors, where company success depends upon the discovery and development of opportunities, the effective combination of internally generated and externally generated inventions, efficient and effective technology transfer inside the enterprise, the protection of intellectual property, the upgrading of 'best practice' business processes, the invention of new business models, making unbiased decisions, and achieving protection against imitation and other forms of replication by rivals. The software sector as described by Nambisan (2002a) is the quintessential high technology industry. It is characterised by a high rate of product and process innovation, high knowledge intensity, rapidly shrinking product and technology life cycles, global markets and intense competition.

The dynamic capabilities concept addresses how to sustain a capabilities advantage in the context of strategic change (Helfat & Peteraf 2009). Teece (2007, p.1319) opines that within fast-moving businesses open to global competition, depicted by dispersion geographically and organisational sources of innovation (and manufacturing); sustainable advantage requires more than the ownership of difficult to-replicate (knowledge) assets. The business also requires unique and difficult-to-replicate dynamic capabilities. These capabilities can be harnessed to continuously create, extend, upgrade, protect, and keep relevant the enterprise's unique asset base. For analytical purposes, dynamic capabilities can be disaggregated into the capacity (1) to sense and shape opportunities and threats; (2) to seize opportunities; and (3) to maintain competitiveness through enhancing, combining, protecting, and when necessary, reconfiguring the business enterprise's intangible and tangible

assets. As this study is concentrated on the capabilities necessary following mergers and acquisitions, it will analyse the capability effects on performance of reconfiguring, enhancing, combining and protecting the firm's assets, in other words, product integration.

2.3 Innovation

The overall study will explore whether, post-merger and acquisition a firm improves performance through software innovation (not invention): by combining and reconfiguring acquired products. In this context, invention refers to the development of a new idea and the establishing of property rights on that idea, for example by patents. Innovation, on the other hand, refers to the commercialisation of the invention (Makri, Hitt & Lane 2010). Within this study, the emphasis is on the creation of new product combinations and their subsequent commercialisation, thus use of the term innovation rather than invention.

Innovation has become an increasingly important source of value creation in many industries (Makri, Hitt & Lane 2010). The importance of innovation has been heightened by rapid technological change and growing knowledge intensity in industries. Because of these factors, innovation must come faster, and there is a higher need for novel solutions, especially in high-technology industries. Thus, firms have turned to mergers and acquisitions as an alternative strategy for obtaining the knowledge necessary to create innovations with the speed and the novelty necessary to either maintain a competitive advantage, or to build a new one (Hitt et al. 2009). The rapid growth of technical knowledge in the past few decades has meant that building and maintaining expertise in multiple technologies is difficult for even the largest corporations. Thus the sheer volume of acquisition activity in the high-technology sector suggests that managers view acquisitions as a mechanism for accessing technology (Ahuja & Katila 2001).

2.4 Dynamic capabilities

The literature was reviewed with relevance to post mergers and acquisition strategy execution, the term dynamic capabilities became increasingly prevalent as a way to encompass the requisite organisation behaviour and skills, particularly in the technology sector. It was Augier and Teece (2009) who framed the chosen approach towards this study. They expose the manager's problem of thinking about strategy in a 'real world' business paradigm as opposed to a pure academic one. Augier and Teece (2009) explain that a manager works across multiple disciplines to make a strategic difference, for example within resources (for allocation and management) and economics (managing income and costs), whilst the literature tends to concentrate on each discipline separately. Teece (2007) asserts that the dynamic capabilities framework contains a richer description of features and factors than those that are contained in the Penrose (2009) resource-based approach. The dynamic capabilities framework pulls together many disparate literatures encompassing entrepreneurship, decision theory, organisational behaviour, innovation and economics to identify the key classes of capabilities that firms must possess if they are to succeed in generating greater incomes over time (Augier & Teece 2008, p.1190).

The seminal work underpinning the links of strategy, organisation behaviour and performance outcome is a paper from Teece (1986), a document that generates the ideas necessary to create a framework and is a precursor to the term dynamic capabilities. Dynamic capabilities are the behaviours required, particularly in a technology environment, by a firm in order to profit from innovation. Dynamic capabilities relate to the enterprise's ability to sense, seize, and adapt, in order to generate and exploit internal and external enterprise-specific competences, and to address the enterprise's changing environment (Augier & Teece 2008; Helfat & Peteraf 2009; King & Tucci 2002; Teece & Pisano 1994; Teece, Pisano & Shuen 1997). The possession of dynamic capabilities is especially relevant to multinational enterprise performance in business environments that are open to international commerce, and are fully exposed to the opportunities and threats associated with rapid technological change (Teece 2007).

In his analysis of profitable strategies, Porter (1980) discusses his Five Forces and recommends that the firm finds an attractive position in its industry, i.e. a position which is growing, has limited competitors and is not exposed to pressure from buyers and suppliers. Porter (1980) extends this advice towards building defences (such as product differentiators) to shield from competitors. Augier and Teece (2008) find this approach insightful, but limited and too product focused, with little attention given to the firm itself or to the management capabilities.

Management capabilities and the organisation's business model have been developed from Penrose (2009) over the last 50 years. In her theory of the firm, one way of looking at the organisation is as a collection of physical and human resources; as an administrative organisation with continuity within the history of the firm. In other words, the firm's name or owners, products produced, geographical location or legal form may change, but it is still considered to be the same firm and there is continuity. Penrose (2009) sees the business enterprise as possessing bundles of fungible resources, generated in part from its prior activities. These resources can be deployed to produce a variety of final products. Managers would endeavour to reconfigure the firm's portfolio of products to meet customer needs. Like Porter (1980), Penrose (2009) explains that profits would then flow from achieving differentiation with the addition of putting excess or unused resources to work. The resources approach provides another way of increasing financial performance. Profits can flow from the possession of scarce and difficult-to-imitate resources or knowledge assets, the services of which are in demand by customers. Augier and Teece (2008) assert that the Penrose (2009) resource-based approach is, like Porter (1980), limited. Augier and Teece (2008) find the framework rather static with little consideration given to how the firm would regenerate the sources of its success. While learning, particularly managerial learning is embedded in the resource-based approach, the organisational (and individual) capabilities that enable the business to build and maintain value-enhancing points of differentiation are not.

The dynamic capabilities framework is to create, deploy, and protect intangible assets that support short and long-term performance. Teece's (2007) framework is built on a Penrose (2009) resource based approach to behavioural theory with organisational decision-making. That is, resource based theory is given the context of business enterprises consisting of portfolios of idiosyncratic and difficult-to-trade assets, competencies or resources. Within this framework, competitive advantage can flow at a point in time from ownership of scarce but relevant and difficult-to imitate assets, especially know-how. However, in fast-moving business environments open to global competition, and characterized by dispersion in the geographical and organisational sources of innovation and manufacturing, sustainable advantage requires more than the ownership of difficult-to-replicate knowledge assets (Augier & Teece 2008; King &Tucci 2002; Teece 2007). Sustainable advantage also requires unique and difficult-to-replicate dynamic capabilities according to Teece (1990 in Teece 2007). These capabilities can be harnessed to continuously create, extend, upgrade, protect, and keep relevant the enterprise's unique asset base. Teece's (2007) dynamic capabilities are described and contextualized in three discrete groups. 1, *Sensing:* to sense and shape opportunities and threats, 2, *Seizing:* to seize opportunities, and 3, *Enhancement:* to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets.

3. Discussion

This research focusses within the third section of the dynamic capabilities framework, *Enhancement*, represented in Figure 2. This is a post-decision study. The strategic decision to undertake a merger or acquisition has been made and executed i.e. sensed and seized in dynamic capabilities terms.

Enhancing, i.e. redeployment and reconfiguration may also involve business model redesign as well as asset-realignment activities, and the revamping of routines. The redeployment can involve the transfer of non-tradable assets to another organisational or geographic location (Teece 1977; Teece 1980). It may or may not involve divestments. Helfat and Peteraf (2003) suggest that capability redeployment takes one of two forms: the sharing of capability between the old and the new, and the geographic transfer of capability from one market to another. Both are possible, but neither is easy.

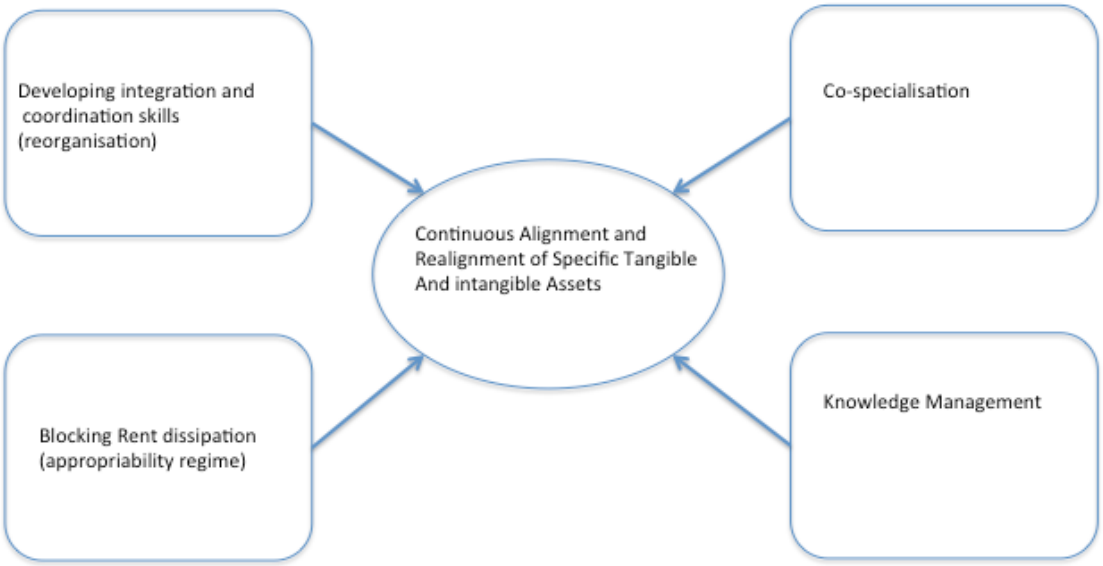

Figure 2: Enhancing: Combination, Reconfiguration, and Asset Protection Skills. Adapted from Teece (2007)

If the firm is to differentiate itself from its competitors, it must provide a product (or service) to its customers that is in some way superior to that of its competitors (Xu, Huang & Gao 2012). Competitive success arises from the continuous development, renewal and reconfiguration of firm-specific assets, which is important. After an acquisition of a software company, the firm has acquired products as well as the people that have knowledge (tacit as well as documented) about the products; in other words, they have the difficulty in replicating skills and capabilities. This means that, as with the Penrose (2009) approach that saw the business enterprise as possessing bundles of fungible resources, generated in part from its prior activities, these resources could be deployed to produce a variety of final products. Managers then endeavour to reconfigure the firm's portfolio of products so as to meet customer needs. Profits then flow from achieving differentiation. This study selects the description "product integration", to explain the development of new product creation to satisfy customers, following mergers and acquisitions.

The dynamic capabilities approach is consistent with the view that emergence of new products and processes results from new combinations of knowledge and that processes of organisational and strategic renewal are essential for the long-term survival of the business firm. In technology sectors according to Teece (2007), the foundations of enterprise success depend upon the effective combination of both internally generated and externally generated inventions and innovations, efficient and effective technology transfer inside the enterprise, the protection of intellectual property, the upgrading of best-practice business processes, the invention of new business models, making unbiased decisions, and achieving protection against imitation and other forms of replication by rivals.

In high technology markets the integration of new products has become a strategic necessity: with customers placing increasing value on cross product integration (Nambisan 2002a), rather than invention such as new patents and new product development. This study is concerned with the impact of the firm's capabilities to embed acquired knowledge in new goods and services (product integration), launch products and services into the market (innovation), and moreover, the firm's ability to increase revenues to the firm, following acquisition activity.

3.1 Product integration

The term product(s) within this research relates to the end product(s) that are the final goods (and services) produced by the firm based on the utilisation of the competences that it possesses. The performance (price, quality, etc.) of a firm's products relative to its competitors at any point in time will depend upon its competences, which in turn depend on its capabilities (Teece, Pisano & Shuen 1997, p.516). The term "Product Integration" is directly related to the transformation of the software product portfolio held by the firm, following mergers

and acquisitions (Nambisan 2002a; Léger & Quach 2009). The extant literature on product development indicates that implementing incremental product changes is contingent on the flexibility of the product strategy and the development environment (Nambisan 2002a).

The new combinations of products demonstrate ability to earn long-term returns. The management's ability to combine and reconfigure specialised assets to meet changing customer needs build long-run value. If an enterprise possesses resources and competences but lacks dynamic capabilities, it has a chance to make a competitive return for a short period; but it cannot sustain supra-competitive returns for the long term except through chance. "It does not earn those Schumpeterian rents associated with 'new combinations' and subsequent recombination, or Kirznerian rents associated with bringing markets back into equilibrium" Teece (2007, p.1344).

The software industry is experiencing dramatic growth (Nambisan 2002b). Grant Thornton (2011) explains that acquisitive software firms in 2011 are looking to build access to new customers and acquire innovative technologies. The ability to recombine and reconfigure the assets and organisational structures as the enterprise grows and technologies change is key to sustained profitable growth (Teece 2007). Routines help sustain continuity until there is a shift in the environment. If innovation is incremental, routines and structures can probably be adapted gradually or in (semi-continuous) steps. When it is radical, such as after an acquisition, then there will be a mandate to completely revamp the organisation (Teece 2007). The integration of each of these acquisitions requires considerable time and effort, thus often causing the burden on the acquirer's management to increase as its string of acquisitions grows (Barkema & Schijven 2008; Penrose 2009). Eventually, major organisational change may be needed to combine all the various pieces into an integrated network of operations suggesting that the role of organisational fit extends beyond the level of an individual acquisition (Barkema & Schijven 2008).

