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ENHANCING PROJECT MANAGEMENT – A QUALITY GATE USAGE

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ABSTRACT

Purpose: *In most companies achieving or delivering quality product or service becomes a complex task especially when setting up a new production process; every time focusing on project completion, meeting deadlines and quality check at the end of the production.*

Two types of quality checks can be applied to reduce the complexity of the project, i) quality control (QC) - which is established for monitoring and continuously check the output and performance of a product at an operational level, and ii) quality management gates (QG) – which are used for decision making that impacts the outcome of the project.

Among these two concepts QG concept is one of the most established approaches to address the described quality issues. In this paper, we attempt to explain QG with an example to understand the supportive tools that are required for a successful implementation of quality gate at the project execution phase.
Design methodology/approach: *The approach described in this case conceptualizes the process of implementation of quality gate to manage the quality performance of the project process flow.*
Research limitations: - This specific time bound research is limited to the implementation of QG only since development of the electronic quality gates needed sufficient time to validate for including the corrective measures after feedback was received to come to the desired outcome of the research.
Research implications: *The findings of the exploratory study can offer valuable insights and recommendations as how the quality gate can be implemented, its necessary supportive tools, how to go about into electronic format, and its benefits.*
Originality/value: *This conceptual research provides comprehensive idea to implement the quality gate in projects by step-by-step procedures to have the best quality management to evaluate and deliver the best project to the customer. It provides immense idea to other researchers and industrialists to choose a right quality management tool.*

Key words: Project Management, WBS, Scheduling, Quality Gate, QG, Business Process Management.

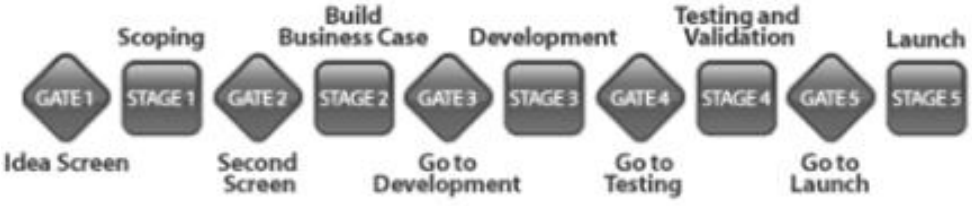
INTRODUCTION

Based on various obervations, and ideas collected from a group of firm managers, In 1986, Robert Cooper proposed the of stage-gate model, to help the firms to reduce the failure posibilities in the product development process, which would help the firm managers to devlier a desired quality product (Cooper, Winning at New Products, 1986). Later in 1960s, NASA implemented "phase review process" which is more alike to stage-gate model which is developed by Cooper (12Manage, 2007), (Cooper, Third-generation new product processes, 1994). There are three different gate process were identified and by the industrial experts to enhance the quality outcome of a project. They are i) Stage Gate, ii) Process Gate and Quality Gate.

1. Stage-gate

For development of product process, state-gate model is the powerful tool, which gives a well-structured and well-organized flow in the project. In stage gate, the project is splits into series of "Stages" and "Gates" as shown in the figure 1. The stages include a) scoping, b) build business case, c) development, d) testing and validation and e) launch of the final product.

Figure 1: Stage-Gate Process



Source: (Stage-Gate:Your Roadmap for New Product Development)

The Stage-gate model increases the work commitment to the assigned project and it also helps to eradicate bias in process validation, between the human conscious or subconscious prediction and confirmation. A stage-gate model can be used as a guide to formalize a model for the entire process to fulfill the desired objective of the project by break down the project into number of possible process to identify and analysis the new suitable process ways and provides new ideas for the further business improvement. In case of non-satisfactory level on increasing levels of commitment, the particular process has to be evaluated and act as a backward feedback loop for more analysis (Barringer & Gresock, 2008).

2. Process Gate

The Process Gate approach is related to the project management, decision making process and the continuous work flow to endorse quality. It is used to address the defect at process stage so that same defect should not be passing that manufacturing station.

