World Journal of Engineering Research and Technology
WJERT
www.wjert.org
SJIF Impact Factor: 5.924

"STRATEGIC ANALYSIS TO ENHANCE CUSTOMER SATISFACTION IN PIPE MANUFACTURING UNIT THROUGH DRIVEN ENGINEERING TECHNIQUE"

Anujanand Choudhary*[1] and Dr. Archana Nema[2]

[1]Putai, PS-Manigachi, Dist-Darbhanga, Bihar.

[2]Professor, BIST, Bhopal.

Article Received on 10/09/2019 **Article Revised on 30/09/2019** **Article Accepted on 20/10/2019**

***Corresponding Author**
Anujanand Choudhary
Putai, PS-Manigachi,
Dist-Darbhanga, Bihar.

ABSTRACT

The critical determinant of success in any industry is the customer's perception of the products and services offered. Hence, organizations focus on customer satisfaction for service quality improvement, business growth, and sustainability. Although the Kano model has been used widely to elicit customers' service quality requirements and improve customer satisfaction. Customer perception is a growing and key issue for continuous improvement and different organizations are becoming more customer-focused. More and more companies and organizations are using customer satisfaction as an indicator on their performance of delivered products and services in a manufacturing unit, Customers do not always explain their needs completely and accurately. In fact, often they speak about what features they want for a product or service, but not clarify why they want those features. To be innovative, an organization needs to know why customers want certain features. Understanding customer needs at this level enables an organization to develop new solutions before its competitors can. That demand may be understood as Voice of the customer or VOC information gathered from market research methods or various quality function deployment techniques. Maintaining and delivering good product quality are an essential part of the goals and aims of a reputed organization. In order to fulfill the expectations of the customers, manufacturers need to continuously develop and improve their existing practices and services. This can be achieved by increasing public involvement and exploring user's perception of the physical condition of the product and the services provided on the network. By engaging the public,

administration cannot only improve their practices but can also set the key focus objects and areas of their operations. Orientation toward cooperation with the customers is a key to effective organizational management. Now a days, most manufacturers & service providers are conducting market research surveys in one form or another. The major benefit with customer satisfaction measurements and surveys is that they can track trends and help an organization to focus on major improvement efforts. This dissertation work focuses on the customers of pipe plant for the importance of understanding and receiving feedback from the customers. The intent of the thesis is to establish a conceptual framework for customer satisfaction measurement within **L&T Construction** situated at **Alirajpur, Madhya Pradesh**. Moreover, the aim is to determine how to utilize results from customer satisfaction measurements, future prospects and how to link customer input into the decision-making process. This research will be undertaken as a qualitative study including both literature review and empirical research. The empirical research will based on a technical benchmarks and case study approach where strategies and practices used by manufacturer.

KEYWORDS*:* L&T-Larsen and Toubro, Voc-Voice of Customer.

OBJECTIVES

The objective of this paper is to detail how the Kano model can be employed and integrated with other quality methodologies to obtain customer requirements and improve product & service quality. It is evident from this systematic review that customer needs and preferences vary with the type of care acquired and services offered by healthcare providers. The findings allow healthcare providers to comprehend customer needs related to service quality and develop sustainable improvement strategies. This article intends to propel further research in service quality improvement of the manufacturing industry. The goal is to identify what type of customer satisfaction surveys are more effective and represents the true customer perception. If we can truly understand the customer needs, then it is possible to provide quality services to the customers. Moreover, the aim is to determine how to utilize results from customer satisfaction measurements, future prospects and how to link customer input into the decision-making process. In addition goal of this paper is to develop a strategic approach to know the customer requirements through various techniques like quality function deployment & Kano model and improvement for their satisfaction in a pipe manufacturing unit. In this study, we use the Kano model to analyze customer needs and satisfaction so that the future success of pipe plant can be ensured by identifying ways to improve customer

satisfaction. The results indicate that's improvement of activities for inline production & services expected tend to prioritize aspects of facilities and services.

1.1 Productivity

1.1.1 Introduction

INTRODUCTION

Productivity improvement is to do the right things better and make it a part of continuous process. Therefore it is important to adopt efficient productivity improvement technique so as to ensure individuals and organization's growth in productivity. The aim of this chapter is to introduce and understand productivity improvement, various techniques of productivity improvement.

1.1.2 Productivity and Productivity Improvement: Concept

Productivity is the ratio between output and input. It is quantitative relationship between what we produce and what we have spent to produce. Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more and more with less and less inputs of resources. Productivity denotes relationship between output and one or all associated inputs. European Productivity Council states that "Productivity is an attitude of mind. It is certainty of being able to do better than yesterday and continuously. It is constant adoption of economic and social life to changing conditions. It is continual effort to apply new techniques and methods. It is faith in human progress". In the words of Peter Drucker productivity means a balance between all factors of production that will give the maximum output with the smallest effort. On the other hand, according to International Labour Organization productivity is the ratio between the volume of output as measured by production indicates and the corresponding volume of labour input as measured by production indices and the corresponding volume of labour input as measured by employment indices**.** This definition applies to an enterprise, industry or an economy as a whole.

The productivity of a certain set of resources (input) is therefore the amount of goods or services (output) which is produced by them. Land and building materials, machines, manpower (labour), technology etc. are the resources at the disposal of a manufacturing company. Therefore higher productivity means that more is produced with the same expenditure of resource i.e. at the same cost in terms of land, materials, machine, time or labour, alternatively, it means same amount is produced at less cost in terms of land,

materials, machine time or labour that is utilized.

In countries where capital and skill are short, while unskilled labour is plentiful and poorly paid, it is especially important that higher productivity should be looked for by increasing the output per machine or piece of plant or per skilled worker. Improving productivity means increasing or raising productivity with the help of using same amount of materials, machine time, land, labour or technology.

1.1.3 Importance of Higher Productivity

If the level of output is increased faster than that of input, productivity will increase. Conversely, productivity will be increased if the level of input is decreased faster than that of output. Also, an organization may realize a productivity increase from producing more output with the same level of input. Finally, producing more output with a reduced level of input will result in increased productivity. Any of these scenarios may be realized through improved methods, investment in machinery and technology, improved quality, and improvement techniques and philosophies such as just-in-time, total quality management, lean production, supply chain management principles, and theory of constraints.

A firm or department may undertake a number of key steps toward improving productivity. William J. Stevenson lists these steps to productivity improvement:

1. Develop productivity measures for all operations; measurement is the first step in managing and controlling an organization.
2. Look at the system as a whole in deciding which operations are most critical; it is over-all productivity that is important.
3. Develop methods for achieving productivity improvement, such as soliciting ideas from workers (perhaps organizing teams of workers, engineers, and managers), studying how other firms have increased productivity, and reexamining the way work is done.
4. Establish reasonable goals for improvement.
5. Make it clear that management supports and encourages productivity improvement. Consider incentives to reward workers for contributions.
6. Measure improvements and publicize them.
7. Don't confuse productivity with efficiency.

Efficiency is a narrower concept that pertains to getting the most out of a given set of resources; productivity is a broader concept that pertains to use of overall resources.

Thus importance of productivity can be summarized as follows:

i) **Productivity is a key to prosperity**. Rise in productivity results in higher production which has direct impact on standard of living. It reduces cost per unit and enables reduction in sale price. It increases wages for workers and increased profit for organization. Higher demand creates more employment opportunities.

ii) **Higher productivity leads to economic growth and social progress**. Higher productivity helps to reduce co-st per piece which make product available at cheaper rate. Thus it is beneficial for consumers. Low price increases demand of the product which in turn increases profit of the organization. Higher profit enables organization to offer higher dividend for shareholders. It increases export and increases foreign exchange reserves of a country.

iii) **Higher productivity requires elimination of waste in all forms**. It is necessary to eliminate wastage in raw material, wastage of time in case of men and machinery, wastage of space etc. to improve productivity.

iv) **Improvement in productivity is important for country,** because it can minimize level of poverty and unemployment.

1.1.4 Some Techniques for Measurement of Productivity

Productivity has been defined as the ratio of output to input. An increase in productivity means an increase in output that is proportionally greater than increase in input. Productivity may be measured either on an aggregate basis or individual basis. On aggregate basis, output is compared with all inputs taken (added) together. This is called as total productivity. On individual basis, output is compared with any one of the input factor and this is called as partial productivity or factor productivity.

$$\text{Total productivity index} = \frac{\text{Total output}}{\text{Total output}} = \frac{\text{Total production of goods and service}}{\text{Labour + Material + Capital + Energy}} \quad I$$

This index measures the productivity of the entire organization with use of all resources. It is a way of evaluating efficiency of entire plant or firm. It has been said that the challenge of productivity has become a challenge of measurement. Productivity is difficult to measure and can only be measured indirectly, that is, by measuring other variables and then calculating productivity from them. This difficulty in measurement stems from the fact that inputs and outputs are not only difficult to define but are also difficult to quantify. Any productivity

measurement system should produce some sort of overall index of productivity.

A smart measurement program combines productivity measurements into an overall rating of performance. This type of system should be flexible in order to accommodate changes in goals and policies over time. It should also have the ability to aggregate the measurement systems of different units into a single system and be able to compare productivity across different units.

The ways in which input and output are measured can provide different productivity measures. Disadvantages of productivity measures have been the distortion of the measure by fixed expenses and also the inability of productivity measures to consider quality changes (e.g., output per hour might increase, but it may cause the defect rate to rise). It is easier to conceive of outputs as tangible units such as number of items produced, but other factors such as quality should be considered.

Experts have cited a need for a measurement program that gives an equal weight to quality as well as productivity. If quality is included in the ratio, output may have to be defined as something like the number of defect-free units of production or the number of units which meet customer expectations or requirements. Therefore, it is very much essential to understand different techniques of measuring the productivity and its improvement. In practice, there are multiple productivity improvement techniques.

Factor productivity or partial productivity indices are of following types:

1.1.4.1 Labour productivity: The important function in any production set-up is that the budgeted quantity of work must be achieved over a period of time. Labour productivity depends upon how labours are utilized. Labour productivity can be higher or lower depending on factors like availability of work load, material, working tools, availability of power, work efficiency, level of motivation, level of training, level of working condition (comfortable or poor) etc. Labour productivity can be measured in terms of hours or money.

$$\text{Labour productivity} = \frac{\text{Total output}}{\text{Labour input}} \quad \text{.....II}$$

$$\text{Labour productivity (in term of hours)} = \frac{\text{Total quantity produced}}{\text{Labour input}} \quad \text{.....III}$$

Actual hours required to produce that quantity Total cost of output produced

Labour productivity (in term of money) == ----------.....IV

Amount in term of spent on worker

The productivity of labour can be increased by increasing efficiency of labour and reducing labour time.

Material productivity: Production system converts raw material into finished product with the help of mechanical or chemical processes. Material productivity plays important role in cost of production. Material productivity depends upon how material is effectively utilized in its conversion into finished product.

Material productivity depends upon percentage of rejection, creation of scrap, level of spoilage, obsolescence, work wastage etc. Material productivity is expressed as:

Total output Number of units produced

Material productivity == ---------- == ----------.....V

Material input Total material cost

Material productivity can be increased by using skilled workers, adequate machine tools, good design of product etc.

1.1.4.2 Machine Productivity: Production system converts raw material into finished product through mechanical or chemical process with the help of machines and equipments. Machine productivity depends upon availability of raw material, power, skill of workers, machine layout etc.

Total output Output in standard hours

Material productivity == ---------- == ----------.....VI

Material input Actual machine hours

1.1.4.3 Capital productivity: For any production set-up, facilities of machines, tools, land etc. are required which are assets of organization. Capital is needed for such assets. As huge capital is locked in assets, their effective utilization is absolutely necessary. Capital productivity depends on how effectively assets are utilized.

