

# **An Investigation in to How a Small Mexican Technological Based Enterprise in Eco-Energy Can Improve its Performance Through the Effective Management of Design.**

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## **Introduction**

One important discussion on nowadays management studies concern on how small technological based enterprises can improve their current performance. It is due to the fact that these organisations are going to be the future drivers of countries development. Thus, it is required the understanding of the context in which these firms are involved. According to different researches, Mexican firms are suffering of varied external problems; nevertheless, its main problem lie on their internal execution. Therefore, an extensive examination of literature review was held in order to discover the actions that other cases studies implemented in order to improve their performance. It was found out that 'the process' of the firm is of main importance. Hence, it was suggested that design can be used within the firm to leverage the performance of the new product development process. So, the objective of this research is to explore and identify the design activities carried out by a small Mexican technological based enterprises. The empirical findings from a case study draw attention to the issues that such company faces in the resources-constrained environment within which it operates. In particular, it reveals that the process of new product development is conducted and adequate to the conditions of the company. It is characterised by lack of experience, insufficient planning, inadequate resources, and lack of skills and capabilities. Consequently, along the research a number of generic managerial issues have been identify, all arising from the detrimental impact of the owner/manager.

## **Contextual overview**

Research evidence showed that Mexico has been suffering harsh competition among its industries. It is due to it does not have adequate foundations to create sustainable competitive advantage under the current environment (26). Some of the problems that the country suffers are involved on the low financing, labour training and technology (23). Although, all of them are the result of a protectionist industry environment developed by Governments during many decades (17).

Mexican technological-based enterprises [TBE] suffer from the same problems that other companies, but there are two more constraints that affect them; few experience, and low awareness of the technological requirements needed. Thus, these companies are not able to base their intensive scientific knowledge to maintain their competitiveness (18). So, they are not able to become producers of goods and services, commit themselves to design, develop and produce new product and/or process of innovative manufacturing through the systematic application of scientific and technical knowledge (11). It means that these companies base their activities in basic activities such as generation of ideas, innovation and high technological development (23).

Mexican TBEs focus their efforts in more approachable activities, and the ones that bring results in the short term. Consequently, new product development [NPD] represents one route to harness product innovation and apply their manufacturing in

new directions. This option enhances the maintenance of a competitive and healthy product portfolio, and the opportunity to sustain a competitive advantage in the long term (7). It is because captures a range of different types of innovative activities leading to the production of new services or products from radical innovations to simple modifications and adaptations to existing products.

Many studies have been developed under the idea that there are different factors that triggered the NPD success. From that large body of knowledge two proposals have been highlighted; macro level activities; and project level activities. One relies on the idea that businesses need to have a holistic and broad view of their activities. Then, it can be discovered actions that may be not apparent at the project level, and yet are important for success (9; 16; 20; 16; 10). Under this situation the NPD depends on their process, organisation, strategy, culture and commitment; and the capacity to reflect their own performance and characteristics within a manageable framework. Contrary, project level focuses on the better implementation of actions that provokes a success performance. Every company has to undertake suitable actions to tailor it activities; hence, they should understand their key activities in order to implement accurately methods and tools that help to leverage their performance. In response, it is suggested that design can become a key area in a TBE's performance.

Large and growing body of knowledge agrees that design brings a significant improvement when it interacts with businesses (1; 2; 3; 4; 6; 8; 13; 14; 15; 19; 22; 24; 27). It is due to design is an effective tool to improve the performance of the product development 'process' within the company. It goes from initial research ideas, supply-chain management, to the point of sales. Likewise, it can affect the performance of the company through its contributions to a range of critical management issues which determine the nature and so the profitability of the product. Design under the context of management science, can be used into four different power values; as differentiator; integrator; transformer; and good business (2). In one study, it was pointed out that most of businesses do not integrate design in to their organisational frameworks because there are two missing links; designers lack of knowledge of management concepts and management as a science; and designer's difficulty in implementing a value model in their everyday practices.

Thus, design can be implemented and managed within an organisation at two different levels: the corporate level and the project level. Thus, designers are able to manage three actions within a firm; the product, process, and the organisation. Design is implemented under these conditions as a strategy action on the tactical or operational long-term goals and day-to-day decision-making. However, any allocation of design depends on the level of awareness of design within the companies' knowledge, and the experiences and know how of general manager and designers. So, design can be used as high-profile activity along the years (21).

