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HOW DIGITISATION IS DISRUPTING AND TRANSFORMING INDUSTRY

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Abstract: The article deals with digitisation and digital technologies, which disrupt today´s classical processes in the Industry. Behind the scenes of the world's leading industrial and manufacturing factories, a deep digital transformation is underway. This is due to new digital technologies (disrupting technologies), which allow to shorten delivery times, increase resource utilization and maximise product quality. This makes the factory more competitive. Selected digital technologies, to help increase the competitiveness of factories, are described in our article.

1 Introduction

At present, all enterprises are looking for solutions in the area of increasing value-added, reducing costs in the context of changing market conditions in terms of financial, technical and personnel. Only copying approaches and methods in business change need not lead to the overall preservation of the competitiveness of the industrial production system. Businesses are beginning to realise that production processes are influenced by customer requirements, information technology, machinery and the environment in which the factories are located. For this reason, they need to reconfigure enterprise manufacturing and support processes and seek support in digitisation and exponential technologies. Historical developments, as well as the impact of globalisation and megatrends, have instigated the need for process change in individual industries. The changing customer demands put great emphasis on the flexibility of production, innovation, and flexibility to respond to changes. It is needed to quickly modify the manufacturing processes in the factories, which is often time-consuming and costly. Many countries and groups of states have prepared their own initiatives to improve the status of individual industries and industrial production. One of the best-known initiatives, especially in the Slovak republic is the Industry 4.0 concept from Germany. Other well-known approaches and initiatives are the Factories of the Future or the Smart Industry and others. The aims goal of these initiatives is to increase the competitiveness of each enterprise through digitization and create so called Smart factory, later Intelligent factory.

Smart Factory (Figure 1) is a type of factory that can handle fluctuations in demand over time, can produce most efficiently and is resistant to machine and equipment failures. In such a factory, people, machines and resources can communicate and work together. If a malfunction occurs, the machine reports itself to maintenance and also identifies the problem. A product in such a factory with the help of RFID chips can control its flow in production, knowing which individual parts it consists of and where it is heading. This implies that the product itself is actively involved in the production process. In such a factory, Smart Logistic, Smart Grid, Smart Buildings, Smart Distribution and "Smart Everything are integrated into one complex. In Smart Factory, the individual cells do not work in isolation, but everything is connected and works together effectively. A Smart Factory can integrate data from shopfloor or whole factory, human and operational assets to manage production, maintenance, inventory tracking, digitalisation, and so on. This can result in a more efficient and flexible system, reduced production downtimes, increased ability to anticipate and adapt to market changes, and thus better competitiveness.

Therefore, production factories need a realistic picture of their current state, the risks, and opportunities involved in digitising their processes, the implications of autonomous objects and implementation of initiatives such as Industry 4.0, in order not to jeopardize their market presence and effectively manage their processes [1,2].

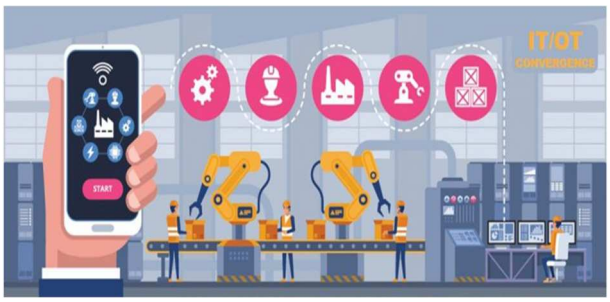

Figure 1 Digitisation in Smart Factory [3]

In modern industrial practice, innovative solutions for the improvement of processes or whole production or logistical systems are continually proposed. To be able to implement new technologies arising from the Industry 4.0 principles, companies must be able to combine the use of both, the latest and the available technologies. While using them, it is imperative for businesses to be aware of the current development trends. Thus, it is necessary to compile a list of technologies based on automatic exploratory (probing) principle that would automatically search for new classical and digital technologies. This list of technologies would serve the business as a basis for assessing the fitness of new technologies for the purpose of increasing the business' performance and its technological level. Given that society as a whole is influenced by technological advances, the industry will also face new challenges and needs. This will be mostly felt in the auxiliary and service processes, as they have technologically developed somewhat more slowly than the main production processes. Over the last 5 years, maintenance and technical service have begun to form a sophisticated system [4].

