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# Quality Management to continuous improvements in process of Ready Mix Concrete production

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**Abstract.** The key benefits from Ready Mix Concrete (RMC) are good quality, lower Life cycle cost, the speed of work and friendliness of environment more than the site mixed concrete, but when the quality of RMC is below threat of several causes resulting poor quality or useless concrete. We will lose all advantages of RMC that we mention before. Therefore, this study investigate the using of Quality management to improve the process of company to produc (RMC) in batching plant and study the impacts of Quality Control (QC), Quality Assurance (QA) on the company by introduce them to the process in order to make improvements on current Quality system to make it continuous improvements. The idea of the work depends on finding the relationship between the Project Management Body of Knowledge (PMBOK) Guide and the quality management by combining them together in process to achieve the best results as soon as possible, higher productivity, less rework, increased customers satisfaction, increased profitability and sustainability by finding company's problems and achieving it through guidelines and instructions of PMBOK Guide also the principles, the tools and the techniques of Quality Management. In order to achieve that, we have investigated three main points: the first one is gathering information to identify the current quality system, the second is identifying and analyzing of these problems and the third is finding solutions based on the principles of management. With a view to manage the process of production, the author used many techniques and tools for management such as Flow Chart for a process, Ishikawa diagrams to define seven main group of problems, Check Sheet to the number of problems occurrence, the FMEA Analysis for thirty-five problems, 5 Whys Analysis to find sources of the problems, Solution effect Analysis to propose the possible solutions. The most important results from this study are the main reasons for the absence of management methodology in the company which is a defect in the Quality system (structure of company, procedure, and resources), lack of management experience and communication and lack interest of Total Quality Management in management methodology. The researcher found lacks in the thoughtful scientific methodology for the management in process of production, therefore the developing of the system of production in the RMC plant is to build a methodology based on a guide of Project Management Body of Knowledge 5th edition because of the maturity level of the project management knowledge areas.

**Keywords:** Process, Product, Quality Management, Quality control, functional Manager, Flowchart, Ishikawa diagram, Check-sheet, FMEA Analysis, 5 Whys Analysis, Solution effect analysis, Quality Assurance, Manufacturing Defect

## 1. Introduction

In business, engineering, and manufacturing, quality has a pragmatic interpretation as the non-inferiority or superiority of something; it has also defined as being suitable for its intended purpose



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(fitness for purpose) while satisfying customer expectations. Quality is a perceptual, conditional, and somewhat subjective attribute and may be understood differently by different people [1]. The adoption of a quality management system is a strategic decision for an organization that can help to improve its overall performance and provide a sound basis for sustainable development initiatives [2]. The standardization, further pioneered by Deming and Juran later in the twentieth century [3]. Deming idea was that the quality's aim must be the customer requirements as he shows it later by his 14 principles for management. Then Juran contribution by adding tools for the area of management knowledge. The set of the activities can be rudimentary and very complex. The maturity of the process and the kinds of activities included in the process can have an enormous bearing on the resultant quality of the product, the establishing such structures of activities naturally creates by Marcel Dekker who found an opportunity to establish feedback loops both internal and external around each process in the company. Both the control and improvement of processes rely on the use of statistical methodology. The gears of sand, gravel, cement and maybe extra additives necessity are delivering to the construction site as one material called concrete. In addition, the source of spotless water is essential with the concrete batching process. Ready Mixed Concrete (RMC) can describe as a type of concrete provided in the plastic state needing no more treatments earlier actuality sited in the work site, which it is to set and strengthen. There are numerous codes provide procedures aimed at execution standards and examinations for approval. The products testing and inspection are the main apparatuses of quality control. Similarly, testing and inspection of raw and fabricated materials are essential. The quality of the concrete product has an actual straight influence on the durability and the strength of the structure of the construction. Therefore, it is an advantage from producing concrete in Ready Mix Concrete batching plant.

## 2. Literature review

The quality process improvement rests on a base of certain fundamental concepts. In this part, the author will review the definitions of the study concepts used in the research:

### 2.1 Process

Set of interrelated resources and activities which transform inputs into outputs, resources may include personnel, finance, facilities, equipment, techniques and methods [4].

### 2.2 Product

Result of the activities or processes (product may include service, hardware, processed, materials, software or a combination thereof). The term product is use throughout this International Standard. It's can be tangible or intangible or a combination [4].

### 2.3 Quality Management (QM)

Quality Management has many definitions for each people. W.E.Deming "Quality should be designed into both product and the process, it is the expected degree of homogeneity and reliability at the lowest possible cost and matched to market requirements" [5]. Joseph Juran said that the quality is the fitness of product and service for use" [6]. Philip B. Crosby defines quality as a conference the requirements. [6]. In addition, Quality means the best conditions for customers, such as the selling price of products and actual usage [8]. Pyzdek produced five principal procedures to defining quality which is have been viewed by Garvin as follows [5]:

- 1) Transcendent "Quantity cannot be defined, but you can find a way to know what it is".
- 2) The product according to quality differences, quantity located to variances for products.
- 3) The User is according to the ability of the quality to meet the requirements.
- 4) Manufacturing is according to tools quality to meet needs [9].
- 5) The Value is according to the level of fineness at the best satisfactory price and control of cost variability.

#### 2.4 *Quality Control(QC)*

It's the monitoring and inspection the process results to evaluate if they meeting with associable standards of quality and define ways to remove causes of non-conformance performance [10].

#### 2.5 *Functional Manager*

He is someone (person) with management authority over an organizational unit within a functional organization [11].

#### 2.6 *Flow Chart*

It is type of diagram or illustrative exemplification explains the solutions archetypal to the problems. It's help to understanding the process and managing it for numerous fields [12]. Its tool to understand the complexity of the situation how several entities and systems relate to each other. The diagram shows the bigger picture and the context of a project or situation [13].