Consequently, design can become the leadership area of the company and approach different solutions under a complex environment that pushes it to re-think the process already established. Design can be used within a firm in to different roles and to adapt to different situations. Hence, designers set the vision of how design can be used within the firm, selling the vision to, and gaining buy-in from, key stakeholders and decision makers. So, the aim of the design manager is to ensure that design processes, procedures and internal functions are adding value to the organisation, through the internal resourcing of design thinking in to a cross a range of business units and projects. As a result, design is going to help to unlock the potential of a proposal, and crafts and delivers the solution, to brief, on time and within budget, to satisfy client and customer needs.

## Research methods

This research considers the use of a case study due to its aim is to bring more insights about the exploration of a single entity or phenomenon [small TBE] bounded by time and activity [design and designers] (29). Data collection was undertaken via detailed, structured close questionnaires [e-mailed]; semi-structured interviews, open-ended questionnaires, documentation and observation for a period of twenty two days; and finally structured close questionnaires. Manager and workers were specifically directed to answer questions about their perception of design; the development of their activities along the new product development; and the specific use of design within the project development. Consequently, the case study was divided in three main parts in order to understand each aspect of the enterprise.

The firm selected to be the case study was chosen from a private list of companies provided by the National Council of Science and Technology [CONACYT] in Mexico. The criteria used to determine the most suitable case study involved the following requirements: [1] size of the company; [2] industry in which it was based; [3] being a particular organisation [it could be supported by public body]; [4] use design<sup>1</sup> as part of its activities; [5] be active in new product development<sup>2</sup>; and [6] develop continuous innovation<sup>3</sup> through technology. Consequently, a private small enterprise based on the development of vehicles with alternative energy was chosen.

As it was mentioned, structured close questionnaires with pre-coded answer categories were used to quantify straightforward where design stood in to the company and captured what people say and do of product of how they interpret design in a company's activities. These questionnaires were applied to staff implicated on design activities and decisions –general manager, project manager, and designer- via e mail. This questionnaire was developed under the basis of the design atlas (1999) developed by the Design Council. Results were prepared according to Likert procedures.

Likewise, Open ended- questionnaires were used to explore the performance of Vehizero in the project management. At the same time semi structured interviews were used and triangulated with ethnographic techniques that were collected, observed and recorded to describe deeply the social-cultural activities and patterns of the firm. Thus, it was possible to get a pretty clear idea of the way in which the respondents think about their social system work, and culture. The questionnaire and interviews were designed through the basis of the British Standard (1999) at the project level. Thus, four divisions were contemplated to measure the performance of the different stages in which the project can be divided in an enterprise. The contents of the questionnaire were; understanding corporate level; managing product design at the corporate level; and managing the design activity.

Finally, structured close questionnaires were used in the last stage to prepare a specific evaluation to the design brief and other considerations that are required in the design activity.

## Case study

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<sup>1</sup> **Design** was used as a verb and noun. As a '*verb*' was focused to generate information from which a required product can become reality. As a '*noun*' was concentrated as the set of instructions necessary to construct a product (British Standard, 1999)

<sup>2</sup> **New Product Development** was used as the range of different types of innovative activities leading to the production of new services or products from radical innovations to simple modifications and adaptations to existing products (Cooper & Bruce, 2005).

<sup>3</sup> **Innovation** was used as the moment in which a new product, process or service is introduced in a specific market... however, innovation required of previous activities such as technical changes, invention, and technological development, which are elements or factor of it. (Corona, 1997)

Vehizero Anonymous Society of Variable Capital [Vehizero SA de CV] was founded in 1999. It was registered as a technological base enterprise that stands in the automotive industry. Since that time, its aim has been design, manufacture and produce lightweight and transport vehicles with hybrid-electric propulsion system. It produces its hybrid vehicles through the use of three different energy sources; a model of batteries, an internal combustion motor gasoline and an electronic energy storage system. Vehizero was created by a chemical engineer who had an idea concerning the development of a cleaner technology. Vehizero suffers from a lack of experience within the management of the company at all levels. Likewise, it deals with financial resources problems and technological development constraints. As a result, this situation makes it difficult to manufacture vehicles. It becomes complex when the company employed fifteen workers from which thirteen employees were in-house employees, and two external of the firm.

