

Optimizing Product Design through Manufacturing Capabilities Using the Kano Model in the Petroleum Industry

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Abstract: Through the study of the Petroleum industry and the Kano Model a study will be undertaken in order to be able to understand the ways in which the Kano Model can be integrated into manufacturing capabilities of the petroleum companies to improve the service in context to the satisfaction of customers by designing and changing the design of products to suit the requirements of customers and create a more expansive market for the products in the petroleum industry. An integration of an improved Kano model will ensure that the customers' wants and needs are available in the information that the data provides after the surveys done in the Kano model. Customers tend to rate the simple requirements with great significance and the important requirement with lesser significance in an attempt to meet their needs for which the customers buy the products. The MC technique that is still used in surveys is considerably outdated compared to the requirements of the current market environments where more importance is given to the essential features of the products rather than the innovative qualities of the petroleum products. As a result buyers are looking elsewhere for more efficient products that will meet the demands of a nation's market from other petroleum companies. The design of the Kano model with the modifications are designed in a manner so that the documentation from surveys will provide customer information and inputs on the improvements that need to be made in the product for it to sell well. The incorporation of the modified Kano model in the Manufacturing Capability will be able to redesign the product integrating the information from the survey design conducted by the petroleum companies.

Keywords: Kano model, Manufacturing Capabilities, Product design, Industrial design.

Introduction

Achieving success with innovative products to suit various markets, is becoming a challenging proposition. The product lifecycle in most of the petroleum products is limited which is why the petroleum industry is looking for ways to be able to decreasing the manufacturing time, increase the product features and being able to produce their products in the market more rapidly. This is especially true in the petroleum industry where there are specific types of products that are manufactured and every company produces the same products therefore, it is the additional manufacturing ability that makes the products of one company superior to another company. The most important factor in the innovation of the products to make it marketable is to take into account the requirements of customers so that it is to the satisfaction of the customers and will sell quickly. It is because of this specific need that the Kano model was created by Dr. Kano.

The data is accumulated from the customer service satisfaction instruments and this data is considered as an essential requirement for the product to provide customer satisfaction which is why this data is incorporated into the product design, so that the product will sell because the customers can identify the products as it meets their needs and this essentially helps a petroleum company to stay competitive in the market. By the process of accumulating and incorporating the data it also addresses the issue of the lifecycle of the product, it helps the organization to assess its design abilities and its manufacturing capabilities to create the design that suits the customer base best. The method of surveying and assessing the levels of customer satisfaction also provides the data that is essential for creating features in the entire range of products and not just individual products. When the data is incorporated into the design of an entire range of products it also makes the manufacturing process cost effective. The levels of customer expectations are revealed in this model of assessment and with these expectations a range of products can be designed that will support the company if one particular company is not selling due to a lack of temporary demand in the market. (Bayus, 1998).

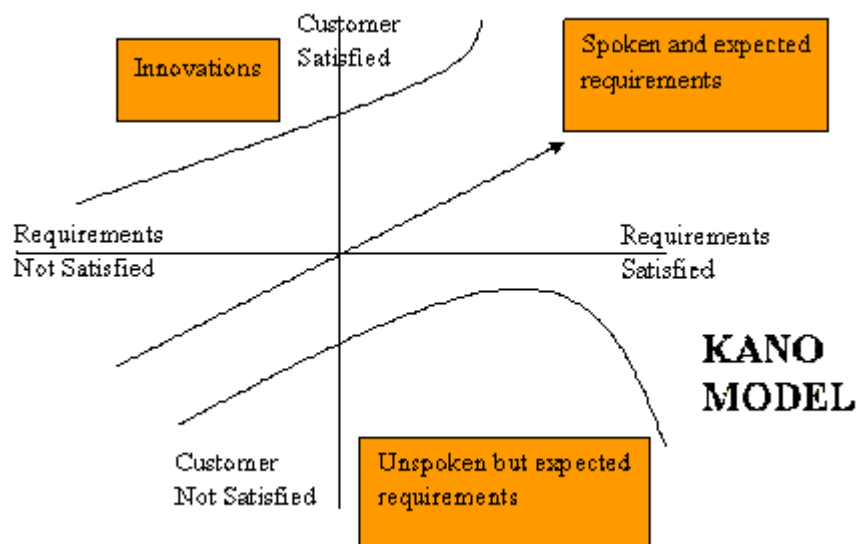
With the information technology and the access to the internet customers are today intelligent customers who are aware of the variety available in a particular product from different companies, this delays the manufacturing capabilities of the product as the levels of customer satisfaction need to be met before the products are manufactured in today's business environment. What this has brought to light is that there is a direct connection between product performance,

performance of the individual features of a product and the levels of customer satisfaction and approval. In the petroleum industry, the petroleum products have gained a high level of reliability which is why the prices are high of petroleum products and the demand for it is increasing in every region in the world. Therefore, according to the Kano model if the reliability of the product level was to be increased then the customers would be dissatisfied or the levels of satisfaction would be less. The level of customer satisfaction would however increase if, other features that were weak in the products were to be enhanced. In order to be able to do this, and find the levels of increased gratification in customers, what additional changes or modifications in the features of the products would increase the levels of satisfaction of customers.

These customer requirements can be assessed by the Kano Model and the model can classify even those product features that do not bring any satisfaction to customers which may or may not be a reason for the product not selling in the market as against a competitor's product. By making full use of the Kano model and integrating the information obtained from the data sets, the manufacturing capability team can progress in designing and refining the design for the manufacturing process. The aim of this study is to examine how the Manufacturing capabilities and the Analytical Hierarchy Process also known by the abbreviation (AHP) can shift its focus to the expectations of customers and design the petroleum products as well make the process efficient using the Kano Model of Customer Surveys. (Stalk, Webber, 1993).

Methodology:

With this specific aim, the customers views of the customer needs and the their requirements of the product were accumulated through data using direct interviews, observation of customers and the analysis of the data collected. The hierarchy diagram was used to quantify on the basis of priority which customer needs were most important and this provided an accurate ratio scale of priorities.