Therefore decision is necessary to take about replacement of fixed assets. Early replacement of fixed assets brings down maintenance cost but requires capital expenses. On the other

hand, late replacement of fixed assets improves ratio of production to capital expenditure, but it increases maintenance cost. Therefore proper balance is necessary. Organization spent large amount (direct expenditure) for assets like direct material, direct wages, land, building, equipment etc. But a production system incurs a lot of direct expenditure like salaries of manpower employed in planning, store keeping, record keeping, inspection etc. Indirect labour is also used for material movement, good housekeeping, cleaning etc. Indirect expenditure is incurred on indirect material like tools, oils, lubricant etc.

$$\text{Capital Productivity} = \frac{\text{Total output}}{\text{Capital input}} \quad \text{..... VII}$$

Table 01: Shown below shows the approach can be used for raising productivity.

Sr. No.	Approach		Type of Improvement	Means	Cost	Results obtained in…
1	*Capital Investment*	*1*	*Development of new basic process or fundamental improvement of existing ones.*	*Basic Research, Applied Research, Pilot Plant*	*High*	*Years*
		2	*Install more modern or higher capacity plant or equipment or modernize existing one.*	*Purchase, Process Research*	*High*	*Immediate after Installation*

Table 01 Approach of raising productivity.

2.1 Quality

Quality is meeting the requirement, expectation, and needs of the customer is free from the defects, lacks and substantial variants. There are standards needs to follow to satisfy the customer requirements.

2.2 Assurance

Assurance is provided by organization management, it means giving a positive declaration on a product which obtains confidence for the outcome. It gives a security that the product will work without any glitches as per the expectations or requests.

2.3 Quality Assurance

Quality Assurance is known as QA and focuses on preventing defect. Quality Assurance ensures that the approaches, techniques, methods and processes are designed for the projects

are implemented correctly. Quality assurance activities monitor and verify that the processes used to manage and create the deliverables have been followed and are operative.

Quality Assurance is a proactive process and is Prevention in nature. It recognizes flaws in the process. Quality Assurance has to complete before Quality Control.

2.4 Control

Control is to test or verify actual results by comparing it with the defined standards.

2.5 Quality Control

Quality Control is known as QC and focuses on identifying a defect. QC ensures that the approaches, techniques, methods and processes are designed in the project are following correctly. QC activities monitor and verify that the project deliverables meet the defined quality standards. Quality Control is a reactive process and is detection in nature. It recognizes the defects. Quality Control has to complete after Quality Assurance.

2.6 QA/QC

Many people think QA and QC are the same and interchangeable but this is not true. Both are tightly linked and sometimes it is very difficult to identify the differences. Fact is both are related to each other but they are different in origins. QA and QC both are part of Quality Management however QA is focusing on preventing defect while QC is focusing on identifying the defect.

2.7 Difference between QA & QC

Table 1

Sl.	**Quality Assurance (QA)**	**Quality Control (QC)**
1.	It is a procedure that focuses on providing assurance that quality requested will be achieved	It is a procedure that focuses on fulfilling the quality requested.
2.	QA aims to prevent the defect	QC aims to identify and fix defects
3.	It is a method to manage the quality- Verification	It is a method to verify the quality- Validation
4.	It does not involve executing the program	It always involves executing a program
5.	It's a Preventive technique	It's a Corrective technique
6.	It's a Proactive measure	It's a Reactive measure
7.	It is the procedure to create the deliverables	It is the procedure to verify that deliverables
8.	QA involves in full software development life cycle	QC involves in full software testing life cycle

9.	In order to meet the customer requirements, QA defines standards and methodologies	QC confirms that the standards are followed while working on the product
10.	It is performed before Quality Control	It is performed only after QA activity is done
11.	It is a Low-Level Activity, it can identify an error and mistakes which QC cannot	It is a High-Level Activity, it can identify an error that QA cannot
12.	Its main motive is to prevent defects in the system. It is a less time-consuming activity	Its main motive is to identify defects or bugs in the system. It is a more time- consuming activity
13.	QA ensures that everything is executed in the right way, and that is why it falls under verification activity	QC ensures that whatever we have done is as per the requirement, and that is why it falls under validation activity
14.	It requires the involvement of the whole team	It requires the involvement of the Testing team
15.	The statistical technique applied on QA is known as SPC or Statistical Process Control (SPC)	The statistical technique applied to QC is known as SQC or Statistical Quality Control

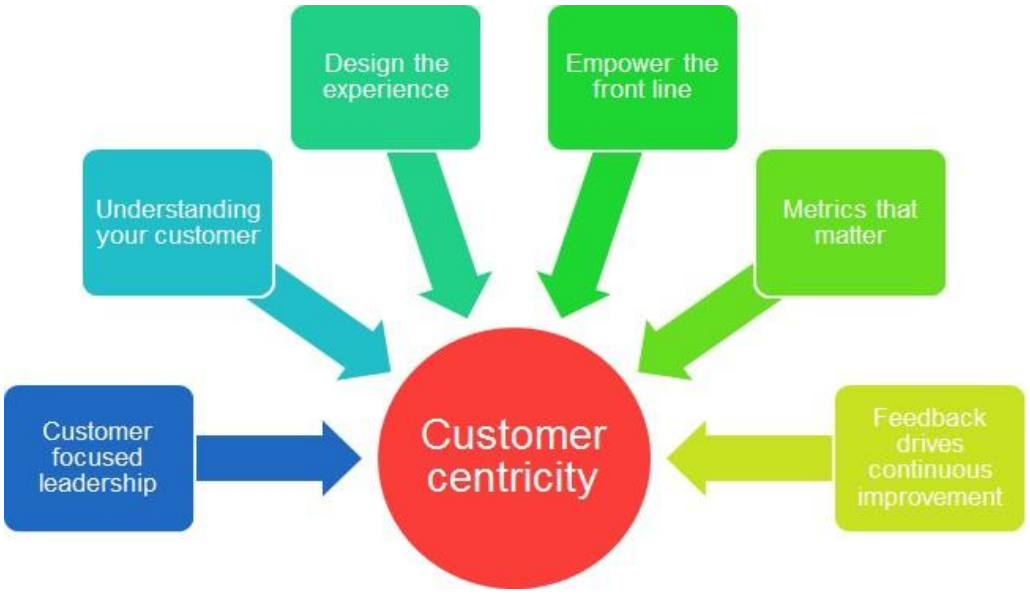
Quality Function Deployment

3.1 Introduction to Quality Function Deployment (QFD)

Quality function deployment is a structured and disciplined process that provides a means for identifying and carrying the customer's voice through each stage of product and service development and implementation. Quality Function Deployment (QFD) is achieved by cross-functional teams who collect, interpret, document, and prioritize customer requirements to identify bottlenecks and/or breakthrough opportunities. QFD involves the functions of marketing, research, design, manufacture, quality, purchasing, sales, and service as required for a specific project. The QFD discipline provides both a framework and a structure for enhancing an organization's planning ability for communication, documentation, analysis, and prioritization. QFD utilizes a series of charts or matrices to help document the process for identifying breakthrough areas that will meet or exceed customer requirements. It works best within a company when there is organizational commitment and a disciplined approach to implementation. QFD is a naturally compatible adjunct to concurrent engineering because it replaces the independent department responsibilities with interdependency and teamwork. It helps to tear down the barriers between manufacturing, design, research, and marketing. The design of new products is transformed from a separated series of steps into a process based on the voice of the customer that is integrated from design to production.

Every organization has customers. Some have only internal customers, some have only external customers, and some have both. When you are working to determine what you need to accomplish to satisfy or even delight your customers, quality function deployment is an

essential tool.



3.2 Background

QFD is a focused methodology for carefully listening to the voice of the customer and then effectively responding to those needs and expectations. First developed in Japan in the late 1960s as a form of cause-and-effect analysis, QFD was brought to the United States in the early 1980s. It gained its early popularity as a result of numerous successes in the automotive industry.

History:-Quality Function Deployment gained recognition in Japan in 1972 when the Kobe Shipyard of Mitsubishi used a matrixing technique to improve its 147 S. G. Shina, Concurrent Engineering and Design for Manufacture of Electronics Products © Van Nostrand Reinhold 1991 148 CUSTOMER-DRIVEN ENGINEERING. QUALITY FUNCTION DEPLOYMENT design process. Its usage spread over the next few years, with many Japanese companies becoming disciples and heavy users of the QFD process. A few examples are Isuzu, Matsushita, Komatsu, NEC Micon. In 1983 Maasaki Imai conducted a seminar in Chicago and introduced the participants to QFD, but little or no activity resulted from this event. In 1984 Don Clausing of MIT returned from Japan and introduced a basic model to the automotive industry. Ford Motor Co. became interested and John McHugh and Larry Sullivan of American Supplier Institute began working with Ford in initial QFD projects. Bob King of GOAL/QPC in his book, Better Designs in Half the Time, published in 1987, introduced a detailed model of QFD based upon the work of Dr. Yoji Akao of Tamagawa University, the leading voice of QFD in Japan. Since 1987 QFD has become a

key design and development planning tool for many companies in the United States. Some examples of companies and their applications include: Clarification of engineering requirements-Ford Light Truck Improved sales-Procter & Gamble hotel products Improved internal customer/supplier relationship-Digital Equipment Corporation Improved external customers/supplier relationship-Ford Climate Control, Cirtek, General Electric, and others Improved manufacturing documentation and control-General Electric Motor Improved hardware and software design-Hewlett-Packar

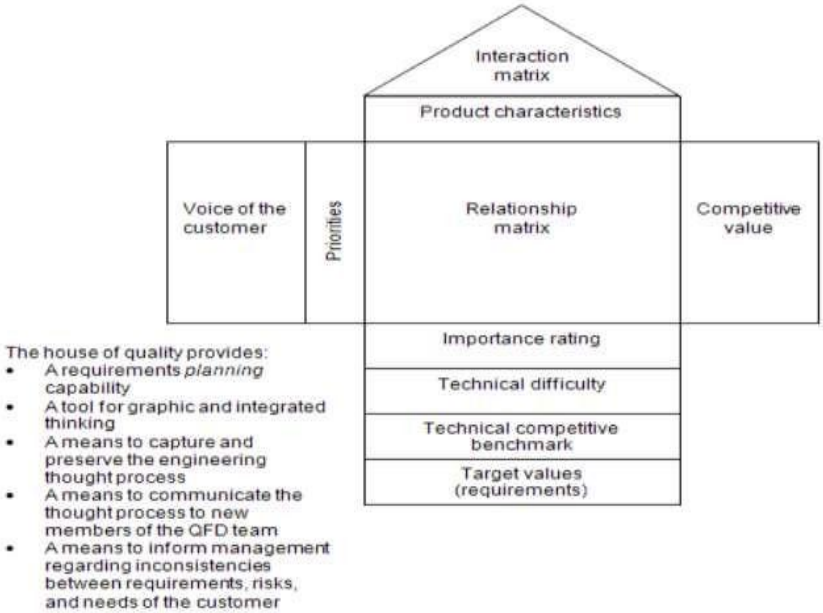
3.3 METHODOLOGY

In QFD, quality is a measure of customer satisfaction with a product or a service. QFD is a structured method that uses the seven management and planning tools to identify and prioritize customers' expectations quickly and effectively. Beginning with the initial matrix, commonly termed the House of Quality (Figure 1), the QFD methodology focuses on the most important product or service attributes or qualities. These are composed of customer wows, wants, and musts. (See the Kano model of customer perception versus customer reality.

Once you have prioritized the attributes and qualities, QFD deploys them to the appropriate organizational function for action, as shown in Figure 2. Thus, QFD is the deployment of customer-driven qualities to the responsible functions of an organization.

