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Evaluation of Quality Assurance Practices Across Project Departments of Manufacturing Industry

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Declaration and acknowledgement

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Secondly, I would like to express my acknowledgement to all 11 respondents for their worthy participation. This thesis would not have been completed without their time and honest feedback.

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Abstract

Emerging market preferences, dynamic product innovation and ever-changing PEST (Political, Economic, Social and Technological) scenarios have driven the requirement of staunch policy upgradation, constant research, and development and thus concoction of profit generating production units. Manufacturers, around the globe, are thus compelled to adopt project management tools and techniques that can ensure adaptability of process, time efficiency and cost saving, that too at a desirable quality.

Generally, project managers are more likely to converge all their efforts and endeavors towards timely completion of such projects with major focus on budget controlling and monitoring. Thus, completely or partially, undermining the contribution of quality assurance and control practices towards overall success of project.

As a result, quality assurance, have been confined to project file documentation, some ticking-boxes checklists and lip service. The objective of this paper is to re assert the importance of quality assurance throughout all the phases of project management lifecycle, and thus highlighting its contribution towards a successful project.

To achieve that, this paper presents literature work regarding incorporation of quality mindset in all five phases of project management. Research Survey Methodology is adopted, which examines the current practices in industry, understanding level of quality concepts among project managers and challenges faced through the experiences and feedbacks from 15 randomly selected project managers, across different age groups, industries, and countries.

The study finishes with survey findings, generated conclusions, and proposed tools for effective quality assurance as a reference for future use.

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Chapter 01

1. Introduction

1.1   Quality Assurance in Project Management

Dynamic market trends, ever changing customer preferences and emerging economic, environmental and sustainability policies have forced industries around the globe to adopt new business and manufacturing strategies. These strategies thus demand, implementation of effective project management tools and techniques, to ensure first mover advantage, cost savings and desired quality.

Projects not only foster innovation and strategic planning, but they also have an immediate impact on revenues. Their implementation strengthens the organization's technological skills and creates a foundation for future business success. (Kerzner 2017)

Superior quality of the project management improve organizational performance excellence, but their collective leverage is frequently misused. Project performance may be improved by using quality practices. Leaders who grasp project quality management will be more successful on individual projects as well as on a portfolio of investments for their businesses..(Kloppenborg and Petrick)

Evaluation of current practices in industries demonstrates that Project managers appear to adopt the 'iron triangle of cost, time and quality' (Atkinson 1999) but consider 'on time and budget' objectives as the only success criteria of project. Quality assurance is typically seen as a "lip service," with most documents containing "ticking boxes." Project managers recognize the risk of a project given its novelty, complexity, and purposeful design features, but they do not appear to prioritize the relationship between risk outcomes and the fundamental causes supported by project quality dimensions.(Basu 2014)

Therefore, this thesis explores the correlation between successful project management and implementation of quality assurance throughout the project's lifecycle. Literature review and practical research has been made, involving the

feedback and assessments from industry experts with proven experiences in project management.

Furthermore, practical recommendations as opposed to current practices have been formulated which can serve as a vital prerequisite for successful projects that lead to organisational competitiveness, improvement of performance, and sustainable growth.

Chapter 02

2. Literature Review

2.1 Project Management

As per *PMBOK Guide,* projects are defined as "temporary endeavors taken to create a unique product or service". That is why projects are treated as a separate function from operations because they are supposed to be temporary, able to quickly reach its defined goals and then, move on to next project. While on other hand, daily operations either manufacturing or services, are expected to be run in longer run in more sustainable ways.

A project is considered successful if it achieves at least four components: schedule, budget, performance, and customer satisfaction. In other aspects, successful projects are those that are delivered on schedule and under budget, function as expected by adhering to design criteria, and fulfill consumers. (Kloppenborg and Petrick 2002)

Project management is both a science and an art (Rita). The science of managing complex processes, decision making, predictive analysis, handling information and teams to achieve a common goal. While the art relates to how a project manager utilizes interpersonal and soft skills to steer, demand, strategize and organize a project to achieve success.

Managing a project has different styles and forms depending upon the type, organization, and objectives of the project.

The widely accepted approaches are:

1. **Predictive:** The most traditional type of approach that relies heavily on the project scope and planning. All the processes are predefined in earlier stages and then the team tries to adhere to these plans to achieve that goal
2. **Agile:** This type of approach works best where if the scope is still not defined and in emerging phase. Overall project management happens in increments to allow for any change or adoption of new scopes. This approach is called change-driven or adaptive.
3. **Hybrid:** A combination of both predictive and agile methodologies that varies depending on the project and organizational structure.

PMBOK, a widely used and recognized, handbook for the project management practices have developed a framework for easy identifying and following in terms of process groups and knowledge areas. It contains five Project Management process groups that are:
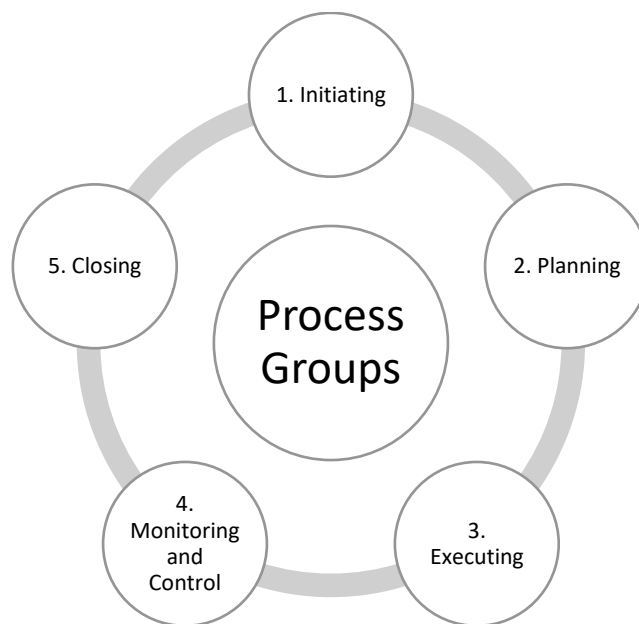
Figure 1- Project Management Process Groups

The project management processes are linked by specific inputs and outputs where the result or outcome of one process may become the input to another process that is not necessarily in the same Process Group.(Project Management 2021)

2.2   Quality Management

Quality Management and Project Management, both have a common shared goal, i.e., "meeting or exceeding customer satisfaction". As per *PMBOK* guide, quality is "the degree to which a set of inherent characteristics fulfill the requirements". Therefore, it can be concluded that quality is the focus of project management. It is the main duty of project manager to ensure that all the processes and stages of project lifecycle are completed in such a way, thus, to create a final product or objective, that meets the customer satisfaction or in other words, satisfaction of all relevant stakeholders.

