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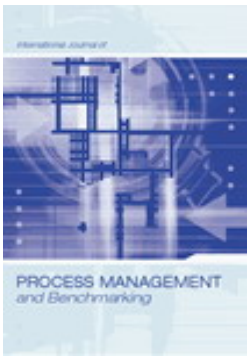

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Scenario building and measurement of the business process maturity using fuzzy cognitive mapping technique: a case study in SAIPA company

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Abstract: One of the current concerns of managers is to develop the business process maturity and identify the conditions for improving the pertaining processes. This eventuates in increased customers, reduced costs along with mechanised business processes. In this regard, this paper unveils a two-stage approach to develop the maturity of business process management exploiting the fuzzy cognitive mapping technique. In the first stage, a systematic review of the relevant literature is carried out. The output of this stage encompasses the maturity levels, factors and indicators of the concerned business process model. Applying the fuzzy cognitive mapping technique, the second stage obtains macro causes and effects, in which, the dimensions of maturity and related relationships are identified to render the possibility of scenario building for the development of business process maturity. In a bid to validate and verify the proposed approach, a real case study is conducted, via which important insights are derived.

Keywords: business process maturity model; fuzzy cognitive map; scenario planning.

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1 Introduction

The rapid changes of the last two decades in technology, and especially the increasing role of information technology and computer systems in the fields of business process management knowledge, have led to changes in the way of management and leadership of the organisation. In this manner, managing organisations with the old ways and structures, dating back to the early twentieth century, has become almost impossible (Fahland, 2019; Vom Brocke and Mendling, 2018; Roeglinger et al., 2012). Speaking intuitively, organisations must prepare themselves to keep up with new information systems. E-commerce, integrated information systems, supply chain management of goods and services and customer relationship management have a prevalent management chapter. The basis of success of all these systems is based on the process perspective and their level of maturity (ABPMP, 2019).

Rapid changes in technology within last two decades and specially development of information and technology in the field of business process management, has completely transformed organisation's management and leadership style and abolished traditional management methods (Winter et al., 2020; Kerzner, 2019; Haddar et al., 2014). Broadly speaking, the maturity of business processes is a process, in which the outstanding tasks and processes of the business are equipped and reconstructed in accordance with new tools and technologies (Van Looy et al., 2013). In a more general view, it can be said that the development of business process maturity is based on new and advanced electronic technologies. This eventuates in increased customers, reduced costs, along with mechanised business processes (Erasmus et al., 2018; vom Brocke and Rosemann, 2015). In the last decade, the number of business process management maturity models has

increased dramatically. Nonetheless, there are still challenges in this area. For example, empirical studies on validation are limited to these models. There are also few guides, through which maturity models can be used as a roadmap, preventing the widespread use of maturity models in business process management (Weber et al., 2017; Tarhan et al., 2016). A systematic review of the literature on business process management maturity, conducted in 2016, evinces that despite the large number of business process maturity models presented in the last decade, there is little empirical evidence that illustrate the validity and usefulness of the mentioned models (Werner-Lewandowska and Kosacka-Olejnik, 2018; Hogrebe and Nüttgens, 2009). However, the current state of research on the maturity of business process management is in its infancy stages, and the academic literature has no structured applications. Accordingly, future research can cover the following subjects:

1 more and stronger emphasis of maturity models on prescription characteristics

2 conducting experimental studies to illustrate the validity and effectiveness of maturity models (Tarhan et al., 2016).

In view of the preceding discussions, this paper proposes a two-stage approach for a prescriptive model to develop the maturity of business process management by the use of the fuzzy cognitive mapping (FCM) technique. The first stage investigates the results of a systematic review of the literature. In this stage, the levels of maturity and all the factors and indicators of the conceptual model dedicated to maturity of business process management are specified. This is capable of identifying the maturity levels and all the factors and indicators of the conceptual model dedicated to the maturity of business process management. The second stage achieves macro causes and effects applying the FCM technique. In this stage, the dimensions of maturity and related relationships are identified in order to provide the possibility of scenario building for the development of maturity. Lastly, to validate and verify the proposed approach, a real case study in SAIPA Company is conducted, via which important insights are gained.

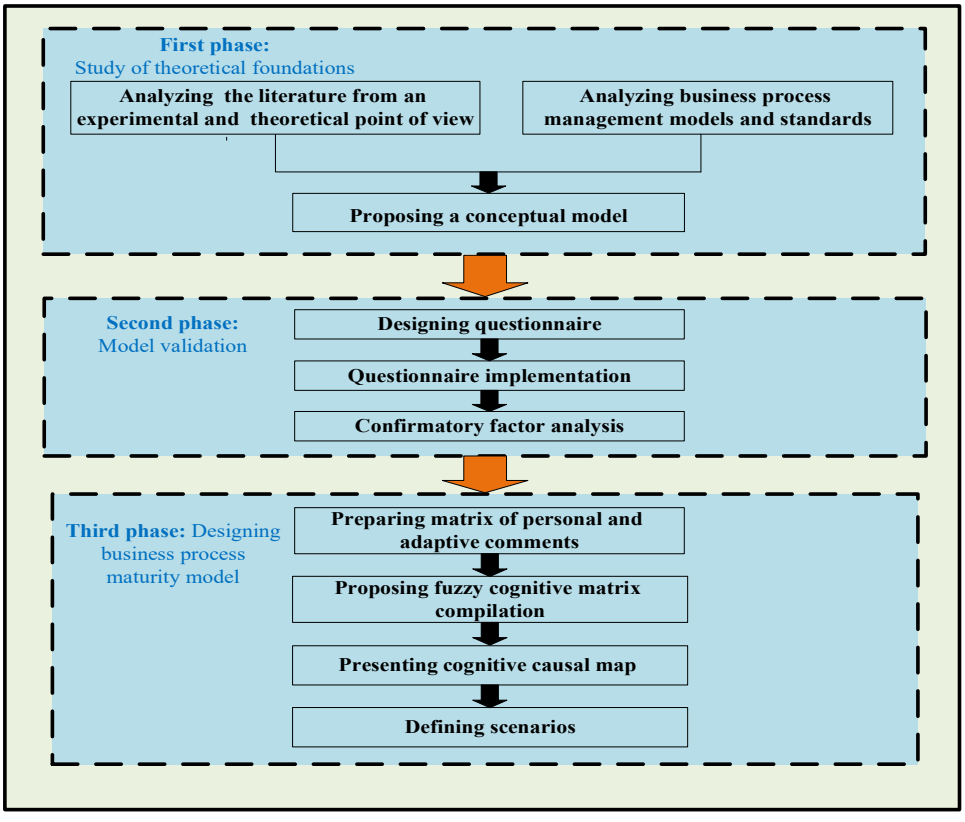
The remainder of this paper is structured as follows. The methodology of the paper is explained in Section 2. Section 3 presents the relevant literature review. Section 4 elaborates the concept of fuzzy cognitive map method. The analyses of the proposed approach are provided in Section 5. Finally, Section 6 concludes the paper.

2 Research methodology

The methodology implemented in the paper is vindicated in Figure 1. In the first phase, the theoretical foundation is proposed by analysing the literature from experimental and theoretical points of view as well as analysing business process management models. Afterwards, based on the obtained results, the conceptual model is devised. More precisely, 33 concepts or indicators in the business maturity model are derived from literature, which belong to four levels, including managed, standardised, predictable and innovative levels. Afterwards, the designed questionnaires are first filled out by experts to evaluate the results obtained from the literature. Then, the method of confirmatory factor

is used to investigate and analyse the experts' opinions. In the next phase, the business process maturity model is designed by applying the FCM technique in order to provide the scenarios. Finally, the validation and usefulness of the concerned business process maturity are discussed by conducting a real case study in SAIPA Company.