Once the needs were prioritized and placed into categories, these were then converted to the characteristics of quality. From here it was seen that these feedback of quality from the customers could help the manufacturing capability and the process of analytical hierarchy in finding the solutions to optimize the sale of the petroleum products even when the demand for the products in the market are low by focusing on the features that would meet the needs of the customer base.

Customer Fulfillment:

Customer fulfillment is considered to be the ability of a company through its product to satisfy the needs of the customer so that the customer is satisfied with the product and there is a guarantee of a repeat sale of the product. The levels of customer fulfillment are dependent upon the presence of customer necessities in the features of the product, the performance of the product and whether the price attached to the product is worth the product features that are there in the product design. Customer satisfaction and fulfillment are also impacted by the different requirements of different customers and the levels of satisfaction are also seen to change over a period of time. The causes for the changes in the levels of satisfaction are mainly due to substitution in the market, due to competitors increase the product differentiation in the market and the additional features that meet the necessities of the customer. Following the innovative changes in the competitors' product features is not enough in today's business environment a petroleum company needs to assess

the changes in the needs of the customers and a continuous evaluation of the changing needs has to be done. To be able to measure this, the Kano model has proved to be an effective tool in the classification of the customer needs and the prioritization of the customer needs. This is done by measuring the customer psychology of the consumption of the product and the measurement of the motivation that makes the customer consume the product. This model can also measure the relationship between the levels of customer satisfaction and the performance of the petroleum products. This relationship is important because it is non linear in nature. The Kano model propositions a dimensional representation of the qualitative experience of customers which is subjective and emotional and the performance of the product which is quantitative and objective. (Christiano et al, 2001)

Therefore the needs of customer satisfaction have to be measured by the specific requirements, tables and classifications of the Kano model which in effect are done by a questionnaire, a classification table and a table that is created for evaluation. With these tables and the questionnaire, it is possible for collect the type of data that is essential in trying to gain the kind of accurate and detailed information that is necessary in order to be able to understand what exactly customer fulfillment is and what features and services of production increase the levels of satisfaction and decrease the level of satisfaction in a company's products.

Besides the needs of customers, the wants of customers also have to be considered as if the product does not have any novelty features but only has the type of features that are essential features the chances are that the customer is likely to shop around for a brand that does have some of the features that the customers want even if they do not need them. It is a scientific model that enables a company to understand that when the products are so similar what can be refined in order to meet the changing customer needs on an ongoing basis. The Kano model was designed to understand and why the costs of production were high and products were not selling. This made Dr. Kano take basic steps from the premise that the products were not selling because the customers did not want to buy them.

If the <u>gas mileage</u> of a car is good, how to you feel? (Functional Form)	1. I like it that way.
	2. I am expecting it to be that way.
	3. I am neutral.
	4. I can accept it to be that way.
	5. I dislike it that way.
If the <u>gas mileage</u> of a car is poor, how do you feel? (Dysfunctional Form)	1. I like it that way.
	2. I am expecting it to be that way.
	3. I am neutral.
	4. I can accept it to be that way.
	5. I dislike it that way.

Source: www.sensory.society.org

Kano Model Questionnaire

The use of specific questionnaires, evaluation tables and classification tables in the petroleum products is used mainly in the classification of the customers' requirements of the product this creates a high level of subjectivity in the data, there is also uncertainty in the data collected as the customers do not fully comprehend the questions or a particular customer's psychology is more complex than others from this the data has to be sieved and correlated to find the actual information of the customer requirements of the products and what exactly will provide higher levels of satisfaction.

Five Categories of Quality:

The essential elements of service and product quality according to the Kano Model are:

- Must be: These are the features of a product that are taken for granted. A barrel of oil that leaks makes the buyer dissatisfied because of the valuable loss from the leak in the barrel but if the barrel does not leak then no increased level of satisfaction is recorded as it is a must be feature that oil should be put in leak free barrels.
- One dimensional: Are features if added create higher levels of satisfaction and if the feature are absent create dissatisfaction.

- Attractive: These are features that if present create satisfaction and if they are not present do not create any dissatisfaction.
- Reversible: This is the phenomenon where a high level of product achievement will cause dissatisfaction in a customer and if they are not there the level of satisfaction will be higher.
- Indifferent: These are feature in products and services that do not crate any high levels of satisfaction or dissatisfaction for customers. (Sethi et al, 2001).

Attributes	Consequences
Safety	The vehicle provides accurate safety warnings.
	The vehicle has high safety and standard ratings.
Efficiency	The vehicle gets good mileage.
	The vehicle is energy efficient.
	The vehicle has high horsepower.
Cost	The vehicle is affordable.
	The vehicle has an extensive warranty.
	The vehicle is a hybrid (i.e., it splits power between electric and gas).
Performance	The vehicle has towing capabilities.
	The vehicle does not compromise speed and handling.
	The vehicle can be driven for longer distances (>400 miles).
Comfort	The vehicle provides a comfortable ride.
	The vehicle has a quality audio system.
	The vehicle is climate controlled.
	The vehicle comfortably fits a sufficient number of people.
Eco-friendliness	The vehicle has low emissions.
	The vehicle is environmentally friendly.

Source: www.intechopen.com

Kano Model Classification Table

Consumer Requirements		Dysfunctional				
		1. Like	2. Expect	3. Neutral	4. Accept	5. Dislike
Functional	1. Like	Q	A	A	A	O
	2. Expect	R	I	I	I	M
	3. Neutral	R	I	I	I	M
	4. Accept	R	I	I	I	M
	5. Dislike	R	R	R	R	Q

Table 1. Kano evaluation table

A=Attractive M=Must-be O=One-dimensional
 I=indifferent R=Reversal Q=Questionable

Source: Kano Model Evaluation Table

Manufacturing Capabilities: The aim of any manufacturing company is to be able to manufacture products with the objective of creating a level of customer satisfaction with the product and making a reasonable profit from the sale of the product in the market. The objectives of a petroleum company are to include in its products and the quality of the performance of its products the following features:

- The product performance of all its features
- The quality of the product
- The cost of the product

In meeting the needs of the customers and in trying to incorporate the features that the customers need and want in the product the design unit has to be able to create a feasible design which the manufacturing unit will have the capability to manufacture or refine. This is also known as the 'design for operation.' In this process the design unit not only consult but also involve the manufacturing unit in the decision making process but the modification that is suggested in this paper is that the service unit should also be included in the decision making process as they are best aware of the levels of customer satisfaction and dissatisfaction with the existing products of a company. By this process the design unit is able to create a feasible design that the manufacturing units can achieve in the product. Design operation is an important aspect as it can be cause of decreased productivity, substandard quality, and higher costs of manufacturing. The entire logic of the Kano Model is to make the manufacturing capabilities and the design capabilities of a company more efficient and cost effective. It is therefore essential that the manufacturing unit should be involved from start to finish of every stage of the design process of a product.