Quality Function Deployment: Most Important Product/Service Attributes or Qualities

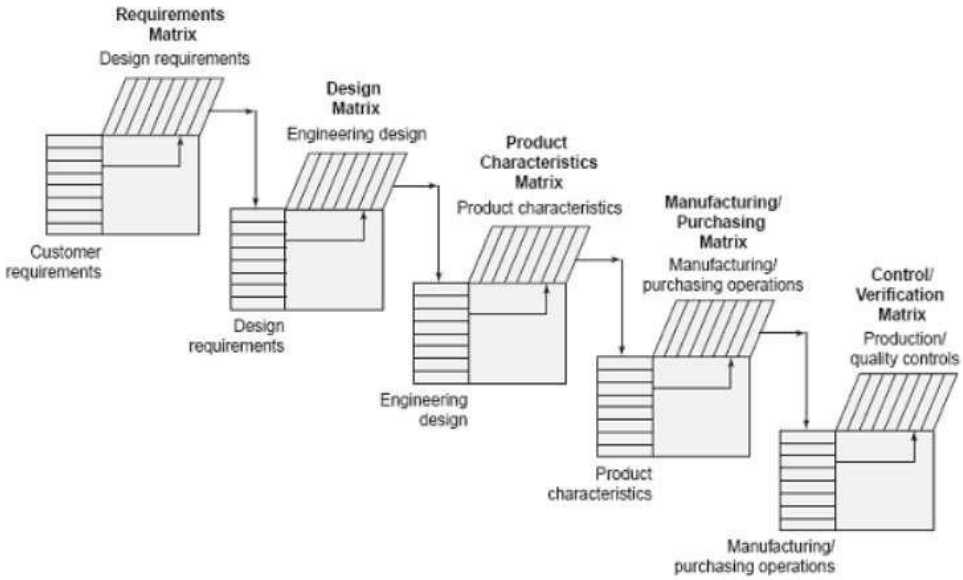
Figure 1 — House of quality template and benefits



Quality Function Deployment of Customer-driven Qualities to Responsible Organizational Functions

Quality Function Deployment of Customer-driven Qualities to Responsible Organizational Functions

Figure 2 — Waterfall relationship of QFD matrices



3.4. How to Measure Customer Satisfaction in Simple Steps

1. Define your goals.
2. Outline a plan.
3. Choose a type of customer satisfaction survey.
4. Customize your survey's layout and questions
5. Determine your survey's trigger.
6. Select your survey medium.
7. Analyze your survey data.
8. Make adjustments and repeat.

3.4.1. Define your goals.

When embarking on any sort of campaign, it's helpful to take a step back and ask, "Why are we doing this?"

In business, one must weigh the value of information -- the customer satisfaction data -- against the cost of collecting it -- the survey process. To be honest, if you won't change anything after collecting your customer satisfaction data, you're better off not collecting it at all. It's going to take time and effort, so you need to put it to use.

Depending on your business or organizational capabilities, there's a lot you can do with this information. It's important to have a goal in mind so you can get the most out your customer

data. Every business faces disappointed or upset customers, but not every company has a solution.

With that in mind, the specific solution isn't necessarily the important part here. The important part is stepping back and saying, "If we see that a segment of our customers is unsatisfied, what will we do about it?"

3.4.2. Outline your plan.

Once your goals are defined, you need an actionable plan to achieve them. Prior to collecting your customer data, your team should outline the actions you'll take after feedback is gathered and analyzed. Some examples you can execute are:

- Improve key UX bottlenecks that contribute to poor customer experience.
- Expedite customer support interactions with the most frustrated customers.
- Operationalize proactive support like a knowledge base and customer education.
- Test different live chat scripts and support strategies.

You can also plan actions based on your segment of highly satisfied customers. Methodologies like NPS® segment your customers into promoters, passives, and detractors for a few reasons. First, NPS provides you with an aggregate NPS score, thus providing a health check and a longitudinal metric to track and improve over time.

Second, it gives you the possibility of segmenting customers based on attitudinal metrics like satisfaction. You can offer your promoters special perks or encourage them to spread the word about your business; they're the most probable people to act as your "external sales force" -- in other words, your willing and excited customer advocates.

3.4.3. Choose a type of customer satisfaction survey.

Once you've sat down and discussed your plans with key stakeholders, you need to design your survey. The first step you should take is determining the type of metrics you'll use to measure customer satisfaction.

What types of metrics measure customer satisfaction?

You can choose among a few different options for customer satisfaction surveys. There's no unanimous agreement on which one is best. A few popular methods are:

- Customer Satisfaction Score (CSAT)
- Customer Effort Score (CES)

- Net Promoter Score® (NPS)

These are all "one-question" methods that vastly simplify the process of collecting customer insights. While you may not think the survey methodology matters much, how you ask the question measures different variables.

3.4.3.1 Customer Satisfaction Score (CSAT)

Customer Satisfaction Rating, or Customer Satisfaction Score (CSAT) measures on average, how satisfied or unsatisfied customers are with your product, services, or customer success program. Usually asked on a scale of 1-3, 1-5, or 1-7, your customer satisfaction score can be calculated by adding up the sum of all scores and dividing the sum by the number of respondents.

Customer Satisfaction Score (CSAT) is the most commonly used satisfaction method. You ask your customers to rate their satisfaction on a linear scale. Your survey scale can be 1 – 3, 1 – 5, or 1 – 10, and there's no universal agreement on which scale is best to use.

CSAT is a metric used to immediately evaluate a customer's specific experience. Here's how Vipin Thomas, Global Lead of Customer Success at Freshdesk, put it:

"CSAT is a transactional metric that's based on what's happening now to a user's satisfaction with a product or service. We try and get a CSAT score within 15 minutes of an interaction.

It's super helpful to improvise on the resolution, mode of delivery, channel, etc. It's ONE of the important metrics to evaluate the performance of the support desk. In fact, we publish ours publicly as well."

3.4.3.2. Customer Effort Score (CES)

Customer Effort Score (CES) is very similar, but instead of asking how satisfied the customer was, you ask them to gauge the ease of their experience.

You're still measuring satisfaction, but this way you're gauging user effort -- the assumption being that the easier a task is the better the experience. As it turns out, making an experience a low-effort one is one of the greatest ways to reduce frustration and disloyalty.

A CES survey may look something like this:

3.4.3.3 Net Promoter Score (NPS)

NPS asks the question, "How likely is it that you would recommend this company to a friend or colleague?"

This measures customer satisfaction but also customer loyalty. In doing so, you can come up with an aggregate score, but you can also segment your responses into three categories: detractors, passives, and promoters.

You calculate your Net Promoter Score by subtracting the percentage of detractors from the

percentage of promoters.

NPS is often used as a more general indicator of customer loyalty and brand devotion. Here's how Thomas explains it:

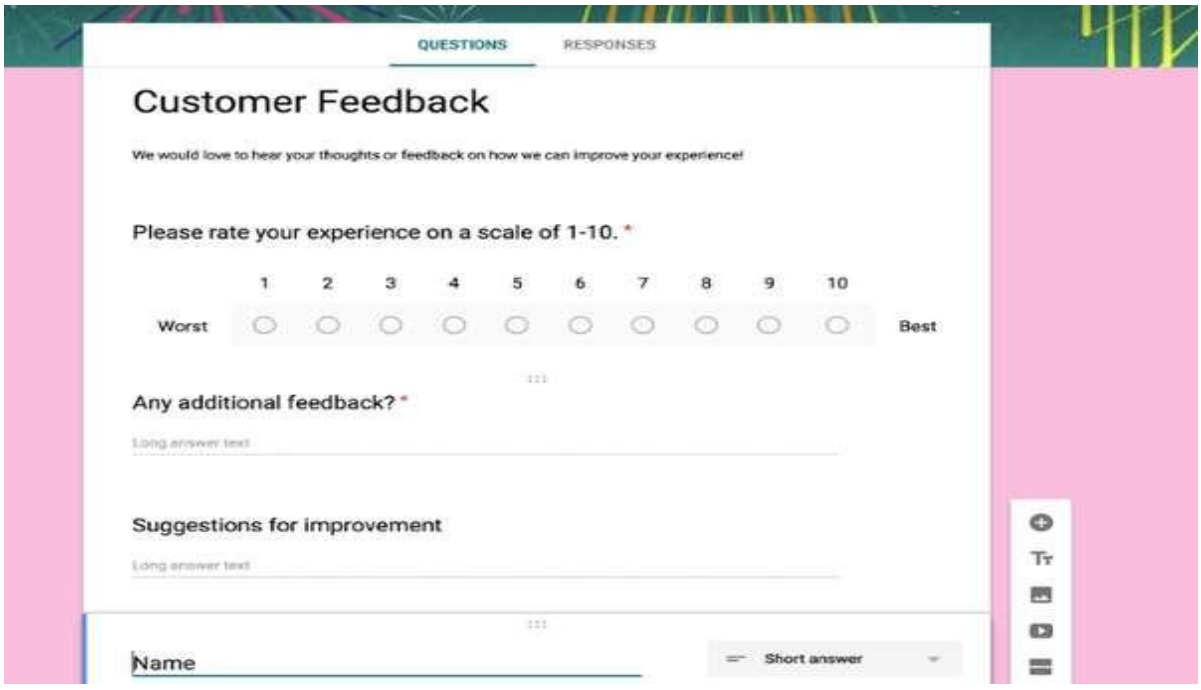
"NPS is consumed by various different teams to drive retention, sales, product improvements & advocacy.

Some important things to consider would be the channel it's delivered on -- email, in-product, phone -- the frequency of delivery, and the target audience within the customer base".

3.4.4 Customize your survey's layout and questions.

The above three styles are commonly used, but those aren't your only options for customer satisfaction surveys. Depending on your goals you can also send longer email surveys that include things like demographic questions. Really, you can customize it to your desires -- just remember that shorter surveys tend to have better completion rates.

Most importantly, don't ask questions if you won't do anything with the information. This not only wastes your time, but your customers' time as well. And, studies show that 66% of adults believe that the most important thing a company can do is value their time. Still, sometimes longer surveys can be useful, like in the example below.



You can use more than one methodology -- since they all measure something different. In fact, Vipin Thomas explains how you can combine multiple scores for a greater picture of customer satisfaction:

"We take CSAT and NPS very seriously, both independently and in conjunction, since a single measure alone won't show the true picture of why customers are detractors or promoters (NPS) or why you have a lesser than expected CSAT. CSAT, in conjunction with NPS, helps with a much targeted approach and often is a more accurate indicator to spot an advocate or someone at risk of churn.

For example, a customer that has had three continuous, negative CSAT scores and is also a detractor on NPS would be an immediate at-risk customer. A customer with positive CSAT and a promoter on NPS are potentially the best source of advocacy and candidates to cross-sell or upsell since they already have seen the value in their interactions with the process and product."

Additionally, I recommend always appending a qualitative, open-ended question, regardless of the survey you use. Without an open-ended question, you risk limiting your insight into "why" the dissatisfaction may be occurring. Qualitative user feedback can give you tons of ideas when it comes to implementing solutions.

Here's how Luke Harris, Customer Success Director at Wayin, puts it: "Qualitative data is the nirvana many of us are searching for, because it provides us with the most human version of customer satisfaction with the added benefit of scale and replicability.

To be able to unbiasedly, capture and track qualitative data helps - especially a scaling business- to quickly ascertain where it should focus, both in terms of product support and development."

3.4.5. Determine your survey's trigger.

This step is all about who you're sending the survey to and when you're sending it.

If you go back to your goals outline, this shouldn't be too hard to determine, at least strategically. People tend to forget this step, but it's crucial as it affects the quality and utility of your data. Tactically, you can trigger a survey pretty much anywhere, at any time, and to anyone. But, doing it strategically, matters specifically when and where it's triggered.

Good examples of event data that can be used to fire a survey are:

- Time since signup
- Key actions taken in your app -- for instance, Qualaroo asks right after you receive your 10th survey response
- Complete user onboarding

Best Practices For Survey Triggering

With all the options for triggering, though, let's start with some best practices:

- The closer the survey is to the experience, the better.
- People forget how they felt the longer you wait.

