USING THE CATWOE METHOD IN THE MANAGEMENT OFINNOVATION. CASE STUDY IN AUTOMOTIVE INDUSTRY

Maria Luciana Atomei, PhD Fellow, ProjectPOSDRU/159/1.5/S/133675, „Gh. Zane" Institute of Economic and Social Research, Romanian Academy, Iaşi Branch, "Gheorghe Asachi" Technical University of Iasi,

Abstract: The overall objective is to contribute to a better understanding of the management of innovation and technology transfer process in automotive companies and improve learners' knowledge and skills to master and to support this process.
For deepening the proposed theme, namely how to use the CATWOE method in management of innovation, the paper focuses on the qualitative analysis, but also using scenarios and fuzzy numbers.
The present analysis aims to help the development of the methods and techniques used in the management of innovation within a case study, starting with the analysis of particularities of management in the automotive field. The study is identifying specialized items that lead to a detailing analyze in a company dedicated to the development and production of automotive components from Timisoara.

Keywords*:innovation, management, CATWOE method, automotive industry.*

Using CATWOE method

This method is through the use of scenarios and facilitates decision making especially in unexpected situations. For successful implementation of the method, it is necessary to consider several developments that could be possible to prepare several action plans foreach situation.

In decision making, leveraging CATWOE is used by describing actual future scenario, including all relevant information for the decision to be implemented. There are specific situations where this method is very secure; an example would be when taking long-term decisions (e.g. storage of waste very dangerous without access to it for longer than a thousand years).

The knowledge-based society needs new methods and instruments for a superior processing of the increased amount of data. In the case of qualitative methods based on reasoning that are used in management in knowledge-based society, the accent is put on the experience and professional quality of top managers to be able to anticipate economic, social and technological events that impact the organization We consider the utilization of elementary nuanced numbers would represent a major step forward in the development methods for the evaluation of attributive characteristics. A new mathematics is needed based on fuzzy number classes, with complex presentations and specific operations. A special advantage for the knowledge-based society could be the development of decision-assisting software with fuzzy numbers - Ciprian Ionel ALECU, 2012 *(Considerations on the development of the qualitative techniques in management processes by using triangular nuanced numbers,*THE YEARBOOK OF THE "GH. ZANE" INSTITUTE OF ECONOMIC

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According to Shoemaker, (Shoemaker, PJH, 1995 Scenario planning: a tool for strategic thinking. Sloan Management Review, 36 (2), p. 25-40), scenario stages of development are:

- *Identify the key factors which are the most important in a decisional process and define the period of time that they vary;*
- *Identify the most important stakeholders decision makers;*
- *Evaluate technical trends, political, economic, social and legislative that can have an impact, which is difficult to assess as compared to those assessed at the decision making process;*
- *Evaluating main sources uncontrollable that in time will have a positive impact or negative impact in the analyzed process. Generally man by nature focuses more on certain aspects, smaller and less on other things that might devein critical over time;*
- *Develop Preliminary scenarios completely different, assessing things in the best case and worst case;*
- *Evaluate the two scenarios and identification of intermediate situations;*
- *Develop Likely behaviors of the actors involved;*
- *Develop an action plan for some situations, most likely without the precision of predictions, but to be covering for most cases.*

This analysis is used to ask a question about the performance that is has to be achieved. The prospects for business development help to analyze the impact of proposed solutions and progress. CATWOE method comprises 6 elements:

1. Customers - who may benefit or who will bring impact on the system and need to be analyzed so as to identify how the process or the system may be affected by them, and how they can be influenced system. From the outset, it must be clear who wins if things would change in that way and who has lost and of course if it is worth the loss. For example, we analyze the research department - development, C is the end customers who will purchase the company's products analyzed or subsequent employers of trained human resources professional.

2. Actors - in other words employees are also analyzed the way in which they fulfill their responsibilities and on how they will implement required new process' activities. Who is involved in the proposed actions, who will be responsible for implementing solutions, such employees will be professionally impact from the proposed project? The answer corrective actions are those that meet those who are members of the program to be implemented. In our case, the actors are company employees, regardless of position or rank.