Project Quality management consists of three main processes:

1. **Plan Quality Management:** Integrated in Project Planning phase, the main task is to identify the quality requirements, standards and expectation of all the relevant customer needs or stakeholders
2. **Perform Quality Assurance:** Integrated in Project Execution phase, it entails the auditing of quality requirements and control methods used, to ensure that appropriate
3. **Control Quality:** Record and monitoring of quality activities to analyze performance and suggest changes if necessary

2.3   Plan Quality Management

Quality Management Plan, like other planning tools, is developed by project manager in the planning phase, with the help of all inputs and feedbacks that are identified from the relevant stakeholders.

The major goal is to develop a management plan that document and records the following:

- the way the team will implement the quality policy
- the way the quality of both the project and the product will be assured during the project
- the resources required to ensure quality the additional activities necessary to carry out the quality plan

On the contrary, Quality Management is not just limited to a plan, some documents and checklists. It is a model that runs in parallel to traditional project management process groups. This model has been concisely explained, by T. J. Kloppenborg and J. A. Petrick, in relation to project management as following:

Table 1- Quality Organization

Quality Organization

Quality initiation
- Project Identified
  ⬇
- Authorization to proceed

Quality Planning
- Authorization to proceed
  ⬇
- Project Plan by all stakeholders

Quality Assurance
- Project Plan by all stakeholders
  ⬇
- Process and Deliverables

Quality Control
- Ongoing Qualification
  ⬇
- Final Deliverables

Quality Closure
- Final Deliverables
  ⬇
- Customer Satisfaction

2.4   Quality Assurance

PMBOK guide defines the term quality assurance as "the auditing of quality requirements and the results from quality control measurements to ensure that appropriate quality standards and operational definitions are used." Quality assurance is the third stage of quality organization following quality planning.

Quality assurance is applied throughout the project processes to ensure the successful completion of project. Thus, it is suitable for all kind of projects irrespective of its type, design, activity, or industry. The importance of quality assurance cannot be neglected as "It is not possible to produce a desired quality and maintain it consistently over a length of period unless adequate control is exercised at every stage". (Jain 2001)

Therefore, contrary to general perception, quality assurance is not just limited to control of measurements, tolerances, and quality indicators. Rather it is incorporated into all the stages and processes implemented in the project. Quality assurance entails adhering to standards, steadily improving project work, and addressing project deviations. Several aspects must be defined when incorporating quality assurance, including the expected level to be reached, qualitative indicators to measure the actual level accomplished per outcome planned, timeframe for assessing quality, mitigation actions, and roles and responsibilities of project team members. Meeting project criteria assures compliance with strategic goals and standards within the most cost- and resource-efficient manner, enabling chances for expansion and performance improvement.

To practice quality assurance, a business must establish and maintain a quality management (often referred to quality system) for its manufacturing system. A quality system includes, along with other things, a collection of established procedures for the organization's numerous processes. Implementing a quality system does not replace existing quality control functions, neither does it result in more inspection and testing; it just guarantees that the proper type and amount of verification is conducted when and when it is intended. A quality system encompasses quality control as its functional arm. Therefore, a quality system is often characterized as a QA/QC program.

In a nutshell, quality assurance is concerned with the avoidance of quality problems. It seeks to reduce the likelihood of producing kinds of mistakes, reducing the need for rework, repair, or rejection. (Chung 1999)

2.5   Quality Control

As per PMBOK guidelines, project quality control is summarized as "monitoring specific project results to determine if they comply with relevant standards and identifying ways to eliminate causes of unsatisfactory performance". This means making the right decisions and actions to keep the project under control. Hence names as Quality Control Activities.

Typically, this is an ongoing process, thus started and completed multiple times within a project. This process must be repeated until a final objective is met or product is accepted by corresponding customers.

The degree of achieving final objective of the project depends heavily on the results of quality control activities. A positive result as an output to a control activity dictates that project is on track and acceptable for quality closure.

Various charts and tools are used to keep the monitoring and control over the required project deliverables. Some of these are:

- Control Charts
- Flow Charts
- Run Charts
- Pareto Diagrams
- Plus Delta Model

For example, Control Charts can be used to monitor

- Project Cost variances
- Project Schedule variances
- Volume and frequency of scope change
- Errors in project documents
- Other process results

These tools help in a better visualization of data, trend, and correlations. Quality Control is performed mainly during Monitoring and Controlling phase of project. This helps Project Manager to have a clear understanding of current progress, quality of activities performed and their respective value addition to overall project. It also aide managers to make a timely action if any parameter or variable is out of project trajectory. Thus, proves to be a critical factor for taking timely corrective actions which in return impact overall project progress.

The scope of this research title is limited to Quality assurance practices; therefore, control phase is not discussed in depth. Nevertheless, each phase of a project quality organization, from quality initiation to quality closure, has its own significance and impact towards a successful project completion.

Chapter 03

3. Methodology

The goal of this research is to evaluate the current practices regarding the implementation of quality assurance during the project management process. This has been proposed by conducting an online survey through a research-oriented questionnaire, that would be circulated among the project managers across different manufacturing sites across different countries. Thus, presenting a research analysis and conclusions based on data from sample units randomly selected.

3.1   Research Method

As the main objective is to evaluate the quality assurance practices across the project management departments of manufacturing units, conducting an online survey has been selected as main research method. The reason being is to "provide a representative image of attitudes and qualities" of large set of people, or in our case, project managers. (Check and Schutt 2011)

Robert Yin, a renowned American social scientist, explained that when the research answers descriptive issues such as "what occurred" or explanatory topics such as "how or why did anything really happen," a case study is an appropriate method. He goes on to say that if one wishes to explore beyond that and respond to the issue of "how often something has happened," a questionnaire is the wiser choice. (Yin, 2012)

Joseph Check highlights the need of survey research that involves obtaining data from a representative group of people via their inquiry replies to internet surveys are frequently seen as less expensive, faster, and more convenient. However, internet surveys can sometimes cause challenges, particularly in terms of authenticity.. (Dillman 2011)

Parry defines validity as "A survey reflects what it professes to represent.". The author expands on the topic by introducing two forms of validity: external and

internal validity. External validity, as defined by Parry, is the relevance of the survey outside the study's boundaries.

Internal validity assures that what is theoretically intended to be assessed is measured. Finally, "validity can be compared with consistency: a study that produces consistent results across trials."(Parry and Crossley 1950)

3.2   Data Collection

Decision to choose the proper and relevant type of survey highly impacts the overall quality and meaningfulness of research. Two types of questions are generally administered, open ended and closed ended. Closed ended are those which provide preset number of responses among which the respondents can choose. Thus, it is used for questions that need to be steered well thus to not cross the limit or boundary of the scope of research.

Open ended questions ask the respondents to give an answer thus providing a blank canvas to user. These types of questions are administered to allow freedom to choose, provide feedback and suggestions as per their own choice. For our research purposes, therefore, a combination of open ended and closed ended questions are selected to respect the scope of project along with freedom to choose.

