A NOVEL MODEL FOR PROCESS MATURITY MEASUREMENT BASED ON FUZZY ANALYTIC HIERARCHY PROCESS

Elif Buyukkaya[1], Selcuk Cebi[1]
[1] Department of Industrial Engineering, Yildiz Technical University, Besiktas, Istanbul, Turkiye

ABSTRACT

By identifying the bottlenecks in the business process, improvements are made on the relevant process. For this, first of all, the maturity of the business process should be determined. In the literature, the process maturity model is used to measure the maturity level of processes. The model is questionnaire-based. It includes an evaluation in 0-1 logic. However, the current structure is not sensitive enough to reflect the decisions of group decision-makers. Therefore, a fuzzy set and Analytic Hierarchy Process (AHP) based approach has been proposed to measure the maturity level of processes. The effectiveness of the method is demonstrated by applying the proposed approach to the vehicle tracking process (VTP) of an organization.

Keywords: Process maturity model, Fuzzy Set Theory, AHP

1. Introduction

Every activity carried out in organizations involves a process. In order to identify bottlenecks in the process and to develop the process, the maturity of the business process should be examined first. Process maturity models, which are used to determine maturity, are models that examine and determine the maturity level of the organization. In terms of process, management plays a guiding role for organizational executives regarding the stages that need to be carried out for organizations to reach the next maturity stage. The first model for process management was proposed in 1986. It was developed under the leadership of Watts Humphrey. Later, published by Mark Paulk and Charles Weber as the Capability Maturity Model (CMM) (Ozveri & Kabak, 2016). De Bruin (2009) stated that maturity models related to processes and management can be categorized into four groups: specific process maturity models, general process maturity models, general management maturity models, and specific process management maturity models. In this study, the first group of models is exemplified by the CMM. The second group of models is exemplified by the "Process and Enterprise Maturity Model" (PEMM) developed by Hammer (2007). The third group of models is exemplified by the "European Foundation for Quality Management" (EFQM) and finally, the fourth group of models is exemplified by the "Process Management Maturity Model" developed by Fisher (2004).

The PEMM model, in which the maturity level can be determined separately within the processes, is more applicable in practice than other process maturity models. The criteria in the model structure ensure the determination of process maturity at the same level of importance for each process. In addition, the current model is not suitable for group decision-making. For this reason, an approach including Fuzzy Set Theory (Zadeh, 1965) and AHP method (Saaty, 1980) has been proposed within the scope of the study. In the proposed model, by applying the AHP method to the factor and capacity areas, it is predicted that the creation of an importance level for criteria in the maturity measurement

in the process will create more efficiency on the maturity of the process compared to the classical application.
The rest of this study is organized as follows; Section 2 gives a brief literature review. Section 3 presents the proposed methodology and the application is given in Section 4. Finally, the concluding remarks are presented in Section 5.

