A New Approach To Assessing Organizational Agility And Recommending IT Levers Of Improvement: Case Study

Mohamed Amine Marhraoui, Mohammed Abdou Janati Idrissi, Abdellah El Manouar

Abstract: The current business environment is changing at a rapid pace due to technological, political, economic and social changes. Companies should be able to continuously adapt to these changes and exploit them as development opportunities. Indeed, organizational agility is a key enabling capability that allows the company to monitor environmental change and act effectively in order to maintain and improve its sustainable performance. Through this article, we focus on the most significant levers, including the IT ones, likely to improve the level of organizational agility. In fact, we propose a global approach for the company in order to evaluate its agility index and recommend improvements according to the IT levers. Concerning the evaluation of the agility index, our approach is based on two widely used methods in the literature: a fuzzy method that calculates the fuzzy agility index and the second one that computes an index based on three metrics which are market share, efficiency and response capacity. For the recommendations part, our approach relies on an AHP model which allows the company to select the IT levers having the highest priority and likely to improve its agility index. Furthermore, we verified the applicability of our approach through a real business case study.
.
Index Terms: Organizational agility evaluation; organizational agility improvement; agility levers; IT agility levers; multi-criteria analysis; AHP; fuzzy agility index.

————————————— ◆ —————————————

1. INTRODUCTION

Nowadays, markets are becoming more unstable and competitive. Successful companies should be aware of changes in their social, political and economical environment [1]. These organizations are able to both adapt and innovate continuously in order to survive in this turbulent environment and thus, to strengthen their competitiveness and maintain a sustainable development [2]. In addition, they should act efficiently and rapidly by taking advantage of their several resources, particularly those related to the use of new information technologies [3] [4]. These mainly concern the use of emerging technologies namely "Big Data", "Business Analytics" and "Knowledge Management Systems" (KMS) for the exploitation of internal and external data of different types in order to improve knowledge of customers and the market context [5][6]. Consequently, this allows companies to better anticipate future needs and respond quickly and efficiently [7]. These technologies exploit the possibilities offered by artificial intelligence algorithms through learning mechanisms [8]. Also, the consumption and the exposure of the Web services within the framework of a service-oriented architecture (SOA) allow the company to optimize the time of introduction of new products through the consolidation / factorization of business services [9]. Companies should ensure that new technologies are adopted to continually monitor their environment and act quickly and efficiently. This will allow them to be strategically agile [10]. Organizational agility (OA) is essential to the survival of the company, which must continually adapt to the evolution of the environment in order to consolidate its performance and ensure its sustainable development. Organizational agility is considered a firm's key dynamic

capability [11] which can help it to detect environmental changes and respond appropriately. This capacity is essential in order to cope with changes and to exploit them as development opportunities. It is broader than the application of agile project management methodologies (XP, Scrum, etc.) because it is a capability both on the operational and the strategic levels.
In this paper, the aim is to provide companies with a global approach that enables them to assess their level of organizational agility at any time, and secondly to help them activate the appropriate IT levers taking into account the priorities of decision-makers in order to improve the degree of organizational agility that ultimately affects the financial, social and environmental performance of the company. We have chosen to focus on the impact of information technologies because we believe that digitalization is among the key elements that can differentiate innovative value-creating companies in an uncertain and volatile environment. This work proposes a new global approach for evaluating organizational agility and recommending its improvement through IT Levers. Our proposed approach integrates results of previous works concerning our OA conceptual framework [12] as well as our proposed methods for evaluating organizational agility [20] and recommending IT levers for improvement [19]. Furthermore, this work has allowed us to verify the applicability of our approach through a real case study. Thus, this integrated approach allows companies to adjust the allocation of appropriate IT resources and to avoid IT investments that make little contribution to the sustainability of the business in order to focus efforts on implementing projects with high added value. The rest of this article is structured as follows. We begin with a description of our proposed overall approach. Subsequently, we present our case study to verify the applicability of our approach. Finally, the conclusion and the perspectives of our research work are underlined.