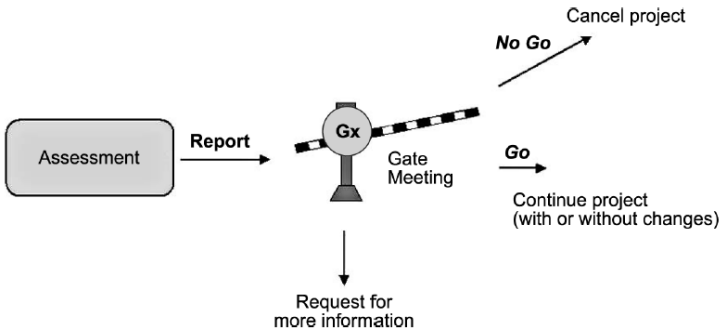


Figure 2: Process Gate
Source: (Chao & Ishii, 2004)

3. Quality Gate

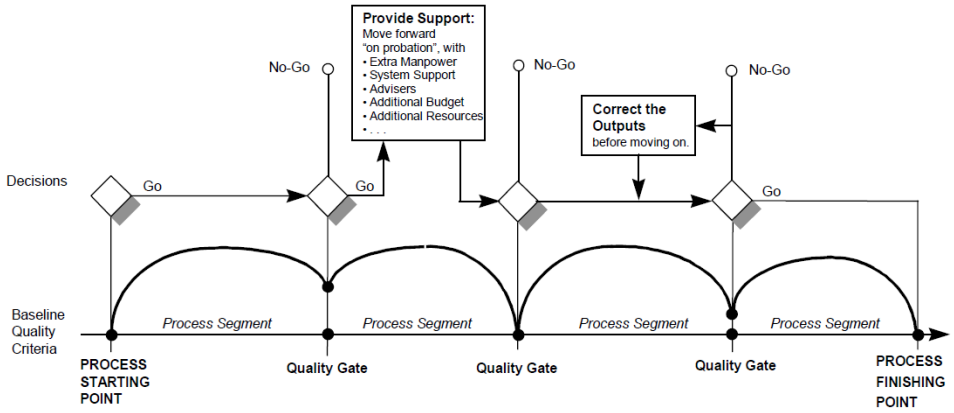


Figure 3: Quality Gate process
Source: (Introduction to Quality Gates, 1998)

A Quality Gate (QG) interfaces between project steps having a collection of quality completion criteria. The QG would be the defined phases and activities between the breakdown of the project work as shown in the figure 3. Each activity has to be passed through the QG for the release for next project activity, by gone through the evaluation of the previous process by means of fixed criteria. It has a check list of items involved in an activity of a project. Also at QG, detail analysis of defect, present status for defect etc. is also displayed.

TYPES OF QUALITY GATES

There are two types of QGs which are defined for different purposes to make control of the quality at operating level and at management level, namely Quality Control Gate and Quality Management Gate (Introduction to Quality Gates, 1998).*Quality Control Gate* are used for monitoring the product quality performance and outcome of the product within the operations process. Here the operational process of a product is divided in to number of possible activities, at the end of the each activity the product passes through the quality check. *Quality Management*

Gate are established for the decision making process which will control the outcome of the project with the desired quality. Here the project is divided in to number of possible activities such as designing, drafting, production, finishing according to the fixed target, timeframe and deadline. At the end of the each activity the product passes through a list of quality criteria which defines the specified output performance specifications, from this at management level decisions will be made to assure alignment between performance and expectations of the final outcome of the project.

CONVENTIONAL QUALITY CONTROL METHOD AND THE QUALITY GATE

Time, cost and quality are the three project management constraints; each is interrelated and impacts with one another. Among these three constraints, quality aspect is something tangible to inspect and becomes the issue at the last stage of any project and affects the whole process time as well the cost involved. There are other quality controls tools such as six sigma, kaizen (continuous improvement), statistical process control (SPC), quality assurance (QA), process capability index, etc. but these tools become most probably towards the final inspection stage. Of course inspection is one of the quality check point but it doesn't reduce the quality problems at the process stage, rework, time and cost incurred. To avoid this (Edwards, 1986) and (Juran & Gryna, 1980) enlightened the concepts of x of quality by mass inspection is not economical because it permits wasteful practices and it should be more economical to do things right the first time. The project planning and control tools offers little help to manage quality and also very few specific tools are there to help the project manager in terms of scheduling, monitoring and control project quality as well the cost to integrate quality into project management process.
In a project, one has to first identify the various activities/major process involved and then breakdown the process/activities according to the major involvement by function area. This given a clear idea about the life cycle of the project and they identified the milestones which are accountable for meeting costs, time and quality criteria. Each milestone carries a sufficient criteria i.e. check list that helps the project manager to control the quality of the project lifecycle at the early stage (Aaron, Bratta, & D, 1993).