Figure 1 Research methodology (see online version for colours)



3 Literature

Many organisations have realised the importance of business processes in the quality of their products and services. However, business process management is yet difficult to exploit in view of the fact that the extensive variety of related subjects such as business process reengineering, process innovation, business process modelling, workflow management and automation. Likewise, a business process requires collaboration and information exchange between different business fields of organisation (Mendling et al., 2018; Van der Aalst et al., 2017; vom Brocke and Rosemann, 2015). Thus, the main question is how different organisations must develop their business processes. The first answer to this question is to know at what level of maturity is the organisation of business process management (Vom Brocke and Mendling, 2018; Rosemann and De Bruin, 2005b).

Capability maturity model integration in the field of software engineering emerged in the beginning of 1990, utilised as a tool to improve software development capabilities. After that, it is employed in hundreds of companies around the world. In the last decade, researchers and practitioners of business process management field developed models with deeper and more extensive maturity models (Hausladen and Schosser, 2020; Larsson, 2006; Roeglinger et al., 2012).

Despite extensive domain and number of promising achievements of accessible maturity models, maturity models are not extensively accepted in practice. Only one part of the research existing in the literature is tested in practice and its benefits are delineated (Combi et al., 2018; Roeglinger et al., 2012). Moreover, recent surveying researches demonstrate a considerable decreasing trend towards this subject (Wolf and Harmon, 2014; Dahlin, 2020).

Poeppelbuss et al. (2011) reviewed 76 articles related to the maturity models published in information systems journals conferences. The authors conducted the research on the features of prescriptive maturity models and realised that theories related to design and adoptions of maturity models are so rare. In a systematic review on maturity models with more extensive domains, by analysing 237 articles between years 1999 and 2010, Wendler (2012) pointed out that research on maturity models is under control of software engineering field. The concept of a multi-criteria model of process maturity assessment was considered by Sliż (2018), where the degree of implementation of process solutions was evaluated. However, accrediting them may not have much of a solid foundation. In other studies, researchers have exploited two models of business process management maturity (Rosemann and Bruin, 2005a; Hogrebe and Nüttgens, 2009; Gronau et al., 2010) Misra et al. (2006) devised a model for organisations, via which they can systematically mature their innovation activities. Likewise, they provided a roadmap to implement the proposed model.

Usoff and Davis (2007) proposed an innovative, transdisciplinary approach to design a business process course. Their approach was able to make significant improvements where applied. Poeppelbuss et al. (2011) proposed a good framework of general design principles through the existing subject literature and illustrated that how a structure for using a set of maturity models work in the field of business process management. Roeglinger et al. (2012) provided an analysis of business process maturity models with focus on their applications regarding general design principle. Accordingly, such models only address primary design principles and some principles for prescriptive goals. Regarding the development of comparative criteria of maturity models, Van Looy et al. (2013) showed a lack of comprehensible definition of puberty models and discrepancies in the scope, terminology, and design of puberty models. With the aim of making the business process maturity models as practical as possible, Felch and Asdecker (2020) proposed a literature review to address a set of criteria to increases their reproducibility and replicability.

Following the past studies, authors added more design elements to the comparative structure using content analysis of 69 maturity models. In addition, 14 elements are appended to the questionnaire to help members of process field for finding better maturity model. The book written by Van Looy et al. (2013) also provided a comprehensive understanding of the framework and 69 models of maturity. Nevertheless, the authors did not propose a systematic roadmap to provide a correct understanding on development of the of maturity model process (Makni et al., 2018; Tarhan et al., 2016).

In order to acquire the concepts and factors affecting on the maturity of business process management, in the present study, articles related to the research topic are collected and reviewed from reputable scientific sources and databases using an in-depth library study. Therefore, out of 147 articles studied, 62 articles related to the research topic are selected and used as a basis for developing a conceptual model. After examining the selected articles, the most important models of process maturity are obtained according to Table 1.

Table 1 The most important models of business process management maturity

Maturity model title	*Reference*	*Maturity model title*	*Reference*
Business process management capability framework (BPM-CF)	Rosemann and Bruin (2005a) and De Bruin and Doebeli (2015)	Process safety degree	Dombrowski and Brinkop (2011)
Business process maturity model (BPMM-FIS)	Fisher (2004)	PMC – process maturity continuum	Gardner (2001) and Fahland (2019)
Business process maturity model (BPMM-HR)	Harmon (2004) and Combi et al. (2018)	Maturity model for knowledge-intensive business processes	Sinha et al. (2011)
Business process maturity model (BPMM-OMG)	OMG (2008)	BPMM – business process maturity model	Jadhav and Sapre (2009)
Business process orientation maturity framework (BPO-MF)	Willaert et al. (2007)	Maturity estimation model	Kangilaski et al. (2013)
Business process orientation maturity model (BPO-MM)	McCormack and Johnson (2001)	Model for business process maturity assessment	Moradi-Moghadam et al. (2013)
(Process and enterprise maturity model (PEMM)	Hammer (2007)	Business maturity assessment model	Paunescu (2009) and Erasmus et al. (2018)
Process management maturity assessment (PMMA)	Rohloff (2009)	Process management maturity (PMM) model	Saco (2008)
Value-based process maturity model (VPMM)	Lee et al. (2009)	Process-structure development model (PSDM)	Dimovski et al. (2006)
Process management maturity model (PMMM)	Cronemyr and Danielsson (2013)	Business process maturity model for public administration	Zwicker et al. (2010)

Maturity models of business process management have three dimensions, including levels, indicators and measuring tools. As given in Table 2, models usually divide their levels into five groups from maturity levels points of view.

In Table 3, 20 maturity models of Table 1 are examined in more detail and the most important indicators and factors related to each level of maturity are determined.

Table 2 Comparison of maturity models with respect to level perspective

McCormack and Johnson (2001)	*Rohloff (2009) and Winter et al. (2020)*	*Harmon (2004)*	*Lee et al. (2009)*	*Rosemann and Bruin (2005b)*	*Fisher (2004) and Di Francescomarino et al. (2018)*	*OMG (2008)*
Lacks generality	Introductory	Introductory	Introductory	Introductory	Silo	Primary
Defined	Managed	Managed	Managed	Repeatable	Tactical integrity	Managed
Communicated	Defined	Defined	Defined	Defined	Process orientation	Standardised
Integrated	Quantitative management	Quantitative management	Quantitative management	Managed	Optimal organisation	Predictable
-	Optimised	Optimised	Optimised	Optimised	Intelligent operating network	Innovative

Table 3 Components and concepts of business maturity models

Code	*Process management maturity level*	*Concept*	*References*
*C*1	Managed	Business process management leadership	Rosemann and Bruin (2005b), Hammer (2007), De Bruin and Doebeli (2015), Rohloff (2009), Lee et al. (2009), Dombrowski and Brinkop (2011), Shafiei and Hajiheydari (2014) and Winter et al. (2020)
*C*2		Organisational business governance	Dombrowski and Brinkop (2011), Shafiei and Hajiheydari (2014), Fisher (2004), Willaert et al. (2007), Cronemyr and Danielsson (2013), and Haarmann et al. (2018)
*C*3		Organisational department requirements documentation	Rosemann and Bruin (2005b), Hammer (2007), Dombrowski and Brinkop (2011), Shafiei and Hajiheydari (2014), Willaert et al. (2007), Cronemyr and Danielsson (2013), De Bruin and Doebeli (2015) and Moradi-Moghadam et al. (2013)
*C*4		Organisational department activity planning	McCormack and Johnson (2001), Harmon (2004), Rohloff (2009), Lee et al. (2009) and Winter et al. (2020)
*C*5		Organisational department performance monitoring and control	Rosemann and Bruin (2005b), Hammer (2007), Shafiei and Hajiheydari (2014), Cronemyr and Danielsson (2013), Fisher (2004), De Bruin and Doebeli (2015), Moradi-Moghadam et al. (2013), McCormack and Johnson (2001), Rohloff (2009) and Di Francescomarino et al. (2018)
*C*6		Organisational department performance and capabilities	Shafiei and Hajiheydari (2014), Cronemyr and Danielsson (2013), Moradi-Moghadam et al. (2013), McCormack and Johnson (2001), Harmon (2004), Rohloff (2009) and Lee et al. (2009)
*C*7		Sourcing management	Willaert et al. (2007), Rohloff (2009), Lee et al. (2009) and OMG (2008)
*C*8		Organisational department configuration management	Rohloff (2009), Lee et al. (2009), OMG (2008) and Winter et al. (2020)
*C*9		Product and service assurance	Cronemyr and Danielsson (2013) and OMG (2008)
*C*10		Data management	Hammer (2007)
*C*11	Standardised	Human resource management	Rosemann and Bruin (2005b), Willaert et al. (2007), Fisher (2004), De Bruin and Doebeli (2015), Moradi-Moghadam et al. (2013) and Di Francescomarino et al. (2018)
*C*12		Organisational process management	Hammer (2007), Shafiei and Hajiheydari (2014), Fisher (2004) and Moradi-Moghadam et al. (2013)
*C*13		Organisational competency advantages management	OMG (2008)