Self-Administered is the scenario in which respondents are able to fill out questionnaires in an unregulated context, according to Ellen Taylor Powell. Researcher administered questionnaires, on the other hand, are those that are presented by a researcher or investigator, usually in the form of an interview.(Taylor-Powell and Hermann 2000)

For our research purposes, therefore, self-administered method is preferred because it is cheap, time saving, can be used for many respondents and without the biasness and interpretations of author.

The sample questionnaire has been attached to Appendix-I for further reference.

Chapter 04

4. Survey Results and Analysis

Survey, carefully designed to draw a feasible conclusion, was circulated among more than 20 randomly selected project members in various parts of the world to ensure geographical diversity.

Among these 20 selected, only 11 showed willingness to participate and filled the survey. Rest of the members excused and some of them even never contacted back.

4.1 Sample Characteristics

The first part of the survey was dedicated to personal information in order to understand the characteristics of our samples. The first question was dedicated to request voluntary permission to mention sample name in acknowledgement of this thesis. Around 55% of participants allowed to mention their names, while rest choose the option to mention only if deemed very necessary.

The figure-2 shows the gender diversity of participants. The original invitation list contained 05 female members but only 01 responded. This less percentage of female project members shows the need of gender balance in project engineering and overall workplaces.
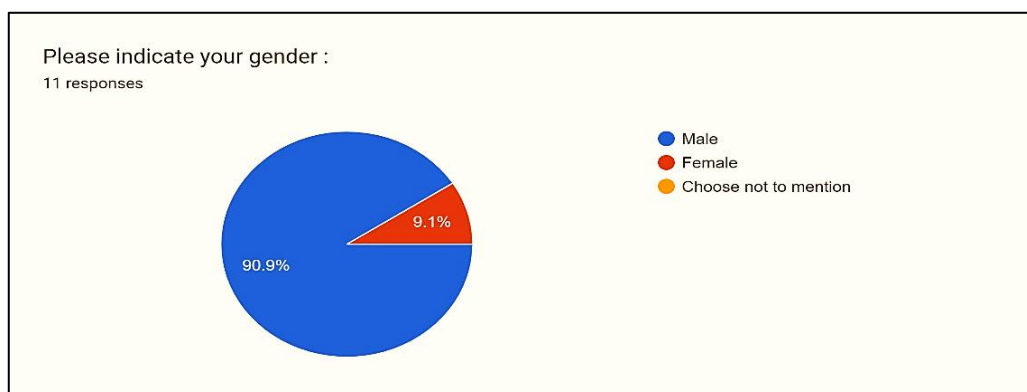

Figure 2- Survey Result Gender Percentage

Among the total, 55% of respondents are working on position title as "Project Manager". 36% are designated as "Project Engineer" or "Project team member". Rest is tilted as "Portfolio Manager".

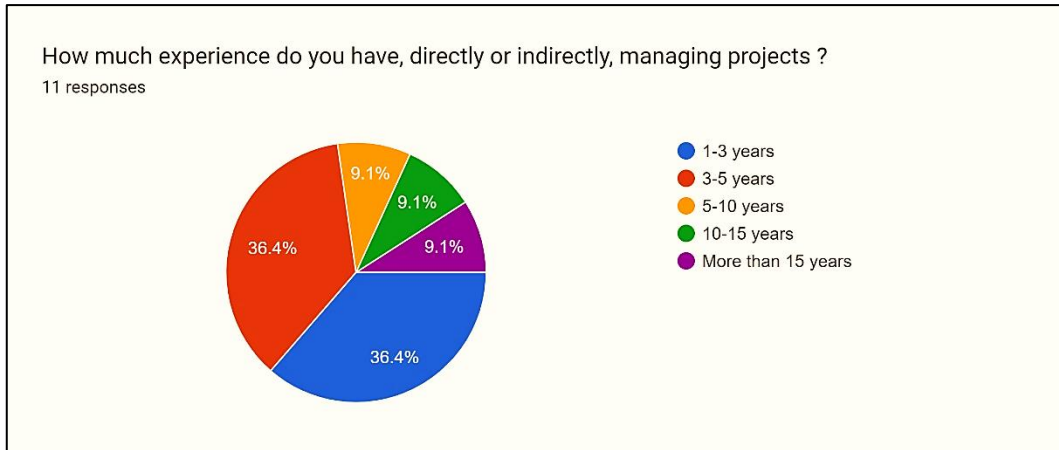In terms of working experience, the division of total years are as follows:

Figure 3-Survey Result Project related experience

Hence, majority of sample data belong to individuals with up to 05 years of experience in directly or indirectly, managing projects.

Figure 4-Survey Result Industry Experience
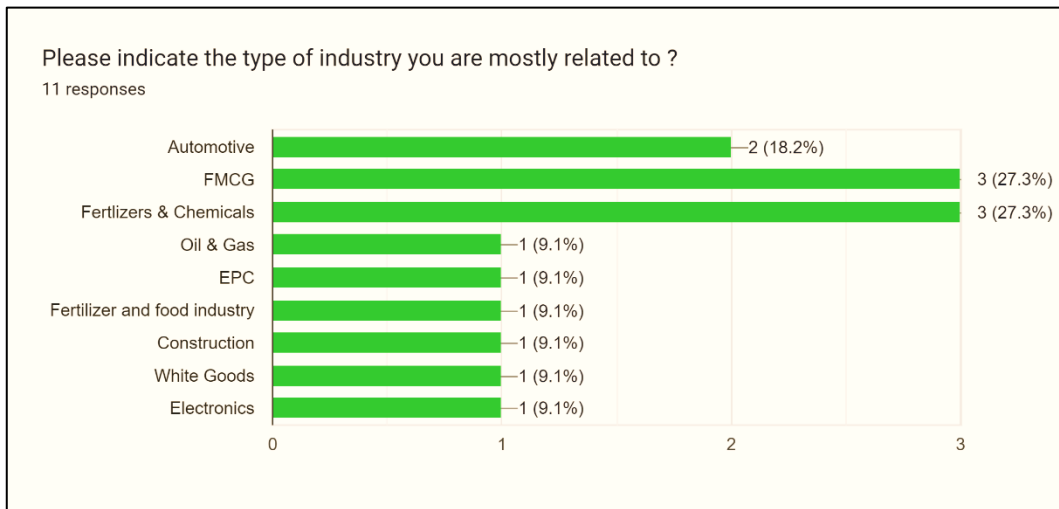
Figure-4 shows that respondents are spread across various sectors of manufacturing industry. The majority belongs to Fast Moving Company Goods and Chemicals sector. Second highest belong to Automotive sector which is also a crucial part of a manufacturing economy. Hence ensuring an impartiality in results and perception of data that is limited to a specific sector or manufacturing unit.