An innovation for an integrated organization is based on two approaches, product lifecycle roadmaps and QG. Roadmaps are a sort of project layout where multi-disciplinary groups of peoples involved as team with a guiding framework to achieve a common goal. Planning, Implementation, Knowledge management, Product life cycle are the four major steps to accomplish a cost effective task on time. These four steps provide guidance and structure to the project execution, and lead to project innovation by controlling these steps.

The next method, QG, is sourced from quality controlling and is a list of pre-defined quality criteria which has to be satisfied before each activity is passed to the next to continue. This QG is an opportunity of early intervention in the development stage of a business project activities and it avoids the error, changing requirements and communication problems between the customer and the supplier and QG acts a single like a traffic light system, with that the Project manager or project supervisor can easily identify the bottleneck of the project (Giebel, Esmann, Preez, & Jochem, 2008).

QG is the predefined quality acceptance criteria reviews that can be used throughout any project lifecycle. QG might involve more paperwork but still this strategic management tool is fully customizable. The clearance of one QG would leads to the passage of project to the next gate, unless the IT project manager and a senior executive reviews the problems occurred in that particular gate for the free flow process throughout the entire project. For example, the project manager of a large CRM project faced a problem during the product development phase. The flow of activities involved designing the architecture to configuring and customizing the CRM application by the developers. Since there was no database support and with unassigned IP address, the impact in project timeline was not correctly measured. If the project manager had utilized the QG processes, he could have detected much earlier at the design phase the timeline of the project. Hence, QG needs to be integrated with both the development & deployment process of an IT projects. IT companies such as AT&T, Lucent Technologies and others have implemented QG successfully for their project development cycle (Charvat, 2003).

The implementation of QG requires some basic supportive project management tools like work breakdown structure, product breakdown structure and scheduling tools to stream line the QG approach into a project. Let's see how these supportive tools contribute the effectiveness for the implementation of QG.

PROJECT MANAGEMENT

Project management is the basic requirement for planning; organizing, managing, leading, controlling and monitoring the available resources like raw materials, time, money, manpower etc. so as to achieve the specific goals. Scope, time, budget and quality are the key challenge to achieve all the project goals. These constraints could be optimized by adopting predefined project management tools. Figure 4 shows the flow of project management process involved in any project.

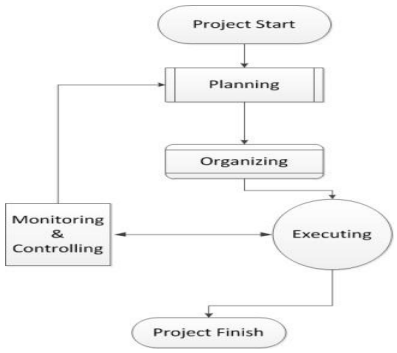


Figure 4: Project management process flow chart

Projects should have a continuous improvement in the project management process for the longer run and the project management has to be integrated and should relate with the goals of an organization. Also the time and resources allocated for project may be limited, so the maximum utilization of these time and available resources guarantees the project success (Ayas, 1997) and (Bachy & Hameri, 1997).

Project management practices helps to avoid the interdependencies of under-recognized and under managed work tasks and promotes "one time event" that increases the ongoing performance improvements by minimizing the inter-relationships between individual work tasks and other project mechanisms. A unified project management approach emphasizes the required project information to pass to all the project participants and provides a unifying influence in the continuous flow of work without any distractions or confusions in the path of continuous improvement of a project (Froese, 2010). In addition to that the project management defines the time period and cost required to complete the project and deliver the product on time. The tools like cause and effect diagrams, delay analysis would give the gaps where the process has to be strengthened (Chao & Ishii, 2004).

