Companies on the Way to Industry 4.0 and their Readiness

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Abstract: The article deals with the overview of the different ways how to measure and evaluate the readiness of companies to industry 4.0. This readiness is described at the national level using readiness indexes. There are presented selected maturity models for the company’s level. The both approaches can be helpful for companies on the way to industry 4.0.

Key words: industry 4.0, readiness, readiness index, maturity model

1. Companies on the way to Industry 4.0

The trends of the Industry 4.0 should affect most people and processes throughout society in the future. The Industry 4.0 concept is gradually gaining a more coherent concept, although it currently covers a wide range of aspects from the 4th Industrial Revolution on the one hand to the assertion of everything as a successful marketing wave on the other.

The 4.0 trends in society are based generally on a combination of new IT technologies, Internet of Things mainly, and new production, transport and handling technologies plus new materials and related processes. The link between IT and manufacturing companies has a great prospect because the production technology and information technology (IT) are also the key strategic technologies in the following 15 years (Global Trends 2030, 2012):

- production technology,
- IT technology,
- health technology

Many significant consultancy companies such as Gartner Group (Gartner, 2016), Boston Consulting Group, Price Waterhouse Coopers (PWC, 2016) or Deloitte present their typologies of what the current trend towards Industry 4.0 should include. Mostly the following trends are mentioned:

- cloud,
- big data,
- internet of things,
- extended reality,
- simulation, digitisation,
- digital twinning,
- various autonomous solutions,
- human and robot collaboration,
- wide range of sensors and their evaluation leading to artificial intelligence.

The real symbol of the new trends is the internet of thing (IoT). The increasing availability of the Internet connectivity, declining the Internet connection costs, and a growing number of devices that include Wi-Fi technology and other sensors are perfect for creating IoT.

It is clear that the concept of Industry 4.0 is based on industrial integration mediated by information technology. This integration involves real-time or near-real-time data sharing, information sharing, and continuous communication.

In general, the concept of Industry 4.0 can be characterized as a transformation of production as separate automated factories into fully automated and optimized manufacturing environments. Production processes are linked vertically and horizontally within enterprise systems. Sensors,
machines and IT systems are interconnected within the value chain across the enterprise boundaries. For this purpose, the Cyber-Physical System (CPS) is the cornerstone for smart factories. These factories have the ability to autonomously exchange information using the Internet-based communication protocols, thus responding in real time to potential mistakes and adapting to changing customer demand for products. Smart products create clever products that are uniquely identifiable.

Many authors speak therefore about these trends as Society 4.0. Within Society 4.0, besides Industry 4.0 there are many other areas focusing on the 4.0 development such as Farming 4.0 (focused on food production), Health 4.0 (focused on health services), Alma Mater 4.0 (focused on higher education) and last but not least eGovernment (or Government 4.0) and the smart city concept. All these “4.0” areas have their readiness models, like for example Health 4.0 (Cavalio, 2016).

Development of companies in Society 4.0 is constantly pursuing the same goals leading to higher profit. Permanently, these goals remain in their interest and emphasize higher quality, lower batch size bundles combined with higher flexibility of production facilities and, above all, cost reductions. Investments in manufacturing branch and in IT technologies have recently gained in importance and they fall under the common concept of Industry 4.0.

2. Readiness of companies at the national level

A company always operates in a certain environment that, in a number of cases, is conditioned and decisive for its digitization and, in general, the ability to innovate. It is not only from the point of view of “micro”, i.e. the company itself, but it is also necessary to look at it from the perspective of its surroundings from a “macro” national level. This also includes, for example, one of the dimensions of the German reference model for Industry 4.0 known as the RAMI 4.0 (Koschnick, 2015).

These national evaluations are interesting because they point to the general preconditions for digitization of a country and its readiness for innovation, which are equally important for the development of Industry 4.0.

The “macro” view covers the whole of society, or individual states. The best known readiness indexes are:

- NRI (Networked Readiness Index)
- GCI (Global Competitive Index)
- Score from the OECD Scoreboard
- Industry 4.0 Readiness Index by Berger (Model, 2018).

A common factor of these national evaluations is the large number of countries surveyed, and also the large scale (number) of assessed criteria. Many of these indexes did not appear in connection with start of Industry 4.0, but they have a longer-term data series. For example the NRI index has been known since 2002.

From a methodological point of view, it is interesting that only one value is given to each country based on a readiness index. It provides the country with feedback and information about its position compared with other countries.

3. Readiness of companies at the enterprise level

In the case of individual enterprise assessments, the situation is different from the one at the national level (mentioned above). At the “micro” company’s level it is not necessary to compare a large number of companies and dozens of indicators. The readiness models are mostly maturity models. Through the literature review, at least the following models are available:

- RAMI 4.0 (The Reference Architectural Model Industry 4.0) from BITCON VDI/VDE, ZVEI (Germany), 2015 (Koschnick, 2015)
- Industry 4.0 Component Model – derivated from RAMI 4.0 and oriented on information technology (Koschnick, 2015)
- SIMMI 4.0 (System Integration Maturity Model Industry 4.0) from TU Dresden and TU Heilbronn (Germany), 2016 (Leyh, 2018)
- IMPULS (Industry 4.0 Readiness) from VDMA and RWTH (Germany) (Model, 2017)
• APM Maturity Model (Asset Performance Management Maturity Model from Capgemmini (Dennis, 2017)
• Industry 4.0 Readiness Evaluation for Manufacturing Enterprises from Academy of Science Hungary (Hungary), 2017 (Halenar, 2016)
• Digitalization Degree of Manufacturing Industry from Uni Erlangen (Germany), 2017 (Bogner, 2016)
• Stage maturity model in SME towards Industry 4.0
• Roadmap Industry 4.0 from Uni Caphenberg, 2017
• Industrie 4.0 MM (Assessment model for Industry 4.0) from Uni Ankara (Turkey), (Gokalp, 2017)
• M2DDM (Maturity Model for Data Driven Manufacturing) from Uni Stuttgart (Germany), 2017
• Industry 4.0/ Digital Operation Self Assessment from Price Waterhouse Coopers, 2016
• The Connected Enterprise Maturity Model from Rockwell Automation, 2014
• Pathfinder 4.0
• Industrie 4.0 Maturity Model from Acatech Studie
• Firma4.cz from the Czech Minister of Industry and Trade (Czech Republic), 2016,

These models are from different European countries, but mostly from Germany, and they have been mostly designed within the last two years.

The models are very complex but they do not contain detailed information about enterprise information systems as a separate dimension. Most models deal with enterprise-wide topics such as following dimensions:
• Strategy
• Leadership
• Corporate culture
• Human Resources
• Technology.

Most models have a Technology dimension and then the IT in the company is spread out in digital product, digital processes and digital control.

The scales used are largely built on CMM (Capability Maturity Model) principles, but some use digitization scale or evaluating the enterprise as a whole. From the point of view of specialization, maturity models range (scale interval) from focusing on the whole enterprise to focusing on digitization, or concentrating on IT technologies.

4. Conclusion
An enterprise achieving a high degree of maturity in industry 4.0 will be the smart enterprise that will offer smart products and smart services to be delivered in an intelligent manufacturing environment in a smart economy. The possibility of measurement of the progress towards industry 4.0 could speed up this process in enterprises. Therefore the usage of the suitable form of maturity model could show the way on the roadmap.

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