—————————————————

- *Mohamed Amine Marhraoui is currently a doctoral student in TIM team, ENSIAS Engineering School, Mohammed V University in Rabat, Morocco, E-mail :mohamed-amine_marhraoui1@um5.ac.ma*
- *Mohammed Abdou Janati Idrissi is currently Professor and researcher in TIM team, ENSIAS Engineering School, Mohammed V University in Rabat, Morocco, E-mail : abdou.janati@um5.ac.ma*
- *Abdellah El Manouar is currently Professor and researcher in TIM team, ENSIAS Engineering School, Mohammed V University in Rabat, Morocco, E-mail : abdellah.elmanouar@um5.ac.ma*

2 PROPOSAL OF AN INTEGRATED APPROACH TO ASSESSING ORGANIZATIONAL AGILITY AND RECOMMENDING IT LEVERS OF IMPROVEMENT

2.1 Description of our integrated approach
Based on our OA conceptual framework and our IT-specific conceptual framework, our integrated approach allows the assessment of organizational agility and the improvement of the impact of IT levers. Fig.1 below describes the main components of our approach. First, we present our OA conceptual framework and the IT-specific one. Then, we focus on how the company can calculate the organizational agility index according to its context in order to monitor its evolution over time. Thus, we specify our recommendations for improvement allowing the company to select and activate the most relevant levers (including IT levers).
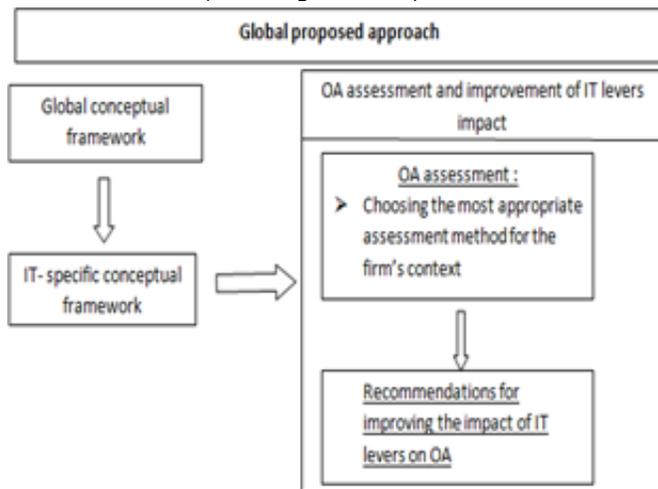

Fig. 1. *Our global proposed approach*

2.2 Conceptual framework
We propose as described in [12] our OA conceptual framework describing the levers having an impact on the organizational agility and thus on the company's performance. These levers belong to six groups: IT, HR, process, knowledge management, innovation and organizational structure. In addition, based on this global framework, a specific framework for the impact of IT levers has been described [12]. These IT levers are: IT resources, explorative / exploitative use of IT, IT skills, IT acceptance and IT innovations [12].

.3 ASSESSMENT OF ORGANIZATIONAL AGILITY
The assessment of organizational agility is based on the selection of the most appropriate method regarding the internal and external context of the company. Our previous review of the literature described in [13] has helped to identify and compare the most relevant methods of organizational agility evaluation. These are: Fuzzy method [14], computation-based method [15], AHP (Analytic Hierarchy Process) [16], performance-based method [17] and complexity-based method [18]. We will focus on the two first methods and eliminate the AHP-based, performance-based and complexity-based methods, as we are interested in our work on evaluating   organizational agility through a global index

integrating various criteria. The method based on AHP allows calculating an index of agility for a criterion, and not a global index of company's agility [16]. The performance-based method proposes a metric calculated using enterprise success (S) and environmental turbulence (T) scores [17]. However, the S and T scores are not explicitly defined via formulas and the access to the calculation tool proposed by the method is not operational. The method based on complexity doesn't allow calculating an index of agility. It proposes only a qualitative (not quantitative) assessment of organizational agility. In fact, the assessment is related to the complexity of the business processes of the company and the level of organizational agility is proportional to the ease of change of business processes [18]. Thus, we propose an evaluation of OA based on the fuzzy and computation-based methods. We describe below how we've adapted these two methods in order to evaluate OA and how we help companies to choose the most appropriate method according to their context.

