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productivity improvement in generation of sops for oil and gas equipment manufacturing

This white paper considers the challenges involved in generation of Standard Operating Procedures (SOPs) in the oil and gas equipment manufacturing sector. It also offers an improved work process for generating better quality SOPs more efficiently.

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Abstract

This white paper considers the challenges involved in generation of Standard Operating Procedures (SOPs) in the oil and gas equipment manufacturing sector. It also offers an improved work process for generating better quality SOPs more efficiently.

The oil and gas equipment manufacturing sector is a high impact one. Any slippages in the process of manufacturing that result into faulty equipment may lead to complications at stages where reversing/ checking the error may not be possible.

The manufacturers are therefore documenting their SOPs to maintain uniformity in processes and output across all levels of functioning, region and geography.

This white paper enables an SOP publisher to understand the advantages of employing an onsite project lead to accelerate the generation of a high quality SOP. A publisher can critically understand the success factor of such an engagement and the process of arriving at the new generation factor.

The Challenges

The difficulties faced by lack of good SOPs have been widely documented. A report by BP was published following the Gulf of Mexico oil spill accident. According to the report 'Deepwater Horizon Accident Investigation', reasons leading to the accident were lack of good SOPs and non-adherence to the existing ones. For example, the investigation team could not identify any established industry standards for conducting negative-pressure tests. This is supported by expert testimony during the July 23, 2010, Marine Board of Investigation (MBI) hearings. Another investigation result states that a defoamer additive was used in the cement slurry, whereas supplier's standards included a specific recommendation to avoid using dispersant or defoamer additives with foam cement, indicating non-adherence to the existing recommendations.

Accidents of such magnitude have a huge impact on the environment, the climate, the ecosystem and human life. This is one reason that safety concerns should be of high priority. High standards in the oil and gas equipment manufacturing sector means that it is of utmost importance to generate uniform output that meets the manufacturing specifications. Quality SOPs are vital to this process and are required to be updated quickly, and as and when required so that workers and executives can follow them immediately. Employees should be trained to adhere to and effectively practise these standards for compliance purposes. Documenting quality SOPs in the industry is indispensable for a number of reasons that include:

- Standardizing output. The varied workforce participating in the process comes with differing experience and expertise. If each individual is led to infer the process outcomes on their own, there is a variation in the final output
- Minimizing variation and promoting quality through consistent implementation of process or procedure within the organization
- Effectively training workforce in case of temporary or permanent change in workforce
- Serving as guidelines or checklists for inspectors during audits
- Minimizing opportunities for miscommunication and addressing safety concerns
- Reducing work effort, along with improved comparability, credibility and legal defensibility

SOPs should be current to remain useful. Therefore, whenever procedures change, SOPs should be updated and re-approved. It has been found that the entire process is time consuming and often leads to delays and missing deadlines. Manufacturers with global operations in other industries such as the automotive industry rely on SOPs to standardize processes in all of their facilities. For example, a Japanese automotive company trains its personnel in the United States on key manufacturing processes and then uses SOPs to make sure that the company's high quality is reflected in every car sold regardless of where it was assembled.

Factors Affecting SOP Generation Time

One of the root causes affecting the generation time of SOPs was found to be the loss of time due to involvement in managerial and/or coordinating activities such as:

- Onsite enginee's lost time in carrying out administration-related activities such as login problems, Engineering Change Order (ECO) problem, and access to customer SAP, thus affecting input capturing activity
- Onsite engineer's inability to get forecast of assembly schedule tools and hence loss of time in getting the schedules
- Onsite engineer's lack of clanity on roles or work
- Loss of onsite and offshore engineer's time during multiple reviews of SOPs
- Lack of proper matrics onsite and offshore engineer to track work in progress and offshore activities
- Lack of proper matrics onsite and offshore engineer to track work in progress and offshore engineers had no proper metrics available to track work in progress

To meet the challenges, SOP publisher need to look at ways to bring down the generation time of creating SOPs without compromising on quality of the document and cost factor.

Setting Up the SOP Work Stream

The QuEST team applied data analysis and value stream mapping to the earlier work stream to analyze the causes for the differences. Based on this, QuEST has introduced a number of corrective actions in the entire process of generation of SOPs.

