engineering processes - ecosystem in an eso

The need for robust processes in Service Organizations need not be debated. We have observed in a services ecosystem, which has similar boundary conditions (customers, resources, cost of resources, bill rates, IT infrastructure), operating processes differentiate a great organization from a good organization.

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Abstract

The need for robust processes in Service Organizations need not be debated. We have observed in a services ecosystem, which has similar boundary conditions (customers, resources, cost of resources, bill rates, IT infrastructure), operating processes differentiate a great organization from a good organization.

At QuEST, a study of the portfolio of our strategic customers provides evidence of high quality processes and practices being implemented in their business. Each one of these is an industry leader and all are multibillion dollar conglomerates. Service Organizations must implement the process based culture to emerge as leaders in their respective domains.

We are a very process based organization and the accreditations we have we have are testimony to that. We have embraced process framework viz. PCMM, CMMi and Quality Systems viz. AS, ISO. This paper is an attempt to summarize our experiences in process development and invite rich participation from the users to mature and improve the process assets of our organization. This paper also provides few check lists that could be useful for process developers and process users.

What is a process? What are key elements of a process?

A process is – "A sequence of interrelated steps involving decisions, and enables work to be completed in a methodical way".

The key elements of a process are:

- Process Definition – What is the process expected to achieve?
- Activities – What are the steps?
- People required to perform these activities and their roles
- Tools to be used
- Training required

These elements are interlinked and absence of any one will result in a huge impact on desired result. If a process is expected to deliver excellent results, all these elements need to be well defined and followed.

Figure 1: Key elements of a process

Deliverable Review Process

Definition : The purpose of Deliverable review is to ensure that the identified deliverables meet the agreed/specified requirements. Deliverable reviews are an important part of verification and are a proven mechanism for effective defect removal.

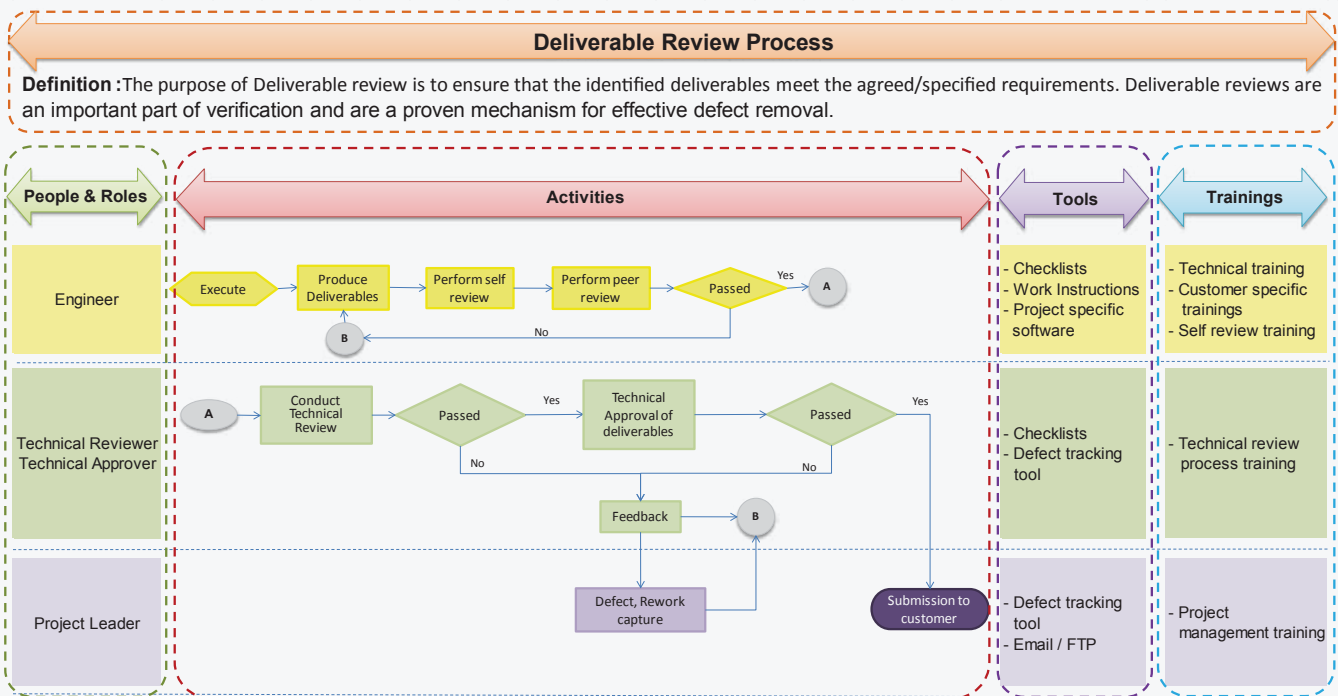| People & Roles	Activities	Tools	Trainings
Engineer	Execute → Produce Deliverables → Perform self review → Perform peer review → Passed — Yes → A ; No → B	- Checklists - Work Instructions - Project specific software	- Technical training - Customer specific trainings - Self review training
Technical Reviewer / Technical Approver	A → Conduct Technical Review → Passed (Yes → Technical Approval of deliverables; No) → Passed (Yes; No) → Feedback → B	- Checklists - Defect tracking tool	- Technical review process training
Project Leader	Defect, Rework capture ; Submission to customer	- Defect tracking tool - Email / FTP	- Project management training

