Problemy Zarządzania – Management Issues, vol. 17, no. 2(82): 96–108
ISSN 1644-9584, © Wydział Zarządzania UW
DOI 10.7172/1644-9584.82.4

Organizational Learning in Industry 4.0

Submitted: 14.01.19 | Accepted: 29.03.19

Regina Lenart-Gansiniec*

Globalisation and the scarcity of resources have contributed to the need to implement and meet higher customer expectations while reducing the number of employees, the workload, and resource depletion. This situation initiated Industry 4.0, the foundation of which is the implementation and dissemination of modern technologies related to process autonomization, artificial intelligence, and the Internet of Things. They are to contribute to improvements in terms of increased efficiency, decision-making, as well as the creation and maintaining of competitive advantage. Changes in the field of robotics, artificial intelligence, and automation technologies indicate that with the growth of their importance and implementation in organisations, changes need to be introduced in the management of organisations, particularly in the context of organisational processes that form the basis for making knowledge-based decisions. This article's aim is to identify the meaning of organisational learning for Industry 4.0 implementation. For the purpose of the article, a literature analysis was carried out using the method of systematic literature review. A model on organizational learning within the Industry 4.0 was proposed. The results of analyses show that organisational learning is strictly related to Industry 4.0, as it stimulates the development, acquisition, transformation, and use of new knowledge, which is, in turn, crucial for the implementation of Industry 4.0. The article also proposes guidelines for management practitioners who may consider the introduction of Industry 4.0 tools into work as a challenge.

Keywords: Industry 4.0, Industry 4.0 implementation, learning organization, Industry 4.0 challenges.

Organizacyjne uczenie się w Przemyśle 4.0

Nadesłany: 14.01.19 | Zaakceptowany do druku: 29.03.19

Globalizacja i niedobór zasobów przyczyniły się do konieczności realizacji i spełnienia wyższych oczekiwań klientów przy jednoczesnym zmniejszeniu liczby pracowników, nakładu pracy i zużyciu zasobów. Sytuacja ta zapoczątkowała Przemysł 4.0., u podstaw którego znajdują się wdrożenie i rozpowszechnienie nowoczesnych technologii powiązanych z automatyzacją procesów, sztuczną inteligencją oraz Internet of Things. Wszystko to ma przyczynić się do usprawnień, poprawy wydajności, podejmowania decyzji oraz generowania i utrzymania przewagi konkurencyjnej. Zmiany w dziedzinie robotyki, sztucznej inteligencji i technologii automatyzacji wskazują, że wraz ze wzrostem ich znaczenia i wdrażania w organizacjach, istnieje konieczność wprowadzania zmian w zarządzaniu, szczególnie w kontekście procesów organizacyjnych stanowiących podstawę do podejmowania decyzji opartych na wiedzy. Celem artykułu jest identyfikacja znaczenia organizacyjnego uczenia się dla implementacji Przemysłu 4.0. Zaproponowano model wdrożenia Przemysłu 4.0 z uwzględnieniem organizacyjnego uczenia się. Na potrzeby artykułu została przeprowadzona analiza literatury z wykorzystaniem metody systematycznego przeglądu lite-

* **Regina Lenart-Gansiniec** – dr, Jagiellonian University. https://orcid.org/0000-0002-9379-1504.

Correspondence address: Jagiellonian University, 4 Lojasiewicza Street, 30-348 Krakow.

Ministry of Science and Higher Education
Republic of Poland

The creation of the English-language version of these publications is financed in the framework of contract No. 607/P-DUN/2018 by the Ministry of Science and Higher Education committed to activities aimed at the promotion of education.

ratury. Wyniki przeprowadzonych analiz wskazują, że organizacyjne uczenie się jest ściśle powiązane z Przemysłem 4.0, ponieważ stymuluje rozwój, pozyskiwanie, przekształcanie i wykorzystywanie nowej wiedzy, a co w dalszej kolejności ma znaczenie dla wdrożenia Przemysłu 4.0. W artykule zaproponowano także wskazówki dla praktyków zarządzania, którzy mogą uznać wprowadzenie narzędzi Przemysłu 4.0 do pracy za wyzwanie.