➢   Evaluation of OA based on Fuzzy method
It is mainly related to calculating the FAI index (fuzzy agility index). The evaluation of agility using the fuzzy method is done in three parts [14]:
   1) Identifying the environmental drivers of agility, the vital levers allowing the company to respond to changes, as well as the sub-levers of level 2 and 3 of each lever.
   2) Evaluating the performance of the sub-levers (of level 3).
   3) Evaluating the weight of each of them by using linguistic variables then reconciling their values. The performance value and the weight of each lever are then deducted.

Subsequently, FAI of the company is calculated and then a level in a linguistic scale is deducted. In our case, we adapt this method using the attributes of our hierarchy (see Table 1 below) in order to calculate the FAI. The latter has a fuzzy value with a center of gravity situated in the interval [0, 1]. By using a technique based on the Euclidean distance, one of the following linguistic values is deducted [very low, low, medium, good, very good]. The attributes of our hierarchy include the criteria (Level (1)) and sub-criteria (Level (2)) representing the main levers of agility as previously described in our conceptual framework (section 2.2). The levers belong to 6 groups: Information Technology (IT), Human Resources (HR), Process (PR), Knowledge Management (KM), Organizational Structure (OS) and Innovation (IN) [19] (Table 1 below).

TABLE 1
PROPOSED HIERARCHY FOR EVALUATING ORGANIZATIONAL

Level(0) Objective	Level(1) Objective	Level(2) Objective	Level(3) Objective
Agile enterprise	Information Technology (IT)	IT resources	IT Architecture (SOA)
			Cloud computing interoperability
		IT competence	Mastery of IT resources
			Use of HRIS
		IT acceptance	Perceived ease of use of IT
			Usefulness of IT
		IT innovations	3D printing
			Robotics
			RFID
			Internet of Things
			Mobile
			Using Groupwares and workflows
			Use of intranets / extranets
		Knowledge management systems	Use of document management systems
			Using content management systems
			Decision support systems
			Big Data Analytics
			Knowledge management using artificial intelligence
	Human Resources (HR)	Mindset	
		Behavior	
		Planning	
		Training	
		Evaluation	
		Motivation	
	Process (PR)	Flexible process	
		Efficient decision making	
	Knowledge management (KM)	Capitalization of knowledge	
		Balance between knowledge management and change	
		Learning organization	
	Organizational structure (OS)	Adaptable structure	
		Multidisciplinary and independent business units	
		Self-organization	
	Innovation (IN)	Introduction of new products	
		Penetration of new markets	

AGILITY [19]

➢ Evaluation of OA based on computation

The organizational agility index is based on 3 metrics: Market Share (MS), Efficiency (EFF) and Response Capacity (RC). The agile index is calculated by adding the 3 metrics (multiplied by an equal weight (0.33)) [15](1).

Index (Agility) = 0.33*MS + 0.33*EFF + 0.33*RC   (1)

The agility index is located at the interval proposed by [15]: [<2: extremely non-agile; 2-4: non agile; 4-6: generally agile; 6-8: agile; 8-10: extremely agile].

➢ Choosing the most appropriate method

Moreover, we propose an AHP hierarchy allowing the firm to choose the best method of agility assessment among the two ones presented above namely the fuzzy method and the computation-based one.

The criteria of the hierarchy are: precision, validity, ease of use, applicability, and standardization [20]. The alternatives include the fuzzy and the computation methods described earlier.

After choosing the appropriate method, the agility index is calculated.