Table 3 Components and concepts of business maturity models (continued)

Code	*Process management maturity level*	*Concept*	*References*
*C*14	Standardised	Process resource management	Moradi-Moghadam et al. (2013), McCormack and Johnson (2001), Harmon (2004), Rohloff (2009) and Lee et al. (2009)
*C*15		Organisational configuration management	Rohloff (2009), Lee et al. (2009) and OMG (2008)
*C*16		Product and service marketing	McCormack and Johnson (2001), Rohloff (2009), Lee et al. (2009) and OMG (2008)
*C*17		Product and service development	McCormack and Johnson (2001), Rohloff (2009), Lee et al. (2009) and OMG (2008)
*C*18		Product and service implementation	Willaert et al. (2007), McCormack and Johnson (2001), Rohloff (2009), Lee et al. (2009) and OMG (2008)
*C*19		Product and service monitoring	Rosemann and Bruin (2005b), Dombrowski and Brinkop (2011), Fisher (2004) and De Bruin and Doebeli (2015)
*C*20		Product and service maintenance	Willaert et al. (2007), Rohloff (2009), Lee et al. (2009), OMG (2008) and McCormack and Johnson (2001)
*C*21		Information and communication technology management	Rosemann and Bruin (2005b), Dombrowski and Brinkop (2011), Fisher (2004), De Bruin and Doebeli (2015) and Di Francescomarino et al. (2018)
*C*22		Process-oriented culture	Rosemann and Bruin (2005b), Shafiei and Hajiheydari (2014) and De Bruin and Doebeli (2015)
*C*23	Predictable	Organisational knowledge and asset management	Rohloff (2009), Lee et al. (2009), OMG (2008) and Winter et al. (2020)
*C*24		Organisational performance and capability management	Moradi-Moghadam et al. (2013), McCormack and Johnson (2001), OMG (2008) and Cronemyr and Danielsson (2013)
*C*25		Integration of processes related to product and service	Hammer (2007), Rohloff (2009), Lee et al. (2009) and OMG (2008)
*C*26		Quantitative business process management	Hammer (2007), Harmon (2004), Rohloff (2009) and Lee et al. (2009)
*C*27		Process knowledge management	Hammer (2007), Dombrowski and Brinkop (2011), Willaert et al. (2007) and OMG (2008)
*C*28		Organisational commitment development	Hammer (2007), Dombrowski and Brinkop (2011) and Cronemyr and Danielsson (2013)

Table 3 Components and concepts of business maturity models (continued)

Code	*Process management maturity level*	*Concept*	*References*
*C*29	Innovative	Change management and organisation improvement	Cronemyr and Danielsson (2013), Rohloff (2009), Lee et al. (2009) and OMG (2008)
*C*30		Business performance adjustment	Willaert et al. (2007) and McCormack and Johnson (2001)
*C*31		Detect and crisis prevention management	OMG (2008)
*C*32		Organisational information system intelligence	Willaert et al. (2007), Rohloff (2009), Lee et al. (2009), Gardner (2001), Fahland (2019) and Winter et al. (2020)
*C*33		Organisational resilience management	Rohloff (2009), Lee et al. (2009) and Gardner (2001)

Given the obtained results, 33 concepts or indicators in the business maturity model are explicitly explained or repeated in the subject literature. The question now is how each of these factors affects each other and how it leads to the development of the level of management of business process management. This research aims to answer this question.

4 Fuzzy cognitive mapping

This section is intended to delineate the basic concept of the FCM method, deploying to design the business process maturity. This method was first proposed by Kosko (1986). FCM involves the experience and knowledge of employees, who are aware with respect to system operation and behaviour in different situations, and then provide hidden patterns of the subject (Papageorgiou, 2011). Experts determine the concepts, internal communications, and allocation of causal fuzzy weights to internal communications. However, the strength of the data depends on the number of available specialists. As a graphical structure, FCM includes conceptual nodes and weight arcs. In FCM, feedback is utilised to show the communication of concepts. In general, the concepts of a FCM represents the salient factors and features of the integrated modelling system, used for basic events, required objectives, system performance, execution mode and process of target units (Glykas, 2013).

This method is one of the soft computing techniques that is able to deal with complex systems in different situations using a logical process (Groumpos, 2010). An FCM method could be applied for many goals like recognising success and performance indices, designing scenario and resource planning of the company (Hobbs et al., 2002). This method helps decision makers to analyse hidden causal relationships and facilitates the achievement of the desired answer.

In this system, it is possible to reach and converge to a point as well as reach equilibrium. The value of using FCM is well understood when managers can test their strategic changes and see the results of changes in pattern concepts (Tsadiras, 2003). Thus, FCM is taken into account a fuzzy directional graph with feedback. Each

connection between two concepts C_i and C_j has a weight. This weight, which is called W_{ij}, exhibits the causal relationship between concepts C_i and C_j. More precisely, the value W_{ij} indicates how the concept C_i affects on the concept C_j. The concept of a variable with time $C_i(t)$ measures the non-negative values of a fuzzy event. Given the W_{ij}, there are three causal relationships between C_i and C_j, described as follows:

- $W_{ij} > 0$ indicates a positive cause between concepts C_i and C_j. This means that increasing/decreasing the value of the C_i concept leads to increasing/decreasing the value of the C_j (i.e., positive causation).
- $W_{ij} < 0$ indicates a negative (inverse) cause between concepts C_i and C_j. This means that increasing/decreasing the value of the C_i concept leads to decreasing/increasing the value of the C_j concept (i.e., negative causation)
- $W_{ij} = 0$ indicates that there are no relation between C_i and C_j. (i.e., zero causation)

Each concept in the FCM has a value of A_i, expressing the quantity of the corresponding physical value. As given in equation (1), this value is obtained by converting fuzzy values, determined by experts, into numerical values.

$$A_i(K+1) = f\left(\sum_{j=1, j\neq 1}^{N} w_{ji} \times A_j(k)\right) \tag{1}$$

where $A_i(K + 1)$ is attributed to the value of concept C_i in step $K + 1$ of simulation, $A_j(k)$ denotes the value of concept C_j in step K of simulation, W_{ij} is the weight of the interconnectedness between concepts C_i and C_j, K is the interaction index in any simulation stage and $f(0)$ is the threshold function (i.e., activation function), obtained from equation (2).

$$f(x) = \tanh(\lambda * x). \tag{2}$$

where λ is interrelated with the real positive number ($\lambda > 0$), determining the incline of continuous function f. Likewise, x specifies the value of $A_i(k)$ in the balance point. As mentioned previously, the threshold function ensures the value of the concepts to be in range [0, 1]. In each stage, the value of A_i is a concept, affected by its pertaining concepts and is updated in accordance with the inference law.