Nambisan (2002a) argues that the adoption of proactive initial technology strategy critically determines the ability and intensity of a high-technology software venture to rapidly and efficiently integrate its product with complementary (where a complementary product is one that enhances the value of a central product when the two are used together by end-users) products. Teece (2007) also finds complementary innovation (and complementary assets) are of great significance, particularly in industries such as software, where, for example, business applications can be especially valuable to users if they can somehow be integrated into a single program suite.

Because of decision-making based on limited information, i.e. bounded rationality, acquirers are typically unable to optimally integrate acquisitions the first time around (Barkema & Schijven 2008). Therefore, the acquisitions can be thought of as pliable, "pieces of clay that firms attempt to mould" (Karim, 2006, p.804) repeatedly to unlock as much of their value potential as possible over time. Barkema and Schijven (2008) find that the post-acquisition integration and restructuring cycles evolve over time, as a firm gains experience with acquisitions and restructuring, noting that it is quite common for firms to use organisational restructuring as a means of experimenting with structure to find more promising configurations (Barkema & Schijven 2008; Karim 2006).

According to the resource-based view of the firm, acquisitions are an important part of the business process of redeploying resources into more productive uses (Ahuja & Katila 2001; Capron and Mitchell, 2009). Through acquisitions, firm-specific assets housed within one organization are merged with assets in another organisation to improve the productivity of the combined assets (Ahuja & Katila 2001). Evaluating the post-acquisition performance of firms provides evidence on the efficiency of this asset-matching and combining process. This study relates acquisition characteristics and firm capabilities to the innovation performance of acquiring firms' innovation outputs: to be measured from the number of new products launched and number of product line changes made (Ahuja & Katila 2001; Nambisan 2002a).

3.2 The mediating effect of product integration

The capabilities discussed have thus far been directly associated with performance. However, this study also focuses on whether, the success of product integration (innovation) in the highly acquisitive software firm has an impact on performance and in which way the capabilities to create and configure new product (i.e. innovate) makes the firm more money. This is to highlight any evidence that the organisation's capabilities and behaviour have a direct relationship to performance; a direct relationship to product integration, or whether the product

integration influences performance indirectly. The questions of whether and how the relationships of the organisation's dynamic capabilities affect performance and the intervention effect of product integration will be analysed in future work using a mediation model as explained by Hayes (2013).

3.3 Performance

Performance in this study is financial, and is defined as the firm's ability to generate revenue from their (output) products and echoes prior research measure of performance (Carrillo & Gaimon 2000; Ireland, Reutzel & Webb, 2005). Secondly, annual reports are used from a single accounting country which means that the revenue recognition accounting standards are measured in the same way and inform the capital markets as to the actual value of the highly technological company (Wagenhofer 2014). Effects of time and firm size are also used to articulate revenue as an accurate measure of real growth (Weinzimmer, Nystrom & Freeman 1998).

Companies that pursue growth through acquisition have a strong tendency to do well in the stock markets, but use accounting techniques that show the benefits of the acquisitions, but partially hide the source of the growth, i.e. the acquisition (Damodaran 2004). Market prices and accounting ratios are often used as an assessment of a firm's performance after mergers and acquisitions (Barkema & Schijven 2008; Léger & Quach 2009).

Within the software business, revenue is a key measure used to persuade the market, competition and the customers on the firm's strengths. In addition, there are strict rules regarding revenue recognition for new software products as outlined by PwC (2009). For example, SunGard (2010) explains that their revenue is highly diversified by both customer and product. The software manager will generally be targeted on revenues for the products they manage and the firm will report on these, for example, Oracle (2011) states they expect (and therefore measure) that software licence updates and support revenues will grow. Oracle (2011, p.3) also "*believe that an active acquisition programme is an important element of our corporate strategy…enhances the products…grows our revenues and earnings*". Teece (2007) agrees, explaining that revenue is a key measure in product planning, adding value to the customers that they will pay for. Therefore it is reasonable to use revenue as the most appropriate measure for performance. As the effect of product integration on performance is a focus, the total revenue will be collected as well as the revenue for software product (licence), software maintenance and software services.

3.4 Knowledge management

As Léger and Quach (2009) point out, a software product is largely intangible in nature, based on knowledge, and has characteristics peculiar to its portfolio. After an acquisition, the two companies have to combine resources in order to achieve organisational integration as well as portfolio integration. The literature examined related to mergers and acquisition in knowledge worker intensive organisations draws heavily on knowledge systems, and the management or integration of them (Augier & Teece 2009; Cloodt, Hagedoorn & Van Kranenburg 2006; Gates & Very 2003; Grimaldi & Torrisi 2001; Teece 2007). Barney (1986) in Cloodt, Hagedoorn and Kranenburg (2006, p.643) determines that it is the firm's ability to acquire, transfer and integrate the acquired firm's knowledge base that creates a sustainable competitive advantage.

The act of acquisition is the beginning of a large project, the majority of which is the integration of the acquired firm (Gates & Very 2003). The challenge is to create shareholder value, while at the same time managing issues in order to avoid value leakage. The maturity of the industry largely determines whether the acquisitive company is to understand how to integrate acquired knowledge, achieve technology integration and understand the non-financial benefits of acquisition. On examining the integration of a firm post-acquisition, Starkey, Tempest and McKinlay (2004, p.339) identify that there is a requirement to integrate the acquired firm's knowledge and use it towards competitive advantage. Barkema and Schijven (2008) agree, and argue that as the initial integration post-acquisition is suboptimal, subsequent acquisitions decreases an acquirer's performance and therefore force a re-organisation of the firm.

In his explanation of dynamic capabilities, Teece (2007) also finds that the ability to integrate and combine knowledge assets is a necessary capability in gaining performance. Following an acquisition, there is specialist knowledge within both the acquirer and the acquired firms, contributing to heightened levels of conflict. The ability towards co-ordinating, learning, product combining and reconfiguring is key to sustain long-term

performance (Teece 2007). Teece, Pisano and Shuen (1997) propose three management leadership skills that are required to sustain dynamic capabilities, namely co-ordination/integration, learning and reconfiguring. Together they form an "orchestration" process: an important managerial function is achieving semi-continuous asset orchestration and corporate renewal. Teece (2007, p.1320) defines orchestration in the context of the management functions identified (co-ordination/integration, learning and reconfiguring) is analogous to that of a musical orchestra conductor, although in the business context the "instruments" (knowledge assets) are themselves constantly being created, renovated, and/or replaced. Moreover, completely new instruments appear with some frequency, and old ones need to be abandoned. While flexibility is certainly an element of orchestration, the management capacity of orchestration as a concept implies much more.

The understanding of the basic business functions that make-up business administration and operations are understood (Teece 2007). The organisation's competencies can be nurtured by inter-organisation links within the organisation structure, necessary in knowledge intensive firms. In the technology sector, within a software house, a large body of the non-administration staff are the technicians, analysts and programmers. Echoed in an ethnographic study of the company Xerox, Orr (2006) found an inter-organisation disconnect where the organisation's managers did not really understand the work undertaken by the technicians. The knowledge workers domain is complex, and that of a software developer means understanding the palimpsest of the product, the layers that have gone before him as well as putting on his own. The divestment of people at Xerox, and hence the management of knowledge was poorly managed, Orr (2006, p.1813) comments on the drive to expense saving within an organisation as often being short-sighted, 'management felt free to trade away functionality…for minor savings in expenses'. These actions uncovered by Orr (2006) point to poor capabilities with respect to knowledge management. The (dynamic) capabilities framework suggests to Augier and Teece (2009) that the scope of the manager includes resource selection decisions, but must also make reference to co-specialisation, or systems integration.

The most valuable assets inside the firm are knowledge related and thus non-tradable. The co-ordination and integration of such assets create value that cannot be replicated in a market. This establishes a distinctive role for managers in economic theory and in the economic system, according to Teece (2007). Managers seek new combinations by aligning co-specialised assets. The need to reconfigure when change occurs requires the allocation, reallocation, combination, and recombination of resources and assets. These are the key strategic functions of executives. Indeed, skills used to identify and exploit complementarities and manage co-specialisation are scarce (Augier & Teece 2009). Figuring out how to increase value from the use of people as well as products in the software business, (that the enterprise owns) involves understanding the granular detail of the firm's asset base, and filling in the gaps necessary to provide superior customer solutions. This is where gap filling may involve building new knowledge bases (assets), or disposing of assets (people).

Management can make big differences through investment choice and other decisions. The dynamic capabilities framework endeavours to capture the key variables and relationships that need to be "manipulated" to create, protect, and leverage intangible assets to achieve superior enterprise performance and avoid the zero-profit trap. However, building and assembling tangible and intangible assets and effectuating change are seen as difficult. Success over time is likely to require achieving necessary internal creative destruction, possibly involving divestments to help sustain superior performance Teece (2007).

Léger and Quach (2009) tested the antecedents of the performance of mergers and acquisitions of software firms on an event basis. They posit that the most noteworthy criterion is inherent in the intangible nature of software products. Essentially based on knowledge, the combination of software firms is associated with certain economic phenomena that are specific to the information technology industry and that emerge from the characteristics of the product portfolio. More specifically, Léger and Quach (2009) ask whether the financial performance of the firms involved in a software business combination is influenced by and results from the characteristics of the new entity's portfolio of software products. In line with this, it was decided to operationalise the Léger and Quach (2009) concepts of software compatibility and software complementarity, as criteria to explain the performance effect of mergers and acquisitions of software firms.

In light of the discussions on creating value in a high-tech knowledge intensive industry after major changes, such as acquisition, the four knowledge management areas selected to focus on are:

- Compatibility: the acquisition of firms with compatible software products (Léger & Quach, 2009), and the capability to leverage product knowledge to integrate the products.

- Complementarity: the acquisition of firms with complementary software products (Léger & Quach 2009), and the capability to leverage product knowledge to integrate the products.
- Competency: the acquisition of technical knowledge that is difficult to imitate or replicate (Léger & Quach 2009), and the capability to leverage product knowledge to integrate the products.
- Divestment: the divestment of people due to the acquisition and the divestment of products capability towards creation of superior performance (Teece 2007).

3.5 Compatibility

Software compatibility is defined as:

> *"the extent to which programs can work together and share data. In another area, totally different programs, such as a word processor and a drawing program, are compatible with one another if each can incorporate images or files created using the other. All types of software compatibility become increasingly important as computer communications, networks, and program-to-program file transfers become near-essential aspects of microcomputer operation"* (Microsoft 2002, p.115).

In the context of a business combination, if the products owned by the firms involved in the merger are compatible, this should reduce investments the new entity needs to make to market a unified product portfolio. In addition, software compatibility can be perceived as a benefit for customers, since it allows the joint use of software and thus gives access to new functionalities without making any additional investments. In other words, in addition to conferring technical advantages, compatibility is directly related to financial investments: the more compatible the software products are, the lower the financial investments required to make them work together (Léger & Quach 2009).

Within the capabilities framework, a key to sustainable profitable growth is the ability to recombine and reconfigure assets as the organisation grows. Software product integration is ostensibly a reconfiguring; a combination of two or more products to achieve a new product offering. This then is the innovation, the assessment of the markets, the reconfiguring of the technology and the evolution of something new (Teece 2007, p.1335). This research is centered on the value to the firm from the specific innovation of product integration; in software business terms, organic growth (SunGard 2010).

Future work will collect data on acquisitions where the software is compatible to the existing portfolio. It is expected that the compatibility of the products held by the new entity will have an impact on the performance of the firm and on product integration.

3.6 Technology complementarity

Software complementarity is defined as compatible programs that are based on the same standards, and require few or no investments to make them work together (Léger & Quach 2009). In post mergers and acquisition research of the software industry, Léger and Quach (2009) found that the performance of the acquisitions in terms of price/book value ratio is impacted positively when the portfolio acquired is technologically complementary to that of the acquirer. They also find the acquirer pays a premium for software portfolios that are compatible and complementary, but the financial markets neglect the characteristics of the portfolio purchased. This implies that the lack of market attention may impact the product integration capability through lack of management/ business drive.

In addition, Makri, Hitt and Lane (2010) found that too much technological similarity, or too much difference, reduces innovation when they investigated invention outcomes post mergers and acquisition on technology firms. However, based on their model on the relatedness of the acquirer and acquired firms, and the invention performance achieved, their findings show that the technology complementarity of the firms is a key to success. Whilst the Makri, Hitt and Lane (2010) knowledge measures distinguished between science and technology, the definition of knowledge complementarity is analogous: Technological is how components are linked together and Scientific is the core design concepts and how they are implemented. Whereas Makri, Hitt and Lane (2010) measure invention and not innovation, their findings informs this study, since invention is required as a first step

towards innovation: in order to gain revenue from it. The Makri, Hitt and Lane (2010) definition of invention is that which is unexploited in the marketplace: invention as the solution of a puzzle, an invention in a lab, and the process of recombination, re-combining in a novel way.

In a study on the unification and aggregation factors that have a positive effect on innovative performance of technology mergers and acquisitions, Cloodt, Hagedoorn and Kranenburg (2006) found that post mergers and acquisitions, the unification of two knowledge bases can provide opportunities for synergies in the firm's future research and development, whilst also reducing redundant or duplicate R&D efforts which can provide a larger research base to finance costs. An important factor in the merger of two firms is their relatedness in terms of particular fields of technology that the acquiring firm shares with the acquired firm, in other words their complementarity. Cloodt, Hagedoorn and Kranenburg (2006) identify two types of complementarity; one, the relatedness of the mergers and acquisitions in terms of the company products and markets concern the industry-aspect; two, on the technological complementarity (relatedness) referring to firm-specific aspects such as technological disciplines (computing infrastructure for example) and engineering capabilities (software languages for example).

