INDUSTRY 4.O :
The combination of the Internet of Things (IoT) and the Internet of People (IoP)

*Dr. P. Mary Jeyanthi

Abstract

This paper specifies the Internet of People, Things & Services (IoPTS) as the visualization where people, things and services are effortlessly integrated into the internet as active participants which exchange data about itself and their perceived nearby environments over a network-based infrastructure. The IoPTS, among many other features, is characterized by its gross sum in terms of services, things,and people that will generate data populating massive directories; its advanced potential for tracking people, things and objects; its focus is on various frontiers, a person can guess multiple identities where every identity is associated with multiple things (devices) linked to numerous services; its vertical agility with a phenomenal rise in the level of difficulty from a governance perspective. As stated by World Economic Forum (WEF), in January 2016, as The Future of Jobs: Skills, Workforce and Employment Strategy for the 4th Industrial Revolution, a mass of developments had moved the world of labor into the "4th Industrial Revolution" that will fundamentally change the way we work, live and relate to each other.

Introduction

During the 1st Industrial Revolution in the 19th century, it was witnessed that Britain moves from farming to an industrial part, focusing on factory output. The Second Revolution initiated mass production of steel. Factories were turning out to be more 'electrical,' bearing of Henry Ford's congregation production line, permitting for mass distribution and huge production to step in.The 3rd revolution is where our nation went "digital." Till the 1950s, technology served on mechanical, electronic and an analog scale. After the 1970s, it has become increasingly digital, moving closer to fully digitizing our society, provided that it's smart home associates to smart security methods. The rapid modifications to the information & communication technologies (ICT) had broken the boundaries among the virtual reality as well as the real world.

* Assistant Professor, Institute of Management Technology, Nagpur, Maharastra, India.
Email : pmjeyanthi@imtnag.ac.in / dr.maryprem@gmail.com

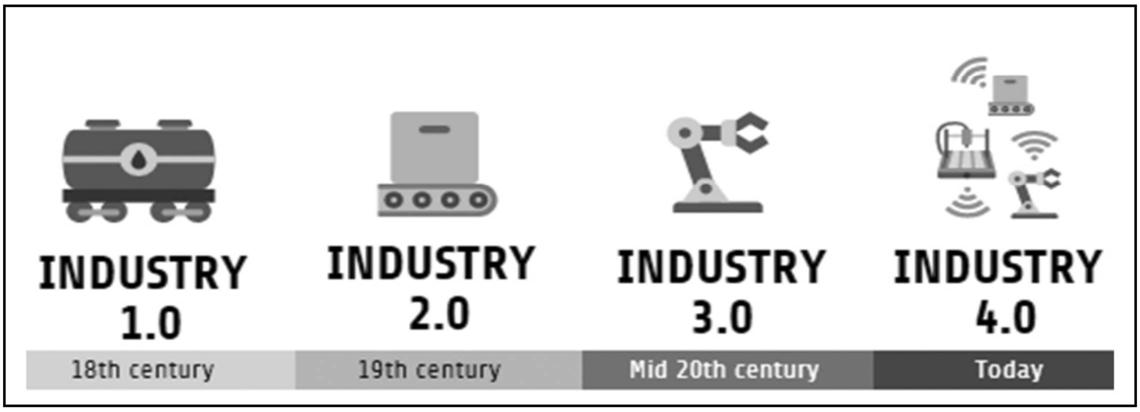

Figure 1: Industry 4.0 trajectory
(Source: DFKI 2011)

The thought behind Industry 4.0 is to make a social network anywhere machines can convey to each other, called as the Internet of Things (IoT) and to the people, known as the Internet of People (IoP). Like this, the machines may communicate mutually and with the producers to make a cyber-physical system (CPS). All of these help industries to incorporate the actual world into an implicit one and allow machines to gather live data, investigate them, and even provide decisions based on them.

A list of these milestones can be found here, but an overly basic summary follows the evolution of the internet. First, the internet connected people to content. Then, it connected people to services. Later on, it connected people to people. Now, it is connecting things to things (IoT).