Vehizero stands in an informal model of management, its activities are generally characterised by behavioural spontaneity, casualness, and interpersonal familiarity. According to the data collected it was considered that the company has two divisions; the administrative level, and the areas at the project level. Vehizero's has drawn its activities [fig. 1.1] within the NPD in such a way that the general manager is involved in most of the activities held within the project. On the other hand, the project manager is more involved with specific physical areas instead of control and manages all the process. Worker carried out with three main key activities within the process of the project proposal, project brief and control project. Finally, in the case of the designers, they just appear in the control project in which they have to deliver the results of their work.

Employees believe that the NPD is divided into three broad divisions; formulation stage which mainly explains the plans elaborated before any technical design can be carried out; evolution stage which relies on the application of the project brief within the process of the company; and transfer stage which focus on the translation of the work generated before into the manufacture of a product.

The formulations stage suffers from the lack of formality in the procedures to generate new ideas, and lead them to generate a good concept that can be later on translated on the evolution stage. Another problem highlighted concerning the low consideration and integration of intellectual activities along the project brief. Thus, design is not considered within the overall planning process of the company. Design is poorly used in this stage because it is managed mainly by the general manager. Design activities depend on the solutions from the engineering and mechanical areas.

The transfer stage within Vehizero struggles with the involvement, coordinating and synthesising among the team members of the project. Thus, employees agree that this stage is fuzzy, informal, intuitive, creative and spontaneous process. It is fuzzy because the lack of requirements and experience provoked that the work among areas clash and repeat along this stage. Its communication, documentation, control and plan few times were retained for record purpose, so it leveraged the informal part of the firm. Vehizero's process is intuitive because staff did not hold any tool that helps them to evaluate the application and evolution of the project within their activities. As a consequence, some of the requirements established in the early stage were changed because they did not match with the current resources and project requirements. Therefore, employees should be creative and spontaneous to solve the problem in the most effective and efficient way. Designers held semi-structured instructions in which they basis the activities that should be developed within their

project. It is mainly because the general manager and project managers of other areas establish the necessary requirements that the designers need. Designers, consequently, have to manage wisely activities concern on the deployment of budget. The evaluation of design activities is done through the integration of their work in the overall project. So, the design work depended on how works and performance the whole product, and after they would know whether should improve it in to the following trials or leave it as it is.

Unfortunately, Vehizero has not achieved the transfer stage. However, some of the actions that are considered in this stage have been developed weakly by Vehizero along the evolution stage –patent, lay out of manufacturing development, and check list for the new product line. As it was mentioned another external company is carrying out the same work but in a formal manner. Vehizero requires attract immediately more investors that want to financially contribute in the manufacturing part, and then allow it to start the transfer stage.

### Analysis

The finding of design capabilities at the corporative level pointed out that design is allocated as a support activity within the product development. It was recognised that this assumption was influenced by the limited boundaries of designer’s knowledge [industrial design]. Likewise, design was considered by interviewed as an important activity within the firm’s plans. Indeed, this statement was referred within the short term, especially in to the prototype stage, but not in the overall plan. Design activities were seen as another area within the company which it aims were concern on help the firm to reach the project’s goal. Finally, the general manager held along the questionnaire an overoptimistic view about the performance of design and the company.

QUESTIONS	G M	P M	D	DT	RES ULT
PLANNING FOR DESIGN					
General Planning Awareness	3	3	3	3	<b>3</b>
General Planning Communication	3	4	3	2	<b>3</b>
Design Planning Awareness	4	4	4	2	<b>3</b>
Design Planning Thinking	4	3	3	2	<b>3</b>
Design Planning Horizons	4	4	4	2	<b>3</b>
PROCESS FOR DESIGN					
General process awareness	3	3	3	2	<b>3</b>
Design Process Awareness	3	2	3	2	<b>2</b>
Design Process Management	3	2	2	2	<b>2</b>
Design Process	3	3	2	2	<b>2</b>

Thinking					
RESOURCES FOR DESIGN					
General resources allocation	4	4	2	2	3
Design resources allocation	4	3	2	2	3
PEOPLE FOR DESIGN					
Design Skill	3	3	3	2	3
Design Organization	4	3	3	3	3
CULTURE FOR DESIGN					
Design Commitment	4	4	3	2	3
Design Attitudes	4	4	3	3	3

The results from design capabilities at the project level demonstrate that the company's performance is declining while the expertise and complexity of activities increasing. It was found out that problems arise mainly in the management of product design, specifically in corporate communication; and monitoring and control in the implementation of plans. The manager's performance is positive, but lacks of expertise in key activities of product design.