#### 2.7 *Ishikawa diagram*

It is the tool of quality management use to help to identify, explore and display all possible causes related to a problem and to furthermore discover the root causes and show dependencies amongst causes and underlying drivers. In other words, it is the graphic illustration of the relationship between a problem or goal (the effect) and its underlying contributors [13].

#### 2.8 *Check-sheet*

Which are also known as tally sheets and may be use as a checklist when gathering data.

It is use to organize facts in a manner that will facilitate the effective collection of useful data about a potential quality problem. They are especially useful for gathering attributes data while performing inspections to identify defects [11].

#### 2.9 *FMEA Analysis(Failure Modes and Effects Analysis)*

An analytical procedure in which each potential failure mode in every component of a product is analysed to determine its effect on the reliability of that component and, by itself or in combination with other possible failure modes, on the reliability of the product or system and on the required function of the component; or the examination of a product [11].

#### 2.10 *5 Whys Analysis*

An effective technique when you want a systematic way to lead a group to understand the actual reasons why a problem is/has occurred. It could also be an essential tool in all your information gathering activities that require a deeper understanding [13].

#### 2.11 *Solution-effect analysis*

An inversion of the fishbone is the solution-effect analysis where you place the possible solution in a box on the left, draw a horizontal line from it towards the right, with further lines leading from this to display possible consequences and effects [13].

#### 2.12 *Quality Assurance(QA)*

The process of auditing the quality requirements and the results from quality control measurements to ensure that appropriate quality standards and operational definitions are used [11].

#### 2.13 *Manufacturing Defect*

An imperfection that causes a product to fail to meet the manufacturer own specifications. Manufacturing defects occur when the raw materials or components used in making the product contain unacceptable flaws, or there are assembly mistakes [14].

### 3. Case study

In the research, we will review the basic problem of Ready Mix Concrete companies that are non-compliance, apply Quality Management to the required degree, and apply only the fraction of quality standard to match with regulations, which are led to the fact that most Ready Mix Concrete companies suffer from the following points:

1. There is no clear Quality Management system in the company.
2. There are problems in the processes of production.
3. Concrete production process needs continuous improvements and updating process.
4. Ignorance of the tool makes the company competitive which is Total Quality Management.

There is no generally single accepted definition of quality [15]. It should be design into both product and the process; it is the expected degree of homogeneity and reliability at the lowest possible cost and matched to market requirements. It is fitness for use or it is the usefulness of product and service [16]. These problems are causes the lack of completion the producing Ready Mix Concrete within the planned time, allocated budget and required quality. The need for RMC become less than before that makes the companies of RMC so competitive to keep its positions in the market by focusing on quality management. The author will focus on adapting modern principles to management. In our case study, we will take AL-Senaf Company of (RMC) production. From the data that we got it from the company and interviews with the head of the company, employees and the field visiting the plant work site. The researcher noticed that in the past two years a production rate has reduced from 1000 to 200-100 cubic meters per day; as a result, the company began to lose skilled employees. The company were deal with a number of reliable contractors began to lose them. It is beginning to lose money on maintenance the parts of the manufactory and equipment that transport concrete to the work site and Lose in money due to materials and fuel losses because equipment aged. Therefore, there is a need to predict the expected these problems or failure in the process based on actual information from this company to analysis it and find solutions. The plant is a copy taken from MB-100W Stationary Concrete Batching Plant from the Turkish company Meka concrete batching plants. From the company's data, interviews with the company's head, employees responsible for the production process. The author found that stationary concrete batching plant is dry mix system and the technical information is as shown in the table below.

**Table 1.** Technical information of the concrete batching plant

No	Technical Data	Value	Unit	Employee	No
1	Capacity	80	m <sup>3</sup> /hr	Civil Engineer	2
2	Mix Tape	DRY	--	Water Treatment Engineer	1
3	Mix Capacity	1.5	m <sup>3</sup> /min	Mechanical Engineer	1
4	Aggregate Compartments	4	Quantity	Air Conditioning Engineer	1
5	Aggregate Weighing Conveyor	800x14.350	mm	Mechanical Technicians	20
6	Mixer Feeding Conveyor	800x29.000	mm	Electrical Technicians	5
7	Aggregate Weighing Capacity	2.200	kg	Supervisor	6
8	Cement Weighing Capacity	500	kg	consultative lawyer	1
9	Water Weighing Capacity	250	kg	consultative Accountant	1
10	Additives Weighing Capacity	20	kg	Hygiene worker	1
11	Cement Screw Conveyor	3	No	Officials administration	4
12	Cement Silo Capacity	100× 3	Ton	Guardian man	2

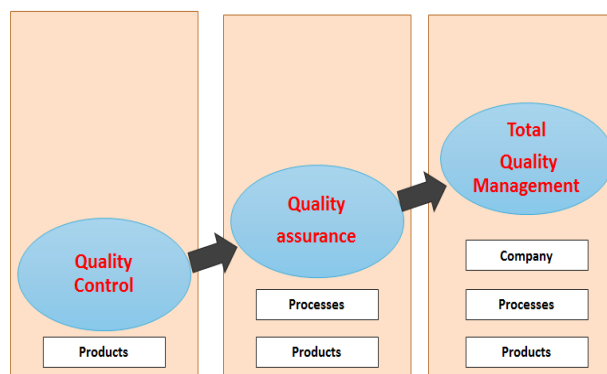
Moreover, the main parts RMC batching plant were aggregate and gravel stocks, batching station, conveyor belt, admixtures tank and scale, storage bucket and discharge gate, cement silo and cement scale, water tank and water scale and control centre. The company product all types of concrete or any type of concrete according to orders but the main products are: Ready Mix Concrete, pre-stressed concrete, precast members and concrete piles.