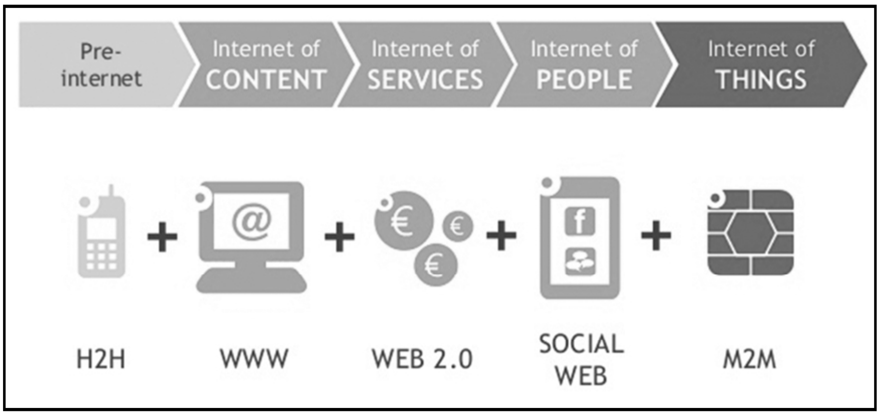

Figure 2: The subsequent step in the internet revolution
Source: Emaze

Machine to Machine solutions (M2M) is a subset of the IoT. It is fundamentally a broad label utilized to describe the technology, which allows networked gadgets to communicate and execute actions without manual support from humans. A discussion of two machines is essentially the foundation of IoT.

‘Things’ are active members in business, information plus social processes by the time they are enabled to communicate and interact among themselves also with the environment via exchanging information and data sensed about the location, while reacting separately to the physical/ real-world events and affecting it by running processes which trigger actions and generate services without or with direct human intervention. Consequently, perhaps the linkage of embedded digital gadgets must not be called as IoT, because IoT includes not only linked things, it also connected places and people.

The transmission of personal (mobile) gadgets and pervasive communication technics is expected to rapidly increase in the coming years. This approachfurthers the Cyber-Physical Convergence visualization. According to this vision, the physical world of the users and the cyber world of Internet applications and services are more and more integrated and converging. Data produced in the real world flow into the cyber world, where the data is exchanged and elaborated. Conversely, the interactions in the cyber world result in actions in the real world.

One of the key effects of this convergence is that humans are more and more at the core of the technical systems they use. The cyber systems and the humans through that they communicate turns out to be actors of an intricate Socio-Technological ecosystem, also designing efficient communication system requirements by considering human behaviors as a structural paradigm, rather than as an afterthought. Moreover, in this view, humans are not anymore passive objects of Internet technologies, but they play an active role in the design and operation in the network

Literature Review

Juniper, conducted research and estimated that 13.4 billion devices were connected in 2015, which represent more than the total of the population on the earth at the time, and this number is expected to triple to 38.5 billion devices by 2020. The chance of interfacing with a lot of regular articles associated with the Internet enables people to get to boundless data whenever and anyplace. This vision opens another skyline of thoughts and advancements that is as of now being considered by researchers and academics.

Jayavardhana Gubbi et.al.examined that Ubiquitous sensing authorized by the Wireless Sensor Network (WSN) approaches cuts crosswise over many zones of the current living. This offers the capacity to quantify, gather and comprehend ecological markers, from fragile ecologies and common assets to urban situations. The multiplication of these appliances in a communicating– activating system generates the IoT, wherein actuators and sensors mix consistent with the earth close to us, as well as the data aredistributed crosswise over phases with the end objective to build up a characteristic working picture. Filled by the ongoing modification of an assortment of enabling remote innovations, for instance, RFID labels & inserted sensor with the actuator hubs, at that point,IoT has undertaken its earliest levels and the progressive innovation in altering the Internet into anentirely incorporated Future Internet. This paper introduced that the Cloud had driven the vision for the overall execution of IoT.

