Work-based-Learning in the Digital Age

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Keywords: Work Design, Work Organization, Work based Learning, Learning on the Job, Vocational Training, Division of Labour, Policy.

Abstract: This paper gives a retrospective about research and practice of work organization in Germany during the last four to five decades followed by an outlook to new challenges in particular in relation to vocational training concepts, which come along with the technical opportunities of the ongoing digitization. The question, how far the work organization could contribute to preserve or enhance the employees' knowledge and skills will be addressed reviewing the actual state of research. Thereby the developed concepts are matched with the current challenges and the concept of the resource based view.

1 INTRODUCTION

Digitization will change sustainably and comprehensively the future of work and work organization concepts. In order to manage the growing challenges due to shorter innovation cycles and more and more interconnected and complex industrial production systems in the course of the so called fourth industrial revolution, the requirements for employees' qualifications and skills will rise correspondingly. For companies it will be a question of work organization and vocational training management whether they will be able to cope with the challenges of the industrial transformation and to deal with the increasing requirements for the employees. The companies are challenged to increase their competitiveness and capacity for innovation as well as to ensure the improvement of employability and adaptability of workers by creation of attractive, stable and healthy working conditions and through innovative concepts of vocational training (Schmidt-Rathjens, 2007). It is already apparent today that the highly controversial debate regarding industrial transformation (including discussions about alternative work organization models) shows that different development paths are conceivable. On the one hand, industry 4.0 can make a significant contribution to improving working conditions and employment opportunities by a specific target group arrangement of work and work organization, by a reduction of mental and physical stress with the help of intelligent assistance systems,

by a promotion of knowledge and experience sharing and by a more effective use of human resources. On the other hand, increasing automation could lead to an exclusion of employees, who are not able to overcome the growing requirements on their skills and qualification. For these reasons, concepts for enterprise-related and an extra-occupational skills management are becoming more important (Deuse et al., 2015; Kagermann et al., 2013).

Based on these developments, this paper gives a retrospective about research and practice of work organization in Germany during the last four to five decades followed by an outlook to new challenges in particular in relation to vocational training concepts, which come along with the technical opportunities of the ongoing digitization. The question, how far the work organization could contribute to preserve or enhance the employees' knowledge and skills, will be one of the most challenging questions.

2 GERMAN PROJECTS

The scientific discussion of the subject work began with the start of the division of labour and in particular with the mass production (Dombrowski, 2012). For many years, German economy has been dominated by taylorist work organization models. The principles of company management according to Taylor are characterized by a strict separation of manual and intellectual work, by methods of
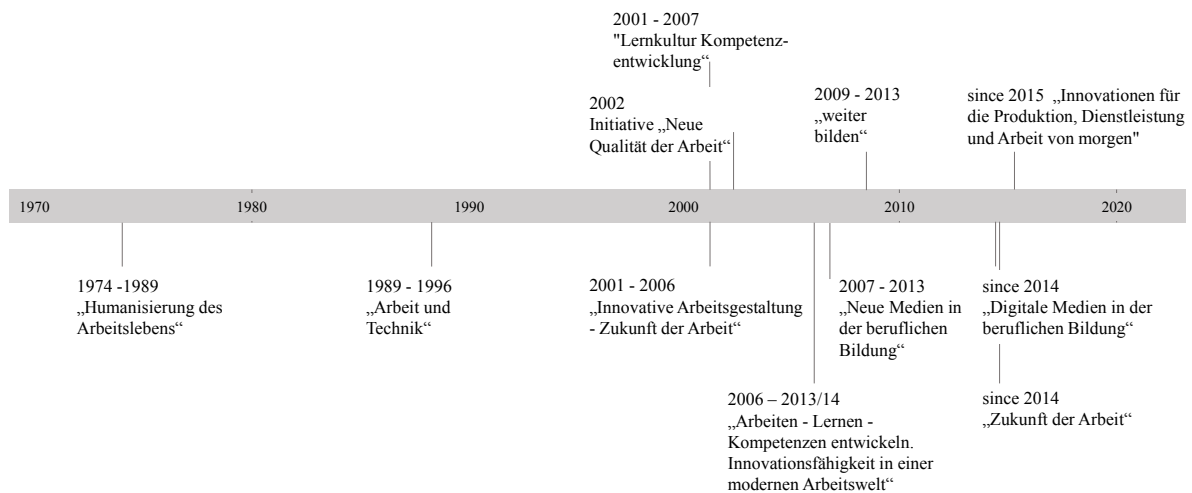
Figure 1: Initiatives and programs of the German federal government (own illustration).