From an organisational learning perspective, a positive effect lies in the ability to better evaluate and utilise complementary externally acquired knowledge, rather than uncomplimentary externally acquired knowledge. This is based on the idea that a firm's absorptive capacity depends mainly on its level of knowledge in a specific field. If the knowledge base of the acquirer is not sufficiently adapted to the acquired knowledge, the absorption process becomes very difficult. Therefore, unrelated technologies often require a radical change, which can easily be counterproductive. However, technological knowledge and engineering capabilities that are too similar to the already existing knowledge of the acquiring company will contribute little to the post mergers and acquisitions innovative performance (Ahuja & Katila 2001; Hitt et al. 2009).

Future work will collect data on the complementarity of the products and technology acquired. It is expected that there will be a positive impact on performance and product integration when the acquired products are complementary.

3.7 Competency

The acquisition of competencies in the software industry is defined by Léger and Quach (2009) as the acquisition of technical know-how or specific technologies, which are difficult to imitate or copy and which would require a corresponding financial investment. Gammelgaard (2004) argues that access to competence (non-tradable, unique resources) is a motive for mergers and acquisitions. Ahuja and Katila (2001) agree that acquisitions are an important part of the business process of redeploying resources into more productive uses and through the acquisitions, firm specific assets housed within one organisation are merged with assets in another to improve productivity.

An early element of the dynamic capabilities framework point to the ability to reconfigure and protect knowledge asset competencies with the aim of achieving a competitive advantage (Teece 2007). Léger and Quach (2009) posit that many prior studies, as well as financial literature, have analysed mergers and acquisitions with relation to shareholder value creation. One of the main performance antecedents identified by Léger and Quach (2009) in post-merger performance in the software industry, is the potential to acquire competencies. The acquisition of competencies has the goal of acquiring skills that are difficult to develop internally or would take too long, meaning that this factor may be crucial to the success of the new entity.

An important managerial function is achieving resource orchestration and corporate renewal. This involves achieving asset alignment, realignment, and redeployment. It is necessary to minimize internal conflict as well as to maximise competencies and productive exchange inside the firm. Redeployment and reconfiguration may also involve asset-realignment activities. Redeployment can involve transfer of the non-tradable resource competencies to another organisation or geographic location (Teece 1977, 1980). Helfat and Peteraf (2003) suggest that competency redeployment takes one of two forms: the sharing of the competency between the old and the new firms (or product lines), and the geographic transfer of the competency from one market to another.

In fast moving business environments open to global competition, the orchestration capability often relies on owning the knowledge assets, as well as to enhance, combine and reconfiguring the difficult-to-replicate assets (Augier & Teece 2009; Grimaldi & Torrisi 2001; Teece 2007). Within a software firm, the products produced

are referred to as creative (Grimaldi & Torrisi 2001), and as such the acquired resources have a lot of tacit product knowledge, hence being difficult to replicate.

A key challenge for companies is not just to acquire knowledge bases (competencies) to expand the firm's existing knowledge base, but also to integrate the knowledge workers in order to improve the post-mergers and acquisitions innovation opportunities (Ahuja & Katila 2001). Hitt et al. (2009) also warn that, post mergers and acquisitions, a positive innovation outcome is dependent on organisational learning (through repetition). Integration of the acquired competencies is key to knowledge management, and learning from the process aids selection of future acquisitions and improves future integrations, thereby giving greater success. The integration of a knowledge base that is of a relatively large size can disrupt existing innovative activities, and render the different integration stages more complex, more time consuming and full of risks (Cloodt, Hagedoorn & Kranenburg 2006, p.644). Due to such problems, integrating a relatively large knowledge base requires additional resources to be devoted to integration activities, leaving fewer resources for the actual innovative endeavour (Ahuja & Katila 2001). Thus, it is expected that with the integration of a relatively large knowledge base, fewer resources will be available for innovative activities, which has a negative impact on the acquirer's post mergers and acquisition innovative performance.

Future work will collect data on whether competencies were specifically sought after as part of the mergers and acquisition. It is expected that the acquisition of competencies will have a positive effect on product integration, neutral on performance.

3.8 Divestment

Divestments in the context of this study refer to changes in the scope of the firm (Barkema & Schijven 2008) and the firm's capability towards divestment, which is that of redeployment and reconfiguration, and involves the firm's decisions regarding asset realignment (Capron, 1999 in Capron & Mitchell 2009; Teece 2007). The assets under review are human and product, thus the definition of divestment is firstly, the human resources divestment (redundancy) that is directly attributed to merger and acquisition activity. Secondly, it is the product divestments (disposals) (Pennings, Barkema & Douma 1994).

Divestments of products and people are used to demonstrate asset shedding and competency divestment. The freeing of dying systems and technologies allow for removal of innovation limitations arising from established frameworks (Teece 2007, p.1335). Teece (2007) argues that divestments are necessary. Over time successful enterprises will develop hierarchies and rules and procedures (routines) that begin to constrain certain interactions and behaviours unnecessarily. This means that inertia and other rigidities stand in the way of improved performance. This in turn implies that, less well-resourced enterprises end up winning business.

In order to solve problems and avoid limitations in innovation, managers that divest assets may end up with a competitive advantage Teece (2007). Post-acquisition, a firm may need to reorganize and reconfigure its people (assets) and also consider the products and boundaries of the firm that are no longer viable. Especially in a technological setting, the divestiture may be fragile and exiting the firm boundaries may not be obviously rational (Hitt *et al.* 2009; Teece 1986, 2007). Barkema and Schijven (2008) found that post-acquisition, divestment activity (people and products) does tend to increase at time of organisation re-organisation, and impacts performance. Divestments are part of the product portfolio restructuring and are common when there are major changes in the scope of a firm through, for example mergers and acquisitions. A regular occurrence in highly acquisitive firms, undertaking organisational restructuring refers to the recombination of existing company departments leaving the scope of the firm unchanged and are required to unlock synergies contained within the acquisition (Barkema & Schijven 2008). In support of this, Damodaran (2004) found the divestiture rate of acquisitions rises to almost 50% of prior acquisitions made, suggesting that few firms enjoy the promised benefits from those acquisitions. The bottom line on synergy is that it exists, or, is extracted in relatively few mergers and acquisitions, and therefore often does not measure up to expectations

Within dynamic capabilities, Teece (2007) explains that an important managerial function is achieving semi-continuous asset orchestration and corporate renewal, including the redesign of routines. This is because the sustained achievement of superior profitability requires efforts to build, maintain, and adjust the complementarity of product offerings, systems, routines, and structures. Inside the enterprise, the old and new

must complement. If they do not, business units (products and people) must be disposed of. Capron (1999 in Capron and Mitchell 2009) finds that asset divestiture and resource deployment can contribute to performance.

Since the divestment of assets post-acquisition is a common feature, and it may impact the firm's ability to create value with product integration, data will be collected on divestments of products and any divestment of people that is directly attributed to acquisition, as opposed to divestment for cost cutting or due to organisation restructure.

It is expected that the divestments of product will positively affect performance and the divestment of people (with their tacit knowledge) to negatively affect the product integration.

3.9 Integration experience

An acquisition is usually not an isolated event, but merely one part of an overarching sequence of acquisitions collectively aimed at implementing a corporate strategy (Barkema & Schijven 2008). The integration of each of these acquisitions requires considerable time and effort, thus often causing the burden on the acquirer's management to increase as its string of acquisitions grows (Penrose 2009). The crucial transforming organisation behaviour identified by Augier and Teece (2009) has been integration management by highly skilled managers and people with capacities to combine and integrate.

The firm is a repository of capabilities and knowledge (Augier & Teece 2009; Penrose 2009) and learning is central to its growth. In order to build profit, the firm builds on routines that are recurrent patterns of action. Seeking strategies based on improving performance, routines and processes evolve, becoming part of the firm's knowledge creation and learning.

Mergers and acquisitions add a new dimension to the firm. An argument posed by Barkema and Schijven (2008) is that even with pre-integration preparation, initial integration is nevertheless, suboptimal. As a result, acquisitive growth decreases an acquirer's performance, eventually forcing it to engage in organisational restructuring to more fully unlock the synergistic potential. The problem is expanded further over time and with acquisition propensity, particularly those acquisitions where the rationale for their selection has been scale, scope or transfer of capability. In studying the effect of multiple acquisitions in conjunction with the number of re organisations over time, they have shown that organisation change is used to increase performance.

More recently, however, Barkema and Schijven (2008) assert that the bulk of the research attention has shifted toward a second contingency that arises in the post-acquisition, or implementation, stage of the acquisition process: organisational fit. The argument is that, although strategic fit is a necessary condition for synergy realisation, it merely creates value potential that can only be realised through effective integration of an acquired firm. Moreover, integration enhances acquisition performance. Hence, after an acquirer selects and acquires a firm with synergistic potential, it is up to the acquirer to unlock as much of this potential as possible by building sufficient organisational fit. However, this is a complex task that requires considerable management time and attention. The integration of each of these acquisitions requires considerable time and effort, often causing the burden on the acquirer's management to increase as its string of acquisitions grows (Penrose 2009), thus suggesting that the role of organisational fit extends far beyond the level of the individual acquisition (Barkema & Schijven 2008).

A key theme of behavioural theory is that repeated tasks are routinised (Augier & Teece 2008); Barkema and Schijven (2008) assert that the restructure 'routine' is necessary to gain synergies. Re-organisation is common after a major event such as an acquisition. In an ethnographic study of a software firm, Ager (2011) noted that this was not an extraordinary exercise. It was done, in order to realise the synergies sought by the deal.

Barkema and Schijven (2008) maintain that, because of the number of acquisitions a firm makes and the subsequent re-organisations that it undertakes, there is a corporate learning which makes the task increasingly routinised. In turn this lowers the demands on the firm's management due to increased experience rather than through bounded rationality, meaning that a firm has "limited information, attention, and processing ability" (Greve, 2003, cited in Barkema & Schijven 2008 p.697). An acquisition is usually not an isolated event, but merely one part of an overarching sequence of acquisitions collectively aimed at implementing a corporate strategy.

In terms of product integration, the strategic, organisational, and human resource decisions made by management are at the heart of enterprise performance. Success requires that managers behave in an intensely entrepreneurial manner and build into their organisation the capacity to transform and reconfigure as opportunities and competitive forces dictate. Such capabilities, if built, constitute the dynamic capabilities required. Not many CEOs have the necessary skills, and fewer still succeed in building them into their businesses. The dynamic capabilities framework developed in the field of strategic management highlights the growing importance of entrepreneurial management (Augier & Teece 2009).

In light of the literature reviewed, within a highly acquisitive software firm, it is expected that the number of acquisitions made will impact the organisation experience. Also it is expected that the organisation will learn from their post-acquisition experience in the form of organisation restructures, thus affecting the performance of the firm, particularly in the subsequent year(s).

4. Conclusions

In extant work, researchers have almost invariably treated acquisitions as isolated events; implicitly assuming that an acquirer can start with a clean slate every time it acquires. In reality, however, an acquisition usually represents merely one element in a broader sequence of acquisitions collectively intended to implement some corporate strategy (Barkema & Schijven 2008; Damodaran 2004).

4.1 Knowledge management

The examined literature related to mergers and acquisition in knowledge worker intensive organisations draws heavily on knowledge systems and the management or integration of them (Augier & Teece 2009; Cloodt, Hagedoorn & Van Kranenburg 2006; Gates & Very 2003; Grimaldi & Torrisi 2001; Léger & Quach 2009; Teece 2007). Figuring out how to increase value from the use of the people as well as products in the software business, that the enterprise owns, involves understanding the granular detail of the firm's asset base, and filling in the gaps necessary to provide superior customer solutions. This is where gap filling may involve building new knowledge bases (assets), or disposing of assets (people). It was found that the acquisition of compatible product(s) does affect product licence revenue in the longer term and reduces the firm's ability to innovate. This may imply that the need for the manager to determine how to use the acquired product is reduced if it is already compatible, i.e. "*the extent to which programs can work together and share data. In another area, totally different programs, such as a word processor and a drawing program, are compatible with one another if each can incorporate images or files created using the other. All types of software compatibility become increasingly important as computer communications, networks, and program-to-program file transfers become near-essential aspects of microcomputer operation*" (Microsoft 2002, p.115).

As the act of acquisition is the beginning of a large project, the majority of which is the integration of the acquired firm (Gates & Very 2003) in his explanation of dynamic capabilities, Teece (2007) finds that the ability to integrate and combine knowledge assets is a necessary capability in gaining performance. Following an acquisition, there is specialist knowledge, within both the acquirer and the acquired firms, contributing to heightened levels of conflict. The ability towards co-ordinating, learning, product combining and reconfiguring is key to sustain performance (Teece 2007). It was found that acquiring and divesting competencies (people) affects the firm's ability to innovate, as might be expected. This perhaps reflects the finding of Teece, Pisano and Shuen (1997) who propose that it is management leadership skills that are required to sustain dynamic capabilities; namely co-ordination and integration, learning and reconfiguring that make the difference. The most valuable assets inside the firm are knowledge related and complex. Within a software house, a large body of the non-administration staff are technicians, analysts and programmers. The co-ordination and integration of such assets create value. The post-acquisition findings will be grouped into asset acquisition and divestment.