MANAGING PRODUCT DESIGN AT CORPORATE LEVEL	ANSWER YES=1 NO=2					T
	G	I1	I2	I3	I4	
Corporate objectives	1	1	1	1	1	1
Corporate planning	.8	.4	.5	.4	.7	.5
Corporate Communication	0	0	0	0	0	0
Monitoring and controlling at corporate level	0	0	0	0	0	0
Evaluation	0	0	0	0	.2	.2
Check list for senior management	.5	.7	.5	.7	.6	.6
		5	5	2	2	

In the management of product design at project level, the company has a positive development of the project idea. But it does not mean that it is the most effective and successful way. Then, the performance rate drop on the design brief activity due to it did not hold with all the necessary requirements. Likewise, staff skills are stronger on scientific background, therefore, the translation of the brief in to activities are awkward and slow.

Finally, the performance of the managing design activity is below expected, as well as, the managing of product design. The data showed that designers depend on the activities developed by other areas along the process of product design. The general

manager is the project manager of design. The only activities managed by designers were concerned on their own practical activities.

<b>MANAGING THE DESIGN ACTIVITY</b>	PM	D	SH	TM
Design objectives	1	0	.66	.55
Planning the design resources	.27	.34	.43	<b>.32</b>
Planning to meet project objectives	0	.4	.2	<b>.46</b>
Design implementation and control	.2	.14		<b>.16</b>
Design evaluation	.62	.45		<b>.54</b>

In the case of the evaluation of the brief, interviewed responses agree on the lack of design brief, or any documented papers in which activities, plans, and procedures requirements are specified. Even though designers do not hold any written document, they evaluated the whole questionnaire. It was seen the total rate responses were .16 which represents an absolutely poor performance on the use of brief. Therefore, it can be inferred that the design brief performance is correlated with the project brief performance but poorly use.

<b>MANAGING PRODUCT DESIGN AT PROJECT LEVEL</b>	GM	PM	D	SH	T
Project idea	1	.50	1	.75	<b>.81</b>
Project proposal	1	.4	1	.4	<b>.7</b>
Feasibility Study	1	0	0	0	<b>.25</b>
Design Brief	.9	.45	.3	.65	<b>.62</b>
Cash plan flow	0	1	0	0	<b>.25</b>
Progress plan	1	1	1	.50	<b>.87</b>
Communication plan	.75	0	.25	0	<b>.25</b>
Communication and control during implementation	1	.50	.50	.50	<b>.62</b>
Communication	.62	.87	.5	.62	<b>.59</b>
Control of the project	1	1	1	1	<b>1</b>
Project review	.81	.43	.31	.68	<b>.56</b>
Final project evaluation	.52	.35	.29	.47	<b>.41</b>

QUESTIONS	P M	Desig ner	Tota l
Does the company hold a Design Brief?	0	0	0
Does the Design brief is a documented paper?	0	0	0
<b>Project Information Stage</b>	0	.33	.33
<b>Project Overview Stage</b>	.6	.33	.46
<b>Design Performance</b>	.3	.30	.34

<b>Requirements</b>	8		
<b>Design Cost Requirements</b>	0	.12	.12
<b>Design Time Scale Requirements</b>	0	0	0
<b>TOTAL</b>	<b>.18</b>		

## CONCLUSIONS

Vehizero's current performance suffers from different problems along its different levels of management; strategy, corporative, operative, and design [Fig. 2.1]. Those problems range from; lack of strategy, lack of expertise and organisation; low financing, low labour training, and lack of technology; lack of expertise, resources, and unstructured organisation; designers have poor experience, and limited skills and capabilities along the NPD, and design concept is so fuzzy, that its management is not accurate. Subsequently, the aim of the following work is to implement a series of actions that increase the awareness of design and it uses along the company. It is design that can boost the performance of the NPD (1; 2; 3; 4; 6; 8; 13; 14; 15; 19; 22; 24; 27). Consequently, it is necessary to consolidate design within the firm.