In view of the facts that employing the business process maturity management models are weak in constructing a dynamic, flexible, and logical roadmap and do not present any instruction about realisation and probability, however, the FCM method is capable of eliminating these weak points. Likewise, by employing the FCM method to define different scenarios of related concepts along with causal relationships, the objectives of the level of business process maturity can be improved in different area. Simulation tools in the FCM method allow the organisation's strategy to be evaluated at a much lower cost before implementation. In addition, by using fuzzy concepts and neural networks, the FCM method has the ability to convert concepts and qualitative indicators in a range of [0, 1].

Here, to implement the FCM method, 15 university professors and business process management specialists with an average of 11 years of experience are selected. Later on, based on fuzzy logic, the effects of each of the 33 factors on each others and the maturity of business process management are evaluated.

5 Results

The structure of the result section is delineated as follows. At first, the questionnaires are first filled out by experts to evaluate the results obtained from the literature. Then, the method of confirmatory factor is used to investigate and analyse the experts' opinions. In the next phase, the FCM method is utilised in order determine the extent to which concepts influence each other and provide the possibility of scenario building for the development of maturity. Lastly, to validate and verify the proposed approach, a real case study in SAIPA Company is conducted, via which important insights are gained.

5.1 Implementation and discussion

Based on the research background, a business process management maturity model has three aspects:

1 levels

2 factors

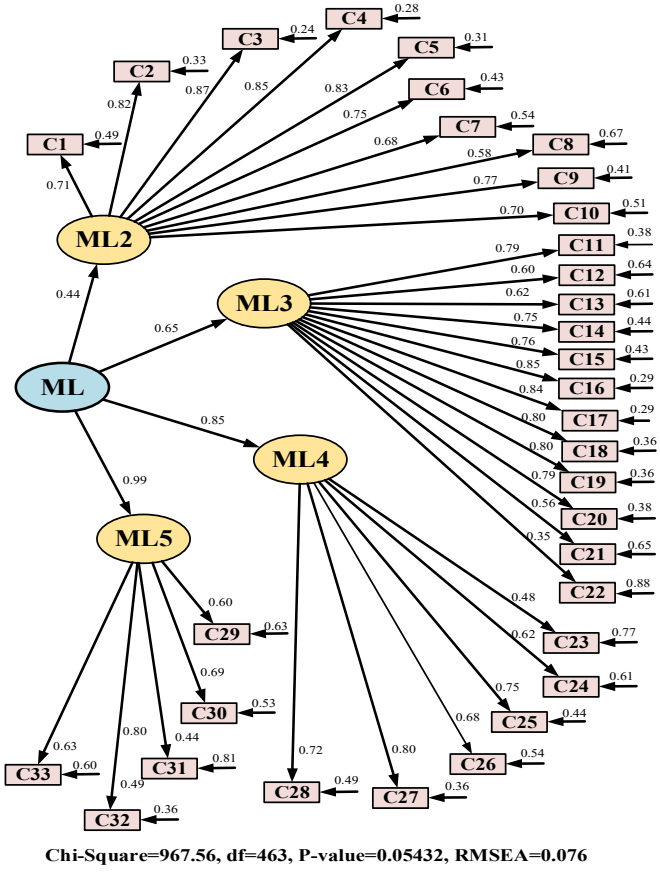
3 indicators.

In the model structure presented in this research, the level of maturity of process management is based on the OMG model. This is due to the fact that given the studies conducted in the literature review, this model is perfect in many aspects. Each level of maturity is essentially a set of goals that are called in the form of a set. In addition, achieving a level of maturity in an organisation also means that a set of actions has worked well to reach a series of goals. Therefore, a correct understanding of the level of maturity of an organisation in this method depends on a better understanding of the goals, defined in each of these levels of maturity. At the first level, there are no process concepts and all actions are completed as individual efforts. To advance to each maturity level by setting goals, the needed actions are delineated.

Regarding the factors and indicators, after a systematic review of the subject literature and with various comparisons that are fully mentioned in the literature section, the concepts of business process management maturity are extracted, as described in Table 3. To evaluate the results obtained from the literature, the questionnaires are first filled out by experts. It is worthy to note that the reliability of the designed questionnaire is also measured using Cronbach's alpha. If the alpha coefficient is 0.70 or more, the questionnaire has reliability and can be implemented. In the present study, the total Cronbach's alpha is 90% and the alpha coefficient of each index is higher than 0.7. The validity of the questionnaire, in addition to the subjective validity obtained based on the opinions of related professors and experts, is extracted using the mean of variance and convergent validity. Notably, based on scientific articles in the literature, the proper value for *AVE* is equal to 0.5. In addition, convergent validity exists, when the value of *AVE* is greater than 0.5. Based on the obtained results, this value is higher than 0.5 for all indicators. The second criterion for examining the fit of measurement models is convergent validity, examining the degree of correlation of each structure with its questions. In accordance with the results, we see CR > 0.7, AVE > 0.5 and CR > AVE. Therefore, the convergent validity of the questionnaire is corroborated. Likewise, to evaluate and investigate the results obtained from the experts' opinions, the method of

confirmatory factor analysis is used, which the related results are demonstrated in Figure 2.

Figure 2 Validation of the research conceptual model by confirmatory factor analysis (see online version for colours)

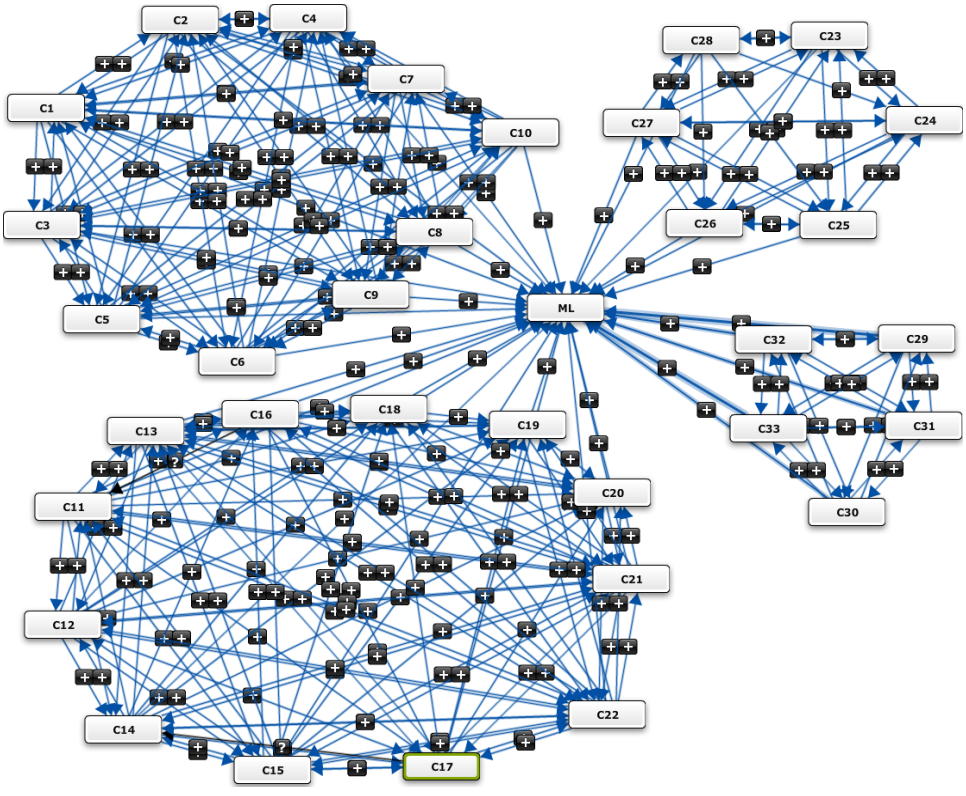


From Figure 2, one can see that the research measurement model (i.e., process maturity levels) is in a standard and significant manner. Speaking intuitively, the results indicate the appropriateness of the model and the test is significant. The results of the second-order confirmatory factor analysis also endorse that the measurement model is appropriate and all numbers and parameters of the model are significant. Thus, after comparing the effective factors and indicators of different models in measuring the maturity of processes, 33 selected concepts are finally verified. The results reveal that concepts *C*1 to *C*10, *C*11 to *C*21, *C*22 to *C*28 and *C*29 to *C*33 are respectively related to levels 2, 3, 4 and 5.