Słowa kluczowe: Przemysł 4.0, implementacja Przemysłu 4.0, organizacja ucząca się, wyzwania Przemysłu 4.0.

JEL: O10, O30

1. Introduction

Changes that have taken place in the modern economy, technological progress, new trends, globalisation, and growing customer expectations have triggered a change of the model or paradigm of the organization's functioning and approaches to management. Increasingly, it is pointed out that Industry 4.0 responds to all challenges, involves fast and disruptive changes that embrace digital manufacturing, network communication, computer and automation technologies, as well as many other relevant areas. In particular, Industry 4.0 includes a variety of technological solutions such as: industrial automation, computerisation, digitisation, robotisation, Big Data, Internet of Things, combination and aggregation of various data in IT systems. The above improves organizations' efficiency and productivity. In addition to its benefits, Industry 4.0 is becoming a new business model (Ibarra et al., 2018, pp. 1–4), which entails changes in the logic or philosophy of the organization's operation. Research shows that there is a need to let go of the traditional style of acquiring and investing in knowledge: "instead of using outdated knowledge, and other resource, organization should acquire new knowledge, translate the acquired knowledge into a core competence, and then develop new products based on the core competence. Learning and innovation are the critical success factor in Industry 4.0, and sometimes it requires willingness to abandon knowledge, experience, and investment to accommodate new technology" (Saban et al., 2000, pp. 99–119). However, despite the importance of organizational learning in Industry 4.0, little is known about this topic: the implementation of Industry 4.0 tools has yet to be examined and subject to a relevant study.

The aim of the article is to explore the impact of organizational learning on Industry 4.0 implementation. Based on the 4I organizational learning model, a conceptual model of organizational learning within the Industry 4.0 was proposed. For the purpose of the article, a systematic review of literature published in the SCOPUS database was carried out; it encompassed the period from 2011 to 1 January 2019.

The article consists of three parts. The first is an overview of literature on Industry 4.0 and organizational learning. The second part presents the methodology of the systematic literature review. The third – and last – part is a discussion of research results, namely the impact of organizational learning on Industry 4.0. In addition, a model of organizational learning with Industry 4.0 is proposed. Considerations end with a summary referring to the purpose of the article and providing practical recommendations for organizations planning to apply Industry 4.0 solutions. The limitations of the systematic literature review and modelling are also presented.

2. Literature

2.1. Industry 4.0

The concept of Industry 4.0 appeared for the first time in 2011 following an article authored by J. Lee. He proposed to define a new opportunities for future German economic policy. It was assumed at the time that the organization's production system consisted of an information system and numerically controlled machines operating autonomously and encompassing elements of artificial intelligence, self-control, self-configuration. and repair (Lee, 2013, pp. 8–10). Numerous researchers indicate that "Industry 4.0 represents the ability of industrial components to communicate each other's" (Pan et al., 2015, p. 1537). They also acknowledge that "the essence of Industry 4.0 conception is the introduction of network-linked intelligent systems, which realize self-regulating production: people, machines, equipment and products will communicate to one another" (Kovacs & Kot, 2016, p. 122).

Among its numerous benefits, "Industry 4.0 significantly influences the production environment with radical changes in the execution of operations. In contrast to conventional forecast-based production planning, Industry 4.0 enables real-time planning of production plans, along with dynamic self-optimization" (Sanders et al., 2016, p. 816). The main elements, or tools that are strictly connected with the idea of Industry 4.0, include the industrial revolution, comprising 3D printing, Big data, Internet of Things, and Internet of Services.

The implementation of Industry 4.0 demands from the organization the fulfillment of several requirements. It ought to be able to (1) capture and generate data and transform them into valuable information facilitating the decision-making process (Brousell et al., 2014); (2) designate dedicated units for analysing data and applying analytical technologies (Macaulay et al., 2015); (3) provide data security procedures, (4) provide organizational structures and production infrastructure, (5) ensure a high level of integration, communication, and cooperation between business processes.

