FMEA for Process of Communication/Information for Launching a New Car Model

Luís Miguel Teodoro Nicolau

Dissertation for the Master's Degree in

Management and Industrial Engineering

Advisors: Prof. Dr. José Manuel Costa Dias de Figueiredo

November, 2015

Summary

The launch of the production of new car models involves many different areas of the organization and requires different approaches and motivations to meet the associated challenges.

In the investigation of this issue, it is considered to be important to start by analysing the individual and sectorial processes, and how decisions are made and resolved, as well as performing a reading of the surroundings and understanding the importance of motivation in identifying and solving problems.

In this thesis, a macro and micro analysis will be performed to propose the improvement of internal processes through the application of FMEA (Failure Mode and Effect Analysis). In this way, it will be possible to identify the possible existing inefficiencies in production planning.

These inefficiencies could originate from the flow of communication, time-based matters and scheduling of activities, issues related to processes and people, and various other causes, and even political aspects ("policy" rules, tax procedures, cultural characteristics...). In this context, which is unavoidably complex, an attempt to point out solutions for improvement will be made.

The difficulties anticipated in this project are basically related to people participating and the sharing and access to information.

Finally, the presentation of viable solutions to solve the difficulties encountered is intended and has the purpose of presenting improvements, which may be used by the organization in the launch of the new models.

Keywords: Project management; Car launch; FMEA; Communication; Motivation.

1. Introduction

Automobile production is characterized by openness to many typical areas of knowledge in engineering and management. The production processes must be accurately and effectively defined, so that they can stabilize an efficient platform development planning.

The objective of this research is to analyse the planning of launch the production of a new car model after the respective approval phase. Our analysis aims to identify recurring problems and possible future problems that may occur (scenario planning), in order to improve the process development planning.

During the planning of the production launch phase the concepts of variations set up are defined (usually from the simplest combinations to the most difficult, for example: starting the production of cars with steering wheels on the right, gasoline engines and manual gearboxes, then the production of cars with the steering wheel on the right, gasoline engines and automatic gears, and subsequently following the same logic but with the steering wheel on the right, diesel engines and manual gearboxes and so forth) with sequences and availability of assembly lines, motors and model's specific individual parts.

Therefore, a qualitative and quantitative analysis of the inherent procedures of the preparation of the launch and identification of the potential inefficiencies, which may cause delays in the launch of the new model and thereby jeopardize its success, is envisioned. We refer specifically to delays because it is an ever-essential variable but, in the course of our research, we will identify problems with other causes.

We believe that it is necessary to understand the inefficiencies to propose, create and develop measures which, in case of discrepancies in the objectives, can prevent delays.

Our research, based on the analysis described aims to present a proposal to improve internal processes of communication / information in the planning of a new car model - in a preventive manner - by applying the FMEA methodology.

2. State of the Art

As a consequence of the need to achieve certain results, the projects (through coordination and synchronisation) articulate three different types of knowledge, which are essential and inter-dependent: technical management, interpersonal management and variable management (Brand, 1998).

Interpersonal management is the type mainly addressed as it is in line with the scope of our research.

2.1 Interpersonal Management

According to Chiavenato (2004), organizations are constituted by individuals and depend on them to achieve the proposed objectives. Moreover, for people, organizations provide a means by which to achieve various personal goals.

2.1.1 Motivation

According to Seiler *et al.* (2012) motivation is a key factor in managing successful projects. Thus, motivation has been into two categories: a) content theories Maslow (1943, 1954), hierarchical needs theory McClelland (1961) and the two factor theory Herzeberg *et al.* (1959); b) Process theories with the equity theory Adams (1963).

2.1.2 Communication

According to Badir *et al.* (2012) communication has always been considered as fundamental in the success of project development (Montoya *et al.,* 2009, *cit in* Badir *et al.,* 2012), the faster information is processed, the faster new products are developed.

Communication is a central theme of the project and its environment. When contributory, adapted, and disciplined, communication flows in three directions - up, down and horizontally. Communication research should focus on the information flows that occur within organizations (Packendorff, 1994).

