PROCESS IMPROVEMENT USING DMAIC METHODOLOGY IN AUTOMOTIVE INDUSTRY. CASE STUDY

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ABSTRACT: Today`s business environment, is more challenging than it ever was. The globalization appearance expanded the previous way of doing business in all fields of industry, forcing the organizations to reconsider both their products and processes, in order to overcome a potential decrease of their competitiveness and profitability. Having the right focus on customers/ market expectation, but also with a keen attention over the internal management and layout, will lead the company towards success, and strengthen its position in the industry. After the economic crisis that strongly affected and weakened the automotive industry between 2007 and 2009, all the key players encountered multiple issues, which can be diminished only by having the right organizational management, optimized cost structure, processes and products, responding to the market needs. To prevent such situations, each organization initiated a long series of internal analysis, based on theoretical concepts given by the literature.
KEY WORDS: DMAIC methodology, process improvement, automotive industry, production planning, evaluation

1 INTRODUCTION

The current case study will be performed in one of the biggest Original Equipment Manufacturer (OEM) from the global automotive industry, and has as a starting point a general issue: the delays and disruptions occurred during the production planning process.

This issue has a significant impact cross the key departments of the organization, generating financial loses and affecting the launches of the new products, therefore there is a strong need for improvement in this area.

Developed by Motorola in the 1986, Six Sigma methodology is a set of techniques and tool for process improvement (Kifor & Oprean, 2006) and it is used widely in the industrial areas. The term "six sigma" comes from statistics and is used in statistical quality control, which evaluates process capability (Tennant, 2001).

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There are two methodologies, inspired by Deming`s Plan – Do – Check – Act Cycle (De Feo, Joseph & Barnard, 2005), comprising each of them a sequence of five phases, known as DMAIC and DMADV.

DMAIC is used for projects aimed at improving an existing business process (De Feo, Joseph & Barnard, 2005),, while DMADV it is used for projects aimed at creating new product or process designs (De Feo, Joseph & Barnard, 2005),.

In other papers, Six Sigma was defined as the management approach of achieving major enhancement in the process by implementing DMAIC cycle through elimination of waste (Singh & Singh, 2014).

2 CASE STUDY

2.1 Define

Based on the previous and current year management analysis, several issues have been identified as drivers for the frequent production planning disruptions that have a direct impact on the organizations forecasted profitability. In order to conclude a feasible study, five of the most important issues have been selected and will become the focus of this paper. Some of these are:

- significant number of recalls (A),
- frequent expectation of the customer behavior (B)
- unstable political situation in the emerging markets (C),
- difficult financial situation of the Original Equipment Manufacturer (OEM) due to the

increasing number of saturated (mature) markets (D).
- production planning delays (E),

The tool used in the analysis of each identified issue was these the problem evaluation matrix (Table1.).

In order to use the proposed instrument, a series of evaluation criteria had to be establish such as:

- severity (S) the project has to correct a frequent issue.
- timeframe (T) the implementation timing shall be maximum one year.
- Criticality (C) the project is critical if that issue weakens the organization).
- Resistance to changes (Rc) selects the project with the lowest resilience rate to organizational changes.
- Measurable (M) the project won`t be launched if all the required data it`s not available.

For the problems evaluation we will rank each issue using a range, between 1 and 5 in which 1 = has a very low impact, and 5 = very high impact. Withal, the evaluation criteria, has been weighted considering the importance had for the organization.

Table 1. Evaluation Matrix

Criteria / Problems	S 30%	T 10%	C 30%	Rc 20%	M 10%	Total
A	5	1	3	5	3	3.8
B	4	3	2	2	3	2.8
C	4	2	3	1	2	2.7
D	5	2	1	1	4	2.6
E	**5**	**3**	**4**	**5**	**5**	4.5

Based on the above analysis results, the most severe issue for the organization is the production planning and the delays generated by this.

It was observed that this problem perpetuated in 92% of the projects in the last two years.

As a consequence, the project team established the following mission: reducing the occurrence rate with 30% by the end of the year.

To accomplish the targeted task, it is mandatory to set up a team in order to conduct and support the corrective activities. The team structure consists of five people:

- coordination and leading role – buyer;
- execution role – engineering manager group, quality engineer, capacity planning representative, supply chain engineer.

Once the project team has been established, the focus will turn on the next stage that will measure and analyze the core problem.

2.2 Measurement and Analysis

This step aims the definition of the limits that clearly indicates where the project starts and where it ends. Therefore a flow chart (figure 1) was used in order to underline these limits.

