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Monika Inków
University of Zielona Góra
e-mail:m.inkow@wez.uz.zgora.pl
ORCID: 0000-0002-3179-9404

MEASURING INNOVATION MATURITY – LITERATURE REVIEW ON INNOVATION MATURITY MODELS

POMIAR DOJRZAŁOŚCI INNOWACYJNEJ – PRZEGLĄD LITERATURY DOTYCZĄCEJ MODELI DOJRZAŁOŚCI INNOWACYJNEJ

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Summary: In recent years it has noticed that innovation and innovativeness have become the basis for the success of not only individual business entities but entire regions and economies. What is more, there have been opinions in the literature that individual innovations are no longer a guarantee of survival for an organization, but such a guarantee is rather the capacity for continuous innovation. Therefore the organization's ability to transform resources in favour of the organization – the innovation capability – is decisive, while the ability to use resources appropriately, including innovation capabilities, is referred to as innovation maturity. In this article the author decided to introduce the essence of innovation maturity models as a tool for measuring innovation maturity. These models are a tool for assessing the level of innovation maturity of an organization. It is worth adding that maturity models originate from the Capability Maturity Model developed by the Software Engineering Institute.

Keywords: innovation capability, innovation maturity, innovation maturity models.

Streszczenie: W ostatnich latach autorzy zauważyli, że innowacje i innowacyjność stały się podstawą sukcesu nie tylko pojedynczych podmiotów gospodarczych, ale całych regionów czy gospodarek. Co więcej, w literaturze pojawiły się głosy, że pojedyncze innowacje nie są już gwarancją przetrwania organizacji, jest nią raczej zdolność do wprowadzania innowacji w sposób ciągły. Decydujące znaczenie ma zatem zdolność organizacji do przekształcania zasobów na korzyść organizacji – zdolność innowacyjna, natomiast umiejętność odpowiedniego wykorzystania zasobów, w tym zdolności innowacyjnych, określana jest mianem dojrzałości innowacyjnej. W niniejszym artykule autorka postanowiła przybliżyć istotę modeli dojrzałości innowacyjnej będących narzędziem oceny poziomu dojrzałości innowacyjnej organizacji, biorących początek od *Capability Maturity Model*, który został opracowany przez Software Engineering Institute.

Słowa kluczowe: zdolność innowacyjna, dojrzałość innowacyjna, modele dojrzałości innowacyjnej.

1. Introduction

In recent years, scholars have noticed that innovation and innovativeness have become the basis for the success of business entities, as well as for regions and entire economies. It is worth adding that more and more authors point out that the survival of organizations in present times does not depend on single innovations, but rather on the ability to innovate continuously (e.g. Saunila, 2016; Blommerde and Lynch, 2016).

Teece's theory of dynamic capabilities is an extension of the resource-based view and an attempt to answer the question of how enterprises can achieve competitive advantage operating in a changing environment (Teece, Pisano, and Shuen, 1997; Teece, 2007; Stawasz, 2014).

In light of the assumptions of the dynamic capabilities concept, internal resources and competencies are insufficient to achieve a competitive advantage. They only create the innovative potential necessary to create innovative solutions (Brzeziński, 2001; Stanisławski, 2013). This potential affects the innovation capability, but it is not the only factor influencing innovative changes introduced in organizations. The ability to transform resources is decisive for the creation of innovation, because the dynamic development of the environment requires the organization's ability to adapt to the changing conditions, including market opportunities and technologies (e.g. Stawasz, 2012, 2014; Stanisławski, 2013; Borch and Madsen, 2007, Liao, Kickul, and Ha, 2009; Batko, 2017).

Innovation capability thus influences the innovative results of the organization as well as its competitive advantage, but this relation is the result of the development of dynamic capabilities (Wang, Ahmed, 2007; Zhang, Garrett-Jones, and Szeto, 2013). In addition, it is worth noting that without sufficiently high dynamic capabilities, the organization may encounter difficulties when developing new innovative solutions (e.g. Stawasz, 2014; Stanisławski, 2013; Zahra and George, 2002), and thus find it difficult to achieve a higher level of innovative maturity, which is measured by innovation maturity models.