separation individual work tasks in smallest possible monotonous repetitive partial steps, by rigid performance requirements, by a monetary incentive pay system and by outsourcing all planning, regulating and controlling tasks in the field of manufacturing (Reichwald and Piller, 2009). By combining these principles and the automation of production, Henry Ford laid the foundation of mass production. From a human point of view, these work organization models have considerable disadvantages. People were only considered as a factor of production. On the one hand, minimal content of work led to on-sided physical strain and on the other hand it led to underuse of people's opportunities and to resignation, demotivation and indifference to product and company with the consequence of frequent absenteeism and a high number of ill staff (Soder, 2015). Experiments, to resolve negative stress and strains through increasing the automation of production, remained unsuccessful. Because of worker's and mainly labour unions' and researchers' permanent criticism, need for action also has been recognized at the political level. Since the early 1970s several institutions initialized a number of initiatives, programs and projects, which are shown in Figure 1.

The objective of the research program "Humanisierung des Arbeitslebens" was to create human working conditions, which consider the employees needs in the work process and develop models for work organization and the workplace design (BMBF, 2014). The program was replaced by the national research and development program "Arbeit und Technik", which was aimed for strengthening the innovative capacity of economy. The focus was on use of opportunities arising

through an integrated work design and technology (BMBF, 2014). The program "Innovative Arbeitsgestaltung - Zukunft der Arbeit" intended to design the process of change in a modifying world of work, in which the boundaries between manufacturing and services merge more and more and knowledge is a growing factor for economic success. Humans and their knowledge and skills are in the focus of the considerations. Regarding this perspective the question was, what skills and competencies are required to design the process of change in the work environment actively and what is the best way to provide specific skills profiles (BMBF, 2014). In the initiative "Neue Qualität der Arbeit" many institutes and companies got involved with the design of a modern working culture and personal policy with the aim to develop, design and control the resources knowledge and expertise, to achieve a higher work quality, which is a foundation for a high innovative capacity and competitiveness (Broll, 2013). The objectives of the program "Lernkultur Kompetenzentwicklung" were research, development and implementation in the area of skills development, to satisfy the future requirements of the company and especially of the employees, because conventional seminar-trainings were recognized to be no longer sufficient.

The approach of the research and development program "Arbeiten - Lernen - Kompetenzen entwickeln: Innovationsfähigkeit in einer modernen Arbeitswelt" was a holistic view to working and learning. It was recognized that the combination of working and learning is an important factor for innovative capacity (BMBF, 2007). In the following program "Zukunft der Arbeit" the challenges for companies and people through the structural

changes, the digitization and increasing globalization, will take up and new concepts to improve innovation capabilities and job-integrated skill development. The initiative "weiter bilden" should support the employees' skill development, in order to strengthen the company's flexibility and competitiveness and to increase the employability of employees through increased participation in training programs (BMAS, 2014). The research program "Neue Medien in der beruflichen Bildung" deals with questions about the quality assurance of training and qualification programs for employees. In this context it was considered, that learning processes can be more flexible, more individual and informal. However the incorporation of technology, media pedagogy and didactics remains a crucial task (BMBF, 2005). The aim of the subsequent research program "Digitale Medien in der beruflichen Bildung" is to establish new educational concepts by the application of digital media in the vocational education and training. In this process existing didactic teaching and learning concepts will adapted to a variety of technology-based learning opportunities and will be spread out in vocational training (BMBF, 2012).

The employment market faces major challenges, because technological innovations, such as digitization, changed the work environment fundamentally and simultaneously raise new questions. Therefore the German federal government supports the program "Arbeit in der digitalisierten Welt" in the context of the initiative "Innovationen für die Produktion, Dienstleistung und Arbeit von morgen" research projects with this focus (BMBF, 2014).