The one reason for many petroleum market have short shelf lives in the market is the design looked good theoretically and on paper but the costs of manufacturing were high or the quality could not be retained. In the petroleum industry all the companies are regulated and the increase level of regulation and environmental safety does not allow for certain types of products to be manufactured even if there is an efficient design for it. The manufacturing capabilities need to take into account the fact that the design unit also has goals to meet and targets to achieve and keeping this in view the manufacturing capabilities in petroleum companies have a characteristic set of practices that they use. The manufacturing capabilities of a company can therefore be characterized as:

- The design capabilities of the company
- This combined with the manufacturing ability of the company
- A set of capabilities that will achieve the different levels of the production
- Operational capabilities. (Jiao et al,1998)

The operational capabilities can be therefore summed up as the total capabilities at all levels of the manufacturing process that enables a company to be able to link the operational performance of the company with the product and the manufacturing strategy. The manufacturing capabilities of a company are created at the planning stage with the most appropriate strategy that is suited for the manufacturing ability of the company.

Manufacturing Strategy:

This is the creation of the ability of a company to have the capabilities to manufacture a particular product by using the correct strategy that will increase the levels of customer's satisfaction, increase the brand value of the company, increase the competitiveness of the company by taking a Resource Based View (RBV) of the company's abilities to manufacture and the manufacturing process. The Resource based View is that not all the resources of a company are evenly distributed in the company units, therefore the resources can provide a competitive advantage for the company if it is strategically managed within the company which is also known as the optimization of resources within a company. Resources in a company are the assets, the procedures, the methods of manufacturing, the skilled people within the company, the finances of the company and the management practices of the company. The general opinion from the different vies of researchers is that a company differentiates itself from its competitors by resources that are valuable, rare and cannot be substituted providing it a competitive edge in the industry.

The Kano Model is a modification of the Six Sigma model and the way to hold on to these advantages of resources is improving the practices and the management programs within the organization, using Lean Manufacturing Methods, Total Quality Management and placing an emphasis on a single functional capability of every independent activity in the manufacturing process. The level of competition within the companies in the petroleum are directly proportional to the level o capabilities that each company ahs in the petroleum industry. The capabilities of a company are non transferrable and is company- specific. What this implied is that a company may have the rigs, equipment, funds machinery, work force and design but it may still be less competitive than another company because of the management practices in the manufacturing process that are not good enough. Management practices are an important part of manufacturing capabilities. The design for manufacturing capabilities also includes the design process that is a part of recycling products, crating products redesigning products and re manufacturing products. The higher the level of manufacturing capabilities that a company has the more likely it is to survive and thrive during lean business periods in the industry.

Concurrent Engineering:

The modern method of product management is to involve the manufacturing unit with the design unit so that the time taken for th product to grow is less and decreases the costs. From the product plan to the design plan and finally to the manufacturing process the design unit and the manufacturing unit have been inter twined so that there can be a simultaneous phase by phase manufacture of the product. This is called production engineering or concurrent

engineering where both the sets of people from the design unit and the manufacturing unit work together simultaneously towards the completion of the product. These two teams also make the decisions regarding the production process and the management processes that will be used in the production. (Tontino, 2007)

The concept of concurrent engineering has been expanded and it now includes:

- Manufacturing personnel
- Material experts
- Chemical experts
- Marketing personnel
- Purchase personnel

They are all integrated as cross functional units of the manufacturing process. The traditional approach of creating the design and then giving it to the manufacturing unit to produce was a challenge as often it was found that the manufacturing units did not have the capability to create the petroleum product to the specification of the designers. There were conflicts and the time for production increased with the costs of production also increasing. It is because of these two basic facts that the approach of concurrent engineering became popular.

The advantages of this type of process are:

- The manufacturing unit can clearly provide the limits of their capabilities
- It provides the scope to be able to choose the materials and the processes that will make manufacturing simpler and faster
- The costs are decided by the design unit and the manufacturing unit together so production costs and the quality does not differ from the plan
- This removes the limitations of an unknown design for which the units have not worked together thereby leaving little room for the defects in the product.

The Challenges in this Type of Process

- The existing boundaries can be longstanding between the phase plans of the design units and the phase plan of the manufacturing units
- If the teams do not gel together then it becomes a challenge to arrive at a unanimous decision by which it becomes possible for the entire production to be derailed exceed costs and become inflexible.

The Requirements for Production:

For the production to be an fluid process that does not encounter any obstructions, the designers need to design the product keeping in mind the capabilities of the manufacturing unit. This will ensure without a conflict that the design that is created can be manufactured as it will then take into account the skills of the manufacturing unit, the equipment available, the technology available and the materials that are available for the manufacturing unit. The most important factor in the design and the manufacturing processes is that the opportunities and the capabilities need to match before a company can produce what it wants. To achieve this match, the company needs to be able to expand the capabilities or change the capabilities to bring the manufacturing capabilities in line with competition. This is one of reasons why the concept of design for Manufacturing (DFM) especially in industrial production is an important concept. This indicates that the design that has been created is in line with the manufacturing capabilities of the company and therefore is practical and feasible design for the company to manufacture. From the phase of Design for Manufacturing (DFM) the Kano Model moves to the Design for Assembly (DFA) phase. This is how the product will be assembled by using the minimum number of parts and the sequence of the assembling process that will make the entire process leaner.

Recycling: This is a process that is important for the designers because material is recovered for future use. Some of the materials can also be used not only in manufacturing the product but also in the production process. Some types of recycled items such as lubricates, water, chemicals, solvents can be recycled into solid or gaseous stages and reused,

which increases the environmental up-gradation of the company and the location and decreases the costs of production and procurement.