2.4 Recommendations for improving the impact of IT

After calculating the organizational agility index, we help the company through recommendations to prioritize the IT sub-levers that are likely to improve its agility index.

The global hierarchy concerns the 6 levers which are (IT, HR, process, knowledge management, organizational structure and innovation). However, for improving the impact of IT, we will focus on the IT lever and its 2 sub-levers. Thus, we eliminate here the gray part of the table 1 [19].

➢ IT levers weight

By applying the AHP method, calculating the weights of the criteria (level (1)) allows to estimate the weight of the IT lever in relation to the other levers (HR, process, knowledge management, organizational structure and innovation). The company can thus have an idea about the effort to be allocated to increase the impact of information technologies compared to the other areas.

If the company is satisfied with the relative importance of the IT levers in relation to the other levers of level (1), we move on to the next step.

➢ Selection of IT sub-levers of agility

The selection of IT sub-levers to be activated is done using the calculated score of each sub-lever (level (3)).

We suggest calculating the IT threshold which is the average of the IT sub-lever scores of level (3) according to formula (2). The IT sub-levers to be activated are those with a greater score than the threshold.

IT threshold = $\dfrac{\sum \text{score of IT sublevers of agility}}{\text{number of IT sub-levers}}$

(2)

3   CASE STUDY

We have chosen to apply our proposed global approach through a case study on a firm which is a leader for professional spray paint systems in Germany.

We present the adopted methodology, as well as the results of the implementation of our approach for evaluating the firm's agility index and recommending IT levers for improving this index.

3.1 Methodology

Through interactive interviews and conf calls, the organizational agility assessment method was selected and then the company's agility index was calculated. Also, a second series of interviews allowed focusing on the levers to activate in order to improve the impact of IT sub-levers on the organizational agility of the company. A series of recommendations, in the form of new initiatives and improvement projects, has been prepared and delivered to the company.

3.2 Results

Below, we present the results of our case study. The calculation of priorities has been carried out thanks to the BPMSG AHP online system which applies the "Eigenvector" method [21].

➢ Choosing the most appropriate evaluation method

The pair wise comparison of criteria is shown in Table 2 on Saaty scale 1 to 9 (1-Equal importance and 9-Extreme importance) [22].

1031

TABLE 2

PAIR WISE COMPARISON OF CRITERIA

	Precision	Validity	Ease of Use	Applicability	Standardization
Precision	1	3	4	4	4
Validity	1/3	1	2	3	4
Ease of Use	1/4	1/2	1	1	1/2
Applicability	1/4	1/3	1	1	1/2
Standardization	1/4	1/4	2	2	1

Then, results show that fuzzy method is the best alternative for the company (76.55%). The consistency ratio CR, which represents in AHP method the coherence of judgments, is about 9% (less than 0.1). After comparing the fuzzy and computation alternatives according to each criteria of level 1, Table 3 below was calculated.

TABLE 3

CHOOSING THE AGILITY ASSESSMENT METHOD FOR THE COMPANY

Level 0	Level 1	Weight	Alternatives	
			Fuzzy	Computation
Choosing an assessment method	Precision	42,03%	75,00%	25,00%
	Validity	11,15%	80,00%	20,00%
	Ease of Use	15,59%	80,00%	20,00%
	Applicability	4,26%	80,00%	20,00%
	Standardization	26,97%	75,00%	25,00%
Alternatives Rankings			76,55%	23,45%

A one-to-one interview session helped determining the index of organizational agility using the fuzzy logic method based on the hierarchy attributes presented previously (Table 1).