Caceres and Friday discussed the development, opportunities,and challenges in the 20th anniversary of Ubicomp. The authors discussed the building chunks of Ubicomp with the uniqueness of the system to adjust to the altering world. Furthermore, they identify 2 critical technologies for emerging the Ubicomp infrastructure like Cloud Computing and IoT.

Atzori et al., reviewed that the IoT can be acknowledged in three standards—web oriented (middleware), things associated (sensors) and semantic-adapted (learning). In spite of the fact that this kind of outline is required because of the interdisciplinary idea of the subject, the helpfulness of the IoT can be released just in an application space where the three ideal models intersect.

Bauernhansl, Hompel& Vogel-Heuser, contemplated that the Industry 4.0 fundamentally impacts the production condition with radical modifications in the execution of tasks. As opposed to ordinary estimate based generation planning, It empowers the current planning of creative designs, alongside the dynamic self-enhancement. In spite of the fact that embedded with the most recent advances and savvy calculations, the smart factory enables it to be based on the establishments of the traditional Toyota Production System.

Weiss, Zilch &Schmeiler, reviewed that in Germany, Industries are assessing their status towards executing Industry 4.0. Around 41% of German firms know about the subject and have begun some concrete activities. In any case, it is far to go and for a few businesses, the theme is as yet obscure. This applies specifically to little scale enterprises where 44% of them are uninformed of Industry 4.0; then again, it is well - 816-Journal of Industrial Engineering and Management has known in bigger organizations, where just 17% are observed to be oblivious of the term. There likewise exists a slack in usage designs of Industry 4.0 between enormous ventures and SMEs.

Sanders &Wulfsberg studied that the industries need to explore the possibilities and benefits associated with integrating all their factory operations. This does not only concern technical issues but also raises important management questions. The initiative extends across the world, called by unlike names in different countries. Hence the findings of this research are applicable to the IoT based manufacturing control practices in any country.

AndrejaRojkoreviewed that, Industry 4.0 is a vital activity recently presented by means of the government of Germany. The objective of the activity is the change of mechanical assembling through digitization and exploitation of the possibilities of new advances. An Industry 4.0 framework is consequently adaptable and empowers individualized and tweaked items. The objective of this paper is to exhibit and encourage a comprehension of Industry 4.0 ideas, its drivers, empowering influences, objectives,and confinements. Building squares are depicted and brilliant manufacturing plant idea is exhibited. The present status of Industry 4.0 availability of the German organizations is displayed and remarked. At last, it is talking about if Industry 4.0 is extremely a problematic idea or basically a characteristic gradual improvement of modern frameworks.

Stephen T. Newman et.al.studied that, Industry 4.0 holds the assurance of augmented flexibility in production, along with the mass customization, improved productivity and better quality. Intelligent manufacturing plays a significant position in Industry 4.0. To understand intelligent manufacturing in anIndustry 4.0, this paper provided a complete review of related topics like IoT-enabled manufacturing, intelligent manufacturing, as well as cloud manufacturing. Similarities and discrepancies in these topics are highlighted based on this analysis. The authors also reviewed key technologies like cyber-physical systems, the IoT, big data analytics, cloud computing,and information & communications technology (ICT) that are used to enable intelligent manufacturing.

Nikola Banduka reviewed that Industry 4.0 is a famous subject, in light of its huge effect on assembling. Industry 4.0 is centered around making "brilliant" condition inside the production framework. Some driving producers of innovation forthe Industry 4.0 are introduced. Numerous papers investigated that new business ideas and techniques for adjusting to the new industrial revolution. This paper gave an overview of a few ideas and procedures. Diverse systems and ideas, chose from writing are contrasted all together with distinguishing the territories that are not secured.

Objectives

The intentions of this study are

- To study the cyber-physical convergence
- To Study the basic components and Principles of the Industry 4.0
- To analyze the impacts of implementing the idea of an Industry 4.0

Methodology

The Properties Of The Industry 4.0

The main features of the Industry 4.0 compriseof horizontal integration through the networks to aid internal cooperation.