Last but not least, the demographics of respondents were scrutinized, within resources, in order to ensure unbiasedness of data due to geographical, political, cultural and economic reasons. Figure-5 shows the spread of respondents across different countries and continents:
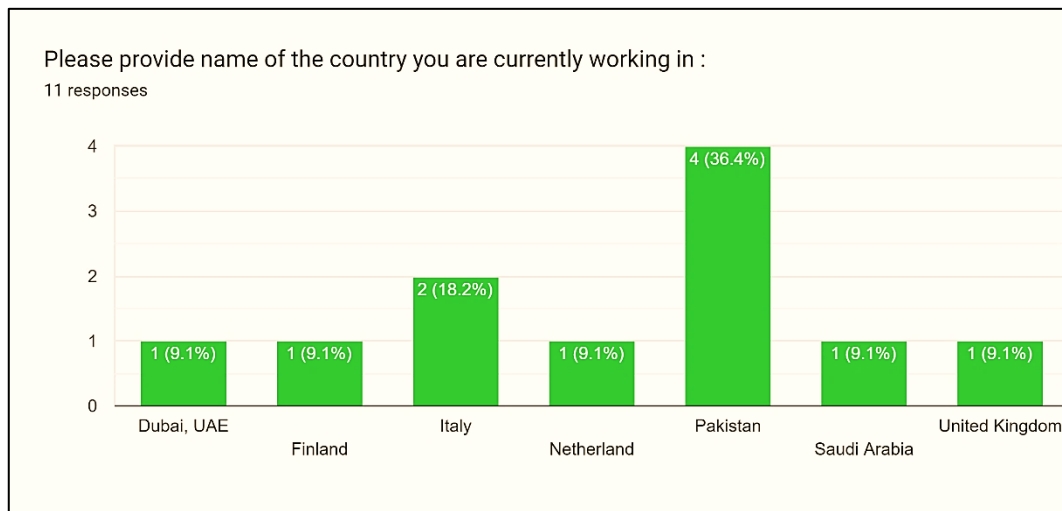

Figure 5-Survey Result Country

4.2   Results and Discussion

The second section of survey was dedicated to "Quality Assurance in your department", to understand the current practices that are performed inside the project departments.

Benchmarking a project management philosophy that is right and suitable for your industry is very crucial. The type of philosophy followed, or guiding material referred to within a department consequently defines the overall issues faced and success of project. Updating of company documents or guided material with latest publications are suggested to ensure implementation of

That is why, the first question was asked to evaluate what philosophies or guiding material are currently in practice within their departments:
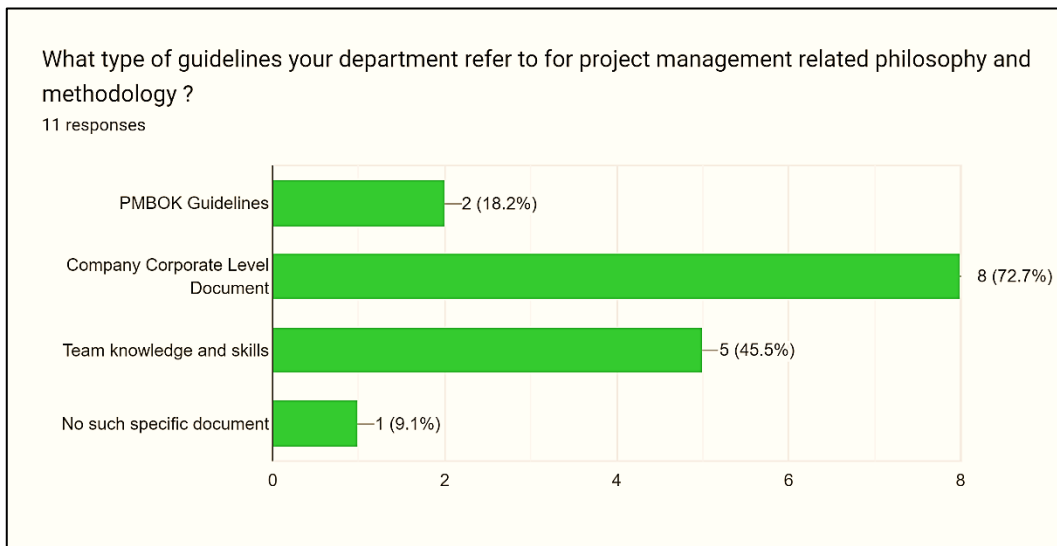
Figure 6- Survey Result Question 01

Analysis of answers clearly shows that most of the departments have a defined corporate or head office level document that are generally referred to for project management related methodologies. This clearly indicates the total dependence on the validity and applicability of that document towards each project. A document without any link to a standard guide or industry practice is just a book of personal experiences and perceptions.

Therefore, the periodic reviews of these documents from a competent authority are crucial to maintain applicability and updating of these documents as per latest practices.

The second highest percentage for dependence on team knowledge and skills is a two-way sword. A team that has been only working on same type of projects and processes is only limited to repeated actions and tasks. This hinders the possibility of process improvement and updating for a better outcome. That is why, research shows that a team having diverse backgrounds and experiences is more likely to perform better and deliver results.

In depth analysis showed that small scale industries having no dedicated corporate level departments tend to adopt PMBOK guidelines as their guidance material. Again, this helps to ensure the understanding of concepts and methodologies, but care should be taken to implement one process for all type of projects situation.

Hence in conclusion, a top reviewed document that is written as per standards and industry good practices, incorporating flexibility to practice innovation and process improvement, easy to understand and implemented, periodically

reviewed, and updated must be served as a guiding material for a thorough quality assurance plan within project departments of manufacturing industries.

What is considered as an ultimate success indicator for a project drives the overall process motivation and concentration. That is why candidates were asked to point out all these factors that are looked up to in their respective departments. Multiple selection of choices was allowed to ensure freedom to choose different factors:
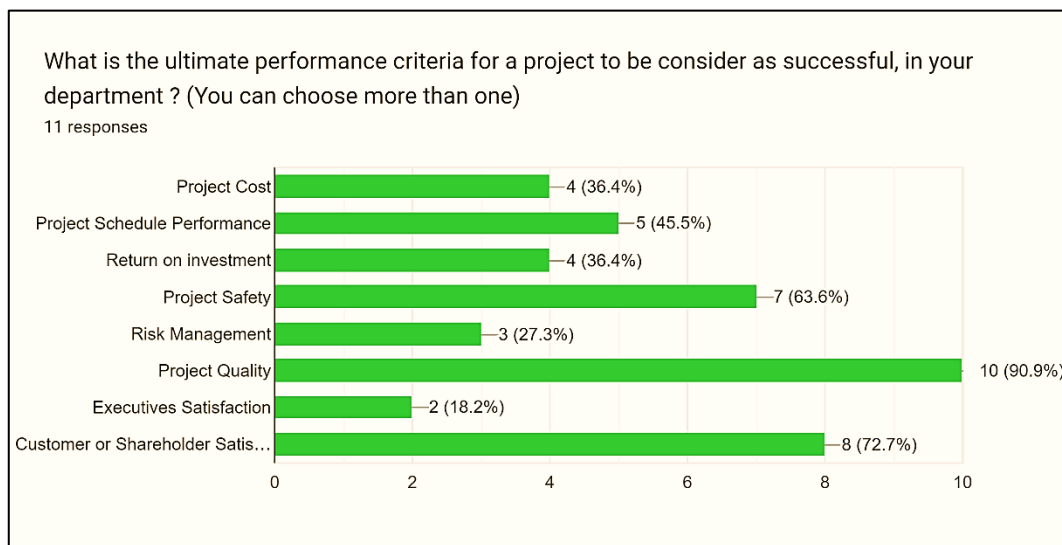
Figure 7- Survey Result Question 02

Data shows that majority of respondents believe that Project Quality is the top priority for a successful project. A project failing to compliance of quality expectations is a failed project irrespective of other factors. That is why the second highest priority was given to Customer satisfaction as this is closely related to project quality expectations.