Figure 2: Deliverable Review Process at QuEST

The guidelines to developing good process are:

- Processes have to be well designed and documented
- Involve users and stakeholders in development of processes
- Responsibility and accountability have to be well articulated
- The tools recommended in a process are relevant and enable to execute the process efficiently
- Users of the process are well trained so that there is a consistency in process execution and results
- Processes should result in consistent outcome

What is a good process ?

✓ Effective ✓ Usable ✓ Relevant

✓ Efficient ✓ Used ✓ Valid

✓ Managed ✓ Reused ✓ Measured

Figure 3: Good process [3]

What are Engineering Services? What is an ESO?

Engineering Services are those service functions that deal with or related to core Engineering Processes. Example: Engineering Analysis, Detail Engineering etc. The distinction that needs to be drawn here is between Engineering Functions and Engineering Service Functions. An example of Engineering Function is auto engine manufacturing. A related Engineering Service Function would be designing the engine. It is similar to the distinction between manufacturing and manufacturing support services [1]. QuEST is an example of an organization in the business of Engineering Service Functions.

ESO (Engineering Service Outsourcing) refers to the outsourcing of specific Engineering Service to third-party service providers. Though Engineering Services are a critical part of any vertical, the recent economic downturn and the need to survive in extremely competitive market environments has forced organizations to outsource them to ESO vendors [2].

ESO enables Original Equipment Manufacturers (OEMs) to develop innovative and cost-effective engineering products in minimal time. Also, ESO services help OEMs access talented and skilled engineering professionals from across the world. Thus, ESO enables OEMs to develop an economic cost structure, use resources in the best possible way, and focus on core competencies [2].

Why processes are important in Engineering Service industry?

OEMs are increasingly demanding high quality, lower cost and faster delivery of services to obtain a competitive advantage over their rivals. To help the OEMs to be competitive, Service Organizations should be able to deliver their engineering services as fast as, or faster than, OEMs can do it internally.

As an industry grows, so does its complexity. Especially, in the service sector where we are dealing with the 'experiences' of the customer, it becomes even more vital to have robust systems in place. 'Service' is an intangible offering that we provide to our customers through our interactions. It is therefore; extremely important to ensure that each time a customer engages with the service industry, they have a hassle free experience through the entire process. In today's competitive market, the battle is not about the service being offered, but it's about the 'manner' in which the service is offered. With very few services having a monopoly in the market, for most of the others it's 'competition' [4].

The challenges that any Engineering Service Organization face are:

- Lack of standard processes and methodologies
- People dependency: Different engineers follow different methods

- Lack of clarity on the usage of right tools and techniques to deliver the same service when multiple options are available
- Lack of measurements which can be analyzed to bring improvements in the processes
- Low efficiency due to poorly defined processes

To overcome these challenges, it becomes vital for Service Organizations to have robust processes in place. Service Organizations need to invest their time and money in building a robust process framework that ensures their smooth and continual functioning besides giving them the much needed competitive edge. A model/framework will enable organizations to identify the key ingredients required to execute their business in the most effective and optimal manner [4].