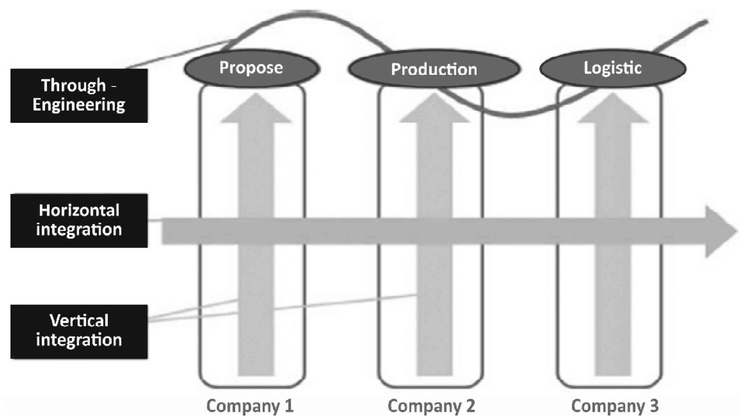

Figure 3: Integration through Industry 4.0
Source: VDI-Wissensforum

A vertical fusion of subsystems in the factory to create an adaptable and flexible manufacturing system and Through Engineering integration, over the entire value chain to facilitate customization of the manufactured goods. The above figure depicts the relationship between3types of integration. The horizontal fusion across many companies as well as the vertical incorporation of productionin the plant are two fundamental building blocks for engineeringintegration over processes. This is since the product life process involves several stages that should be performed by different companies.

The nine technologies are related to the digitization of the industrial sector and are broadly interconnected in their expected effect on the industry. The technologies include the deployment of autonomous robots that toil with people in production.

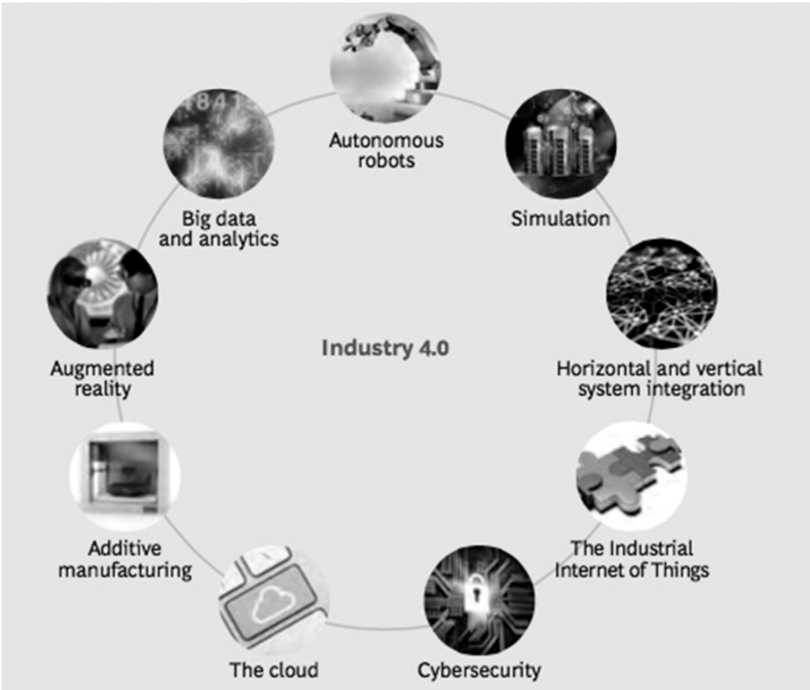

Figure 4: Technologies that transforms the Industrial Production
Source: BCG Analysis Report

Optimized, isolated cells will assemble as a fully automated, optimized and integrated production flow give rise to greater efficiencies and altering traditional productive relationships between suppliers, customers,and producers.