Additional tools such as WBS, Gantt chart, Critical Path Method (CPM), SWAV (used to identify the bottlenecks or conflicts during the entire scheduling period) and PERT technique are the supportive tools for the efficient outcome for a QG.

1. Planning

Work break down structure (WBS): The breaking down of a single task into multiple levels of tasks to reduce the complexity of the process and to speed up the project to complete with the desired quality on time is defined as Work break down structure. As such, the task is broken into several possible small tasks and provides a clear cut idea about the whole process of the project and reduces the complexity in it. Work breakdown structure provides a set of criteria for distinguishing between the hierarchical levels. It is an influential tool for a successful organization (Ayas, 1997). WBS has to be the first plan of any project, and then a detailed study has to be carried out about the product and the project site. Product breakdown structure, assembly breakdown structure (ABS) and organizational breakdown structure (OBS) are the basic structures used to derive an efficient work breakdown structure which are the required and necessary tools has to be prepared before initiating any project (Bachy & Hameri, 1997).

Product breakdown structure (PBS): PBS is an effective tool which categorized the complex components of a final product in a hierarchical form. It is similar to work breakdown structure. PBS comprises the complete product components list or sequence flow of product information represented in a data (tree) structure (figure 5) and also it comprises the technical description of manufacturing, machining, and quality control for all the all elementary parts (Bachy & Hameri, 1997).

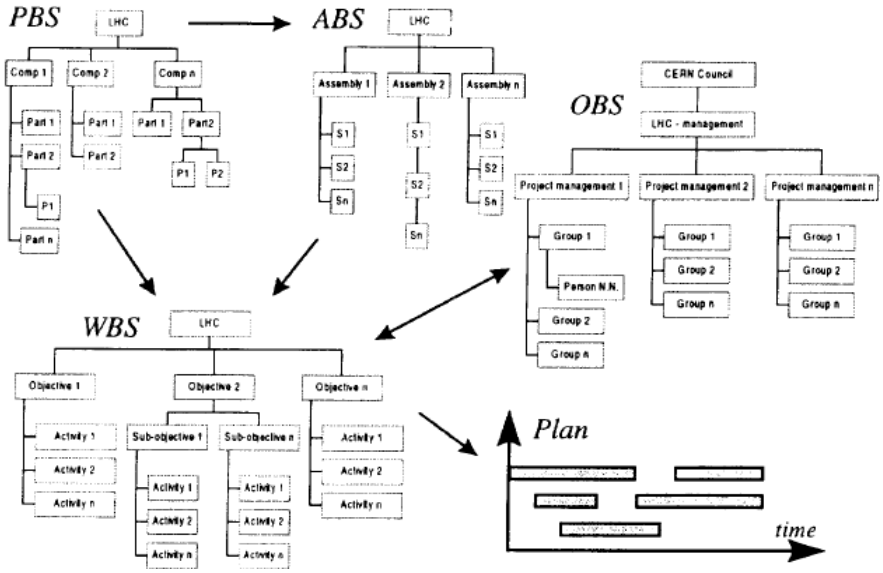


Figure 5: Preparatory process for a project [Source: Bachy & Hameri, 1997]

The main difference between product breakdown structure (PBS) and work breakdown structure (WBS) is that just product and work. The PBS entails the physical and functional elements of a product whereas WBS focuses on the number of works involved in a project. WBS is designed as per the PBS in any project along with that organizational breakdown structure (OBS) and assembly breakdown structure (ABS) are also took part in building a perfect Work breakdown structure (WBS). The figure 5 shows the clear picture about the implication of these three breakdown structures to arrive a perfect project plan.

2. Organizing

Project Scheduling: Project scheduling is the process of organizing and committing to decide, how to make use all the resources like manpower, time and budget between a varieties of possible tasks. It can be simply say that project scheduling is an established timetable consists of start and finish time of a project. Scheduling is mainly focus on time availability for a project and its maximum utilization to accomplish the task. The purpose of scheduling is to minimize the time and cost with the available resources like manpower, equipments, raw materials etc. to maximize the production efficiency. As per (Chen, Ling, & Chen, 2003), scheduling for a large project especially for a new product development (NPD) process is a challening task and requires potential knowledge and determination.