Process improvement models like CMMI provide the framework and guidance to build robust processes. CMMI is a process improvement model that helps organizations to effectively use processes in a structured manner to achieve business and process excellence. It is a capability maturity model that moves from level 1 to level 5 based on the maturity attained by the organization at each level [4].

Role of Engineering Processes in Profitability and Business Growth

Reliable, scalable processes are the foundations for profitable growth of a business. Sustainable and scalable profitability can be achieved when organizational processes operate efficiently.

Process efficiency and profitability can be achieved by,

• Standardizing the process for routine work enables deployment of lower skilled engineers and relieves experienced resources to address new challenges

• Automating repetitive processes to perform activities in a shorter time
• Developing and documenting Best Practices / Methodologies for a service to execute the tasks in the most efficient way
• Establishing Knowledge Management system in the organization to ensure that the right people have the right knowledge at the right time and avoid reinventing the wheel

Key elements of Engineering Process

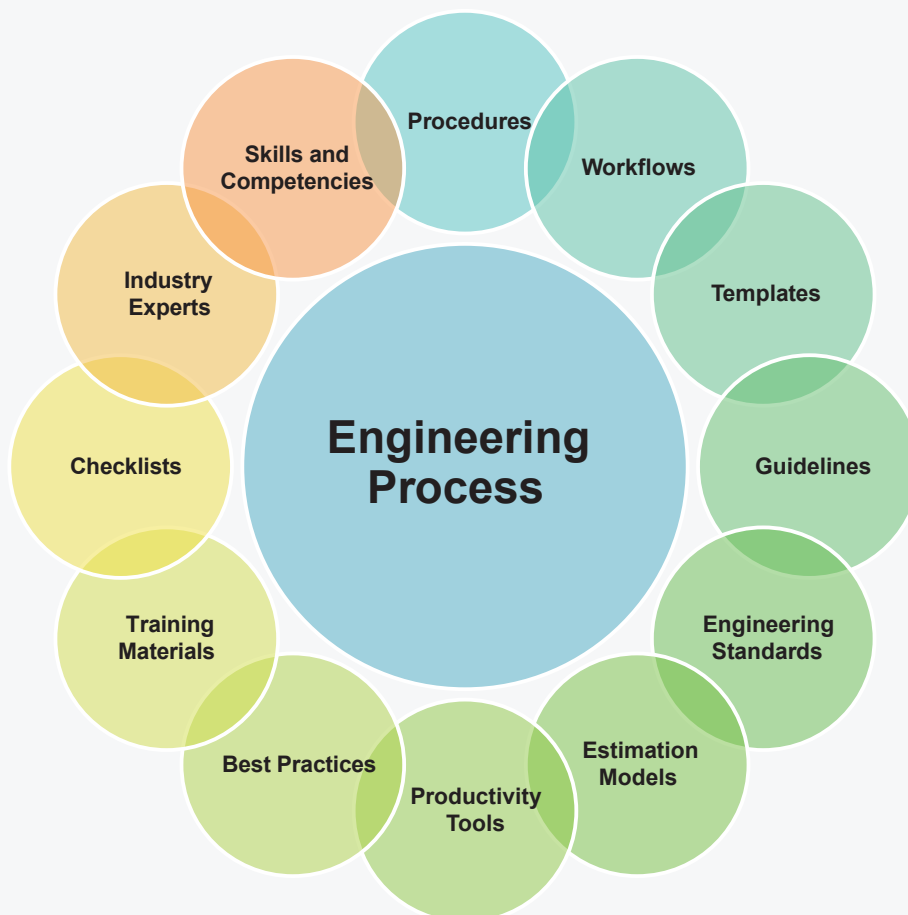The key elements that constitute an Engineering Process are depicted in Figure 4.

Figure 4: Elements of Engineering Process

A brief description about these elements is provided in Appendix - Brief description on elements of Engineering Process.