After identifying the factors affecting on the maturity level of business process management, according to Xirogiannis and Glykas (2004) and Xirogiannis et al. (2008), the FCM method is utilised in order to determine the extent to which concepts influence each other. In this regard, based on the in-depth calculation technique, academic experts are interviewed in order to draw the FCM method. In the first step, the variables obtained from the literature are explained to the experts and they are asked to describe the

relationships between these variables. The relations are described with positive and negative signs and the power of each relation divides into different groups, including very powerful (0, 1), powerful (0.08, 0.09), strong (0.06, 0.07), intermediate (0.5), weak (0.03, 0.04), very weak (0.01, 0.02) and without any effect (0). All the verbal weights are converted to numerical weights using a centre of gravity determination method. It is worthy to note that the same scale is used for all interviewees. The last step in forming a FCM is to integrate cognitive maps from each interview into each other. Thus, the integrated matrix is implemented in Mental Modeler software. The relevant results are shown in Figure 3.

Figure 3 Effects of concepts on each other (see online version for colours)



Concepts or nodes that are not affected by other nodes and only affect other nodes are called transmitter nodes. In addition, nodes that do not affect other nodes and are only affected are called receiver nodes. Other nodes, that both affect and are effected, are called ordinary nodes. As can be seen in Table 4, there are 33 concepts that one of them is receiver node and other are ordinary nodes. Table 4 indicates the degree of input, output and centrality of each concept. The degree of output also equals to the sum of the absolute values of the weights that enter from this node to other nodes. The degree of centrality is also obtained from the sum of the previous two indicators, indicating the degree of importance of a node

Table 4 Rates of output, input, and centralisation of the concepts

Concepts	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*	*C14*	*C15*	*C16*	*C17*
Output rate	0.74	0.68	0.61	0.37	0.28	0.21	0.21	0.58	0.24	0.72	0.7	0.71	0.29	0.53	0.33	0.41	0.37
Input rate	0.27	0.31	0.4	0.45	0.53	0.54	0.45	0.43	0.49	0.42	0.16	0.43	0.5	0.38	0.39	0.34	0.33
Centrality rate	1.01	0.99	1.01	0.82	0.81	0.75	0.66	1.01	0.73	1.14	0.86	1.14	0.79	0.91	0.72	0.75	0.7
Concepts	*C18*	*C19*	*C20*	*C21*	*C22*	*C23*	*C24*	*C25*	*C26*	*C27*	*C28*	*C29*	*C30*	*C31*	*C32*	*C33*	*ML*
Output rate	0.26	0.19	0.09	0.71	0.53	0.43	0.24	0.18	0.16	0.2	0.11	0.86	0.63	0.54	0.76	0.86	0
Input rate	0.43	0.49	0.57	0.34	0.41	0.07	0.12	0.19	0.33	0.13	0.09	0.3	0.31	0.36	0.32	0.36	3.09
Centrality rate	0.69	0.68	0.66	1.05	0.94	0.5	0.36	0.37	0.49	0.33	0.2	1.16	0.94	0.9	1.08	1.22	3.09

Table 5 Maturity level of business process management for the first ten scenarios

Scenario	*Value*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*	*C14*	*C15*	*C16*	*C17*	*C18*	*C19*	*C20*	*C21*	*C22*	*C23*	*C24*	*C25*	*C26*	*C27*	*C28*	*C29*	*C30*	*C31*	*C32*	*C33*	*ML*
1	Initial	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.11	0.12	0.12	0.13	0.13	0.11	0.12	0.13	0.09	0.05	0.07	0.06	0.07	0.06	0.04	0.03	0.04	0.04	0.04	0.04	0.06	0.04	0.05	0.04	0.04	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.19
2	Initial	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.07	1	0.1	0.1	0.13	0.12	0.11	0.11	0.12	0.11	0.05	0.06	0.05	0.06	0.05	0.03	0.03	0.03	0.04	0.04	0.02	0.05	0.04	0.05	0.04	0.03	0.02	0.04	0.03	0.03	0.04	0.04	0.04	0.18
3	Initial	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.04	0.05	1	0.09	0.11	0.12	0.11	0.1	0.11	0.11	0.02	0.03	0.02	0.03	0.04	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01
4	Initial	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.03	0.04	0.04	1	0.08	0.09	0.05	0.06	0.06	0.06	0.02	0.03	0.02	0.04	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0	0.01	0.01	0.01	0.01	0.01	0.08
5	Initial	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.02	0.02	0.02	0.04	1	0.09	0.05	0.04	0.05	0.05	0.03	0.04	0.03	0.05	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.04	0.02	0.04	0.02	0.01	0.03	0.04	0.04	0.05	0.03	0.13
6	Initial	0.02	0.02	0.03	0.03	0.04	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.02	0.02	0.03	0.03	0.04	1	0.05	0.04	0.02	0.03	0.02	0.02	0.04	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0	0.04	0.02	0.02	0	0	0.02	0.01	0.02	0.01	0.04	0.1
7	Initial	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.03	0.03	0.03	0.03	0.04	0.03	1	0.03	0.05	0.04	0.02	0.01	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0	0.03	0.01	0.01	0	0	0.01	0.01	0.01	0.01	0.04	0.08
8	Initial	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.06	0.06	0.11	0.12	0.13	0.1	0.08	1	0.09	0.09	0.02	0.03	0.03	0.04	0.05	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.04	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.11
9	Initial	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.03	0.04	0.04	0.05	0.04	0.04	0.04	0.04	1	0.04	0.01	0.01	0.05	0.02	0.01	0.04	0.04	0.04	0.04	0.05	0.01	0.01	0.01	0.02	0.04	0.01	0	0	0.01	0.01	0.02	0.01	0.01	0.08
10	Initial	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	0.1	0.11	0.09	0.12	0.14	0.13	0.11	0.12	0.13	1	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.02	0.01	0.02	0.01	0.04	0.03	0.05	0.04	0.01	0.02	0.02	0.02	0.05	0.03	0.13