Who you survey changes what insights you get. If you survey website visitors about their satisfaction, the respondents are anonymous and may be a customer or they may not. This will bring you different data than sending an email to recent customers. You should survey your customers more than once to see how things change longitudinally. Especially if you operate a SaaS company or a subscription service, regular NPS surveys can help you analyze trends both at the aggregate and individual level. Survey people after a key moment of their customer journey. If a respondent gives you a high score, think about adding a follow-up ask. For instance, Tinder asks you to rate their app in the app store if you give them a high score.

3.4.6. Select your survey medium.

In general, there are three primary methods by which you can send customer satisfaction surveys:

- In-App or On-Site Surveys
- Post-Service or Post-Purchase Surveys
- Long Email Surveys

Each of these may require a different software or tool. For instance, Usabilla or Hot Jar specialize in triggered in-app surveys. But if you're sending post-purchase surveys, you may need something that offers a web interface, like Type form. Email surveys can usually be performed with any survey tool, like Survey Monkey or Google Forms.

Matt Hogan, Head of Customer Success at intricately, also emphasizes the need to collect continuous and real-time feedback, regardless of major feature launches or company- based events-

"I recommend surveying in-app and on a rolling basis. This will keep the constant feedback loop going. The technology available makes it easy to manage this."

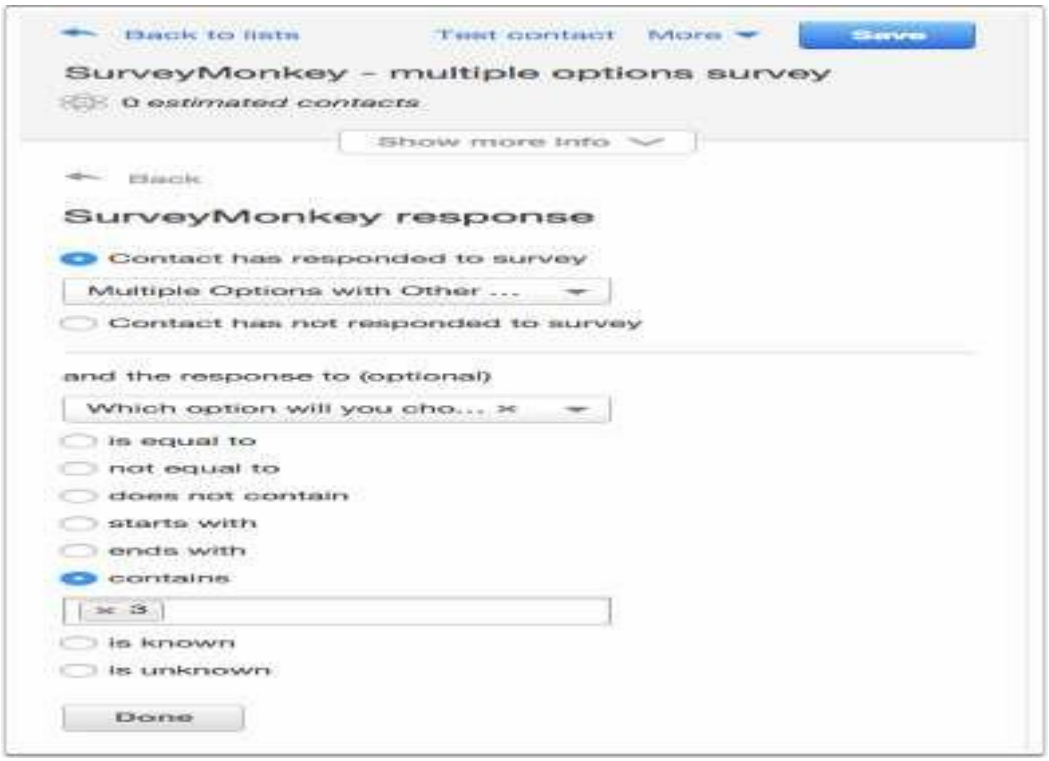
3.4.7. Analyze your survey data.

Once you've collected your data, make sure it doesn't just sit there dormant and unused. You've got all this customer insight, and it's just waiting to be uncovered!

Depending on the survey's format, this could be a simple process or one that requires a Ph.D. in statistics and survey design.

As I mentioned before, calculating Net Promoter Score (NPS) is straightforward. You just subtract the percentage of detractors from the percentage of promoters.

Most NPS tools give you the ability to easily segment respondents based on their category, and they usually integrate with products where you can take action based on each segment. For instance, Hub Spot users can easily integrate with their survey tool of choice to trigger emails based on survey response score.



3.4.8. Make adjustments and repeat.

Back to my first point: Now that you have these insights, what are you going to do about it?

Ultimately, this is a personal decision that will reflect your own findings and capabilities. You may find that a whole segment is dissatisfied because of a particular experience. In that case, you may need to further investigate why that experience is causing dissatisfaction and make changes to improve upon it. You may find that you have a small percentage of super fans.

Now that you can identify these people, perhaps you can work with your marketing and customer success teams to plan advocacy programs.

The possibilities are endless, but it all starts with accurately measuring customer satisfaction. But asking for scores is only a part of it -- make sure you're creating conditions for customers to leave you high scores, too. Check out the Hub Spot Customer Code and these tips from other companies for more ideas.

3.5.Customer Satisfaction

There are a number of definitions of customer satisfaction flying around, but they are all focused on the same thing – how a company's product or service measures up to customer expectation. Companies place a great deal of focus on customer satisfaction because it can have a major impact on revenue – the higher the level of customer satisfaction, the more likely customers are to remain as customers. Furthermore, a high level of customer satisfaction increases the likelihood of revenue generated from customer referrals and helps you to build your brand.

Many call centers use customer satisfaction surveys at the end of calls. Customers are asked to complete a quick survey after every call to and rate the level of service they received and understand how the customer feels about your business. Customer satisfaction surveys help companies to uncover problems with their service in a timely manner. They also provide visibility into the performance of each member of your team.

If your call center uses customer satisfaction surveys it is important that you turn the data you collect into action. If agents are consistently getting low scores in surveys, coaching sessions should be set up to identify and eradicate the behaviors that result in negative customer sentiment.

3.6.Importance of Customer Satisfaction

Customer satisfaction is an important metric for companies as it provides an insight into

things like customer loyalty, likelihood of churn, and also helps identify issues with the product or service. Companies that provide a high level of customer satisfaction can also use it to differentiate themselves from their competitors.

The importance of customer satisfaction was highlighted by a 2008 survey conducted by Accenture which showed that poor customer service, and not price, was the main reason for customer churn. By increasing the level of customer satisfaction you can reduce customer churn rates at your company.

Similarly, a high level of customer satisfaction reduces negative word of mouth. McKinsey estimates that an unhappy customer tells 9-15 people about their bad experience. One thing companies who provide a low level of customer service sometimes overlook is the collateral damage caused by unhappy customers. It is bad enough losing business because you provided a customer with a low level of service, but what about losing 15 more customers as a result? Customer satisfaction can have a massive impact on your business and appropriate care should be taken.

You should also remember that acquiring new clients is a lot more expensive that keeping the clients you already have. Misallocating resources and overlooking customer happiness as you chase new business opportunities is a common mistake that must be avoided.

3.7 Final Thoughts

While there's no one solution for improving customer satisfaction levels, the key is to develop a customer-centric mindset that will help inform decisions and company direction. Staying up to date with call center best practices is also something to keep in mind. The above list of recommended tactics from a wide variety of sources represents only the beginning – the possibilities are endless.

Methodology to Customer Satisfaction

4.1 Ways to Customer Satisfaction

4.1.1 Develop Customer Service Communities

"The most advanced companies are using [customer service] communities to generate product ideas and test new products. Seventy-two percent of respondents [who participated in a Get Satisfaction survey] are using communities to get feedback on how existing products are used; 67 percent use them to collect ideas for new products or features from customers;

and 46 percent rely on them for feedback on prototypes or beta products."

4.1.2. Treat Customers like You Would Want to Be Treated

"Remember that your customer wants to see the sunny side of you and your business, so have your filter on and put yourself in their shoes. A good way to instill this attitude among your staff is to do some simple role play in which they act out a few scenarios that involve both easy-going and difficult customers. Observe how they handle the situation and coach them on areas to improve."

4.1.3. Provide Multichannel Support

"With newer communications channels such as social, mobile, web chat, and email becoming increasingly important to customers, companies must develop an Omni channel approach to their customer service in order to connect with customers on the channels they prefer to use. Multichannel support not only offers customers a seamless transition between channels; it also prevents them from having to repeat information they may have already provided to different call center agents, which can be both irritating to customers and potentially damaging to a company's reputation."

4.1.4 Make Employee Satisfaction a Priority

"Simply put, when your employees are happy, they can provide better customer service. Studies have proven that employees often perform better at the jobs when they feel appreciated. Give each employee a personalized 'thank you' every now and then, and introduce an employee of the month program, if you don't have one already. If you can help your employees take pride in their jobs, their work performance will also improve."

4.1.5. Encourage Agents to Take Ownership of Problems

"Encourage operators to take ownership of problems and spend time dealing with the customer, rather than escalating or passing over the problem. This gives advisors a real sense of pride in their job and means they are taking their own action and really shows excellent customer service."

4.1.6. Turn Customer Survey Data into Action

"Good data reflects the experiences your customers actually have with your company. Furthermore, good data equips your company to take action. [The key is to] develop a satisfaction survey that probes truthfully into the heart of your gaps and opportunities."

4.1.7. Figure out What the Customer Really Wants

"Figure out what the customer really wants, if you can solve the problem they will pay; the value is often not in the discount you can offer but rather in the solution you can provide."

4.1.8. Focus on Company Culture

"The best companies put a focus on culture. They implement training programs around their cultural values to ensure everyone shares the same values and that they are consistently demonstrated when dealing with customers."

4.1.9. Stay Current on Customer Reviews

"In a world that is heavily dependent on the internet, consumers are quick to hop online and share how they feel about a product or service. Take the time to log onto the internet and observe what people are saying about your business. Find out what people enjoy, as well as what they'd like to see improved. The reviews you stumble across might surprise you and introduce you to areas of improvement that you had not previously considered. An expert from Meyers Transport Ltd says problems with shipping and receipt of goods, especially, can often be identified through customer reviews. Being aware of these issues is the first step towards resolving them."

4.1.10. Offer Proactive Customer Service

"The key here is to contact your customers before they need to pick up the phone and contact you! To be effective, these contacts should be timely, personalized and relevant to the consumer.

The best proactive strategies make regular contact throughout the consumer lifecycle. Examples include: payment reminders, fraud monitoring, and personalized loyalty and reward schemes. This strategy can reduce inbound calls and improve agent efficiency. This proves that offering great customer service isn't just good for the consumer, it's good for the business as well."

4.1.11. Personalize

"In everything you do, make sure the customer feels like he or she is the only one that matters. Use the customer's name, refer to personal information and congratulate a customer on his or her birthday. Make them feel at home."

4.1.12. Slash Wait Times

"Everyone is busy, and if your company can't provide the highest levels of service your customers won't hesitate to find someone who can. Customer wait time needs to be eliminated or managed. Bureaucracy needs to be replaced with customer-friendly processes. Be easy to do business with, and your customers will reward you over and over again."

4.1.13. Put a Social Media Plan in Place

"Customers are increasingly demanding speedy responses—sometimes as quickly as in real time—to their complaints on social media. A company that isn't paying attention can wreak havoc with its reputation."

4.1.14. Rethink the Approach to Doing Business & Building Relationships

"Because consumers are operating differently today, and more differently tomorrow, companies must embrace the environment in which we're operating. It's only fair to customers that companies rethink their approach to doing business and building relationships with them."

4.1.15. Demonstrate Product Knowledge

"One of the most important aspects of successful customer service revolves around product knowledge. In other words, any and all agents who have direct customer contact should know the company's product and/or service inside and out.