Tool kit for Process Developers

Sl. No.	Description	Check
1	Users and stakeholders affected by the process should be involved during development of the process	
2	Processes should be harmonized with other dependent processes and tools of the organization	
3	Processes should have minimum steps and handoffs to make it lean • Processes which are longer or involve many steps can be subdivided into phases to help effectively monitor and control the task. Example: A project management process can be divided in to Quotation, Planning, Initiation, Execution and Closure	
4	Processes should be well documented: • Clearly defining the inputs required to start the process, different criteria to be met and expected results • Define the roles of the people involved, measures to be taken or people to be contacted in case of discrep ancies • Tools and methods to be used, standards to be followed at different stages of the process • Checks to be performed, conditions to be fulfilled at different stages before moving to the next step • Necessary training required for the users of the process	
5	Process should have scope to make best use of available tools or development of new tools for automation	
6	Process should give consistent output every time the process is used by same/different people	
7	Identify the measures for the process for monitoring and controlling the process performance (effectiveness and efficiency metrics).	
8	Processes must be scalable	
9	Before implementing across the organization, the process should be piloted to see if it works as expected and yield the desired results	

Table 1: Tool kit for Process Developers

Tool kit for Process Users

Before adopting a process, users must verify if the process is appropriate for executing the tasks and achieve desired results. Some checks that users should perform before adopting a process are:

Sl. No.	Description	Check
1	Is the process relevant to the task?	
2	Helps to perform a task flawlessly?	
3	Provides guidelines to carry out each step of the task?	
4	Guides to use right tools and techniques to perform the task?	
5	Guides to take the right decision when more than one result is possible?	
6	Gives flexibility to adopt changes to the defined methodology within specified boundaries?	
7	Ensures the results are achieved within the planned time, cost and quality requirements?	
8	Is the process scalable?	

Table 2: Tool kit for Process Users

Tool kit for Management

Before sponsoring a process development, management should verify that the process is a value add to the business and helps in business growth. Some checks that management should perform before sponsoring a process are:

Sl. No.	Description	Check
1	Is the process aligned with business objectives?	
2	Does the process help in delivering value to customers?	
3	Does the process help bring profitability to the organization?	
4	Does the process ensure business continuity (No people dependency)?	

Table 3: Tool kit for Management

Expectations from Process Developers, Users and Management

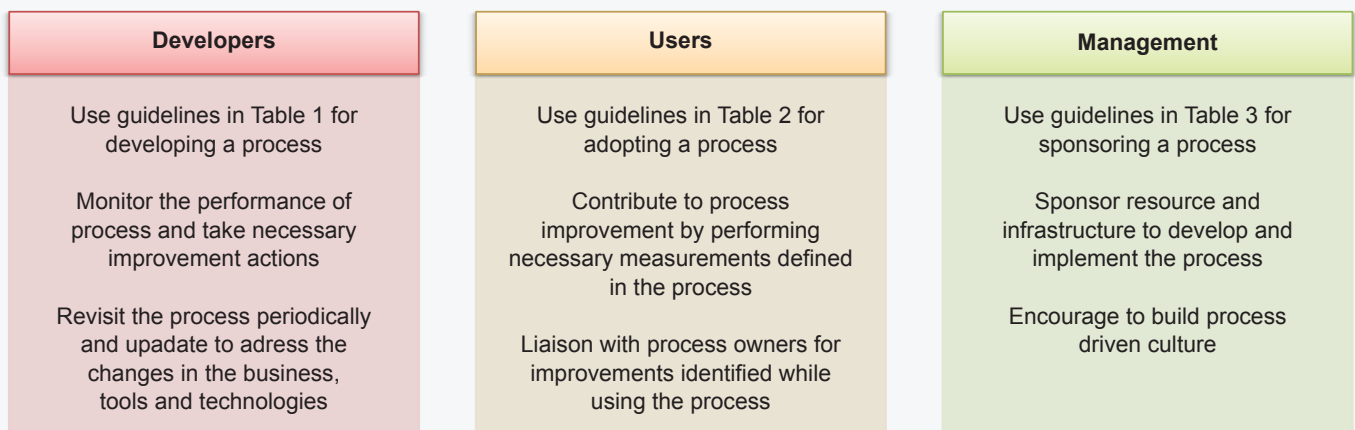| Developers	Users	Management
Use guidelines in Table 1 for developing a process	Use guidelines in Table 2 for adopting a process	Use guidelines in Table 3 for sponsoring a process
Monitor the performance of process and take necessary improvement actions	Contribute to process improvement by performing necessary measurements defined in the process	Sponsor resource and infrastructure to develop and implement the process
Revisit the process periodically and upadate to adress the changes in the business, tools and technologies	Liaison with process owners for improvements identified while using the process	Encourage to build process driven culture