 DOI 10.7172/1644-9584.82.4

2.2. Organizational learning

Four main approaches to defining organizational learning can be identified in literature, each taking into account different aspects of the concept, namely behavioural, cognitive, social, and technical. The behavioural approach defines organizational learning as adaptive behaviour of the organization to changes in the environment (Rokita, 2005, p. 115). The cognitive approach defines organizational learning in the context of behaviours and actions taken in the organization that will allow the organization to learn, adapt to external and internal environmental changes in order to maintain a sustainable competitive advantage and to use and enrich existing knowledge resources (Chen, 2005, pp. 4–22). In the social approach, organizational learning is connected with the organizational structure and culture, transformation leadership and the organization's ability to acquire, disseminate, use, and store knowledge (Argote, 2011, pp. 439–446). The technical approach combines organizational learning with information processing and assimilation of knowledge potentially useful to the organization, which further leads to the extension of the scope of potential behaviours (Huber, 1991, pp. 88–115). In this work, organizational learning shall be understood, in accordance with the behavioural perspective, as a "psychosocial process of change in perception and behaviour, occurring within the organization and between organizations" (Crossan, 2007).

3. Research methodology

A systematic literature review for the search, identification, and analysis of each study was performed This method allows to "minimize researcher bias regarding the inclusion or exclusion of studies and to clearly channel how and to what extent the review was performed through transparency" (Karaosman et al., 2017, p. 30). An inductive approach was applied here, including three stages: (1) planning the review, (2) review, and (3) reporting. A detailed description of the systematic review of the literature is presented in Figure 1.

At the first stage, i.e. review planning, keywords subsequently used to search the databases were identified. The database was filtered with keywords such as "organizational learning" and "Industry 4.0". Academic studies were collected from a single international electronic database, SCOPUS. It was chosen because it is a comprehensive academic source that includes a wide range of multidisciplinary, peer-reviewed scientific articles; it is used for many systematic reviews. The following criteria were adopted in the search for scientific articles used in the systematic review of data: (1) articles published online before January 2019, (2) articles containing words identified in the in abstract, title, and keywords, (3) articles published in peer-reviewed journals, and (4) articles in English. The analysis omits reviews, conference materials,

working documents, book reviews, and comments. The search was narrowed down to management science journals. On this basis, 19 publications were selected. After the removal of duplicates, the first selection process was carried out in order to eliminate non-academic articles and those that were not accessible in their entirety. Subsequently, after the initial selection process, articles were briefly reviewed: this stage involved reading their titles and summaries in order to select those that deal with the analysed issues directly. At this stage, 10 publications were excluded, which left us with 6 articles published in the 2006–2018 and subject to further analysis. The 10 articles were eliminated because they did not directly relate to organizational learning's relationship with Industry 4.0. The snowball method was applied in order to avoid overlooking publications important for the study. Literature review was extended by publications referred to by authors of the analysed papers. In the end, 26 scientific articles were analysed. The next section outlines the main findings of the analysis.

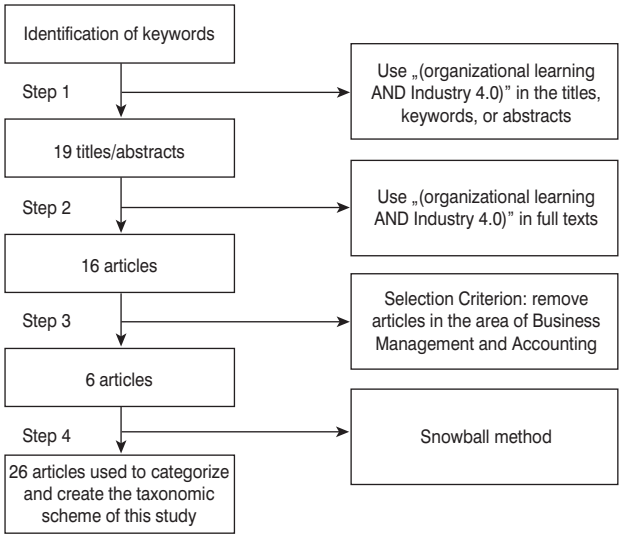

Fig. 1. A schematic diagram of the systematic literature review. Source: own study.

