

PRIORITIZATION OF KEY PERFORMANCE INDICATORS FOR SMALL AND MEDIUM ENTERPRICES

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Abstract: *Performance measurement, as a new approach of monitoring enterprise activities, was primarily introduced and successfully realized in the manufacturing industries. In the last years, measurement methodology is becoming more popular and widely spreading. A high amount of different researches has been carried out in this area. As result-different frameworks, systems and method were created for SMEs. Key performance indicators (KPI) are known as assessing tool for performance measurement. The main idea is based on measuring present processes and comparing them to previous and also to the best in the specific sector. The indicators would provide exactly information regarding bottlenecks and also would help to eliminate weak spots in companies. The continuous measurement of all processes is one of the ways to achieve success and optimize production.* [1]

In the following sections, the SMARTER goal setting method, oriented to KPIs is briefly introduced and the fuzzy AHP model in connection to SMARTER criteria has been established.

Key words: Small and medium enterprises, key performance indicators, Analytical hierarchy process, SMARTER criteria.

1. INTRODUCTION

Due to globalization, hard competition, privatization and deregulation in each field and sector, implementation of new technologies, optimization of production processes, knowledge establishment and innovation potential of company have

emerged the main factors of competitive advantage [2,3]. Businesses currently must operate within a dynamic environment of fierce competition, shrinking budgets, and heavy price pressures [4]. As a consequence, organizations deal with many key performance indicators (KPIs) in different areas [5]. However, due to the high amount of different metrics and their various impacts on enterprise's health in total, the management had being faced with difficulties in right indicators selection and in decision making. In addition, KPIs that have changed situation in one company do not supposed to work in another. Numerous amounts of factors, starting from labor's education and qualification skills, condition of machine park to the financial component (budget, revenue, investments) and their influence on present moment, are making impossible to standardize metrics so that they could work at different company with same efficiency. The objective of this paper is to introduce the Fuzzy AHP and the opportunity to rank metrics based on SMARTER criteria.

2. SMARTER GOAL SETTINGS

In any company, goals are guiding enterprise's effort, supporting and optimizing resources, helping in moving straight ahead to their visions. In other words, the goal setting is one of the important processes that should be done at first place by management [6]. However, by setting objectives, which are complicated, there is a risk that they can be too overwhelming to everyone. Furthermore, KPIs, which are reflectors of

enterprises goals, should be based on criteria, that make them suitable for further studies. [5] In 1981, G.T. Doran has proposed SMART way of setting objectives. Although, many organizations have applied SMARTER model considering the fact, that two additional criteria are good reminder to managers that they are staying on top of the process. [7] *Specific* - Goals should be detailed and as specific as possible. Loose, broad or vague goals are not desirable. When goals are specific, it is much easier to hold someone to account for their achievement. Taking into account KPI- the clear understanding of what its measures, should be.

Measurable - Each objective, process or KPI should be measurable. The measure itself could be quantitative or qualitative, but measurement shall comply with standards and requirements, depending of the main goal.

Achievable – Objectives should be set at right level. They need to be ambitious and realistic however, making them too simple won't be motivating. In addition, each KPI should have the standard value that should be achieved.

Relevant (if sometimes it's linked with agreed then it's similar to achievable) – every colleague in a team or as individual, need to understand and compare how the objective is relevant to their role and main course of the team. Furthermore, KPIs should provide insight in the performance of the company in obtaining its strategy. In case, when KPI is not measuring a team's or enterprise's goal or doesn't affect the organizations' performance, it's useless.

Time-specific (or time-sensitive) – Work or tasks should have deadlines. Having the frame for completion would provide possibility to monitor and analyze the progress. In addition, each KPI has a meaning if every knows the time frames in which it is measured and realized.