#### 4. Quality Management

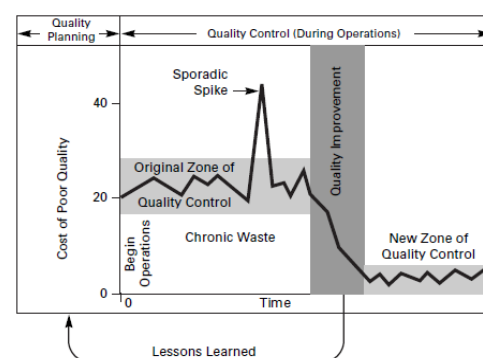
It contains the procedures and actions of the company performance which define the rules, aims, and responsibilities of quality thus the process drive fulfil the requirements aimed at which it was accepted. It is use rules and processes to carry out within the process setting, the quality management system of the company fit with the process improvements activities as undertaken on behalf of the performing organization. Quality Management working to guarantee that the process desires including product needs are met and validated. It is conformance the requirements of customer. According to the PMBOK Guide Quality Management, procedure is as follows:

##### 4.1 Plan for Quality Management

The reference of quality for our plan of management is PMBOK Guide (the fifth edition). It is desirable to investigate possible improvements in the drying efficiency in terms of efficiencies [18]. Plan for QM is the procedure of recognizing necessities of quality for the process deliverables, detailing how the process will validate acquiescence with quality requirements to deliver supervision and coordinate on how quality will achieve and confirm through the process. Plan for QM is start with identify the producer of production apply QC and QA by change the structure of company using Flow Chart diagram, then define and displaying the problems or failures in process by gathering data about the whole process of production Ready Mix Concrete and clarify it by using Ishikawa diagram to locate point of cause. Then we will identify the occurrence of problems by check sheet for thirty days, after that we will analyse these problems by FMEA analysis (detection, occurrence, severity and risk priority) and 5whys analysis. Then propose solutions for all problems by an inversion of the Ishikawa diagram, which called the solution effect analysis. Finally, the Flow Chart after apply them in process of production, and we will draw the whole process after applying QC and QA.



**Figure 1.** Quality control, Quality assurance.



**Figure 2.** Juran trilogy diagram.

##### 4.2 Perform Quality

To understand the quality performance we must identify the quality current system, therefore, author will start with the structure of the company, where the company structure is the functional type of organization. It is a grading where every member has the only one supervisor. Speciality persons, such as engineering, accounting, production and marketing, collect the members of teamwork. The functional manager is an entity who can role the management rule with the functional zone of the production, the administrative also human resources role, finance and the account or the procurement. Therefore, the author changes the structure of the company from the Functional organization to the Composite organization type as shown in table below:

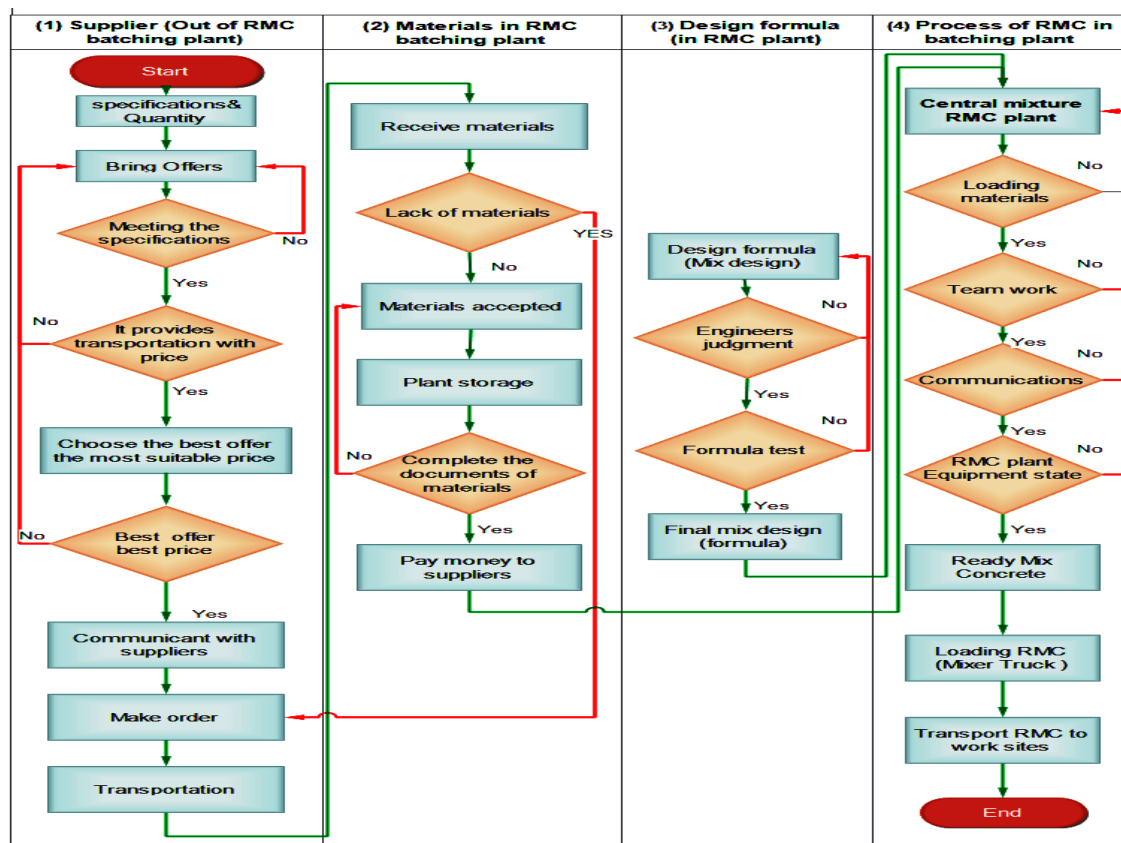
**Table 2.** Influence of Organizational Structures from Functional to Composite.

No	Project characteristics	Organization Structure	Functional Organization	→	Composite Organization
1	The authority of Project Manager		None or Little	→	High to nearly Total
2	The Availability of resources		None or Little	→	High to nearly Total
3	The responsibility of project budget(Manager)		Functional	→	Project
4	The role of Project Manager		Part of time	→	All time
5	Administrative staff of project management		Part of time	→	All time

Its mean that the company might manage a maximum of its procedure by the strong matrix, however, permit some work to manage by functional management zone. In a composite organization, the resources of the company related in the process of production. The project manager takes a countless deal of the authority and the individuality. The divisions can straight reporting to project manager or deliver different products to the numerous projects. In addition, some composite organization team members are regularly collocated, practical partnership methods frequently used to achieve the welfares of the work's team.

