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Challenges for the future of industrial labor in manufacturing and logistics using the example of order picking systems

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Abstract

This paper presents prospects for a human-centered design of future industrial labor in a framework depicting the dilemma between technological feasibility and labor-politically desirability, under the constraint of an economically reasonable design of work and technology. Using the example of order picking systems, this paper focuses on the challenges of progressive digitization in industrial processes. The analytical approach is the socio-technical system, which assumes that new technologies will also result in personnel and organizational changes. These considerations form a framework, which amalgates the perspectives of human actors, technology and organization and ultimately leads to a complementary design of industrial labor.

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Keywords: Manufacturing; Logistics; Industry 4.0; Internet of things; Order Picking; Industrial Labor; Societal Challenges; Socio-technical System

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1. Digitization as societal trend

The increasing diffusion and integration of digital technologies into all areas of societal life has experienced a renewed boost in recent years. This is because of, on the one hand, the new technical potentials that these technologies offer, and people's acceptance and habits of use. On the other hand, new economic applications are emerging much more vigorously than ever before [1, 2]. In addition to uses in mobility and transport, energy supply, medicine and other sectors, manufacturing and logistics are key areas of application for the new information technologies. So-called cyber-physical systems (CPS) – physical machines and components networked via internet – form the technological basis of a dawning "third industrial revolution" [3]. In an industrial-policy perspective, with intelligent automation and networks leading the way for the advantages of extensive collaboration and economies of scale, new markets and sales opportunities, which also provides a far-reaching macroeconomic impetus. Thus digitization is having an intense impact, above all in many national policy programs and business strategies as a leading "narrative" of progress and prosperity [4], while being stylized by management as a "really big deal".

This paper focuses on the societal challenges and consequences that arise with the digitization of industrial value creation– while sidestepping the intense technological and economic issues in the debate (for a summary see [5]). It begins by outlining the German debate – carried on under the heading "Industry 4.0" – over the developmental prospects for industrial labor in Germany (part 2). In this debate the sometimes contradictory assumptions and prognoses which often overlook the formative opportunities for the future of work and employment are encountered. By contrast, in (part 3) a *socio-technical* perspective is put forth for discussion, emphasizing the specific interactions of human, technology and organization and their interrelated configurations. Those challenges are then transferred onto the logistics use case of order picking systems. In (part 4) this approach is condensed into a framework for the design of digital industrial labor in order picking systems, which realizes humane working conditions on the one hand, and exploits the full technical and economic potentialities of digital technologies on the other.

2. Perspectives on the development of industrial labor

Many expert studies suggest that work will permanently change in all its relevant dimensions with the progressive application of digital technologies in nearly all sectors. In an industrial sense, this concerns not only the activities on the shop floor, but also the indirect areas, from planning and control systems to product development. The demands on leadership and management are likely to change significantly. Moreover, a thorough reorganization of inter-enterprise work and value chains is to be expected. However, answers to the question as to *how work will change* vary significantly: On the one hand, there are sceptical answers, stressing risks such as high levels of job loss, de-qualification, new kinds of stress and employee surveillance capabilities and thereby, increased social insecurity. On the other hand, optimistic expectations of job creation, increasing qualitative demands on labor and a general revaluation of jobs and skills are being expressed, constituting a "new, more humane turn" altogether [4]. This optimistic perspective and the chances of a revaluation of labor are under discussion in the context of the "Industry 4.0" discourse in Germany. The position of the "Research Committee of the Platform Industry 4.0", whose theses stress that with "Industry 4.0" are linked "multiple opportunities for a human-oriented design of the work organization", can be seen as representative [6]. The fact that this represents a very desirable development perspective in the broadest societal and industrial policy sense needs no further justification.

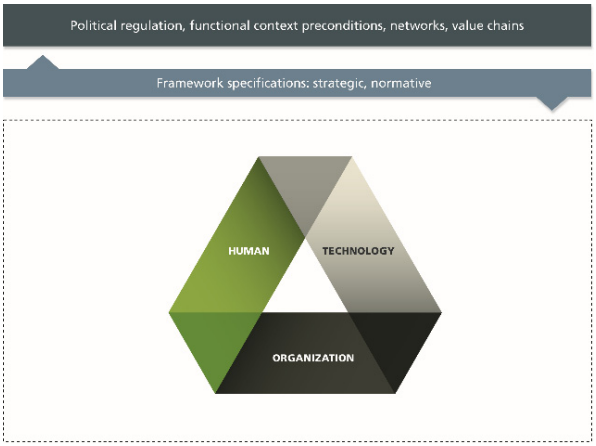

Fig. 1. The socio-technical system.

However, the actual realization of human-oriented forms of labor will not come about by itself. Rather, it requires a holistic and strategically oriented design approach and course of action. The model presented here will illustrate this in several ways: First, there are the "social media" functions of communication and the networks between objects, machinery and human actors that are already widespread in private life and are now increasingly appearing in production and logistics. Secondly, it points to the need in the future implementation of "Industry 4.0" systems to continually take into account the socially oriented, overall context of an industrial process. (See [7] for more information).

3. Approach of the "socio-technical system" using the example of order picking systems

An analysis and design approach for this model is provided by the concept of the "socio-technical system" [8]. This concept forms the basis of a research project entitled "Social Manufacturing and Logistics" (*SoMaLI*) at TU Dortmund University, Germany, as a joint effort of the Research Group of Industrial and Labor Research (FIA) and the Chair of Materials Handling and Warehousing (FLW). The aim of the project is to develop, a design for the social, technological and organizational challenges of "Industry 4.0" based on interviews with experts from companies and umbrella associations.

In the socio-technical system concept, the issue is not one of "either technology or human", but one of a *concerted design of a total socio-technical system*, taking into account the structural

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