The purpose of this article is to present the essence of the innovation maturity models which are used as a tool to measure of the innovation maturity of organizations.

2. Innovation capability and the innovation maturity of enterprises

An organization's innovation capability is currently of interest to an increasing number of researchers (e.g. Lawson and Samson, 2001; Patalas-Maliszewska and Kłos, 2013; Stawasz, 2014; Breznik and Luhovnik, 2014), and it is defined, for example, as "the ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders"(Lawson and Samson, 2001, p. 384), as "the potential of an organisation to innovate (Neely, Filippini, Forza, Vinelli and Hii, 2001; O'Connor and Ayers, 2005), as "the assembling of the

‘right ingredients’ for innovation in an organisation” (Hamel, 2006), as ”a highly integrated ability to shape and manage multilateral skills and resources” (Stawasz, 2014, p. 99), or as ”the ability to formulate and implement innovation strategies and it is associated with the capability to create, enlarge and modify resources employed for innovation in order to develop new products, services, processes and/or markets” (Dodgson, Gann, and Salter, 2008). It is worth noting that, according to many authors, having high innovation capability is an important source of company performance (e.g. Calantoe Cavusgill, and Zhao, 2002; Tsai and Tsai, 2010; Chow and Gong, 2010; Aziz and Omar, 2013), innovation performance (e.g. Mir, Casadesus, and Petnji, 2016) and the opportunity to achieve a competitive advantage (e.g. Guan and Ma, 2003; Basterretxea and Martinez, 2012; Zaleśna, 2013; Żołnierski, 2005).

It should be noted that innovation capacity is particularly important for enterprises operating in an environment of rapid change (Teece, Pisano, Shuen, 1997; Eisenhardt and Martin, 2000; Breznik and Lahovnik, 2014), in particular in such an environment in which companies from the IT industry operate. Birchall and Tovstiga (2005) even believe that innovation capability is the most important capability that enterprises have, which Schumpeter has already written about, recognizing the value of continuous innovation (Schumpeter, 1934). The research carried out by Breznik and Lahovnik (2014) is also worth mentioning; these authors distinguished six dynamic capabilities, (managerial capability; marketing capability; technological capability; R&D capability; innovation capability; and human resources capability), which contribute to achieving a competitive advantage by IT companies, indicating innovation capability as the key one, defining it as the strategic strength of IT companies (Breznik and Lahovnik, 2014).

The ability to properly use existing resources, including dynamic innovation capabilities (Lachniewicz, Łuczka, and Stawasz, 2010, p. 6; Gajdzik, 2012; Niedzielski, 2005; Corsic and Neau, 2015), recognized by researchers as a key element in the development of innovation (Lawson and Samson, 2001; Hogan, Soutar, McColl-Kennedy, Sweeney, 2011; Zaleśna, 2013; Pomykalski, 2001, Patalas-Maliszewska and Kłos, 2013, Hurmelinna-Laukkanen Sainio, and Jauhiainen, 2008) is referred to as innovation maturity. Therefore it can be concluded that the innovation maturity of an organization can be perceived through the prism of its dynamic capabilities, including dynamic innovation capability. An organization’s greater dynamic innovation capability is reflected in the growing number of innovative solutions presented in response to changes in the organization’s environment, leading to an increase in the level of innovation maturity of that organization (Stawasz, 2012; Stanisławski, 2013).

However, innovation maturity models derived from dynamic capability maturity models can be used to measure the level of innovation maturity (e.g. Wendler, 2012; Esterhuizen, Schutte, and du Toit, 2011). Researchers express a growing interest in these models (e.g. Corsic and Neau, 2015; Esterhuizen et al. 2011; Mirkowska, 2010).

Innovation maturity models allow to assess the level of innovation maturity of an organization, and they also indicate in which areas it is worth making changes

so that the organization can achieve a higher level of innovation maturity and a competitive advantage.