Figure 5:Expectations from Process Developers, Users and Management

Process Improvement

With the changes in customer demands, business growth, technology upgrades, processes need to be revisited and improved.

Need for process improvement arises to

- Improve efficiency and effectiveness of a process
- Improve performance
- Improve profitability of the organization
- Improve quality of the results of a process
- Reduce cost involved
- Reduce cycle time
- Reduce people dependencies
- Reduce rework

Process improvement can be effected by adopting systematic approach of Identifying, Analyzing and Improving. Different techniques and tools like Six-Sigma, PDCA (Plan-Do-Check-Act) etc help to systematically carry out the improvement initiatives and achieve the desired improvements.

An example of PDCA approach followed at QuEST to reduce the internal defects in an Engineering Service is shown in Figure 7.
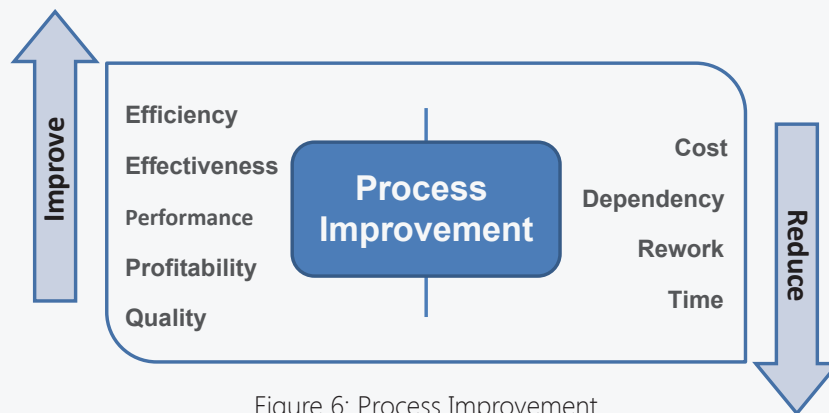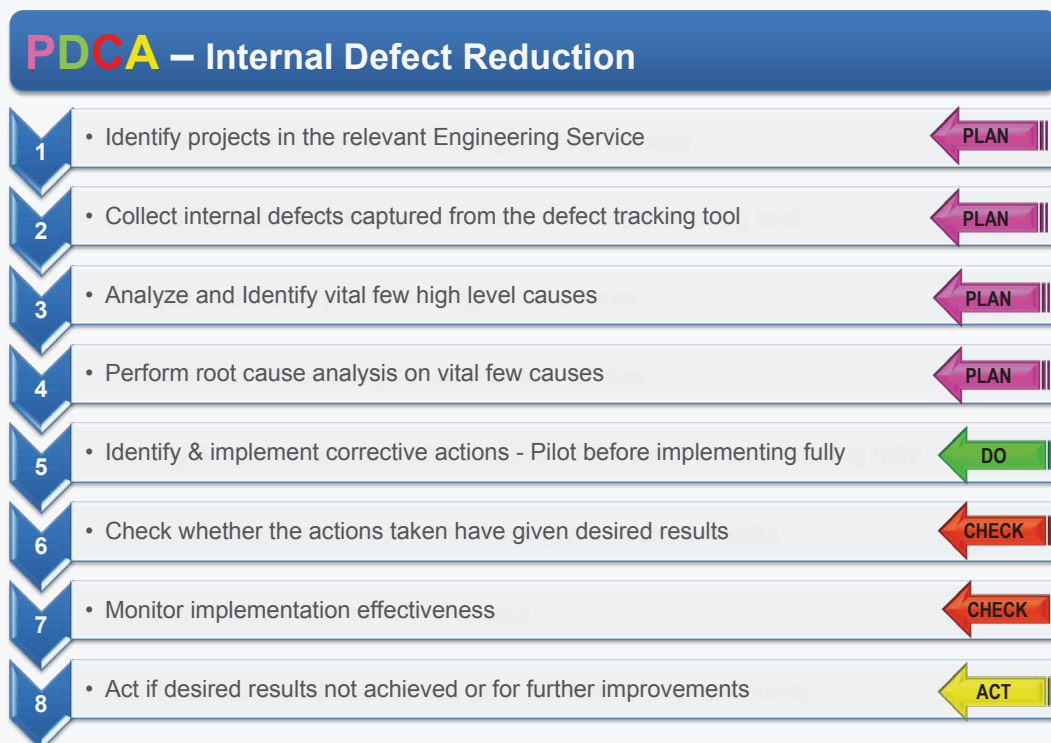
Figure 6: Process Improvement