4.2 Integration experience

Barkema and Schijven (2008) find that the post-acquisition integration and restructuring cycles evolve over time, as a firm gains experience with acquisitions and restructuring. They note that it is quite common for firms

to use organisational restructuring as a means of experimenting with structure to find more promising configurations (Barkema & Schijven 2008; Karim 2006). The term "Product Integration" is directly related to the transformation of the software product portfolio held by the firm, post mergers and acquisitions (Léger & Quach 2009; Nambisan 2002a). As the acquisition is usually not an isolated event, but just one part of an overarching sequence of acquisitions collectively aimed at implementing a corporate strategy (Barkema & Schijven 2008), a count of the number of organisation restructures will be used for the integration experience as a measure towards success of product integration.

As mergers and acquisitions add a new dimension to the firm, an argument posed by Barkema and Schijven (2008) is that even with pre-integration preparation, initial integration is, nevertheless, suboptimal. As a result, acquisitive growth decreases an acquirer's performance, eventually forcing it to engage in organisational restructuring to more fully unlock the synergistic potential. In studying the effect of multiple acquisitions in conjunction with the number of re-organisations over time, they found that organisation restructure is used to increase performance.

The literature suggests that the benefits of acquisition experience enables an acquirer to increase its acquisition performance, and indicates that firms can develop a restructuring capability, although extant theory predicts that it is difficult for them to do so, since restructurings occur infrequently and are highly heterogeneous and causally ambiguous (Zollo & Winter 2002 in Barkema & Schijven 2008). Although organisational restructuring tends to be a traumatic event that leads to a substantial dip in firm performance in the short term (Amburgey, Kelly & Barnett 1993; Greve 1999, cited in Barkema & Schijven 2008), Barkema and Schijven (2008) assert that in the long term it enables a firm to more fully unlock the synergistic potential of its acquisitions and thus, to increase its performance to higher levels than before. This study echoes the difficulty, finding that organisation restructures do not aid overall revenue but do aid product licence revenues. Conversely, they reduce innovation efforts.

Restructuring experience impacts the number of product integrations positively in the short term and negatively in the longer term, although not significantly. This may reflect the restructures' impact on the combination and integration capabilities that impact in the longer term. This is in line with the dynamic capabilities model explanation from Augier and Teece (2009), that managers effectuate the deployment and redeployment of resources, typically in response to price signals. In short, the strategic, organisational, and human resource decisions made by management lie at the heart of enterprise performance. Success requires that managers behave in an entrepreneurial manner, and build in the capacity to transform and reconfigure as opportunities and competitive forces dictate. Not many CEOs have the necessary skills, and fewer still succeed in building them into their businesses, which would go towards an explanation of the lack of performance in terms of revenue and product integration.

4.3 Recommendations for Further Research

This study suggests that it is important for future research to move beyond the notion of acquisitions as isolated events, toward recognising their embeddedness in sequences intended to implement a corporate strategy, which allows for a long-term and dynamic approach to studying their performance effects.

Future work proposed is to design a conceptual model, and collect empirical data that reflects the dynamic capabilities model, specifically the third stage (enhance/ reconfigure), in order to describe, explain and account for the effect of product integration on the firm's performance. The study will focus on heavily acquisitive firms, as acquisition intensity has significant impact on the organisation learning activities, performance outcomes and portfolio scope (Barkema & Schijven 2008). In practice, public software firms that are highly acquisitive are competing in larger markets and need to recombine and reconfigure to maintain competitive (Damodaran 2004; Nambisan 2002a; Teece 2007). Prior research has explained that highly acquisitive organisations are able to learn through repetition of routines and processes. However, implementations may be limited as more acquisitions are added, because the managerial resources are increasingly tied up (Augier & Teece 2009; Barkema & Schijven 2008; Léger and Quach 2009).

After an acquisition, firms integrate to gain performance. The study will aim to test whether a further stage is required towards attaining performance, which is to integrate the acquired software products. The research theory will be tested with panel data of acquisitive software firms that have made multiple acquisitions over a

decade. Prior research has often used either a single event as the unit of analysis (event driven), or has highlighted change over one, two or three years (Barkema and Schijven). In line with prior research, a (longitudinal) ten year dataset is sufficient (Ahuja & Katila 2001; Barreto 2009; Cloodt, Hagedoorn & Van Kranenburg 2006). A longitudinal study of firms is required to explain the extent to which software firms reconfigure and recombine, i.e. that product integration happens, and the product integration has an effect on performance.

Concentrating on dynamic capabilities within organisational behaviour theory, the research question centres on the factors that impact product integration post mergers and acquisitions, and whether the performance potential from a software product acquisition is enhanced with, or via, product integration. The ability to realign and innovate will increase performance over the long term (Pierce & Teece 2005).

References

Ager D. L. (2011) "The Emotional Impact and Behavioral Consequences of Post-M&A Integration: An Ethnographic Case Study in the Software Industry," *Journal of Contemporary Ethnography*, 40(2), pp. 199–230. doi: 10.1177/0891241610387134.

Ahuja G. & Katila R. (2001) "Technological acquisitions and the innovation performance of acquiring firms: A longitudinal study," *Strategic Management Journal*, 22(3), pp. 197–220. Available at: http://onlinelibrary.wiley.com/doi/10.1002/smj.157/abstract (Accessed: September 28, 2014).

Amburgey T. L., Kelly D., & Barnett W. P. (1993) "Resetting the clock: the dynamics of organizational change and failure". *Administrative Science Quarterly*, 38. pp. 51–73.

Augier M. & Teece D. (2008) "Strategy as Evolution with Design: The Foundations of Dynamic Capabilities and the Role of Managers in the Economic System," *Organization Studies*, 29(8-9), pp. 1187–1208. doi: 10.1177/0170840608094776.

Augier M. & Teece D. J. (2009) "Dynamic Capabilities and the Role of Managers in Business Strategy and Economic Performance,", 20(2), pp. 410–421. doi: 10.1287/orsc.1090.0424.

Barkema H. G. & Schijven M. (2008) "Toward Unlocking The Full Potential Of Acquisitions : The Role Of Organizational Restructuring," *Academy of Management Journal*, 51(4), pp. 696–722. Available at: http://www.jstor.org/discover/10.2307/20159535?uid=3738032&uid=2129&uid=2&uid=70&uid=4&sid=21103543546491 (Accessed: September 28, 2014).

Barreto I. (2009) "Dynamic Capabilities: A Review of Past Research and an Agenda for the Future," *Journal of Management*, 36(1), pp. 256 – 280. doi: 10.1177/0149206309350776.

Berkery Noyes (2013) "Berkery noyes releases software industry M&A report for full year 2012.", PR Newswire.

BSA (2008) *Software Industry Facts and Figures*. Washington.

Capron L. (1999) "The long-term performance of horizontal acquisitions," *Strategic Management Journal,* 20(11).

Capron L. & Mitchell W. (2009) "Selection Capability: How Capability Gaps and Internal Social Frictions Affect Internal and External Strategic Renewal," *Organization Science,* 20(2), pp. 294–312. doi: 10.1287/orsc.1070.0328.

Carrillo J. E. & Gaimon C. (2000) "Improving Manufacturing Performance Through Process Change and Knowledge Creation," *Management Science*, 46(2), pp. 265–288.

Cloodt M., Hagedoorn J. & Van Kranenburg H. (2006) "Mergers and acquisitions: Their effect on the innovative performance of companies in high-tech industries," *Research Policy*, 35(5), pp. 642–654. doi: 10.1016/j.respol.2006.02.007.

Damodaran A. (2004) *Investment Fables*. New Jersey: Financial Times Prentice Hall. Available at: http://csinvesting.org/wp-content/uploads/2012/08/investment_fables_damodaran.pdf (Accessed: September 28, 2014).

Eisenhardt K. M. & Martin J. A. (2000) "Dynamic capabilities: what are they?," *Strategic Management Journal*. John Wiley and Sons, 21(10-11), pp. 1105–1121. Available at: http://www.jstor.org/stable/3094429 (Accessed: September 28, 2014).

Gammelgaard J. (2004) "Access to competence: an emerging acquisition motive," *European business Forum*, 17.

Gates S. & Very P. (2003) "Measuring performance during M&A integration," *Long Range Planning*, 36(2), pp. 167–185. doi: 10.1016/S0024-6301(03)00004-9.

Grant Thornton (2011) *Software Industry M&A update*. Available at: www.GrantThornton.com (Accessed:July 2015)

Grimaldi R. & Torrisi S. (2001) "Codified-tacit and general-specific knowledge in the division of labour among firms: A study of the software industry," *Research Policy*, 30(9), pp. 1425–1442.

Hayes A. (2013) *Introduction to mediation, moderation, and conditional process analysis*, New York, NY: Guilford, pp. 3–4. Available at: http://www.personal.psu.edu/jxb14/M554/specreg/templates.pdf (Accessed: September 28, 2014).

Helfat C. E. & Peteraf M. A. (2003) "The dynamic resource-based view: capability lifecycles," *Strategic Management Journal*, 24(10), pp. 997–1010. doi: 10.1002/smj.332.

Helfat C. E. & Peteraf M. A. (2009) "Understanding dynamic capabilities: progress along a developmental path," *Strategic Organization*, 7(1), pp. 91–102.

Hitt M. A., King D., Krishnan H., Makri M., Schijven M., Shimizu K. & Zhu, H. (2009) "Mergers and acquisitions: Overcoming pitfalls, building synergy, and creating value," *Business Horizons*, 52(6), pp. 523–529. doi: 10.1016/j.bushor.2009.06.008.

Ireland R. D.; Reutzel C. R. & Webb J.W. (2005) " Entrepreneurship research in AMJ: What has been published, and what might the future hold?", *Academy of Management Journal*, 48(4), pp. 556-564

Karim S. (2006) "Modularity in organizational structure : the reconfiguration of internally developed and acquired business units," *Strategic Management Journal*, 823(April 2005), pp. 799–823. doi: 10.1002/smj.

King A. A. & Tucci C. L. (2002) "Incumbent entry into new market niches: The role of experience and managerial choice in the creation of dynamic capabilities," *Management Science*; 48(2), pp.171-186

Léger, P. M. & Quach, L. (2009) "Post-merger performance in the software industry: The impact of characteristics of the software product portfolio," Technovation, 29(10), pp. 704–713. doi: 10.1016/j.technovation.2009.05.016.

Makri, Hitt & Lane (2010) "Complementary technologies, knowledge relatedness, and invention outcomes in high technology mergers and acquisitions,", 31(6), pp. 602–628. doi: 10.1002/smj.

Microsoft (2002) *Microsoft Computer Dictionary*. 5th edition, Microsoft (ed.). Washington: Microsoft Press.

Nambisan S. (2002a) "Complementary Product Integration by High-Technology New Ventures: The Role of Initial Technology Strategy," *Management Science*, 48(3), pp. 382–398.

Nambisan S. (2002b) "Software firm evolution and innovation–orientation," *Journal of Engineering and Technology Management*, 19(2), pp. 141–165. doi: 10.1016/S0923-4748(02)00007-3.

Oracle (2011) *United States Securities and Exchange Commission Form 10-K Annual Report*. Washington D.C.

Orr J. (2006) 'Ten years of talking about machines', , 27, pp.1805-1820

Pierce L. & Teece D. (2005) *The Behavioral, Evolutionary, and Dynamic Capabilities Theories of the Firm: Retrospective and Prospective, Work,* pp. 1 – 49. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1161171 (Accessed: July 15, 2014).

Pennings J. M., Barkema H. & Douma S. (1994) "Organizational Learning and diversification," *Academy of Management Journal,* 37(3), pp. 608–640. Available at: http://www.jstor.org/stable/256702 (Accessed: September 28, 2014).

Penrose E. (2009) *The theory of the growth of the firm.* 4th ed. Oxford University Press.

Porter M. (1980) "Industry Structure and Competitive Strategy: Keys to Profitability.," *Financial Analysts Journal,* 36(4), pp. 30–41.

PWC (2009) *Software Revenue Recognition A user friendly guide for navigating through the many complexities*. Available at: http://www.pwcrevrec.com (Accessed January 12, 2015)

PWC (2014) "Strong Start to 2014 Technology M&A with Uptick in Billion Dollar Deals, Says PwC US," Press release. Available at: http://www.pwc.com/us/en/press-releases/2014/q1-2014-tech-deals-press-release.jhtml (Accessed: August 28, 2014).

PWC (2013) *US technology M&A insights Analysis and trends in US technology M&A activity 2013.* Delaware. Available at: www.pwc.com/technology (Accessed: July 15, 2014).

Starkey K., Tempest S. & McKinlay, A. (2004) *How organisations learn: managing the search for knowledge.* 2nd edn. London: Thompson learning.

SunGard (2010) *United States Securities and Exchange Commission Form 10-K Annual Report.* Pennsylvania. Available at: http://www.sec.gov/cgi-bin/browse-edgar?company=&CIK=0000789388&action=getcompany (Accessed: July 15, 2014).

SunGard (2009) "SunGard Announces First Quarter 2009 Results". Available at: http://www.sungard.com/pressreleases/2009/corporate050709.aspx (Accessed: July 15, 2014).

Teece D. (1986) "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy," *Research Policy*, 22(2), pp. 285–305. doi: 10.1016/0048-7333(93)90063-N.

Teece D. (2007) "Explicating dynamic capabilities: the nature and micro-foundations of (sustainable) enterprise performance," *Strategic Management Journal*. Wiley Online Library, 28(13), pp. 1319–1350. doi: 10.1002/smj.

Teece D., Pisano G. (1994) "The dynamic Capabilities of Firms: an introduction," *Industrial and Corporate Change*, 3 (3) pp. 537-556.

Teece D. (1977) "Technology transfer by multinational firms: the resource cost of transferring technological know-how," *The Economic Journal*, 87, pp. 242-261.

Teece D. (1980) "The diffusion of an Administrative Innovation," *Management Science*. 26 (5).