2.1 Concepts of Humanization the Working Life

The aim was, due to a tendency of moving away from taylorist work organization models, to examine options to improve job contents and relationships, to reduce onerous (stressful) and hazardous (harmful) work situations and to adapt the general working conditions closer to the needs of working people (Salfer and Furmaniak, 1981). During this and follow-up programs important principles of work design were formulated, which are valid up to the present time (Hartmann, 2015). For example, the concept of the sociotechnical system of Emery and Trist was continued and improved (Bochum, 2015). Nowadays it is still important that interests of the people and organizations are considered systematically and effectively in the development

and implementation of new technologies (Hartmann, 2015). Another important subject of the program was the concept of task completeness (Mühlbradt, 2014). At that time it was recognized that a higher task complexity is essential for a learning-enhancing work organization, and for successful learning (Bieber and Haubner, 2013). Furthermore concepts of individualized flexible work structures were developed. Taylorist organizational models were characterized by the search for the optimal solution to carry out a work task. In contrast to that, various alternative forms of work and work systems should be available in individualized flexible working structuring models (Strohm and Ulich, 1997). That way an according to various personalities and a learning-friendly design of tasks for employees with different abilities and work requirements is possible. Especially in the context of demographic change, these concepts also have great importance today, for example for older employees or in mixed-age teams (Hartmann, 2015). Other concepts of the program included an autonomy oriented, participatory labour organizations, in which employees participate in the work organization and get more influence on their work situation and qualifying work designs, which should help to ensure that the employees can evolve (Fricke, 1975). The current relevance of these issues is reflected in the support of joint (common) learning processes for a competent organization, in the development of problem solving skills to deal with complex labour requirements and in creating new prospects for knowledge management. The program's deficits were, for example, that mainly political and labour union interests were pursued and the reference to business strategies was unclear.

2.2 Concepts of Learning Culture and Skills Development

Extensive research and work design approaches were dedicated to the issues of building a new learning culture for the promotion of innovation and competitiveness of the business location Germany (Erpenbeck and Sauer, 2000). This new learning culture should be shaped not only by classical learning in further education institutions, but increasingly from learning in the work process, learning in the social environment as well as from learning in network and multimedia. In addition to the acquisition of knowledge the teaching of values, the development of new skills, attitudes and behaviours as well as the ability to use existing experiences and information come to the fore should continue (Bulmahn, 2003). Particular attention was

paid to informal learning in the work process and the development of measurement concepts and procedures and empirically determinable dimensions and indicators of suitability for learning in the work process (Frieling et al., 2006). A program's weakness was that in real life, a design of work systems regarding suitability for learning was hardly implemented, since the real actors of the work system design were not reached and involved (Hartmann, 2015).

2.3 Concepts to Strengthening the Innovation Capacity

The degree of integration of learning into the corporate culture is also reflected in the form of corporate work organization. Studies of the EWCS (European Working Conditions Survey) identified and confirmed correlations at country level between the characteristics of a learning-conducive work organization and companies' innovation performance in 2005 and 2009 (Hartmann, 2015; Valeyre et al., 2009). It was shown that versatile companies exhibited a higher innovativeness which was based mainly on the skills and qualifications of their employees. Fundamental are an appropriate and thoughtful work design embedded in a corporate culture that enables simultaneous learning in digital work environments. (BMBF, 2005). Therefore, development of competence and the creation of a learning culture promoting innovation are seen as crucial priorities by the federal government in the coming years. Since the early 2010s a number of funding programs and initiatives have been launched to raise awareness of the aforementioned issues. The Federal Minister of Education and Research Mrs. Johanna Wanka addressed the urgency and necessity of these issues at the conference "Arbeit in der digitalisierten Welt" in 2015. So the current core elements of the German government's new high-tech strategy will be expanded to include the topic of work in the digital world.

3 CURRENT CHALLENGES DUE TO THE INDUSTRIAL TRANSFORMATION

For the design of work in the course of digitization a central task will be to implement the competence development through learning on and in the work process. Therefore the work design must be adapted in the course of the digitization.