Figure 1. The flow chart of the analyzed process

Once the flow chart was mapped, this analysis will continue with the identification of root causes, using the Fishbone diagram (figure 2), that will guide further the steps of this case study, underlining the points where the improvement is needed.

All the causes identified after the completion of the Fishbone diagram, have been considered for a more detailed analysis, in order to establish the occurrence frequency (table 2). Each team member, provided the input collected from the department that`s representing. Based on each key department feedback, a complete overview was established, reflecting the frequency of each cause occurrence (figure 3).

2.3 Improvement

Considering the previous analysis three main causes have been identified and based on these findings three improvement alternatives are being proposed:

- for cause 1 - Lack of skills/ knowledge:
- Additional training offered by the organization;
- Implementing self-assessment tools for the employees;
- Q&A Lessons learned sessions;
- for cause 2 - General process/ guidance might not cover the complexity of the project:
- Developing a more complex process;
- Increasing the number of standardized projects;
- Dividing the process into customized scenario based procedures, that can cover the various/ multiple situations;

- for cause 3 - Significant number of data bases that the employee needs to access and work with:
- Reduce the number of the data based used for the daily activities;
- Developing support tools that for the processes execution;
- Implementing a support tool for process execution, that integrates the required databases features and the knowledge needed to ensure the completion.

This activity will evaluate each alternative using several criteria such as:

a. Total cost;

b. Impact;

c. Cost/benefits balance;

d. Resistance to changes;

e. Implementation timing;

f. Uncertainties related to efficiency.

To evaluate the proposed improvement alternatives based on the selected criteria, the team used a quality instrument (table 3) that enables the selection of those alternatives with the highest score:

3 – high impact

2 – average impact

1 – low impact

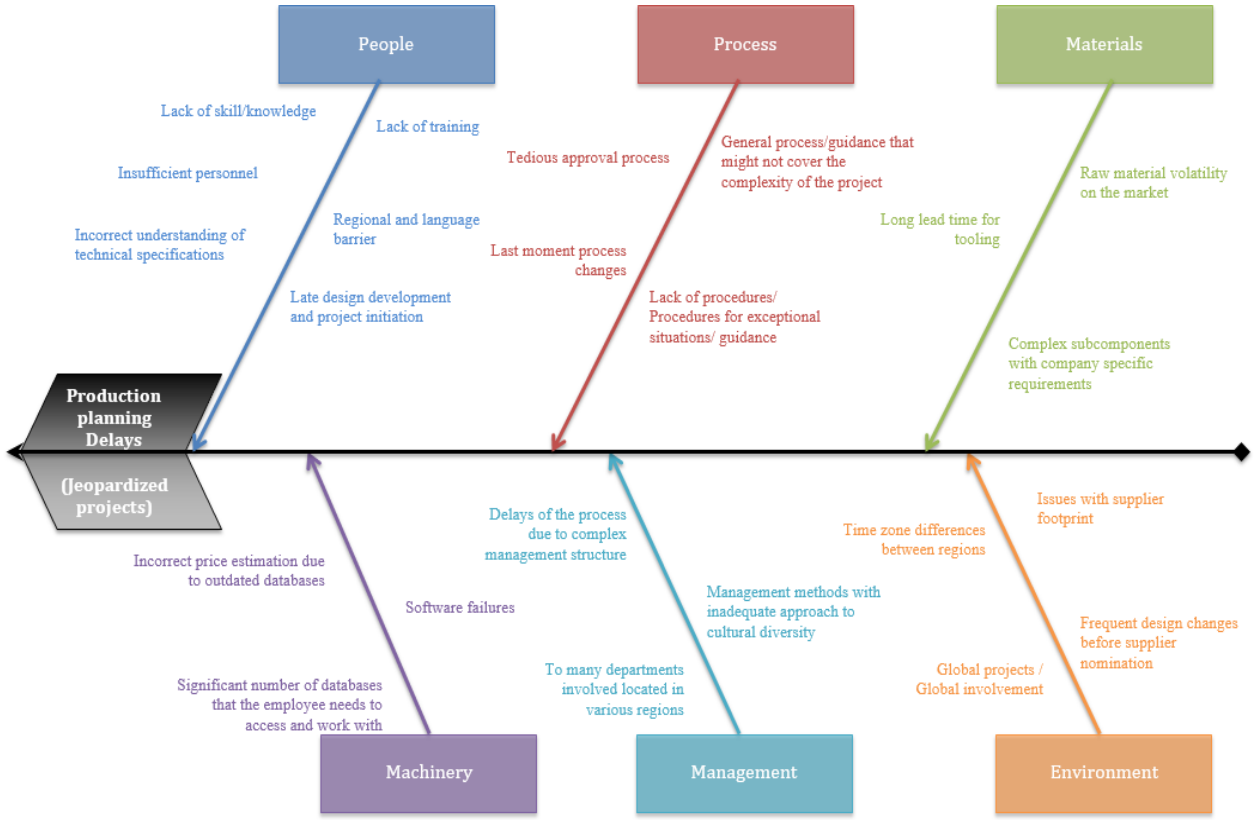

Figure 2. Fishbone diagram

Table 2. Cause occurrence frequency

Group	Cause	Correspondent	Frequency	Rate	Score
People	Lack of skills/ knowledge	A	46	9	414
	Insufficient personnel	B	14	3	42
	Lack of training	C	18	1	18
	Regional and language barrier	D	7	1	7
	Incorrect understanding of the technical specifications	E	23	1	23
	Late design development and project initiation	F	33	1	33
Process	Tedious approval process	G	16	1	16
	Last moment process changes	H	29	1	29

Group	Cause	Correspondent	Frequency	Rate	Score
	General process/ guidance might not cover the complexity of the project	I	38	9	342
	Lack of procedures or for exceptional situations guidance	J	19	1	19
Materials	Raw material volatility	K	7	1	7
	Complex subcomponents with company specific requirements	L	11	3	33
	Long lead time for tooling	M	3	9	27
Machinery	Incorrect price estimations due to outdated database usage	N	8	3	24
	Software failure	O	5	3	15
	Significant number of data bases that the employee needs to access and work with	P	53	9	477
Management	Too many departments involved in various regions	R	13	3	39
	Management methods with inadequate approach to cultural diversity	S	12	3	36
	Delays of the process due to complex management structure	T	9	3	27
Environment	Global projects/ global environment	U	14	1	14
	Frequent design changes before supplier nomination	V	13	1	13
	Issues with supplier footprint	X	5	9	45
	Time zone differences between regions	Z	9	1	9