Teece D. J., Pisano G. & Shuen, A. (1997) "Dynamic capabilities and strategic management," Dosi G., Nelson R. R., & Winter S. G. (eds) *Strategic Management Journal*. John Wiley & Sons, 18(7), pp. 509–533. doi: 10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z.

Wagenhofer A. (2014) "The role of revenue recognition in performance reporting", *Accounting and Business Research,* 44(4), pp.349-379

Weinzimmer L. G., Nystrom P. C. & Freeman S. J. (1998) "Measuring Organic Growth: Issues, Consequences and Guidelines", *Journal of Management*, 24(2), pp.235-262

Xu K., Huang K.-F. & Gao S. (2012) "Technology sourcing, appropriability regimes, and new product development," *Journal of Engineering and Technology Management*. Elsevier B.V., 29(2), pp. 265–280. doi: 10.1016/j.jengtecman.2012.03.003.

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Decision-Making processes for effective problem solving to potentiate organisation sustainability

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Abstract

The purposes of this article are to analyse the decision-making processes for practical problem solving, and to understand the ways employees make decisions, based on the knowledge they have from previous problems solutions. To achieve these objectives, the following research questions were used to frame this study: Do employees have access to knowledge and tools to help them in their decision process on how to solve a particular problem? What kind of decision-making strategies for problem-solving situations can be implemented to make the organisation sustainable? One large-sized multinational organisation in Portugal was selected for this case study research. Fifteen employees were interviewed to provide insight into the research questions. The research findings support the conclusion that depending on the complexity of the problem, the employee needs to decide if he has the knowledge and the tools to achieve a solution to solve the problem. The use and share of employees' knowledge to make the decisions is a significant factor to solve problems and strengthen performance.

Keywords: Decision Making, Problem Solving, knowledge, sustainable organisations

1. Introduction

To overcome the problem-solving situation and facilitate decision-making processes (Dhami et al. 2015; Curseu & Schruijer 2012) organisations create problem-solving routines. According to Johnson (1995), problem-solving involves three phases: preparation (understanding the problem); production (developing different alternative solutions) and judgment (the decision needed for selecting a solution). Argyris and Schön (1996) suggest a fourth phase: review and reflective assessment of both outcomes and processes.

Even with that kind of routines implemented to help the organisation make decisions and respond to problem situations, knowledge integration is also conditioned by its complexity (Ederer et al. 2016) and because factors are depending on the source/receiver of knowledge that affects the practical use and integration of knowledge.

These new quality criteria have the goal to improve the transfer of problem-solving knowledge with the application of previously learned knowledge to solving a new problem (Mayer & Wittrock 1996). Moreover, Nonaka et al. (2000) assume that knowledge can be an enabler or a disabler of problem-solving.

In this context, it is essential to understand the strategies that organisations use in their decisions making process, both for employees and managers. This study analyses the ways employees use their knowledge to make operational decisions to solve the emergent issues, with the goal of understanding and contributing to a more efficient process.

To achieve that aim, it is necessary to gather data about employee's perceptions about the process, as they seek ways to facilitate the decision-making (Fischer 2015; Fox & Poldrack 2014; Frederick 2005) based on individual knowledge and that leads to useful problem-solving routines.

To find out how organisations empower their employees in the decision-making process to solve problems (Gettinger, Kiesling, Stummer, & Vetschera 2013), this study intends to answer the following research questions:

1. Do employees have access to knowledge and tools to help them in their decision process on how to solve a particular problem?

2. What kind of decision-making strategies for problem-solving situations can be implemented to make the organisation sustainable?

This topic introduced the study, presenting an overview of the background and problem statement, outlined the purpose of the investigation, stated the research question and a brief theoretical perspective. The review of the literature will focus on knowledge management, decision-making processes, and problem-solving routines.

The methodological framework used is a qualitative case study, followed by topics which discuss the findings of the study, provides the implications for theory and practice and recommends directions for future research.

2. Literature Review

2.1 Decision-making Processes

Decision-making is portrayed by bounded rationality; a close and critical link exists between the nature and limitations of human decision and the structure and activity of the organisation. Cyert and March (1963), pointed out that in an established organisation, a scope for decision-making is limited by prior decisions, either explicit or implicit, as well as being restrained by moral commitments to individuals and departments. These authors developed a model of the firm that behaves as an entity, similar to the pattern of the goal-directed, economising, and learning individual. This decision-making coalition model focuses on cost, as well as on the decisions of the firm. Like Simon (1945), they emphasise both a theory of search and a theory of choice. Nevertheless, it is crucial to assume that past decisions can influence new decisions (Greiff et al. 2015).

For the scope of this paper, strategic decisions are those fundamental decisions which are "important, regarding actions taken, the resources committed, or the precedents set" (Mintzberg et al 1976). They are the decisions made by the managers and employees of an organisation that can affect its performance. Selznick (1957) differentiates the strategic decision (critical) from the routine decision. Key decisions are the responsibility of the managers and fall into four categories (tasks). The first task involves the definition of the institutional mission and role. The second is to make and shape "character-defining," the institutional embodiment of purpose, which includes building policy into the structure or deciding upon the means to achieve the ends desired. The third task is to preserve the institutional integrity**.** Drucker (2002) emphasises that strategic decisions are multi-dimensional decisions, which will have an impact on the future of the enterprise. From this perspective, the great difficulty lies in finding the right question, not the right answer (Ackoff 1970). The fundamental role of top managers is seen as shaping organisational objectives and strategy, with tactics intervening to define organisations' relations with their resource environments. Thus, strategy and strategic decisions act as an important driver of businesses' performance outcomes.

In contrast to strategic decisions, operational decisions are internally focused and absorb much of the agency's time and effort, as they are the decisions made about the organisation's daily functioning. Examples of these types of decisions would be the allocation of resources, scheduling tasks, and monitoring performance. Ackoff (1970) defines planning as anticipatory decision-making, which is comprised of two planning components: strategic and tactical. Strategic planning decisions are those which are broad in scope, have long-term effects, and are related to organisational goals. Tactical decisions are concerned with selecting the most efficient means to achieve the targets set in the strategic plan. Ackoff stresses that both are needed to maximise the organisation's progress and that planning at the corporate level is more strategic than it is at any other level in the hierarchy.

The main point is that these decisions directly affect the nature and the success of the firm. Other key points are that they include choices about new products or markets (Ackoff, 1970), as well as decisions about organisation design and the adoption of new technologies. Such decisions are typically novel and occupy the thinking of senior management. However, they can be significantly influenced by people lower down in the organisation (Bower, 1970). Bower's conclusions are aligned with the study of Crozier (1964), who discusses the relative power and the basis of the authority of four groups within the monopoly: production workers, maintenance workers, lower supervisors, and the management team. Although the strength of the management team is severely limited by the rationalisation of the work process, the maintenance workers have a good deal of power in such a system because the machine breakdown is "the last source of uncertainty remaining in a completely routinised organisational system." (Crozier 1964). The

relationship among the participants demonstrates how a person with technically the lowest power could, in part, control the initiation of action by others.

Braybrooke and Lindblom (1963) reinforce the complexity of decision-making processes in organisations, and they explain that the integration of parts of the information is a very convoluted process and therefore limited by the capacities to understand the relationship of all the parts. It is not, therefore, a techno-scientific accomplishment but a result of practical procedures. The approach to decision-making process assumes, aforementioned, several limitations. First, the employee has limited problem-solving capacities. Second, the inadequacy of information and third, the cost of the analysis process. Additionally, the evaluation method of the results of the decision-making process, the balance of observed facts and results. Nonetheless, the openness of the process and the diverse forms and contexts in which problems arise (Braybrooke and Lindblom 1963).

2.2 Problem Solving Techniques

Billett (2001) distinguish between routine and non-routine problems: Routine problems involving situations that have been experienced before: A) Simple, repetitive and well-understood situations, which are handled in a tacit mode, with very little conscious thought. The pure nature of these cases allows for easy explication. B) Routine situations within a different context, when workers face problems that are similar but are not exact repetitions of previous experiences. When routine problems become more involved, the capability to address critical situations depends on the ability of each one, to recognise and diagnose the problem quickly.

Non-routine problems need workers' knowledge to solve novel problems that may represent their most valuable contribution: A) Solving novel problems need workers' ability to define the problem and to work collaboratively with other employees from different sections to find a solution. B) Emergent problems can be described as workers proactively identifying problems to explore or process improvement or new work situations. C) Solving problems outside of expertise: these are problems that are unique and outside of their existing domains of experience and know-how.

2.3 Sustainable Organizations and inherent Psychology of Sustainability

Since the United Nations published the World Commission on Environment and Development (WCED, 1987), remarks regarding sustainability became vital in any managerial discussion (Dyllick & Hockerts 2002). While several industries continuously operate and vision their future, as activists towards a positive ecologic impact or, by reducing the consumption of scarce resources, often, it is from within their internal approach that the highest dignity of sustainability occurs.

H.R. (Human Resources) Managers acknowledged the importance of attracting and retaining talent, maintaining employee's health and safety and, or fostering CSR (Corporate Social Responsibility) strategies. Furthermore, Pfeffer (2010) describes the concern for human sustainability which balances interests and needs between employees and their companies'. However, particularly the generation Y wants to pursue a career in a corporate environment which is strongly influenced and focus on sustainability, green management, and social responsibility. Therefore, H.R. managers have a critical role in designing these desirable settings, if aligned with the shareholders' interests.

Regarding Sustainability's etymological meaning and origin, it refers to sustain with ability. This article focusses on the capacity of employees to foster organisational sustainability. Di Fabio and Gori (2016) described this same capacity as the core of individual intrapreneurial resources, supported by an explanation that employees are often faced with severe constraints of resources, changes and transitions, therefore, the positive relational management (Di Fabio 2016b) to foster

organisational well-being or civility. Aforementioned, there are a set of instruments that should be made available to employees such as, knowledge and tools, to support the overhead reflection issues. Furthermore, for the agents to have a methodology to base their decision process.

In a business context, companies have been pointed as a significant key-driver to achieve organisational development (Bansal 2005). Leal Filho (2000) argues that a shared meaning of sustainability is a strategy for corporate sustainability. Therefore, there must be a pre-predisposition from the internal stakeholders to successfully achieve those as mentioned earlier.

Di Fabio (2017) concluded that challenges are a sort of opportunity for organisations to develop its well-being in the unpredictable environment characteristic of the 21st century. For this reason, understanding the underlying psychology of sustainability becomes a powerful knowledge for organisations to promote a healthier workplace environment and to deliver competitiveness for its operations.

2.4 Problem Solving to Potentiate Organizations Sustainability

Retaining highly qualified employees is of vital importance to the long-term viability of businesses. Workers become familiar with the company's culture. Each business will have different approaches to deal with chronic psychological stress at work. For employees to make wiser decisions, enterprises must provide them with the resources and instruments to achieve that goal. Therefore, it is a role of the SHRM (Strategic Human Resources Manager) to define a sustainable corporate approach. Moreover, the meaningfulness of the organisation vision needs to be acknowledged by its human capital as their own: Di Fabio (2016a), describes this relationship in several forms, whether as a work-life project, an organisational project, an inter-organisational project or as a group project. The same author emphasises and infers that projects sustainability is directly tied to the feeling of coherence, direction, purpose, significance and belonging of its member. Kurt Lewis defined that Behaviour as a function given by the individual characteristics of a person with the environment offered by organisations. Moreover, the fundamental attribution error is of greatest importance, both in individual and organisational understanding: in others, generally, we over-estimate the role of personal factors and underestimate the role of situational factors (i.e. the personality of an individual and their life circumstances, correspondently).

However, while pursuing organisational development or team management, it is critical to understand that people differ in their motivational drivers whilst, this paradigm might be oversimplified in the following major elements: (1) extrinsic motivation - doing the job for a tangible reward, to gain intangible social benefits or to directly avoid a punishment (i.e. a competitive wage/reward, to not be dismissed from a job or social popularity, respectively); (2) intrinsic motivation - the act of doing the job successfully, mastering a technique or procedure, or pure enjoyment per se, solely brings a feeling self-reward and therefore, internal gratification which is transformed into a motivational driver; (3) transcendent/altruist - the motive of collaborating in a task ultimately relies on the philanthropic purpose or the positive impact that it may cause on other people´s lives. Notwithstanding, the motivation psychology adverts for the extrinsic incentive bias which explains how often people misunderstand and misinterpret the importance of extrinsic factors for others and inappropriately uses it as a bargaining tool, leading to a poor motivation capability. Moreover, the Vroom Expectancy Theory explained the motivation as a result of:

$$Motivation = Expectancy * Instrumentality * Valence$$

This motivational theory may be interpreted as follows in which (1) expectancy is understood as the probability that people's effort leads to performance, i.e. "If I put a higher effort in this task, will I perform as expected from me?"; (2) instrumentality, as the belief that performance leads to a reward, i.e. "If I perform as expected from me, will I be rewarded?"; (3) valence, which is the

inherent individual value assigned to the offered reward by the organisation, i.e. How do I value the reward that would be given to me?

According to the notion of Sustainable HRM, for employees be able to express themselves with confidence and to trust the process, there must be a practice of Human-Resources Mindfulness. This concept aims to enhance organisational awareness through anticipation and coping with great practices. Table 1 synthesises the highest principles of OM (Organisational Mindfulness). To potentiate corporate sustainability through problem-solving, there must be a regular exchange of perspectives and direct participant of knowledge employees. Furthermore, it is decisive to design expectations, work-related interests, and mostly experience-based knowledge through storytelling. OM approach aims to allow those internal stakeholders to express their voice without fear of retaliation when they face a moment of critical decision-making.