Remanufacturing:

Remanufacturing in the Kano Model that reuses all the parts that can be reused and replaces the parts that are damaged and sells it back in the market. The costs are normally lower but it can be the same cost as a new one if the original company manufactures the product. Other companies can also remanufacture the products of original manufacturers. In the petroleum industry the remanufactured parts are the pumps the solvents, the mixes the machinery which are remanufactured by companies like Schlumberger, Gilbarco, Wayne and Tokheim and the efficiency of these products is as good as the new ones. The costs are generally lower for remanufacturing as it only requires unskilled labor and skilled labor for assembling the parts which can be done by a workforce and does not require executive cadre skills. The other aspect of the Kano model concept that is sued in the manufacturing capabilities is the Design for Disassembly (DFD) which applies to the design created of products in a way so that they can be taken apart more easily by using lesser parts in the design and using different types of industrial snap fits instead of nuts, bolts and screws. (Kano et al, 1984).

In the Kano model the design, the product facility and the manufacturing capabilities are all focused on the list of possible customer requirements and segregated into two lists one for the internal customers and one for the external customers. To increase the customer base of the company the Kano model also incorporates the future needs and the needs of the potential customers of the company though information that is gained from business intelligence. It has been shown that Dr Kano's model of evaluating the conditions of the customers has worked in the manufacturing capabilities of the petroleum companies that have used it. This is done by using the functional and dysfunctional questionnaires which have been illustrated above in this paper as a conducting instrument for the survey exercise.

What the Kano model aims at is to be able to provide the changing needs of the customer environment and wants. When the requirements are basic the importance of that performance for a customer decreases even if the performance increases. The importance of features can be specifically found from the Kano model itself where the basic importance the higher importance and the ratings of importance given by customers show the performance of the competitors viz a viz the company's own products. The model also brings to light that the unwanted or unflattering comments of customers about products are 'must have qualities,' 'one dimensional qualities' the two important gratifications according to the Kano model are 'better' and 'worse' to understand the levels of customer gratification and disappointments.

The Kano model is important because it provides the essential features that are lacking to making the product success in the market or it provides the features that the customers are looking for to meet the new requirements for which the customer will need to use the products. What the model clearly shows is that it can be sued in total quality management in the manufacturing capabilities to improve the levels of the manufacturing capabilities by aligning it with the needs of the customer and the designs that would satisfy the customer without creating any major dissatisfaction in the process.

Literature Review

Definition of Kano Model: According to the various definitions of the Kano model the most important definitions that have appeared which are also accurate are that:

The Kano model is a theory of satisfying customers and developing products based on the five categories of product quality. (Business Dictionary, 2015).

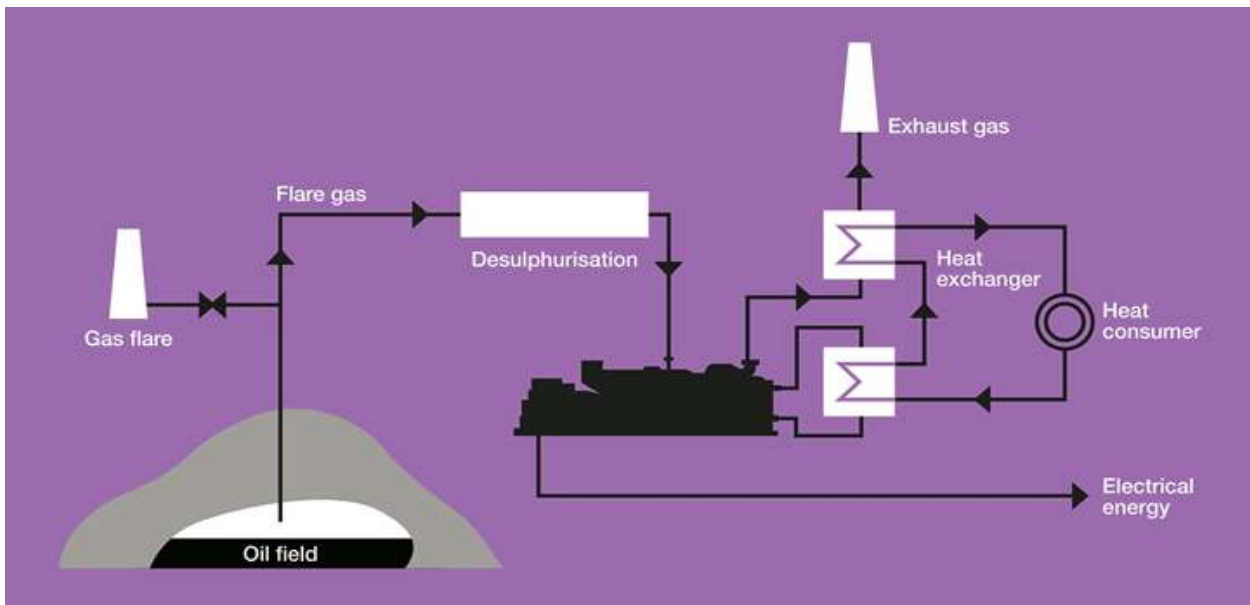
The Kano Model can also be said to be the development of products that are based on the customer satisfaction needs which have been categorized into five categories. These categories are:

The guarantee of quality from the customers' perception

When customer needs are fulfilled then the customer is satisfied and if the needs are not met then the customers are dissatisfied.

The level of quality attractiveness which when met the customers are satisfied but it does not make a difference to the satisfaction levels of the customer.

Quality that is indifferent does not satisfy or dissatisfy a customer



Kano Model Manufacturing Process in Petroleum Industry

Reverse quality is the type of quality that too many added features in a product dissatisfies the customers and it is not bought while other may look only for product with many added features. From here the levels of customer satisfaction are identified and the quality of the product is aligned to the development of the product. (Kano et al,1984)

The Use of Kano Model in Product Design: The Kano model takes into account the importance of the customer perception of a particular product. This entails researching the different designs of a product through customer perception surveys which enable a manufacturing unit to understand what the final market design should be in order to maximize the levels of customer satisfaction and product sale. While designing a product there are several activities that take place. The activities in which the Kano model is used are:

- Discovering customer needs
- Finding out the functional requirements of the product
- The product design concept that needs to be developed
- Carrying out an analysis of the levels of customer satisfaction and dissatisfaction of the competitor's products.

