



**EUROPEAN
INTERNATIONAL
UNIVERSITY**



COVER PAGE AND DECLARATION

	Master of Business Administration (M.B.A.)
Specialisation:	
Affiliated Center:	
Module Code & Module Title:	
Student's Full Name:	
Student ID:	
Word Count:	
Date of Submission:	

I confirm that this assignment is my own work, is not copied from any other person's work (published/unpublished), and has not been previously submitted for assessment elsewhere.

E-SIGNATURE: _____

DATE: _____

EIU Paris City Campus

Address: 59 Rue Lamarck, 75018 Paris, France | **Tel:** +33 144 857 317 | **Mobile/WhatsApp:** +33607591197 | **Email:** paris@eiu.ac

EIU Corporate Strategy & Operations Headquarter

Address: 12th Fl. Amarin Tower, 496-502 Ploenchit Rd., Bangkok 10330, Thailand | **Tel:** +66(2)256923 & +66(2)2569908 | **Mobile/WhatsApp:** +33607591197 | **Email:** info@eiu.ac

Table of Contents

1- Introduction.....	2
2- Operation.....	3
2.1- The organization structures.....	4
2.2- Market and customer satisfaction and requirement.	5
2.3- Quality control/Quality Assurance.....	9
2.3-1. Row material process:.....	13
2.3-2. In process inspection:.....	16
2.4- Socially responsible operation.	24
3- Conclusion	25
4- References.....	27

1- Introduction.

The Big Green Tractor is an air conditioning and HVAC manufacturing company in the kingdom of Saudi Arabia, recently due to the high increase in energy, material, manpower cost, the company start from suffering in declining growth in business, income and profits. that make the company at the risk of business failure which can lead to total shutdown in a very competitive market. The company top management decided to find and analysis the cost, wastes, process to improve and lead to a more competitive product with higher customers value and lower production cost. Additionally, the company planning to make their system and procedure more aligned with the new green environmental regulations and utilizing the 21st new tools.

Evaluating the current implemented system, auditing the different manufacturing/ quality /material/ management system operations and highlighting strength/weaknesses and the opportunity for improvement. It was so clear for the possibility of improvement and cut cost by eliminating the cost of defect and by proper utilizing of resources and avoiding the 9-major category of wastes.

Lean 6 sigma used as a tool for eliminating the different kind of waste and to improve the quality of process outputs by identifying and removing the cause of defects and minimizing the variability in processes (Barbara Wheat, Chuck Mills, and Mike Carnell, 2001)

2- Operation

A lean 6 sigma committee in the company formulated from different departments (production, quality, material, maintenance and R&D).

The committee intention to continually discuss and review customer requirement and feedbacks (complaints). The committee use the received information and data for determining and analyzing for future improvement.

The company targeted enhancing growth by:

- modernizing and using state-of-the-art production equipment's and process leading more efficient utilizing the resources and higher productivity operations. Which in turn reducing the production cost with higher quality product.
- Cutting and eliminating the non-conformance quality cost, the company can save time, defect, manpower, re-work, material...etc.
- Analyzing the 9 major wastes found in industrial operations.
- Continually improve and putting new targeted waste reduction KPI's

A DMAIC approach will be used for improving the current process and finding the optimal solution in order avoiding the defects and enhance product quality and minimizing the defect waste. The committee will meet in regular biases for regular enhancement and/or whenever a complain feedback received from customer, with the aim of finding new challenges and solutions that enhance the product quality and competitiveness and add more value.

The committee planned to review the organization structure process from start raw material till finished product and delivery to clients and going through the in-process activities with also all the supporting services such as HR, training department.

2.1- The organization structures.

Defining the interrelations and responsibilities boundaries is the first document needed for the company to achieve performance and efficiency in work and avoiding conflict. A well-planned structure will ease and speed up the work and will insure the optimum communication between deferent company departments.

“Organizational structure improves operational efficiency by providing clarity to employees at all levels of a company. By paying mind to the organizational structure, departments can work more like well-oiled machines, focusing time and energy on productive tasks.” (David Ingram, 2019).

The Big Green organization structure redefined and built with eliminating the unwanted sections and department, merge some of the processes and relocating some of the activities to achieve the highest efficiency and productivity. As a result, a higher utilization for at least 3 out of 8 M resources:

- 1- Manpower: with the properly allocating the tasks among employees in such explicit way, will clearly create a homogenous work environment with lowest overlapping between responsibilities and without any conflict. Which will achieve the max utilization of people and time.
- 2- Management: with proper hierarchical structure, each person will clearly know to who he must be reporting, and who's his bellow team.
- 3- Methods: organization structure will simplify the formulation of methods and easing the acceptance to the methods changes.