In many cases, developing robust product knowledge involves managers helping agents build their confidence so they're motivated to succeed. To do this, managers might try mapping out their assessment of an agent's product knowledge and compare it against the agent's, identifying any gaps that exist and making it easier to put together a professional development plan for the future."

4.1.16. Benchmark Customer Satisfaction

"Benchmarking is the process of comparing your own organization or operations against other organizations in your industry or in the broader marketplace.

You might compare your most successful competitor's customer processes and satisfaction with your own. Or, you might look at a firm outside of your industry known for remarkable customer service practices. Establishing a benchmarking initiative is an important component

of measuring and improving your customer service and satisfaction."

4.1.17. Set Clear Expectations and Exceed Them

"Nothing is more frustrating for a consumer than wandering around in a digital world unsure of what to expect from a business, or when. Let customers know up front what your standards and practices are. How long will they wait for a response or a callback? Will that response truly be on target and accurate? Removing the customers' uncertainty about such common issues in customer service lets them know that a company is committed to their success and satisfaction, especially when the business builds in enough leeway that it can routinely exceed expectations."

4.1.18. Study Complaints and Compliments

"Every message from a customer presents an opportunity to improve customer satisfaction. Compliments show you what to reinforce, while complaints point to new ideas and action steps for improvement."

4.1.19. Hold Daily Stand Up Meetings with your Team

"Problems tend to come in waves. You might have a bug of the week, a new release causing more questions or a seasonal volume increase. Instead of letting agents figure out how to deal with this on their own, take it on as a team with daily stand-ups. You'll start the day on the same page and fire up."

4.1.20. Ask How Your Clients would like to be responded to

"One way to increase customer satisfaction is to communicate with clients through their preferred method. For online consumers, email is the standard method. This allows them to maintain the anonymous status which is important to online consumers. Even when consumers provide a telephone number, they may be surprised when you contact them by phone. If you decide to place a call, take into consideration that it is a more personal and perhaps invasive action.

Prepare notes or a list of questions beforehand to ensure you cover all your points and maximize the time. By contacting people in their preferred method, you will most likely have a better chance of reaching them with that reasonable time frame, communicating effectively and achieving your goals."

4.1.21. Provide Additional Benefits

"Who doesn't like added benefits? Or, a special offer once in a while? Surprising your customers with a free goodie unexpectedly can go a long way in building concrete relationships.

Sometimes, an unanticipated discount on the products your customers have been eying for some time can work. On other events, you can consider throwing in an additional accessory or a week's worth post-purchase support for free. You would be amazed at how effective these little things can be in building a positive image of your brand. It helps in increasing customer satisfaction immensely."

4.1.22. Offer Free Product Training and Support

"This is a clear, business-winning decision. Nothing decreases customer satisfaction more than being confused with how to make a product work. And free product training and support will be how you alleviate this customer frustration. Why does this work? For starters, when people spend money on something, they tend to doubt themselves and their ability to make the product work right. With detailed, free training, you'll alleviate that self-doubt and win a life-long customer."

4.1.23. Press Reset after Every Call

"Dale Carnegie said "Dealing with people is probably the biggest problem you face, especially if you are in business. Yes, and that is also true if you are a housewife, architect or engineer."

Each new customer interaction should be entirely fresh and new for you. I used to imagine an actual reset button that I would press after something frustrated me. Shed any frustration before you interact with the next customer with a few deep breaths. Then, visualize the amazing potential of your new opportunity to interact with your next customer."

4.1.24. Ask for More Feedback

"Sometimes, it can be difficult to find ways to improve customer satisfaction. But there are always more customers who have valuable insights that they haven't given to you. It's up to you to go fishing, not for compliments, but for criticisms. In your survey, after asking customers how satisfied they are, you should provide a form where they can type out a response. You have a few different options here. It's most common to ask customers to

explain why they gave you the score that they did.

You can pick more customers' brains by phrasing your question/statement more clearly. For example, you could ask: "What could we have done differently to improve your experience?" By being upfront about what you're asking, customers will provide you with more insightful responses."

4.1.25. Empower Your Agents

"Agents who have been carefully hired and properly trained then need the authority to handle customer issues before they need escalation. No customer really wants to have to ask to speak to a supervisor they want to be talking to someone who can solve the problem in the first place. Giving your reps the power to make their own decisions makes your customers happy, and it also keeps your reps happy, reducing agent turnover. More operational cost savings!"

LITERATURE REVIEW

5.1 Importance

This chapter introduces the concept and process of customer satisfaction measurement, its background, how customer satisfaction is formed In addition, the different methods and models related to satisfaction measurement and service quality are covered. Many public organizations have adopted the customer focused management style from the private sector and the challenges regarding the differences between the natures of public and private sectors are presented. Finally, the establishment of a system in gathering customer data is discussed. Today, customer focus and satisfaction is a driving force for many companies and organizations. Measuring customer satisfaction provides an indication on how an organization is performing or providing products or services. Customer satisfaction has traditionally been studied within market research and the term customer satisfaction measurement is widely used in particularly business terminology. Customer satisfaction is generally understood as the satisfaction that a customer feels when comparing his preliminary expectations with the actual quality of the service or product acquired. In addition, customers generally want the best possible product or service for a low cost. The perception of the best product or service and lowest price can, however, vary significantly by customer segment or industry. In order to obtain an overall picture of customer perception, a company or organization needs to measure the customer. (Czarnecki 1998.).

5.2 Expectations and Experiences

Service quality or customer satisfaction is formed by the difference between the customers' expectations of a service and the actual perceived service. In other words, customer dissatisfaction occurs if the expectations are greater than the performance (Wisniewski 2001). Customer satisfaction always requires an experience of the operations of a company or an organization. The level of customer satisfaction is formed by the correlation between a customer's expectations and his experiences. In other words, the customer always compares the experiences with the expectations he has of the company or organization. Customer satisfaction occurs when a customer's experiences of a service match the expectations and customers are impressed when they get more than they anticipated. In addition, the level of customer satisfaction is formed by the image of the company or organization. Many companies and organizations have made customer satisfaction their top priority by developing a carefully designed customer satisfaction framework. (Bergman et al. 1994.).

Figure 1. The customer satisfaction equation (redrawn from Craig 1993.)

Figure 1: Provides a summarized overview of which key factors result in satisfied customers.

In the 1980"s, Professor Noriaki Kano developed the Kano model, which is visualized in Figure 2. The model describes how customer satisfaction is created and it separates quality dimensions into three different types of needs which together determine the customer's perception of quality. These needs are divided as followed: 1. Stated needs 2. Implied needs 3. Unconscious needs.

According to the model, the stated needs are expected by the customer to be satisfied and these needs are regarded as important. Hence, customers are satisfied when the stated needs are satisfied. The implied needs are so obvious to the customer that the customer does not even mention these when asked for example in a survey. The implied needs do not create greater customer satisfaction as these needs are considered as obligatory to fulfill. But on the other hand, if these needs are not fulfilled, the level of customer satisfaction will decrease dramatically. The unconscious needs are needs that are unexpected by the customer but what may result in high levels of customer satisfaction. The absence of these needs will, however,

not lead to dissatisfaction. (Bergman et al. 1994, Sandholm 2000.).

The level of satisfaction is determined by comparing the expectations of the customer with the experience generated from the contact or encounter between the customer and the company or organization. If a customer's expectations were higher than the actual experience, the level of satisfaction is negative, i.e. the customer is not satisfied with the company. If the level of satisfaction is very negative, the company or organization often gets negative feedback and complaints. When a customer's expectations meet the experiences, the level of satisfaction is neutral. If the customer had high expectations, the customer relation with the company will strengthen. A customer with low expectation from before will not be fully satisfied, even if he is not disappointed with the company or organization. If a customer's experiences exceed the expectations, the level of satisfaction is positive and the customer is satisfied. The essential thing is to influence the customers" expectations in order to have an effect on the level ofsatisfaction.

Company Profile & Operation

6.1 Introduction to Organization

Larsen & Toubro is a major technology, engineering, construction, manufacturing and financial services conglomerate, with global operations. L&T addresses critical needs in key sectors - Hydrocarbon, Infrastructure, Power, Process Industries and Defense - for customers in over 30 countries around the world. L&T is engaged in core, high impact sectors of the economy and our integrated capabilities span the entire spectrum of 'design to deliver'. With over 7 decades of a strong, customer focused approach and a continuous quest for world-class quality, we have unmatched expertise across Technology, Engineering, Construction, Infrastructure Projects and Manufacturing, and maintain a leadership in all our major lines of business. Every aspect of L&T's businesses is characterized by professionalism and high standards of corporate governance. Sustainability is embedded into our long-term strategy for growth. L&T Construction's Water & Effluent Treatment business vertical provides state-of-the-art design, detailed engineering, procurement, project management, project execution, commissioning and operation & maintenance for:

- Water Transmission, Treatment, Distribution and Management
- Municipal Used Water Collection, Treatment and Reuse
- Industrial Water Treatment to achieve Ultra-Pure Water
- Industrial Effluent Treatment and Zero Liquid Discharge / Recycle

- Desalination Plants - Sea Water / Brackish Water
- "Unaccounted for Water" Projects to Monitor the Water Loss
- Lift Irrigation Projects
- Refurbishments of Treatment Plants
- Canal Relining projects

6.2 Profile

Water, one of the most vital sectors in the world today, calls for comprehensive infrastructure solutions. L&T Construction's Water and Effluent Treatment business segment provides complete solutions through its concept to commissioning capability covering design, detailed engineering, procurement, project management and execution that cover:-

- Urban & rural water supply
- Industrial water supply and treatment plants for recycling
- Water treatment plants
- Waste water treatment and network
- Refurbishment of treatment plants
- Lift irrigation projects
- Rehabilitation of canals
- Unaccounted For Water (UFW)

With a fiscally sound approach to projects, proven project management skills, country wide operational presence and an experience & expertise that spans over 70 years, L&T is recognized as the leader in developing and providing water infrastructure in the country. At L&T Construction, the impetus for creating efficient and reliable water infrastructure is well supported by a multi-disciplinary team of professionals who cater to turnkey project requirements through meticulous planning and efficient project management. The organization leverages its domain expertise for providing suitable process systems / schemes to meet varying and ever-increasing customer requirements. To facilitate seamless project control, L&T aligns work schedules by integrating sequences through project monitoring software like MSP and Primavera which is backed up by a centralized inhouse information system for data retrieval.

6.3 Lift Irrigation Projects and Rehabilitation of Canals

L&T's industrial water supply business possesses the domain knowledge and expertise to execute lift irrigation project schemes on EPC basis covering every spectrum of work. Services offered include design and construction of intake wells, overhead tanks, pumping stations, distribution channels and delivery cisterns covering transmission of bulk water through large dia. pipeline networks to complete electromechanical and instrumentation works with SCADA system installations. The canal systems in India are largely unlined resulting in substantial transmission losses due to seepage. L&T excels in this area by designing and constructing fool-proof lining systems for new canals and rehabilitating existing canals.