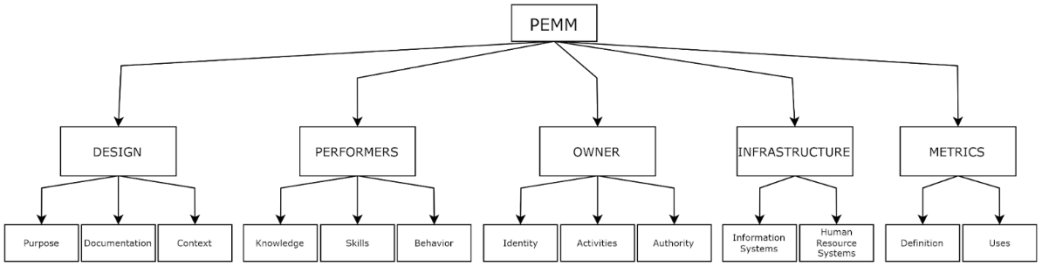
2. Literature Review

The number of academic studies on process management maturity models in the literature started to increase at the end of the 1990s. Some of these studies on PEMM in the literature are as follows; In 2007, the Process and Organizational Maturity Model was developed by Hammer (2007). The model consists of 2 different content assessment tools that enable the measurement of the maturity levels of an enterprise and the processes of the enterprise. These tools consist of factor and factor-related capacity areas. Klimas (2011) presented the "Advanced Process and Organization Maturity Model" (Advanced PEMM), which is a combination of the principles of the "Process and Organization Maturity Model" (developed by Hammer (2007)) and the "Process Oriented Organization" (presented by Goncalves (2000)) (Klimas, 2011). Ilisulu et al. (2015) developed a self-assessment tool to increase the maturity of processes and clarified the suitability of this self-assessment tool by evaluating the model with PEMM. Tkacheva (2019) examined the use of business intelligence, the process of the work done, and the use of the office in order to bring companies in the financial sector to a higher maturity. In the companies where the study was conducted, both process and organizational process maturity were measured using PEMM (Tkacheva, 2019). Jeppsson examined the suitability of Business Process Reengineering (BPR) and PEMM in the pharmaceutical industry. While carrying out this study, PEMM was used especially in the R&D unit (Persson & Jeppsson, 2017). Koops (2016) used PEMM together with several maturity models to evaluate the implementation of a Business Process Management System and the impact on Business Process Management Maturity of an international company operating in the field of finance. Statistical improvements were made to the application while applying PEMM (Koops, 2016).
It is seen that the studies on the Process and Enterprise Maturity Model (PEMM) have been conducted mostly in the service, public, education, health, and energy sectors.

3. Methodology

When PEMM is examined in terms of its structure and functioning, it is observed that there are 2 different matrix structures. One of them is matrices used for processes. The other one is used to determine the maturity levels of the organization for process management. In PEMM, 5 process maturity factors are considered for the evaluation of a process. Each factor provides a capacity area. For each capacity area, maturity assessment is made over P1, P2, P3, and P4 process maturity levels. Organizations do not make a sharp distinction such as true/false in the evaluation of the maturity levels for the factors in the matrix. They present their preferences as "*agree (>80%)*", *"partially agree (20%-80%)"* and *"disagree (<20%)"*. When determining the process maturity level for each factor, the lowest process maturity level of the process capacity areas within that factor is accepted as the process maturity level of the factor.
In the proposed model, an analytical perspective on the maturity assessment has been provided to the classical PEMM. To provide a process-specific assessment, a weighting has been made on the factors and the capacity areas related to the factors by using the fuzzy

set theory and AHP method. The weightings of the factor and capacity areas were determined by normalization on a scale of 1-9 on the comparison matrix.
Figure 1. Hierarchical Structure for PEMM factors



4. Application

Within the scope of the application, the Vehicle Tracking Process (VTP) of an enterprise was considered (Figure 2). The opinion of the senior management of the company was taken at the weighting stage of the design parameters affecting the process. Then, information about the process was obtained from the VTP manager and an expert familiar with the process. The opinions of the participants were collected using a process maturity form.