Table 6 Maturity level of business process management for scenarios 11 to 19

Scenario	*Value*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*	*C14*	*C15*	*C16*	*C17*	*C18*	*C19*	*C20*	*C21*	*C22*	*C23*	*C24*	*C25*	*C26*	*C27*	*C28*	*C29*	*C30*	*C31*	*C32*	*C33*	*ML*
11	Initial	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.21	0.2	0.23	0.23	0.2	0.2	0.22	0.19	0.09	0.12	0.1	0.12	0.1	0.06	0.06	0.06	0.07	0.07	0.07	0.1	0.07	0.09	0.08	0.06	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.33
12	Initial	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.14	1	0.2	0.22	0.23	0.2	0.2	0.22	0.18	0.07	0.09	0.07	0.09	0.09	0.05	0.04	0.05	0.05	0.05	0.06	0.07	0.05	0.06	0.05	0.05	0.04	0.03	0.04	0.04	0.05	0.05	0.06	0.28
13	Initial	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.13	0.15	1	0.2	0.21	0.15	0.17	0.17	0.14	0.07	0.09	0.07	0.1	0.09	0.05	0.04	0.04	0.05	0.05	0.05	0.07	0.05	0.06	0.05	0.04	0.03	0.02	0.04	0.04	0.05	0.05	0.06	0.25
14	Initial	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.12	0.14	0.15	1	0.21	0.15	0.15	0.16	0.14	0.07	0.09	0.08	0.11	0.09	0.05	0.04	0.05	0.05	0.05	0.05	0.08	0.04	0.08	0.06	0.07	0.04	0.03	0.06	0.07	0.07	0.08	0.07	0.3
15	Initial	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.12	0.15	0.15	0.16	1	0.16	0.15	0.14	0.12	0.06	0.08	0.09	0.08	0.07	0.05	0.05	0.05	0.06	0.06	0.05	0.06	0.04	0.08	0.06	0.05	0.03	0.02	0.05	0.04	0.06	0.05	0.08	0.27
16	Initial	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.13	0.15	0.14	0.16	0.15	1	0.15	0.16	0.13	0.06	0.08	0.07	0.09	0.08	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.04	0.07	0.05	0.04	0.03	0.02	0.04	0.04	0.05	0.05	0.08	0.25
17	Initial	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.15	0.22	0.22	0.23	0.21	0.17	1	0.2	0.17	0.07	0.09	0.08	0.1	0.1	0.05	0.04	0.05	0.05	0.05	0.05	0.07	0.05	0.08	0.05	0.05	0.03	0.03	0.04	0.04	0.05	0.05	0.07	0.27
18	Initial	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.14	0.16	0.16	0.16	0.16	0.14	0.15	1	0.12	0.06	0.07	0.1	0.08	0.09	0.07	0.06	0.07	0.08	0.08	0.05	0.06	0.04	0.07	0.07	0.04	0.03	0.02	0.04	0.04	0.05	0.04	0.05	0.25
19	Initial	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	0.19	0.19	0.22	0.24	0.24	0.2	0.21	0.23	1	0.06	0.09	0.07	0.09	0.07	0.06	0.04	0.05	0.06	0.06	0.05	0.07	0.05	0.08	0.06	0.08	0.06	0.03	0.05	0.05	0.05	0.08	0.07	0.29

Table 7 Maturity level of business process management for scenarios 20 to 27

Scenario	*Value*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*	*C14*	*C15*	*C16*	*C17*	*C18*	*C19*	*C20*	*C21*	*C22*	*C23*	*C24*	*C25*	*C26*	*C27*	*C28*	*C29*	*C30*	*C31*	*C32*	*C33*	*ML*
20	Initial	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	1	0.26	0.3	0.31	0.28	0.27	0.3	0.26	0.11	0.13	0.11	0.14	0.13	0.07	0.07	0.07	0.08	0.08	0.08	0.11	0.08	0.1	0.08	0.07	0.06	0.06	0.06	0.07	0.07	0.08	0.09	0.4
21	Initial	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.23	1	0.29	0.29	0.24	0.24	0.26	0.23	0.1	0.13	0.11	0.14	0.13	0.07	0.06	0.07	0.08	0.08	0.07	0.12	0.08	0.1	0.08	0.07	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.38
22	Initial	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.22	0.22	1	0.29	0.23	0.23	0.25	0.22	0.11	0.14	0.12	0.15	0.12	0.07	0.06	0.07	0.08	0.08	0.07	0.12	0.08	0.12	0.09	0.09	0.06	0.06	0.08	0.09	0.1	0.11	0.1	0.41
23	Initial	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.23	0.22	0.25	1	0.24	0.23	0.24	0.21	0.1	0.13	0.13	0.13	0.11	0.08	0.07	0.08	0.08	0.09	0.07	0.11	0.08	0.11	0.09	0.08	0.05	0.06	0.07	0.07	0.08	0.08	0.11	0.39
24	Initial	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.23	0.22	0.25	0.24	1	0.23	0.25	0.22	0.1	0.12	0.11	0.14	0.12	0.07	0.06	0.07	0.08	0.08	0.08	0.11	0.08	0.11	0.08	0.07	0.05	0.05	0.06	0.07	0.07	0.08	0.11	0.38
25	Initial	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.28	0.28	0.31	0.29	0.25	1	0.28	0.25	0.11	0.14	0.12	0.14	0.13	0.07	0.06	0.07	0.08	0.08	0.07	0.11	0.08	0.11	0.08	0.07	0.05	0.06	0.07	0.07	0.08	0.08	0.1	0.39
26	Initial	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.23	0.23	0.25	0.25	0.22	0.23	1	0.21	0.09	0.12	0.13	0.13	0.11	0.09	0.09	0.09	0.1	0.11	0.07	0.11	0.08	0.1	0.1	0.07	0.05	0.05	0.06	0.06	0.08	0.07	0.09	0.37
27	Initial	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.26	0.28	0.32	0.31	0.27	0.28	0.31	1	0.1	0.13	0.11	0.13	0.11	0.08	0.06	0.07	0.09	0.08	0.07	0.11	0.08	0.11	0.09	0.1	0.07	0.06	0.07	0.07	0.08	0.1	0.09	0.4

Table 8 Maturity level of business process management for scenarios 28 to 34

Scenario	*Value*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*	*C14*	*C15*	*C16*	*C17*	*C18*	*C19*	*C20*	*C21*	*C22*	*C23*	*C24*	*C25*	*C26*	*C27*	*C28*	*C29*	*C30*	*C31*	*C32*	*C33*	*ML*
28	Initial	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	1	0.28	1	0.36	0.3	0.29	0.32	0.29	0.12	0.16	0.13	0.17	0.15	0.08	0.07	0.08	0.09	0.09	0.09	0.12	0.09	0.13	0.1	0.1	0.07	0.06	0.08	0.09	0.1	0.11	0.11	0.47
29	Initial	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.24	1	1	0.35	0.26	0.26	0.29	0.26	0.12	0.16	0.13	0.17	0.15	0.08	0.07	0.08	0.08	0.09	0.08	0.13	0.09	0.12	0.09	0.1	0.06	0.06	0.08	0.09	0.1	0.11	0.11	0.45
30	Initial	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.24	0.24	1	1	0.26	0.25	0.26	0.24	0.12	0.15	0.15	0.16	0.13	0.08	0.08	0.08	0.09	0.1	0.08	0.12	0.08	0.14	0.1	0.1	0.06	0.06	0.09	0.09	0.11	0.11	0.13	0.46
31	Initial	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.24	0.24	1	0.3	1	0.25	0.28	0.25	0.12	0.15	0.13	0.17	0.14	0.08	0.07	0.08	0.08	0.09	0.08	0.12	0.08	0.13	0.09	0.1	0.06	0.06	0.08	0.09	0.1	0.11	0.13	0.46
32	Initial	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.29	0.3	1	0.34	0.27	1	0.3	0.28	0.12	0.16	0.13	0.17	0.16	0.08	0.07	0.08	0.09	0.09	0.08	0.12	0.08	0.14	0.1	0.1	0.06	0.06	0.08	0.09	0.1	0.11	0.12	0.46
33	Initial	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.25	0.25	1	0.31	0.25	0.25	1	0.24	0.11	0.14	0.15	0.16	0.13	0.1	0.09	0.1	0.11	0.12	0.08	0.12	0.08	0.13	0.12	0.1	0.06	0.06	0.08	0.09	0.11	0.11	0.11	0.45
34	Initial	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Final	1	1	0.27	0.29	1	0.36	0.29	0.29	0.33	1	0.12	0.15	0.13	0.16	0.13	0.09	0.07	0.08	0.09	0.09	0.08	0.12	0.08	0.14	0.1	0.12	0.08	0.06	0.09	0.09	0.1	0.13	0.12	0.47

As shown in Table 4, there are concepts $C1$ and $C10$, i.e., business process management leadership and data management, among the five concepts, affecting on other concepts of business process management maturity. Notably, this subject is completely consistent with the literature on the subject of research. This is due to the fact that if there is sufficient support and accountability from the organisational process manager regarding the management and performance of the organisation's process improvement activities, the organisational process improvement activities are supported by administration manager and the activities and systems of organisational management are aligned with the strategies and goals of improving organisational processes. Then, effective measures can be taken to develop the level of process management maturity in the organisation. On the other hand, data management, as an underlying concept, is very influential on other concepts of maturity. Therefore, basic information systems and infrastructure are needed to start a business process management development maturity mechanism. Infrastructures and databases also need to be created as a minimum quality level for the growth of other concepts of maturity.