Hence, this clearly indicates the importance of project quality and to ensure that, a comprehensive quality assurance plan

Figure 8- Survey Result Question 03

The aim of next question was to understand the responsible department of overall project quality assurance. As per figure 8, majority of answers shows that project department itself is the end responsible department for quality assurance. This practic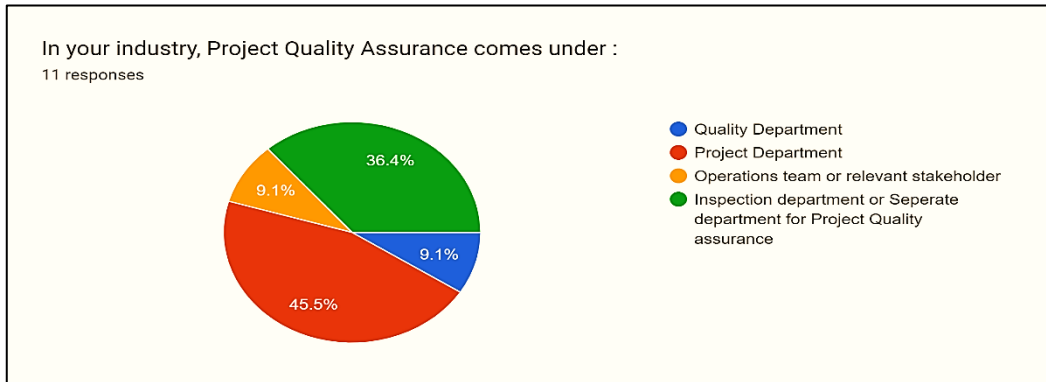e should only be implemented if separate resources or peers are responsible to ensure quality audit plans. Otherwise, this would lose its credibility.

A good practice is to assign a dedicated resource or department to ensure quality audit of project team. In different industries, this task is assigned to inspection or quality departments that are better equipped to analyze and conclude.

Consequently, respondents were asked to quantify the importance of implementation of effective quality assurance system. Out of linear scale of 10, most answers were biased towards the higher end, thus presenting a majority-curve, with average peak value at 9 out of 10.
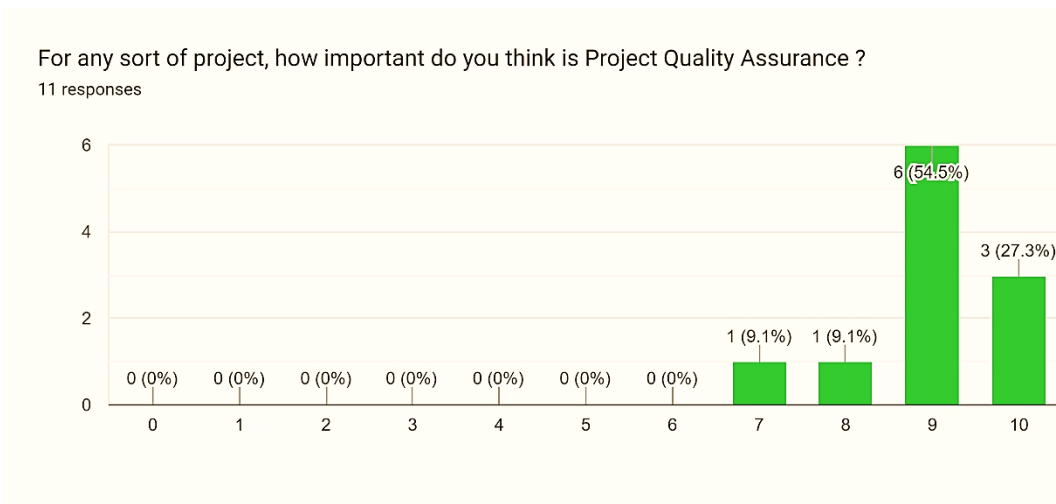

Figure 9- Survey Result Question 04

On the other hand, the respondents were asked to quantify the actual importance that is given to this element of projects in their departments. A quick evaluation of data depicts that almost all of project managers and project team members believe that this element lacks the due importance and diligence as compared to what is it worth.
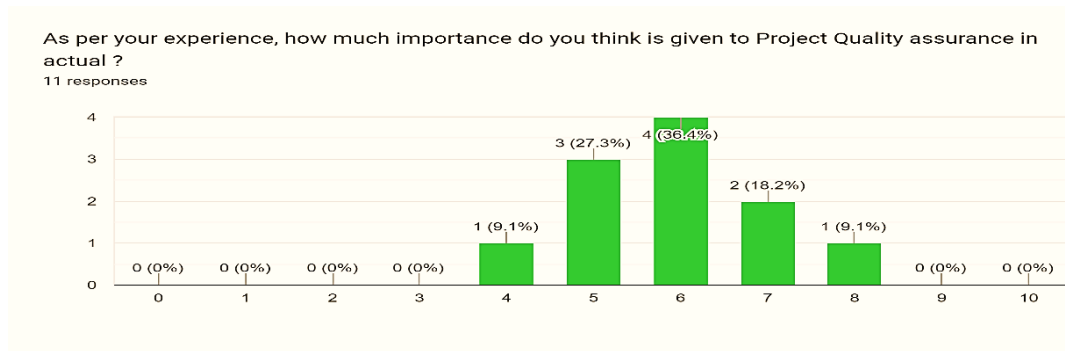
Figure 10- Survey Result Question 05

Thus, presenting a bell-curve like shape with average value at 06 out of 10. This clearly depicts the degree of importance and attention this topic deserves.