One of the important corrective actions suggested is the allocation of a dedicated onsite project lead who will be responsible for the overall planning and scheduling of the project work onsite. This will allow the onsite engineers to take care of activities related to the successful execution of the project. It will also allow them to establish better coordination and communication among the team members who are both onsite and offsite, as well as the client. This should cut down on the time lost in various administration-related activities such as login problems, ECO problem, access to customer SAP, forecast of assembly schedule tools and greater clarity of roles and work thus leading to higher productivity. The following is the list of activities to be carried out by the onsite project lead:

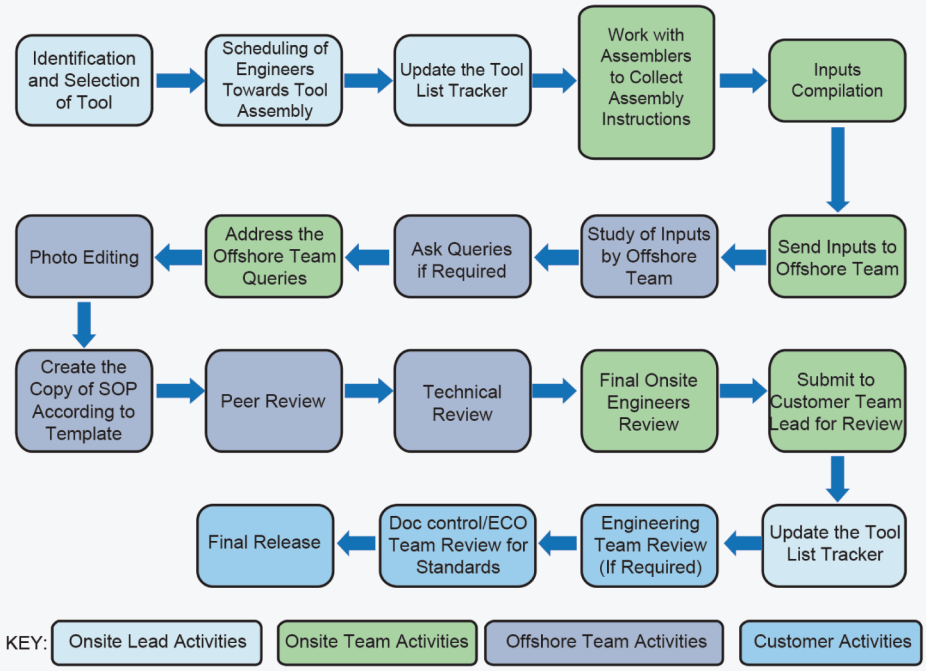
- Identifying tools to assemble
- Selecting the tools required on a priority basis
- Scheduling and plan the delivery of SOP
- Solving the computer/login issues and other admin activities
- Carrying out the ECO process
- Coordinating with the document control department
- Creating document control number
- Coordinating between offshore and onsite team
- Tracking the onsite team performance

These tasks will help in planning, scheduling and improving productivity in the generation of SOPs by:

- Providing forecast to onsite engineers
- Ensuring on-time delivery
- Eliminating the need for coordination and/or managerial activities from onsite engineers
- Allowing the onsite engineers to focus on execution/data collection

This will enhance team performance, final output and customer satisfaction.

Of the total number of sub-activities involved in the generation of an SOP, 86.4% of the activities should ideally be carried out by the publishing team, and the rest will require client’s participation. Amongst the total number of activities to be carried out by the publishing team, 36.4% of the work is done by the onsite team while the remaining 50.0% is taken care of by the offshore team. A flowchart of the QuEST SOP work stream follows:

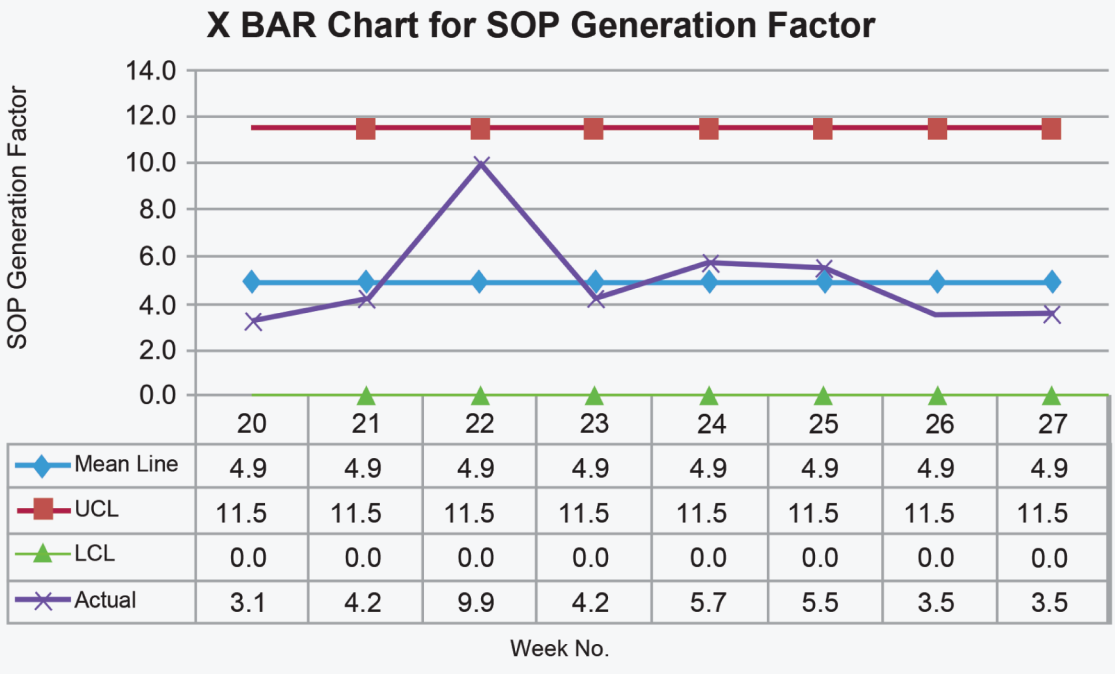


This updated work stream helped in achieving an improved productivity, and a better SOP generation factor of 3

Productivity Improvement Parameters

Time as a Parameter for Improvement

SOP generation factor is an indicator of time required to prepare an SOP. The relation between SOP generation factor and time taken to prepare an SOP are directly proportional. Therefore, this directly effects the cost factor and delivery time. The higher generation factor is due to loss of time resulting out of redundant activities.



	20	21	22	23	24	25	26	27
Mean Line	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
UCL	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
LCL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Actual	3.1	4.2	9.9	4.2	5.7	5.5	3.5	3.5

Targeted SOP Generation Factor based on Juran's Entitlement Method			
Sl. No.	Parameter / Description	UOM	Value
1	Average SOP Generation Factor	Nos	4.9
2	Best (Minimum) Observed SOP Generation Factor	Nos	3.1
3	Difference Between Average and Minimum	Nos	1.8
4	Entitlement or Improvement Opportunity	Nos	1.5
5	Revised Target for SOP Generation Factor	Nos	3.4

Quality as a Parameter for Improvement

Majority of the tasks for generating SOPs revolve around publication. Grammatically correct and error-free content with relevant graphical representations at appropriate places is essential as quality parameters. Other quality parameters that may affect the final output are skill improvement, familiarization with work, skill levels of employed human resource, tools and infrastructure.

Taking into account the quality parameters for calculating improvement, the targeted value of average SOP generation factor was calculated at 3.

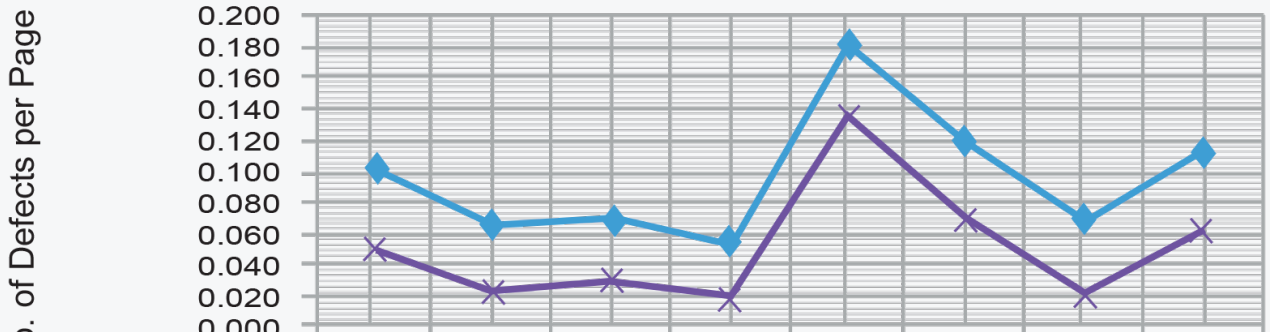
No Compromise on Quality

According to Juran, the quality of a deliverable should never be compromised in the enthusiasm of reducing the SOP generation factor. QuEST strongly believes in the same.

