Participative Knowledge Management to Empower Manufacturing Workers

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ABSTRACT
Due to the rapid technologic change, we see the role of manufacturing workers continuously changing: the increasing automation of manufacturing processes has reduced the amount of manual work, whereas the increasing complexity of manufacturing systems requires workers to build-up broader and deeper skills. In this paper, the authors suggest a participative knowledge management approach to empower manufacturing workers. Starting from a comprehensive empirical analysis of the existing work practices in a manufacturing company, the authors have developed and validated a knowledge management system prototype. The prototype is aimed for training, problem solving, and facilitating the discovery, acquisition, and sharing of manufacturing knowledge. The conducted evaluation of the prototype indicates that workers’ skills and level of work satisfaction will increase since the knowledge management system allows faster problem solving by finding better solutions for observed defects.

KEYWORDS
Defect Management, Knowledge Extraction, Knowledge Management, Social Factory

1. INTRODUCTION
In recent years, a number of manufacturing companies have recognized the growing need for developing new approaches to increase workers’ job satisfaction and workplace attractiveness. This challenge has been highlighted in the Factory of the Future agenda (EFFRA, 2014) promoted by the European Commission, which calls for proposals on new approaches for skill and competence development, and knowledge management. Through its ubiquity and openness the Web has become a major source of inspiration for new tools and approaches that enable the sharing of information and ideas (John, 2013). Web platforms like Wikipedia, YouTube, and Facebook have promoted new ways of information search, sharing, and social networking. Users do not only consume, but actively produce information and engage with the information produced by others in a participative way.

Implementing a collaborative approach from the Web into a factory is a challenge that traditional manufacturing companies face in order to remain an attractive employer for younger workers (EFFRA, 2014). While younger workers are adopters of such recent technologies, and also “expect” to work with those in their job, fit strategies to engage older workers must also be put in place to avoid creating a “digital divide” (Pick & Nishida, 2015). Moreover, the ageing of the workforce leads to a continuous loss of manual and practical competences that is hardly affordable for the company, which must implement fit strategies to assess and contrast this phenomena (Jennex, 2014).

A growing number of studies has shown how social and mobile technologies can help to capture and process knowledge and to empower knowledge workers at their office workplaces (Faraj,
The adoption of ICT technologies plays a major role in the transition to a knowledge economy that is focused on the transformation of human knowledge in decision support systems that could generate economic value (Brown & Duguid, 2001; Gold, Malhotra, & Segars, 2001). This transition is ongoing at a global level and it is driving innovations from the ICT as a by-product of the so-called Information Age (Dutta, 2012).

In many industrial domains, manufacturing workers are still mainly manual workers; the challenge for the above mentioned transition is to empower them to become knowledge workers. Their work should be facilitated through innovative and dedicated knowledge management approaches, inspired by the digital transformation within office environments. This requires implementing knowledge-based strategies into manufacturing work that acknowledge the central role of the manufacturing worker.

In this paper, we present a participative knowledge management approach to empower manufacturing workers in their work practices with the aim to improve their problem-solving capacities, eventually leading to an increasing attractiveness of their workplace. The developed solution is based on four key enablers of knowledge creation identified by Elliot and O’Dell (Elliott & O’Dell, 1999): culture, technology, infrastructure and measurement. We focus on the management of explicit manufacturing knowledge, which can be expressed in words (Nonaka, 1991). We have developed a prototype of a manufacturing knowledge management system (KMS) based on an extensive analysis of the existing work practices in an Original Equipment Manufacturer (OEM) in the automotive industry. The subsequent requirements were elicited in a design-research-based approach at an automotive supplier company. This KMS is intended to empower workers in one of the most difficult and stressful tasks in their job: finding an appropriate solution for manufacturing defects.

A preliminary evaluation of the developed prototype conducted together with future users has shown that the participative knowledge management approach proposed by the authors is well suited to be integrated in a streamlined manufacturing process. It is solving a real problem for manufacturing workers by allowing the sharing of useful and quality-relevant knowledge and ultimately empowering them. The KMS uses state-of-the-art technology to retrieve the knowledge within its repository, such as semantic search, and adopts standard and widespread human machine interfaces like tablets instead of traditional workstations. The basic idea of the KMS is to provide a continuous support to manufacturing workers who can then use knowledge acquired by their peers to solve the daily issues that arise during their shifts. Another advantage of the developed solution is the transformation of the shop floor into a social environment where all the peers can share their ideas, receive feedback and, in general, gain a higher motivation to collaborate together.

After laying the theoretical background for our study (section 2), we describe our research approach, i.e. in gathering needs and eliciting requirements of industrial workers for empowerment (section 3). In Section 4 we introduce the adopted case study and describe the as-is situation and the challenges of the manufacturing workers to be taken on. In Section 5, we describe the KMS which has been developed according to the needs and requirements of the case study. The paper closes with a presentation of the results of our preliminary evaluation of the developed prototype in section 6 and a summary and outlook of future research in section 7.

2. THEORETICAL BACKGROUND

2.1. Knowledge Management in Manufacturing Companies

To have an optimal management of the workforce in a manufacturing company, it is fundamental to valorise the compromise and collaboration attitude of the employees (Wang & Ting, 2011). These two attitudes could be exploited simultaneously only if a formalization of the employees’ knowledge is available: collaboration and compromise must be based on a common idea and understanding. Many authors studied how the use of a KMS can improve the organizational performance. Greco et
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