Since the impact of the digitization could not be anticipated nowadays we have to rely on forecasts and prognosis. However the current predictions differ strongly from each other. For sure it can be said that work quality, qualification requirements, work organization and human-computer interaction will change significantly (Botthof, 2015). The most important transformations in the course of the ongoing digitization are expected in the division of labour between humans and automated systems (Brynjolfsson and McAfee, 2014). Simple repetitive work tasks, which require a low degree of qualification, will be automated quickly in the coming years (Frey and Osborne, 2013). Highly qualified work assisting systems will become more and more important. Consequently lower skilled employees need to be qualified for more creative and complex tasks. But since these workers are not used to the classic education and training new forms of training and especially work-based-learning become central aspects to prevent scenarios which Frey and Osborne describe in their publication. The authors estimate for instance that 47 % of the current US-American workforce will lose their jobs due to the digitization (Frey and Osborne, 2013). Similar conclusions are reached by a German prediction published in the economic magazine "Wirtschaftswoche" (Tutt, 2015). However these first studies neglect the job creation potential of the digitization. The Boston Consulting Group expects for example an employment rise by 390.000 for Germany due to the digitization (Rüßmann et al., 2015).

However it seems very clear that these new employment potentials are in line with a significant shift in the skills and qualifications required (Hirsch-Kreinsen, 2014; Rüßmann et al., 2015). Nevertheless the digitization means also a historic opportunity for new work design and especially work-based-learning (Senderek et al., 2015). On the one hand work systems for the so called Industrie 4.0 will be set up from scratch and offer a lot of design opportunities. On the other hand learning support systems can be directly implemented.

4 LEARNING IN THE CONTEXT OF THE RESOURCE BASED VIEW

Based on the works of Penrose (1959) Barney (1991) and Wernerfelt (1984) advanced the concept of the resource-based view (RBV). The RBV uses

the competence available in the enterprise for the explanation of strengths and weaknesses of an enterprise in comparison to its competitors. Competence encloses cognitive aspects and practical abilities. Competence enables an enterprise to achieve a competitive advantage, however in the longer term only if competence cannot be copied (Grant, 2005; Prahalad and Hamel, 1990). According to Prahalad and Hamel (1990) the core competences should be designed that they can be used for the production of a huge number of goods and services and provide a benefit to the customers. Thereby a unique selling proposition can be derived which competitors cannot imitate (1990). However if companies totally rely on external work system design and do not command it, advantages in competitiveness can be copied easily. Thus the work system design needs to include not only engineers but also internal human resource management and IT-experts. Consequently a competitive edge does depend on companies abilities to design their work systems learning conducive.

5 CONCLUSION

The need for a suitable learning-conducive work design and organization was recognized way before the challenges of the current digitization have arisen. The research on work design and organization in Germany can be divided into three phases. Firstly concepts for the humanization of working life were developed from the 1970s to the 1990s which shape the analysis and design of learning-conducive working systems. Secondly during the learning culture and skills development research stream methods were elaborated to determine specific indicators analysing learning from work situations. Finally the current research to strengthen the innovation capacity focusses on the contribution of work based learning to the innovativeness and competitiveness of companies.

All three research streams provide important contributions for the learning enhancing work design. However the challenges of the current industrial transformation increase the need for further research concerning work-based-learning. For sure work-based-learning could contribute significantly to cope with the challenges of changing qualification demands and provide an opportunity for the future employability of low skilled workers. Thus work-based-learning concepts need not only to be incorporated early in the design of new work

systems but also have to be adapted for the inclination of the available technologies.

In addition to that the competitiveness of companies will depend highly on their ability to learn. Learning can be considered as one of the core competencies which are described in the resource based view. Since companies' lack of understanding their own work systems will decrease their competitiveness. Consequently there is a need of qualifying the employees to understand and cope with the new arising work systems in the age of digitization.

REFERENCES

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage.In *Journal of Management, 17*(1), 99-120.

Bieber, D., and Haubner, D. (2013). Innovationen im Dienstleistungssektor am Beispiel von altersgerechten Assistenzsystemen. Nutzer- und Beschäftigten-integration als Basis für Innovationen. In ver.di - Vereinte Dienstleistungsgewerkschaft (Ed.), *Dienst-leistungsinnovationen: offen, sozial, nachhaltig.* Berlin.