Current Project

Project Name:- Alirajpur Lift Irrigation Scheme Customer:-Narmada Valley Development Authority, M.P Contractor :- L&T Construction-WET IC

Project Value:-789 crore

Period:-14-02-2017 to13-02-2020

Scope of MS pipe:-270 KM Range:- 400mm ID to 1200 mm ID

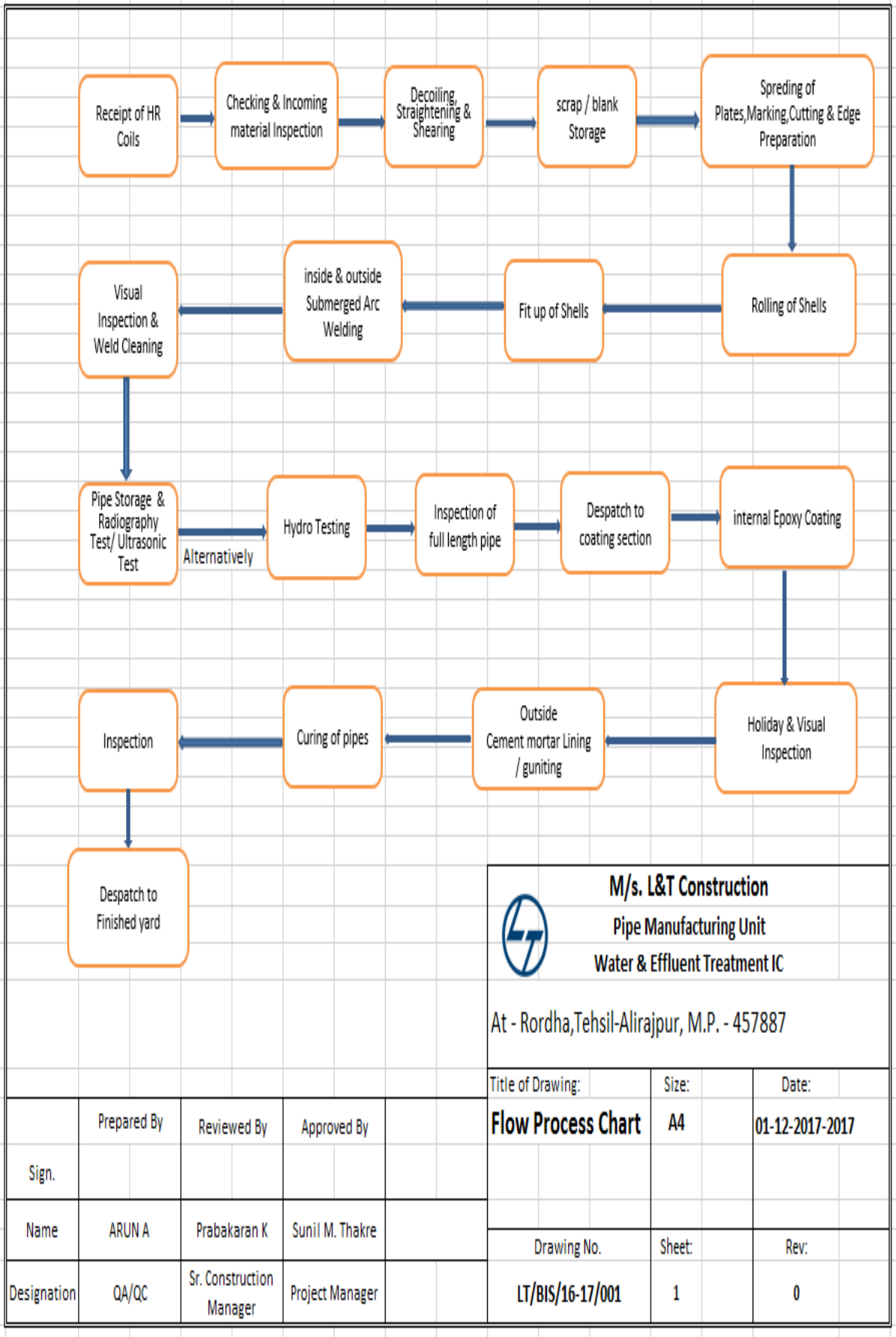
Manufacturing unit Address:- Rordha,Dist-Alirajpur,M.P.-457887

6.4. Pipe Plant Products

MS pipes as per IS 3589:2001 standards

ID X THK (mm)	*SCOPE (m)*	*REV. SCOPE as on 23-07-19 (m)*	*SCOPE (No.)*	FORMING (No.)	FORMING (m)	% COMPLETION (FORMING)
400X3.15	***63401***	***63528***	***10567***	10326	62388.63	**98.21**
450X3.15	***16950***	***16950***	***2825***	2803	16958.32	**100.05**
500X3.15	***39488***	***39488***	***6581***	6522	39458.80	**99.93**
600X3.15	***22493***	***22493***	***3749***	3696	22422.90	**99.69**
700X4	***24266***	***24266***	***4044***	4014	24303.41	**100.15**
750X4	***1720***	***1720***	***287***	284	1729.435	**100.55**
800X4	***13432***	***13409***	***2239***	2223	13441.78	**100.24**
900X5	***8456***	***8424***	***1409***	1390	8377.38	**99.45**
1000X5	***24750***	***24525***	***4125***	4092	24752.99	**100.93**
900X6	***198.67***	***198.67***	***33***	33	198.67	**100.00**
1100X6	***6733***	***7119***	***1122***	1174	7147.245	**100.40**
1200X7	***5091***	***4985***	***831***	824	4989.35	**100.09**
TOTAL	**226978.67**	**227105.67**	**37812**	**37381**	**226168.893**	**99.59**
	m	**m**	**No.**	**No.**	**m**	

6.5. Process Flow Chart



6.6 Hydro Test Requirements

HYDRO TEST PRESSURE REQUIREMENT AS PER IS 3589:2001 PIPE MANUFACTURING PLANT (L&T,ALIS,RORDHA,ALIRAJPUR)					
S.NO	O.D (mm)	T(mm)	Theoretical Test Pressure (BAR)	Recommended Test Pressure (BAR)	P (PSI)
1	406.30	3.15	22.29	23	317.08
2	456.30	3.15	19.85	20	282.34
3	506.30	3.15	17.89	18	254.45
4	606.30	3.15	14.94	15	212.49
5	708.00	4.00	16.25	17	231.06
6	758.00	4.00	15.17	16	215.82
7	808.00	4.00	14.24	15	202.47
8	910.00	5.00	15.80	16	224.72
9	1010.00	5.00	14.24	15	202.47
10	1112.00	6.00	15.52	16	220.68
11	1214.00	7.00	16.58	17	235.82

Driven Engineering Technique

7.1.Kano Model Analysis

The Kano Model of Customer (Consumer) Satisfaction classifies product attributes based on how they are perceived by customers and their effect on customer satisfaction. These classifications are useful for guiding design decisions in that they indicate when good is good Enough, and when more is better.

Project activities in which the Kano Model is useful:

- Identifying customer needs
- Determining functional requirements
- Concept development
- Analyzing competitive products

Other tools that are useful in conjunction with the Kano Model:

- Eliciting Customer Input
- Prioritization Matrices
- Quality Function Deployment
- Value Analysis

The Kano Model of Customer satisfaction (Figure 1) divides product attributes into three categories: **threshold, performance, and excitement.** A competitive product meets basic attributes, maximizes performances attributes, and includes as many "excitement" attributes as possible at a cost the market can bear.

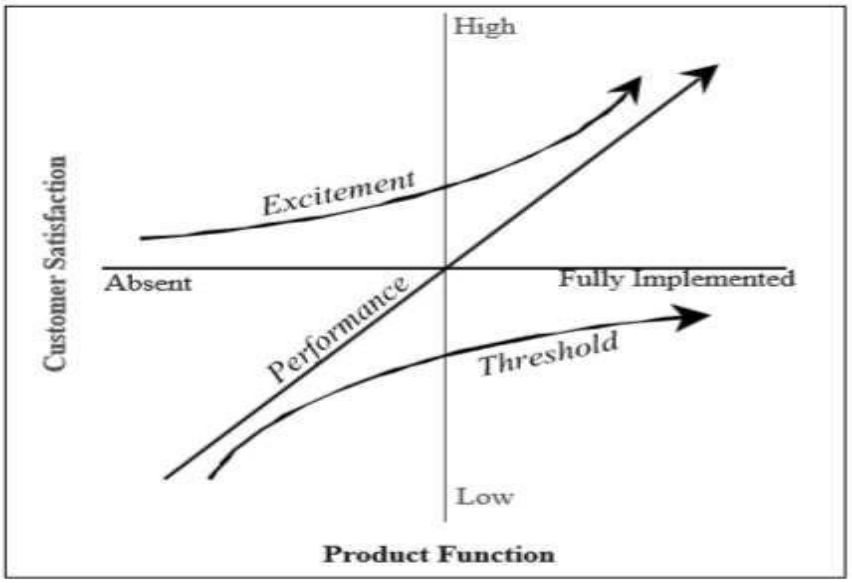


Figure 1: Kano Model

7.1.1 Threshold Attributes

Threshold (or basic) attributes are the expected attributes or "musts" of a product, and do not provide an opportunity for product differentiation. Increasing the performance of these attributes provides diminishing returns in terms of customer satisfaction, however the absence or poor performance of these attributes results in extreme customer dissatisfaction. An example of a threshold attribute would be brakes on a car.

Threshold attributes are not typically captured in QFDs (Quality Function Deployment) or other evaluation tools as products are not rated on the degree to which a threshold attribute is met, the attribute is either satisfied or not.

7.1.2 Performance Attributes

Performance attributes are those for which more is generally better, and will improve customer satisfaction. Conversely, an absent or weak performance attribute reduces customer satisfaction. Of the needs customers verbalise, most will fall into the category of performance attributes. These attributes will form the weighted needs against which product concepts will be evaluated.

The price for which customer is willing to pay for a product is closely tied to performance attributes. For example, customers would be willing to pay more for a car that provides them with better fuel economy.

7.1.3 Excitement Attributes

Excitement attributes are unspoken and unexpected by customers but can result in high levels of customer satisfaction, however their absence does not lead to dissatisfaction. Excitement attributes often satisfy latent needs – real needs of which customers are currently unaware. In a competitive marketplace where manufacturers' products provide similar performance, providing excitement attributes that address "unknown needs" can provide a competitive advantage. Although they have followed the typical evolution to a performance then a threshold attribute, cup holders were initially excitement attributes.

7.1.4 Other Attributes

Products often have attributes that cannot be classified according to the Kano Model. These attributes are often of little or no consequence to the customer, and do not factor into consumer decisions. An example of this type of attribute is a plate listing part numbers can be found under the hood on many vehicles for use by repairpersons.

7.2 Application of The Kano Model Analysis

A relatively simple approach to applying the Kano Model Analysis is to ask customers two simple questions for each attribute:

1. Rate your satisfaction if the product has this attribute? And
2. Rate your satisfaction if the product did not have this attribute?

Customers should be asked to answer with one of the following responses:

A) Satisfied;

B) Neutral (It's normally that way)

C) Dissatisfied;

D) Don't care.

- Basic attributes generally receive the "Neutral" response to Question 1 and the "Dissatisfied" response to Question 2. Exclusion of these attributes in the product has the potential to severely impact the success of the product in the marketplace.
- Eliminate or include performance or excitement attributes that their presence or absence respectively lead to customer dissatisfaction. This often requires a trade-off analysis against cost. As Customers frequently rate most attributes or functionality as important, asking the question "How much extra would you be willing to pay for this attribute or more of this attribute?" will aid in trade-off decisions, especially for performance attributes. Prioritisation matrices can be useful in determining which excitement attributes would provide the greatest returns on Customer satisfaction.
- Consideration should be given to attributes receiving a "Don't care" response as they will not increase customer satisfaction nor motivate the customer to pay an increased price for the product. However, do not immediately dismiss these attributes if they play a critical role to the product functionality or are necessary for other reasons than to satisfy the customer. The information obtained from the Kano Model Analysis, specifically regarding performance and excitement attributes, provides valuable input for the Quality Function Deployment process.

7.3 Kano Model Methodology

7.3.1. Fundamental Kano Model Concepts

The Kano model was developed in 1984 by Noriaki Kano. It aims to connect the requirements fulfilled by products or services with customer satisfaction and identifies three types of requirements that influence ultimate customer satisfaction. Figure 1 presents the fundamental concepts of the Kano model. The horizontal axis of the diagram indicates the extent to which a product aspect fulfills customer requirements and the vertical axis indicates the extent to which customers are satisfied with the product or service. The three major types of requirements are must-be, one-dimensional, and attractive.