4. Results and discussion

4.1. Organizational learning and Industry 4.0

Although many authors are convinced of the significant impact of organizational learning on Industry 4.0, there is a lack of in-depth analysis in this field. It is recognised in the literature that Industry 4.0

 DOI 10.7172/1644-9584.82.4

has features of radical and incremental innovation. A radical change is defined as a "strategic change in production/services, markets served, and technological breakthroughs used to produce a product or render a service based on significant innovation" (Koberg et al., 2003, p. 23). Thus, it is an innovation that is completely new and unrelated to the existing technology and methods. On the other hand, incremental innovation aims to improve existing technologies and use them to achieve a new goal. It means linear, cumulative change in a process or product, representing minor improvements or simple adjustments in current technology. In this perspective, Industry 4.0 is important for the implementation of new products, markets, and business models (radical innovation); in addition, existing technologies must be adapted or combined with new solutions (incremental innovation). Studies published thus far suggest that organizational learning is important for incremental and radical innovations. Organizational learning has a stronger influence on incremental than on radical innovations. This is due to the fact that organizations implementing incremental innovations place emphasis on expanding new insights rather than consolidating existing knowledge. This is also confirmed by other authors, who stress that all innovations depend on core knowledge (Salim & Sulaiman, 2011) and organizational learning. This is due to the fact that organizational learning supports creativity, inspires new knowledge and ideas, and increases the potential for their understanding and application, promotes organizational intelligence and orientation on innovation.

As pointed out by Ediz (2018), the development of 4.0 technology changes the way knowledge is acquired, shared and used. A change in knowledge management initiated in connection with the implementation of Industry 4.0 has reduced the human factor in operational transaction management. This is confirmed by the findings of Trantopoulos et al. (2017), who acknowledge that Industry 4.0 intensifies the organization's practices connected with knowledge, particularly knowledge flow and data collection (Del Giudice & Della Peruta, 2016; Soto-Acosta et al., 2014).

In the literature on organizational learning, Industry 4.0 is often presented as the key to the organization's successful learning (Lasi et al., 2014, p. 239). The implementation of Industry 4.0 is characterised by a high rate of change, innovation, and uncertainty, and therefore organizations must be agile, creative, flexible, anticipating, and adapting to the needs of their customers (Shamim et al., 2016, pp. 5309-5316). In addition, as Shamim et al. (2017) point out, to maintain innovation and creativity of the organization, which is necessary for the implementation of Industry 4.0, organizations need creative and innovative employees who are able to work in an uncertain and competitive environment. In this approach, Industry 4.0 requires learning, knowledge management, and innovative capabilities that can facilitate the acceptance of technologies by their employees (Nov & Ye, 2008, p. 448). In turn, Saban et al. (2000) believe that strengthening the

innovation process in organizations requires the organization's readiness to give up obsolete investments and knowledge, as well as acquiring knowledge and transforming it into key competences. These findings are confirmed by the results of research conducted by Shamim et al. (2017) in the hotel industry. Researchers conducted semi-structured interviews with 10 employees from five different hotels. They emphasize that Industry 4.0 introduces a change in the optics or logic of the functioning of this industry. It results from challenges related to mass personalisation, intelligent work, and digitalisation. It was therefore concluded that learning and knowledge management accelerate the pace that is required to implement Industry 4.0.

4.2. Model of organizational learning with Industry 4.0

To illustrate the relationship between organizational learning and Industry 4.0, process modelling was used. This approach was adopted because process models allow for determining actions and behaviours, their sequence along with the circumstances and dependencies that occur. During the construction of the model, it was necessary to make eight assumptions regarding its correctness. According to them, a correctly constructed model should: (1) be characterised by simplicity and take into account all of the researched aspects in a comprehensible/comprehensive manner, (2) include empirically verified elements, (3) be reliable and refer to internally coherent phenomena, (4) be original and develop knowledge, although it may refer to research findings of other academics, (5) explain behaviour in surveyed organizations, (6) enable predicting the behaviour of organization taking into account various factors, (7) take into account new areas of research, and (8) enable to verify and test dependencies (Phipps, Simmons, 2007, p. 215).