3. Transformation - this component of the method include the analysis of changes that were made to the system or process. Also the nature of these changes is actually listed and stated startup information, and expected results. What processes or technologies and systems are affected by your change - actions that are supported by the company's system (certain rules, workflows). If taken as an example, this process is called training and is analyzed in all its

prospects, and can also be represented by new processes that are implemented in the production of finished goods of the company.

4. Weltanschauung - environment - this step of the method CATWOE requires the system to be analyzed in the wider context, understanding the relevance of each process will be implemented in the system. So every detail is accompanied by an explanation of the presence of this aspect.

The whole company is analyzed from the perspective of society as a whole vision. So any solution or program update will be reported to the superordinate system that analyzes thus taking advantage of highlighting of the consequences from the company that may occur.

5. Owner - in this phase are analyzed system owners / process and all those involved in the issue under examination. Who owns the process, who is assigned to investigate the situation? It aims at factors that actions have enough influence to stop the system if it were like this - in our case, if the company owner does not wish to oppose or make changes or proposed solution.

6. Environmental constraints - also includes analysis of external elements in the process or the system will evolve and function. These day constraints will advance or will endanger the project. What day constraints or limitations that may impact on the implementation of the solution, or that may affect the ultimate success? These relate to the limits of any kind (ethical, financial, human).

Who owns the process, who is assigned to investigate the situation, what role to play in implementing solutions and who is responsible for each risk that must be defined? As one method applied in a case study does not consider all important aspects of the topic to be analyzed by the method CATWOE we gather information along with the analysis of several specialty items Company profile analyzed, and finally all results It offers translation of future programs and solutions as appropriate to the situation faced by employees and company.

Case Study CATWOE in an automotive company

This paper presents a case study using the tool Catwoe method applied to the case of three scenarios from an automotive company that refer to methods and techniques of innovation to keep a company competitive on the automotive market.

These scenarios were analyzed in a company road by one team consists of four specialists R & D department and four experts of the department of marketing and management from research and development department.

The engineers are specialists in several fields - two specialists in design and design with knowledgeable in automotive design and the two specialists from the outside company are collaborating with automotive company that produces and delivers most of injection tools needed for production. The team has undergone a focus group surveys on all six indicators of evaluation of Catwoe method.

Scenario 1

In scenario 1, we present the current situation in a company producing automotive lighting systems, a situation perceived from the perspective of management and from the point of view of the market situation.

Most wide range of products with very high volumes within the company are lighting lamps using simple technology, with light, known on the market and used by most manufacturers in the automotive. Bulb technology is suitable for design and classic styling of vehicles, with simple forms, straight lines and circular-based, with an area of light under the current rules, but with a fairly limited distribution of light.

This technology does not require a large number of components, and could reduce the lamp lens, housing, light bulb, support, sealing, fasteners (washers, nuts, screws, pins). Components are classic, simple, you need a small work team - engineer mechanic, optician (also responsible for product approval) process and test engineering / manufacturing and assembly line operators. The production line is reduced to work with all cell processes included. It is containing line fasteners / adjustment / pressing appropriate but which are interchangeable and easy to install and use. Like technology, the bulbs have a lifespan low, all which are used in the automotive division involve changing them at intervals that depend on the operating environment of the lamp / the vehicle.

Due to harsh environmental conditions (agricultural machinery, fluctuating temperatures, dust, humidity) and due to the need to change bulbs, lamps can be designed completely watertight, so further increasing the risk of actually working environment. The risk of deterioration of wiring due to high-frequency lamp replacement becomes more pronounced the opportunity to reverse the damaging wiring or electrical connections. Environmental effects supported by these factors are felt on the appearance of the lamp. One of the main drawbacks is the need to create adaptive forms of new vehicle models - requiring design models after irregular geometric shapes, and lighting requirements from many angles, a modern and innovative - based on a futuristic stylistic aspect. In terms of managerial, technological wear and the emergence of new requirements in automotive development trend leads to decreased sales and loss of existing customers and minimizes the possibility of attracting new customers.

The development of all areas related automotive trend towards design as innovative and tailored customer requirements leads to the need for modern lamps and matching new technologies.