Explainable or Evaluated – Very often, KPIs have been measured without understanding of their purpose and whole process. Managers need to ensure, that

everyone, who is involved in measuring process, is aware of goals. In addition, from point of “evaluated”, KPIs should evaluated performance and progress of what is measured (is it performance of a team, or of a process)

Relative or Reviewed – KPIs should be relative and ensure that their definitions and goals still could be applied when enterprise is growing or volumes are rising. [5,7,8]

3. AHP and FUZZY AHP APPROACH

Analytical hierarchy process (AHP) is a mighty method, which was developed by Saaty in 1980s [9] to simplify the decision making process. It includes qualitative and quantitative techniques and provides possibility to decompose difficult and complicated problems into sub-problems where each level shows a set of objectives or criteria relative to each sub-group. [5,10,11] Although, the nine-point scale simplifies the choice of criteria and provides information regarding dominance of each element over others regarding importance to each criteria of the higher levels of the hierarchy and individual points of view are made in groups, taking into account the pertinent decision maker and are handled as foundation for analysis on the reasons for specific judgements, [12,13] there is the one week spot, which occurs during the setup of comparisons matrixes. When the number of characteristics is rising in hierarchy, more matchings between attributes needs to be applied. Therefore, consistency test should be carried out till comparisons matrixes would become consistent. To reduce the time and eliminate confusions in case of large matrixes, Fuzzy AHP method [10] should be applied. In comparing to Saaty's scale (Table 1), the membership scales is been used and values are lying between range [0,1] (Table 2) Furthermore, proposed methodology is more straight forwarded and easier to use for decision-makers. [10,11]

Importance	Definition	Explanation
1	Equal importance	Two criteria/elements contribute equally to the objective
3	Moderate importance	One element is slightly over another
5	Strong importance	One element is strongly over another
7	Very strong importance	Criteria/element is favored very strongly over another
9	Absolute/Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Used to express intermediate value	

Table 1. AHP nine-point scale [^{13,14}]

Scale values	The relative importance of the two sub-elements
0.5	Equally important
0.55 (or 0.5 0.6)	Slightly important
0.65 (or 0.6 0.7)	Important
0.75 (or 0.7 0.8)	Strongly important
0.85 (or 0.8 0.9)	Very strongly important
0.95 (or 0.9 1.0)	Extremely important

Table 2. Scale for Fuzzy AHP pair-wise comparison

4. INTEGRATION OF FUZZY AHP WITH SMARTER CRITERIA

The Fuzzy AHP hierarchy has been built based on SMARTER criteria and combined with 13 KPIs (Table 3) that were sorted by group of experts (outlier's detection methods, like Tukey's, Adjusted Boxplot, Standard deviation method, Z score and Modified Z score, were used) optimized from amount of 41 KPIs. [¹⁵]. The goal, which was established for this approach, is the acquiring of sustainable KPIs for improvement of productivity, effectiveness and finding out optimal parameters to check and monitor with production

monitoring system. On the first level, comparison between SMARTER criteria should be established. On the second level, the sub-criteria (KPIs) should be compared to each criteria from first level. (Fig. 1) Example of fuzzy comparison matrix at sub-criteria level is illustrated on table 4. The calculation of the priority weights (W) should be foreseen as next step:

$$(W = w_1, w_2, \dots, w_n) \text{ [}^{10}\text{]}$$

$$w_i = \frac{b_i}{\sum_{i=1}^n b_i}, (1) \text{ where}$$

$$b_i = \frac{1}{(\sum_{j=1}^n \frac{1}{r_{ij}}) - n}$$

r is the value of pair-comparison from fuzzy comparison matrix, n is the amount of criterias (in our case n=7 at first level and n=13 at sub-criteria level).

Expert group (in number of 10 people) that have at least 5 years experience in production or in similar to main research of this paper field, would be formed. The main idea is to raise the quality of analyze data. As a result, the ranking list for 13 KPIs would be created.

