From Factory of the Future to Future of the Factory: Integration Approaches

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Abstract: Nowadays, manufacturing systems transform themselves to become Factories of the Future (FoF) that is to say highly flexible, rapidly adaptable to external changes and aiming for a high degree of sustainability. This trend has generated several research streams that we analyse in this paper through a deep bibliographical review. This review leads us to conceptualize 3 main approaches: Computer Integrated Manufacturing, role of human work force and other integration approaches. A potential issue identified within the research is the interplay between computer-based and organization based approaches to manage the dynamic interactions among product, processes and production systems. The conclusions and orientations of future works are thus outlined to support the development of this co-evolution perspective for the successful transformation of Factories.

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1. INTRODUCTION

In the present era of greater Information Technology (IT)-based manufacturing systems, several initiatives are committed to the transformation of industry to attain the Factory of the Future (FoF) - highly flexible, rapidly adaptable to external changes and aiming for a high degree of sustainability (Herrmann et al., 2014). For instance, the Advanced Manufacturing Partnership in USA, the Horizon 2020 in the European Union, as well as the Industry 4.0 by the German government, among others, launch projects in this area. As a consequence the literature related to FoF is in constant growth with a variety of concerns, underlying approaches and application areas.

Therefore, this paper aims to provide a comprehensive insight of the underlying approaches and evolving conditions of production systems under the concept of the FoF. To succeed in, a bibliographic analysis is worked out following a defined methodology that will be detailed in the next section. This analysis will enable us to depict a global picture of what has represented the ‘Factory of the Future’ over time, particularly in the last three decades. Sections 3 to 5 are dedicated to the description of the three research streams we identify: (i) CIM (Computer Integrated Manufacturing) approach, (ii) the Role of Human Workforce and (iii) Other Integration Approaches. Section 6 pinpoints the possible work directions stemming from the bibliographical analysis. Section 7 concludes with the further aspects to develop a collaborative framework based on the co-evolution of product, processes and production systems.

2. METHODOLOGY OF RESEARCH

To structure the literature review we perform, we look for general guidelines providing the steps to follow. We found several works focusing on meaningful recommendations for crafting a literature review. For example, in (Kitchenham et al., 2007) guidelines for performing a systematic literature review in Software Engineering are proposed. They suggest a three-phased approach: i) Planning the review, ii) Conducting the review and iii) Reporting the review. As well, vom Brocke et al. (2009) proposes a framework that points out a circular process which characterizes a literature review. It integrates 5 main steps: i) Definition of review scope, ii) Conceptualisation of topic, iii) Literature search, iv) Literature analysis and synthesis and iv) Research agenda. This framework is interesting because it details the planning review and the reporting review steps proposed in (Kitchenham et al., 2007). Indeed, the scope review has to be defined and the topic conceptualised before performing the literature review as such. The result of the literature review is a research agenda. That is why our work is based on the framework of (vom Brocke et al., 2009) (see Fig. 1). This framework helps us to select, analyse, classify and report studies collected according to our review scope: “What does the manufacturing vision referred as the ‘Factory of the Future’ (FoF) entail?”’. Hence, we set up our bibliographical research using the key words ‘Factory of the Future’ and “Factories of the Future” by querying the database ISI Web of Knowledge from all years. Seeing the number of publications in the field, we delimit the type of documents as ‘Articles’ and ‘Reviews’; and the areas of research as

This query gives us a result of 80 papers. After reading abstracts, we excluded a certain number of papers for the following reasons: i) one anonymous paper ii) 17 papers without clear evidence and/or unavailable abstracts (between 1982 and 1990) and 1 out-of-scope paper from 2016 iii) 1 editorial paper including a brief literature review. At the end, 60 articles are analysed.

To observe the context in which these investigations are positioned, we analyse the number of different journals in which the considered papers are published. They are distributed over 50 different journals through the 1982-2017 period. This evidence shows that the publication sources for the FoF topic are quite various. Moreover, Fig. 2 shows that there are certain variations in the annual number of publications. From the 1984 to 1996 period, there are consecutive publications each year with an average number of 2 papers per year. After, there is a drop between 1997 to 2013 with only 6 papers. Since 2014 the FoF problematics gains again importance with a peak of 10 articles for the first trimester of 2017.

Our first objective was to identify common subjects about which the selected articles are dealing with, in order to set up homogenous categories of works. These will enable us to structure the analysis we want to do and to outline the main contributions underpinning the FoF. To identify these categories, we read the abstracts and extract common areas of interest. As such, in the former publications, belonging to the 80’s, the main stake of researches were to perform FoF through Computer-Integrated Manufacturing (CIM) approach. Thus, these studies form the first category with different sub-categories underlying the way CIM can be implemented. Later, among the works from mid-90’s until now, we identified a common group of works concerning other integration paths than CIM implementation to perform FoF. They highlight the integration efforts of new approaches for enhanced processes and production systems. Subsequent sub-categories are defined to place specific issues surrounding these integration approaches. Over all the period, several researches have a special focus on the characteristics of the human functions and roles parallel to the introduced CIM up to further forms of integration. These work deal with the adaptive role of the human interaction within the entire organisation, especially with the technologies required to perform integration enabling FoF. As a result, these works are finally included in a whole category.

So, we set up the following categories and sub-categories:

A. CIM Approach
   A1. Technology enablers and barriers for CIM
   A2. Flexible Automation
   A3. Decision Support Systems
   A4. Production Models

B. The Role of Human Workforce

C. Other Integration Approaches
   C1. Continuous Improvement
   C2. Holistic Factory
   C3. Processes for Sustainable production
   C4. Decision Support Systems

The distribution of the papers analysed according these categories and sub-categories is detailed in Table 1.
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات