Rev. Roum. Sci. Techn.– Électrotechn. et Énerg.
Vol. **66**, *1*, pp. 41–46, Bucarest, 2021

DIGITAL DISRUPTIVE INNOVATION EFFECTS IN THE MANUFACTURING INDUSTRY

DAN BIZUBAC[1], BERND OTTO HOERMANN

Key words: Computer integrated manufacturing, Enterprise resource planning, Innovation management, Organizational aspects, Technology management.

Industry 4.0 reshapes the manufacturing environment starting with improved technological processes, enhanced software implementations and managerial approaches. Nowadays studies consider only the technical changes and do not assess the impact on the organizational culture, which can provide a better competitive advantage. The concepts approached in this paper are the automated guided vehicles technology (AGV), the overall equipment effectiveness (OEE) software implementation, and their impact on the organizational environment. The researchers examined the symbiosis between the physical innovations and sociocultural changes. The basis for the AGV technology employs mobile vehicles interconnected through a centered pathway decision making system in a local wireless network. OEE indicators have been the latest software implementation in terms of reports for the production's efficiency. Combining the two technologies has been proven sustainable in most of the situations researched, however, AGV autonomy and collision control remain incapable of providing efficient results. To determine the impact on the culture, a quantitative study was conducted using a survey. Findings have demonstrated that the Millennial generation are supportive of an innovative, informal culture. It is mandatory for employees to have a strong mentor who can influence in a positive way their career using technology and software changes.

1. INTRODUCTION

Currently, the global environment is being transformed by the latest industrial revolution. When elaborating a theory around the fourth industrial revolution, all aspects within a certain organization need to be taken in consideration for an unbiased statement.

The first industrial revolution is the period at the end of the 18th century. It began with the use of steam power, mechanization of production and the rolling processes for making iron. In the new environment, the volume of production was increased by at least eight times. By using the new technologies, mechanized breakthroughs in different industries such as mining and material manufacturing have increased the human productivity [1].

Academics [2] around the world refer to the second industrial revolution as the start of the 20th century. This is linked to the electrical energy industry and how it was produced and distributed.

The third revolution, according to the same academics [2], started around the year 1970. It focused on the initial automation of processes and how the first computer technologies were introduced in production.

Finally, the 4th industrial revolution started at the beginning of the latest century and its core is structured around the topics of internet of things, artificial intelligence and autonomous robots. Literature [3] identifies the last revolution using the term "Industry 4.0" and describes the new horizon of organizational lifecycle of products according to the increased customer demands.

The main change in the 4th industrial revolution is how the autonomous machines and the digitalization of processes impacts the labor market. The question which may be raised now is "What will be the strategic decisions that organizations will need to take in order to benefit from the evolution of industrialization?".

Industry 4.0 uses the concept of digitalization as a mixture of different technologies by modelling artificial intelligence in the production machines and robots. Internet of things (IoT) has been a deciding part when defining the new industrial revolution. Through IoT, the production lifecycle has been reduced by improving the automated manufacturing process. Robots used in production are equipped and designed with video cameras, infrared or temperature sensors and are connected to the plant using network systems [4].

When discussing about innovation, studies have emphasized the technical aspect in production without taking in consideration that a change occurs simultaneously in different areas. Therefore, besides the mechanical and software improvements of the Industry 4.0, organizational and management approaches are also needed in order to adapt to the market's demands.

The purpose of this paper is to explore the new Industry 4.0 concepts implemented in a manufacturing plant in Poland and the effects of the IoT concepts developed, on the organizational culture from human perspective. The authors propose a discussion on the appropriate management style that will transform and expand even more the current environment. The paper presents in detail the innovation within the mechanical solution, followed by the enhanced software implementation and finally, the finding resulted from the organizational culture study.

2. STUDY RELEVANCE

In an international environment which is transforming every day, business leaders must find a way of adapting their interconnected processes. In a time when more companies compete in the same market, the ability to innovate is seen as something that can differentiate in each industry. In order to satisfy the customer requirements, new manufacturing processes implemented in different plants and productions lines have been set up to maximize the company's value [4]. Since simple processes are becoming more and more automated by machines, employees have become more willing to prove themselves as being able to take strategic choices, coordinate more processes in the production flow or even become innovative in their area of

[1] Technical University of Cluj-Napoca, Department of Manufacturing Engineering, Muncii Blvd 103-105, Cluj-Napoca, 40641, Romania, bizubacdan@gmail.com

expertise. Their need of change and improvement is also correlated with the work presented in literature [5] where it is stated that people will change their values and work environment when a new industrial revolution occurs.

In research, some of the most significant areas where the Industry 4.0 changes have appeared are: advanced software customization, increased collaboration with stakeholders, IT focused commercial environment, product value creation, agile environments and enhanced automated processes [6].

The new environment is data centered in the context of a symbiosis between physical products with digital services. In this direction, companies have been starting to use several customized solutions with a low level of individuality [7]. Opportunities rose and the business environment is shaped according to the unique customer requirements that appear [8].

Smart factories are starting to be build, where the internet of things (alongside their supporting architecture and infrastructure) integrates physical machines, intelligent robots, artificial intelligence, enhanced production areas and processes led by the human nature in order to form the new and improved environment [9].

In the German culture, smart factories have been transformed a step even further, where the efficiency of resources together with their productivity and time losses has been measured [10]. By creating such a system, where all of the items are linked through an interconnected network, controlling the design and the production process is possible during the entire lifecycle of a product [11].

3. TECHNOLOGY INNOVATION

Automated guided vehicles have been invented more than 50 years ago. In the past, this type of systems was rudimentary and mainly seen as tractors which followed a specific wire in a warehouse. Since the first AGV was invented, this technology has improved and nowadays, complex vehicles that can follow laser pathways and have collision navigation systems exist in the industry.

Recently, in the academic literature, improvements for the scheduling of AGVs and other secondary equipment have been addressed and their research conclusions are considered the latest in this area [12].

In terms of material handling, academics have studied how a certain buffer in the system may impact on its performance. They have also demonstrated that there is a need of improvement in flexibility and how the routing is processed. A final statement is that an AGV with a dynamic routing will perform more efficient as one with a planned routing [13].

In the algorithm of obstacle detection, the AGV calculates a reservation graph which is used to reserve a certain space and therefore to avoid an obstacle before entering in a collision [14].

The problem for the flow system design was addressed after detailed research on the pathway for routing [15]. A different and innovative flow network was used containing only unidirectional arcs.

When an area is overcrowded by AGVs, research has been done on how the AGVs will steer to avoid collisions with other AGVs. It has been demonstrated that there is a need for bidirectional control policies that prevent inefficient pathways [16].

Designing an AGV is a detailed process that requires advanced engineering and software skills. First, in terms of the hardware used, the following need to be decided: how is the movement modeled, which is the system's general configuration, how is the kinematic computation and what other components of the AGV are connected to the system.

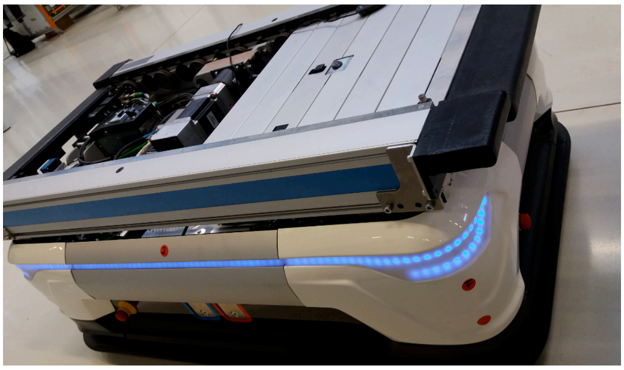

Fig. 1 – The AGV represented by the white with blue stripes mobile vehicle.

For this research, the authors have experienced that one of most important parts for creating a network of AGVs is guiding and movement model. To obtain an efficient model, parameters such as area size, steering ability, position of manufacturing operations and the free space between them need to be taken in consideration.

The product plant simulation uses a bridge connection between the physical AGVs and their core system where enhanced programming algorithms have been implemented. In terms of navigation systems, a symbiosis between vision-based guidance together with a hybrid pathway was chosen.

Because the internal memory of the AGVs is limited, the authors have created a buffer between the network connection from the AGVs and the core programming system. The buffer captures the information and communicates it in a bidirectional way, providing also a better efficiency and reducing data losses.

Fig. 2 – The AGV collecting a test piece from the current station.

The information stored in the buffer contains:

- Specific WebService;
- Calling Key - combination between the mechanical operation and the mobile vehicle;
- Physical resources needed to perform the operation;
- AGV number

- Material number and type;
- Status of the AGV.

The following buffer sample values were used in practice for testing.

Table 1

Sample buffer test values

Item	Type	Rights	Description
1000	String [50]	Read and Write	Area Production ID
AMC	String [50]	Read and Write	Motor Type
VB1	String [50]	Read and Write	Navigation
101	String [50]	Read and Write	AGV Number
1	Byte	Read and Write	Status of AGV
1101	String [50]	Read and Write	Status of Equipment
5010.101	String [50]	Read and Write	Calling Key
5010.WS	String [50]	Read and Write	Resource
5010	String [50]	Read and Write	Operation
Semi	String [50]	Read and Write	Material Type
D123ARANH3	String [50]	Read and Write	Material Number
AGVWS	String [50]	Read and Write	Called Web Service

Testing has determined that an operational system may be used but the authors consider that other aspects of this technology need to be addressed.

The problem of AGV autonomy is still something that has not demonstrated independence from a charging centered system [42]. Error minimization still exists and is depending on the type of connection and network used. In order to improve the transport time, such ideas as buffering the data to the AGV and error-control should be implemented in the core programming systems. When discussing about a plant with many operations on the production line and with hundreds of AGVs, there is a certain need of implementing a central collision system.

4. COMPUTER AIDED SOFTWARE INNOVATION

The physical technology for manufacturing is evolving at the same pace as the computer and software tools used in manufacturing and engineering. Supporting the AGV new technology and improvements already presented, the authors have decided to incapsulate the OEE software technology.

OEE is used in the most recent industrial revolution from a computer aided perspective which reinforces the existing technologies. OEE is considered the procedure where the equipment's performance is measured using a coding system and extrapolated to the guidelines developed. In contradiction with the OEE standard which provides simple and clear rules, the implemented systems have become imperfect in terms of rate and time efficiency.

Several reasons for measuring the performance have been defined in theory [17]:

- Control improvement
- Process responsibility
- Objective strategic alignment at all levels of the organization
- Communication of detailed business processes
- Capacity improvement

The term of OEE was strictly defined it as equipment related performance evaluation [18]. The concept started as a simple metric which was highly appreciated by managers because it consisted of a displayed database of information rather than a detailed and difficult system [19]. OEE usage has been seen as understanding the set of quantitative data, which evaluates the productivity for a period of time.

Following the initial definitions, a standard for the quantitative measurement within the OEE was developed. The standard reproduces with visual data how effective the equipment with a production area is [20]. As a novelty in terms of computer-innovation, there is a need in careful enhancements such as adding the planned downtimes, adjusting the lack of raw materials, calculating the human shifts and representing them on a scale [21].

Six different major equipment losses exist [19]:

- Productivity reduced by equipment failures causing defective finished goods
- Stoppages due to the adjustment time when switching from one production type to another
- Minor breakdowns when a malfunction in the machine is occurring
- Differences between the actual operating speed of an equipment and its design
- Pre-configuration and initial stabilization reduced times
- Rework losses due to equipment malfunctioning

The first two categories refer to the availability of the equipment, the second two for the performance and the remaining two will evaluate the quality.

Fig. 3 – OEE metrics: availability, performance, quality.

Availability measures the scheduled time for an industrial machine where production is done at the normal rate. The period of time when the machine is not operating has been defined as "availability losses". These states are represented by binary codes within the system and visually displayed for the operator to have an instant overview of the production area.

For the performance indicators, the speed for producing finished good must be evaluated. This quantitative indicator evaluates how many pieces are produced compared to the overall capacity of the machine in an ideal environment. Using the performance indicator, the overall producing quantity of the equipment is stored in the "machine operating time".

Quality represents the indicator that counts the number of accepted pieces produced from the overall production quantity in that shift. Quality is a measurement that is already improving due to disruptive innovation. Starting with human inspection to video and image defect recognition with specific computer software, quality is innovated in a rapid pace.

The authors have configured within the plant simulation software the production line and its equipment to send a four-digit value incapsulated in the communication send by the AGVs. The four-digit variable is built using the data received from the machine as follows: the first bit corresponds to the Red Light (idle or pause time) of the machine, the second bit to the Green Light (working time), the third bit evaluates the production status and the fourth bit represents the speed of the machine. The overall combined value is translated through logical if-conditions into the OEE mode. The OEE mode has a defined state and a group that is impacted by the actual state of the system.

Table 2

OEE Modes Detailed Description

State	Mode	Group	Red Light	Green Light	Prod. Status	Speed
Default	0	Run	0	0	0	n/a
Unknown	1	Unknown	n/a	1	1	>0
Change	2	Change	n/a	1	0	n/a
Waiting Product	3	Wait	0	1	1	=0
Waiting Downstream	4	Wait	1	0	0	n/a
Stopped With Unknown Fault	5	Stop	1	n/a	1	n/a
Stopped And Not Running	6	Stop	1	1	0	=0
Breaks	7	Break	1	1	1	=0
Training	8	Train	1	1	1	2
Shift Change	9	Change	1	1	1	3

The coding procedure for capturing the stoppages was responsible in centralizing the information in a local database and evaluating the type of stoppage. Once a stoppage has occurred and the stoppage mode was sent, a blocking logic for the system was started. The stoppage needed to be addressed by the operator and to confirm that the system can be restarted. Once the system can be restarted, the stoppage mode was reset to the original value and the equipment started. The time between the different stoppages were considered the "downtime distribution".

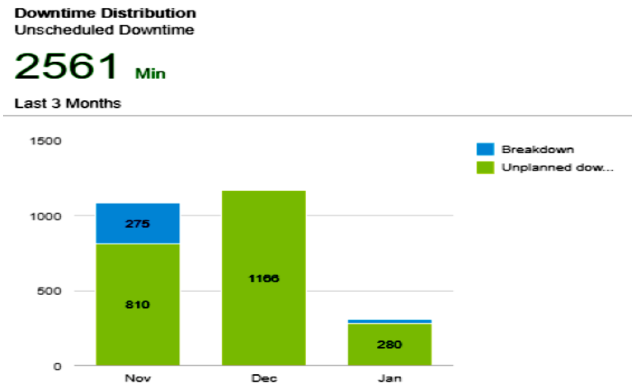

Fig. 4 – Downtime distribution.

In order to obtain and calculate the "capacity utilization", the existing data from different unplanned stoppages must be extrapolated with the planned stoppages.

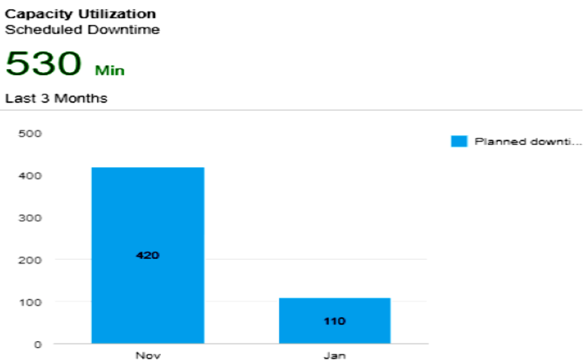

Fig. 5 – Capacity utilization.

The procedure for the good/scrap quantities uses a similar logic as the procedure for the stoppages. Once the mode is sent through the AGV from the equipment's sensor, the quantity for the machine is captured and stored within a table in the system's database. If the quantity is negative, a secondary procedure called deducts the data from the existing quantity. Otherwise, the new quantity is added and counted as qualitative finished goods.

In the current case, there can be a correlation between losses and the AGV technology which is not fully efficient when discussing about collision control. When the AGV technology cannot transport the product from one station to another, the OEE is impacted for future equipment's and therefore, stoppages occur. Rework and remanufacturing need to be considered when discussing about an OEE system as well. The utilization of the equipment is influenced by a product which is reinserted on the line and needs adjustments.

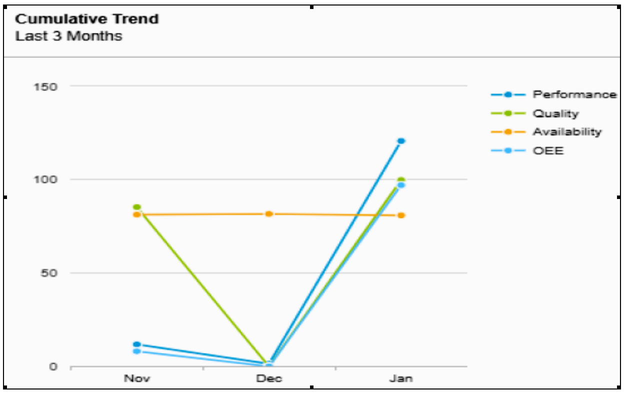

Fig. 6 – Cumulative trend for the last 3 months.

5. ORGANIZATIONAL TRANSFORMATION

The latest industrial revolution transforms the business environment in the same manner as engineering innovations develop. The statement for describing the organization culture applied on the context of Industry 4.0 is "only recently that researchers and management practitioners started looking at organizations as institutions that are being affected by an independent variable that affects employee work behavior" [22].

Other literature assesses the organization culture based on a hierarchical model in a three-level diagram [23]. The first level contains all the visible features of an environment in an organization. In a second level, technical and social traits which usually are learned in time are described. On the third and last level, the concept of perception is discussed. From a practical point of view, in an engineering environment, if a concept such as the AGV technology or the OEE software-measuring tool is developed in the internal project's constraints, the whole project team with its project leader, will share the same beliefs as one. Nevertheless, the long-term impact will equally impact the team and the leader.

Innovative organizational cultures are defined by traits such as: detail attention, team and people centered environments, openness to novelty, balance between stability and risk taking [24].

The levels of engagement in daily tasks may be seen a strong advantage or disadvantage in terms of the organizational culture. Informal and collaborative environments have been labeled in scientific journals as strong companies [25].

Moreover, determining how powerful an organization is should provide sufficient data in order to identify the organization's overall business performance [26].

When discussing about change management, which is strictly in direct contact with the latest industrial revolution, employees in leadership roles should provide enough support. The latest technologies and software improvements are influencing the overall workplace environment. If change appears, management should be opened enough in order to present the innovation novelty and explain the benefits that appear [27].

According to these findings, the constant changing environment must incapsulate in the company's strategy, the vision and mission of the changes in order to develop an innovative culture [27].

Bidirectional connections have been demonstrated in history between the type of organizational culture supported by its values and the performance of the business [28].

Therefore, a more detailed analysis of the environment has been researched to determine the effect on the business environment from the organizational culture [29]. It is argued that "genetics" play an important role when discussing about behavioral traits, however, other traits are constantly evolving from daily activities and adapting to new environment changes.

While more research journal debate on the fact that genetics play an important factor in the development of an individual and moreover, an organizational culture, it has been demonstrated that genetics will not influence the external environment just as present and independent from other factors [30].

The change in generations in the workplace is also impacting the work environment and the culture. Age generations have different values, mindset and work ethic. The newest generation which was added to the work environment is named "Millennials". Their main characteristic is a higher degree of confidence, trust and positive attitude [31]

Millennials have also been labeled as hard-working employees, achievement-focused and who rank high when it comes to assertiveness and self-esteem. The Millennial culture has also been linked to people who are easily adapting to change and who are technologies driven individuals [32].

Agile companies have become more and more present in the work and business environment. Changing from a traditional company to an agile organizational culture is also considered a way of innovating [33].

The Millennial culture, which usually has proven itself as not being a "blaming" culture, is considered to easily adapt to agile principles. Owning a part of the manufacturing or computer process is a characteristic of both the Millennial generation and of the people within of agile cultures. Aligning the personal values at the starting point of an innovation and transformation to the agile principles is required in order to achieve success on a long-term basis. [34].

Observing the technology together with the computer driven innovation that has been implemented, the authors have decided to test a more complicated existing hypothesis.

The researchers attempted to determine if the symbiosis between software and engineering processes is impacting the organizational culture. Moreover, if possible, it desired to determine if the newest generation had also an impact on the culture and processes.

A quantitative study was processed containing 50 questions in order to determine the values impacted by the changes in the culture. The study was started 6 months after the AGV technology and the OEE software was implemented. The researchers have evaluated the answers from a pragmatical approach.

The survey questioned 150 people in order to obtain theoretical saturation and to validate the study. Every question had scale on which the surveyed person should rank according to its personal values.

The themes questioned were feedback, mentorship, vision, communication, work-life balance, extrinsic drivers and teamwork and their implications from the business.

First, Millennials prefer the change and an innovation environment with a recurrent feedback. More than 85 % of the people the people questioned, find that when the change occurred in the company, their work needs to be evaluated and monitored in order to provide a good performance monitor [35]. When it comes to giving feedback about how a colleague is performing, people have, unfortunately split between afraid to give feedback (64.32 %) and capable of giving feedback (35.68 %). Surprisingly, the current employees believe that when a change occurs, feedback needs to be tied to the actual action, not the person itself.

When discussing about mentorship, 92% of the people consider that a mentor is needed when a change this large occurs. People also have stated that they approve an environment where leadership is empowering but some level of control needs to occur in order to have a profitable business environment [36].

Vision can be seen be most employees and they have aligned their personal beliefs to the values of the organization. As much as 76 % of the respondents see that they can meet their goals and remain in the organization's boundaries [37]. When asked about communication, the respondents (72.8 %) see that the innovation change was communicated in a well process to the whole team and they benefited from the accurate and transparent communication within the organization. Problem solving was done in a constructive manner and employees felt as a part of the change process (98 %) [38].

Findings suggest that all employees have a work ethic and respect for working in a constantly changing and innovating environment (89% consider that building a career in this industry will help fulfill their desires) [39].

When the discussion reaches the topic of extrinsic drivers, people consider that the availability for technology is needed more every day. Technology comes with gadgets, computers, software programs and artificial intelligence like the ones that have already been implemented [39].

Discussing about teamwork, 80% of the employees consider that it is highly required. A collaborative and informal environment should be the strong foundation on which the processes and procedures should be built in the current organization. This finding is supported by the whole idea of the Millennial culture who is labeled as teamwork oriented [32].

7. **CONCLUSION**

In academic references, the concepts of Industry 4.0 are mostly limited to the technical and software aspects and do not consider their implications to the organizational culture within a certain industry which is an important factor that can provide competitive advantage.

Implementing different software systems and innovative technologies require an organizational culture that is continuously focused on the changing abilities of the individuals. Concepts such as the AGV technology and the OEE software effectiveness system have been successfully implemented, however, it is difficult to state that these will be successful in the current organization. Even though the respondents of the survey have demonstrated openness and can be labeled as innovators, in a digital environment, an industrial change and its implications on the work force cannot be measured in a short and limited period of time in order to provide sustainable results.

Received on September 13, 2020

REFERENCES

1. D. S. Landes, *The Unbound Prometheus; Technological Change and Industrial Development in Western Europe from 1750 to the Present*, Cambridge University Press, London (1969).
2. G. Prause, S. Atari, *On sustainable production networks for Industry 4.0*. Entrepreneurship and Sustainability Issues, **4**, *4*, pp. 421-431, https://doi.org/10.9770/jesi.2017.4.4(2) (2017).
3. B. Ebersberger, H. Lööf, *Multinational enterprises, spillovers, innovation and productivity. Royal Institute of Technology*, CESIS – Centre of Excellence for Science and Innovation Studies. https://ideas.repec.org/p/hhs/cesisp/0022.html (2004).
4. S. Háša, R. Brunet-Thornton, (Eds.) *Impact of organizational trauma on workplace behavior and performance*, IGI Global Disseminator of Knowledge, https://doi.org/10.4018/978-1-5225-2021-4 (2017).
5. F. Hecklau, M. Galeitzke, S. Flachs, S., H. Kohl, *Holistic approach for human resource management in industry 4.0*. Procedia CIRP, **54**, pp. 1-6. https://doi.org/10.1016/j.procir.2016.05.102, (2016).
6. C. Arnold, D. Kiel, K. I. Voigt, *How the industrial internet of things changes business models in different manufacturing industries*. Int. J. Innov. Managm., https://doi.org/10.1142/S1363919616400156 (2016).
7. F. Rennung, C. T. Luminosu, A. Draghici, *Service provision in the framework of Industry 4.0*. Procedia – Social and Behavioral Sciences, **221**, pp. 372-377 (2016).
8. S. Schneider, P. Spieth, *Business model innovation: towards an integrated future research agenda*. Int. J. Innov. Managm., **17**, *1*, 1340001, https://doi.org/10.1142/S136391961340001X, (2013).
9. J. Qin, Y. Liu, R. Grosvenor, *A categorical framework of manufacturing for Industry 4.0 and beyond*. Procedia CIRP, 52, 173-178. https://doi.org/10.1016/j.procir.2016.08.005 (2016).
10. H. Kagermann, W. Wahlster, J. Helbig, *Recommendations for implementing the strategic initiative INDUSTRY 4.0*. National Academy of Science and Engineering, Berlin/Frankfurt (2013).
11. W. Bauer, S. Schlund, D. Marrenbach, O. Ganschar, *Industry 4.0 – Volkswirtschaftliches Potenzial für Deutschland*. BITKOM, Berlin (2014).
12. C. Basnet, J.H. Mize, *Scheduling and control of manufacturing systems: a critical review*, Int. J. of Computer Integrated Manuf., **7**, pp. 340-355 (1994).
13. I. Sabuncuoglu, D. L. Hommertzheim, *Dynamic dispatching algorithm for scheduling machines and AGVs in a flexible manufacturing system*, Int. Journal of Production Research, **30**, pp. 1059-1080 (1992).
14. C. W. Kim, J. M. A. Tanchoco, *Conflict-free shortest-time bidirectional AGV routing*, Int. J. Production Research, **29**, pp. 2377-2391 (1991).
15. W.L. Maxwell, J.A. Muckstadt, *Design of automatic guided vehicle systems*, IIE Transactions, **14**, *2*, pp. 114-124 (1998).
16. N. N. Krishnamurthy, R. Batta, H., Karwan, *Developing conflict-free routes for automated guided vehicles*, Operation Research, **41**, pp. 1077-1090 (1993).
17. W. Kaydos, *Operational Performance Measurement: Increasing Total Productivity*, St. Lucie Press: Boca Raton, FL, USA (1999).
18. S. Nakajima, *Introduction to TPM: Total Productive Maintenance*, Productivity Press Inc.: Cambridge, MA (1988).
19. S. H. Huang, J. P. Dismukes, J. Shi, Q. Su, M. A. Razzak, R. Bodhale, D. E. Robinson, *Manufacturing productivity improvement using effectiveness metrics and simulation analysis*. Int. J. Prod. Res., **41**, 513–527 (2003).
20. ∴ *Standard SEMI Documentation Book*, E79-0200 (2000).
21. O. Ljundberg, *Measurement of overall equipment effectiveness for TPM activities,* Int. J. Operat. Prod. Manag., **18**, pp. 495–507 (1998).
22. O. O. Owoyemi, J. O. Ekwoaba, *Organizational culture: A tool for management to control, motivate and enhance employees performance*, Amer. J. Business Managm. **3**, *3*, pp. 168-177, (2014).
23. S. P. Robbins, T. A. Judge, *Organizational Behavior*, 14th Ed. New Jersey: Pearson Education, Inc. (2011).
24. W. P. Onyango, *Effects of organization culture on change management: A case of the vocational training centre for the blind and deaf sikri*, Eur. J. Business Managm., **6**, *34*, pp. 204-214 (2014).
25. M. Ahmed, S. Shafiq, *The impact of organizational culture on organizational performance: A case study of telecom sector*, Global J. Manag. Business Res.h: Admini. and Manag., **14**, *3*, pp. 22-29 (2014).
26. R. K. Agrawal, A. Tyagi, *Organizational culture in Indian organizations: An empirical study*. Int. J. of Indian Culture and Business Manag., **3**, *1*, pp. 102-110 (2010).
27. E. A. Yildiz, *Study on the relationship between organizational culture and organizational performance and a model suggestion*, Int. J. of Res. in Business and Soc. Scie., **3**, *4*, pp. 103-110 (2014).
28. R. McCarney, J. Warner, S. Iliffe, *The Hawthorne effect: a randomized, controlled trial*, BMC Medical Res. Meth., **7**, *1*, pp. 30 (2007).
29. R. Plomin, J.C. DeFries, G.E. McClearn, P. McGuffi. *Behavioral genetics*, 5th ed. New York: Worth (2008).
30. E. F. Keller, *The mirage of a space between nature and nurture*. Durham: Duke University Press, (2010).
31. A. B. Guha, *Motivators and hygiene factors of generation x and generation y-the test of two-factor theory*. Vilakshan: The XIMB J. of Manag., **7**, *2*, pp. 121-132 (2010).
32. S. Hauw, A. Vos, *Millennials' career perspective and psychological contract expectations: does the recession lead to lowered expectations?* J. of Business and Psychol., **25**, *2*, pp. 293-302 (2010).
33. D. Anderson, E. Schragenheim, *Agile management for software engineering: Applying the theory of constraints for business results*, Prentice Hall: Upper Saddle River (2004).
34. D. Hussman, *How to maintain and promote healthy agile culture. extreme programming and agile methods - XP/Agile universe*, 4th Conf. on Extreme Programming and Agile Methods. Calgary, Canada, August. pp. 190-191. Springer-Verlag (2004).
35. R. Hackman, G. Oldham, *Motivation through the design of work: Test of a theory*, Organizational Behavior and Human performance, **16**, pp. 250-279 (1976).
36. B. Bass, *Leadership and Performance Beyond Expectations*, The Free Press, New York, NY, (1985).
37. O. O'Donnell, R. Boyle, *Understanding and managing organisational culture. Dublin, Ireland*, Institute of Public Administration (2008).
38. K. K. Myers, K. Sadaghiani, *Millennials in the workplace: A communication perspective on Millennials' organizational relationships and performance*, J. of Business Psychol., **25**, pp. 225-238 (2010).
39. J. A. Cogner, *Training leaders for the twenty-first century*, Human Resource Management Review, **3**, *3*, pp. 203-218 (1993).
40. R. I. Mogos, C. N. Bodea, M. I. Dascalu, O. Safonkina, E. Lazarou, E.L. Trifan, I.V. Nemoianu, *Technology enhanced learning for Industry 4.0 engineering education*, Rev. Roum. Sci. Techn.– Électrotechn. et Énerg., **63**, *4*, pp. 429-435 (2018).
41. J. Arhip, A. Borlan, O. G. Müler, *Image processing for acquiring target coordinates with a platform*, Rev. Roum. Sci. Techn.– Électrotechn. et Énerg., **55**, *4*, pp. 426–435 (2010).
42. B. Anton, A. Florescu, S. G. Rosu, *Automotive battery management systems*, Rev. Roum. Sci. Techn.–Électrotechn. et Énerg., **63**, *3*, pp. 306–313 (2018).