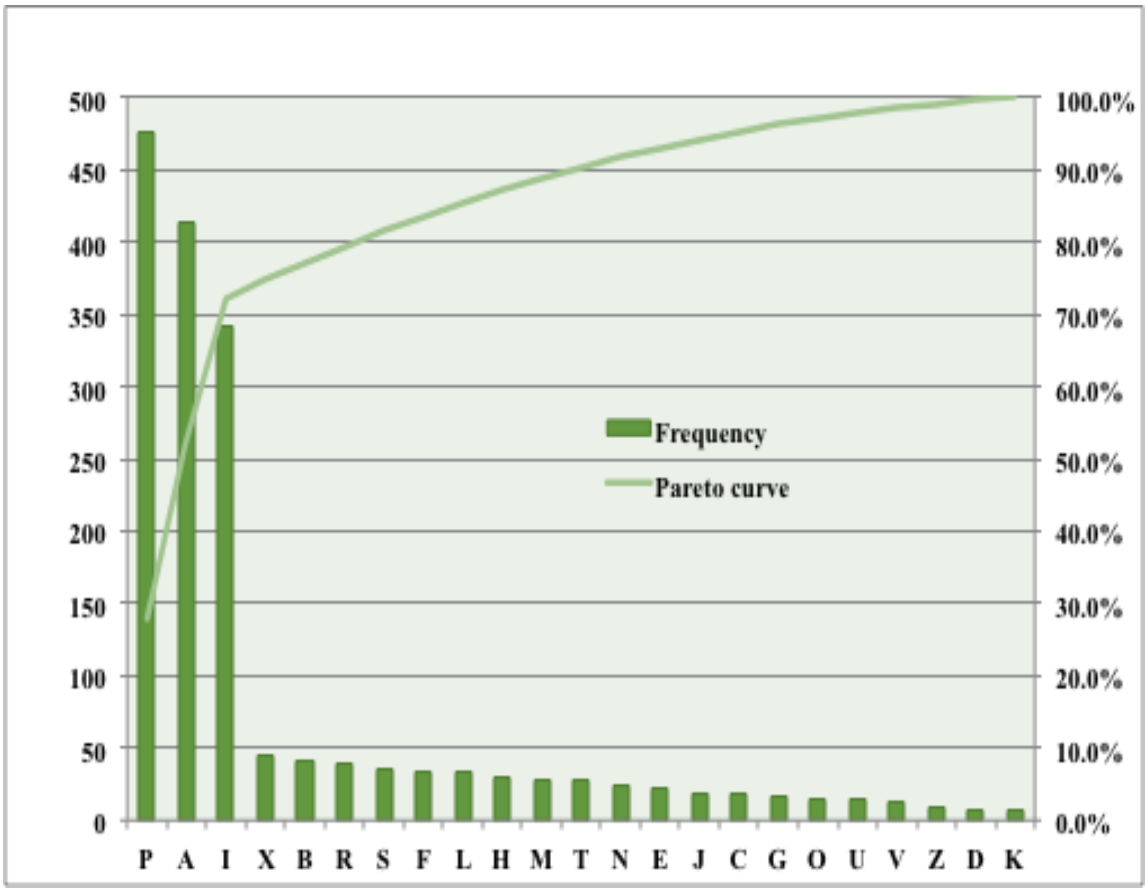

Figure 3. Pareto diagram

Table 3. Alternative selection matrix

Cause	Solutions	Selection criteria						Total
		a	b	c	d	e	f	
Lack of skills/ knowledge	Additional training offered by the organization	3	2	2	2	3	2	14
	Implementing self-assessment tools for the employees	2	3	3	2	3	3	16
	Q&A Lessons learned sessions	3	2	2	1	2	2	12
General process/ guidance might not cover the complexity of the project	Developing a more complex process	2	3	2	3	3	2	15
	Increasing the number of standardized projects	2	2	2	2	2	2	12
	Dividing the process into customized scenario based procedures that can cover the various / multiple situations.	1	2	2	2	2	2	11
Significant number of data bases that the employee needs to access and work with	Reduce the number of the data based used for the daily activities	2	3	3	2	3	2	15
	Developing support tools for the processes execution	2	3	3	3	3	2	16
	Implementing a support tool for process execution, that integrates the required databases features and the knowledge needed to ensure the completion.	2	3	3	3	3	3	17

Based on the alternative evaluation, the team elaborated an action plan (table 4), covering a set of corrective actions, the resources needed, with designated responsibilities and a time frame available for completion, behind each item.

2.4 Control

Considering the improvement activities planning table, above presented, the team found suitable to design and implement control elements.

The purpose of these elements is to ensure that the corrective activities have been used and maintained. All these activities are highlighted in the control diagram shown below (table 5).

2.5 Recommended activities

This is the last stage of the improvement project and during this activity the team has to ensure that the resulted real improvements will be successfully applied also in other similar matters/issue. The obtained results can constitute the basis for future projects that are aiming the improvement of the planning process within the automotive industry. The experience accumulated by the team and the results obtained based on this case study, can be taken in consideration for the creation of an internal knowledge database, for future reference or similar situations

3 CONCLUSIONS

The delays and disruptions in the production planning process, remains a continuous challenge for the OEM`s, since it requires a set of actions and tools that can reduce significantly the occurrence of such situations that impact the profitability directly.

A proper set up, will drive the processes to the right course of action for each organization, as was also highlighted with the above case study, performed inside one of the main players from the biggest OEM from automotive industry.

There is a strong need to have tools in place within organization that can easily support the execution of the process, leaving no room for flaws and enhancing the knowledge of the employees.

As concluded in this paper, it is essential to identify the causes that could impact the process had in focus and implement feasible solutions that would lead each entity to a competitive level in the targeted market, by eliminating flaws within the processes, increase the human resources knowledge, resulting a high quality level on both products and company environment.

With this takeaways, future researches can be conducted in this area, in order to develop more advanced support tools, that are strengthening the processes and the overall organization within the Automotive industry, and not only.

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Table 4. Improvement activities planning

#	Cause	Corrective action	Required resources	Responsible(s)	Timing
1	Lack of skills/ knowledge	Implementing self assesment tools for the employees	Material resources: hardware/software equipments	Buyer	2,5 Quarters
2	General process/ guidance might not cover the complexity of the project	Developing a more complex process	Material resources: software/stationery Human resources	All team members	2 Quarters
3	Significant number of data bases that the employee needs to access and work with	Implementing a support tool for process execution, that integrates the required databases features and the knowledge needed to ensure the completion.	Material resources: hardware/software equipments Human resources	IT support	1 Quarter

Table 5. Control diagram

Variables	How it is measured	Where	Reference	Who is measuring	Decision maker	Who is checking	Frequency	Where is documented
Implementing self-assessment tools for the employees	Checking the hardware / software equipment	In the designated area for this type of equipment	Purchase documentation	Business planner	Purchasing executive director	Project coordinator (buyer)	Quarterly	In the project documentation files
Developing a more complex process	Analyzing the brainstorming sessions	In the purchasing area	Decision table	Business planner	Regional vice-president		Biannually	
Implementing a support tool for process execution, that integrates the required databases features and the knowledge needed to ensure thon.	Checking the results obtained based on the usage of the tool	The designated departments	Annual reports	Business planner	Purchasing executive director		Quarterly	

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