7.3.1.1 Must-be Requirement

Must-be requirements are also referred to as basic requirements, which represent the minimal criteria that must be met by a product or service. If they are not fulfilled, customers will not

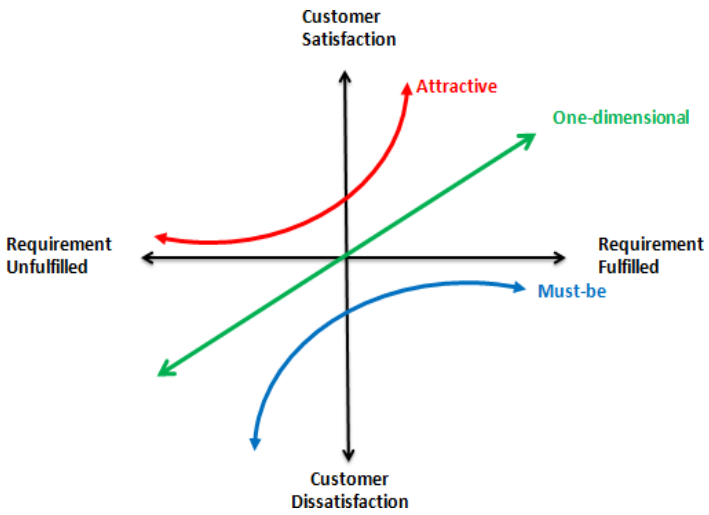
be satisfied with and have no interest in the product or service. Furthermore, even if these requirements are fully fulfilled, they will not generate any additional customer satisfaction beyond a neutral level.

7.3.1.2 One-dimensional Requirement

The one-dimensional line goes through the origin at 45 degrees. It represents the needs that are directly related to customer satisfaction. That is, the more functional the product or service is with regard to this type of need, the more customers are satisfied. If these types of requirement are fulfilled, they can become a strong source of customer satisfaction and should therefore be given high priority in service design or product development.

7.3.1.3. Attractive Requirement

The attractive curve indicates an area in which the customer is more satisfied when the product, service or process is more functional but is not dissatisfied when the product, service, or process is less functional. These types of requirement are neither explicitly expressed nor expected by the customer. Therefore, even if they are not met, they will not cause any dissatisfaction. They merely represent unexpected surprises that will be pleasing to customers if present.



7.4. Advantages of Kano Model

Considering its characteristics, users of the Kano model might benefit from the following advantages.

7.4.1. Setting of Development Priorities

The must-be requirement has the highest priority in product or service development. In other

words, the must- be requirement can be regarded as encompassing the functions that each product or service must have. The suppliers of products or services do not have any choices in this respect and must provide products or services that satisfy must-be requirements. However, if the must-be requirements are already fulfilled at a satisfactory level, it is not useful to invest in improving them further. Improvements in one-dimensional or attractive requirements will have a much stronger influence on customer satisfaction.

7.4.2. Better Understanding of Requirements

Once the Kano model is applied to the analysis of customer needs and satisfaction, it is easy to quantitatively identify and understand which types of products or services have a greater influence on customer satisfaction based on the customer satisfaction coefficient, which will be explained in more detail later in this paper.

7.4.3. Distinguishing among Market Segment Characteristics

The Kano model can also be applied in different market segments to distinguish among products and services according to their characteristics. If the questionnaire conducted for the Kano model includes sufficient customer- oriented variables, the results can be used as the ideal basis for market segmentation and thus the differentiation of products and services according to the utility expectations of different customer segments.

8.4.4 Aiding in the Design Trade-off Process

If two features of a product or service cannot be met simultaneously due to technical or financial reasons, the Kano model can be used to quantitatively identify which one has the greater influence on customer satisfaction based on the customer satisfaction coefficient.

Chapter 8 Problem Formulation

8. Problem Formulation

This dissertation work consists of four parts-

8.1. The first part presents the idea behind and concepts of customer satisfaction and the 10.2 methods used to measure the degree of satisfaction.

8.2. The second part focuses on production and clearance of pipe on schedule.

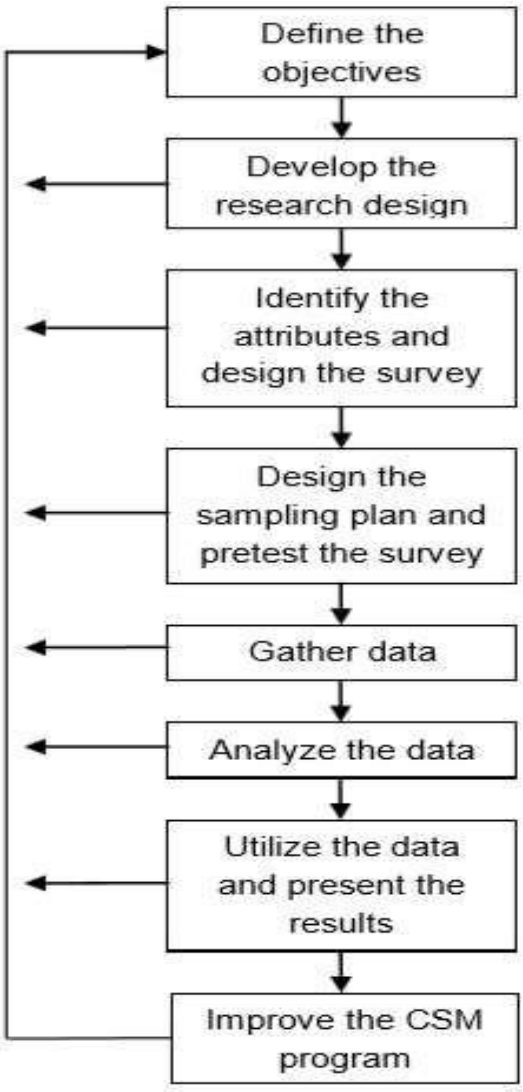
8.3. The third part focuses to reduce the defect in products

8.4. The fourth part results of the analysis as well as conclusions of work out.

PIPE MFG. STATUS OF ALIS - as on 09-09-19										
ID X THK (mm)	REV. SCOPE as on 23-07-19 (m)	SCOPE (No.)	FORMING (m)	HYDRO COMPLETED (No.)	HYDRO BALANCE (No.)	RT COMPLETED(No.)	RT BALANCE(No)	UT BALANCE (No.)	RELEASED FOR FURTHER PROCESS (No.)	% COMPLETION (RT)
400X3.15	63528	10567	62388.628	10157	169	10130	196	N.A.	10130	95.87
450X3.15	16950	2825	16958.32	2788	15	2780	23	N.A.	2780	98.41
500X3.15	39488	6581	39458.80	5216	1306	4569	1953	N.A.	4569	69.42
600X3.15	22493	3749	22422.90	3596	100	3594	102	N.A.	3594	95.87
700X4	24266	4044	24303.41	3084	930	2540	1474	N.A.	2540	62.80
750X4	1720	287	1729.435	283	1	284	0	N.A.	284	99.07
800X4	13409	2239	13441.78	2206	17	2205	18	N.A.	2205	98.50
900X5	8424	1409	8377.38	1309	81	1210	180	N.A.	1210	85.86
1000X5	24525	4125	24752.99	3998	94	3987	105	N.A.	3987	96.65
900X6	198.67	33	198.67	33	0	33	0	0	33	99.66
1100X6	7119	1122	7147.245	1070	104	1013	161	160	1013	90.27
1200X7	4985	831	4989.35	710	114	98	726	114	98	11.80
TOTAL	227105.7	37812	226168.9	34450	2931	32443	4938	274	32443	85.80
	m	No.	m	No.	No.	No.	No.	No.	No.	%

8.1 Problem formulation - Part 1 Methodology / Strategic Approach

Quality function deployment (QFD) is a method developed in Japan beginning in 1966 to help transform the voice of the customer into engineering characteristics for a product. QFD as a "method to transform qualitative user demands into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process. It identifies and classifies customer desires (What's), identifies the importance of those desires, identifies engineering characteristics which may be relevant to those desires (How's), correlates the two, allows for verification of those correlations, and then assigns objectives and priorities for the system requirements. This process can be applied at any system composition level (e.g. system, subsystem, or component) in the design of a product, and can allow for assessment of different abstractions of a system.



8.2 Problem formulation- Part 2

Production and clearance of pipes in due date i,e up to 31 July 2019

The scope of pipe manufacturing is 270km.manufacturing was started in March 2017

In spiral saw mill, the production speed is 1.25 to 2 meter per minute, in this way 400 pipe dia, 6m length is manufactured around 120 no. in a shift of 8 hours i.e 420 min, Each pipe possesses lead time of hydro test is around 5 min, so for hydro testing of 120 no. pipes, time required is 120 x 5 = 600 min.so actual hydro testing takes place 84 no.in a shift.

The major bottleneck occurs during hydro test that 26 no. of pipe per shift is balance for hydro test, the study will focus to resolve the issue or find an alternate way to reduce this bottle neck.

8.3 Problem formulation- Part 3

The study will focus on how to reduce pipe weld defects as per present observations each 1out of 5 pipes comes under repair of length 1m to 2m , however all parameters are being maintained properly although repair comes significantly. This repair develops a major bottleneck because it takes too much time to repair and does not make sound quality for customers. Our aim is to find a root cause for its occurrence repeatedly and search a best solution to avoid such repair.

8.4 Problem formulation- Part 4

The study will summarize all above problems of pipe manufacturing unit and detailed study will be done to find optimum solution, a feedback survey based on quality function deployment and kano model will be done to search the voice of customer, then data analysis of root cause will be done, and will have to find an optimum solution and will be presented.

8.5. Expected Results

1. Customer feedback survey will provide the satisfaction level of customers, the feedback will be based on productivity, quality, safety, time schedule, and process approach, and communication, progress of work, least satisfaction area and scope of improvements and analysis based on Kano model.
2. Reduction of bottleneck for operation to utilize lead time in effective way and the way to hydro test testing in line.
3. the product which out from mill will not have any repair by changing techniques of welding parameter to get better results.

Application of the Kano Model at L&T Pipe Manufacturing Unit

9.1 Questionnaire

L&T Construction, pipe plant Rordha having a capacity of pipe manufacturing:- 400mm to 1200mm is a place that aims to provide best products and services to their clients **Narmada Valley Development Authority**. In order to determine which types of products and services have a greater influence on customer satisfaction, the Kano model was applied following the steps presented below.

9.1.1. STEP 1

Step 1 involves surveying target to the customer representative (NVDA) about each function through a pair of questions **(functional and dysfunctional). Functional questions are asked**

in a positive way and dysfunctional questions are asked in a negative way. The customers are asked to choose from among five choices for each question. In the case of pipe mill, a total of 20 questions regarding product & service quality of the production plant were asked to 25 persons. An example of a Kano model question used in the questionnaire is presented below.

Functional question: "How would you feel if plant provided Good Quality?" **Alternatives:** I like it / it must be that way / I'm neutral / I can adjust with it / I dislike it **Dysfunctional question:** "How would you feel if Plant didn't provide good quality?" **Alternatives**: I like it / it must be that way / I'm neutral / I can adjust with it / I dislike it.

9.1.2 STEP 2

Step 2 is to use the evaluation table 1 to count and summarize the results. The abbreviations used in the evaluation table represent **one-dimensional requirements (O), attractive requirements (A), must-be requirements (M), indifferent requirements (I), questionable requirements (Q) and reverse requirements (R).**

For instance, if one respondent chose "I like it" for a functional question and answered "I can live with it" for a dysfunctional question, the tested product or service feature would be classified as **an attractive requirement (A). For indifferent requirements (I),** the customer is neither satisfied nor dissatisfied if the product, service or process is dysfunctional or fully functional with regard to that particular aspect. Questionable requirements (Q) represent results that exhibit contradictory answers. **Reverse requirements (R)** signify that the product or service feature is not wanted by customers and that they strongly expect the reverse (Elmar Sauerwein, 1996). One-dimensional, must- be and attractive requirements, together with indifferent requirements, are primarily what we are investigating in the Kano model analysis.