Top level organizational structure for the Big Green company showing high level management responsibility and dependency prepared.

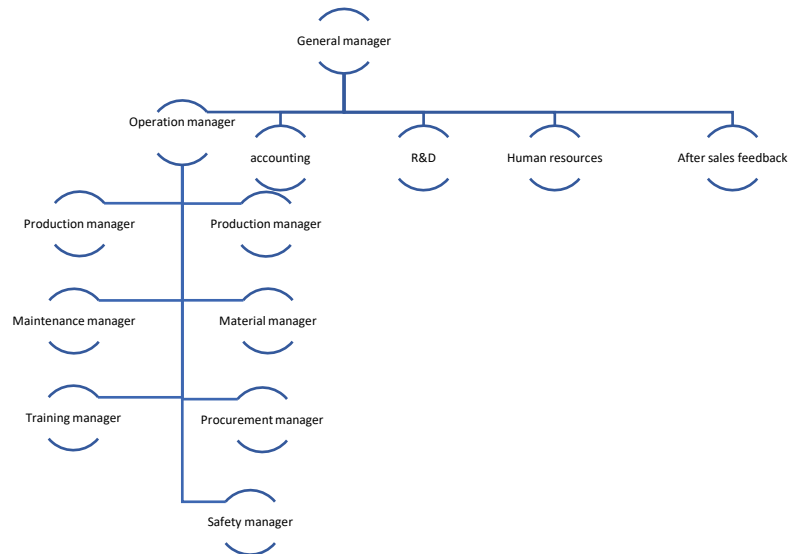


figure 1

2.2- Market and customer satisfaction and requirement.

building a product for customer must at least be according to customer requirements and needs. that always the ultimate golden quality and business goal, which will eventually make the clients fully satisfied with the value he receives with our air conditions over other competitors.

A procedure required for reaching out the customer in periodic timing in order to measure:

- 1- Customer overall satisfaction on our products.
- 2- Customer opinion compared to other competitors.

- 3- Reasons for customer that make him to choose Big Green product (price, quality, delivery, technical solution, after sales maintenance)
- 4- Lost customer opinions for reason they choose a competitor product (price, quality, bad history,

A committee formulated from top manager, production manager, quality manager, R&D manager, after sales manager, procurement manager required to meet and analyze the survey outputs especially point 3 and 4. and an action plan initiated to enhance point 3 and eliminate the reasons found in point 4. The action plan should be based on DMAIC method. Based on the survey analysis, the company using Ishikawa diagram tools decide on where, how and what changes to be planned to minimize the quality defects and customer dissatisfaction and increasing the product value.

A written and documented Ishikawa diagram plan for each customer feedback or a quality waste problem must be recorded and reviewed periodically till the agreed planned results achieved.

Analyzing the main cause of lost customer using Pareto chart, long delivery lead time was representing around 85% of the reasons.