The following table comprises data points that represent the quality of SOPs generated before implementation of the recommended process:

Sl. No.	Week No.	Pages of SOP Submitted	Cumulative Page of SOP Submitted	Defects / Page				Cumulative Defects / Page			
				Appearance	Functional	Critical	Total	Appearance	Functional	Critical	Total
1	20	199	199	0.035	0.010	0.005	0.050	0.035	0.010	0.005	0.050
2	21	84	283	0.012	0.012	0.000	0.024	0.028	0.011	0.004	0.042
3	22	68	351	0.029	0.000	0.000	0.029	0.028	0.009	0.003	0.040
4	23	103	454	0.010	0.010	0.000	0.019	0.024	0.009	0.002	0.035
5	24	67	521	0.075	0.060	0.000	0.134	0.031	0.015	0.002	0.048
6	25	101	622	0.040	0.030	0.000	0.069	0.032	0.018	0.002	0.051
7	26	169	791	0.012	0.012	0.000	0.024	0.028	0.016	0.001	0.046
8	27	173	964	0.035	0.023	0.006	0.064	0.029	0.018	0.002	0.049

Defect Trend for SOPs



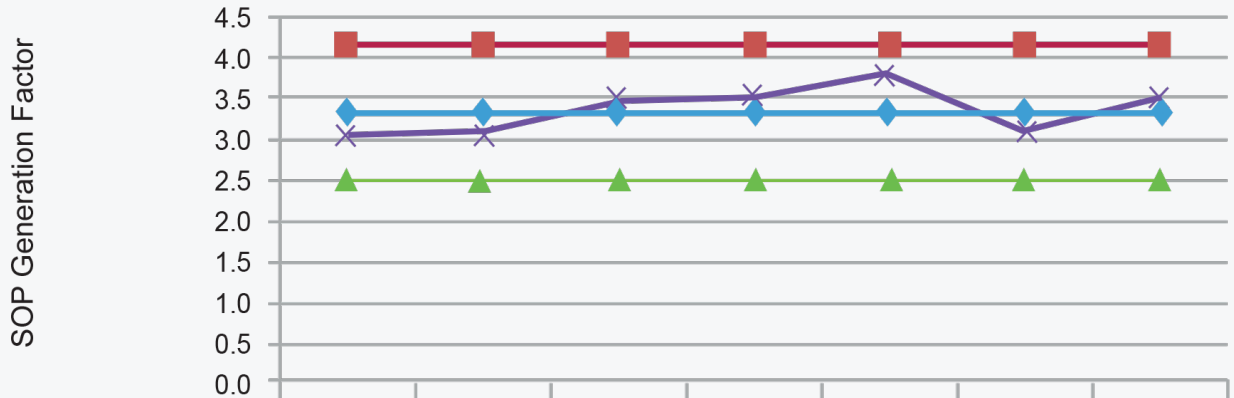
	20	21	22	23	24	25	26	27
Cumulative Defects/Page	0.050	0.042	0.040	0.035	0.048	0.051	0.046	0.049
Defects/Page	0.050	0.024	0.029	0.019	0.134	0.069	0.024	0.064

Week No.

When compared with the allowed number of defects (i.e., three defects per two pages of SOP generated), the quality of the deliverable was found to be reasonably good.

Post the implementation of the new work stream (the recommended process), the critical parameters of SOP generation factor and the quality of SOPs generated were found to be