Table 1. Organisational Mindfulness (OM)

Principles of OM	**Outputs**	**Literature**
Reluctance to simplify interpretations	[1] Promote scepticism to identify and to reduce blind spots – mitigate unforeseen events by collaborative mindset; [2] Organize an exchange of different point of views among internal stakeholders based on an innovation-driven; [3] Exchange of knowledge through experience-based.	(Weick & Sutcliffe, Managing the unexpected, 2001) (Weick & Sutcliffe 2007)
Sensitivity and attentiveness to local operations	[1] Involve employees and their tacit knowledge; [2] Anticipate or detect harmful health-related side effects of workflows or unexpected events in project work; [3] Adapt from work practices and routines to an awareness-model where unexpected events are part of the process.	(Weick & Sutcliffe 2007) (Becke 2013) (Siegrist 1996)
Commitment to resilience	[1] Entails the ability to "bounce back from errors and handle surprises at the moment"; [2] Intervention practices that alter problematic frame conditions of knowledge work to facilitate employees' regeneration of health resources; [3] Rebalancing reciprocity between management and workers, especially concerning reorganisation processes.	(Vogus & Welbourne 2003) (Becke 2013)

Underspecification of the structure	[1] "Fluid decision-making" which enables organisations to turn decision structures upside down during periods of emergency or severe crisis, thereby utilising local expert knowledge as an organisational resource for containing and coping with hazards; [2] Deferred work autonomy employees can draw on to cope effectively with unexpected events in work processes.	(Vogus & Welbourne 2003) (Weick & Sutcliffe 2007)
Preoccupation with failure	[1] Errors and near misses are conceived as sources of organisational learning; [2] Potential failures or adverse side effects of HR strategies and practices can be attributed to a structural imbalance between economic, social and ecological dimensions; [3] Requires an infrastructure that combines a vigilant awareness of unintended side effects and failures; [4] Practices with a structure that facilitates (organisational) learning from failure.	(Weick & Sutcliffe 2007)

Organisational routines can be conceptualised as "repetitive, recognisable patterns of interdependent actions, carried out by multiple actors (Feldman & Pentland 2003). Routines are identified by the duality of structure and agency (Giddens 1984): there are, therefore, repeated social interactions that must be maintained, reproduced and altered by the human agency. In this way routines can be sustainable according to the definition explained previously.

Routines involve humans' capacity to interpret, to modify, to re-enact and to adjust habits to unpredictable work processes and contexts (Levinthal & Rerup 2006). There must be, therefore, a reflective learning curve within an organisation. The reflection in matter refers to each actor, where are influenced by their knowledge and previous experiences. Based on this practice of inquiry the past, employees will be able to pursue sustainable outcomes from their decisions better. According to the table 1, the Organisational Mindfulness provides a set of tools or HRM system that provides employees access to knowledge and tools to help them in their decision process to solve unexpected or specific problems (Fischer et al 2017).

According to (Jordan, Messner, & Becker 2009) in the mindful HR-infrastructure, there are two basic variants of organisational routines:

1. Promote *collective mindfulness* through the practice of reflections in ongoing, work-related operations and interactions. Aforementioned is, for instance, to start and follow-up regularly with the assigned team, to update, adjust and solve. The author recommends that this structure should be informal and most flexible (scrum-meetings). This methodology allows internal stakeholders if there is a purpose, pre-disposition, and awareness, to pursue sustainable development, to continuously self-monitor and self-reflect over difficulties of the project itself or from its peers. Therefore, for this goal, organisations must sensitise their employees for health-related issues, without a formal committee for the purpose. It shall develop solutions to cope with stressors collectively in ongoing work processes, mostly by the flexibilization and redistribution of project tasks, offer social support and approach project managers with confidence and trust that the employee's well-being is of great significance for the organisation sustainability.

2. *Reflection-on-action* takes place outside work operations (Jordan, Messner, & Becker 2009) such as training's, reviews of completed projects or steering committees. The importance of this is to create awareness on the top-managers for arising health-related problems within smaller segments of the business. Communications between this two parties will necessarily overview the decision-making process of employees and its consequences. By making use of this awareness towards peers', will enable companies to be more efficient approaching their H. R. and consequently, creates a meaningful engagement of employees with their roles within the organisation.

3. Research Methodology

The methodological approach was qualitative, and it was applied the method of cases or intensive analysis. Furthermore, the data was gathered through interviews with employees.

3.1 Research Findings

The context of the organisation helps to understand the perceptions of the workers according to the procedures used to problem-solving situations and the decision-making process.

In respect to the problem-solving methodology we acknowledge that it is framed by production methodology used by the organisation and it has established rules that define the autonomy and the complexity of the problems that can be solved by each level of workers:

> "We have a good system of decision-making in problems solving situations, and it is part of the new methodology of work." (Middle Managers)
>
> "Workers have autonomy to take decisions to solve less complex problems, and problems and solutions are registered in a database that can be consulted when a problem occurs, facilitating the use of knowledge." (Department Managers)

Workers have an essential role in problem-solving situations. Their knowledge is the critical factor to identify the problem and the possible solutions.

Production Managers who work directly with the workers have identified workers with two different attitudes:

> "a) Workers that don't show any concern about the problems. b) Workers that try to help in an individual base and when they cannot solve the problem, they communicate it to the shift Manager." (Production Managers)

The organisation uses temporary workers when necessary and when the contract of some of these workers is near its end, they assume a hostile attitude and do not show any concern for the quality, the achievement of production goals or the product quality. However, it seems that most workers have an active link to the organisation showing involvement and participating in the decision-making process at their level of responsibility.

During the research process it was identified the following decision-making strategies to make the organisation sustainable:

Strategy 1 – be open-minded and autonomous

Most of the knowledge in organisations is dynamic because it is concentrated on workers, but some of that knowledge is static (documental information, for example). It is essential that the dynamic knowledge can be stored in repositories which over a period will become a substantial source of relevant information and expertise.

> "Each workplace has one level of autonomy associated, in respect to decision-making and problem resolution." (Production Managers)

> "If I have a simple problem in my machine, normally I know how to fix it. It is only when the problem seems to be very complex tht I consult my shift Manger" (Operators)

Knowledge can be a criterion for autonomy and decision-making. The more knowledgeable workers are, the more potential they have and the more autonomous they can be, unlike other workers that are less knowledgeable. When the worker's range of knowledge is more comprehensive, his contribution is more significant, and he is in a position to make some technical decision.

> "It is possible to seek a description of the problem's resolution, and access a set of quality tools: analysis, diagnosis, information and research." (Middle Managers)

During the workday, workers face several problems, and they solve most of them in an unconsciously (in a tacit way), automatically and in a few seconds. Other situations require more time, effort, teamwork and collaboration. Situations can vary widely: some are well known and require routine, even automated knowledge, while others are more complex and require extensive abstract knowledge.

> "When there is a problem, we have some technical procedures that we need to follow. If it is a simple problem that the Operator knows how to solve, he can make the decision without consultation of the manager. If he cannot discover a solution, he then informs the Team Manager, and together they try to find a solution. If it is a very complex problem, a team with several Operators and Technicians is created to analyse the problem. The Operator that finds the problem also participates in this team that meets one time per week to decide the more efficient corrective solutions." (Department Managers)

It is important to point out the alignment of perception in every hierarchical position according to decision-making and problem resolution procedures. During Technicians interviews, they described an identical procedure or routine when a problem occurs to Department Managers and Middle Managers. They said that when a problem emerges:

> "Depending on the complexity of the workstation, the Operator decides if he has the knowledge and the tools to solve the problem by him or if he needs help from the shift Manager. If the problem is too complex, he does not have the autonomy to decide the solution to the problem, and then he informs the Shift Manager that evaluates the type of problem, like if it is a quality problem or if it assumes some other form." (Technicians)

Operators also have a similar perception of problem resolution:

> "If it is a problem in a machine, the evaluation is made by me. I have the autonomy to make the first evaluation. If the problem is very complex, we have an internal system that initiates with an intervention order send to maintenance, and it is also communicated to the shift Manager."

> "If it is a quality problem, all the production stops, and we quickly analyse the problem, trying to identify the phase where it has initiated. Sometimes the problem started in the previous shift."

> "In the Welding section the procedures are the same: we analyse the problem, and if we can, we solve it. The remaining problems are registered in proper documentation." (Operators)

Using (Piaget, J. 1996) distinction of problem types as either routine or non-routine, (Billett 2001) identified routine problems like the ones "requiring individuals to expend little conscious or effortful thinking". Routine problems are addressed through a process called assimilation, that is, the ability to act gained through repeated practice, without conscious thought. Solving routine problems reinforces and refines existing knowledge.

> "For instance, if it is a quality problem, we have some procedures that we need to follow according to the Quality Manual, and the problems need to be registered as well as their specific solution. The people involved in the problem and the solution are also identified so that if another problem like that occurs in another area of the plant, all employees have access to the problems and solutions database." (Department Managers)

Non-routine, or novel problems, require "extensive conscious thinking" (Billett 2001) and extended knowledge through accommodation (Piaget, J., 1996). The learning occurs when one encounters a new task or challenge. Solving novel problems enables workers to identify and close gaps in knowledge and learn new models, clues and cues on how to proceed'.

> "Solving new problems gathers the involved people in the discussion of the solution. They discuss the problem, identify it and implement several actions according to the problem resolution." (Middle Managers)

The use of routines in creating and using knowledge in decision-making processes to problem-solving began with the problem-finding phase, and then the problem is analysed by the Operator and/or the shift Manager. If they cannot solve the problem, they consult the quality database where they store all problems and solutions. If the problem is too complicated, they created a team to solve it, and when they find the solution, they implement it and register the problem and its solution in the database.

Strategy 2 – focus on the needs of the business

Workers are more prepared to solve technical problems then organisational ones:

> "Some problems are mere anomalies that employees can identify, and they have an easy solution, especially when we are dealing with technical problems, and not with organisational ones (for these they do not have the necessary knowledge). This has been an everyday battle, with systematic procedures thought to make all the employees involved in the decision-making process." (Production Managers)

Workers are always looking for new ways to improve their practices and routines. Middle Managers focused on a particular issue and determined to implement a more efficient methodology of problem-solving.

> "There is going to be implemented a more rigorous, standard and detailed methodology, not only in the production lines but also in the other sections of the organisation. Production System is going to organise what already is a good practice, making it even more efficient." (Middle Managers)

> "Problem resolution is the priority; correcting problems is something that we think about constantly and whenever the machines are working. Our priority is keeping a continuous production process." (Middle Managers)

> "We are already well equipped to facilitate problem-solving situations, and the plant organisation is an important factor, but we are creating standards that will help to solve problems more quickly." (Middle Managers)

According to Johnson (1955), problem-solving involves three phases: preparation (understanding the problem); production (developing different alternative solutions) and judgment (selecting a solution). Argyris and Schön (1996) suggest a fourth phase: review and reflective assessment of both outcomes and processes.

Even if it is essential to have tools, procedures and routines to help the organisation respond to problem situations or challenges, this kind of factors can sometimes be a barrier to new knowledge development and even to knowledge use.

The problem-solving approach creates a high level of interaction and the closeness and the trust among workers is the key to the degree of tacit knowledge shared. Most problem situations are solved unconsciously, automatically and in a few seconds. Other situations require more time, effort, teamwork, collaboration and extensive abstract knowledge.

Strategy 3 – think about what makes the organisation different from others

The routines created for decision-making in the problem-solving process began with the problem-finding phase; then the problem is analysed by the Operator and/or the shift Manager. If they cannot solve the problem, they consult the quality database where they store all problems and solutions. If the problem is too complicated, they created a team to solve it, and when they find the solution, they implement it and register the problem and the corresponding solution in the database.

The organisation has several routines to create and share knowledge and Production System imposes a constant creation of new knowledge, especially regarding the organisational innovation process.

The innovation process is a critical factor because of the importance of implementing new ways of production and new organisational processes to accomplish higher efficiency. Involving workers in this process requires the use of management tools such as communication and the promotion of workers' involvement and participation. The organisation uses several mechanisms to promote knowledge share and develop new ideas. It is important to point out the suggestions system (mainly used to make production improvements), the workshops on innovations and new products, and the knowledge networks (especially the informal ones).

Looking for another perspective, we can say that this organisation is a learning space at a technical and organisational level. One of the most useful tools to create and disseminate knowledge is through workshops with people from different sections or people from just only one section.

Costumers and external specialist often participate in the workshops and help the discussion and the creation of new knowledge that helps implement new practices, tools or technology. There is a connection between sharing knowledge and achieving the business goals or solving practical problems.

4. Conclusions

This research contributes to understanding the decision-making process in problem-solving situations. The decision process depends on the knowledge, ability, and level of responsibility for the employees. Thus, on complex problems, it is hard to determine which decision is best. According to Ackoff (1970), the most critical aspect is the process of planning, a process focused on timing, sequence, and dynamics. Billet (2001) proposes a typology for decisions.

In light of the theory and also the empirical results it is possible to state that this organisation has a routine of problem-solving implemented that includes several phases: it began with the problem-finding phase; then the problem is analysed by the Operator and / or the Manager. If they cannot

solve the problem, they consult the quality database where they store all challenges and solutions. If the problem is too complicated, they created a team to address it, and when they find the solution, they implement it and register the problem and the corresponding solution in the database. Each worker has the autonomy to make decisions to solve problems associated with their level of responsibility and depending on the complexity of the problem.

Three strategies of problem-solving with the goal to make the organisation more sustainable were identified the following strategic approaches:(1) – be open-minded and autonomous; (2) – focus on the needs of the business; and (3) – think about what makes the organisation different from others. They can contribute to the construction of a model of decision-making in problem-solving situations and be a support, helping to identify solutions and creating new organisational and technical practices and processes.