BMAS. (2014). Initiative "weiter bilden" mit positiver Bilanz. Retrieved from http://www.bmas.de/DE/ Themen/Aus-und-Weiterbildung/Meldungen/esf-initiative-weiter-bilden.html website:

BMBF. (2005). Förderprogramm Neue Medien in der Bildung. Auditempfehlungen zum Förderbereich „Neue Medien in der beruflichen Bildung". Retrieved from http://www.google.de/url?sa=tandrct=jandq= andesrc=sandsource=webandcd=6andved=0CEYQFjA FahUKEwicotyppZbGAhXBXBQKHYWtAPoandurl =http%3A%2F%2Fwww.dlr.de%2Fpt%2FPortaldata %2F45%2FResources%2Fa_dokumente%2FBMBF-neue_medien_in_der_beruflichen_bildung.pdfandei=S C2BVZzeHMG5UYXbgtAPandusg=AFQjCNGFPjQJ pCbAFfFuponlaOyLZnwlLwandbvm=bv.96041959,d. ZGUandcad=rja

BMBF. (2007). Arbeiten - Lernen - Kompetenzen entwickeln. Innovationsfähigkeit in einer modernen Arbeitswelt. BMBF-Forschungs- und Entwicklungs-programm. Retrieved from http://pt-ad.pt-dlr.de/_ media/Broschuere_Arbeiten-Lernen-Kompetenzen-entwickeln.pdf

BMBF. (2012). Digitale Medien in der beruflichen Bildung. Förderprogramm des Bundesministeriums für Bildung und Forschung. Berlin: Bundesministerium für Bildung und Forschung (BMBF).

BMBF. (2014). Innovationen für die Produktion, Dienstleistung und Arbeit von morgen. Retrieved from http://www.bmbf.de/pub/Innovationen_Produktion_Di enstleistung_Arbeit.pdf

Bochum, U. (2015). Gewerkschaftliche Positionen in Bezug auf „Industrie 4.0". In A. Botthof and E. A.

Hartmann (Eds.), *Zukunft der Arbeit in Industrie 4.0* (pp. 31-46). Berlin: Springer Vieweg.

Botthof, A. (2015). Zukunft der Arbeit im Kontext von Autonomik und Industrie 4.0. In A. Botthof and E. A. Hartmann (Eds.), *Zukunft der Arbeit in Industrie 4.0* (pp. 4-6). Berlin: Springer Vieweg.

Broll, W. (2013). Augmentierte Realität. In R. Dörner, W. Broll, P. Grimm and B. Jung (Eds.), *Virtual und Augmented Reality (VR / AR) - Grundlagen und Methoden der Virtuellen und Augmentierten Realität*. Berlin [u. a.]: Springer Vieweg.

Brynjolfsson, E., and McAfee, A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. New York: W. W. Norton and Company.

Bulmahn, E. (2003). Grußwort der Bundesministerin für Bildung und Forschung, Edelgard Bulmahn, zum 4. Zukunftsforum "Lernkultur für morgen - Forschungs- und Entwicklungsprogramm ,Lernkultur Kompetenzentwicklung'" vom 12. bis 14. März 2003 in Berlin. In Arbeitsgemeinschaft Betriebliche Weiterbildungsforschung e. V. / Projekt Qualifikations-Entwicklungs-Management (Ed.), QUEM-report. Schriften zur beruflichen Weiterbildung. Heft 79. Zwei Jahre "Lernkultur Kompetenzentwicklung". Inhalte – Ergebnisse – Perspektiven (pp. 3). Berlin.

Deuse, J., Weisner, K., Hengstebeck, A., and Busch, F. (2015). Gestaltung von Produktionssystemen im Kontext von Industrie 4.0. In A. Botthof and E. A. Hartmann (Eds.), *Zukunft der Arbeit in Industrie 4.0* (pp. 99-109). Berlin: Springer Vieweg.

Dombrowski, U. (2012). Arbeitswissenschaft in Deutschland. *Industrial Engineering, 3*, 30-33.

Erpenbeck, J., and Sauer, J. (2000). Das Forschungs- und Entwicklungsprogramm „Lernkultur Komptenzentwicklung". In QUEM (Ed.), *Kompetenzentwicklung 2000: Lernen im Wandel – Wandel durch Lernen* (pp. 289-335). Münster.

Frey, C. B., and Osborne, M. A. (2013). The future of employment: how susceptible are jobs to computerisation? Retrieved from http://www.oxford martin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf website.

Fricke, W. (1975). *Arbeitsorganisation und Qualifikation. Ein industriesoziologischer Beitrag zur Humanisierung der Arbeit*. Bonn - Bad Godesberg: Verlag Neue Gesellschaft

Frieling, E., Bernard, H., Bigalk, D., and Müller, R. F. (2006). *Lernen durch Arbeit - Entwicklung eines Verfahrens zur Bestimmung der Lernmöglichkeiten am Arbeitsplatz*. Münster: Waxmann Verlag GmbH.