Big Data and Analytics: In the Industry 4.0 perspective, the assortment and comprehensive assessment of data from various sources like production systems, enterprise&customer-management systemswould become standard to sustainconcurrent decision making.

Autonomous Robots: Robots may cost less with greater capability, eventually work together with each other and work safely together with humans.

Simulations: It would be used further extensively in the plant activities to leverage currentdata mirror the real world in a virtual representation and increasing quality, that can include products, humans,and machines.

Horizontal and Vertical system Integration: Through Industry 4.0, departments, functions, companies,and capabilities would become far more cohesive, since cross-company, worldwide data-integration networks develop and facilitate truly automated value chains.

The Industrial Internet of Things: Industry 4.0 will be augmented with entrenched computing, permits field devices to interconnect with one another and with additional centralized controllers, as essential. It will too decentralize analytics and decision making, enabling real-time responses.

Cybersecurity: With the enlarged connectivity and use of normal communications procedures in Industry 4.0, the need to defend critical business systems from cybersecurity extortions increases intensely. As a result, safe, reliable communications as well as sophisticated individuality and access management of machines and consumers are important.

The Cloud: The presentation of cloud technologies will increase, achieving response times of just numerous milliseconds. As an outcome, machine data and functionality will progressively be organized to the cloud, allowing more data-driven facilities for production systems.

Additive manufacturing: With Industry 4.0, these industrialized methods will be extensively used in 3D-printing firms to produce small consignments of customized products that bid construction benefits, such as difficult, lightweight projects.

Augmented-reality: system based on Augmented-reality, support variety of services, like selecting parts in a warehouse and sending instructions over the mobile devices.

The Basic Components Of The Concept Industry 4.0

Cyber-physical system (CPS): CPS is a set of interacting physical and digital components, which may be centralized or distributed, that provide a combination of control, sensingcomputation,andinteracting functions, to affectresults in the real world through physical processes. It usages sensors to obtain information about physical limits and actuators to involve in control over physical processes.

Internet of Things: The integration of the Internet of Things and Internet of service in the industrial process originated by the fourth industrial revolution. Internet of Things allows “things” and “object” as RFID, sensors, mobile phones integrate into unique links, which can work together with other objects to attain a common goal. On this foundation, the Internet of Things can be well-defined as a network in which CPS works together through single links.