References

Ackoff R. L. (1970). *A concept of corporate planning.* New York: Wiley.

Argyris C., & Schön D. (1996). *Organisational learning II: Theory, method and practice, Reading, Mass.* Addison Wesley.

Bansal P. (2005). Evolving sustainably. *Longitudinal Study Corp Sustain Dev, 26*(3), 197-218.

Becke G. (2013). A concept for social sustainability at organizational level. In G. Becke, *Mindful change in times of permanent reorganization: Organizational Institutional Perspectives.* Heidelberg: Springer.

Billett S. (2001). Learning throughout working life: Interdependencies at work. *Studies in Continuing Education*, 19-35.

Bock et al. (2005). Behavioural intention formation knowledge sharing: examining roles of extrinsic motivators, social-psychological forces, and organisational climate. *MIS Quarterly, 29*, 87-111.

Bower J. L. (1970). *Managing the Resource Allocation Process.* Irwin: Homewood.

Braybrooke D., & Lindblom C. E. (1963). *A strategy of Decision.* Free Press.

Crozier M. (1964). *The Bureaucratic Phenomenon.* London: Tavistock.

Curseu P., & Schruijer S. (2012). Decision styles and rationality: an analysis of the predictive validity of the general decision-making style inventory. *Educ Psychol Meas, 72*(6), 1053-1062.

Cyert R. M., & March J. G. (1963). *A Behavior Theory of the Firm.* Englewood Cliffs: Prentice Hall.

Dhami M. K., Mandel D. R., Mellers B. A., Tetlock P. E. (2015). Improving intelligence analysis with decision science. *Perspect. Psychol. Sci.* 10, 753–757.

Di Fabio A. (2016a). *Constructing and Managing Personal Project, Career Project, Life Project: The Challenge of Sustainability*. Invited lecture at the seminar organized by the Faculty of Health Sciences, Hokkaido University, Sapporo, Japan.

Di Fabio A. (2016b). Positive Relational Management for healthy organizations: psychometric properties of a new scale for prevention for workers. *Front. Psychol*. 7:1523. doi: 10.3389/fpsyg.2016.01523

Di Fabio A. (2017). *Promoting Sustainable Development and Well-Being in a Culturally Diverse World*. Keynote at the First international cross-cultural conference "Healthier societies fostering healthy organizations: A cross-cultural perspective" organized by the Department of Education and Psychology, University of Florence, May 26–27, 2017, Florence. Co-presidents F. Cheung, J.-M. Peirò, D. H. Saklofske, and F. van de Vijver.

Di Fabio A., and Gori A. (2016). Developing a new instrument for assessing acceptance of Change. *Front. Psychol.* 7:802. doi: 10.3389/fpsyg.2016.00802

Drucker P. (2002). *Managing in the Next Society.* New York: Truman Talley.

Dyllick T., & Hockerts K. (2002). Beyond the business case for corporate sustainability. *Bus Strategy Environ, 11*, 130-141.

Ederer P., Patt A., Greiff S. (2016). Complex problem-solving skills and innovativeness – evidence from occupational testing and regional data. *Eur. J. Educ.* 51, 244–256.

Feldman M. S., & Pentland B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Adm Sci Q, 48*, 94-118.

Fischer A., Greiff S., Funke J. (2017). "The history of complex problem solving," in *The Nature of Problem Solving: Using Research to Inspire 21st Century Learning*, eds Csapó B., Funke J., editors. (Paris: OECD Publishing;), 107–121.

Fischer A., Holt D. V., Funke J. (2015). Promoting the growing field of dynamic decision making. *J. Dynamic Decis. Mak.* 1, 1–3.

Fox C. R., & Poldrack,R. A. (2014). Prospect Theory and the brain. In *Handbook of Neuroeconomics.* New York: Elsevier.

Frederick S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19*(4), 25-42.

Gettinger J., Kiesling E., Stummer C., & Vetschera R. (2013). A comparison of representation for discrete multi-criteria decision problems. *Decision Support Syst, 54*, 976-985.

Giddens A. (1984). *The constitution of society.* Berkeley: The University of California Press.

Greiff S., Fischer A., Stadler M., Wüstenberg S. (2015). Assessing complex problem-solving skills with multiple complex systems. *Think. Reason.* 2, 356–382.

Johnson D. M. (1955). *The Psychology of Thought and Judgement.* New York: Harper.

Jordan S., Messner M., & Becker A. (2009). Reflection and mindfulness in organizations: rationales and possibilities for integration. *Managerial Learning, 40*(4), 465-473.

Leal Filho W. (2000). Dealing with misconceptions on the concept of sustainability. *Int J Sustainability in High Education, 1*(1), 9-19.

Levinthal D., & Rerup C. (2006). Crossing an apparent charm: Bridging mindful and less-mindful perspectives on organizational learning. *Organ Sci, 17*(4), 502-513.

Mayer R. E., & Wittrock M. C. (1996). Problem-solving transfer. In D. C. Berliner, & R. C. Calfee, *Handbook of educational psychology* (pp. 47-62). New York: Macmillan.

Mintzberg H. et al. (1976). The structure of "unstructured" decision process. *Administrative Science Quarterly,* 21(2), 246-275.

Nonaka I. et al. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long Range Planning, 33*, 5-34.

Pfeffer, J. (2010). Building sustainable organizations: the human factor. *Acad Manage Perspect, 24*, 34-45.

Piaget, J. (1967). *Autobiographie*. Cahiers Vilfredo Pareto, 4(10), 129–159

Selznick P. (1957). *Leadership in Administration.* New York: Harper and Row.

Siegrist J. (1996). Adverse health effect on high-effort/low-reward conditions. *Journal of Occupational Health Psychology, 1*(1), 27-41.

Simon H. A. (1945). *Administrative Behavior.* New York: Free Press.

Vogus T., & Welbourne T. M. (2003). Structuring for high reliability: HR practices and mindful processes in reliability-seeking organizations. *Journal of Organizational Behaviour, 24*(4), 877-903.

WCED. (1987). *Our common future.* Oxford: Oxford University Press.

Weick K. E., & Sutcliffe K. M. (2001). *Managing the unexpected* (1st Edition ed.). San Francisco: Jessey-Bass.

Weick K. E., & Sutcliffe K. M. (2007). *Managing the unexpected* (2nd Edition ed.). San Francisco: Wiley.

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EUROPEAN JOURNAL OF WORKPLACE INNOVATION

Quality beyond Borders: Dantotsu or How to Achieve Best in Business

By David Hutchins

Routledge, London 2019, ISBN 978-1-138-56510-4

Reviewed for the European Journal of Workplace Innovation

By Richard Ennals

Review

This is the ninth book on Quality issues from David Hutchins. It is likely to have a major impact among different communities around the world. Remarkably, Hutchins has innovative arguments for the international communities concerned with Quality (and in particular Quality Circles), Education (and in particular Students' Quality Circles), and Workplace Innovation.

Hutchins knew and worked with the leading Quality Gurus from both the USA and Japan. He is the last one standing (or rather, riding his racing cycle). He opens and ends his book with fresh insights into the fundamental differences between their core messages. From the USA we are told about statistical control and compliance. From Japan, the focus was on empowering workers, respecting their experience and skill, and protecting then from the worst excesses of Taylorist top-down management. We learn new details about post-war relations between the USA and Japan, which have had long consequences. Hutchins brings the strands together, possibly for the first time.

The book is totally lacking in pomposity. There are very few academic references (thus leaving an intriguing challenge for the next generation of researchers), but in the one-page Bibliography we are referred to the Quality Gurus in the sequence in which they are cited in the text. Instead, we hear the consistent voice of a practitioner with long and rich experience, writing for an audience who are themselves engaged in practice. The book is also a handbook for distance learning students of David Hutchins International Quality College, which provides recognised qualifications on Quality Management. When Hutchins talks about "leaders", he does not simply mean "managers".

Different readers will find that "Quality beyond Borders" complements Hutchins' earlier well-regarded book "Hoshin Kanri: The Strategic Approach to Continuous Improvement" (Gower 2008), and the various editions of the book by Dinesh Chapagain "Guide to Students' Quality Circles" (Quest-Nepal 2006, 2013, 2019).

"Quality beyond Borders" is not a work of literature, to be read through once and then put on the shelf. It is intended to be a practical handbook, introducing a wealth of Quality tools and case studies.

For the Quality community, the focus is on workplace practice, rather than on a series of "fads". Hutchins can point to numerous cases where his work has brought dramatic results, but he presents a calm account in terms of common sense, and respect for the skill of workers.

For the Education community, Hutchins explains how he was impressed by seeing the first Students' Quality Circles, which were first presented at conventions 25 years ago, based on the innovative leadership of Jagdish Gandhi and Vineeta Kamran, at the world's largest school, City Montessori School in Lucknow, India. Hutchins and American Quality Guru Donald Dewar encouraged the development of an international movement, co-ordinated through the World Council for Total Quality and Excellence in Education, which has overseen national and international conventions. Students work together to solve practical problems, and present case study accounts.

For the Workplace Innovation community, there has been a growing realisation of the importance of Quality in the search for improved productivity and sustainability. Companies have recognised deficiencies in their procedures and, through organisations such as the European Workplace Innovation Network, have asked for advice on how to proceed. This book is now being recommended.

David Hutchins is a calm and distinctive voice from inside Quality, Education and Workplace Innovation. He does not make grandiose claims, but he "tells it as he sees it".

The implications of Hutchins' work are radical, knocking down the borders between what have been distinct discourses and communities. Quality is shown to be integral to work and the workplace. Education and Working Life are re-envisioned in terms of empowerment. Academic researchers and campaigners for Workplace Innovation may come to realise that their subject is not new after all.

For researchers in the tradition of Socio-Technical Systems Thinking, there may be the recognition that we can understand the differences between the American and Japanese approaches, and that we can learn from those differences. A Quality Circle in a Japanese company has a very different cultural context from one in an American company.

Similar points can be made about Students' Quality Circles. In Nepal, Quest-Nepal has built a formidable national movement, with an extraordinary system of concurrent conventions across the country. As attention turns to the need for Workplace Innovation in Nepal, it is argued that a lead can come from the experience of SQCs in Education. As for changing the workplace and the economy, Quest-Nepal declare "Together We Can".

The book should be widely read in industry, education and governments. As Hutchins intended, "Quality beyond Borders" should be used as a handbook for continuous improvement.

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EUROPEAN JOURNAL OF WORKPLACE INNOVATION

A new take-off for EUWIN!

Steven Dhondt
Peter Totterdill
Geert Van Hootegem

The European Workplace Innovation Network (EUWIN) was created in 2013 at the request of the European Commission (DG GROW). Its goal was to develop and promote the idea of Workplace Innovation at the European level. The European Commission wanted to spread the idea that innovation in companies not only was the result of R&D investments but needed to be supported by the work practices in companies too! A substantial amount of the innovative ideas originates in the minds of first-line workers. And equally important, more than half of innovations do not succeed because employees have not been engaged in the innovation process itself. The European Commission sees this as an enormous opportunity to boost the innovative potential of Europe. EUWIN was born!

Over the past years, the network developed itself speedily and with ever greater impact. In the end, EUWIN had reached over 10.000 persons and companies through conferences. Hundreds of thousands of persons looked for information on the knowledge bank and websites created with the help of Workplace Innovation Ltd. Hundreds of experts and collaborators pushed the message across to thousands of companies all over Europe. Even the European Commission was astonished by the network-effect the EUWIN-initiative created. The positive impact secured that the European initiative received more funding than planned. And even after the finalization of the European funding for EUWIN, the European Commission submitted a call at the beginning of 2019 for five new workplace innovation networks. Nineteen proposals were submitted. Workplace Innovation has found some hard ground all over Europe.

For us as coordinators of the EUWIN-network, we remain contacted by so many persons from all over Europe. With the partnership that originally supported EUWIN, we had made an agreement not to be too formally about all the activities. EUWIN would function as a loosely coupled network to support any action at the EU-level on the topic of workplace innovation. This has worked fine in the past years since the final funding from the EU. In 2018, together with University of Agder, the network organized a major event in Norway. Workplace Innovation Europe (WIE) continued to help Scotland develop its workplace innovation strategy with the active involvement of EUWIN partners. In the Basque Country, Sinnergiak is fully developing the Gipuzkoa Workplace Innovation Platform. In Belgium, Flanders Synergy transformed itself into Workitects. And so on. Gradually, it became clear to the core partnership that EUWIN needs a more formal grounding. The network partners are getting more and more questions about coordinating European initiatives, about training and accreditation of workplace innovation specialists, about how to fund and support company workplace innovation initiatives, how to develop national and regional programmes to support workplace innovation.

It is great that workplace innovation receives so much attention all over Europe. And this is why we, as the core partnership of EUWIN, see the responsibility to give EUWIN a new take-off. This time not funded by the European Commission, but rather as a collaborative effort from the network partners. In the past months, the network has developed a proposal how to collaborate, what topics to collaborate on and how to fund these initiatives. Bottom-line: EUWIN is relaunching itself to promote and develop workplace innovation. The focus is on European initiatives. The partners look after the national and regional interests. EUWIN will come with more conferences, website and knowledge bank initiatives, with more ideas about accreditation of specialists, with more news and many more ideas. And this is where you yourself come in! EUWIN is not possible without the help of so many individuals and organisations. It is you who needs to provide us with ideas and suggestions. Our emails are available. Please let us know what you think!

Steven Dhondt, Peter Totterdill & Geert Van Hootegem

EUROPEAN JOURNAL OF WORKPLACE INNOVATION

Discussion

Coping with the Future: The Brexit Kodak Moment

Richard Ennals

Abstract

It is all too easy for politicians and other decision makers to ignore or fail to take account of research which would complicate their decision-making processes. In this article we take the case study of the UK and departure from the European Union (known as "Brexit"). A Referendum in June 2016 voted to Leave. The case was discussed in a keynote talk at the "Coping with the Future" conference at the University of Agder in October 2018. Crisis and chaos continue in October 2019.