Each elementary sub-lever belonging to the six groups (IT, HR, Process, Knowledge management, innovation, and organizational structure), has been linguistically qualified on a scale ranging from very low-low-medium-good to very good (see fig2 below). We've used the "FuzzME" tool [23] which allows qualifying linguistically and numerically each sub-lever of our hierarchy and then calculating the agility index of each group.
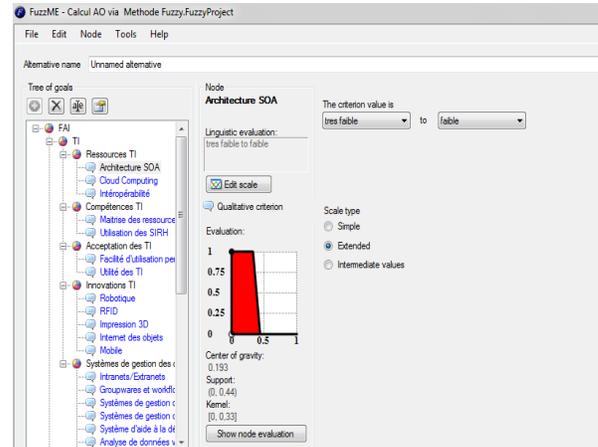

Fig. 2.   Agility index for each sub-lever

On this basis, an agility index was calculated for each group (see Table 4 below).

TABLE 4

AGILITY SCORE FOR EACH GROUP

Group	Agility index
IT	0,54
HR	0,53
Process	0,50
Knowledge Management	0,67
Innovation	0,80
Organizational structure	0,52

Finally, the final FAI score (Fuzzy Agility Index) was calculated (0.59) corresponding to a medium to good level (see fig3 below).
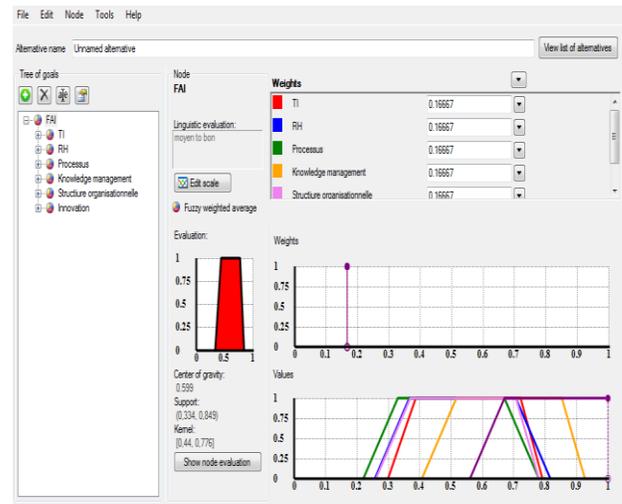

Fig. 3. Agility index of the firm

This index confirms the perceived idea that the company has on its level of agility. In fact, the company is aware of its strengths in terms of product innovation thanks to R&D teams and the optimized time for the development of new chemical products. Nevertheless, the difficulties slowing organizational agility are related to anchoring the traditional structure with centralized decision-making processes. Also, as the employee population is a generational mix, the change in terms of processes and work tools is differently perceived by employees. Finally, the company is aware of a lack of decision support systems based on artificial intelligence, a lack of

business processes digitalization and a need to adopt disruptive technologies. We've found that the IT lever has an average index (0.54) compared to other levers. Knowledge management and innovation are the most important levers with a respective index of 0.67 and 0.80. The company could thus invest more in information technologies to increase their impact on its organizational agility. In the following section, we present the IT sub-levers to be prioritized by the company. Therefore, we calculate the weight of the IT sub-levers and then we select the IT sub-levers with the highest priority.

> ➢ Pair wise comparison of IT sub-levers of agility

A pair wise comparison makes it possible to rank the IT sub-levers of agility according to their weights.

Hereunder, we present the pair wise comparison of IT sub-levers of level (2) (CR = 6.8% <0.1) (Table 5).

The pair wise comparison of IT sub-levers of level (3) of our hierarchy is done similarly.