Bearing the above in mind, assumptions of the 4I model by Crossan and her colleagues were taken into account in designing the model. Levels have been included, e.g. organizational learning processes and their dynamics. This approach will enable a holistic view of the organizational learning and Industry 4.

In addition, it is most often applied in analyses of organizational learning factors, including the absorption capacity (Sun & Anderson, 2010, pp. 130–150), value streams in product development (Schulze et al., 2013, pp. 1136–1150), the development of services (Stevens & Dimitriadis, 2004, pp. 1074–1084), leadership (Vera & Crossan, 2004, pp. 222–240), and strategic renewal (Jones & Macpherson, 2006). In addition, it allows for studying organizational learning regardless of the size of the enterprise (Matlay, 2000, pp. 202–210) and can be used to analyse this process in commercial and public organizations (Maden, 2012, pp. 71–84). The results of a systematic review of literature were taken into account to determine the final shape of the model.

The systematic review of the literature provided a great amount of insightful information on the relationship between organizational learning

 DOI 10.7172/1644-9584.82.4

and Industry 4.0. Considering that the concept of Industry 4.0 is relatively new and has been dynamically developing, it was proposed to take into account three organizational learning processes in the modelling, namely intuition, integration and institutionalisation.

First of all, intuition – as a process taking place in the minds of employees – consists in reformulating, modifying or generating new knowledge by means of individual experience and insights. This enables the employee to adopt a new perspective on the organization and to create new ideas on the basis of his/her personal experiences. In the context of Industry 4.0, the management staff, their intuition, conviction, commitment and support, as well as their awareness of the potential benefits that can be gained from Industry 4.0implementation, become more important (Vowles et al., 2011; Jeyaraj et al., 2006). Apart from that, the implementation of the Industry 4.0 concept requires engaging the management in processes of change management, in particular convincing employees about the benefits of Industry 4.0. Hence, the management staff and their intuition can be important for the efficiency and organizational changes, for creating and initiating new solutions, promoting changes, fostering positive expectations, inspiring with a common vision and enthusiasm, motivating employees to take action, encouraging them to experiment and take risks, thus creating a work environment where employees feel at ease and have a greater ability to search for innovative ways in which to accomplish their task. This is why it is important that the management provide employees with training oriented at boosting their IT competences. For example, Vowles et al. (2011) analysed the implementation of Industry 4.0 and discovered that managers' intuition and support had a significant and positive impact on the implementation of Industry 4.0. Similarly, Jeyaraj et al. (2006) revealed that support from the management is one of the predictors of Industry 4.0 implementation.

Second, interpretation is a process that occurs at the individual level, but also at the group level of organizational learning. The use Industry 4.0 encourages organisations to see complex problems in a new light. Its aim is to facilitate the creation of knowledge through making employees aware of the importance of Industry 4.0 for the organization. In other words, Industry 4.0 allows organizations to re-interpret their problems and allows employees to create knowledge frameworks with which they can interpret new knowledge. Employees develop their skills, views, attitudes, and goals, in particular under the influence of the community within which they operate. On top of that, by entering into interactions, conversations, joint actions and decision-making, individuals' knowledge becomes manifest, it flow and is verified. Collective decision-making, actions or discussions are important, as they allow problems to be looked at in a new light. It contributes to common understanding and the creation of new knowledge. Collective decision-making comes down to the transfer of decision-making powers to lower levels of the organization. In practice, employees are authorized to

make decisions using organizational resources. Studies indicate that such this approach may contribute to organizations' compatibility with Industry 4.0 (Shamim et al., 2016, pp. 5309–5316).