Concept $C20$, which is product and service maintenance, has the highest input level. This implies that an organisation can support its services and products well when the other concepts of business process management maturity are well implemented. If an organisation performs better in marketing products, services and support for them will be more efficient and effective.

Concept $C33$, i.e., organisational resilience management, has the highest degree of centrality as well as importance in an organisation. Accordingly, today, this concept has long been mentioned as one of the important concepts with an expression such as economic resilience in organisations and even in the country. Concept $C21$, i.e., information and communication technology management, can have a greater impact on the development of business process management maturity. Concept $C12$, i.e., organisational process management, is one of the most important concepts that can lead to the development of maturity. Thus, after determining the relationships between the variables, which is called the neighbourhood matrix, it is incumbent upon to perform the next step of the FCM method. Therefore, in this step, the initial values of each concept are specified and then by using an iterative algorithm, the new value of each concept in each step is obtained employing equation (1). This value indicates at what level this concept will be activated. Speaking intuitively, this level of activation can be interpreted as a relative frequency ratio. That is, it states how much this concept allocates to itself when it activated.

In the next step, the selected scenario, which is a matrix of $1 \times n$ (n is the number of nodes), is first multiplied by the neighbourhood matrix ($n \times n$). The result of this matrix multiplication will be another matrix ($1 \times n$), used as the next iteration input. In view of the elements of this matrix are not necessarily in the range [–1,1], they must be normalised. For this purpose, the hyperbolic tangent function [i.e., equation (2)] is used, in which λ is presumed to be equal to 1. Thus, the input of this function is the output of the previous iteration matrix and its output is used as the input iteration of the next iteration. Alternatively stated, to perform dynamic analysis at each stage, it is assumed that one of the concept nodes is active (i.e., node i). In this case, we are faced with a vector, whose value in row i is 1 and other rows are zero. In this analysis, the desired vector is multiplied by the neighbourhood matrix. Afterwards, using the hyperbolic tangent function on the output matrix, the upper and lower limits of the output matrix terminals are modified and this vector is again multiplied in the neighbourhood matrix.

This process continues until the output vector is merged in two consecutive iterations and a steady state occurs. It is worthy note that this has happened in repetition 10. The relevant results for the first ten scenarios are shown in Table 5. It is worth to note that, first, the value of $C1$ is assumed to be equal 1 and the rest of the concepts are presumed to be zero. In this case, the amount of *ML*, which indicates the level of maturity of business process management, is calculated with the help of Mental Modeler software. Then, for the second scenario, the value of the two concepts $C1$ and $C2$ is considered to be equal 1 and the other concepts are assumed to be zero. In this case, *ML* is obtained 0.15. Similarly, if all the concepts are equal to 1, the value of *ML* will reach 1. In the same way, as the value of concept $C3$ is 1 and other concepts equal to zero, the value of *ML* will be 0.12. Thus, if this procedure is continued in the same way for other concepts, the value of *ML* will not be better than 1. Hence, the best practice for the first step among 10 first scenarios of business process management development is to concentrate on concept $C1$, being the business process management leadership.

Table 6 shows the maturity level of business process management for scenarios 11 to 19. Here, concept $C1$ is taken into account equal to 1 and other concepts from $C2$ to $C10$ will be considered equal to 1, respectively. Thus, in scenario 11, the values of concepts $C1$ and $C2$ are equal to 1 and other concepts equal to zero, which in this case the value of *ML* is 0.33. In scenario 12, concepts $C1$ and $C3$ are equal to 1 and other concepts are equal to zero, leading to *ML* to be 0.28. Next, continuing the same procedure until scenario 19, the best value for *ML* happens in scenario 11, where both $C1$ and $C2$ equal to 1. Thus, in the second step, business process governance is the next practical step that should be utilised for developing the level of maturity of business process management.

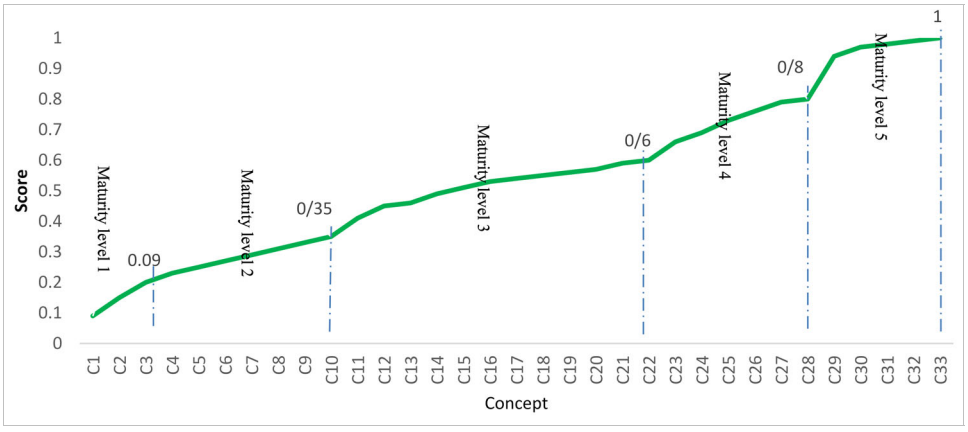
For scenarios 20 to 27, maturity level of business process management is given in Table 7. In this case, the concepts $C1$ and $C2$ are considered to be equal to 1 and one of the concepts from $C3$ to $C10$ is equal to 1. In addition, other concepts are equal to 0, which in this case, in scenario 27, three concepts $C3$, $C2$ and $C5$ are equal to 1 and others are zero. This case is the best condition for the value of *ML*. Hence, organisational units' activities are the third practice, which are considered for developing business process maturity management.

Table 8 indicates the maturity level of business process management for scenarios 28 to 34. Here, concepts $C1$, $C2$ and $C5$ will be equal to 1 and one of the concepts $C3$, $C4$, and $C9$ equals to 1 and other concepts equal to zero. In addition, the best scenario for *ML* happens when $C4$ equals to 1, which contributes to *ML* equal to 0.47.

As shown in Figure 4, based on the model presented in this paper, the levels of business process management maturity are divided into 5 levels, including elementary, managed, standardised, predictable and innovative, describing the various states that an organisation goes through as its capacity and processes progress. In the first level (i.e., elementary), the processes of organisations are heterogeneous and sometimes temporary, and usually the results are different from what is expected. In these conditions, according to the obtained results, the maximum maturity level score is 9 out of 100. In the second level (i.e., managed), the management performs the work internally to ensure that it can be carried out in several repetitions. The maturity level score in this condition is 35 out of 100. In the third level (i.e., standardised), standardised processes are obtained from the best practices and working groups and appropriate guidelines are provided to meet the needs as much as possible. In this case, the maturity level score is 60 out of 100. In the fourth level (i.e., predictability), the capabilities of the organisation are realised through the establishment of standard processes. At this level, the processing

performance is statistically examined. In addition, by having this information, it will be possible to predict the process output. In this situation, the maturity level score is 80 out of 100. Finally, in the fifth level (i.e., innovative), the improvement measures are active and dependent on opportunities to minimise the gap between the current capabilities of the organisation. Obviously, in this case, the maturity level score is 100 out of 100. Therefore, in this article, the stages of improving the level of maturity of process management are delineated. Therefore, it is clear how organisations can increase their level of maturity step by step.