TABLE 5
PAIR WISE COMPARISON OF IT SUB-LEVERS OF LEVEL(2)

	IT resources	IT skills	IT acceptance	IT innovations	KMS
IT resources	1	1/3	1/4	1/2	1/2
IT skills	3	1	1/2	2	1
IT acceptance	4	2	1	3	1
IT innovation	2	1/2	1/3	1	2
KMS	2	1	1	1/2	1

> ➢ Selection of IT sub-levers of agility

After, we calculate the priority of IT sub-levers of level (3) as shown in table 6 below (priority column).

We calculate an IT threshold as the average of the IT sub-lever scores of agility (3). In this case,

IT threshold = ∑(score of IT agility sub levers) / 19 (3)
IT threshold = 0,004113

Thus, we select the most influential IT sub-levers of agility (Table 6 below).

TABLE 6
SELECTION OF IT SUB-LEVERS OF AGILITY

IT sub-levers of agility	Priority	Selected sub-levers
IT Architecture (SOA)	0.001996	No
Cloud computing	0.003169	No
interoperability	0.002515	No
Mastery of IT resources	0.010686	Yes
Use of HRIS	0.010686	Yes
Perceived ease of use of IT	0.016598	Yes
Usefulness of IT	0.016598	Yes
3D printing	0.001083	No
Robotics	0.006693	Yes
RFID	0.002534	No
Internet of Things	0.003920	No
Mobile	0.002851	No
Using Groupwares and workflows	0.001542	No
Use of intranets / extranets	0.001378	No
Use of document management systems	0.001938	No
Using content management systems	0.000983	No
Decision support systems	0.004300	Yes
Big Data Analytics	0.004442	Yes
Knowledge management using artificial intelligence	0.003640	No

In this case study, the company should focus on the use of robotics for automating processes, decision support systems and Big Data analysis for an accurate and timely decision making. In addition, the company should develop IT acceptance (usefulness and perceived IT) by ensuring an effective change management among employees while deploying new systems. Finally, the IT skills of employees, including the mastery of IT resources and the effective use of HRIS, should be enhanced through training and collaborative platforms.

4   CONCLUSION

Through this article, we have proposed a global approach allowing the company to evaluate its agility index and recommend IT levers of improvement. Our global approach integrates results of our previous works concerning an OA conceptual framework as well as some proposed methods for evaluating organizational agility index and recommending IT levers for improvement. To evaluate the agility index, our approach allows the company to choose a method among a fuzzy method and one based on computation according to its context. Our approach helps the company to essentially improve the impact of IT on its organizational agility, by prioritizing and selecting the most appropriate IT levers. This allows the company to refine its IT strategy by adopting the tools and practices that help it to improve its agile transformation. Decision-makers can "monitor" the agility level of their company and optimize the use of IT resources for a

better agility and thus to achieve a sustainable performance. Through the case study, we've noticed how our approach has helped the company to assess its organizational agility index. This index is coherent with the perception of the company's executive. In addition, the company is aware of the provided recommendations of IT levers which should be implemented in order to enhance its organizational agility. Finally, we plan to apply our proposed approach to another set of companies belonging to different sectors (telecommunications, energy, banking ...). Another perspective could be to extend our approach to allow choosing among proposed predictive scenarios for OA evolution.

REFERENCES

[1] K. Lawrence, "Developing Leaders in a VUCA environment," Unc Exec Dev, pp. 1-15, 2013.

[2] R. Dove, "Agile Enterprise Cornerstones: Knowledge, Values, and Response Ability," in Baskerville, R. et al. (Eds.), Business Agility and Information Technology Diffusion, Springer, Berlin, pp. 313-330, 2005.

[3] P. T. Kidd, "Agile Manufacturing: A Strategy for the 21st Century," IEEE Agile Manufacturing Colloquium, pp. 1-6, 1995.

[4] E. Overby, A. Bharadwaj and V. Sambamurthy, "Enterprise agility and the enabling role of information technology," European Journal of Information Systems, vol. 15, no.2, , pp. 120-131, 2006.

[5] A. Bifet, "Mining big data in real time," Informatica, vol. 37, no. 1, 2015.