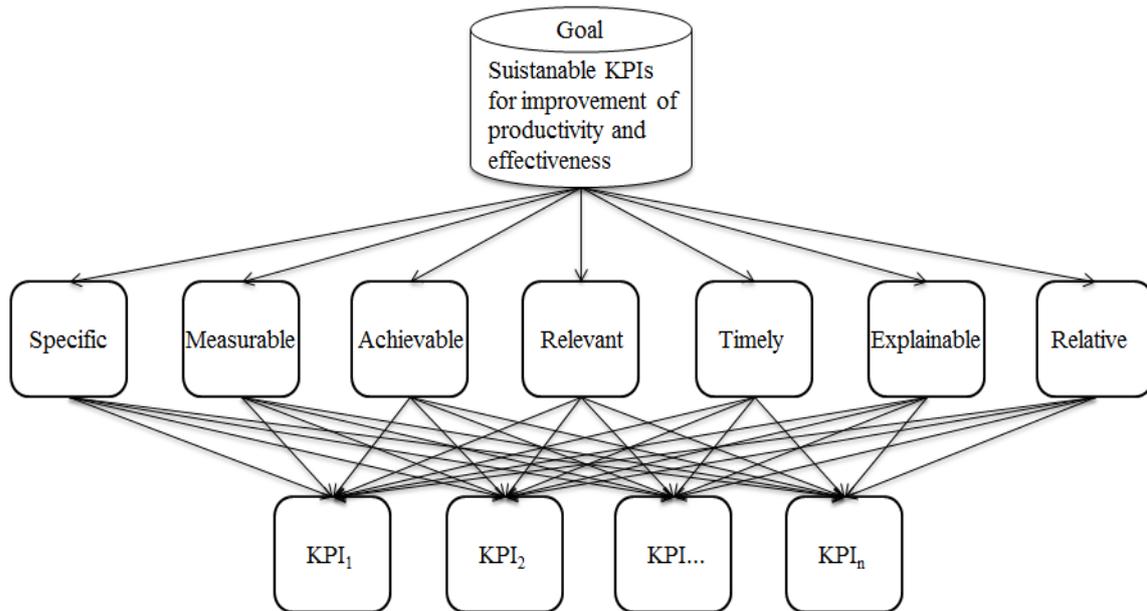


Fig 1. AHP hierarchy integration with SMARTER criteria.

Table 3. KPIs selected for study

KPI abbreviation in comparison matrix	Definition
KPI1	Inventory turnover
KPI2	% of additional freight costs
KPI3	Product quality/quality ratio
KPI4	FPY (first pass yield)/Throughput yield
KPI5	DPU (defects per unit)
KPI6	Employee's efficiency
KPI7	changes implementation time
KPI8	Actual production Time
KPI9	OEE (Overall Equipment effectiveness)
KPI10	NEE (Net Equipment effectiveness)
KPI11	OTD (On time delivery)
KPI12	Tact time
KPI13	Unit/Line Reliability

Table 4. Example of fuzzy comparison matrix at sub-criteria level

	Specific												
	KPI1	KPI2	KPI3	KPI4	KPI5	KPI6	KPI7	KPI8	KPI9	KPI10	KPI11	KPI12	KPI13
KPI1	0.5												
KPI2		0.5											
KPI3			0.5										
KPI4				0.5									
KPI5					0.5								
KPI6						0.5							
KPI7							0.5						
KPI8								0.5					
KPI9									0.5				
KPI10										0.5			
KPI11											0.5		
KPI12												0.5	
KPI13													0.5

Table 4. Example of fuzzy comparison matrix at sub-criteria level.

5. FURTHER RESEARCH

The comparison matrixes would be completed by experts and weights would be calculated based on equation 1. The acquired results would help to arrange ranking list of selected KPIs. Data collection and whole EAM model testing on different companies are foreseen as next steps. The optimization and improvement processes of EAM and KPI selection model should take part continuously. To summarize:

- KPIs priority calculation and ranking
- Data collection from different SMEs
- Optimization and improvement of EAM as continuous process and integration to the production monitoring system [16, 17]

6. CONCLUSION

Considering “harsh economic environment” nowadays and wish of every

enterprise be successful in their field by earning revenue, the measurement and optimization of processes remains one of the major task for the managers. The KPI should provide ability to follow up present situation at company and to discover critical spots not only at production but at whole enterprise. Described approach of synchronization Fuzzy AHP and SMARTER criteria for achieving important steps in KPIs selection and ranking was described in this article. 13 KPIs which were selected for previous study are seen as key stones of enhancement the position of SME. Furthermore, the future steps were defined for next researches. The KPI selection model could become powerful tool in management’s hands, which would serve as general key in decision making process, considering improvement and optimization of production. In addition, model should reduce analyze time and make processes more understandable

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