The other types of measurement tools in which the Kano Model is used today is in the areas of activities that relate to:

- Gathering customer input
- The priority levels of matrices can be determined
- It is also used in Quality Control systems
- The Kano model is used to provide in depth understanding of customer value and product value to the customer (Calgary,1999)

Case Study: The case study that will be used here is from the American Petroleum Institute. The details of the case study are related to the manufacturing capability of the company. In the Petroleum industry the use of the Kano Model is larger than just designing products with customer satisfaction perceptions even though that is the very basis of the Kano Model. The areas in which the Kano Model is used in the petroleum industry also known as the oil and gas industry are in the form of Q1. The area specifics of the use are in the following areas of the manufacturing capabilities of Petroleum companies/Oil & Gas companies:

- In catalysts necessitating the change of processes
- Using the Kano Model in the Q1 layout
- Using the model in conjunction to normative references for improvements in manufacturing capabilities
- In the area of product specification
- The Kano Model is used in the processes approach for quality management
- When the manufacturing capabilities and the design have to be improved with quality being the objective
- Kano Model is a set strategy model that is used in the industry for management functions and responsibility to create better management functions

- The Kano model has been used to successfully point out the competency requirements of a petroleum company
- The Kano has created a standardized method for controlling documentation though creating efficient processes
- The Kano model has improved the risk identification processes, the risk management processes and the risk assessment processes.(API, 2015).

The entire Q1 is based on the competency of the Kano Model in the above mentioned areas.

In Kano Micro Oil the processes in the manufacturing capabilities are defined as per the illustration provided below. In Kano Oil the first thing that has been done is to standardize the processes taking into accounting the results from customer survey researches that have been conducted over a period of time. The company got its name from remodeling all the processes according to the Kano Model which created the value and proved that Dr. Kano's model provided efficiency and stability by simplifying the processes, standardizing the processes, creating resilience and a flexibility in the organization that has led to the essential levels of customer service in an industry where the prices of the commodity are controlled.

The changes in the structure that has been made in Kano Oil Company are structured and designed according to his original diagram where the levels of customer satisfaction was shown in the y – axis of the Kano graph. This is illustrated in the diagram (2) in this paper. What is evident is that the curve of the arrow and the level of positive satisfaction is directly proportional and the level of positive dissatisfaction and the downward trend of the arrow is also directly proportional.

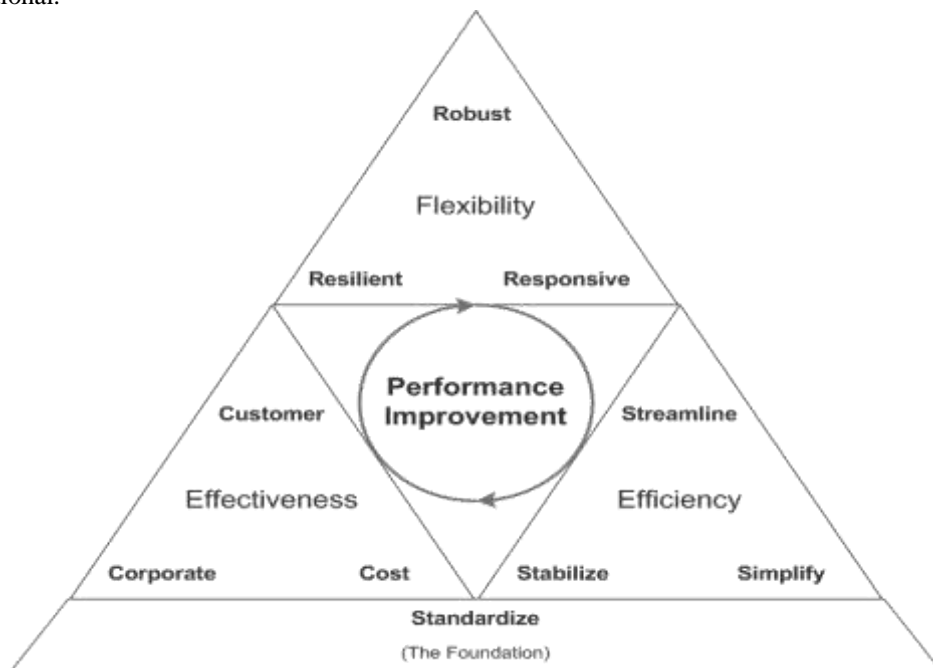


Diagram 1

The depiction of the diagram shows that the foundation level of any oil company has to be standardized. The area of corporate management stability in processes of design and manufacturing capabilities lowering of costs and the simplification of the processes leads to the processes to be efficient and effective. This automatically streamlines the performance levels by which the organization can visibly see improved performances within the organization. The improved processes naturally make the company more responsive to the needs of the customers and the needs of the product as well in order for the revenues to flow in and for the product to be able to compete in the market. This creates resilience within the organization. The combination of resilience and responsiveness of the organization creates the flexibility and this helps the company to adapt to the changing business environments which is common in the petroleum industry.

There are three thresholds that are visible in the Diagram 1. The three thresholds are the Kano Model thresholds of:

- Threshold Level
- Performance level
- Excitement Level.