PDCA – Internal Defect Reduction

#	Step	Phase
1	Identify projects in the relevant Engineering Service	PLAN
2	Collect internal defects captured from the defect tracking tool	PLAN
3	Analyze and Identify vital few high level causes	PLAN
4	Perform root cause analysis on vital few causes	PLAN
5	Identify & implement corrective actions - Pilot before implementing fully	DO
6	Check whether the actions taken have given desired results	CHECK
7	Monitor implementation effectiveness	CHECK
8	Act if desired results not achieved or for further improvements	ACT

Figure 7: Internal defect reduction - PDCA approach followed at QuEST

Importance of IT in running processes

Today, Information Technology (IT) has dramatically changed the way businesses operate. IT plays a crucial role in running the organizational processes in an efficient and effective way. IT should be leveraged to a maximum extent to:

- Automate the process
- Harmonize different organizational process
- Standardize the process across different divisions of the organization

- Monitor and control the process
- Data gathering and handling

At QuEST, Integrated Project Management System (IPMS) helps to effectively carry out the project through constructive workflow to achieve the project objectives. Tool harmonizes Project Management Processes with Knowledge Management, Engineering Processes, Quality Management System, Financial Systems and also interacts with the Human Resource System.

Engineering Processes at QuEST

To enhance the capability of the services delivered, QuEST management has invested in formation of Engineering Process Group (EPG) for each of the services. EPGs are the custodians of Engineering Processes for services delivered by QuEST.

The key objectives of EPG at QuEST are:

• To develop, deploy, measure and improve Engineering Processes for Engineering Services supported by the organization
• Promote re-usability of processes, tools and knowledge across the domains
• Provide guidance and support towards technical development of engineering workforce

Each group is headed by an EPG Leader. The role of an EPG Leader includes:

• Own all the processes for an Engineering Service across the organization
• Review / develop Engineering Processes for the respective service area
• Compile all guidelines and checklists for Engineering Processes
• Continually improve Engineering Processes used in the organization with the intent of improving quality, increasing productivity and reducing the cycle time for delivery

• Collect critical data – defects, effort index and schedule index for the represented service, analyze and improve
• Build virtual teams representing services across the organization
• Develop Estimation Models for activities in the respective service area
• Develop Best Practice documents in consultation with domain experts and teams across the organization
• Promote development of Best Practices, Productivity Tools, Training Materials in respective service areas
• Identify and indent the Engineering Standards required for the service
• Support Technical Competency Assessment of engineers
• Analyze current capability vs business opportunities, study the customer requirements, enhancements in existing / new engineering tool and propose a 'Service Road Map' to the sales

QuEST has 6 fully functional EPGs currently supporting process improvements across multiple service offerings.

Conclusion

The need and importance of processes in an ESO have been explained in this paper. Our experiences in QuEST have been collated and presented in the form of checklists which could be useful to process developers and their management. The applicability of standard frameworks (like CMMi) and their different components (like EPG) have been explained along with how QuEST has implemented and benefited from them.

Appendix - Brief description on elements of Engineering Process

Procedures, Workflows and Guidelines

Procedure documents detail the set of activities which are conducted as a part of the process. Guidelines provide detailed explanation on how to perform these activities. Workflows help to perform these activities in sequence, guides on decisions to be taken and handoffs between different stakeholders.