Scheduling can be done by two ways, forward and backward. Forward scheduling is to determine the time required to start the project to the end date or due of the project. In case of backward scheduling, it is just reverse of the forward scheduling, it determines the planning the tasks from due date of the project to the start date of the project. In QG approach forward scheduling is most likely in use. A schedule maker should have a well-designed work breakdown structure and product breakdown structure before start creating a project schedule; this would help the scheduler to create an effective estimate for each task with available resource list for each task.

Activity networks, Gantt Chart technique are the basic project scheduling tools and also scheduling could be done with the help of project scheduling software packages available in the market such as Microsoft project, Prime avira by Oracle, these two applications are the most user friendly and most efficient, apart from these two there are other software packages are available in the market such as Clarizen, Genius Project, Daptive PPM etc.

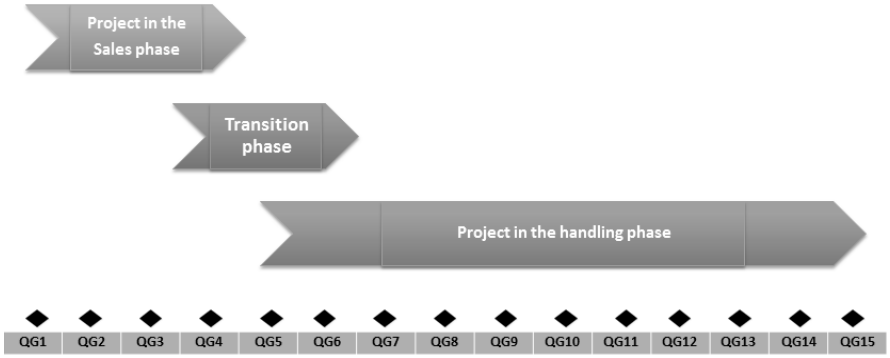
IMPLEMENTATION OF QUALITY GATE

A project is a plan or proposal for a desired goal and it has a group of activities which has a starting point and an end point and it deals with the 4M's (Man, Money, Material and Machine). While implementing a QG in a project, the project has to be broken into possible small activities. Per se a project could be divided into three [1]phases right from receiving a project from customer to the end i.e. delivering the product or service to the customer are like:

1. Sales (Order booking) Phase
2. Transition Phase
3. Order Handling Phase - Project definition, Design, Production, Equipment installation and Commissioning

In an overview a project consists of various activities to accomplish the task, parse there are fifteen activities involved right from customer enquiry to product delivery and commissioning of the project. These activities are divided into three phases i) sales, ii) transition and, iii) project handling. All the three phases has to be undergone through the QG. There are nearly fifteen QGs, in that first four QGs falls under the project sales phase, and the remaining eleven QGs falls under the project handling phase. As shown in the figure 6.

Figure 6: Overview of sales and order handling Quality Gate



Each stage has their unique activities to complete the task and transfer the project to the subsequent activities. For example the sales stage has the activities of customer inquiry, general conditions, specifications customer input), cost estimation & risk assessment (customer input) and negotiations. Once these sales activities are done then the sales department has to move the

[1 Phase: it's a separation of group of activities involved in a project]

project to the next process called project execution. In such a way the project has to undergone through the above said six stages to fulfill its destiny.

1. Quality gate in sales (order booking) phase

In sales phase covers right from getting an order to confirmation of the order until handover the order to the project execution phase to start the project. The QG in the sales phase has to be followed and recorded by the sales and marketing departments. The QG in the sales phase is clearly shown in the figure 7. If there is any issue in this part the order will not enter in to the project execution phase, so that no project has to be executed in the project execution phase without the clearance from the sales phase. This helps to avoid the loss of production in case of unconfirmed or un-clarified projects.