Table 1: Kano Evaluation Table.

Customer requirements		Dysfunctional				
		1.like	2.must be	3.neutral	4. live with	5.dislike
Functional	1.like	Q	A	A	A	O
	2.must be	R	I	I	I	M
	3.neutral	R	I	I	I	M
	4. live with	R	I	I	I	M
	5. Dislike	R	R	R	R	Q
		Customer Requirements A: attractive, O: one-dimensional, M: must-be, Q: questionable result, R: reverse, and I: indifferent.				

09.1.3 STEP 3

It involves determining the category of the evaluated product or service feature according to the answer frequency. Generally, the results are evaluated and interpreted according to the answer frequency. However, if the questions are in-depth or detailed, the results may be distributed. Hence, it is suggested that **if (O+A+M) > (I+R+Q), the maximum value of (O, A, M) should be adopted. Otherwise, the maximum value of (I, R, Q) should be used [2]. In addition,** when the results have the same two frequency requirements, the classification that would have the greatest impact on the product or service should be chosen. **The priority order should follow M > O > A > I.**

09.2 Analysis of Questionnaire Results

09.2.1 Profile of Respondents

The questionnaire was conducted among 25 customer representative because they are treated to be the main respondent to pipe mill when it runs under Narmada valley Development Authority. In total, 25 effective responses were collected.

09.2.2 Customer Need Dimensions

Elmar Sauerwein et al. pointed out that when making product development decisions, the general rule of **must be > one-dimensional > attractive > indifferent,** should be applied to set priorities. Must-be requirements have to be fulfilled first. Otherwise, there would be major dissatisfaction. The cost of meeting this type of requirement can be regarded as an entry cost. The fulfilling of one-dimensional and attractive requirements can largely increase customer satisfaction and help the providers to differentiate their products and services from those of others to be competitive.

09.2.3 Survey Parameter Analysis

1) Plant Infrastructure

All the plant & machinery were classified as attractive requirements based on location at village Rordha, Dist.:- Alirajpur, MP. The plant is spread in 2 hectare area having BIS licensed products confirming to IS 3589:2001. Plant is equipped with large byard spiral mill having Dia. 400 mm to 1200 mm pipe product.

2) Production Process

Pipes are produced with forming of HR coils with controlled dimension and application of SAW welding without any weld defect was regarded as an indifferent requirement. The results show that customers are not so much focused on welding process and input variables like voltage, current, forming time, forming speed, welding speed & welding consumables and fluxes.

3) Product Quality

Dimensions and weld Quality of pipes as per requirements of IS 3589:2001 & was classified as a one-dimensional requirement, showing that respondents hope to accept the product for their long lasting service for as long as possible.

Testing facilities & Services

Customers were asked about sample testing like Mechanical, Hydro, RT, UT, and their satisfaction level at each half yearly basis. Performance were measured with categorization as indifferent characteristics.

Table 2

Dimension	Assessed Characteristics	A	O	M	I	R	Q	Total	Category
Plant infrastructur e	Satisfied with storage/ stacking of pipes?	**36**	26	12	10	11	05	100	**A**
	Satisfied with raw material / consumable condition??	**29**	33	12	10	08	08	100	**O**
	Plant infrastructure, space and Equipment's?	24	22	**35**	03	12	04	100	**M**
Production process	Input parameters like current, voltage, forming angle, speed flux, fillers, welding process?	20	20	14	**35**	05	06	100	**I**
	Methodology to follow during production	15	25	14	**33**	05	08	100	**I**
	Interchanging sequence of hydro test	**35**	25	12	10	11	05	100	**A**

	Production Schedule	06	10	09	**45**	15	15	100	**I**
Product Quality	Dimensions, length and quality of product	**38**	24	23	10	05	00	100	**A**
	Weld visual and surface finishing	12	15	08	25	**35**	05	100	**R**
	NDT & DT results	**38**	24	12	10	11	05	100	**A**
Testing facility & services	Measuring & Testing instruments availability	**30**	30	12	08	9	1	100	**A**
	Documentation of final acceptance	26	**36**	12	11	14	01	100	**O**
	Hydro testing facility	05	05	10	**60**	10	05	100	**I**
	Releasing for dispatch	15	12	15	**35**	20	03	100	**I**

09.2.4 Customer Satisfaction Coefficient

The customer satisfaction coefficient indicates the extent to which satisfaction increases if a product requirement is met or the extent to which satisfaction decreases if a product requirement is not met. It is useful to know the average impact of a product or service requirement on the satisfaction of all customers. The calculation of this coefficient is as follows.

$$\text{Enhanced Satisfaction Coefficients} = \frac{A+O}{A+O+M+I}$$

$$\text{Reduced Dissatisfaction Coefficients} = \frac{O+M}{A+O+M+I}$$

A positive customer satisfaction coefficient ranges in value from zero to one; the closer to one the value is, the higher the influence on customer satisfaction. The negative customer satisfaction operates in the same way. A value of zero signifies that this feature does not cause dissatisfaction if it is not met. In this way, all the evaluated characteristics can be represented visually in a diagram. It is helpful to know their influence on customer satisfaction and set priorities when designing products or services. The customer satisfaction coefficients for pipe plant are shown in Table 3.

Table 3

Dimension	**Assessed Characteristics**	**Category**	$\frac{A+O}{A+O+M+I}$	$\frac{O+M}{A+O+M+I}$
Plant infrastructure	Satisfied with storage/ stacking of pipes?	**A**	0.74	-0.45
	Satisfied with raw material / consumable	**O**	0.74	-0.54

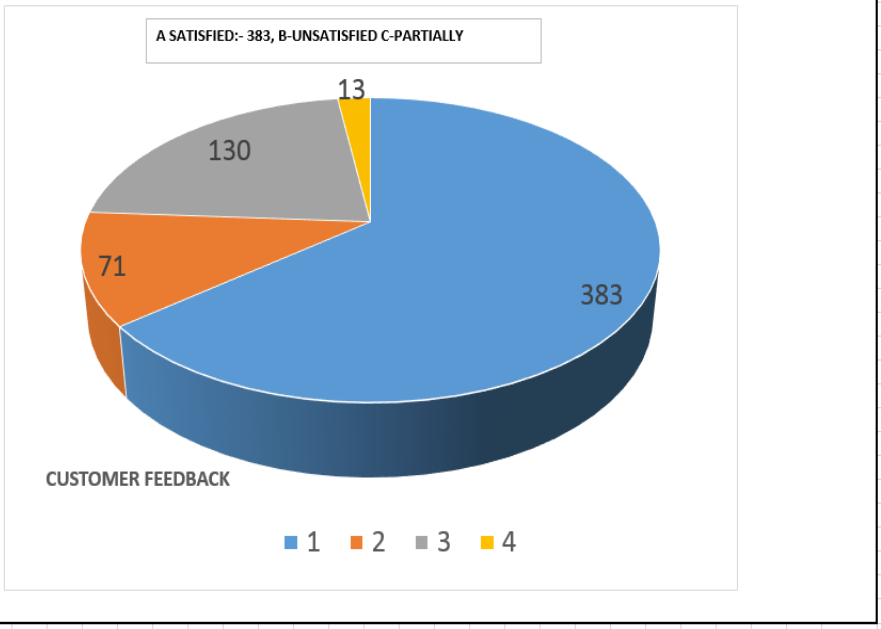
	condition??			
	Plant infrastructure, space and Equipment's?	**M**	0.55	-0.68
Production process	Input parameters like current, voltage, forming angle, speed flux, fillers, welding process?	**I**	0.45	-0.38
	Methodology to follow during production	**I**	0.46	-0.45
	Interchanging sequence of hydro test	**A**	0.73	-0.45
	Production Schedule	**I**	0.23	-0.27
Product Quality	Dimensions, length and quality of product	**A**	0.65	-0.49
	Weld visual and surface finishing	**R**	0.45	-0.38
	NDT & DT results	**A**	0.74	-0.43
Testing facility & services	Measuring & Testing instruments availability	**A**	0.75	-0.53
	Documentation of final acceptance	**O**	0.73	-0.56
	Hydro testing facility	**I**	0.13	-0.19
	Releasing for dispatch	**I**	0.35	-0.35

The customer satisfaction coefficients are shown in table 3. The diagram can be approximately divided into four quadrants according to the four types of requirements. It is clear from the diagram that most of the plant infrastructure, production process and product quality a r e located in the area between one-dimensional and attractive requirements. So manufacturer should therefore pay more attention to these types of needs. It is not necessary for features located in the indifferent requirement quadrant to be focused on over the other three types of requirements. Localization requirements are found in the middle between the indifferent and attractive quadrants.

Figure 4: Customer Satisfaction Coefficient Diagram.

Data Analysis Based On Survey.

NO. OF CUSTOMERS PARTICIPATED																									
OPTIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
A	14	11	11	15	14	16	14	14	16	16	18	12	14	17	20	14	19	15	17	18	19	16	14	13	16	383
B	0	10	6	3	3	2	3	2	0	0	2	5	3	0	1	3	1	5	3	2	2	5	5	4	1	71
C	7	3	5	5	7	6	4	8	7	8	4	6	7	7	3	6	4	3	4	4	3	3	4	6	6	130
D	3	0	2	0	0	0	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	13



CONCLUSION

The Kano model is a theoretical model that connects the requirements fulfilled by products or services with customer satisfaction and identifies three types of requirements that might influence ultimate customer satisfaction: must-be, one-dimensional and attractive. The application of the Kano model to customer service is expected to provide useful information on the types of requirements that must be fulfilled to enhance customer satisfaction.

According to our preliminary analysis using the data obtained from the questionnaire survey, it seems that most of the customers are strongly interested and to strict with product schedule and clear pending pipes on schedule with full maintained quality. So that pipes will be released on time.

1. In plant infrastructure there was stuck of pipe production were needed to find the solution and decision were made for manufacturing of 12 meter pipes instead of 6m length. Whole hydro testing set up has been extended to 12m length.
2. Preheating of HR coils were & flux were implemented, at temperature 200 -250 degree Celsius for reducing the weld defect
3. Grit blasting of HR coils before use so that contamination of rust is obsolete so repair of

pipe earlier was 5% reduced to 0.1%.

Hence, Kano model Analysis was very helpful to know the unknowing requirement s which was not stated, with the help of questionnaire it was easier to understand and meet customer satisfaction level.

11. BIBLIOGRAPHY

1. Huang, J.W. Application of Kano Model in Requirements Analysis of Y Company's Consulting Project. American Journal of Industrial and Business Management, 2017; 7: 910-918. https://doi.org/10.4236/ajibm.2017.77064.
2. Received: June 14, 2017 Accepted: July 10, 2017 Published: July 13, 2017.
3. Ullman, David G., The Mechanical Design Process, McGraw-Hill, Inc., U.S.A., 1997 pp. 105-108 ISBN 0-07-065756-4.
4. Jacobs, Randy, Evaluating Satisfaction with Media Products and Services: An Attribute Based Approach, European Media Management Review, winter, 1999. http://www.tukkk.fi/mediagroup/emmr/Previous%20Issues/Satisfaction.htm.
5. Lowe, A., Ridgway. and Atkinston h., "QFD in new production technology evaluation'' Int. j. prod., Eco., 2000; 6(2): 103-112.
6. Kano Model Analysis of Customer Needs and Satisfaction at the Shanghai Disneyland Author: - Pan Qiting*, Nobuhiro Uno**, Yoshiaki Kubota***.
7. Graduate School of Management, Kyoto University, kiroro07@gmail.com.
8. Graduate School of Management, Kyoto University, uno@trans.kuciv.kyoto- u.ac.jp.
9. Graduate School of Management, Kyoto University.