Therefore, under the corporation's conditions it is necessary to implement design at the operational level, and in the future move to the tactical level (1). Design has to be implemented as a leadership of the company actions at the operational level, and supported for a specific skills, tools, methods and techniques of design management (5; 6; 12; 28).

In order to achieve this objective, it is required to allocate design at the operational level [Fig.2.2]. Consequently, an appropriate design concept has to be developed in order to reflect the design activities desired, and the current design activities held by the company. It is also needed a framework in which design is implemented along the project [Fig. 2.3] and, thus, raise its awareness among members of the firm, especially designers. Likewise, the framework has to help the organisation to generate a system in which it implements more efficient and effective actions. It has to be ensured that diverse activities can be adequate and evaluated within the firm. So, employees are going to be able to modify it according to the necessities of the company. Thus, employees are going to be able to increase the number of tools and methods to improve their performance.

The plan is divided in five main parts which are going to be implemented over a period of five years:

1. Conceiving design
2. Implementing design
3. Acting design
4. Thinking design
5. Strengthening design

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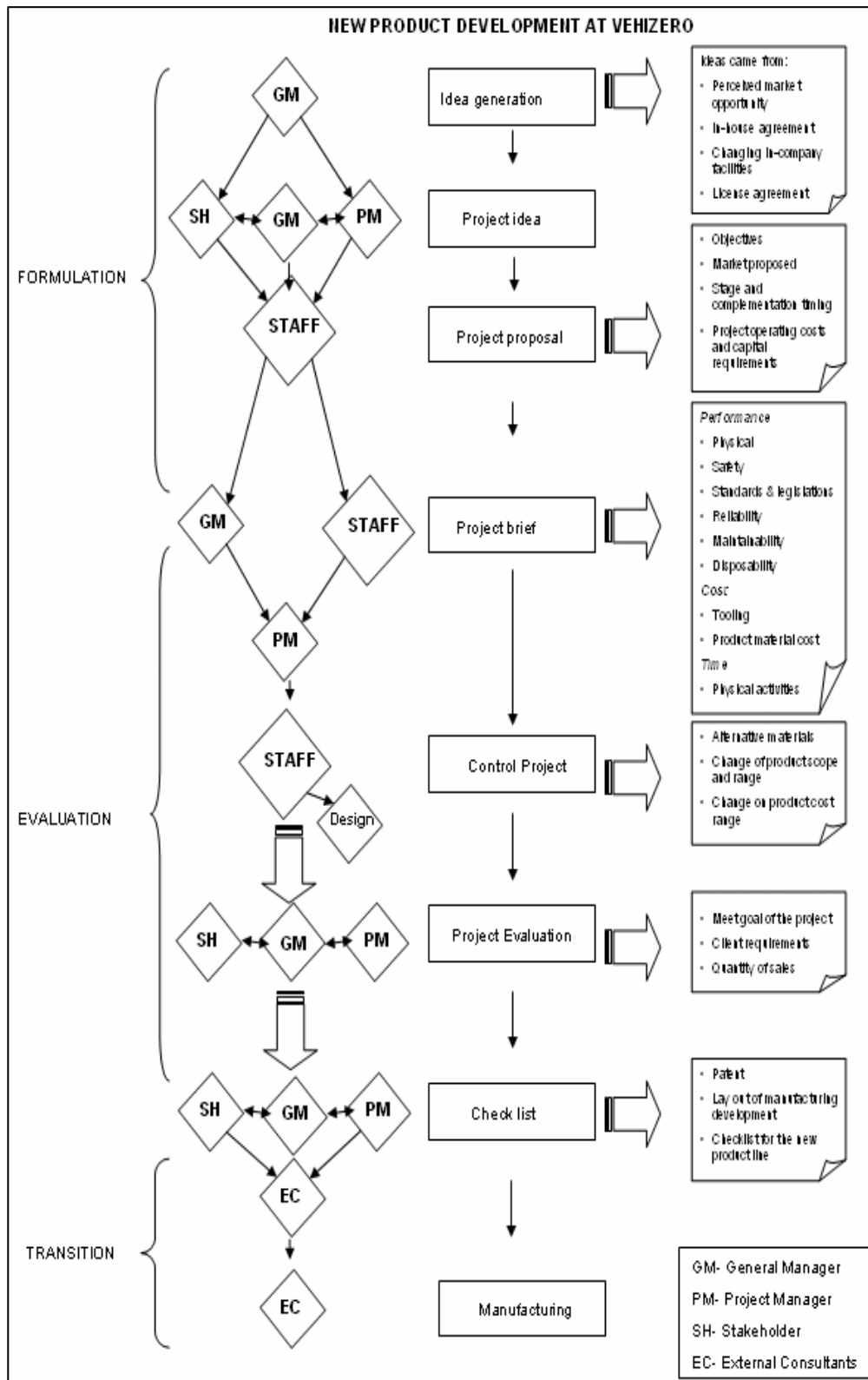
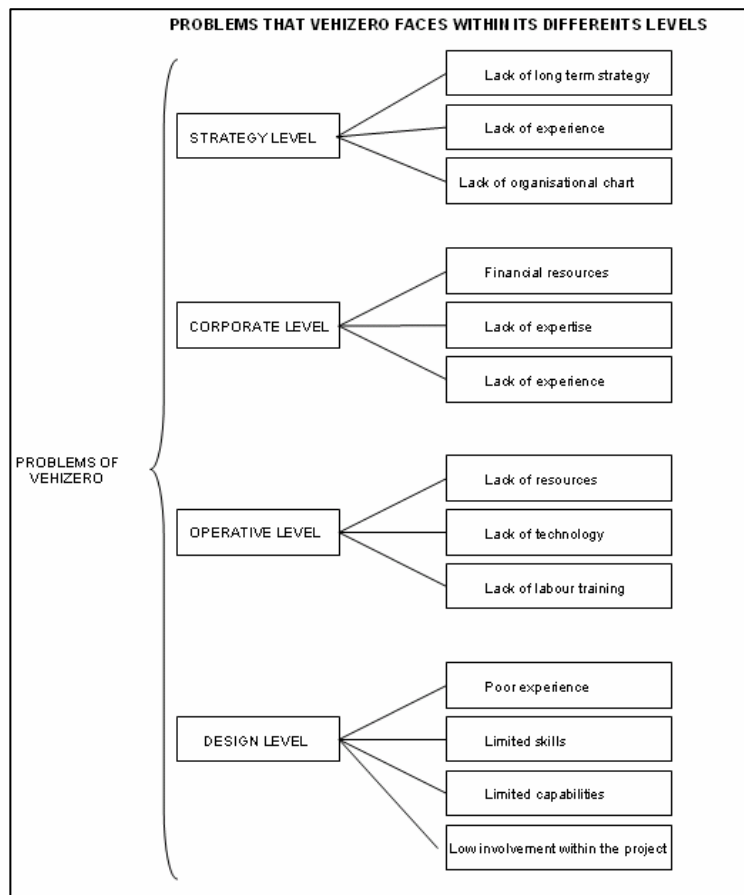