The need to establish communication also depends on the complexity of the tasks involved. With increasing interdependence between activities, greater is the need for relevant communication for the task (Thompson, 1967, *cit. In* Packendorff, 1994).

Communication within organizations is subject to failure. To avoid this, people from lower levels should be encouraged to participate in the resolution of problems in order to build confidence between different individuals and groups within the companies (Donnelly *et al.,* 2000).

Management, in its various forms and "layers", should facilitate and manage communication, in order to ensure that it is effective, accurate, timely and clear. Simultaneously, the identification of the preferred frames of communication of the interested parties, the assessment of the best way to enable and ensure the integrity and accuracy of the process through the establishment of protocols, the use of tools and ensuring the use of consistent applications, can be identified. The implemented communication structure should be tested in order to verify that messages are sent and received effectively (Pritchard, 2004).

Communication can be improved by:

- Monitoring the decision;
- Regulating the flow of information;
- Using feedback;
- Empathy;
- Simplification of the language;
- Listening effective;
- Informal communication (Donnelly *et al.,* 2000).

Senders should take into account communication duties and the receivers need to understand the concerns of the sender, so that these exchanges can be addressed effectively and without errors. These roles should be established by each interested party and all should be aware and in agreement with their communication responsibilities. After responsibilities have been established, the different parties can decide on the form of communication and appropriate tools (Pritchard, 2004).

To determine which tool is the most appropriate, the following questions should be asked:

- Does this tool serve its purpose?
- Can it be applied in the organization?
- Is the tool's information available in the organization?
- Are we apt to use this approach? (Pritchard, 2004).

If the answer is yes to all the aforementioned questions, the tool may be appropriate for the project and the respective team (Pritchard, 2004).

Thus, it can be concluded that communication is essential for effective management in project development. Practical management and the availability of information should be simple, succinct, comprehensible/legible, objective. The tools to be used should be universal and available to all the interested parties.

2.2 Variable Management

In project management, those involved and integrated in the project have different interests and they engage in disputes because of limited resources. Using, analyzing, controlling and planning procedures, a minimization of the impact of these uncertainties is achieved.

2.2.1 Failure Mode and Effects Analysis – FMEA

FMEA is an analysis technique to identify and minimize potential failures and their effects in the systems, products, processes or others (Raymond *et al.,* 2008). It is used for the prevention of team problems in a simple, effective and efficient way.

2.2.1.1 Concept

The FMEA consists on the analysis of systematic activities and processes in the design and development of products or services, by searching for potential problems and their respective solutions, which leads to cost reductions, reduced development time, and ensures greater reliability of the processes and products (Carlson, 2014).

This process consists of three distinct phases:

1. Identification and evaluations of the potential failures of a product, service or process and its effects;
2. Identification of actions that can eliminate or reduce the potential failure mode;
3. Documentation of the analysis process (Carlson, 2014).

2.2.1.2 Development

The analysis is performed by identifying the project system, process/product analysis, its functions, the types of failures that can occur, their effects and the possible causes of the failures. After this analysis is performed, an individual risk evaluation of the detected failures is constructed using indices. Subsequent action is taken to eliminate or reduce the detected risks of failure (Raymond *et al.,* 2008).

The method has ten stages of development, which are as follows:

1. Constitution of the team and the scope for action;
2. Definition of the client;
3. Identification of the functions, requirements and specifications;
4. Identification of the potential failure modes;
5. Identification of the potential effects of failure;
6. Identification of the potential causes of failure;
7. Identification of the existing controls;
8. Identification and prioritization of the risk;
9. Recommendation of actions;
10. Verification of the results (Carlson, 2012).

3. Problem

After the general stages of approval and design of a new model, the freezing of the design and the respective allocation of a project to a particular manufacturing facility is carried out.

Subsequently, a study of the investment that will be required for its implementation at the factory begins. This will be made based on assumptions and technical estimates, due to the limited initial knowledge on the new installation project, particularly in a primary stage.

Thus begins the design, development and verification of all the technical specifications of the parts and individual items process, which has a co-orientation between the product engineering and the production engineering planning, affecting the factory chosen to produce the new model.