2 Digitisation and it's disrupting in the factories

Globalisation makes factories meet competitors in a completely different way than before. Manufacturing isn't about huge factories and long assembly lines anymore. Gone are the days of papers drawings, 2D schematics, spec sheets, and punch cards. Now, processes are digitised. Designs are completed in 3D CAD files; digital twins exist to mirror the objects they're building, and everything connected via the internet of things [5].

The term of digitisation resonates in the media, at conferences, in articles and in various forums, mostly only in general terms. Just in some only research and overview articles are good examples of implementation of digitisation and new trends in factories (Figure 2). We perceive digitisation meaning and its definition as something going on around us, but often without further concretization. But a close look at this often ruminate concept can really reveal its great potential for each enterprise.

Figure 2 Control of the production system with digital data [3]

In factories, digitisation also brings together the world of traditional information technology and the operating environment of manufacturing technology, which until recently was unthinkable and literally taboo. Here too, the benefits are evident. Immediate overview of productivity, the possibility of introducing a high level of automation of production processes, gradual robotization of an increasing number of production operations, implementation of selected functions of so-called artificial intelligence, coordination of production processes within distributed and globalised production, etc. A separate chapter is the emerging IoT (Internet of Things), Industrial Internet of Things (IIoT) solutions where their functional focus and applications for the business environment appear to be limited only by the technical and creative capabilities of developers and designers.

That's digitisation. So how does it transform the manufacturing industry [6,7]? In section 2.1 - 2.3 are four examples of the possibilities [7].

2.1 Manufacturing will move a lot faster

The first thing is that the digitisation transforms the manufacturing industry and to result is the speed of manufacturing of each factory. Driven by rapidly changing consumer tastes and an accelerated pace of new product introduction/innovation. The manufacturing process must search a reconfigurable way, for the best way to adapt. Increasing productivity is one of the results of implementing digitisation, allowing projects to move faster and manufacturers to hit more key deadlines. For example, manufacturers will be able to rapidly move from design to floor and back again as changes come through from the engineering team. In these days is this process exceptionally manual in many circumstances. 3D designs are converted into 2D spec books, and then those books are delivered to machinists on the floor who review and "redline" (literally mark-up) the books. Then those books are returned to engineering teams for revisions. In this process is a lot of inefficiencies:

- Printing a spec book might take hours with complicated designs.
- Redlining need to be done page by page, rather than simply reviewing the changes.
- Delivering is fine if the floor is below you. But what do you do when the factory is too far? For, example between Europe and Asia?

And the problem is that this process is entirely manual. Here does not exist so-called auto-check and of course, any opportunity for any innovation and process optimisation. Digitisation transforms these old processes and makes these processes more efficient by solving these problems. With this are opens the door for modern manufacturing innovation [8-18].

2.2 Digitisation is the best step towards the Industrial Internet of Things (IIoT)

The Industrial Internet of Things (IIoT) is a concept of a total product data loop. Nowadays every machines or equipment are loaded with sensors already in a manufacturing process due to, those sensors provide continuous feedback throughout the manufacturing supply chain (the reason is: maintenance of these devices, planning of the production process and so on). In response to real data from the processes like maintenance requirements and wear and tear, the manufacturing process can be improved. Some refinement happens automatically, for example, M2M communication, but some data is fed into business intelligence (BI) tools and dashboards. And these things giving people the ability to find efficiencies. The kernel of these critical processes is data. These data can be gathered and managed on a whole range. And that data can only be reasonably gathered and managed if it's an entirely digital product:

- Designs can be changed automatically in response to environmental challenges.
- Changes can be pushed automatically to the shop floor.
- Products can be altered as they roll off the line.

In the end, we may achieve a point where automation and artificial intelligent continuously optimise existing designs, layouts, and so on in response to information from real processes (results is the concept of the Digital Twin). In results will be that the engineers to focus on the innovation of new products.

2.3 Global manufacturing processes

The major problem of classical processes is that factory struggle if they're manufacturing across multiple locations, it means for example, in Europe and Asia. Nowadays is the manufacturing a global industry and in some cases is this a huge problem, but other times it is an advantage. Digitisation can offer to benefit for global manufacturing value chains for a few reasons. The first point is, that the data is easier to share. It's much easier to share files in the network than it is to send files through the mail. Even if the files are sent and then printed out, that's another data translation, and thus another vulnerability for each enterprise. The second point is, that the follow-the-sun manufacturing is more realistic. When factories moved offshore and engineering consultants started becoming more common (especially in the BRICS countries), for the first time follow-the-sun manufacturing started to be perceived as an attainable reality. Nowadays, it is a very comfortable thing for each big enterprise. The idea is that as one plant or design office closes for the day, the next one in the time zone over is just opening up. Work can be handed off seamlessly to a new team, and there's never any "downtime" overnight. However, this is only possible if:

- Each factory can share data essentially in real-time across multiple global locations.
- If all the necessary data can be accessed by anyone, at any time.

The second point is so difficult, due to is that we overlook how important it is to ask for consultation or help of us experienced co-worker. Especially at engineering handoff points, when clarification is so often needed. That's not possible in the global enterprise methodology, so it's imperative that all the information is conveyed the first time. Digitisation can help in every field, for example, with both simple clarities but also with process enforcement. An excellent example from practice is that we want to have every field in a form to be completed. This process is not perfect, but with digitisation, we have levers can pull to increase compliance.

2.4 Pros and cons of the digital transformation in the factories

Each new approach has its pros and cons. Digitisation and Industry 4.0 have tremendous benefits, but they also have some difficulties. Many arise from technical shortcomings (obsolescence of technology processes), lack of readiness for digitisation and robot automation, human prejudice, unwillingness to accept new things, and so on. Here are some pros and cons of digitisation:

Pros:

- Unifying and cleaning up information in the factories.
- Implementation of automated systems - elimination of human errors.
- Time-saving - remote access and remote correction.
- Higher process reconfigurability.
- Development time - decreasing
- Better competitiveness.
- Lower operating costs.
- New information, new knowledge - linking with many new specialists in the area.
- Increase of the attractiveness of a factory that uses new technologies - workers like to brag about what they work with (hidden advertising).
- Expansion of exponential technologies.
- Increase in OHSAS.
- Increase in productivity.

Cons:

- Higher costs for implementing new technologies.
- Fear of the unknown.
- Hacking attacks, power outages and the Internet, etc.
- Double data backup.

- Older generations of people may not handle new technologies.
- Misinformation and hoax.

3 How digitisation disrupting of the maintenance management

Recently we all have been hearing a lot about Industry 4.0, Smart Manufacturing, digitisation etc. The first thought which comes to one's mind is obviously how is it going to affect me. Will it help or disrupt? Before we go in details lets first understand the key challenges faced by maintenance in today's world. How these new technological advances can play a role in approaching these maintenance challenges. Maintenance is always being looked upon as a money guzzler (an item of property - house, car, machines, devices, gadgets etc; that constantly fails to result in paying more to fix.) so the obvious challenge is to making maintenance as a Profit centre to a Cost centre. Controlling cost and expenses is the biggest challenge faced by many maintenance managers. Managers are being pressured to do more with less. Another key challenge in this time of high-pressure situation is to keep the team motivated and in the right mindset to foster a culture of Innovation. Managing workload balance, stress-free atmosphere, providing equal opportunity and space to each individual for his own development are some of the few aspects that need to be taken care of.

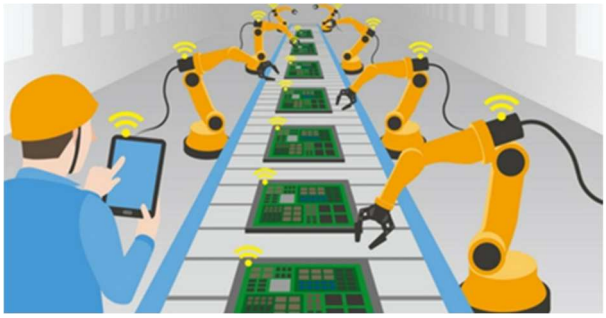

Figure 3 Maintenance worker in Smart factory [3]