Fig. 1.1 Division of Task of Vehizero in the New Product Development



*Fig. 2.1 Problems that Vehizero Faces within its Different Levels*



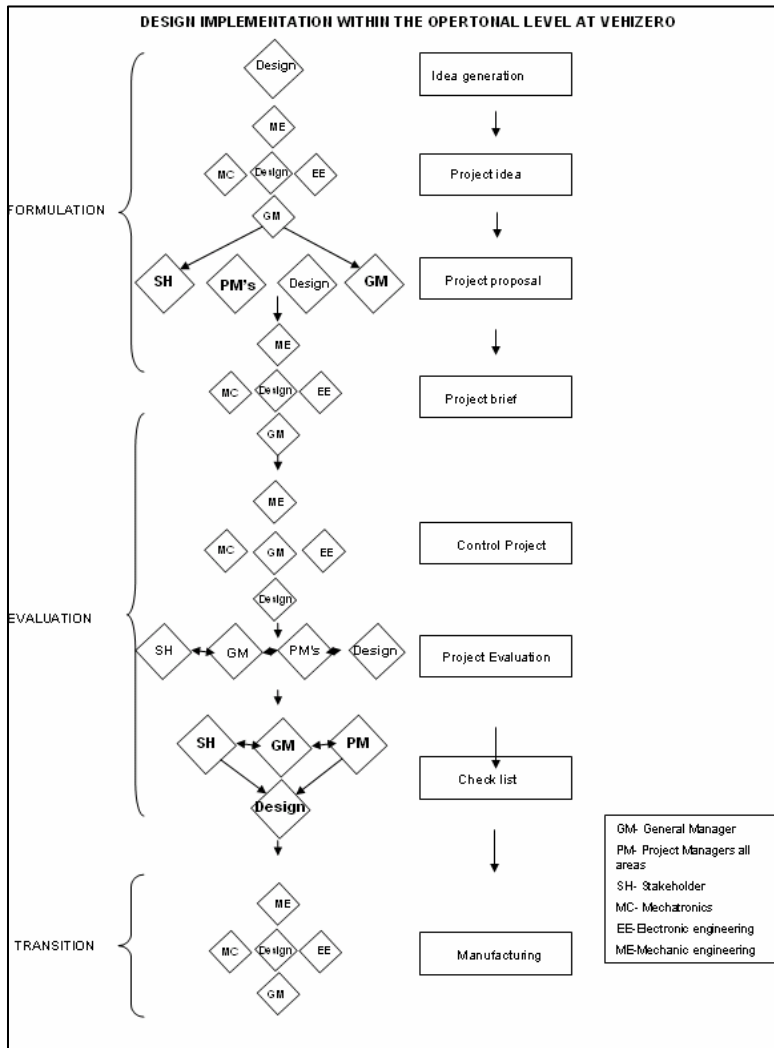


Fig. 2.2 Design Implementation at the New Product Development at Vehizero

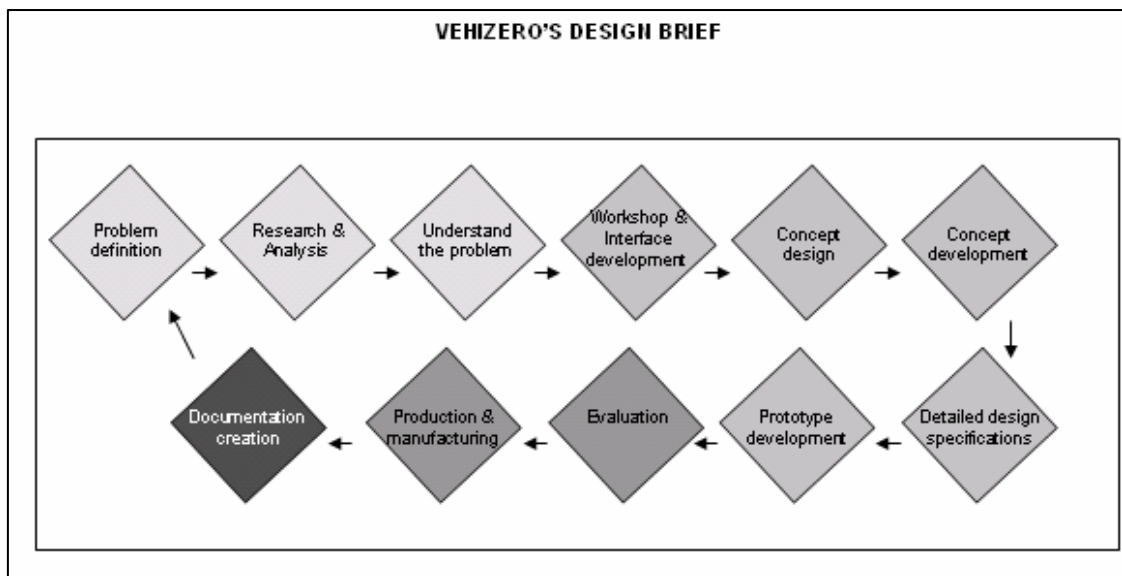


Fig. 2.3 Vehizero's Design Brief from Thinking Design