Scenario 2

The main solution to improve the lamps keep changing appearance through the use of more complex shapes, but also to obtain a better distribution of light. Providers offer alternative lighting sources to bulb - classic bulbs type xenon, halogen (light output thus increases by approx. 20% and also increases the lifetime of the bulb).

However, new solutions offered by suppliers of components without increasing costs to final product. A solution of technical, design engineer is provided and means creating a new component to assist in the reflection of light (spotlight, magnifier) - a new mechanical component but which require a new molding tool and a locking system on the lamp.

New forms of design requires changing their behavior because the materials used must support the sealing system, which leads to partial or total replacement of gaskets by using other processes - using glue adhering to plastics.

The complexity of the forms require replacement of the ultrasonic welding technique, for example, by the use of more thermally stable materials, but also to radiation and scratch resistance. For some functions of auto headlamp, electronic components can be integrated to ensure LED operation only certain modules of the full set of features, but the process can be considered only for a short period of time, to integrate all the necessary requirements of new technologies.

However transition to LED technology cannot be done abruptly but gradually achieved, the integration of electronic components require a completely different approach to the whole concept of the lamp. LED functionality is conditional on an electronic circuit - printed circuit board. This component involves the purchase of a new dedicated lines and adapting the entire assembly process and production requirements of the new technologies.

Scenario 3

In scenario 3, we present an innovative solution in line with market requirements - fully achieve lamps using LED technology. Lamp life exceeding five years, requiring no adjustments during the lifetime of this technology standing out through low consumption (a technology of the future, especially during the development of electric cars) but also through innovative design, power lighting and light distribution. LEDs provide methods for automatic adjustment, independent without being ordered by distance, but by using sensors.

Of course, to assimilate this technology based on electronic components, large investments are necessary both in terms of production as from the point of view of staff capabilities. LED lamps can be programmed on automated assembly lines-through automated bots, but also lamps testing requirements are very high - over time and customer demands have skyrocketed.

New technologies available to give more room for progress in implementing design ideas but also bring new challenges and new problems to solve. LED technology used in the lamps brings a new design, a new form, a new mode of production, and high temperatures inside the new products.

LED lamps are completely sealed, so solutions must be found of ensuring the complete tightness through various modes of bonding, ultrasonic welding and at the same time providing a great way to remove heat released by the LED.

In this analysis, the team **established the most important factors that influence the CATWOE method:**

1. Product price - this indicator has major impact on sales but also on the competitiveness of the market and is influenced by development costs, production and technology necessary to produce a lamp. The price of the lamps is given by these three factors in the economic context of the automotive market, and having a major local supplier.

2. Aspect and product functionality - client and design methods developed in compliance with assets, define the look and functionality of a product. Most products are

produced to customer specific requirement and is one innovative aspect, in line with developments vehicles.

3. Level of product innovation - this indicator is given by the company's technological level and the level of training of human resources in research and development teams. At the same time the level of innovation is constantly evolving pushed by competing companies and the growing requirements of customers new and higher.

4. Qualified - company has programs to encourage higher education to raise the level of training of the entire staff, and training programs - you can even repeat, to give every person the chance to learn some processes, but also can contribute to their improvement. There is also a program spurred by financial bonuses for new ideas, tracing the courts or long-term improvements.

5. Staff replacement - thanks to the multitude of companies involved in the automotive, staff turnover is quite high alert and one each department wanting people better trained, with experience in the field - thus preventing a huge budget spending for multiple iterations in product development due to lack of experience.

6. Employee Involvement - Human resources and Management Company organizes actions to identify potential problems or other organization that could motivate employees. Use motivation through involvement in specific projects, financial motivation and analysis of the achievement of performance required by the job description.

7. Support for a result-oriented management - Management team is involved in all stages of product development in order to understand and direct the best efforts of the entire project team, but also to keep under control the final price of the product.

8. The means of production - are required by the market at current levels, but consistently reviewed for improvement.

9. Technical skills staff - ensure training of personnel, and implementing programs communication, teamwork.

10. Organizational flexibility - working hours are flexible, being able to organize employees so that they feel as comfortable at work. Flexibility exists at developed products directly to customers - the company is always trying to achieve the customer needs and offering solutions to most challenges new products.