Third, integration boils down to a common understanding among members of the group. It focuses on updating ideas through collective actions and common practices. It includes testing, evaluation and, finally, the implementation ideas – therefore, it begins with organizational cognition and ends with action. cooperation and adaptation lead to a common understanding and meaningful actions. Organizational learning requires the engagement of teams in solving complex problems, developing new ideas, or coordinating initiatives. In this context, Industry 4.0 can be supported by project teams that provide a source of knowledge and a chance to reuse innovative solutions (Shamim et al., 2016, pp. 5309–5316). Moreover, team work facilitates learning and the implementation of innovations (Khedhaouria & Jamal, 2015, pp. 932–948).

Fourth, institutionalization is related to embedding individual and group learning systems, structures, strategies, culture, and organizational procedures. The organizational structure, in particular characterised by decentralization, flexibility, horizontal communication, and team work, is of great importance to Industry 4.0. It is often stressed that flat organizational structures facilitate the implementation of Industry 4.0 solutions (Shamim et al., 2016, pp. 5309–5316). A flat organizational structure streamlines communication and reduces the distance between the employees and top management, which positively affects employees' participation in discussions and making decisions, and accelerates feedback from the management to employees.

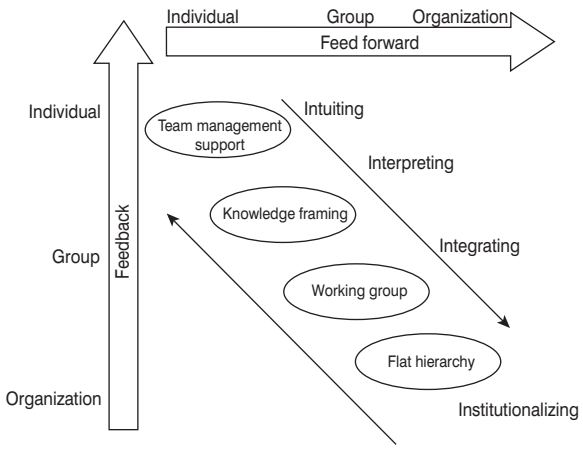

Fig. 2. Model of organizational learning with Industry 4.0. Source: own elaboration based on Crossan et al., 1999.

 DOI 10.7172/1644-9584.82.4

Given the above, while designing the conceptual model of organizational learning with Industry 4.0, assumptions of the 4I model by Crossan and her colleagues were taken into account (1999). Figure 2 shows how organisational learning can be used in Industry 4.0. If the management plans to implement Industry 4.0, it is worth ensuring that organizations have the skills or the ability to re-identify problems and gaps in knowledge and abilities. In this way, if Industry 4.0 is implemented using organizational learning, both processes – i.e. Industry 4.0 implementation and learning – are accelerated.

5. Conclusion and future research

Contemporary organizations face strong competitive pressure and strive to improve efficiency and meet the constantly growing market demand for personalised and innovative products. This requires the organization to raise the level of integration, communication, and cooperation between business processes, which is, in turn, associated with the adoption of incremental and radical innovations. The emergence of Industry 4.0 reveals the dynamics and complexity of adopting these new and rapidly growing concepts. Apart from the numerous benefits of Industry 4.0 for organizations, certain requirements must be met for its implementation. The literature indicates that organizational learning may be one of them. Therefore, a theoretical framework has been proposed, along with a more detailed conceptual model of organizational learning for Industry 4.0 that could provide a better understanding of connections between individual organizational learning processes and Industry 4.0.

The proposed conceptual model (Figure 1) is an adaptation of the 4I model developed by Crossan et al. (1999) and includes the following: intuition, interpretation, integration, institutionalisation, feed-forward, and feedback. In this model, it is assumed that all activities undertaken as part of organizational learning are important for Industry 4.0, in particular: intuition of the management, transfer of rights to employees, work carried out in project teams, flexible organizational structure, horizontal communication, prevention of deviations, creativity, innovative competences, and problem-solving skills. Industry 4.0 gives organizations the opportunity to challenge assumptions about the way they have always acted in their organizations. In this context, leadership plays a decisive role in initiating changes. This is in line with the findings of Vera and Crossan (2004), who highlight the importance of strategic leadership.