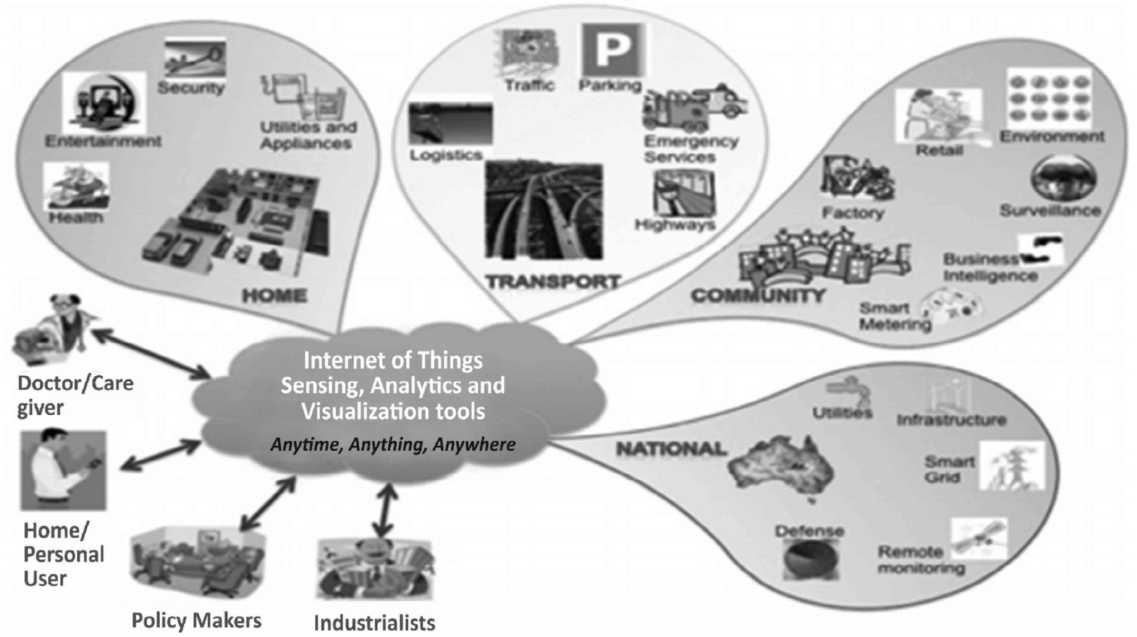

Figure 5: Schematic diagram of IoT.
Source: Cluster of European research projects, 2010.

Internet of Service: It allows the provision of services via the Internet. With the vast development and assortment in electric and smart devices, gaining more and more of them generates complexities and weakens the utility of each additional device., Tablets, laptops,Smartphones, TV's or even wristwatches are flattering more and more consistent, but the more we buy, the added value of the previous device becomes distorted.

Smart Factory: Smart factories are a key feature of Industry 4.0 and it adopts a so-called Calm-system. A peaceful system is a system that is capable to deal together with the physical world as well as the cybernetic. It also can be nourished with soft infoconcerning the object being industrial such as sketches and models. The Smart Factory can be well-defined as a factory where CPS interconnects over the IoT and contribute people and machines in the accomplishment of their tasks.

Internet of People (IoP): IoT technologies with embedded IoS can be used to generate the Internet of People (IoP). It could be seen as CPS with improved, people-centric applications, as dissimilar to things centric ones. The combination of the real world with the virtual world for the benefit of people, and enabling the development of sensing applications in contexts such as health monitoring, social network enhancement, or fulfilling people's special needs.

The Basic Principles Of The Concept Industry 4.0

Concept Industry 4.0 is based on six basic principles:

- **Interoperability** - In concerns with this idea of the CPS and people linked via the IoT and the IoS. The use of collaboration between these elements is key to the victory of this model.
- **Virtualization** - It is competent to monitor the physical methods through CPS. Sensor data got are connected to the virtual initiative model and replication models. This makes a copy of the physical world in a cybernetic environment.
- **Decentralization** - With the mounting market demand for products surges the difficulty of the central control. Embedded processors allow the expedient to be free to choose which significantly reorganized control systems is.
- **Capacities in real time** - It is vital to collect and scrutinize data in real time. On the foundation of the info gathered can reply in real time.
- **Service-orientation** - Services firms, CPS and people are obtainable through IoS and thus they can be obtained to further parties. They can be interior or exterior.
- **Modularity and re-configurability** - Modular systems are competent to compliantly adapt to changing supplies to extend or change modules. So, they are simply editable for cyclical changes in the merchandise characteristics. The structure must also be proficient of automatic pattern changes.

Relations between principles and components of Industry 4.0

The above principles and components are interconnected. Not all components Industry 4.0 can use all the principles. For example, the principle of virtualization cannot be used in the Internet of things, but on the other hand, the data obtained in CPS can be implied and then continue to use them. The basic relationship between the principles and components are listed in table 1.

Table 1: Relationship Between Principles and Components

	CPS	IoT	IoS	Smart Factory
Interoperability	X	X	X	X
Virtualization	X	-	-	X
Decentralization	X	-	-	X
Capacities in real time	-	-	-	X
Service-orientation	-	-	X	-
Modularity &reconfigurability	-	-	X	-

Source: German Research Report, 2014.

Impacts of the Fourth Industrial Revolution

Companies face difficult challenges in the acceptance of these new technologies. To shape and withstand a lead in the competition to full implementation, they need to widen and deepen their practical information about digital skills and the related use cases—and then grow and implement personalized digital industrial strategies.