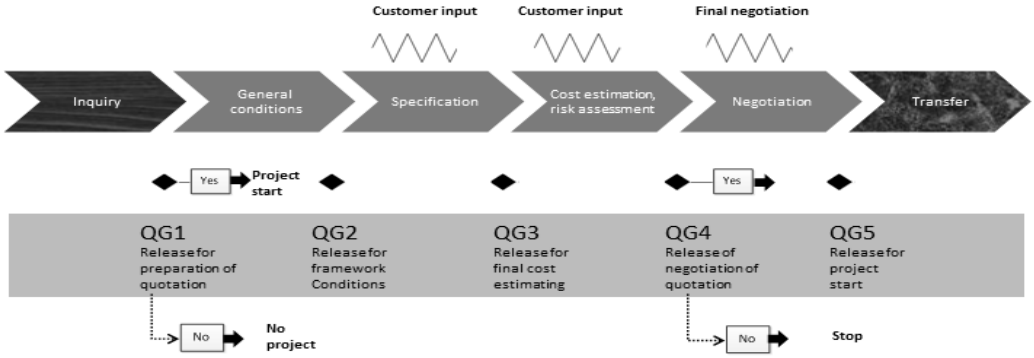


Figure 7: QG in project sales (order booking) phase

2. Quality gate in transition phase

Transition phase is just transferring the approved project to the production or manufacturing department with the required specifications, budget constraints, time frame and other documents. These documents also go through the gates to avoid the unnecessary confusion or unclear information to start a project. If the information is unclear then the project would not go for the project execution phase to start the project and it would be return to the sales department for the clearance.

3. Quality gate in order handling phase

The graphical representation of order handling phase is shown in the figure 8 which clearly explains the passage of different projects in the QG; here the QG from QG5 to QG15 are falls under the order handling phase. That is after the order has confirmed and passed through the QG in the sales phase the order has been released for the project start by the sales people to the project management people. In each and every quality a set of document called checklist regarding previous activity has been recorded and filed in the project folder for the further references. The light indicator in the figure signs the completion of QGs in that particular activity of the project, here the project has successfully passed up to the QG number 12. The QG 13 is

under process and the red sign indicates the QG14 and QG15 are yet to be completed. This helps to track the project whether it moves along with the schedule of the project. If any delay/problem occurs in a particular activity, it helps to find the solution easily and it eliminates the repetitive of work of the whole process. By referencing the previous QG was the projects had been passed through the project manager can easily identifies the location within a less time. That's why all the QGs must be documented in the folder once the project passed through that particular QG. The main advantage of this QG is that if any problem occurs in an activity the subsequent QG will not allow the project to move on to the next activity of the project. So the accuracy of the project can be achieved.