The proposed conceptual model may be useful for conducting further analyses and research on the importance of organizational learning for Industry 4.0. With its help, management staff can analyse the organization's readiness to implement Industry 4.0. This may facilitate decision-making in the context of the adoption and implementation of Industry 4.0, and provide guidance on transforming organizational learning into tangible benefits.

First of all, the implementation of Industry 4.0 requires the support of the management, which encourages employees to seek new solutions to problems and engage in innovative behaviour, including the use of Industry 4.0. Second, the common knowledge framework developed in the organization results in the development of a common meaning, consistent interpretation of and behaviour towards problems encountered by the organization. This meaning results from a number of arrangements generally accepted by the employees. Third, working in teams and employees' cooperation in problem solving accelerate decision-making processes and facilitate learning and implementing innovations. Fourth, a flat organizational structure speeds up the flow of information, contributes to the independence of employees, and increases the chances of employees' participation in discussions on Industry 4.0 and in making decisions.

The above analyses and research present certain limitations, due primarily to the limitations of the systematic literature review methodology. Only English-language publications from a single international database were used in the study, while post-conference materials were not taken into account. Moreover, the proposed model has yet to be validated and, for the time being, remains a purely theoretical framework. Nevertheless, the analyses and considerations, along with the proposed model, can be a starting point for further analyses of the importance of organizational learning for Industry 4.0.

This project was financed from the funds provided by the National Science Centre, Poland awarded on the basis of decision number DEC-2016/21/D/HS4/01791.

References

Argote, L. (2011). Organizational learning research: Past, present and future. *Management Learning*, *42*(4), 439–446.

Brousell, D.R., Moad, J.R., & Tate, P. (2014). The Next Industrial Revolution: How the Internet of Things and Embedded, Connected, Intelligent Devices will Transform Manufacturing. *Frost & Sullivan, A Manufacturing Leadership White Paper*. Retrieved from: https://www.allegient.com/wp-content/uploads/FS_Industrial_revolution.pdf.

Chen, G. (2005). Management practices and tools for enhancing organizational learning capability. *SAM Advanced Management Journal*, 1.

Crossan, M.M. (2007). Organizational learning. In: S.R. Clegg, J.R. Bailey (eds.), *International Encyclopedia of Organization Studies*. London: Sage.

Crossan, M.M., Lane, H., & White, R. (1999). An organizational learning framework: from intuition to institution. *Academy of Management Review*, *3*(24).