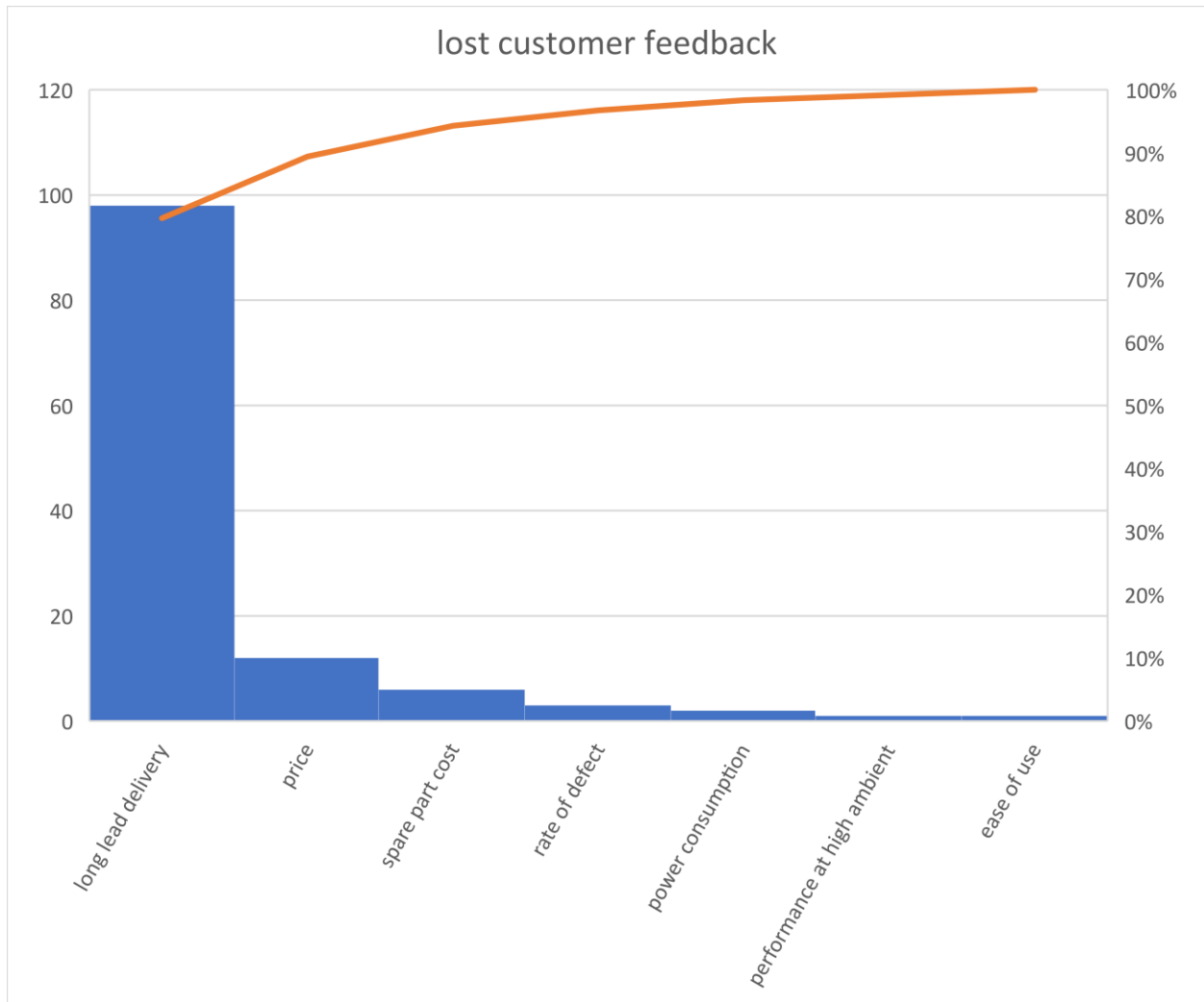


Figure 2

A written and documented Ishikawa diagram plan for each customer feedback or a quality waste problem must be recorded and reviewed periodically till the agreed planned results achieved