Figure 4 Levels of business process management maturity (see online version for colours)



5.2 Case study

SAIPA is an Iranian car manufacturer, which is established in 1965 with an initial capital of 160 million Rials under the name of 'Iranian Citroen Iran Car Production Compan'. It is registered on March 6, 1976 and reached the operation stage two years later. The name of the company was changed to the exclusive name of SAIPA in early 1975. SAIPA has based its philosophy and attitude on five principles:

1 balanced and continuous growth

2 creating sustainable value for stakeholders

3 competitive cost leadership

4 achieving the top Iranian brand

5 minimising risk in investment.

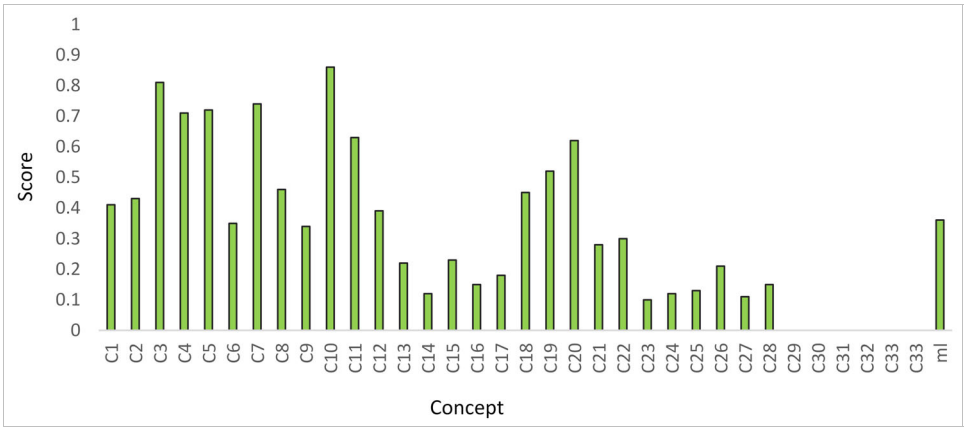
In addition, the mission of SAIPA company is the production and supply of passenger and commercial vehicles with the greatest compliance with the most adaptation to the needs of customers. At present, the share of automakers in GDP of Iran in the last year is about 3.5 %, in industry 18.8 %, and in employment is 12%. Therefore, it can be said that the automotive industry is one of the drivers of the economy in Iran. Likewise, SAIPA with a market share of almost 40% is one of the two main poles of automakers. Therefore, the development of benchmarking and of process maturity models is important

for Iranian automakers and the managers of these companies have paid much attention to this issue.

5.2.1 Finding

In order to implement the model in the case study of SAIPA, the level of maturity of business process management is measured based on the fuzzy logic of each of the 33 factor. Accordingly, if any of the concepts at the level of the sample under study are fully implemented, the number is considered to be 1 and if they are not implemented, it is 0. Figure 5 shows the implementation of each of the concepts of maturity level in SAIPA.

Figure 5 Levels of SAIPA business process management maturity level (see online version for colours)



In the next stage, the obtained results are implemented in Mental Modler software and it is found that the level of business process management maturity in SAIPA is 36 out of 100. This score shows that the level of maturity of SAIPA processes is at the beginning of level 3. Therefore, SAIPA needs to first fully implement 10 concepts or components, affecting on maturity level 2 of business management and then prepare itself to go to a higher maturity. As mentioned in the research findings section, business process management leadership (i.e., concept *C*1) and organisational business governance (i.e., concept *C*2) and product and service assurance (i.e., concept *C*9) are the most important components of this level that should be paid more attention in the first steps. Therefore, if all concepts *C*1 to *C*10 are considered to be equal 1, that is, scenario 10 is done in SAIPA. In this case, with calculations performed in Mental Modler software, the current state of process management maturity (i.e., 36 out of 100) will be upgraded to 48 out of 100. In order to complete the concepts and components, affecting on the level 3 of SAIPA, it is incumbent upon to define and implement its process management system in the first step. Accordingly, reviewing the classification of processes based on the OEM APQC 2018 model, is one of the basic needs of level three in the process management maturity. Therefore, if all the factors, affecting on the levels two and three in the maturity of business process management, i.e., concepts *C*1 to *C*2 are considered to be 1 and scenario 22 is taken into account, the obtained score in Mental Modler software will be 63 out of 100.

As mentioned above, at the four levels of business process management maturity, organisations pay special attention to the quantitative management of processes and their knowledge management. Noteworthy, SAIPA is not in a good position regarding these indicators according to the performed evaluation. Therefore, if SAIPA does these components i.e., concepts *C*23 to *C*28, completely, it will increase its score to 80 out of 100. Note that it is assumed that scenario 28 is done and all the concepts of maturity of levels 2 and 3 are equal to 1.

According to the performed evaluation, it can be concluded that SAIPA does not have almost any of the indicators of maturity level 5. Organising change and improvement of the organisation, adjusting business performance in accordance with strategies, managing the prevention of shortcomings and crises, intelligent management of business performance and managing organisational resilience are the concepts of *C*29 to *C*33. In order to reach the maturity of concepts to 1, which results in the level of maturity of business process management of SAIPA to be equal 1, it is incumbent upon to improve the mentioned concepts.

6 Conclusions

Business processes maturity is the description of the evolutionary improvement path in the organisation, through which contradictory, immature and irregular business activities move towards maturity and regular processes, eventuating in improved work. Accordingly, the development strategy, derived from the maturity of business processes, provides a roadmap for continuous process improvement and helps to identify process defects, which contributes to make logical, step-by-step and guided progress in the organisation. In this regard, this paper proposes a two-stage approach for a prescriptive model to develop the maturity of business process management by the use of the FCM technique. The first stage presents a systematic review of the literature. This stage is capable of identifying the maturity levels, factors and indicators of the conceptual model dedicated to the maturity of business process management. The second stage achieves macro causes and effects by applying the FCM technique. In this stage, the dimensions of maturity and related relationships are specified in order to render the possibility of scenario building for the development of maturity.

In a bid to examine the performances of the proposed approach, wide experiments are carried out. In accordance with the obtained results, the research measurement model (i.e., process maturity levels) is in a standard and significant manner. The results of the second-order confirmatory factor analysis also endorse that the measurement model is appropriate and all numbers and parameters of the model are significant. The reliability of the questionnaire is also measured using Cronbach's alpha. The relevant results corroborate that the questionnaire has reliability and can be implemented. In addition, based on the model presented in this paper, the levels of business process management maturity are divided into 5 levels, including elementary, managed, standardised, predictable and innovative. In the first level (i.e., elementary), the processes of organisations are heterogeneous and sometimes temporary. In these conditions, according to the obtained results, the maximum maturity level score is 9 out of 100. In the second level of maturity (i.e., managed), the management performs the work internally to ensure that it can be carried out in several repetitions. The maturity level score in these conditions is 35 out of 100. In the third level (i.e., standardised), standardised processes

are obtained from the best practices and working groups and appropriate guidelines are provided. In this case, the maturity level score is 60 out of 100. In The fourth level (i.e., predictable), the capabilities of the organisation are realised through the establishment of standard processes. At this level, the processing performance is statistically examined. In this situation, the maturity level score is 80 out of 100. Finally, in the fifth level (i.e., innovative), the improvement measures are active and dependent on opportunities to minimise the gap between the current capabilities of the organisation. In this case, the maturity level score is 100 out of 100. Therefore, in this article, the stages of improving the level of maturity of process management are delineated. Therefore, it is clear how organisations can increase their level of maturity step by step.

The concerned study can be developed in number of promising directions to enrich the relevant literature. Building scenario for business processes management in accordance with executive improvement measures is an interesting avenue for future research. Alternatively stated, the proposed concepts of business process management maturity can be extended to executive actions. In addition, ranking and prioritising the improvement measures in order to mature the organisation's processes is another appealing direction. Eventually, the future research may be aimed at using different methods to measure the concepts of maturity.

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