11. Ability for distribution and promotion of company products - used catalogs, presenting the whole wide range of products and accessories offered with several options and dedicated customer at the same time ensuring even and implementation of specific requirements customer. The company constantly participates at fairs road for presenting new products and innovations and tapping new requirements.

12. Reputation- analyzed company is a family company with a history of more than a hundred years, which has offices in many countries, an independent company.

13. Market share of the company - company enjoys a highly experienced teams of experts in related fields and serves major customers in the market.

14. Pricing - is defined by departments dedicated to this sector and is closely linked to the products developed.

15. Force-selling services for identifying potential customers in the market are constantly analyzed and redesigned according to existing findings and confirmed orders.

16. Experience of the company - Company develops production in lighting technology and electronics for the automotive industry, with having one of the largest distribution organizations of machine parts and accessories in Europe.

17. The financial capacity of the company - is a large company with several offices under the collaboration, the company may invest in various branches of production but also move certain manufacturing sectors in favorable areas of lower costs.

18. Productive capacity of the company - This indicator will be assessed through the evaluation of the production equipment, also level of production technology, the degree of flexibility of workers, the degree of compliance with quality standards and delivery times.

19. The managerial capacity of the company - top management participates in various programs of analysis and programming production and development strategies across the company.

20. The market share of competitors - competitors are at a balanced and influence strategies and main development company.

21. Degree of innovation - almost every office, there is a team or a department of research and development, with the main aim to bring ideas and innovative products.

22. Legislation in automotive- the automotive field, the output is repeatedly verified and certified both nationally and internationally, according to the latest and highest standards.

For the evaluation of the **first scenario**, we have the matrix bellow:

CATWOE categories	**Items**	**Impact**	**Level of significance**
CLIENTS	product price	5	50%
	Aspect and product functionality	4	30%
	Level of product innovation	3	20%
ACTORS	Qualified employees	3	25%
	Staff replacement	4	30%
	Employee Involvement	3	25%
	Support for a result-oriented management	2	20%
TRANSFORMATION PROCESS	The means of production	4	20%
	Technical skills of the staff	3	30%
	Organizational flexibility	3	40%
	Ability for distribution and promotion of company products	5	10%
WORLD VIEW	Reputation	4	25%
	Market share of the company	5	25%
	Pricing	4	25%
	Force-selling services	3	25%
	Experience of the company	5	35%

OWNER	The financial capacity of the company	5	25%
	Productive capacity of the company	4	25%
	The managerial capacity of the company	4	15%
ENVIRONMENTAL CONTRAINTS	The market share of competitors	4	50%
	Degree of innovation	3	25%
	Legislation in automotive	3	25%

For the evaluation of **the second scenario**, we have the matrix bellow:

CATWOE categories	**Items**	**Impact**	**Level of significance**
CLIENTS	product price	6	30%
	Aspect and product functionality	5	40%
	Level of product innovation	5	30%
ACTORS	Qualified employees	4	15%
	Staff replacement	5	30%
	Employee Involvement	4	25%
	Support for a result-oriented management	4	30%
TRANSFORMATION PROCESS	The means of production	4	30%
	Technical skills of the staff	6	45%
	Organizational flexibility	3	10%
	Ability for distribution and promotion of company products	4	15%
WORLD VIEW	Reputation	5	25%
	Market share of the company	4	25%
	Pricing	3	25%
	Force-selling services	4	25%
OWNER	Experience of the company	5	25%
	The financial capacity of the company	4	25%
	Productive capacity of the company	5	15%
	The managerial capacity of the company	4	35%
ENVIRONMENTAL CONTRAINTS	The market share of competitors	6	45%
	Degree of innovation	4	25%
	Legislation in automotive	3	30%

For the evaluation of **the third scenario**, we have the matrix bellow:

CATWOE categories	**Items**

		Impact	Level of significance
CLIENTS	product price	4	30%
	Aspect and product functionality	6	40%
	Level of product innovation	5	30%
ACTORS	Qualified employees	5	30%
	Staff replacement	6	20%
	Employee Involvement	6	30%
	Support for a result-oriented management	4	20%
TRANSFORMATION PROCESS	The means of production	4	30%
	Technical skills of the staff	4	30%
	Organizational flexibility	5	20%
	Ability for distribution and promotion of company products	5	20%
WORLD VIEW	Reputation	4	20%
	Market share of the company	4	40%
	Pricing	4	30%
	Force-selling services	5	10%
OWNER	Experience of the company	5	25%
	The financial capacity of the company	4	25%
	Productive capacity of the company	5	25%
	The managerial capacity of the company	4	25%
ENVIRONMENTAL CONTRAINTS	The market share of competitors	6	20%
	Degree of innovation	5	40%
	Legislation in automotive	6	40%

After evaluation and analyses of the three scenarios, bellow matrix of the consequences is obtained:

Scenario		**ACTORS**	**TRANSFOR-MATION PROCESS**	**WORLD VIEW**	**OWNER**	**ENVIRONMENTAL CONTRAINTS**
S1	[4.3]	[3.1]	[3.2]	[3.6]	[3.8]	[3.1]
S2	[4.2]	[4.8]	[4.4]	[5.1]	[4.4]	[4.9]
S3	[5.1]	[4.2]	[4.4]	[4.1]	[4.5]	[5.3]

Identifying optimal course of action under uncertainty is based on criteria specific decision. The most popular and used criteria developed include:

- Criterion pessimistic (Abraham-Wald);

$$V^* = \max_i \min_j \left(\tilde{R}_{ij}\right)$$

The criterion Bayes-Laplace (the equiprobability).

$$V^* = \max_i \left\{\tilde{E}_i\right\} = \max_i \left\{\frac{1}{n}\sum_j \tilde{R}_{ij}\right\}$$

In our **case we have *m*= *6 (lines / criteria*) and n = 3 (columns /scenarios/ variants** decision).

The results matrix (original matrix)

	V1	V2	V3
C1	4.3	*4.2*	5.1
C2	*3.1*	4.8	4.2
C3	*3.2*	4.4	4.4
C4	3.6	*5.1*	4.1
C5	*3.8*	4.4	4.5
C6	3.1	*4.9*	5.3
Min	**3.1**	***4.2***	**4.1**
$\mathbf{V^* = \max_i \min_j \left(\tilde{R}_{ij}\right)}$			**4.2**

Pessimistic technique developed by AbrahamWald, on the premise that the optimum solution is one that requires maximum benefit in situations where objective condition sare unfavorable.

Specific indicator V_j , $j = \overline{1,6}$ will be determined with formula from relations bellow:

$$V_1 = \min_{1 \le i \le 5} u_{i1} = \min(4.3, 3.1, 3.2, 3.6, 3.8, 3.1) = 3.1$$

$$V2 = \min_{1 \le i \le 5} u_{i1} = \min(4.2, 4.8, 4.4, 5.1, 4.4, 4.9) = 4.2$$

$$V3 = \min_{1 \le i \le 5} u_{i1} = \min(5.1, 4.2, 4.4, 4.1, 4.5, 5.3) = 4.1$$

According to this criteria, V2= $\max_i \min_j \left(\tilde{R}_{ij}\right)$ **= 4.2,** corresponding to the second scenario is the optimum solution with maximum benefits and in unfavorable conditions, so the conclusion is that companies should develop and maintain in the production products with both technologies - bulbs and LEDs, this solution being favorable regarding costs, evolution of design and other competitors market - this solution is analyzed in terms of Abraham technique.

The techniquedeveloped byBayes-Laplaceis defined by formula:

$$V^* = \max_i \left\{\tilde{E}_i\right\} = \max_i \left\{\frac{1}{n}\sum_j \tilde{R}_{ij}\right\}$$

In our case, average max is selected to take the variation of all factors into account in conditions in which there is a favorable trend and not an ultra-optimistic scenario:

	V1	V2	V3
C1	4.3	*4.2*	5.1
C2	*3.1*	4.3	4.2
C3	*3.2*	4.4	4.4
C4	3.6	*5*	4.1
C5	*3.8*	4.3	4.5
C6	3.1	*4.3*	5.3
Average	**3.5**	***4.4***	**4.6**
$V^* = \max_i \{\tilde{E}_i\} = \max_i \left\{\frac{1}{n}\sum_j \tilde{R}_{ij}\right\}$			**4.6**

Laplace proportionality in this case is giving the third scenario as being the optimum scenario, because of the higher values for all the six criteria of the method (C1…C6). Each state has the objective conditions comfort probability y of occurrence. The optimal variant is the average of the results for the corresponding states is considered most favorable, in table above, this is the third scenario - $V^* = \max_i \{\tilde{E}_i\} = 4.6$.