CAUSES OF LOW CUSTOMER SATISFACTION BECAUSE OF LONG LEAD DELIVERY

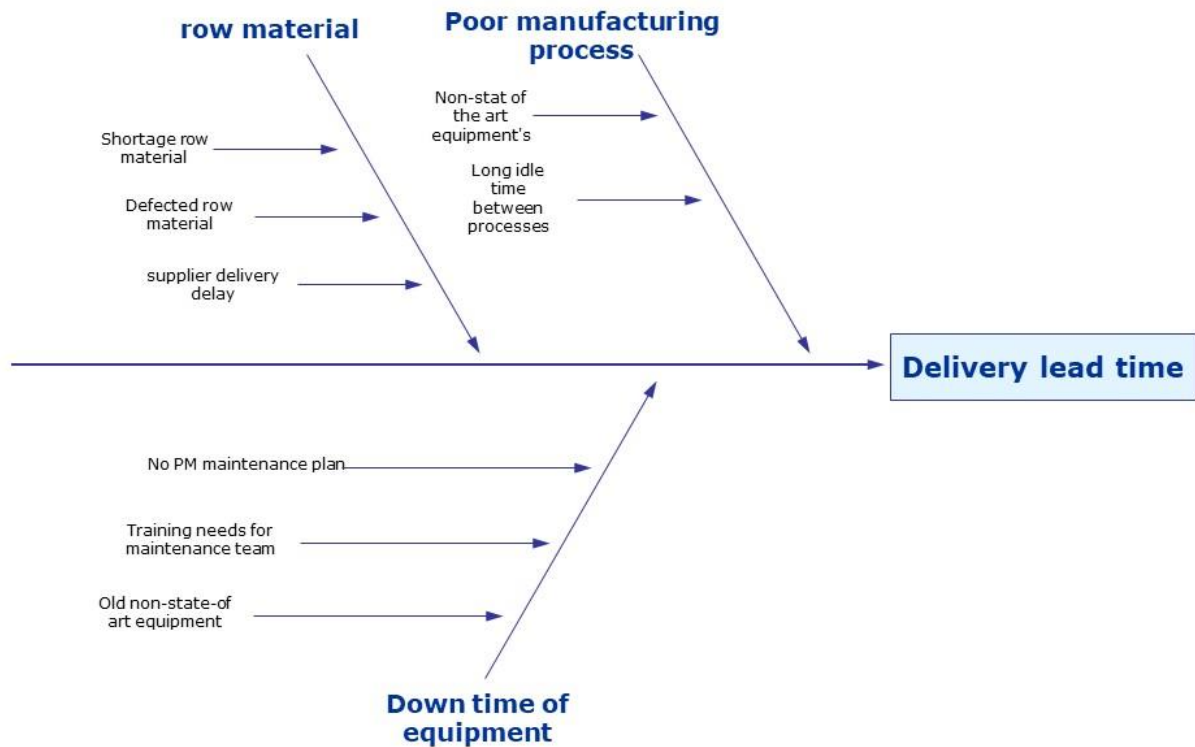


Figure 3

With the Ishikawa diagram, found the main reason for long lead delivery time is:

- 1- Long idle time between processes.
- 2- Shortage of row material.

An action plan with detailed time/responsibility/resources/activities to be prepared for this two main cause of long delivery with KPI to measure and insure the elimination of them.

2.3- Quality control/Quality Assurance

The Big Green main target making their air condition and HVAC products to be accepted by the customer and satisfying their needs. The customer needs a product free of defects/ with lowest maintenance requirement/ reliable and safe in use.

A proper building for quality system with lean principles can help the big green company by eliminating and minimizing the quality cost by:

- 1- Minimizing the appraisal cost, by building a system more oriented on prevention strategy to insure the conformance with quality requirements
- 2- And Eliminating the non-conformance cost.

Using the principles of lean to prevent non-conformance by using:

1- Visual management

At assembly shop-floor in the production, to make sure about the proper assembling of machine accessories (hinges, handles, inspection window, rubber, gasket ...) an elastration colored booster with simple instruction was kept inside the accessory's preparation section. Showing in few steps the proper fixing and installation.



Figure 4

2- Poka-yoke

Using this approach to prevent the un-intended human errors and reducing excessive inspection. An engineered mechanism used to make sure the output of each stage not passed to next stage. Bellow arrangement was done to insure such goal:

- Using a combination of both different color code and numbering for wires to differentiate between the control and power wires. So, the wire will not be terminated unless match in color and number. Using this approach help by eliminating the human errors which could happen in mixing between wire, also avoiding the burn of power and control circuits in case of wrongly termination of wires.

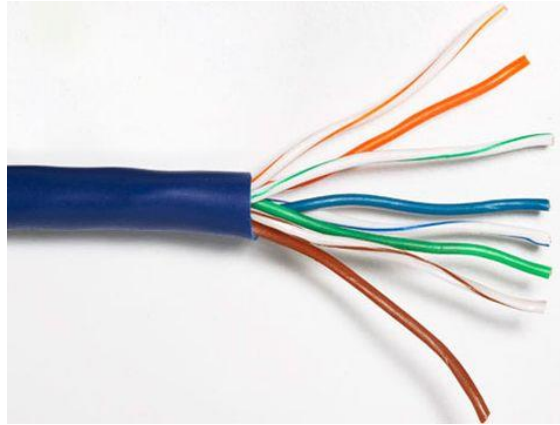


Figure 5

- Using different junction box for different compressor circuit.

So, with the separation between the electrical component for different circuit, that make easy for the technician to install the right component (terminal, fuse, contactor, ...) on the right circuit and eliminating any chances for mixing in between them.

- Using different size pre-filters with different MERV for the different model of machine.
with this technique, it's impossible to mix between the filters MERV of different machine models, as they will not fit on position. So, the correct MERV filter will be installed only on the correct machine.

3- ANDON

ANDON technique was used on the electrostatic painting line, with light signals linked to a monitoring device continuously measuring the pH value of a degreasing chemicals. As the pH within the specified programed limit, the ANDON device will keep green. Once

the pH out of the accepted range a red light will be eliminated to inform the responsible engineer about the issue and stop the line from running. A wrong value pH lead to a powder paint not firmly sticking to the metal surface workpiece which will fail in the impact test. The scrap metal and painting powder which was related to faulty degreasing process was eliminated as seen in bellow analysis. The pH meter was installed by August.

defect reason\month	January	February	March	April	May	June	July	August	September	October
bad degreasing	120Kg	135Kg	112Kg	117Kg	95Kg	0Kg	0Kg	0Kg	0Kg	0Kg
over curing	32Kg	50Kg	15Kg	30Kg	33Kg	25Kg	22Kg	25Kg	31Kg	23Kg
robot speed	8Kg	5Kg	6Kg	2Kg	0Kg	3Kg	8Kg	2Kg	1Kg	5Kg

Table 1



Figure 6

In each process and procedure in production, a clause in the procedure must describe how to use the DMAIC approach in analyzing the non-accepted product, or challenges (challenges can be productivity, or waste reduction, or environmental or downtimes issues required to enhance).