So, let's explore how these new technological advances such as Smart / Intelligent machines (Figure 3), Predictive analytics, Artificial Intelligence and stuff like this will help the maintenance team in future. Normally whenever we initiate new initiatives the first question raised is how much CAPEX (capital expenditures - the money, a factory spends to buy, maintain, or improve its fixed assets, such as buildings, vehicles, machines, equipment, or land.) is required? What is the ROI etc. Implementing these new technologies need not be always costly/expensive. Simple intelligent sensors gather information, sending it to cloud where the machine learning and predictive analytics model plays its vital role in developing a health index for the motor. This health index is calculated, monitored on a real-time basis. Based on the health index we do not only get the alerts, but we also get the prescriptive recommendations. With this, we can predict the failure or stoppages much early where one can act and avoid failures to happen in future. Maintenance man-hours are avoided as there is no need to keep a daily track of parameters, conduct costly predictive maintenance and above all avoid maintenance spares inventory cost. We do not need to keep a spare motor or a bearing etc. as the predictability of failures is improved so that we can plan for spares in advance once we get any alert. This way digitisation helps in avoiding various cost related to maintenance.

With real-time monitoring and predictive analytics, the maintenance worker will get more free time which they can utilize for competency development and training. Generating innovation ideas and implementing the same. This shift from reactive maintenance to proactive maintenance shall reduce stress as the surprise breakdowns get eliminated. In a nutshell, Digitalisation is a boon not only maintenance but stakeholders throughout the value chain too. It is here to stay and is evolving with new technologies, the time has come to catch up with these latest technologies and grow along with it.

4 Intelligent maintenance in the Industry

Predictive maintenance now enables factories to take their first steps toward designing the maintenance processes of their factories much more efficiently. This is absolutely vital, since 70 percent of the total operating costs for machinery, factories and other capital goods are generated during the service phase. This means that, alongside reliability, reducing service costs is increasingly becoming a priority. However, it is worthwhile considering predictive maintenance in the broader context of a completely digitised service chain. Only by linking previously separate service processes, from intelligent sensors, proactive maintenance, innovative service technologies and logistics all the way to improved engineering, for example, is it possible to achieve the ultimate objective – factory that have the very highest levels of availability with costs as low as possible. Instead of isolated solutions, must be used specialized, systematically and reliably linking service processes (Figure 4), digitised from start to finish. Sectors such as the aviation industry have employed this condition-based maintenance approach for years. The aim is now to transfer this method to other industries and supplement them with new analysis opportunities. The advantages of this next generation maintenance solution can be seen in concrete maintenance and servicing savings.

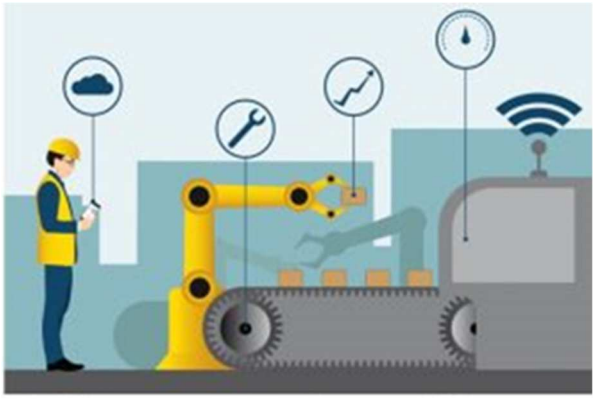

Figure 4 Maintenance worker in diagnostics process [3]

The next generation of the maintenance solution brings a digital transformation to the service phase. It completely covers the digitised end-to-end service approach and leaves no question unanswered when it comes to advising. Added to this is a comprehensive implementation package embracing design, transformation and operation. Factories can use this to design the service for their processes in such a way that they can be operated in the most reliable, cost-effective and sustainable way possible. It also draws on the established concept of TPM (Total Productive Maintenance), which focuses on the continuous improvement of production – with zero defects and outages as well as no loss of quality.