Why in our analyse, with Abraham Wald method, the result is the second scenario and with Laplace method is the third scenario ?

In case of pesimistic method Abraham, scenario number 2 is favorable, becouse progress is needed, but not with so many risks of implemeting the new products. In case of Laplace proportionality, the favorable solution is the third scenario, according to new design requested on the market and according to the new revolutionary shapes desired by customers.

Conclusions

CATWOE is a technique that by directing conscious, leading to a detailed analysis of the issue. Its origins can be found in cyber, which analyzes the behavior of systems. Therefore, this method is used, in particular when working on the definition of the root system. It applies to systems having a problem, or need to find a solution, or to pursue change. CATWOE seek solutions analyzed, looking for the essence of the problem, and defines key areas that have influence on future solutions and addresses the principles on which it can operate in the future in search of ideas.

In this paper, the method of analysis is considered CATWOE through three scenarios proposed within an automotive company, highlighting the strengths and weaknesses of items with impact in each scenario.

We propose a qualitative analysis of different scenarios based on specialty indicators, within a company competitive in the automobile market. This analysis was conducted using the method for obtaining matrix CATWOE consequences and using Abraham Wald and Laplace method.

First criteria – Abraham Wald, is giving results corresponding to the second scenario and is identifying this as being the optimum solution with maximum benefits and in unfavorable conditions, so the automotive companies should develop products with both technologies - bulbs and LEDs. These actions are for a transitional period required by a growing technology market automotive LED technology.

Second criteria – Laplace, is evaluating all indicators of CATWOE method, as an average and the result is giving the third scenario as being most optimum. Therefore, the method in the third scenario, which involves the development of future projects using the lamps and totally LED technology, is according to Laplace criteria and also it is according to the latest market trends in design, shapes and consumer demands. This scenario implies investment inthe future but that progress, is the best and biggest indicator of progress for future products. Lamp life will be higher, without the need for further adjustments, consumption is reduced and the design is adaptable, easy to design, to stringent market requirements. Therefore, this analysis shows that achieving fully lamps using LED technology, considerable advantages that can justify the investment required. LED assemblies are so current customers desired products automotive market and different solutions design engineers think of lamps as good.

The transition from the state of crisis to the state of opportunity becomes the ground on which technocratic, structural, cultural and political approaches make a difference in managing. The qualitative analysis of the level of uncertainty provides an optimal insight into the best management techniques and methods that may contribute to achieving development objectives under crisis conditions. To conduct such an assessment process, we propose the use of rectangular fuzzy numbers. In this paper, first we develop a personal analysis of the notion of rectangular fuzzy numbers with an associated variable center of gravity and specific mathematical operations - Ciprian Ionel ALECU, 2011, *Qualitative assessments and optimal decision under uncertainty using rectangular fuzzy numbers*,THE YEARBOOK OF THE "GH. ZANE" INSTITUTE OF ECONOMIC RESEARCHES, Gheorghe Zane Institute for Economic and Social Research (from THE ROMANIAN ACADEMY, JASSY BRANCH), vol. 20(2), pages 95-102.

After making a conceptual model illustrating the realization of the wishes of management, this model is integrated into the real world, day constraints of the environment and takes the necessary measures to amend or support in achieving goals. This analysis highlights the advantages and shortcomings of the model, what is achievable and what is meant to be fulfilled. In an ideal situation, these measures could be taken along the way, but in reality, some changes are needed at the outset. Then the necessary amendments are analyzed as feasibility, costs, after which it will decide on the possible and impossible situations (or realizable cost too high).

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CATWOE Technology (Checkland ScholesSoft Systems Methodology And in Action, 1990) includes an analysis of a phenomenonon several levels, which in turn should be investigated and observed, to provide insight as close to employees' needs but also to understand good complementary phenomena.

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