3. Innovation maturity models

As Wendler (2012) notes, maturity models are used to "define a set of levels or stages, describing the development of the examined object in a simplified way. These stages should be sequential in nature and represent a hierarchical progression. Furthermore, they should be closely connected to organizational structures and activities […] stages or levels which measure the completeness of the analysed objects via different sets of (multi-dimensional) criteria" (Wendler, 2012, p. 1319). The CMM model developed in 1986 by the Software Engineering Institute is seen as the source of maturity models. Researchers wanting to develop a framework for assessing the maturity levels of software processes have developed the so-called Capability Maturity Model (CMM) (Paulk, Curtis, Chrissis, and Weber, 1993).

It is worth mentioning that currently maturity models are gaining more and more attention in many areas (Röglinger, Pöppelbuß, Becker, 2012), for example: inventory management (Niemi, Huiskonen, and Karkkainen, 2009), supply chain management (Lockamy and McCormack, 2004), new product development (NPD) (Fraser, Moultrie, and Gregory, 2002), R&D projects (Berg, Leinonen, Leivo, and Pihlajamaa, 2002), project management (Cooke-Davies and Arzymano, 2003; Ibbs, and Kwak 2002) quality management (Morsal, Ismail, and Osman, 2009) industrial maintenance (Macchi and Fumagalli, 2013), product development (Farrukh, Fraser, and Gregory, 2003), logistics (Battista and Schiraldi, 2013), collaboration (Campos, Chalmeta, Grangel, and Poler, 2013), environmental concerns (Ormazábal and Sarriegi, 2013), and finally innovation capability (Table 1). Table 1 presents the results of a systematic literature review on the existing models of innovation maturity.

Table 1. Identified innovation maturity models

Author	Model name	Model characteristics
1	2	3
Tata Consultancy Services Ltd Narayana, 2005	The Innovation Maturity Model	This model highlights the maturity levels based on the Capability Maturity Model.
PRTM, 2007	PRTM Innovation Maturity Model	The model consists of four levels of innovation maturity that have not been named, where each level of the model is characterized by a set of representative management practices in four areas (vision and strategy, insights, management, organization).
Essmann, 2009	Innovation Capability Maturity Model	The model consists of a total of five levels of maturity, 1, 3 and 5 and two intermediate levels between them, i.e. between 1 and 3 and 3 and 5. The distinguished maturity levels are:

Table 1, cont.

1	2	3
		1) *Ad hoc* and limited. 3) Formalization and predictability. 5) Integration, synergy and autonomy. It is a three-dimensional model, covering elements from the following areas: innovation maturity, organisational construct and innovation capability construct.
Think for a Change, 2009	IM2-Innovation Maturity Model	This model has six levels of innovation maturity: Innovation deficient, Innovation Structure, Innovation processes, Innovation standards, Innovation optimized, Continuous innovation. The following items of analysing were also highlighted: culture, leadership, people, processes, tools and techniques, training, services, capturing ideas, managing ideas, strategic planning and metrics.
OVO, 2010	Innovation Maturity Model	Four levels of innovative maturity have been distinguished in the model: novice, apprentice, journeyman, master, and five areas in which the analysis is carried out: strategy, people, methods, founding, measures.
INPAQT, 2010	INPAQT Innovation Capability Maturity Model	Five levels of innovative maturity were distinguished: creativity, collaborative customer centered, business case-driven, integrated innovation management, co-innovation. In addition, each of the levels has been assigned the areas of analysis: level 1) opportunity analysis, idea generation, idea management, level 2) stakeholder analysis, value proposition, competence group analysis, level 3) risk analysis, cost-benefit analysis, business case, level 4) portfolio management, road-mapping, business strategy, level 5) entrepreneurial innovation, strategic alliance management, supply chain management.
Praveen Grupta Accelper Consulting, 2010	Business Innovation Maturity Model (BIMM)	This model includes five levels of innovation maturity: sporadic innovations, idea innovations, managed innovations, nurtured innovations, sustained innovations.
Howard, 2010	Excellence in Innovation Framework (EiI)	The model has five levels of maturity: commitment, putting a process in place, monitoring activity, SMART goals and improving performance, and continuously improving performance and seven areas of analysis: collaboration, environment, finance, knowledge, senior management, risk, and staff.
Funchall, Herselman and Greunen, 2011	People innovation capability maturity model	The model distinguishes five levels of maturity, which are: random, emerging, specified, measurable, aligned and three areas of analysis: people, innovation and capability.