Templates

Templates are the tools required to enforce standardization. Templates across the service are required to bring standardization and save lot of time. Examples: Drawing template, Analysis report template etc.

Engineering Standards

Engineering standards are documents that specify characteristics and technical details that must be met by the products, systems and processes that the standards cover. The purpose of developing and adhering to standards is to ensure minimum performance, meet safety requirements, make sure that the product/system/process is consistent and repeatable, and provide for interfacing with other standard-compliant equipment (ensure compatibility) [5].

Estimation Models

Estimation models are mathematical algorithms or parametric equations developed using the experience of practitioners which are used to calculate the effort / competitive cost of the projects to be quoted to customer. Robust estimation models for every service in the organization are essential. Estimation models will form an important part of the organizational asset and will help drive a number of improvements and investments.

Productivity Tools

Any tool (software, mathematical, statistical, analytical or graphical) that helps us improve productivity in a service to be delivered to customer. Productivity Tools are typically developed when the tasks are repetitive. Productivity Tools can be leveraged to improve the efficiency (least amount of effort) and effectiveness (best results) of executing a task, based on repeatable procedures that have proven themselves over time for a good number of people.

Best Practices

A method or Best Practice is a technique or methodology that, through experience and research, has proven to reliably lead to a desired result. A commitment to using the Best Practices in any field is a commitment to using all the knowledge and technology at one's disposal to ensure success.

Training Materials

Training Materials on the services offered are required to facilitate learning among a wider spectrum of engineers. They should be derived from project/individual learnings to enable learning among a larger population of engineers.

Checklists

Checklists are tools designed to verify the requirements. They help to eliminate the defects in the deliverable. They provide list of checkpoints to perform Self Review.

Industry Experts

An Industry or domain technical expert is one who will spread one's knowledge and expertise across the organization there by promoting usage of Best Methods / Practices of delivering tasks.

This can be accomplished by:

- Assisting engineering teams to arrive at solutions
- Sharing and reviewing Best Practices in their areas of expertise
- Participating in Technical Reviews
- Providing assistance to the sales team
- Engage in training and competency development

Skills and Competencies

Skills and competencies of engineers need continuous enhancement to be able to meet the technology changes and customer needs. Each service should have a framework defining levels of competencies required to deliver a particular type of task and training to be provided to engineers to achieve next level of competencies. Competency analysis & development needs to be carried out in the organization to identify & enhance the knowledge, skills and process abilities required to perform business activities, tasks & responsibilities.

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Author Profile

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Santosh Puthane is a Manager with the Technology Excellence Group (TEG) at QuEST Global. He is based out of Bangalore, India and manages core TEG functions of Knowledge Management, Technical Review Process and Engineering Processes.

Santosh joined QuEST Global in 2000 as a structural analyst. He executed and managed structural analysis projects for our customers across Power Generation and Industrial & FMCG domains till 2010 and then moved to the Technology Excellence Group.

Prior to joining QuEST he worked as Design Engineer in BDK Engineering Industries Ltd., Hubli, Karnataka, India. He has supported Design & Development of high pressure industrial valves.

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About QuEST Global

QuEST Global is a focused global engineering solutions provider with a proven track record of over 17 years serving the product development & production engineering needs of high technology companies. A pioneer in global engineering services, QuEST is a trusted, strategic and long term partner for many Fortune 500 companies in the Aero Engines, Aerospace & Defence, Transportation, Oil & Gas, Power, Healthcare and other high tech industries. The company offers mechanical, electrical, electronics, embedded, engineering software, engineering analytics, manufacturing engineering and supply chain transformative solutions across the complete engineering lifecycle.

QuEST partners with customers to continuously create value through customer-centric culture, continuous improvement mind-set, as well as domain specific engineering capability. Through its local-global model, QuEST provides maximum value engineering interactions locally, along with high quality deliveries at optimal cost from global locations. The company comprises of more than 7,000 passionate engineers of nine different nationalities intent on making a positive impact to the business of world class customers, transforming the way they do engineering.

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