The results of the DMAIC should at least mention any suggestion for:

- Updating the quality plan for the process and enabling,
- Recommendation for new manufacturing process which requires less resources

- Recommendation for different equipment's, tools capable of finishing the work with less defect and higher productivity.
- Recommendation for precedent processes update which can enhance the current and ascending process (i.e., new handling procedure in previous process to next process can save time or defect)
- Training needs.

2.3-1. Row material control:

Quality plan should include inspection for row material at receiving and before in production. Detecting and catching the non-compliance material early can save a lot of waste and efforts in correcting the defects which will be so costly to solve during production or after final product shipping to clients. A procedure should be set to insure only the approved row material to be available for production. Material which still not approved or rejected to be identified and quarantined in case of rejected. The approval process should include the involvement of all related department (production, quality, technical, warehouse).

Prevention quality approach used in row material as the first tool to minimize the defects and the cost of appraisal quality. By preparing a procedure describing for a systematic step on how to:

- Select a supplier with clear selection criteria
- Approval process for supplied row material from newly selected supplier.
- Approval process for approved supplier
- Alternate supplier for each high-risk row material (which production can have no progress without)
- A continual re-validate the approved suppliers.

The new suppliers must undergo evaluation and approval from all main departments (quality/production/warehouse/procurement/accounting/R&D) with unique checklist and requirement for approval. To approve a new supplier, he must at least gain 70% or more at each department evaluation. For supplier providing more than one row material, each different type of row material must be evaluated and tested separately and pass the 70%.

For old, approved supplier, the supplied row material must undergo receiving inspection each time procured to ensure the compliance with the originally tested and approved samples. No deviation allowed and full conformance only accepted. Any minor deviation will require new approval process.

Avoiding the idle waste time and to ensure the optimum use of company resources (manpower, machine, money) the company must be continuously running with no disconnect due to row material shortage, The *main row material used in manufacturing with unique and critical specs* must be identified, and two or three different suppliers must be evaluated and approved for cases where one supplier not available then immediately second supplier cover the shortage.

material	supplier	country	rating
scroll compressor	copeland	USA	A
	copeland	thailand	A
	danfoss	france	B
	danfoss	china	B
	bitzer	germany	B
	bitzer	USA	B
screw compressor	bitzer	germany	B
	Hanbill	Taiwan	A
sheet metal	SAPEC	KSA	A
	Ghurair	UAE	B
copper	muller	USA	A
	K-copper	Korea	B
centrifugal fan	Nicotra	Italy	A
	Yeilda	china	B

axial fan	Ebm	germany	A
	Zeihl	germany	A
	Yeilda	china	B

Table 2

The row material procedure needed to plan for:

- selecting and evaluating suppliers (new, regular supplier) continuously monitoring the supplied row material.
- Determining the acceptance level for supplied product
- Planning for the required minimum re-order point for stock quantity for the row material to insure the smooth, continuous production flow **without idle time waste** (Kristina Lopienski, 2019). And to be periodically reviewed taking into consideration the market **forecasting with quantitative method** using **the simple moving average formula for the last 5 years**.
 - o Counting the lead time of the row material from supplier/boarders/customs (B).
 - o The re-order point should insure during period B, the available stock should never be Zero and must not be more than 10% of the re-order point.
 - o ERP system with notification set for each material at the re-order point to alarm the material officer for critical material status.
- Planning for the max stock quantity for row material. The formula must take into consideration the **inventory waste** by Row material warehousing period should not be more than 30 days in company storage area.

With the application of re-order and max stock for row material, delivery time was reduced by 60% as can be seen from bellow chart. As the main reason for long delivery of projects as mentioned on 2.2 was:

- 1- Long idle time between processes.
- 2- Shortage of row material.