 DOI 10.7172/1644-9584.82.4

Del Giudice, M., & Della Peruta, M.R. (2016). The impact of IT-based knowledge management systems on internal venturing and innovation: a structural equation modelling approach to corporate performance. *Journal of Knowledge Management*, *20*(3).
Ediz, C. (2018). Evaluation of Industry 4.0 from a Knowledge Management Perspective. *International Congress on Politic, Economic and Social Studies*, 4.
Huber, G.P. (1991). Organizational learning: the contributing processes and the literatures. *Organization Science*, *2*(1).
Ibarra, D., Jaione, G., & Igartua, J.I. (2018). Business model innovation through Industry 4.0: A review. *Procedia Manufacturing*, 22.
Jeyaraj, A., Rottman, J.W., & Lacity, M.C. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. *Journal of Information Technology*, 21.
Jones, O., & Macpherson, A. (2006). Inter-organizational learning and strategic renewal in SMEs: extending the 4I framework. *Long Range Planning*, *39*(2).
Karaosman, H., Morales-Alonso, G., Brun, A., & Rosen, M.A. (2017). From a systematic literature review to a classification framework: Sustainability integration in fashion operations. *Sustainability*, 9.
Khedhaouria, A., & Jamal, A. (2015). Sourcing knowledge for innovation: knowledge reuse and creation in project teams. *Journal of Knowledge Management*, *19*(5).
Koberg, C.S., Detienne, D.R., & Heppard, K.A. (2003). An empirical test of environmental, organizational, and process factors affecting incremental and radical innovation. *Journal of High Technology Management Research*, 14.
Kovacs, G., & Kot, S. (2016). New Logistics and Production Trends as the Effect of Global Economy Changes. *Polish Journal Management Studies*, 14.
Lasi, H., Fettke, P., Feld, T., & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*, *4*(6).
Lee, J. (2013). Industry 4.0 in Big Data Environment. *German Harting Magazine, Technology Newsletter*, 26.
Macaulay, J., Buckalew, L., & Chung, G. (2015). *Internet of Things In Logistics*. Germany: DHL Customer Solutions & Innovation.
Maden, C. (2012). Transforming public organizations into learning organizations: a conceptual model. *Public Organization Review*, *12*(1).
Matlay, H. (2000). Organisational learning in small learning organisations. *Education + Training*, *42*(4/5).
Nov, O., & Ye, C. (2008). *Personality and Technology Acceptance: Personal Innovativeness in IT, Openness and Resistance to Change*. Proceedings of the 41st Annual Hawaii International Conference on System Sciences. HICSS.
Pan, M., Sikorski, J., Kastner, C.A., Akroyd, J., Mosbach, S., Lau, R., & Kraft, M. (2015). Applying Industry 4.0 to the Jurong Island Eco-industrial Park. *Energy Procedia*, 75.
Phipps, R., & Simmons, C. (2017). *Understanding Customers*. Oxford: Butterworth Heinemann.
Rokita, J. (2005). *Zarządzanie strategiczne. Tworzenie i utrzymywanie przewagi konkurencyjnej*. Warszawa: PWE.
Saban, K., Lanasa, J., Lackman, C., & Peace, G. (2000). Organizational learning: A critical component to new product development. *Journal of Product & Brand Management*, *9*(2).
Salim, I.M., & Sulaiman, M.B. (2011). Impact of organizational innovation on firm performance: Evidence from Malaysian-based ICT companies. *Business and Management Review*, (5).
Sanders, A., Elangewaran, C., & Wulfsberg, J. (2016). Industry 4.0 Implies Lean Manufacturing: Research Activities in Industry 4.0 Function as Enablers for Lean Manufacturing. *Journal of Industrial Engineering and Management*, *9*(3).

Schulze, A., Schmitt, P., Heinzen, M., Mayrl, P., Heller, D., & Boutellier, R. (2013). Exploring the 4I framework of organisational learning in product development: value stream mapping as a facilitator. *International Journal of Computer Integrated Manufacturing*, *26*(12).

Shamim, S., Cang, S., Yu, H., & Li, Y. (2016). *Management approaches for Industry 4.0: A human resource management perspective*. IEEE Congress on Evolutionary Computation.

Shamim, S., Cang, S., Yu, H., & Li, Y. (2017). Examining the Feasibilities of Industry 4.0 for the Hospitality Sector with the Lens of Management Practice. *Energies*, 10.

Soto-Acosta, P., Colomo-Palacios, R. & Popa, S. (2014). Web knowledge sharing and its effect on innovation: An empirical investigation in SMEs. *Knowledge Management Research & Practice*, *12*(1).

Stevens, E., & Dimitriadis, S. (2004). New service development through the lens of organisational learning: Evidence from longitudinal case studies. *Journal of Business Research*, *57*(10).

Sun, P.Y.T., & Anderson, M.H. (2010). An examination of the relationship between absorptive capacity and organizational learning, and a proposed integration. *International Journal of Management Reviews*, *2*(12).

Trantopoulos, K., von Krogh, G., Wallin, M. W., & Woerter, M. (2017). External Knowledge and Information Technology: Implications for Process Innovation Performance. *MIS Quarterly*, *41*(1).

Vera, D., & Crossan, M.M. (2004). Strategic leadership and organizational learning. *Academy of Management Review*, 29.

Vowles, N., Thirkell, P., & Sinha, A. (2011). Different determinants at different times: B2B adoption of a radical innovation. *Journal of Business Research*, *64*(11).

 DOI 10.7172/1644-9584.82.4