#### 4.3 Control Quality (*Quality Control in the process*)

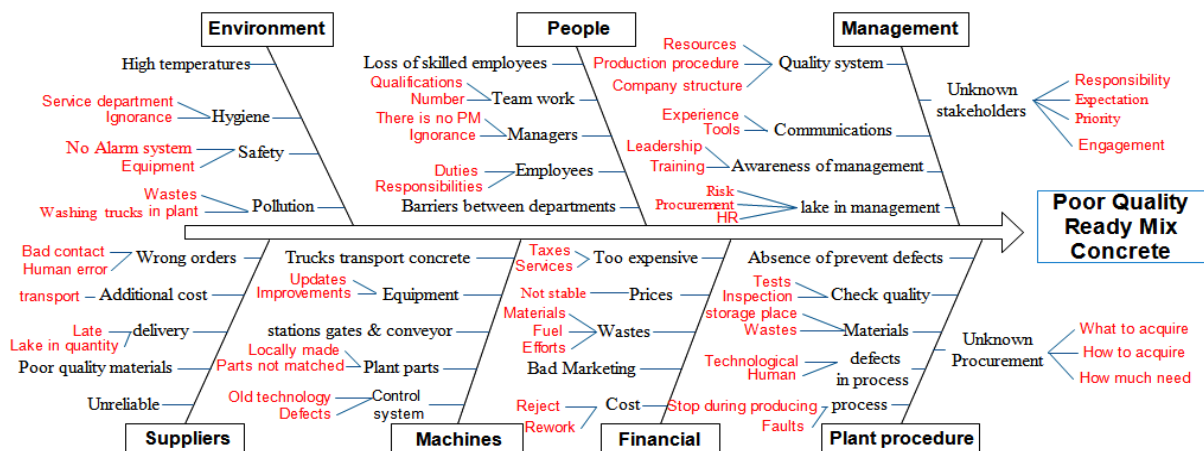
Quality Control (QC) is monitoring and inspection the process outcomes to evaluate if it is meeting with associable principles of quality which defines means to remove reasons of non-conformance standards. In addition, it is the company unit, which allotted responsibility for good quality. Moreover, it is the single of the fundamental three administrative procedures by the quality which can managed process, the second is quality planning and the third is a quality improvement as shown in Juran's diagram below which shows the mutual relation of these procedures [6]. We will use the Flowchart to descript the process, which is kind of diagram denotes an algorithm workflow by presenting the phases as strongboxes of numerous types and the orders by linking them by arrows. It is a procedure for documenting, designing, analyzing and managing the procedure in several fields [12]. To improve the effectiveness of the processes of the company that produces the service or products [17]. The process can be tangible, intangible or a combination [4]. Starts usually by materials, services we would like to purchase it from organizations, and suppliers then check these offers are in agreement with the specifications. The standard to accept the offer for the company is a price, not quality. The company then selects the best offer. After that, the suppliers will transport the materials to the plant and when it arrives it will be received without inspection just check the quantity is complete or not if there is a shortage of quantity the stakeholder will communicate with the supplier to complete it which always deliver late and poor quality. The materials will go into the company's stores. The paperwork is then will complete. On the other hand, the design and planning department will perform the mixing formula for the concrete after taking the judgment of the engineers into account. Then they are practically testing the formula if its success will use directly in production. Then the mixing phase in the plant where the inputs will be the materials from stores, additives materials, water and the mixing formula from design and planning department and the outputs is Ready Mix Concrete as a product. The process begins with mixing stations; notice that material losses are big on the ground. Then make sure that the team of work is ready to work as well as communications. Then the gates will open to the stations and the materials falling with the effect of it is weight then transport by conveyor belts to scale and cement transport by a screw feeder to the same scale to discharge gate to the mixture trucks to the customers.



**Figure 3.** The Flowchart of stationary batching plant.

#### 4.3.1 Fishbone or Cause-effect tool (Ishikawa diagram)

It is the graphic illustration of the relationship between a problems or goals (the effect), and its underlying contributors the root causes [11]. The fishbone or the cause and effect chain tool it is also sometimes called Ishikawa or root cause analysis, which is offer an optical diagram of the roots (the factors) that linked to a specific problem (the effect) and the best used while discovering a specified problem at an early or during stage of the analysis phase to dig deeper. It is assistance to discover, recognize, show probable reasons connected to the problem to discover the source causes and show dependencies of amongst causes and underlying drivers.



**Figure 4.** Ishikawa diagram indicates the problems.



The author used Ishikawa diagram to explore, identify and review all likely reasons linked to problems and to the additionally discover the root causes and show dependencies amongst causes and underlying drivers were the main categories of problems were Management, People, Procedure, Financial, Machines, Suppliers and Environment as shown in the figure below. The figure shows all causes related to problems of the company where they identify and display by main seven categories to which are be related to 34 secondary causes and the related causes are 1-4 for each one of 34 causes.

#### 4.3.2 Check-sheet

In order to record the number of occurrence of problems of plant the researcher used the Check-sheet table for thirty days (not all problems can measure, some of it cannot measure like quality system).