Keywords: Brexit, Kodak Moment, temporal logic

A Writing Project

In early 2017 there was a writing workshop in Copenhagen, organised by the University of Agder, which brought together researchers and PhD students, largely from Norway, who shared a need to write and publish. As is my habit, I was taking detailed notes of the series of presentations. In my room at the end of the day I identified an emerging theme: "Coping with the Future". I also identified a new concept, which was introduced by Halvor Holtskog: "Kodak Moments": disruptive and transformative events.

The book "Coping with the Future: Rethinking Assumptions for Society, Business and Work", edited by Johnsen, Holtskog and Ennals, published in April 2018 was the outcome of an intensive collaborative process. Each chapter was co-authored and repeatedly edited, going through many stages of a collective creative process. The book does not promote a Nordic or Norwegian Model: it exemplifies it. I have no doubt that each of our team of contributors would highlight different aspects of the project and the book, starting from their own specialist perspectives. This article is a personal view.

Action Research and Kodak Moments

I have been an Action Researcher for 50 years. I chose to add a focus on particular "Kodak Moments", going beyond the narrow focus of individual companies. Readers will see discussion of the Brexit process in the UK; and of the election of President Donald Trump in the USA. Both events were unexpected, disruptive and transformation, with enormous continuing impacts. They reinforce the view that the future is uncertain and unpredictable. This presents particular challenges for social science, which are explored in the book.

I am not content to observe. I am engaged, as a senior citizen of a society undergoing change at all levels: local, original, national and international.

In the early summer of 2017, as our book was taking shape, I was approached by Allan Larsson: former Swedish Minister of Finance, Director-General for Employment and Social Affairs in the European Commission, and recently a personal adviser to the Swedish Prime Minister, the President of the European Commission, and the Director-General of the International Labour Organisation.

Larsson wanted to know what was going on in the UK, with regard to Brexit. I explained that I have no power in UK politics. I have worked with Larsson on a number of occasions since 1998, trying to understand and improve the world in which we are living through, in difficult times. See *Concepts and Transformation* 3.1. 1998, and the *European Journal of Workplace Innovation* 3.1 2017.

Brexit for Beginners

On 7th October 2017 I submitted an article "Brexit for Beginners", in the "Curmudgeon Corner" section of *AI & Society*, drawing on the literature of belief systems in Artificial Intelligence. It was published online a few days later. I introduced the key dramatis personae, and the basic plot of an interactive theatre piece, "The Young Gentlemen of Etona". The focus was on key individuals who met as students at Oxford. Several of them, including David Cameron and Boris Johnson, had previously been pupils at Eton College. They were long-term rivals for political power in the UK. Their desire for political power was stronger than their adherence to particular political principles.

In research terms, I have been interested in whether the conjectures in this article, from October 2017, have subsequently been refuted. In November 2018 the article was published in *AI & Society* 33.4 2018.

The Brexit Negotiations

There is an additional context which we must consider. Events in the real world have continued to develop. As I spoke on 9th October 2018, I needed to consider how to cope with a future which was due to be announced on 10th October, when the Chief EU Negotiator on Brexit, Michel Barnier, reported on the progress of negotiations. There was a scheduled European Council meeting on 17th – 18th October, and potentially there could be a special summit on 17th -18th November 2018. The UK was due to leave the EU on 29th March 2019. There were then two delays: the current scheduled departure date is 31st October 2019.

Each day, we still cannot predict with any certainty what will happen tomorrow. If you listen to my keynote talk, or read the text which I used, you can compare it with the continuing public picture.

It is not my task in this article to argue for a particular position on Brexit. My action research has included engagement with conversations and dialogues across many political parties, countries and disciplines. My key findings concern the logical, legal and cultural context of the Brexit debate.

As I wrote the keynote talk, there was an effective news blackout on what is going on behind closed doors. The negotiators for the UK and the EU entered the "tunnel", in order to achieve a final draft agreement. This happened again with the new Prime Minister Boris Johnson.

I have been active in Facebook debates which have been hosted by Allan Larsson. On 7th October 2018, my online discussion reached the point where my interlocutor confessed that he could not follow my argument. This was not due to a lack of knowledge of the law and politics. It was a question of being unable to follow the logic. On Monday 8th October I added a wealth of new arguments, taking account of temporal logic.

Gödel and Howorth

My starting point was a philosophical problem which was raised by considering the work of both Kurt Gödel (1962) and Jolyon Howorth (2018), who set out clear guidance on what could be handled by logic and negotiations. In 1931, Gödel, in his "Incompleteness Theorem", first argued that symbolic systems, at a given level of abstraction, could not be both complete and consistent. That has constrained our understanding of what is possible in the key technical field of logic and computer science.

Jolyon Howorth is Emeritus Jean Monnet Professor of European Law at Bath University, with visiting professorial posts at Yale and Harvard. In an LSE blog published on 25th September 2018, Howorth argued that, given the stated "red lines" of the various parties to the Brexit negotiations, and in particular the UK government, there was no possibility of a successfully negotiated deal. He recommended that the Prime Minister Theresa May should acknowledge this, and seek to revoke Article 50 of the Lisbon Treaty.

For Brexit, this increased the focus on finding solutions to the thorny problems of the Irish border and customs arrangements. Again, in this article I do not need to adopt particular positions. As I write today, UK Prime Minister Boris Johnson is trying to secure Parliamentary approval for his own proposed solution to the continuing problem. Crucially, he changed the "red lines" regarding Northern Ireland.

With the help of logicians and lawyers, I have been exploring how complex problems can be represented in logic. This builds on work at Imperial College in 1985, where I was research manager. The Imperial College team, led by Robert Kowalski, represented the 1981 British Nationality Act in predicate logic, and interrogated it on the computer, as a logic program. There was a presentation at the Royal Society. There were radical but largely undiscussed implications for practical democracy.

Temporal Logic

In this article I focus on the additional technical areas of temporal logic and non-monotonic reasoning.

My Facebook interlocutor argued, with impressive authority, that once there was agreement on the terms of withdrawal, with a Withdrawal Agreement, then Brexit would take place, and that the process would be irreversible.

I argued that the Leave majority in the 2016 referendum was respected, when the UK went ahead with the Article 50 process. However, although there was agreement on a mood of opposition to UK membership of the EU, there had as yet been no agreement on an alternative destination. The two stages of "divorce", and developing a new trade relationship, were to be handled separately.

Are we nearly there yet? Unfortunately, we do not know, as we have not yet set a destination in our "Policy Sat Nav".

What do we want? We don't know. When do we want it? Now.

No Deal or No Brexit

Theresa May repeatedly warned that if there was no rapid agreement on defining the chosen Brexit settlement, then there would be a risk of "No Brexit".

What does that mean? It should not necessarily mean "No Deal", with the catastrophic economic and social consequences which would be likely. The UK and the EU could reach some pragmatic understanding. Donald Tusk, President of the European Council, has expressed this view.

The situation would not be an example of that form of breakdown, resulting in No Deal. The issue would be the continued absence of a UK position, and the lack of parliamentary support for any given Brexit model, such as "Norway" and "Canada +++". On that basis, there was effectively no possibility of a Brexit deal, as there is no public substantive UK government proposal which meets EU "red lines". This continues to be the situation in October 2019.

In principle, therefore, I suggested that the correct next step, in constitutional terms, would be for the UK to revoke Article 50 of the Lisbon Treaty. This echoed the view expressed by Jolyon Howorth, in his blog published by LSE on 25th September 2018.

My Facebook interlocutor argued that once withdrawal is agreed, then it is too late to revoke Article 50, which would also require unanimous approval by the other 27 EU member states. However, before the Withdrawal Agreement has been reached, revocation of Article 50 is possible. Once confirmed by the EU 27 member countries, this would lead to the outcome of "No Brexit". The UK Parliament has since rejected the Withdrawal Agreement three times. This week it is to be asked to vote again.

Non-monotonic reasoning

What does this mean for the frequently stated principle that "nothing is agreed until everything is agreed."? We may begin to realise that it makes little sense. It does not capture the nature of negotiations, which are incremental and dynamic, with developing areas of consensus and trust.

We are being invited to engage in non-monotonic reasoning, which involves analysing a data base of propositions which is constantly changing, based on moves in the negotiation process. There can be advances and retreats, progress and setbacks.

In 1980, with a pilot class of 9-year old pupils, I developed and published a murder mystery database (Ennals 1983). As more evidence was collected, the database was updated. Pupils sought to plant evidence to incriminate particular suspects. Susie had been killed with a "blunt instrument". Our pupil detectives listed a number of possible weapons, including a football boot, a cricket bat, and a wooden

leg. They reasoned with a changing database. Purists such as Professors Michael Griffiths and Pat Hayes deplored this non-monotonic reasoning. Meanwhile, the example spread across the world, for example as "Sherlock Holmes", but with distinctive and familiar items of evidence.

There was a related issue, explored by Keith Clark (1978) at Imperial College: "negation as failure". The answer "NO" to a query to a database should be understood as "Not proven to be YES".

Temporal Logic: Goodman's Paradox

There is a classic logical paradox which offers insight into temporal logic. Nelson Goodman (1955), in "Goodman's Paradox", used the example of "Grue". This means "Green before noon and Blue after noon". The meaning of "Grue" changes with the time of day. This provides a powerful lens with which to scrutinise major policy changes, such as the UK Government's Universal Credit system.

There are clearly issues around the temporal dimension. It does not seem obvious that politicians and negotiators have grasped the complexities of temporal logic.

What is the consequence of this gap in understanding? It appeared that if the gap was not filled before Michel Barnier made his report on 10th October 2018 in Brussels, then it might simply be too late. There is a stated sequence of stages in the Brexit process, but without reversibility, or understanding of the issues concerned. Boris Johnson's team appear to have understood this, as the new deal implicitly required the Withdrawal Agreement to be renegotiated, to take account of the changed "red lines".

The apparent failure to grasp the temporal dimension of legislation and negotiation casts a giant shadow across the workings of our countries, and of international relations.

Channel Tunnel

I should add that the logics of law in the UK and the EU have distinct histories. Linking them in treaties is like building the Channel Tunnel, as was memorably studied by the Tavistock Institute (Pomares 2018). The cultures of working life on the two sides of the Channel were very different.

Cliff Edge

The UK has sleepwalked to the cliff edge of disaster. Disaster can still be averted, but, literally, it still requires "action this day". A few targeted conversations could halt the runaway train in time. We need words and actions.

Can we cope with the future? We may soon find out.

References

Ennals R. *Beginning micro-PROLOG*. Chichester, Ellis Horwood, 1983.

Ennals R. "Partnership for a new organisation of work and Europe as a development coalition: An interview with Allan Larsson, Director-General of DG-V, European Commission." *Concepts and Transformation* 3.1 1998 1-10.

Ennals R. "Brexit for Beginners: The Young Gentlemen of Etona". *AI & Society: Knowledge, Culture and Communication*, 33.4 2018.

Clark K. "Negation as Failure". In Gallaire H. et al (eds.) *Logic and Data Base*. New York, Plenum 1978.

Goodman N. "Goodman's Paradox" in *Fact, Fiction and Forecast*. Oxford. OUP 1955.

Gödel K. "The Incompleteness Theorem". In Meltzer B. and Braithwaite R. *On Formally Undecidable Propositions of Principia Mathematica and Related Systems*. New York, Dover 1962

Howorth J. "Brexit has become unnegotiable." LSE Blog. 25th September 2018.

Johnsen H.C.G., Holtskog H. and Ennals R. (eds.) *Coping with the Future: Rethinking Assumptions for Society, Business and Work*. London, Routledge 2019.

Larsson A. "How to understand the times we are living through". *European Journal of Workplace Innovation*. 3.1. 2017.

Pomares E. Personal Communication. October 2018.

Sergot M., Sadri F., Kowalski R., Kriwaczek F., Hammond P. and Cory T. "The British Nationality Act as a Logic Program." *Communications of the ACM*.29.5 1986

News Item

Action Research Industrial PhD at Sabanci University, Turkey

Sabanci is a major Turkish holding company. The company built the impressive Sabanci University campus, outside Istanbul. Teaching started in 1999. The Library is called the İnformation Centre,The Performance Centre, Student Centre and Sports Centre are very modern. The 50-bedroom Education Development Unit is on the top floor of the Business School. Catering services are excellent.

Prof Oguz Baburoglu, founder of Arama Participatory Management Consultancy, led the Search process from 1995 which designed Sabanci University, which hosted the 1998 Fred Emery Memorial Conference. This led to the book "Educational Futures", edited by Oguz Baburoglu and Merrelyn Emery; Sabanci University Press, Istanbul 2000). In the last 8 years Sabanci University has achieved high rankings and won numerous awards for innovation and entrepreneurship.

Following a decision by the Sabanci University Board of Trustees, Prof Oguz Baburoglu is now Arama Chair at Sabanci University, tasked with developing the new Action Research Industrial PhD Programme. A design workshop was held 28th - 29th September 2019, with local, faculty and potential students, as well as international faculty. A Course Catalogue, in English and Turkish, was submitted. It is intended that the programme will be offered from 2020.

The Industrial PhD programme is intended for students, both Turkish and international, who are in senior executive roles. It starts with a focus on a Transformation Project, supported by a set of taught courses which present the depth and breadth of Action Research, delivered by teams of international and local faculty.

For details of the programme, and the Course Catalogue, please contact Prof Oguz Baburoglu at *baburoglu@sabanciuniv.edu*