The preparation process of the launch of a new production model starts with the progressive authorization of the parts at a technical development level. It is dependent on the human factor, meaning the experience in production planning of the engineering department for the identification, selection and comparison of assembly processes needed for the development, for which there is not yet know-how. Thus, it is necessary to verify and validate the technical specifications, tools, and equipment and guarantee the conditions required for layouts and all the necessary production means.

Thus, engineering planning to production should have a comprehensive view of the product in all of its parts. By obtaining detailed information and thoroughly checking the most important features it is possible to achieve the synchronisation of the assembly processes of parts, tools, complexities and torques. By analysing process to process, and station to station, it is possible to achieve the comparison of existing processes in the production line of other models. Thus, having knowledge of the available technical equipment in use, the process origins and the development of parts, it is possible to prevent any failures in the planning.

Due to the fact that the new model is still in an evolutionary technical process and given the lack of knowledge about it and its final specifications, implementation is initiated by dividing the different parts into sub-projects by engineering departments (electrical, seats, engines, etc.).

The manufacturing process starts with the construction of prototypes and later with an experimental series, in limited numbers, which is based on the procedures and technical specifications required by the product engineers and the quality engineers of the interested parties (the various engineering departments involved, the pilot plant, sales and marketing). Once a particular process or technical development is considered to be relevant to test and test on the line, a sample is selected and it becomes possible to test and verify the development of the processes and equipment. This has the objective of training the employees involved in the production areas.

When starting the launch phase and production of the new model, there are several components that were not yet considered in previous phases due to the design having been decided late and due to technical issues in the development of the parts. This leads to the absence of a supplier and technical information ignored by omission and/or forgetfulness. This directly affects the car's launch curve performance, because of training and ineffective training of the employees involved in production.

Thus, the late authorization of the parts results in equipment that was not considered in the verification of processes phases, the arrival of parts out of the stipulated deadlines or in imperfect conditions, as they were designed with basis on presupposed primary technical assumptions of the development of the new model.

Late authorization of the parts also has direct implications on the launch regarding processes that were not taken into consideration. These may have additional requirements that were not considered or tested as well as parts tested with certain options and that could have been tested on other options. Due to this, there will be unknown implications either in the assembly or requirements, or mounting auxiliary equipment, control and testing.

The verified delays also derive from communication lacks, due to insufficient and/or missing information from product development, logistics and suppliers.

The aforementioned factors may delay and/or jeopardize the launch, specifically the release curve. As a result, it is possible to conclude that team spirit, mutual aid, identification and motivation of all those involved are indispensable to achieve the project's objectives, as well as communication among all parties involved, both internally and externally. It is necessary to ensure processes for quick access to information, in other words, filtration systems for relevant information for the development.

4. Case Study

The development of a car model is based on a process product oriented, which is developed through research, creativity, commutated experience (lessons learned) gained over theyears with numerous developments and respective launches.

In the development of each new product there is a set of well-established number of stages, ranging from the concept to the introduction into production. The various stages are as numerous as different.

The problem under study, our research question, concentrates on the phases after the new model has been confirmed, between the phases of the start of the manufacturing of the tools to the whole process of gradually releasing the technical information and product development, implementation at the factory, early prototypes and subsequent start of production.

At the beginning of this transitional phase of the project, the quantity and quality of the information available is relatively scarce, which causes direct consequences and induces errors in the implementation process and start of the production of the new model.

This research arose from the need to address minor flaws in communication/information felt among the various interested parties throughout the development and implementation of the new products. These failures can be caused by:

- Product development, dependent on the information provided;
- Development of the various activities of production planning and liaison those interested.

5. Conclusions

This project consisted of a macro and micro analysis to propose the improvement of internal processes of communication/information exchange in the launch of a new car model, via the application of FMEA analysis methodology.

Throughout the development of the project the launch of the *facelift* of the sports model was referred to by identifying inefficiencies in the process of communication/information, which originate in the processes arising from activities developed by the production planning.

Research inefficiencies were identified via various reports that arose from the construction process of the cars. An attempt to identify their origin of the problems and the stakeholders involved was made basically consulting with stakeholders to discover what problems they had felt in the launch of the facelift in the process of communication/information.