The aim of next questions was to understand the current practices that are currently in place in project departments. Therefore, to check the knowledge level and training regarding quality assurance, respondents were asked to identify the phase in which quality assurance plays a role in their department. The analysis is as follows:
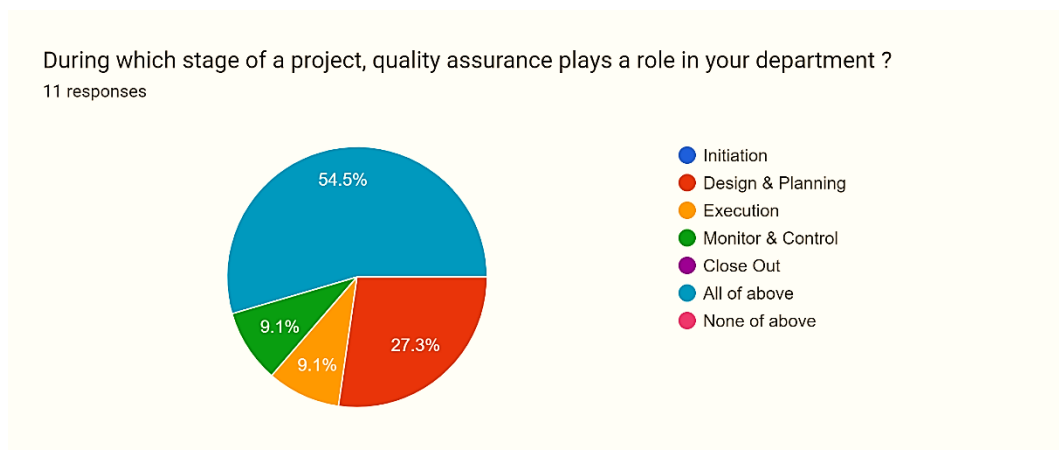
Figure 11- Survey Result Question 06

Around half population of sample data have a clear understanding of concept that Quality assurance is a on-going process and work parallel to all phases of project lifecycle. The design and planning phase quality assurance only deals with a

standard technical checklist system which is usually incomplete and treated just as a formality.

The last question was to identify that how quality assurance is being practiced and what tools are used for it.
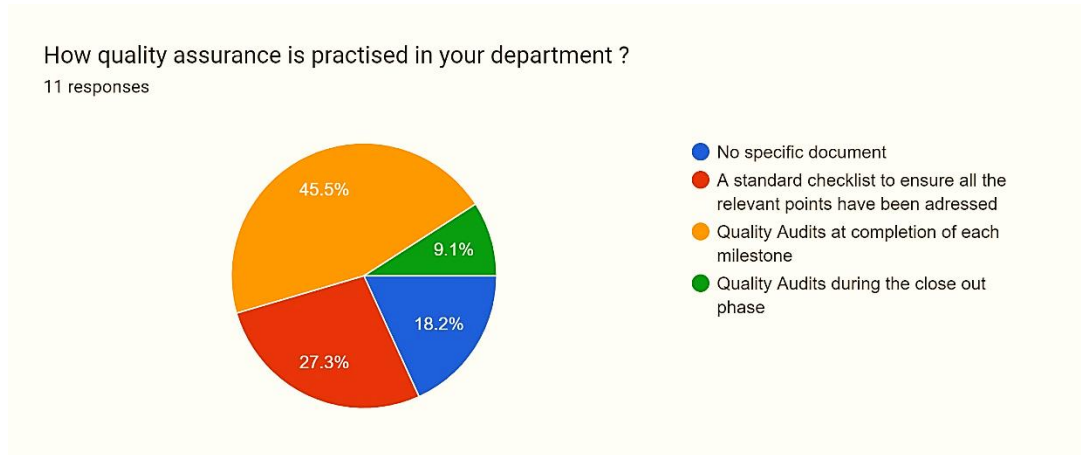
Figure 12- Survey Result Question 07

Again only 45% of population are currently utilizing the correct practices while remaining 55% are following the one-for-all type of solution.

Last but not the least, in order to identify the problems or challenges that project teams face, for implementation of an effective quality assurance system, the following question were made part of survey:
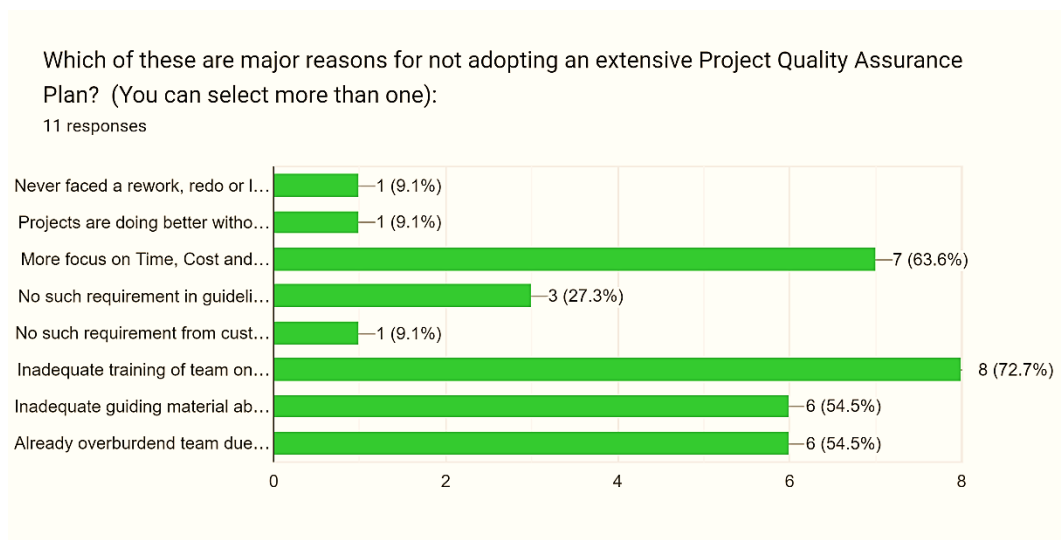
Figure 13- Survey Result Question 08

The above chart clearly depicts and scrutinize the top 03 reasons or root causes of problem.

Among the total, 73% of respondents believe that "Inadequate training of team on quality assurance practices" is the top reason or hurdle. The second main reason identified is "More focus on time, cost and safety". The third highest percentage is for two reasons. "Inadequate guiding material" and "Already overburdened team due to short staffing".

In summary, organizations and project members can simply improve the performance of quality assurance system within their departments by working on these top 03 root causes. This could drastically enhance the overall delivered project quality, reduced rework, decreased quality losses, timely completion and ensure customer satisfaction.

Chapter 05

5. Tools for effective Quality Assurance

Contrary to general belief, quality assurance is not just limited to technical applicability but rather have been divided into four pillars that plays its role throughout the life of project.

Table 2-Quality Assurance Pillars

Pillar	Activities	Tools
1. Customer Satisfaction Level	1.1 External Customer Quality Assurance 1.2 Internal Customer Quality Assurance	Customer Significance-Success Matrix
2. Improvement in Process	2.1 To Conduct Ongoing Review of Project Process Adequacy 2.2 To Conduct Interim Project Termination Review 2.3 To Improve Processes Based on Data Analysis	Project Check Sheet, Project Histogram Process Qualification Levels Interim Project Termination Review
3. Fact-Based Management	3.1 Conduct and Report Results of Quality Audits 3.2 Interpret Results of Quality Control Measurements 3.3 Collect and Share Project Quality Assurance Lessons Learned 3.4 Authorize New or Additional Tests as Needed	Project Quality Audit Control Chart Plus Delta Model
4. Empowered Performance	4.1 Project Manager Manages Stakeholder Relations 4.2 Manage Feedback Changes	Change Control Form

Each pillar has different tools and techniques that contributes towards a meaningful quality assurance plan. These pillars are:

5.1   Customer Satisfaction:

Managing both, internal and external customers, is a mandatory requirement for a project. The overall satisfaction level of these customers then classifies a project as successful or not successful.