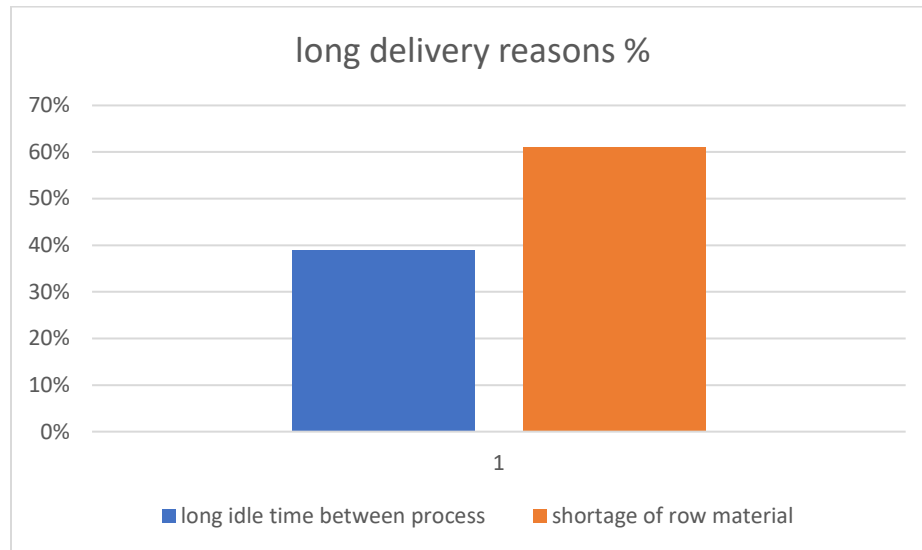


Figure 7

Lean 5S team for utilizing new state of the art equipment implementation (from production, quality) regularly review the opportunities for improvement and suggestions for reducing the time/motion/transportation/ and material waste:

- Using forklift in material handling
- Using scissor lift for high stacked material on shelves
- Using ERP system for material planning
- Using barcode system for material dispatching
- Using identification and coding system for material in/out control

2.3-2. In process control:

During production activity, Customer and design requirements must be defined to make sure compliance at different stages in production. 6 sigma careful planning at this level is very

sensitive and greatly reduce the number of defected/ rejected outputs (Summers 2011, p. 9).

Defining of the exact issues in operations that leading to low quality product will help in analyzing and finding solutions and improvement for the process. process flow map and FMEA tool can be used in identifying all possible failures could happen during production and making the proper measures to avoid.

A process flow map made showing the activities in production and the interrelation in between them with deciding the appropriate quality control measures.