5 Operator 4.0 in the maintenance management

The vision of the Operator 4.0 is generally aimed at building relationships based on trust and interaction between people and machines, enabling smart-based businesses to leverage not only the power and capabilities of smart machines but also empower their operators with new skills and technical support to fully exploit production the possibilities resulting from the Industry 4.0 concept (Figure 5). These technologies, which are already in use by several factories today, include augmented reality, virtual reality, collaborative robotics, and so-called wearable sensors that sense human body functions [11].

In addition to strengthening physical skills, factory digitisation also requires a change in workers' knowledge and behaviour. Based on its Future of Jobs Report, the World Economic Forum has defined 10 skills that will characterise the Operator 4.0 in 2020 (Figure 6).

Figure 5 Maintenance worker in Smart factory [12]

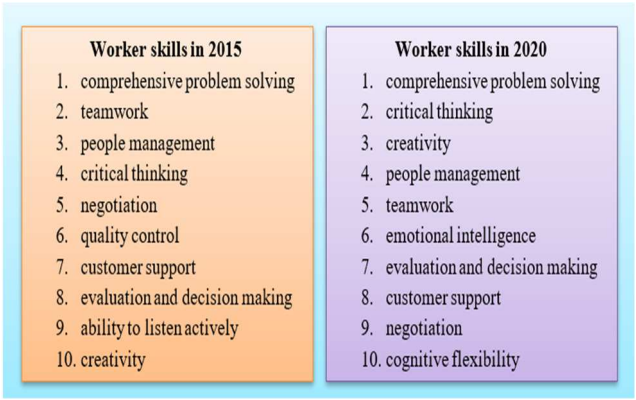

Figure 6 Worker skills of Operator 4.0

An ideally qualified maintenance technician should be able to cope in the near future with a "multipath" compound from the following disciplines:

- Technical expertise – mechatronics.
- Methods - the routine use of TPM principles.
- IT technologies - gather information and their analysis and transformation into information and knowledge.
- The spectrum of technical problems that a maintenance technician has to solve requires of the multidisciplinary expertise in the areas of electrical engineering, mechanics and control systems, with the degree of their detail, given by specific manufacturing technologies, and by their trouble-free operation is a responsible technician.

6 Conclusions

The article gave an insight, how digitisation disrupts the established things in the industry. This disruption will be caused, that workers will be used new technologies to strengthen their skills, increase safety and streamline work activities across all factory processes. As the industry continues to move towards digitisation, automation and robotics, many of the activities that are now manual today, will be changed or disappear.

Each enterprise should not underestimate the development chances brought by the emerging digitisation, especially factories. New trends, which are described in this article, were also starting to change some of today's factories. Over the past 30 years, corporate culture has evolved considerably. But with the coming of Industry 4.0 will change significantly. Without building the right digital culture, management is not able to maintain the necessary talents in factories. The way of thinking supporting the use of new technologies should be highly collaborative, going beyond the boundaries of the business towards partners and customers. Only in this way is it possible to achieve the key idea of the Industry 4.0 concept - integration. However, it is only possible to successfully develop these ideas in an environment where these initiatives are supported at the level of top management.

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References

[1] VAVRÍK, V., GREGOR, M., GRZNÁR, P.: *Vplyv súčasných trhových zmien na dimenzovanie kapcít výrobných systémov'*, Invention for enterprise [print]: proceedings - 1. vyd., Žilina: CEIT Stredoeurópsky technologický inštitút, pp. 152-155, 2018. (Original in Slovak)

[2] TREBUŇA, P., MIZERÁK, M., EDL, M.: 3D scanning technologies and the 3D scannning process, *Paripex-Indian Journal of Research, PIJR*, Vol. 8, No. 4, pp. 1-3, 2019.

[3] IT/OT Convergence in the Factory of the Future, [Online], Available: http://www.synchrono.com/it-ot-convergence-in-the-factory-of-the-future/ [23 Mar 2020], 2018.

[4] ČAPEK, J., KOVÁČOVÁ, L., WOROBEL, R., BUBENÍK, P.: Measurement of business processes, *Technológ*, Vol. 9, No. 3, pp. 36-40, 2017.