This simply means that providing an adequate level of quality at each point of contact with customer so that a perception is solidified in customer mind. This will ensure easy accessibility, good communication, strong commitments and understanding and a rapid complaint response system. Consequently, a continuous improvement methodology starts taking place, hence improving the overall project management process.

An overall satisfaction of customers ensures more business and profits for organization. Therefore, the implementation of quality assurance practices to better understand the scope and requirements of a project is highly recommended.

Customer-Significance-Success matrix is an effective tool in assessing and focusing all the efforts on customer centric features and preferences. This helps to avoid extra re-work, scope change problem and resource wastage. Moreover, as customer is placed at center of the process, all the actions and decisions are driven as per customer expectations. This ensures mutual understanding, trust and effective two-way communication.

Additionally, a satisfied customer is a prime indicator of a successful project. Thus, quality assurance of customer significance is an effective tool for benchmarking success.

A typical matrix is shown below:

Customer Significance	Project Effort	
	Low	**High**
High	Vulnerable	Most Focus
Low	Doesn't Matter	Overkill

Table 3-Customer Significance Matrix

5.3 Process Improvement

The project quality assurance plan should not be limited to planning and design but also to overall processes. The adequacy of type of processes used, method practiced and referred to should also be reviewed. This inherently helps to avoid one-method-for-all type of projects.

Data collection and analytics is big part of this process. Analyzing trends for improvement in processes, finding out bottlenecks and continuous improvement are some key steps for this.

The simplest tool for identifying the problems through data are *Project Check Sheets*. These data collection forms are easier to use, collect data analytically and analyze without the use of any further processing. A sample of Project check sheet is shown below:

Problem/Defect /Bottleneck	Week			
	1	2	3	Total
A	I I	I I	I	5
B	I	I I I	I I I	7
C	I I I I	I I	I I I I	10
Total	7	7	8	22

Table 4-Project Check Sheets

Hence clearly indicating the problem in task/process C for each corresponding week. Another useful tool for graphical viewing of data is project histograms. These are used to graphically interpolate processes data to analyze the most frequent or rising trend. Therefore, allowing to fix the problem in earlier stages.

5.4   Fact Based Management

The fact-based management implies to base the decisions and action taken purely based on data collected, measured, and analyzed. This helps in overall decision-making process and to avoid human centric biasness. Thus, reduce the chances of any extra work, wastage of resources and time. Fact based management utilizes various phases to implement an overall quality assurance system. These phases are:

Project Quality Audits: Project Quality audits are critical part in managing overall project quality. These are utilized to ensure that all the processes, design specifications, quality conformance parameters etc. are being effectively followed and any deviation from original are properly communicated and recorded. Hence, corrective actions can be taken timely and in a systematic manner.

Here it is worthy to mention that these audits are not just limited to technicality and quality aspects but also to managerial side referring to project goal, sustainability, environmental and social standards.

Quality Control Measurement: Awareness of statistical parameters, functions and terminologies are one of the key requirements for a good project manager. Otherwise, any outlier in control charts, deviation from control limits etc. could lead to a series of problem. In this regard, a not so familiar project manager can over or under react in the situation and thus leading to failures.

Quality control charts are one of the main tools considered for this phase. The data for these charts are daily collected and measured. Hence allowing a real time updating of these charts and thus allowing project manager to make timely decisions based on rising trends. Thus, any outlier from upper control limit or lower control limit can be given its due attention and call for any corrective action accordingly.

As data is of no use without a strong analysis and clear interpretation, that is why quality control measurement is considered a main pillar in effective quality assurance plan.

Artificial Intelligence and Data Analytics: The future of data belongs to artificial intelligence. Keeping in view, its importance, this topic has been discussed in detail in later phases.

5.5 Empowered Performance

Relationship management and its auditing is another critical pillar of an overall quality assurance system. These include managing relationship with both internal and external stakeholders thus to satisfy each one throughout all parts of project. Thus, creating an overall enabling culture and environment of project team, high level motivation of team and vendors and a satisfied project customer

Effective Communication: The first and major factor in this process is effective communication. Although, customer expectations have been recorded in earlier phases but managing a functional communication channel has been proven to be effective in building trust and confidence of relevant stakeholders.

Proper stakeholder identification and trusting them with responsibilities and tasks enable a refreshing environment of motivation and commitment. These commitments thus later emerge and play its part in empowered performance of team and project success.

Feedback and Remunerations: Quality assurance and auditing of overall team motivation level alongside their enjoyed benefits and work life balance is also very crucial for determining the success of project. A good remuneration system for excellent performers of the team creates a healthy competitive environment thus allowing everyone to perform at their best of abilities.

Conversely, auditing of feedback system in place is also critical. Feedback system ranging from scope change request, quality control processes and performance of each member should be performed and recorded as part of the process.

5.6 Artificial Intelligence and Data Analytics

With the rise of industry 4.0, the world is moving towards an artificial intelligence-based reality. The widespread use of this technology has shifted the overall dynamics of manufacturing industry. All the conventional processes have been and would be replaced eventually. From supply chain to marketing and sales, artificial intelligence and machine learning has innovated the way the things operate and for all the right reasons.

Out of all the functions of a manufacturing unit, the one that has been more impacted is Quality Control. Conversely to manual quality control, the AI system links data collection to data analyzing in real time and quickly performing corrective actions, thus saving valuable time and resources. AI-powered software is integrated into system that is continuously trained to classify data accordingly and then detect any redundancy faster than any human possible.

Moreover, it does not only detect redundancies but also find sequences and trends thus leading to root cause of problem. Consequently, presenting a thorough report highlighting the bottleneck and the trouble making parts of the whole process. Thus, training its algorithm in a way to continuously monitor data, analyze the trends, do problem solving and help project managers in decision making process.

Process Automation and data analytics are some of the most demanding skillsets required for a project manager. Top organizations look for someone who is highly handy with replacing manual workflows with automated solutions and make sound decisions relying on data. That is why, the future of project management b belongs to this technology.

Many commercial based data analytics tools are available now in market that are revolutionizing the way the project management and quality assurance works. Integration of these tools have been already done for IT based industry where quality assurance practices have been made part of whole process.

The manufacturing industry is still lagging in this regard because of lack of training and awareness. Although, leading consultation firms like PricewaterhouseCoopers, Deloitte, Boston Consulting Group, EY, and KPMG etc. are some early adopters and leading the innovation for whole industry.