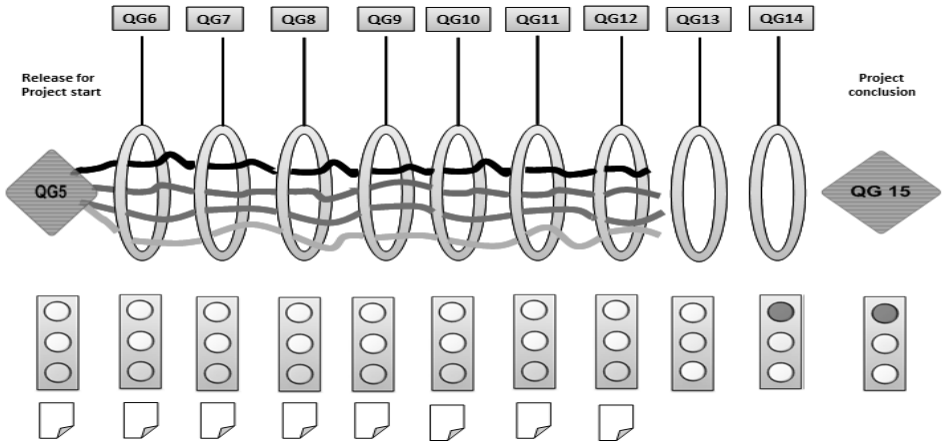


Figure 8: Overview of Quality Gate at project execution phase

4. Field and task-overlapping

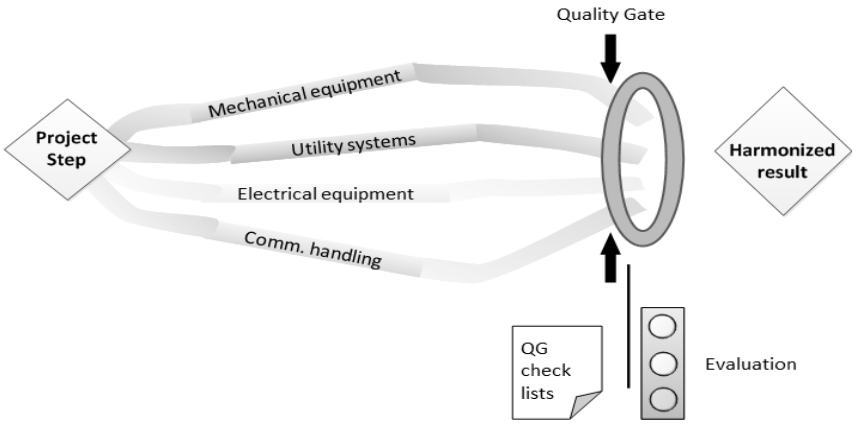


Figure 9: Field and task-overlapping

Each and every activity has some sub-activities to accomplish the particular activity of a project. The result of each activity would be a harmonized of different sub-activities. For example let's take an activity called detailing. This activity may be sub divided into basic engineering of mechanical equipments, electrical equipments, utility systems and commission handling, and

also for detail engineering of mechanical equipments, electrical equipments, utility systems and commission handling etc. The QG checklist has these sub-activities list for the evaluation to give a harmonized result of an activity.

QUALITY GATE NORMS

- As a rule, the QG must be applied in all projects for which SDE bears the overall project responsibility.
- In selected QG, section-specific items are contained as separate parts in the check lists.
- In small-scale projects it may be possible to skip certain QGs. The decision on this is taken by the project management in coordination with the project principal.
- The signed QG records must always be stored as .tif or .pdf files in the basic project folder of the respective project under "QG".
- When subsidiaries participate in the project, they shall be involved in the implementation of the QGs

PROCESS TO IMPLEMENT THE QUALITY GATE

The major steps in the process to implement the QG include: First - build a WBS with a Product breakdown structure (PBS) and Assembly breakdown structure (ABS); Next prepare a complete time schedule with the available resources and budget; Thirdly, set up the QG criteria; Fourth, train project team members; Fifth, implement QG, and finally take corrective actions.

BENEFITS OF QUALITY GATE

Some of the major benefits of QG include: helps project manager to take a quick decisions, avoids the poor or underperformed ideas in the path of continuous project improvement, provides product success with the desired quality and prevents the poor outcome and redirects to corrective actions; increase the participation and motivation of employees towards the project goal, reduces the communication barriers or unnecessary confusions, effective utilization of resources to achieve the quality and benchmarks, takes complete control of quality, cost and time and also enables prioritization and focus.

CHALLENGES IN QUALITY GATE

Some of the major challenges include increased paper work, extra work load for employees to revise or review all the documents and process before passing on to next step, additional time for the employees to learn a new strategic tool and proceed through lengthy quality criteria.

APPLICATION OF QUALITY GATE

The following table 1 shows some of areas where QG were implemented.

Table 1: Application of Quality Gate

IT Industry	IT Projects (Charvat, 2003) Software Development (Ambartsoumian, Dhaliwal, Lee, Meservy, & Zhang, 2011) & (Youn, 2011)
Construction Firms	Architecture, Engineering, Constructions and Facility Management (Froese, 2010)
Industry with more partnering and alliances	[Cooper, 2006]

CONCLUSION

Quality is the satisfactory index for a product to the customers. The control of inter dependable factors of cost, quality and time are carried out by various quality management techniques, such as six sigma, kaizen, statistical process control, quality assurance, process capability index etc. These quality tools help to prevent defects and to increase quality at the end of the production process, which includes the cost of rework, rejection, manpower and time. As such QG would bring down the time of searching the project back records, easy to identify the problem at early stage, reduces the cost of rework, increase the accuracy and effective projects to their clients. Moreover it gives a standardized format to carry out a project to define specific standard requirements. By computerizing the QG process would reduce the usage of paperwork and record keeping and floor space. While computerizing QG, and inter-relate with the scheduling software package would give the better outcome.

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