1	2	3
Müller--Prothmann, Stein, 2011	I²MM – Integrated Innovation Maturity Model	The model consists of five levels of maturity. The following process areas are analysed: Quality Management, Ideation and Product Development, Requirements Engineering, Innovation Management.
Enkell, Bell, Hogenkamp, 2011	Open Innovation Maturity Framework	The model consists of three elements: climate for innovation, partnership capacity, internal processes and five levels of maturity: initial / arbitrary, repeatable, defined, management, optimization and the following stages.
Zaleśna, 2013	Maturation model for innovation management	The model consists of five stages. 1. A non-innovative company, not thinking about new products. 2. Awareness of the need for change. Interest in innovation. No planned activities. 3. Openness of owners to innovation. Brainstorming and other creativity techniques. Seeing clients as a source of ideas. 4. First innovative projects. Cooperation with external organizations. Learning to be an innovative company. 5. A mature innovative company. Many innovative projects. A continuous stream of innovation.
Mudholkar, 2014	A Supply Chain Innovation Maturity Model	There are three levels of maturity: reactive, structured, control and continuous improving.
Corsic, Neau, 2015	Innovation Capability Maturity Model	The authors distinguished five levels of innovative maturity.
Raffai, Szikszai, 2015	Innovation Capability Maturity Model	There are five levels of maturity that have not been named and five areas of analysis, which are: market knowledge, training, managing possibilities, guest orientation, rationality.
Hüsig, 2015	Computer Aided Innovation Maturity Model	Five stages were distinguished: standard IT tools; focused CAI tools, Integrated CAI systems, Enterprise CAI and Open CAI 2.0 ; Holistic CAI 2.0. solutions.
Cukier, Kon and Lyons, 2016	Startup Ecosystem Maturity Model	The authors distinguished in this model four levels of maturity: nascent, evolving, mature, self-sustainable and eight areas of analysis: exit strategies, entrepreneurship in universities, angel funding, culture values for entrepreneurship, specialized media, ecosystem data and research, ecosystem generations, events.
Stahl, Obach, Yaghmaei, Ikonen, Chatfield and Brem, 2017	Responsible Research and Innovation (RRI) Maturity Model	In this model five levels of maturity were distinguished, which are: unaware, exploratory/reactive, defined, proactive, strategic and three areas of analysis: purpose (motivation), process (activities undertaken), product (outcomes).

Table 1, cont.

1	2	3
Arends, 2018	Firm-level Innovation Capability Maturity Model	This model distinguished five levels of maturity, which are: ad-hoc, low, intermediate, high, excellent and six areas of analysis: vision and strategy, value network, process and governance results and feedback, resources, culture.
Bessiti, 2018	Innovation Maturity Matrix	There are five levels of maturity, which are: awareness, defined, limited, manager, sustained and three areas of analysis: knowledge scale, actor scale, context scale.
Demir, 2018	Strategic Management Maturity Model for Continuous Innovation	There are six levels of maturity: undefined, initial, planned, performer, optimized, excellent and seven areas of analysis: leadership, planning and executing, process and tools, structure and model, people and culture, performance management, innovation.
Planview	Innovation Management Maturity Model	The model is based on five maturity levels and four dimensions: strategy, people, processes, and tools.
PDMA, Tim Foundation	The Innovation Maturity Model	The model includes five levels of maturity: investigation, implementation, ability, efficiency, perfection.
IRDG	Innovation Capability Maturity Model (ICMM)	This model differentiates between the five levels of innovation maturity which are: seeding, championing, managing, strategizing, and venturing.
Gartner Group	Maturity Model for Innovation Management	The model distinguishes five levels of maturity and six dimensions of innovation management. Maturity levels: Reactive Level, Active Level, Defined Level, Performing Level, Pervasive Level, Dimensions of Innovation Management: Strategy and Intent, Processes and Practices, Culture and People, Organization and Infrastructure, Partnerships and Open Innovation, Innovating How We Innovate.
BERG Consulting	The Innovation Maturity Model	The model consists of five levels of maturity: innovative practices at the entry level, emerging innovative practices, coordinated practices in the field of innovation, innovation, innovation in industry
KPMG	Innovation Maturity Model	The model distinguishes five levels of innovative maturity: a non-innovative company, a low-innovation company, a novice innovator, an experienced innovator, an innovation leader. The model analyzes areas such as innovation activity, comprehensive investment activity, market and economic effects, and the scale of innovative activity.