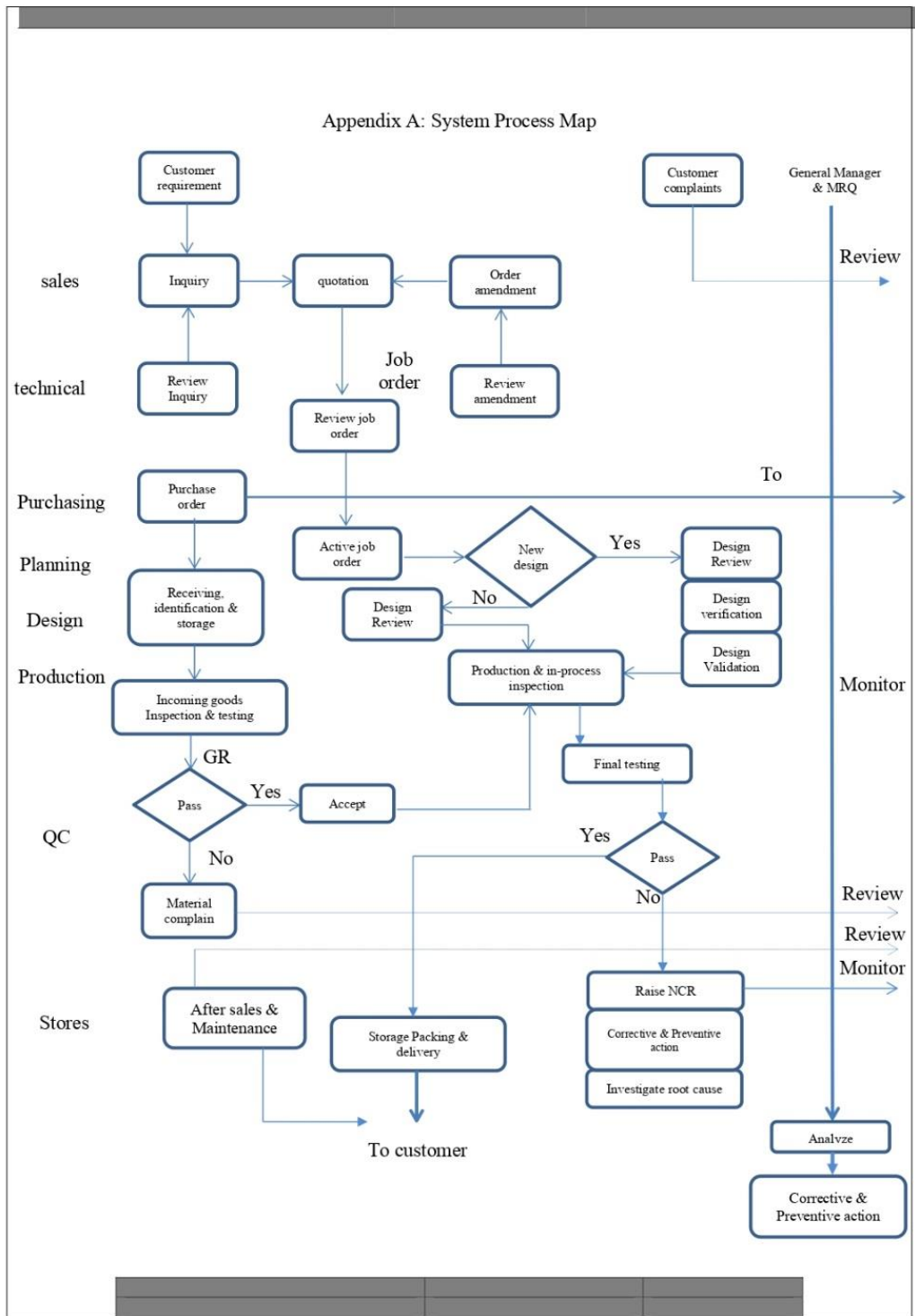


Figure 8

FMEA analysis, table 3

function	failure mode could happen	effect of failure	Serious of effect (S)	failure root cause	occurrence rating (O)	current process control	detection rating (D)	Risk priority number (RPN) SxOxD	criticality SxO	recommended action	review
CNC metal fabrication	wrong dimension cutting	non fit parts on final product	7	non confirmed drawing by client	4	QC inspector after finish fabrication	7	252	36		
		scrap workpeice	9		8		5	360	72		
CNC metal fabrication	wrong bending direction	non fit parts on final product	7	non confirmed drawing by client	4	client signature on first page of submittal	5	180	36		
		scrap workpeice	9		8		5	360	72		

electrostatic painting	wrong painting color RAL code	product will be rejected by customer	10	missing information on production report	9	production report to be pre-order before start production for preview from production engineer	5	450	90		
				non confirmed submittal by client	6	client signature on first page of submittal	4	240	60		
	wrong painting thickness	product will be corroded after short period of installation at customer site	10	wrong measuring device	4	calibration for measuring device	6	240	40		
				faulty powder spraying report	5	periodic maintenance of powder spraying guns	5	250	50		
				missing information on production report	8	production report to be pre-order before start production for preview from production engineer	5	400	80		
	low adhesiveness painting	product will fail and rusted at short period of installation at customer site	7	wrong degrading %	8	pH measuring before start of painting line	7	392	56		
				wrong water washing temperature	5	water temperature reading twice a day	6	210	35		

A **lean manufacturing committee** established among the company and represented from different departments with the objective of cutting non-value-added cost to improve performance by systematically removing waste (. A periodically meeting with the aim of discussing the 9 different types of waste.

- 1- Over production
- 2- Waiting
- 3- Non-utilized talents
- 4- Transportation
- 5- Inventory
- 6- Motion
- 7- Defect
- 8- Extra processing
- 9- Resistance to change

A brainstorming meeting report must be documented with action plan and solutions addressing bellow main topics:

- 1- State-of-the-art production machinery (save time, manpower, accuracy, lower start up reject, lower start up reject, lower setup and adjustment, lower generated waste)
- 2- Re-planning the manufacturing processes with more cost-efficient approach (eliminating unnecessary activity, combining similar activity at one point, avoiding repeated activity, lower material use, lower waste) with saving the 8 main resources.
 - a. Using laser fabrication machining enables the use of almost 90% of the flat sheet metal area because of the no dead zone which usually required in the regular

hydraulic punching machine. Metal scrap reduced from 33000kg yearly to 8700kg for the year 2020.

- b. Installing a powder coating cyclone in the electrostatic painting chambers, enables the reuse of all excess powder paint falling in the powder chamber after the painting process. So, all powder dust collected, filtered and recycled which reduce the painting powder consumption by 18% for the year 2020 (from 17000kg to 14600kg)
 - c. Installing reclaiming tanks with pumps for the freon instead of purging the freon to atmosphere, which supporting company commitment toward global warming potentials and ozone depletion potentials international concerns.
- Creating the VSM value stream mapping for the production and manufacturing process and defining the current suggesting the time and process enhancement.
 - Reduction of waste generated from the manufacturing process (metal, paper, chemicals) by establishing new manufacturing processes and contracting with recycling companies for collecting and selling the generated waste.