[6] M. Barrett, E. Davidson, J. JPrabhu and S. L. Vargo, "Service Innovation in the Digital Age: Key Contributions and Future Directions," MIS Q., vol.39, no.1, pp. 135–154, 2015.

[7] L. Mathiassen and J. Pries-Heje, "Business Agility and Diffusion of Information Technology," European Journal of Information Systems, vol.15, no.2, pp. 116, 2006.

[8] M. Santo, "Bloom's Taxonomy of Learning and Knowledge Management Relationship," Knowledge Management: Action Learning, 2010.

[9] R. Hakikur and D. Dinis de Sousa, "Information Systems and Technology for Organizational Agility, Intelligence, and Resilience" IGI Global, 2001. http://www.igi-global.com/book/information-systems-technology-organizational-agility/97310.

[10] Y. Lu and K. Ramamurthy "Understanding the Link between Information Technology Capability and Organizational Agility: An Empirical Examination," MIS Quarterly, vol. 35, no. 4, pp. 931-954, 2011.

[11] D. J. Teece, "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance," Strategic management journal, vol. 28, no.13, pp. 1319-1350, 2007.

[12] M. A. Marhraoui and A. El Manouar, "IT-enabled organizational agility-Proposition of a new Framework," Journal of Theoretical and Applied Information Technology (JATIT) , vol. 95, no. 20, pp.5431-5442, 2017.

[13] M. A. Marhraoui and A. El Manouar, "Comparative review of the main agility assessment methods: a context-based selection proposal," Proceedings of The 10th MAC Prague 2017, pp. 172, 2017.

[14] C. Lin, H. Chiu and C. Po-Young , "Agility Index in the Supply Chain," International Journal of Production Economics, vol.100, no.2, pp. 285–99, 2006.

[15] A. Ganguly, N. Roshanak and V. F. John, "Evaluating Agility in Corporate Enterprises," International Journal of Production Economics, vol.118, no. 2, pp. 410–23, 2009.

[16] J. Ren, Y. Y. Yusuf and N. D. Burns, "A prototype of measurement system for agile enterprise," in proceedings of the international conference on quality, reliability and maintenance; pp. 247-252; by Professional Engineering Publishing, Bury St Edmunds, 2000.

[17] C. Yauch, "Measuring agility as a performance outcome, ", Journal of Manufacturing Technology Management, vol. 22, no. 3, pp. 384-404, 2011.

[18] B. M. Arteta and R. E. Giachetti, "A Measure of Agility as the Complexity of the Enterprise System," Robotics and Computer-Integrated Manufacturing, 13th International Conference on Flexible Automation and Intelligent Manufacturing, vol. 20, no. 6, pp.495–503, 2004.

[19] M. A. Marhraoui and A. El Manouar, "An AHP Model towards an Agile Enterprise," International Journal of Advanced Computer Science and Applications (IJACSA), vol. 8, no. 11, pp. 151-156., 2017, http://dx.doi.org/10.14569/IJACSA.2017.081119.

[20] M. A. Marhraoui and A. El Manouar, "Multicriteria model for choosing organizational agility assessment method" In Proceedings of the 12th International Conference on Intelligent Systems: Theories and Applications (SITA'18). ACM, New York, NY, USA, Article 39, 6 pages, 2018, DOI: https://doi.org/10.1145/3289402.3289539.

[21] K. D. Goepel, "BPMSG AHP Online System: Multi-Criteria Decision Making Using the Analytic Hierarchy Process, " 2014.

[22] T. L. Saaty, "A scaling method for priorities in hierarchical structures," Journal of mathematical psychology, vol. 15, no. 3, pp. 234-281, 1977.

[23] P. Holecek and J. Talasova, "FuzzME: a new software for multiple-criteria fuzzy evaluation," Acta Universitatis Matthiae Belii ser. Mathematics, vol. 16, pp. 35-51, 2010.