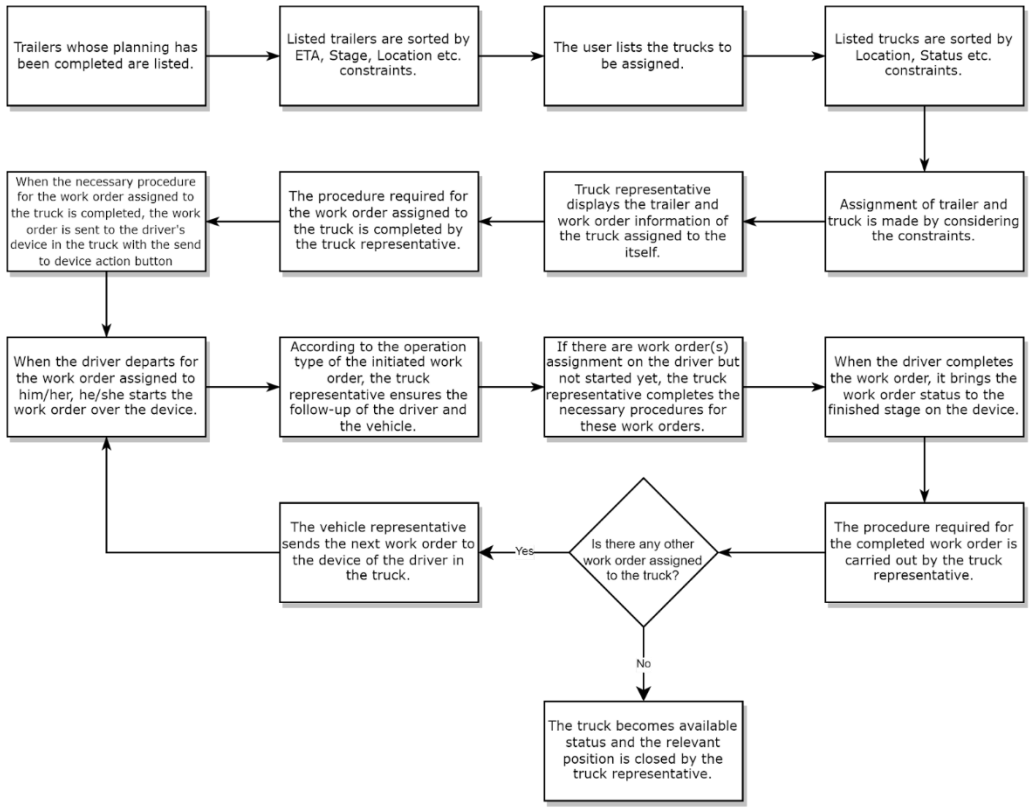


Figure 2. The framework of VTP

In order to compare the existing method with the proposed approach, the preferences of the participants were taken as follows:

1. Classic PEMM Assessment: Process maturity forms were filled out using Agree/Partially Agree/Disagree statements
2. Process maturity forms were completed using a 5-point linguistic scale of Very High/High/Medium/Low/Very Low

Using the factor and capacity domain eigenvector (weight) values and the analytical values corresponding to the subjective statements on the process maturity form, the percentage maturity of the vehicle tracking process (VTP) was obtained (Figure 3).

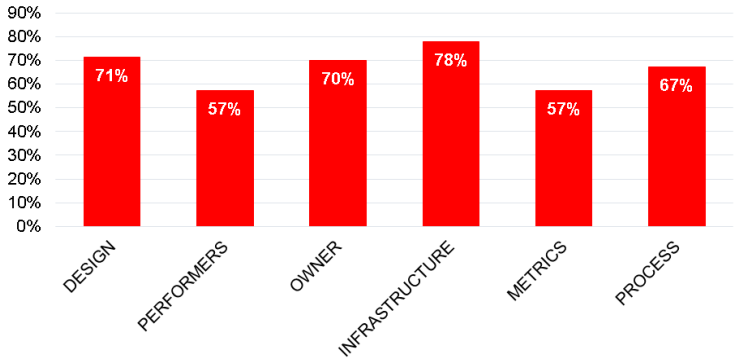


Figure 3. Process maturity level for VTP

5. Conclusion

Within the scope of the proposed study, a fuzzy set and AHP-based process maturity model has been proposed. The validity of the proposed method was measured by applying it to VTP. As a result of the application, the maturity value of the whole process was obtained as 67% from the proposed method, while the classical model defined the process as P1 maturity level. In future studies, the results of the models can be compared by using AHP method with fuzzy set extension.

6. References

De Bruin, T. (2009). Business Process Management: Theory on Progression and Maturity. *PhD Thesis*, Queensland University on Technology School of İnformation Technology.

Fisher, D.M. (2004). The business process maturity model: A practical approach for identifying opportunities for optimization.

Goncalves, J. E. L. (2000). Processo, que processo?. Revista de administração de empresas, 40, 8-19.

Hammer, M. (2007). The Process Audit. *Harvard Business Review*, *85*(4), 111-123.

Ilisulu, F., & Tarhan, A., & Turetken, O. (2015). İş Süreci Olgunluğu İçin Bir Öz Değerlendirme Aracı. *In UYMS*.

Klimas, D. (2011). Business Process Maturity Level Determination: A Methodological Outline. *Ekonomika*, *90*(2), 114-127.

Koops, M.N.M. (2016). The impact of BPMS implementation on Business Process (Management) Maturity a nested case study in an international financial institution. *PhD Thesis*, Eidhoven University of Technology, Master of Science in Operations Management and Logistics.

Ozveri, O., & Kabak, M. (2016). Süreç Yönetimi Olgunluk Modelleri ve Bir Organizasyonun Süreç Yönetimi Olgunluğunun Değerlendirilmesi. *Journal of Economics and Administrative Sciences, Volume: XVIII*, Issue: 1, Year: June 2016, Pages: 101-110. DOI NO: 10.5578/jeas.24209

Persson, A., & Jeppsson, F. (2017). A Process and Enterprise Maturity Model (PEMM) Analysis of the Hampered Big Pharma Drug Discovery Process.

Saaty, T.L. (1980) The Analytic Hierarchy Process. McGraw-Hill, New York

Tkacheva, N. (2019). Achieving higher BPM maturity level through introduction of business process office and business intelligence in the company. *PhD Thesis*, Doctoral dissertation, Univerza v Ljubljani, Ekonomska fakulteta.

Zadeh. L. A. (1965). Fuzzy sets. Information and control, 8, 338–353.