**Table 3.** Check-sheet of Ready-Mix Concrete batching plant for 30 days.

No	Defect type	10 days	10 days	10 days	Total
1.	Late delivery of materials or full quantity				4
2.	Additional cost (transportation & loading cost)				4
3.	Wrong orders due bad communications or errors				2
4.	Provide poor quality materials.				4
5.	The faults and stop the plant during production				7
6.	Wastes of materials and fuel				6
7.	Materials place storage				4
8.	Defect in test & inspection				4
9.	Gates & conveyor defects changes quality				3
10.	Equipement transpot concrete.				3
11.	Bad communcatinos				7
12.	Lack of awareness of management				6
13.	Loss skilled employees				3
14.	Lake of numbers team of work				6
15.	Lake of qualifications team of work				4
16.	Employee's awareness responsibilities & duties				4
17.	Bad Marketing and service after sale				4
18.	Cost loss because reject, return, or rework.				3
19.	Prices not stable (materials, fuel and products)				4
20.	Services (electricity & water) & taxes (expensive)				3
21.	High temperatures				6
22.	Environment issues due to the wastes				5

In the table above the biggest occurrence number the faults or stop the plant during production and bad communications and awareness of management.

#### 4.3.3 FMEA ANALYSIS

It is the systematic way to monitoring, reporting, and access the reasons and the impacts of kinds of constituent defects and it includes the quantitative evaluation of the important results of the defect type [11]. The obstacles and the problems will analysis in expressions of the occurrence probability, the detection ease and the significant influence on the entire process of the company. The author uses this method of analysis to prioritize possible defects depending on the detection, occurrence, and severity management the problems.

$$PPN = X_1 \times X_2 \times X_3 \quad (1)$$

Where:

$X_1$ = Ease of detection

$X_2$ = Probability of occurrence

$X_3$ = Severity of problem

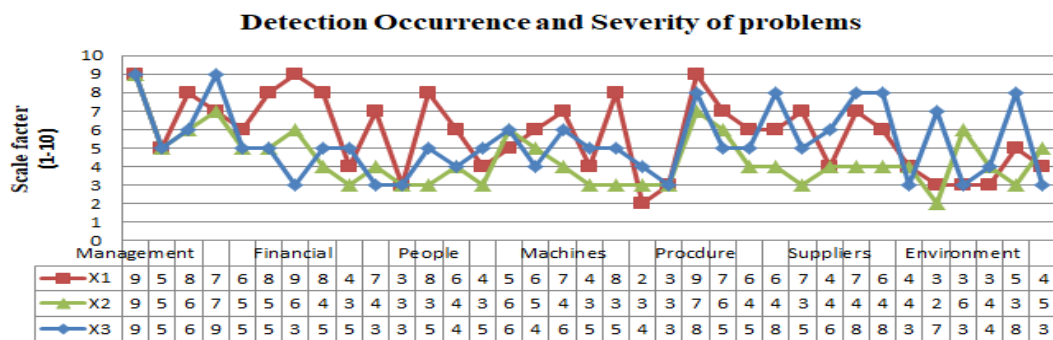
PPN= Problem Priority Number

The Problem Priority Number (PPN) will calculate using by multiplying detection by occurrence by Severity of problems. Higher PPN is the most significant problem of the company [20].

The scale number is from (1) to (10) where 10 the biggest priority or impact.

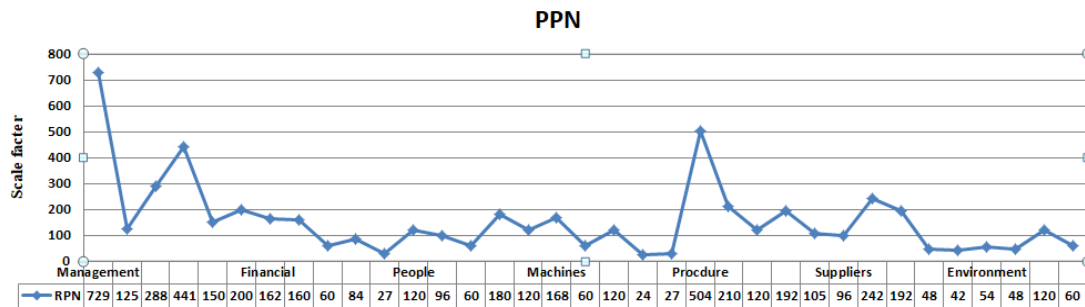
**Table 4.** FMEA analysis for Ready Mix Concrete.

No	Subject	Problem	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	PPN
1	Management	Defect in Quality system	9	9	9	729
2		Unknown stakeholders	5	5	5	125
3		Lack awareness of QM	8	6	6	288
4		Experience Communicat	7	7	9	441
5		HR management	6	5	5	150
6		Risk management	8	5	5	200
7	Financial	Wastes due to defects	9	6	3	162
8		Bad Marketing	8	4	5	160
9		Reject or Rework.	4	3	5	60
10		Prices not stable	7	4	3	84
11	People	Services & taxes	3	3	3	27
12		Loss skilled employees	8	3	5	120
13		Qualifications of worker	6	4	4	96
14		Barriers & departments	4	3	5	60
15	Machines	Numbers of Team Work	5	6	6	180
16		Responsibility & Duties	6	5	4	120
17		Old technology & C. S	7	4	6	168
18		The Plant locally made	4	3	5	60
19	Procudure	Gates & conveyor defects	8	3	5	120
20		Updates of process	2	3	4	24
21		Equibment transpot con.	3	3	3	27
22		Stop during production	9	7	8	504
23	Suppliers	Wastes materials & fuel	7	6	5	210
24		Materials place storage	6	4	5	120
25		Defect Test & Inspection	6	4	8	192
26		Absence prevent defect	7	3	5	105
27	Environment	Unreliable	4	4	6	96
28		Poor quality materials	7	4	8	242
29		Late delivery&quantity	6	4	8	192
30		Additional cost	4	4	3	48
31	Environment	Wrong orders	3	2	7	42
32		High temperatures	3	6	3	54
33		Hyigien	3	4	4	48
34		Sefety	5	3	8	120
35		cleaning trucks inside	4	5	3	60



**Figure 5.** The Detection, Occurrence and Severity of problems.

The detection evaluates the real opportunity of you finding the deficiency before happening. The scale number (1) is meaning we have wide controls on finding the deficiency. The occurrence probability evaluates the real opportunity to the failure mode appears (the bigger number means a higher opportunity). The severity evaluates the likely loss or damage that might occur during the process of production or due to human usage, (the bigger number means a higher possible loss).