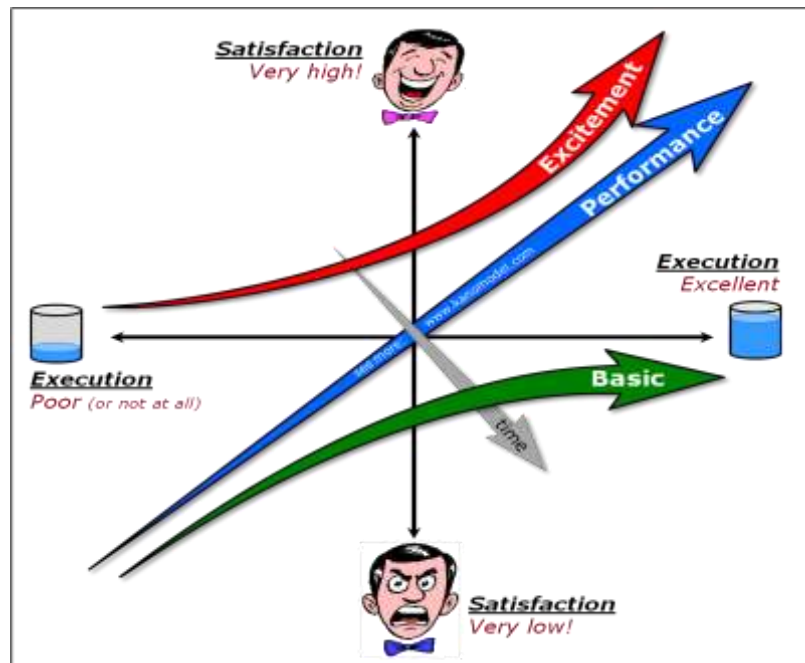


Diagram 2

This is the next level of the Kano Model Understanding where the threshold attributes are the features in a product that must be represented and does not provide any scope for the manufacturing capability to create a product differentiation. On the reverse, if the features were absent then it would lead to high levels of dissatisfaction and even extreme dissatisfaction. Performance attributes are those features in a product design that will generally increase the level of customer satisfaction in the case of the petroleum companies it would be the efficiency of the fuel or the by products that have been innovated from oil refining. On the reverse if the feature is absent from the product it causes extreme dissatisfaction of the customers. The excitement attribute are those that are non verbal and not expressed or expected by the customers and it provides high levels of satisfaction when the experience the product with these features. At the same time if these features are absent from the product there is no great level of dissatisfaction in the customers. (Calgary, 1999).

Application of the Kano Model in the Petroleum Companies: the simplest way to analyze through the Kano model is to ask the customers two very simple closed ended questions:

- What would be your satisfaction level if the product had (name the feature) in the product?
- What would be your level of dissatisfaction if the product did not have (name the feature) in the product.

The same two questions can be used to analyze the levels of the efficiency of processes and activities as it is being done in the oil and gas industry today. The responses to the questions according to the Kano Model analysis for all processes and activities in a company should be in the following terms:

- Yes, satisfied
- No, dissatisfied
- Neutral attitude
- I don't care (Ullman, 1997)

BP Exploration and Courtauld is another company who has seen measured results by implementing the Kano Model. The use of the Kano model has been different from the use of the model in Kano oil. In BP, the culture space of the customers has first been identified and then research done on that C space using the Kano Model. The flow of information has been gathered and put up for constructive debates and discussions as to what should be and what should not be featured in the petroleum products as well as the management processes. The design insights and the process insights emerge and they are placed on the Kano model of customer satisfaction and dissatisfaction. The insights on management processes are placed in a similar fashion on satisfactory processes and unsatisfactory processes.

The structured changes are then made and the analysis is done of the implemented process in a measured manner using the Kano Model Analysis. (Mole et al,1998)

The methodology that is used in the petroleum companies is a four stage methodology.

Stage 1: The ReAR analysis is then and all the feedback is collected from observation.

Stage 2: The requirements for improvements are then identified from the results of the observation and the analysis.

Stage 3: These identified requirements are then assessed with the Kano Model.

Stage4: The comparison of the identified features in products or the manufacturing capabilities of competitors is done and the changes within the organization are made accordingly.

The Kano evaluation table that is used is:

Customer Requirements

Functional Answers

Like features

Must be features

Attractiveness of features

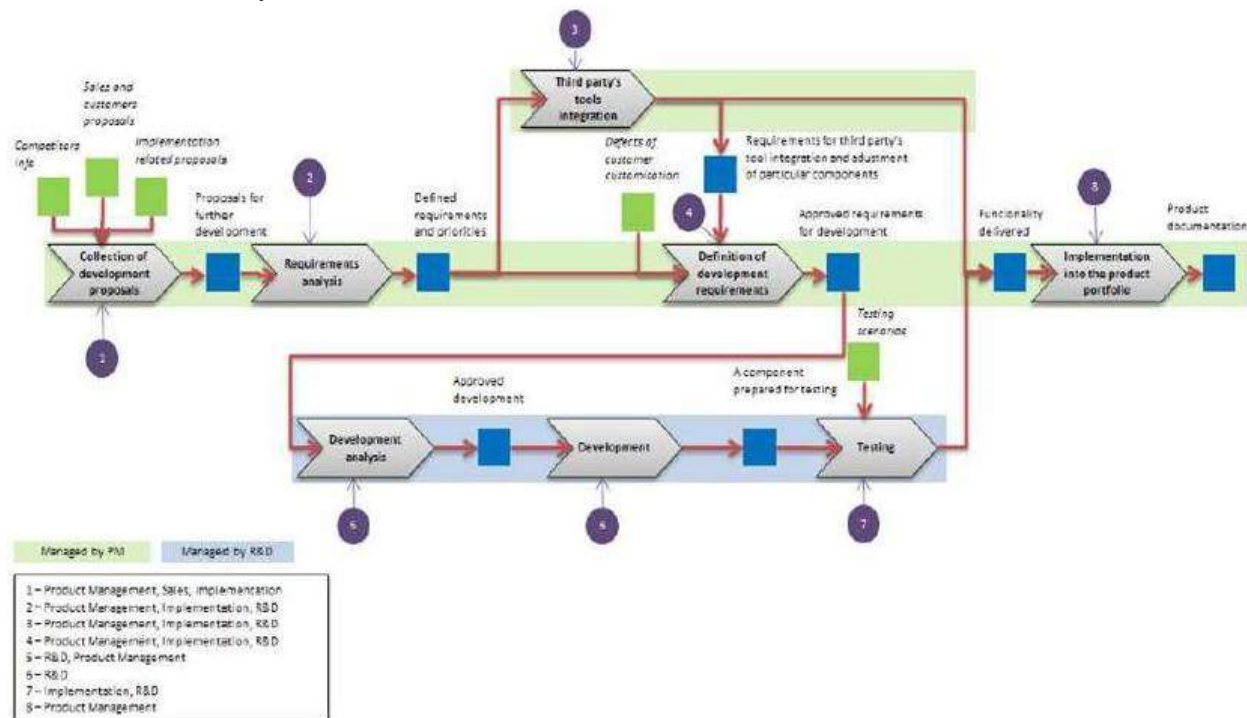
Dysfunctional Answers

Neutral to features

Can live with the features

Dislike features (Rejeb,2008)