Grant, R. M. (2005). *Contemporary strategy analysis* (5. ed.). Malden, Mass. [u.a.]: Blackwell.

Hartmann, E. (2015). Arbeitsgestaltung für Industrie 4.0: Alte Wahrheiten, neue Herausforderungen. In A. Botthof and E. A. Hartmann (Eds.), *Zukunft der Arbeit in Industrie 4.0* (pp. 9-20). Berlin: Springer Vieweg.

Hirsch-Kreinsen, H. (2014). Wandel von Produktionsarbeit - „Industrie 4.0". *Soziologisches Arbeitspapier 38*. Retrieved from http://www.wiso.tu-dortmund.de/ wiso/is/de/forschung/soz_arbeitspapiere/Arbeitspapier _Industrie_4_0.pdf website:

Kagermann, H., Wahlster, W., and Helbig, J. (2013). Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0 - Deutschlands Zukunft als Produktionsstandort sichern. Berlin: Promotorengruppe Kommunikation der Forschungsunion Wirtschaft – Wissenschaft.

Mühlbradt, T. (2014). Was macht Arbeit lernförderlich? - Eine Bestandsaufnahme *MTM-Schriften Industrial Engineering*. Zeuthen: Deutsche MTM-Vereinigung e.V.

Penrose, E. (1959). *The Theory of the Growth of the Firm*. Oxford: Oxford University Press.

Prahalad, C. K., and Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review, 68*(3), 79-91.

Reichwald, R., and Piller, F. T. (2009). *Interaktive Wertschöpfung open innovation, Individualisierung und neue Formen der Arbeitsteilung* (2., vollst. überarb. und erw. ed.). Wiesbaden: Gabler.

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., and Harnisch, M. (2015). Industry 4.0. The Future of Productivity and Growth in Manufacturing Industries. Retrieved from https://www.bcgperspectives.com/Images/Industry_40 _Future_of_Productivity_April_2015_tcm80-185183.pdf. website:

Salfer, P., and Furmaniak, K. (1981). Das Programm "Forschung zur Humanisierungdes Arbeitslebens". Stand und Möglichkeiten der Evaluierung eines staatlichen Forschungsprogramms. *Sonderdruck aus: Mitteilungen aus der Arbeitsmarkt- und Berufsforschung*(14), 237-245.

Schmidt-Rathjens, C. (2007). *Spezifische Bedingungen von KMU bezüglich der Entwicklung und Erfassung der betrieblichen Lernkultur - Die Lernkultur-Checkliste (LKC-KMU)*. Berlin: Arbeitsgemeinschaft Betriebliche Weiterbildungsforschung e. V.

Senderek, R., Mühlbradt, T., and Buschmeyer, A. (2015). Demografiesensibles Kompetenzmanagement für die Industrie 4.0 In S. Jeschke, A. Richert, F. Hees and C. Jooß (Eds.), *Exploring demographics - Transdisziplinäre Perspektiven der Innovationsfähigkeit im demografischen Wandel* (pp. 281-295). Wiebaden: Springer VS.

Soder, J. (2015). Lean Industrie 4.0: Erfolgreich mit Werten und Menschen im Mittelpunkt! Retrieved from http://www.huffingtonpost.de/johann-soder/lean-indus trie-40-mensch-im-mittelpunkt_b_7230102.html website

Strohm, O., and Ulich, E. (1997). *Unternehmen arbeitspsychologisch bewerten. Ein Mehr-Ebenen-Ansatz unter besonderer Berücksichtigung von Mensch, Technik, Organisation*. Zürich: VDF.

Tutt, C. (2015). Abschied von der Arbeit. *Wirtschaftswoche, 5-2014*, 18-23.

Valeyre, A., Lorenz, E., Cartron, D., Csizmadia, P., Gollac, M., Illéssy, M., and Makó, C. (2009). Working conditions in the European Union: Work organisation. Retrieved from http://www.eurofound.europa.eu/sites/ default/files/ef_files/pubdocs/2008/62/en/1/EF0862EN .pdf website.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*(2), 171-180.