Computers in Industry 81 (2016) 1–10

Contents lists available at ScienceDirect

Computers in Industry

journal homepage: www.elsevier.com/locate/compind

Emerging ICT concepts for smart, safe and sustainable industrial systems

ARTICLE INFO

Article history:
Available online 8 May 2016

Keywords:
Safety
Smart systems
Sustainability
Intelligent manufacturing systems
ICT

ABSTRACT

This editorial introduces the special issue on Emerging Information and Communication Technology (ICT) concepts for smart, safe and sustainable industrial systems in the Elsevier journal Computers in Industry. The 13 papers in this special issue were selected because of their high quality and also because they propose emerging ICT solutions that address at least one of the three dimensions we suggest as basic requirements to design usable future Industrial Systems that must be safe, smart and sustainable. Previous global discussions about the state of the art with regard to the topic of this special issue are provided, as well as exploratory guidelines for future research in this area.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

This special issue aims at shedding light on new emerging ICT concepts for smart, safe and sustainable industrial systems.

Markets are currently imposing very strict requirements, demanding high-quality customized products with shorter delivery times and shorter lifecycles, forcing companies to adapt their processes with the help of flexible, safe and reconfigurable production structures. This leads to the challenge of designing systems that exhibit better re-configurability, agility, robustness and responsiveness while ensuring the maintainability, sustainability and long-term performances of their processes, products and logistics systems.

In this context, the technological evolutions in ICT have allowed researchers to develop new emerging concepts that were not even conceivable in the past. They are based on the instrumentation and interaction of a multitude of different interconnected and even decision-capable *smart* objects (belonging to industrial and/or logistics systems), embedded or distant, with associated information counterparts (agents, holons) or purely digital. These “bottom-up” approaches lead to emerging behaviours that must be controlled and integrated with existing, more “top-down” approaches. The latter are often materialized by centralized or hierarchical management systems. These emerging ICT concepts provide new, powerful solutions to challenges as yet unsolved using classical approaches. This special issue focuses on the above challenges and solutions, and especially on the way emerging “bottom-up” behaviours are efficiently and effectively integrated with “top-down” approaches to constitute a kind of hybrid control system with a dynamic structure and distributed intelligence capable of meeting industrial needs and rapid market changes.

The articles included in this special issue concern the following topics of interest and theoretical backgrounds dealing with the lifecycle of smart objects: holonic/multi-agent architectures, computing and service-oriented manufacturing, Cyber-Physical Systems, Intelligent Products, product-driven control, Internet of Things, ambient intelligence, optimization, energy awareness, and self-organized and bio-inspired systems. Some papers in this special issue are extended versions of chapters published in the book edited after the 4th edition of the SOHOMA’14 Workshop on Service Orientation in Holonic and Multi-Agent Manufacturing, held in Nancy in November 2014 [13].

This editorial is organized as follows: firstly, the context of this special issue is presented, which deals with three dimensions: safe, smart and sustainable. Secondly, the papers composing this special issue are positioned according to their contribution to one or several of the dimensions introduced, and are presented briefly. Perspectives are then introduced as a guideline for future work.

2. Smart, safe and sustainable industrial systems

From our point of view, to be liveable and usable, future products, processes and industrial systems will be characterized according to three dimensions: Smart, Safe and Sustainable (denoted ‘3S’ hereinafter), as depicted in Fig. 1. In this figure, some emerging research topics that can be studied at the intersection with any two of the three dimensions are provided.

“**Safe**” is taken here in the broad sense, referring for example to the *reliability,availability, security, testability and maintainability dimensions* of products, processes and industrial systems that are evaluated through dependability studies [7]. This dimension aims at ensuring the correct functioning and the permanent safety of the

http://dx.doi.org/10.1016/j.compind.2016.05.001
0166-3615/© 2016 Elsevier B.V. All rights reserved.