Other inefficiencies were also identified. The production planning is unaware of their origin as they originate from the mother house, specifically in product development. These are constraints on the effective performance of production planning and which there is no way to improve, so an attempt has been made to propose measures that would mitigate these inefficiencies/conditions.

By conducting a survey with the stakeholders, an attempt was made to understand the needs and difficulties they feel in the development of their work and we tried also to identify other inefficiencies that have not been previously identified.

The responses obtained from the questionnaire and in particular the response to the open question, led to new proposals for improvement. In this sense the process had positive results with positive feedback.

Thus, a proposal based on FMEA was made to identify potential causes of failure and their effects. An attempt was made to identify control procedures and possible recommended actions to improve the identified inefficiencies. A table to classify the severity, occurrence and detection of the failures was simultaneously developed for the implementation of the proposed FMEA. This proposal is in section five of the dissertation.

The FMEA proposal serves as guide for application, in a preventive manner, to provide easy identification of the inefficiencies in the process of communication/information in the launch of new models. There will always be the need to update the resulting complexities inherent to each release of new models. The FMEA proposal should be subject to review for the improvement of inefficiencies that were not contemplated or forecast by monitoring the application in the next release of the new model.

A new questionnaire should also be given to the stakeholders, particularly to the production teams in order to obtain a wider feedback from the production planning activities.

When carrying out a new investigation stakeholders should be separate in order for their needs in the improvement of the process of communication/information to be more easily identified.

By revising the FMEA and the developing a new questionnaire, there should be a promotion of lessons learned in order to improve the process of communication/information.

6. Bibliograpy

Adams, J. S. (1963). Toward an understanding of equity. *Journal of Abnormal and Social Psychology 67*, 422-436.

Badir, Y. F., Büchel, B., & Tucci, C. L. (2012). A conceptual framework of the impact of NPD project team and leader empowerment on communication and performance: An alliance case context. *International Journal of Project Management*, 914-926.

Carlson, C. S. (2012). *Effective FMEAs: Achieving Safe, Reliable, and Economical Products and Processes using Failure Mode and Effects Analysis.* England: Wiley.

Carlson, C. S. (2014). Undertanding and Applying the Fundamentals os FMEAs. *2014 Annual Realiability and Maintainability Symposium* (p. 32). ReliaSoft Corporation.

Chiavenato, I. (2004). *Gestão de pessoas.* Rio de Janeiro: McGraw Hill.

Donnelly, J. H., Gibson, J. L., & Ivancevich, J. M. (2000). *Administração - Principios da Gestão Empresarial.* Mc Graw Hill.

Herzeberg, F., Mausner, B., & Snyderman, B. (1959). *The motivation to Work.* New York: John Wiley.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, 370-396.

Maslow, A. H. (1954). *Motivation and Personality.* New York: Harper & Row.

McClelland, C. (1961). *The achieving Society.* New York: The free Press.

Montoya, M. M., Massey, A. P., Hung, Y. Y., & Crisp, C. (2009). Can you hear me now? Communication in virtual product development teams. *Journal of Product Innovation Management 26* , 139-155.

Packendorff, J. (1994). Temporary Organizing: Integrating Organization Theory and project Management. *Proceedings of the IRNOP Conference on Temporary Organizations and Project Management* (p. 21). Umea, Sweden: Umeå Business School, Dept of Business Administration.

Pritchard, C. (2004). *The Project Management Comunications Toolkit.* London: Artech House, Inc.

Raymond, M. J., Beauregar, R. M., & McDermott, R. E. (2008). *The Basics of FMEA. New York: A Productivity Press Book.* New York: A Productivity Press Book.

Seiler, S., Lent, B., Pinkowska, M., & Pinazza, M. (2012). An integrated model of factors influencing project manager's motivation - Findigs from a Swiss Survey. *International Journal of Project Management*, 60-72.

Thompson, J. D. (1967). *Organizations in Action: Social Science Bases of Administrative Theory.* New York: McGraw-Hill.

Wheelwright, S. C., & Clark, K. B. (1992). *Revolutionizing Product Development: Quantum Leaps in Speed, Efficiency, and Quality.* New York: The Free Press.