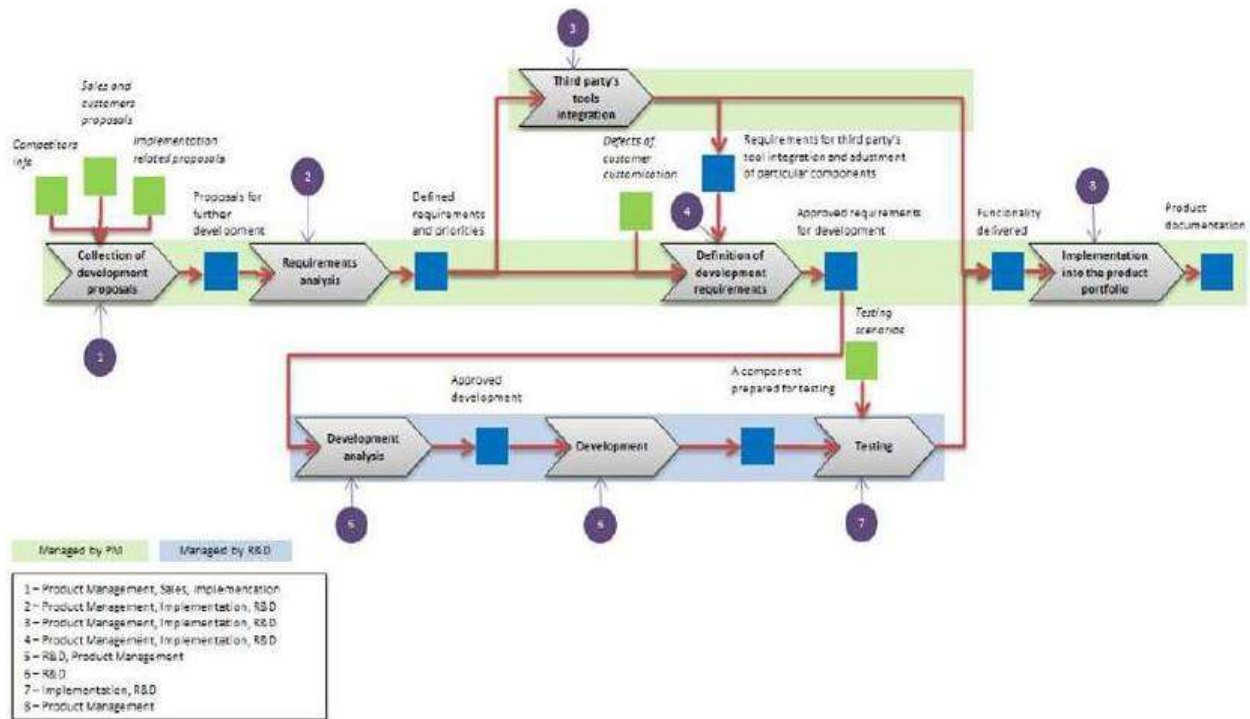
Kano's Functional and Dysfunctional Matrices



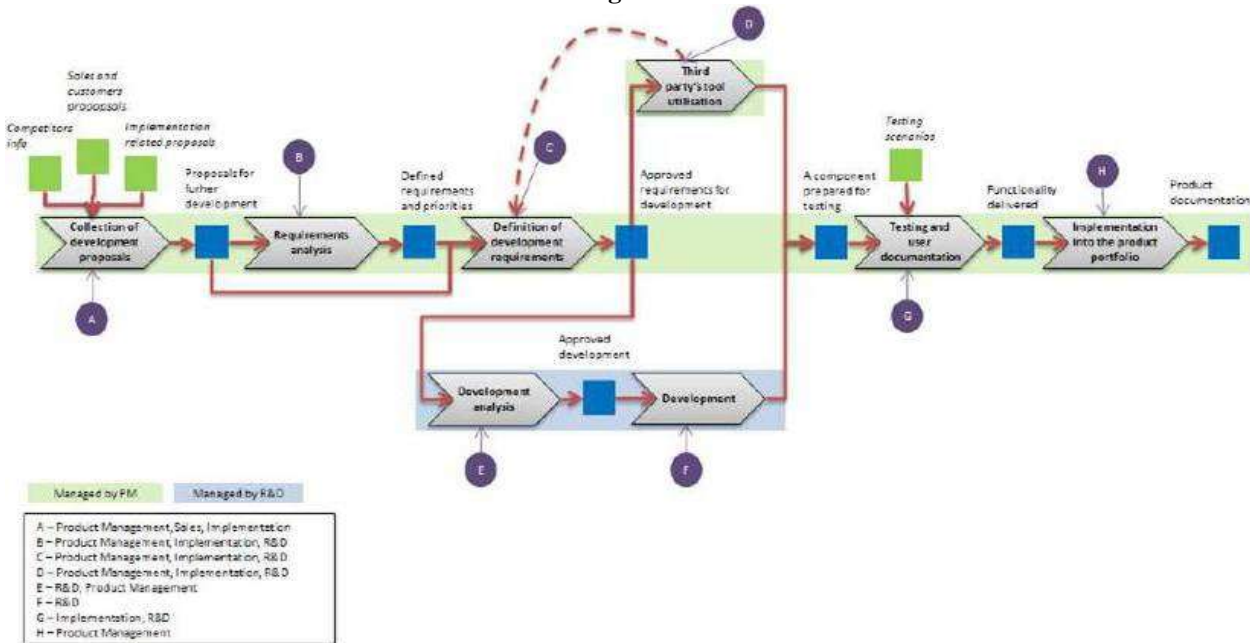
Functional Requirement Process

Diagram 3

The functional matrix and the dysfunctional matrix that have been described above and tabulated above, are illustrated in diagram 3,4 and 5. This is the process in which the Kano Model is utilized in the petroleum industry. Judging by the entire process of use in the petroleum industry the changes that can be made in the model is first of all to make the functional matrix categories more precise in expression and the dysfunctional matrix also more precise in expression. By changing the general phrases instead of four stages the entire analysis can be done in three stages itself which is the modification that is being used in the petroleum industry along with covering the needs and the expectations in one go, aligning the services, processes and the product manufacturing to suit all the stakeholders involved in the processes, the insights are concentrated to create one product design/architecture and finally the coordination of the entire processes for product development that will hit the competitive market.