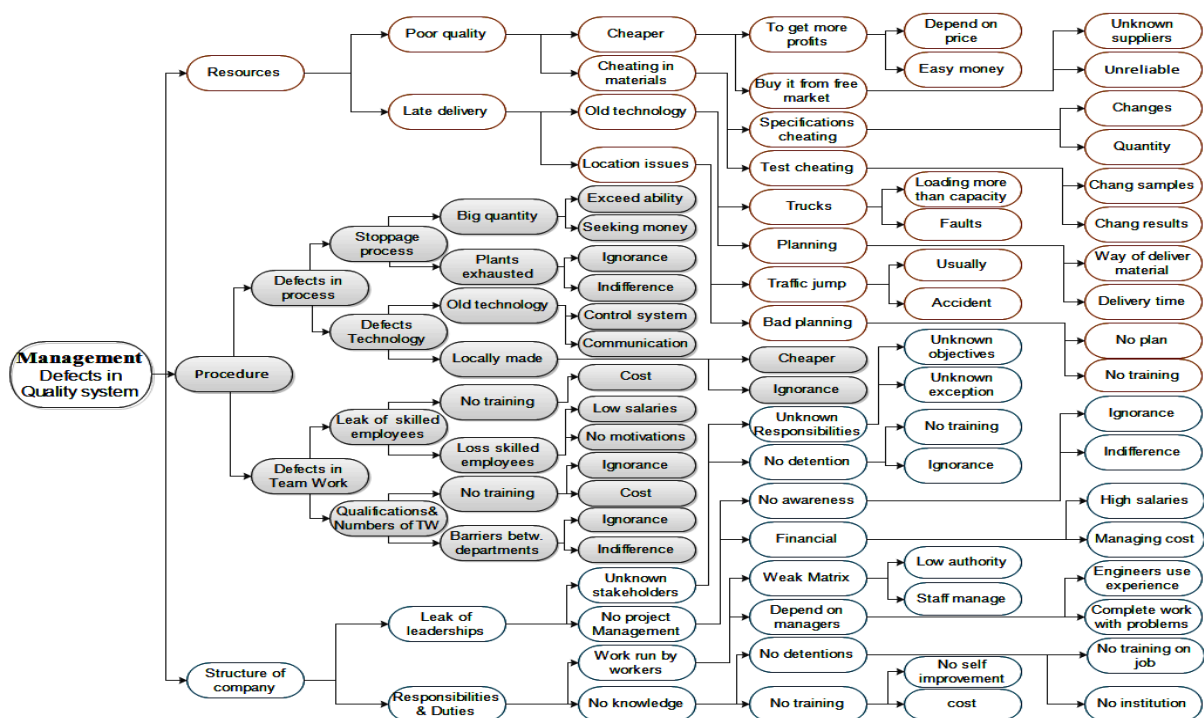


**Figure 6.** The Problem Priority Number.

In the tables above, the author used the number of occurrence of problems from check sheet results and multiplying it by detection and severity to give, as risk priority number of the results was the biggest numbers was for the defects in the quality system (729) as shown in figures below.

#### 4.3.4 5 Whys Analysis

An effective technique when you want a systematic way to lead a group to understand the actual reasons why a problem is/has occurred. It could also be an essential tool in all your information gathering activities that require a deeper understanding [8]. The author used why 5 analysis to find sources of the problems where the sources were as shown in the figure below:



**Figure 7.** The 5 whys analysis for Management /Defect in Quality system.

The author used a systematic way to leads to understanding the real reasons why problems are occurred in the plant for the most important point according to the outcomes of FMEA Analysis that

were the defect in the quality system. Based on Quality tools to meet requirements [13]. The figure above showing the results of the 5 why analysis to manage the defect in the quality system of the company. The sources of problems are unreliable or unknown suppliers, deception or change in specifications and quality, manipulation of the samples and results of tests, errors in planning for the way of the products delivery, errors in plan of delivery time, lack in training and development plan, ignorance loss of the skilled staff due to low salaries or cost. In addition, there is no project manager, producing with errors and defect in the company structure, low authority and lack of leadership and training programs on works.

#### 4.3.5 Solution-effect analysis

An inversion of the fishbone is the solution-effect analysis where you place the possible solution in a box on the left, draw a horizontal line from it towards the right, with further lines leading from this to display possible consequences and effects [13].

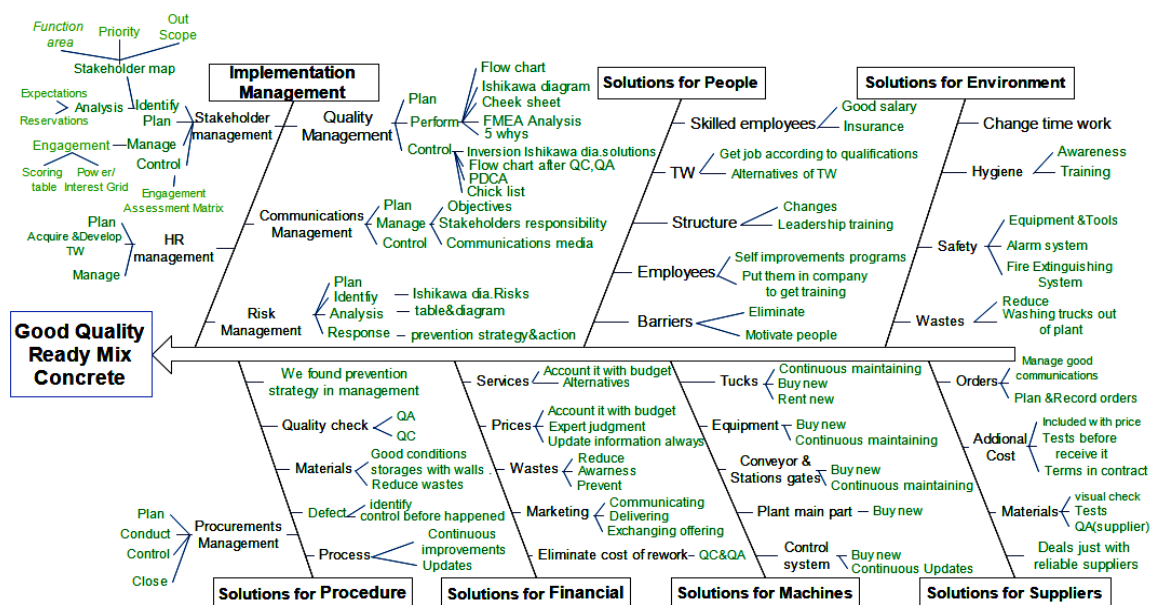


Figure 8. The solution-effect analysis.