week 35 meeting brain storming (lean committee for waste reduction)				
improvement	saving 1	saving 2	saving 3	saving 4
replacing CNC hydraulic machine with laser machine	reducing the kg of scrap by 30-40%	reducing the manpower from 2 operator to 1 on each machine	reducing the time needed to fabricate workpiece from 15 to 4 minutes	the handling for work piece on the laser machine robotic, not manual like the CNC
using battery charged forklift for material handling	reducing the time for transporting material between different departments in factory	reducing the toxic gases emissions from deisel engine	reducing the manpower needed for transporting material using the manual liftingjacks	
connecting the laser machine to the programming office through network	saving time in trasfering the fabrication programs to machine using manual SD cards.	saving manpwoer by no need for programming officer to transfer programs to laser machine		
degreasing the sheet metal at higher water temperature	reducing the amount of chemicals needed for degreasing			
using plasma cutting machine instead of gas cutting torch	reducing the time needed for cutting the work piece from 20 minute to 10.	reducing the toxic gases emissions from the torch flame	saving the start up defect generated from calibrating the torch flame	

Table 4

2.4- Socially responsible operation.

The big green company chemical waste generated in three locations during productions.

- 1- At degreasing process for the electrostatic powder painting
- 2- The use of thinner in copper pipe CNC bending for cleaning inner surface of pipes
- 3- At the commissioning using the freon gases for charging the air conditioning equipment's

The process for control on use and disposal of chemical waste incorporate two actions:

- 1- Finding nonchemical green alternatives operations methods to reduce or eliminate the use of chemical material.
- 2- Following the chemical material supplier recommendations.

Alternative's solution plan prepared to show the recommended action with the saving on chemical quantity waste.

chemical waste alternative plan			
chemical waste	green alternative	chemical saving	negative effect on cost
degreasing chemical	using water at higher temperature	reducing the amount of chemical to 50%	no extra energy cost, since heating water using sunlight cells
thinner for pipe cleaning	replacing hard copper pipe with semi anneled copper pipe.	saving the thinner consumption by 100%	higher price copper pipe, but almost compensated by the saving from saving thinner and saving manpower
freon gas for charging	no alternative	no saving	

Table 5

With the remaining chemical which still in-use in production, a disposal procedure plan using the chemical supplier MSDC recommendation to be prepared with a periodic review for either:

- 1- finding new alternatives to replace the chemical,
- 2- updated supplier recommendations for MSDC and disposal.

ISO 14001 (environmental management system, 2015) and ISO 45001 (Occupational health and safety management, 2018) requirements implemented in the company to insure the systematic and standardized approach in updating the chemical waste and safety best practices and replacing traditional work procedure to a greener alternative.

Risk identification, assessment, control, evaluation plan with complete responsibilities created and implemented to insure the continuous safe work environment and the proper control on all hazardous practices

3- Conclusion

Big green company working in a very competitive and challenging market. To increase the competitiveness of our air conditioning product in the market, a solution to

- Keeping and protecting the 8 resources
- increase the value of product delivered to customer and
- reducing the cost of product/productions.

main added value to customer would be by avoiding product with defects, ensuring a reliable product, and ensuring reasonable short delivery time.

Using DMAIC and the appropriate tool for the defining and analysis (SIPOC, flow chart, FMEA, 5-Why, Ishikawa diagram...) can help in finding appropriate and state of the art solutions.

Wastes are the main killer for any industry, and it can be hidden in all process in the production with different nature. Finding and eliminating them, can help the company in increasing revenue and reducing delivery also to have a competitive price to penetrate the market.

A lean 6-sigma committee represented by persons from different departments (quality, production, material, procurement, R&D) meeting continuously and whenever client negative feedback or challenges arise, with the goal of enhancing current process by finding more cost-efficient solutions and new state of the art manufacturing equipment's will surely allow the big green for more grow.

Applying international best practices for green production and environmentally friendly activity and using the stat of the art and 21st century tool, can support the company in surrounding society.

4- References

- ISO 14001 environmental management system, 2015
- ISO 45001 Occupational health and safety management, 2018
- Summers, Donna C.S (2011). Lean Six Sigma: Process Improvement Tools and Techniques. One Lake St, Upper Saddle River, New Jersey: Prentice Hall. ISBN 978-0-13-512510-6.
- Barbara Wheat, Chuck Mills, and Mike Carnell. Leaning into Six Sigma: The Path to Integration of Lean Enterprise and Six Sigma. Boulder City, Colorado. 2001.
- David Ingram, 2019. Why is organizational structure important?. Retrieved March 12 2019 from <https://smallbusiness.chron.com/organizational-structure-important-3793.html>
- Kristina Lopienski. (August 14, 2019). How to Calculate the Reorder Point with the ROP Formula. Retrieved from <https://www.shipbob.com/blog/reorder-point-formula/>