Process to incorporate functional requirement
Diagram 4



Utilization of 3rd party tool
Diagram 5

Source: IBIMA Publishing (Bures,2012)

Suggestions for Improvements: The suggestion for improvements is based on the study that has been undertaken in depth of Dr Kano's Model for manufacturing capabilities. In the petroleum industry, where the prices are controlled and the petroleum by products are sold for specific requirements only, it is necessary to make the processes leaner so that the entire structure can be simplified and most of the waste functional and employees can be diverted under one family of function type so that the costs are less, the time taken is less and the is easier to pinpoint where the process is going wrong as it will cause delays in the other dependent processes.

What has improved in the petroleum companies that are using the Kano model is that the activities are more flexible and efficient. This comes from the responsiveness that develops of the company once the implementations of the changes are made after it has been analyzed with the Kano Model. Despite a fall in prices and lesser barrels being

produced today, the Q1 system being used with the Kano model has made the processes more efficient and has lowered the costs of production and created cellular units within the production unit that can function effectively and are resilient to all types of changes in the business environment as they levels of satisfaction and the levels of dissatisfaction are measured and this provides an accurate assessment of where the company stands with the business customers. The four stages can be released to three stages in effect making the model more cost effective and organization friendly where the results obtained will be quicker from the analysis saving time and effort which in a business are key elements. From here one can go one step further and create a greater efficiency and leaner processes by using the Six Sigma processes from where the model has been developed.



Diagram 6

Analyzing the Kano Model: Analyzing the Kano Model from its use shows clearly that the Kano model is a Six Sigma process and in conjunction with the Six Sigma processes the best of the Kano Model emerges as has been seen by its use in the Petroleum industry. The above study that has been undertaken is from Kano Oil Company and the confirmation of the model's use in the petroleum industry in a similar manner has been found in BP petroleum Research. The Kano model that is described above from the study that has been undertaken is different from the other industries as this model is specific to the petroleum industry only. The form in which this is used in the ceramic industry is different and the way this model is used in the automotive industry is even more different even though the basics of the model remain unchanged in all three industries where the success of the Kano model has been recognized. The concept is creating an attractive quality one that creates employee satisfaction and customer satisfaction. The five classifications have already been mentioned as have the three attributes in the earlier part of this paper.

The graph that represents the levels of satisfaction and dissatisfaction has also been illustrated in this paper. The four stage process has also been identified as used in the petroleum industry. The first stage is the strategy of the processes that is adopted. The marketing strategy is analyzed, the project selection is done and the product development process is chosen. In the second stage the customer matrices are developed, and the results assimilated and plotted on the Kano Graph to understand the features that must be in the product for gain customer satisfaction and secure the investments in the manufacturing process. In the third stage the data that has been collected is analyzed, a list of features and functions is then created after discussions with not just the manufacturing unit, but with the service department, the sales department and the product design department to ensure that what the design department have created the manufacturing unit is capable of manufacturing it and the sales department can confirm that they can sell the product in competitive market. The fourth stage is using the Kano Model questionnaire and understanding the levels of customer satisfaction and dissatisfaction before manufacturing the product and placing it in the market. The collected data is then summarized and the final features that should be included or not included are listed before the manufacturing processes for the product can begin and the changes in the design are also done accordingly. (Long Sheng et al,2010)

According to the Fars Petroleum Company the Kano model has provided for the company an accurate measurement of the levels of customer service requirements and the changes that the company had to institute in the Customer relationship Model after the analysis was done by the company according to Kano model stages that have been described above.(Farokhran,Ezeegilo,2014)

The hard value savings from the Kano models in the companies in the petroleum industry are:

- Savings in energy, power use and raw materials. A reduction in the cost of spare parts and useless features of a product.

The soft value savings from the Kano model in the companies in the petroleum industry are:

- Improvements in safety and in quality, meeting the environmental regulations, better customer experiences have been recorded and the process of doing business with a customer has also improved.

The two disadvantages that have appeared are that this model provides the determination of the value of a product on individual attributes but not within the attribute. The customer choice is based on the overall features of the product and rarely based on only one feature of the product. (Dr Briones, 2014) One of the most critical areas of petroleum companies that the Kano model has simplified is the area of finding innovative ways that would turn the attention of the customer to the companies petrol pumps in the country so that they would travel a little distance more than the nearest petrol pump to fill gas at the company's petrol pump station. (Liu, 2011).

The Criticism of the Kano Model: The criticism is that it is purely subjective data on which the manufacturing capabilities and the design capabilities of a company invest in. If the data is incorrect because the research samples were not in the mood to answer or were stressed out and anxious or in a hurry than large investments would burn up in oil and gas because the effectiveness and the supposed quality of a product has been based entirely in subjective data of a Kano Model Analysis. (Mac Donald et al, 2006).

Conclusion

The Kano model has been named after Dr Kano and it is a model that is used to understand the levels of quality in services or features in products that increases the levels of customer satisfaction or dissatisfaction. The Q1 system of the American petroleum Institute has been taken as a yardstick and the companies using the Kano model in the petroleum has been studied. The results have been placed in this paper from page 10 to page 19. The benefits that have been derived by using this model not only service but in product design, and the manufacturing capability processes have been discussed in detail in these pages and illustrated for clarity. The suggestions that have been made after the study for the Kano model have been placed in page 17. The criticism of the Kano model that has emerged during the course of the study has been highlighted on this page itself so that further studies can be undertaken of this model and as the business environment changes the Kano model can be further modified for greater efficiency and use in the petroleum companies in all countries.

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