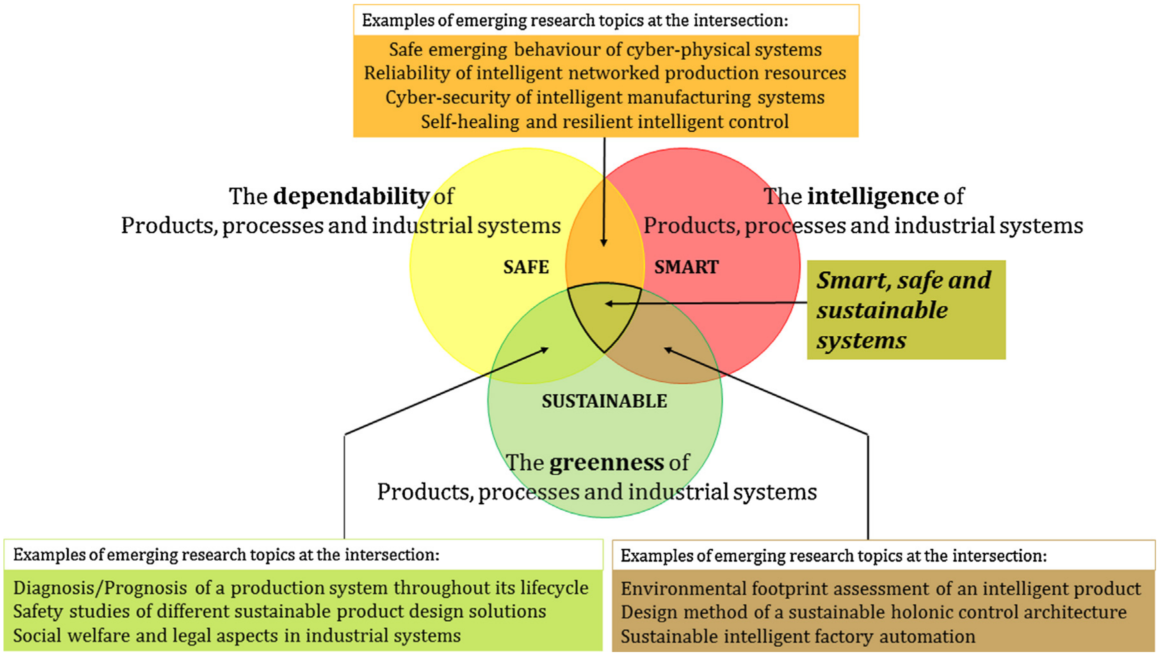

Fig. 1. The future of products, processes and industrial systems: the 3S' point of view.

three types of entities, in whichever lifecycle phase they evolve or are studied. *Robustness* and *resilience* are also relevant concepts when dealing with reaction and adaptation to perturbations during their use, whether localized or more global [9]. This vision is not new; it was initially designed for complex systems when designers were seeking to develop systems from a functional point of view, possibly including Integrated Logistics Support (ILS), and co-designed to ensure functional support of the complex system [37]. We think it is crucial to consider safety as a whole and through this, to look at future products, processes and industrial systems with a global, functional view of their lifecycle. In such a context, it is worth mentioning that only few studies have been carried out to ensure the safety and the dependability of future industrial systems characterized by the "bottom-up" approaches introduced [66]. Some of the papers in this special issue address this dimension, thanks to which future industrial systems, products and processes will be predictable: They will be doing what they are designed to do in a safe way, they will perform safe production processes, and their interaction with humans will not be dangerous or will not result in hazardous decisions being made.

"**Smart**" represents the *intelligent control dimension* of products, processes and industrial systems; it refers to computing and service-oriented, intelligent solutions and means that will be engaged in the aforementioned products, processes and industrial systems. Future products and systems will be systematically connected: objects (products or resources) will communicate with each other to choreograph production as well as with people to improve the efficiency of the production and logistics systems, and the design process. For example, the German strategic initiative 'Industry 4.0' fosters the development of smart industrial systems using cyber-physical systems. As discussed in some of the articles in this special issue, the majority of recent research concerns improving production, transport/logistics (e.g., the physical internet) and supply chains performances. New controls based on advanced ICT convergence such as distributed control [71], holonic organisation [28], multi-agent frameworks [40], service orientation [14], virtualization and virtual commissioning [8], cloud manufacturing [83], cyber-physical systems [39], intelligent products [45] and Internet of Things [3] will foster the development of innovative smart industrial solutions. In such a context, interoperability with existing information and decision systems, typically Manufacturing Execution Systems (MES) and Enterprise Resource Planning (ERP) is a key issue to ensure the viability of smart solutions for which the use of ontologies can be proposed [2]. To design optimized and reactive smart industrial solutions, the integration of optimization techniques from Operation Research, with learning models, simulation models or reactive technics is now widely addressed by researchers. Thanks to this dimension, future industrial systems, products and processes will be able to sense, communicate, and decide; they will be able to react, learn, adapt and evolve in the face of unexpected events.

"**Sustainable**" represents the *greenness dimension* of products, processes and industrial systems to maintain an equilibrium between economic, social and environmental requirements and constraints. The most frequently quoted definition of "Sustainable development" is from Our Common Future, also known as the Brundtland Report [76]: "*Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". In 1993, Allenby and Graedel proposed the *industrial ecology* concept [33,24] introduced for the first time the concept of sustainable manufacturing and more recently [27] defined it as "*the ability to smartly use natural resources for manufacturing, by creating products and solutions that, thanks to new technology, regulatory measures and coherent social behaviours, are able to satisfy economic, environmental and social objectives, thus preserving the environment, while continuing to improve the quality of human life*". This dimension requires the adoption of a global view on the system's lifecycle (Product Lifecycle Management – PLM, lifecycle analysis and assessment, . . .), [85]. Specifically, energy represents a promising field of research [60]. Thanks to this dimension, future products, processes and industrial systems will feature the right balance between the three economic, environmental and social pillars of sustainable development; their footprint will be as minimal as possible and their potential benefits for society will be as high as possible, while enabling the economic growth of companies.

Download English Version:

https://daneshyari.com/en/article/508569

Download Persian Version:

https://daneshyari.com/article/508569

Daneshyari.com