- Potential job damages as a result of additionalmechanization of low-skill jobs, scattering to middle-skill jobs. These job losses might potentially lead to improved levels of variation.
- The growth of new jobs spurred by technological developments and potential growth in education and re-education to come across demand.
- Long-termincreases in efficiency and productivity, potentially decreasing the cost of trade and lashing economic growth.
- Increased technological innovation, mutually with the improvement of products and services with digital capabilities, cumulative their value, resilience and durability and altering customer prospects.

The fourth industrial revolution may be additional likely to profit the developed economies, with developing frugalities facing challenges next the decline in worth of low-skill labor.

Some of the Challenges in the implementation of Industry 4.0

- IT security issues
- Reliability and immovability needed for dangerous machine-to-machine communication (M2M), including very short and steady latency times
- Lack of satisfactory skill-sets to accelerate the march to fourth industrial revolution
- General hesitancy to change by participants
- Lack of rule, forms,andstandard of certifications

Conclusion

Though the idea of Industry 4.0 is not yet extensive, it has the potential to enter and improve many features of human life. Starting from variations in business models and manufacturing method models, it will disturb all levels of manufacture and supply-chains, including industries and production managers, customers, cyber-physical systems designers, factory workers, end-users, etc. The concept of Industry 4.0 potentials many positive changes to the industrial, including mass customization, increased production speed, flexible production, higher product quality, optimized efficiency, decreased error rates, data-driven decision-making, better customer immediacy, new value formation methods,and improved work life. On the other hand, there are many challenges ahead, such as subjects regarding business model changes, security, safety, legal issues, regularization and an excess of human resource planning tasks. However, the critical mistake is disinclined to take a portion of these changes, because the upcoming of Industry 4.0 is not yet clear – its achievement or failure lies in the hands of all the investors.

References

- AndrejaRojko, Special Focus Paper—Industry 4.0 Concept: Background and Overview, IJIM, Volume 11, 2017.
- Stephen T. Newman, Intelligent Manufacturing in the Context of Industry 4.0: A Review, Engineering, Volume 3, 2017.
- Nikola Banduka, From Concept to the Introduction of Industry 4.0, International Journal of Industrial Engineering and Management (IJIEM), Volume 8, 2017.
- Mourtzis, D. "Challenges and future perspectives for the life cycle of manufacturing networks in the mass customization era" Logistics Research, 2016.
- Juniper Research, *Internet of Things' Connected Devices to Almost Triple to over 38 BillionUnits by 2020.* 2015.
- Lasi, H., Fettke, P., Kemper, H.G., Feld, T. and Hoffmann, M. (2014) Industry 4.0. Business & Information Systems Engineering, Volume 6, 2014.
- Kagermann, H., How Industrie 4.0 will coin the economy of the future?-The results of the german High-tech strategy's and Strategic initiative Industrie 4.0), Royal Academy of engineering, 2014.
- Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M., How virtualization, decentralization and network building change the manufacturing landscape: An Industry 4.0 Perspective. International Journal of Mechanical, Industrial Science and Engineering, Volume 8, 2014.
- Gubbi, J., et al., *Internet of Things (IoT): A vision, architectural elements, and future directions.*Future Generation Computer Systems, Volume 29, 2013.
- Dora, M., Van Goubergen, D., Kumar, M., Molnar, A., &Gellynck, X., The Application of lean practices in small and medium-sized food enterprises. British Food Journal, Volume 116, 2013.
- Kagermann, H., Helbig, J., Hellinger, A., &Wahlster, W., Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0: Securing the Future of German Manufacturing Industry; Final Report of the Industrie 4.0 Working Group. 2013.
- R. Caceres, A. Friday, Ubicomp systems in 20: progress, opportunities, and challenges, IEEE Pervasive Computing, Volume 11, 2012.
- L. Atzori, A. Iera, G. Morabito, The Internet of Things: a survey, Computer Networks, Volume 54, 2010.
- H. Sundmaeker, P. Guillemin, P. Friess, S. Woelfflé, Vision and challenges for realising the Internet of Things, Cluster of European Research Projects on the Internet of Things, 2010.