[5] VAGAŠ, M., ŠIMŠÍK, D., ONOFREJOVÁ, D.: Faktory úspešného nasadenia automatizovaných riešení v kontexte priemyslu 4.0, *Atp journal*, Vol. 26, No. 5, pp. 56-58, 2019. (Original in Slovak)

[6] RAKYTA, M., GRENČÍK, J.: *Maintenance 4.0 - digitization, personal ensuring and education'*, International Conference National Forum on Maintenance 2018 - 1. vyd., Žilina: Žilinská univerzita v Žiline, pp. 168-177, 2018.

[7] Enginess Team: How Digitization Is Transforming Manufacturing Industry, [Online], Available: https://www.enginess.io/insights/how-digitization-is-tranforming-manufacturing-industry [23 Mar 2020], 2018.

[8] BUČKOVÁ, M., KRAJČOVIČ, M., PLINTA, D.: *Use of dynamic simulation in warehouse designing*, Intelligent Systems in Production Engineering and Maintenance - Cham: Springer International Publishing AG, 1st. ed., pp. 485-498, 2019.

[9] GAŠOVÁ, M., GAŠO, M., ČECHOVÁ, I.: *The innovative system of data collection in ergonomics'*, Aktuálne otázky bezpečnosti práce: 31. medzinárodná konferencia BOZP - Košice: Technická univerzita v Košiciach, pp. 1-6, 2018. (Original in Slovak)

[10] HOLUBČÍK, M., VODÁK, J., SOVIAR, J.: *How to manage business in collaborative environment*, Knowledge management in organizations, proceedings, Cham: Springer International Publishing AG, 1st. ed., pp. 299-311, 2018.

[11] HORVÁTHOVÁ, B., DULINA, Ľ., KRAJČOVIČ, M., KASAJOVÁ, M.: *The impact of Industry 4.0 on work activities*, Aktuálne otázky bezpečnosti práce: 31. medzinárodná konferencia BOZP - Košice: Technická univerzita v Košiciach, pp. 1-6, 2018.

[12] CURTIS, B.: ISA Uniquely Qualified to Prepare Automation Professionals for the Challenges of the Future, [Online], Available: https://automation.isa.org/isa-uniquely-qualified-prepare-automation-professionals-challenges-future/ [23 Mar 2020], 2018.

[13] STRAKA, M., TREBUŇA, P., STRAKOVÁ, D., KLIMENT, M.: Computer simulation as means of urban traffic elements, *Theoretical and Empirical Researches in Urban Management*, Vol. 10, No. 4, pp. 40-53, 2015.

[14] KOVÁČ, J., SVETLÍK, J., DRABIKOVÁ, E.: *Use of mixed reality in dismanting of components*, Sovremennyje koncepciji razvitija nauky, Ufa: Omega Science, pp. 6-9, 2018.

[15] RUDY, V., MALEGA, P., KOVÁČ, J.: New Approaches to Designing Production System Structures, *Acta Mechanica Slovaca*, Vol. 23, No. 1, pp. 14-21, 2019.

[16] PEKARCIKOVA, M., TREBUNA, P., MARKOVIC, J.: *Case study of modelling the logistics chain in production*, Modelling of Mechanical and Mechatronic Systems (MMaMS), Book Series: Procedia Engineering, Vol. 96, pp. 355-361. https://doi.org/10.1016/j.proeng.2014.12.125

[17] KLIMENT, M., POPOVIČ, R., JANEK, J.: *Analysis of the Production Process in the Selected Company and Proposal a Possible Model Optimization Through PLM Software Module Tecnomatix Plant Simulation*, Procedia Engineering: Modelling of Mechanical and Mechatronic Systems MMaMS 2014: 25th-27th November 2014, High Tatras, Slovakia. Vol. 96, pp. 221-226, 2014.

[18] KOSTKA, J., PÁSTOR, M., ČARÁK, P., FRANKOVSKÝ, P., KULA, T.: *Analysis of the causes of defects in structural elements with a combination of hole drilling methods and photoelasticimetry*, Experimental Stress Analysis 2019, International Scientific Conference, Brno, Czech Republic, Czech Society for Mechanics, pp. 214-224. 2019.

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