In conclusion, artificial intelligence is revolutionizing the conventional project management and quality assurance practices as it is more agile, fast, accurate, organized, and easy to interpret for timely decision making and problem solving

Some of the AI based tools for quality assurance and project management are (Alshaikhi, 2021):

Name	Description	Used By
Project manager	Centralized tool that can be used across multi functions within an organization. Automates quality assurance alongside project life cycle.	NASA, Siemens, Nestle, Ezcorp
Project Insight	An all-in-one place, easy to use online software. API Integration enables to customize it as per requirement	J.D. Power, Theda Care
Proof Hub	One project planning software that can easily replace other 6-7 paid apps. User friendly interface and customizable	Netflix, Nike, Google
Trello	Quick setup and across function workflows management. Visual aided Kanban boards and cards for checklists and pending tasks	John Deer, Zoom, Visa
Click Up	With availability of 30+ apps, no other tool is required. Also allows to import the data from other platforms. Automatic task assignment and workflow management	IBM, Stanley Security, Samsung
Asana	Match conventional workflows with automated scrum planning. Centralized communicating channel for effective communications	Deloitte, General Electric, USAID

Table 5-AI Based Project Management Software

Chapter 06

6. Conclusions

The main aim of this thesis is to reiterate the importance of an effective and results driven quality assurance system for project lifecycle. The excessive attention towards the iron triangle of project i.e., time, cost, and scope, makes it difficult for project team members to focus on the key ingredient that is mutual and beneficiary to all of them.

Without a thorough quality assurance system in place, project is at higher risk of rework and compromised final product which in turn reflects on customer satisfaction and thus overall, business performance.

Within the confined resources, a survey was conducted with the help of 11 project team members having different work experiences in different sections of the manufacturing industry, across the world. Hence, analyzing this sample data, a hypothesis was drawn that could be generalized for overall industry.

As per the majority of respondents, quality assurance is not given its due importance irrespective of sectors. In fact, it has been reduced to mere checklist filling and lip-service.

The top three major root causes identified, that act as a major hurdle in project departments, are "Inadequate training of team members on quality assurance practices, More focus on time, cost and scope, and finally, Inadequate guiding material on this topic". Another reason being is not allocating enough resources in planning phase thus losing its effectiveness.

Finally, this thesis presents some tools and techniques that are helpful for an effective quality assurance plan. Instead of a one standard checklist for all, these tools are spread throughout each phase of project lifecycle. The modern use of artificial intelligence and data analytics for quality assurance has also been discussed along with mention of some industry practiced software.

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8. Appendix

Evaluation of Quality Assurance Practices Across Project Departments

This questionnare is being collected as part of masters degree reserach thesis at Politecnico Di Torino, Italy. All the responses are purely voluntary and shall be strictly used for educational purposes only.

* Required

1. Personal Information
This section is related to collection of your personal information for record purposes, thus to indicate unbiasness in data (Such as Age, Gender, Position and Experience etc)

1. Would you like to disclose your personal Information for the acknowledgment in detailed report (such as Name, Gender, Country)?

    Mark only one oval.

    ◯ Yes, author can mention it
    ◯ No, only use for this survey
    ◯ Only if deemed necessary

2. Please provide your full name :

    _____

3. Please indicate your gender :

    Mark only one oval.

    ◯ Male
    ◯ Female
    ◯ Choose not to mention

4. Please mention your current title :

    Mark only one oval.

    ◯ Portfolio Manager
    ◯ Project Manager
    ◯ Project Team Member

5. Please provide name of the country you are currently working in : *

    _____

6. How much experience do you have, directly or indirectly, managing projects ? *

    Mark only one oval.

    ◯ 1-3 years
    ◯ 3-5 years
    ◯ 5-10 years
    ◯ 10-15 years
    ◯ More than 15 years

7. Please indicate the type of industry you are mostly related to ? *

    Check all that apply.

    ☐ Automotive
    ☐ FMCG
    ☐ Fertlizers & Chemicals
    ☐ Oil & Gas
    ☐ EPC
    ☐ Other: _____

Quality Assurance in your department

This section is dedicated to understand the current practices that are regularly performed in your department.

8. What type of guidelines your department refer to for project management related philosophy and methodology ? *

    Check all that apply.

    ☐ PMBOK Guidelines
    ☐ Company Corporate Level Document
    ☐ Team knowledge and skills
    ☐ No such specific document
    ☐ Other: _____

9. What is the ultimate performance criteria for a project to be consider as successful, in your department ?
    (You can choose more than one)

    Check all that apply.

    ☐ Project Cost
    ☐ Project Schedule Performance
    ☐ Return on investment
    ☐ Project Safety
    ☐ Risk Management
    ☐ Project Quality
    ☐ Executives Satisfaction
    ☐ Customer or Shareholder Satisfaction
    ☐ Other: _____

10. In your industry, Project Quality Assurance comes under : *

    Mark only one oval.

    ◯ Quality Department
    ◯ Project Department
    ◯ Operations team or relevant stakeholder
    ◯ Inspection department or Seperate department for Project Quality assurance
    ◯ Other: _____

11. For any sort of project, how important do you think is Project Quality Assurance ?   *

Mark only one oval.

No Importance

- 0 ◯
- 1 ◯
- 2 ◯
- 3 ◯
- 4 ◯
- 5 ◯
- 6 ◯
- 7 ◯
- 8 ◯
- 9 ◯
- 10 ◯

Maximum Importance

12. As per your experience, how much importance do you think is given to Project Quality assurance in actual ?   *

Mark only one oval.

No Importance

- 0 ◯
- 1 ◯
- 2 ◯
- 3 ◯
- 4 ◯
- 5 ◯
- 6 ◯
- 7 ◯
- 8 ◯
- 9 ◯
- 10 ◯

Maximum Importance

13. During which stage of a project, quality assurance plays a role in your department ?   *

Mark only one oval.

- ◯ Initiation
- ◯ Design & Planning
- ◯ Execution
- ◯ Monitor & Control
- ◯ Close Out
- ◯ All of above
- ◯ None of above

14. How quality assurance is practised in your department ?

Mark only one oval.

- ◯ No specific document
- ◯ A standard checklist to ensure all the relevant points have been adressed
- ◯ Quality Audits at completion of each milestone
- ◯ Quality Audits during the close out phase
- ◯ Other: _____

Difficulties Faced and Sugestions

15. Which of these are major reasons for not adopting an extensive Project Quality Assurance Plan?
(You can select more than one):

Check all that apply.

- ☐ Never faced a rework, redo or low-quality final result issue
- ☐ Projects are doing better without an extensive quality assurance program
- ☐ More focus on Time, Cost and Safety
- ☐ No such requirement in guidelines we follow
- ☐ No such requirement from customer or relevant stakeholders
- ☐ Inadequate training of team on project quality assurance
- ☐ Inadequate guiding material about its implementation
- ☐ Already overburdend team due to short staffing
- ☐ Other: _____

16. Is there any suggestion or key finding you would like to propose related to subject?
(Optional)

_____
_____
_____
_____
_____