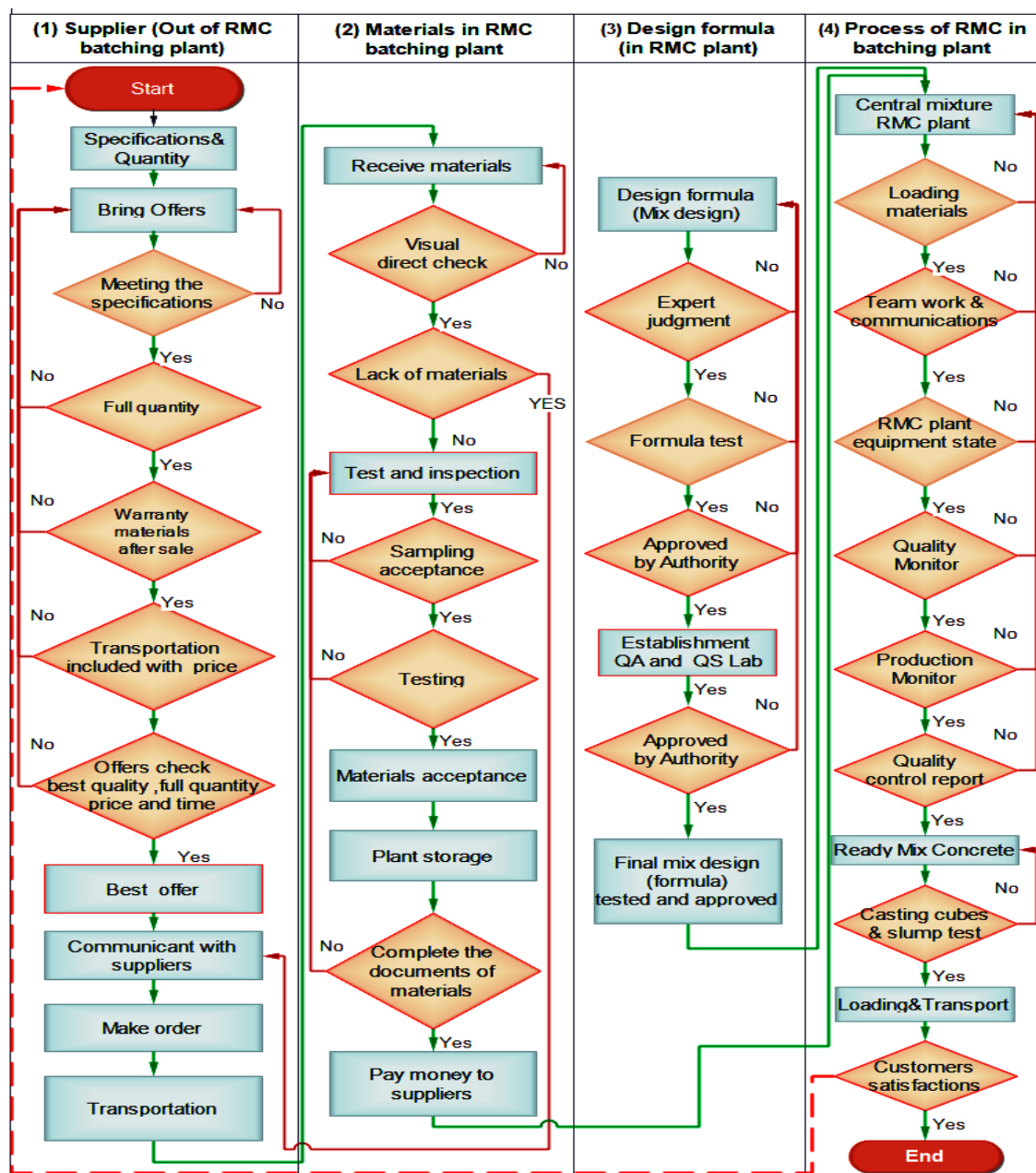
The figure above shows what the researcher proposed as solutions to all problems in the company. The researcher suggested (1- 4) solutions for each problem, some of them would be applied through the quality control and quality assurance. In addition, the several tools and techniques that author used it before, help to cover the other knowledge areas like human resource, communications, procurement, risks and stakeholders in future to reach Total Quality Management. The quality control deals with products therefor when the author applies quality control found:

The product enters the inspection and testing department to the quality control team where the results of this process are three cases:

1. The first is a mandatory report on the quality control and production process.
2. The second is product conforms to the specifications then delivery.
3. The third is the product not conforming to specifications thus resulted in four cases:
  - a. Accepted with permission then accept request and report.
  - b. Repair request and report then return to process.
  - c. Type change: the requested change and report then return to process.
  - d. Reject products then reject report then disposal of the products.