Source: own elaboration.

Analysing the data contained in Table 1, it can be seen that the vast majority of the presented models of innovation maturity are models covering five levels of maturity. Two of the presented models are six-level models, and three of them are four-level models, while one of them includes three levels of innovation maturity. In all the models listed in Table 1, the authors pointed to different levels of innovation maturity, from the lowest to the highest ones. The lowest level was generally characterized by the lack of any innovation activity (e.g. Zaleśna, 2013; Essmann, 2009; Williams, 2010), while the highest level was based on the continuous improvement and management of innovation processes (e.g. Zaleśna, 2013; Esterhuizen et al., 2011; KPMG 2014), i.e. the included companies were often referred to as "innovation leaders". The maturity models mentioned above can be indicated as a some kind of maps used to assess the innovation capacity of organizations, including those operating in the IT industry. The basic idea of the presented models is that a higher level of maturity indicates the increased possibilities of managing innovation capacity (Rapaccini, Saccani, Pezzotta, Burger, and Ganz, 2013). Moreover, these models, being a multi-criteria assessment of innovation maturity, also indicate in which areas the organization should make changes in order to be able to move to a higher level of maturity.

4. Conclusion

The literature analysis allowed the author to identify twenty-seven existing models of innovative maturity. Analysing these models, it was noticeable that the models of the organization's maturity are tools that present the theory of how the organization's innovative capability is gradually evolving along a predicted, desirable or logical path. Therefore, as noted by Röglinger et al. (2012, p. 4) these models are called stage models, growth stage models, or stage theory.

The main goal of innovation maturity models is to outline maturity paths that include the features of each stage of maturity as well as the logical relationships between them. However, when talking about the purposes of the organization's use of maturity models, including innovative maturity models, it is worth mentioning the three basic goals distinguished in the literature, which are: descriptive, prescriptive and comparative (Röglinger, Pöppelbuß, and Becker, 2012). Innovation maturity models serve a descriptive purpose when they can be used to describe current activities. The prescriptive goal is realized when the model provides information on how the organization can achieve the future desired levels of maturity, and also if it shows what improvement measures to implement in order to achieve the desired higher level of innovative maturity. The last of the mentioned goals of using innovative maturity models – the comparative goal – gives the organization the possibility of external or internal comparisons.

It is also worth noting that organizations that are looking for a suitable model of innovative maturity should be aware of the purpose for which they want to apply

this model. In the case of descriptive application, it seems that most of the existing models of innovation maturity are able to provide information regarding the diagnosis of the organization of its processes in terms of innovation, while referring to the prescriptive aim it is worth noting that not all of the innovation maturity models give specific guidance as to what the organization should do to move to a higher level of innovation maturity.

Summing up the above considerations, it can be said that innovation maturity models are a tool to assess the current state of an organization. By specifying the exact level of innovation maturity of the organization being studied, they also allow to determine the goals that can be achieved in the future by defining priority actions, as well as identifying ways of their implementation and the necessary resources. Therefore it can be concluded that, in addition to identifying the current state of the organization, innovation maturity models also indicate what the organization should do to increase the level of its innovation maturity.

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