## 5. Quality Assurance

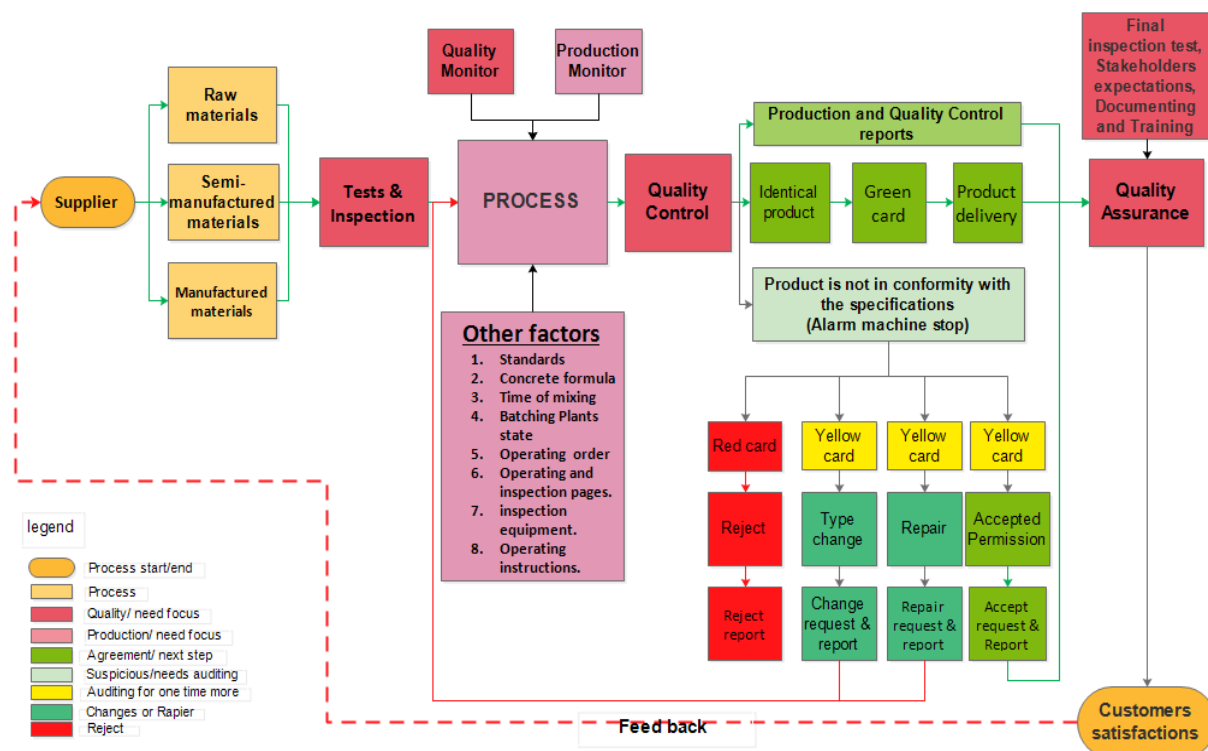
It is the procedure of predicting the whole process execution on a good foundation to give sureness that the process will comply to the suitable standards of the quality, it's also, the company unit that is allotted the responsibility to assure the quality [10]. It plays an important role in the maintenance of quality-processed products at levels and tolerances acceptable to the consumer. It also assures meeting with government regulations, reducing the probability of spoilage, minimizing the cost of production and raise the product value [21]. The systems of quality will deliver the base to meet with customer's expectations, satisfaction, motivation the team of work and repetitive improvements. The prevention action of the defect exists in the quality assurance which is different from the detection of defect and rejection of defect in quality control where has been mentioned before as it is focusing on quality in the earlier level of the process.



**Figure 9.** The Flow chart of Ready-Mix Concrete plant after applying QC and QA.

It is deal with process and products in our case as following:

- From the beginning, the materials must be good quality, complete quantity and delivery on time, price included the price of transportation and loading (all these topics must be establish as terms in the contract with the suppliers).
- The basic criterion for accepting the offer must be quality, not price and quality assurance of the material by the supplier.
- Put monitors production and Quality monitors in a process and take into account many other factors (team of work, communications, equipment and quality and production reports) as shown in flowchart and figure below.
- Inspection and test materials arrival to the plant a prerequisite for acceptance, complete paperwork and pay the money. The test outcomes show that when the quantity of discarded of the mix bigger the strength of compressive will reduce [22]. The temperature of the concrete is also a significant factor in making of good or poor quality concrete [23].
- Use expert judgment in the mixing formula then tests it practically, approved by the authority and establishes QA and QS Lab in a plant to test formula and products.
- Receive production and Quality Control reports making a final inspection and testing according to the quality assurance given [24]. Alternatively, focus on stakeholder's expectations, documenting and training.



**Figure 10.** The QC and QA in process of the RMC production.

The figure above showed the details outline of a process with full details about all process from the suppliers to deliver the product to customers and the service after that, where, we note changes in the process after introducing Quality Control into the process. As a summary, the figure presents the complete process, Quality Control role and Quality Assurance role in RMC production by showing the outcomes of each of its, the impacts and how it works.

## 6. Conclusions

The idea of combining PMBOK with Quality Management tools was the most effective choice that led to conclusions as flowing:



1. It is formed a clear path or practical steps that can be followed and use even by others in the process of continuous improvement in the production path and high quality.
2. The author (by following this combining path) was able to identify the problems in the process, the ease of detection, the probability of occurrence, the severity of the problem, the comparison between them (diagram), and finally the priority of the problem. The biggest problem was the defect in the quality system.
3. The highest value of the Problem Priority Number (PPN) is for the management (Defect in Quality system), where these PPN show us through the analysis that the problems from management come in first place (have the biggest influence on process). The problems of procedure in the second place, in third place are problems due to suppliers, and the rest to other problems.
4. Through, the analysis author could trace the roots and causes of the problems, how it is related, and it is an impact to do processed later which makes these improvements to the process continuous.
5. The changes in structure of the company to apply the improvements that introduced by author in process of production have countless influence on engaging everyone (suppliers, stakeholders, managers, team of work, customers) in process of RMC production, defining responsibilities, duties, and improving the process continuously to ensures the quality of the product to achieve consumers satisfaction and to makes feedback which achieves continuous improvements.
6. The most important results of the study were the main reason of the absence of management methodology in the company, which are the defect in the quality system, lack of management experience in management, communication and lack of interest, and the ignorance methodology.

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