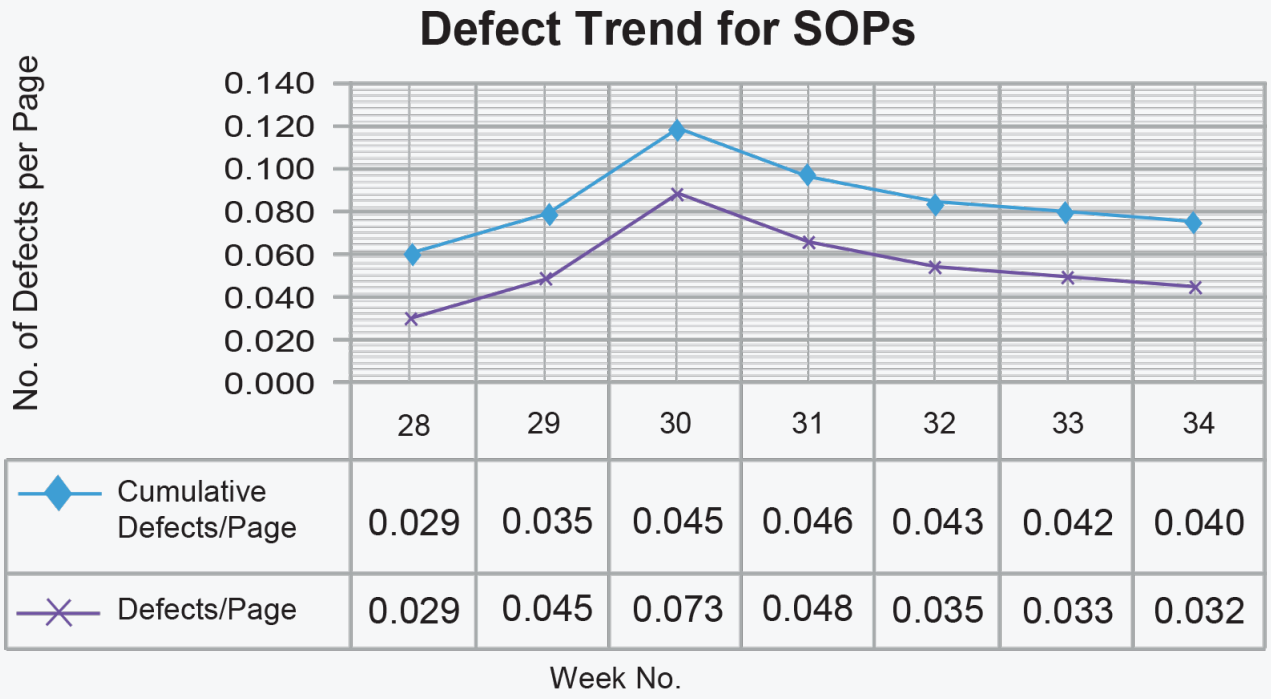
X BAR Chart for SOP Generation Factor



	28	29	30	31	32	33	34
Mean Line	3.3	3.3	3.3	3.3	3.3	3.3	3.3
UCL	4.2	4.2	4.2	4.2	4.2	4.2	4.2
LCL	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Actual SOP Factor	3.1	3.1	3.4	3.5	3.8	3.1	3.4

Week No.

Sl No.	Week No.	Pages of SOP Submitted	Cumulative Page of SOP Submitted	Defects / Page				Cumulative Defects / Page			
				Appearance	Functional	Critical	Total	Appearance	Functional	Critical	Total
1	28	205	205	0.024	0.005	0.000	0.029	0.024	0.005	0.000	0.029
2	29	112	317	0.027	0.018	0.000	0.045	0.025	0.009	0.000	0.035
3	30	123	440	0.033	0.041	0.000	0.073	0.027	0.018	0.000	0.045
4	31	146	586	0.034	0.014	0.000	0.048	0.029	0.017	0.000	0.046
5	32	230	816	0.022	0.013	0.000	0.035	0.027	0.016	0.000	0.043
6	33	90	906	0.022	0.011	0.000	0.033	0.026	0.015	0.000	0.042
7	34	157	1063	0.019	0.013	0.000	0.032	0.025	0.015	0.000	0.040



The average SOP generation factor reduced to 3.3 with a minimal standard deviation of 0.3, indicating a more stable process. The productivity improvement parameters were further tested against a hypothesis for Single-Tailed Student's T-test for equality of means of the two samples, and F-Distribution test for equality of the variances. The tests were carried out to re-check if there was any significant improvement in means before and after implementation of the recommended solution, and to ascertain that changes are not due to any random/un-assignable causes.

Rejection of the null hypothesis and acceptance of the alternate hypothesis confirmed an improvement in the process with a reduced SOP generation factor and with compromise on quality, by QuEST. This was inferred on the basis that the level of defects per page continued to be the same, while the X-Bar chart for the piloting stage reflected no over or undershoots indicating that the process was more stable. Thus, there was significant value added for the client.

Conclusion

While going through the new work stream it is evident that the addition of an onsite project lead is a significant factor in the updated process.

However, this involves an addition of cost contributed by a non-revenue role from which long-run gains are expected. The benefits may include satisfied customers who can provide new and long term business plans that may make up for the cost in part, if not fully.

Other initiatives that are likely to be undertaken to further improve the generation factor, without compromising on the quality of deliverables are:

- Improvement in productivity using break-even analysis technique and technological improvements to arrive at various levels of technology or costs, based on the amount of work-load situations
- Further reduction of SOP generation time through application of parallel processing at the start of designing (adoption of Concurrent Engineering Practices), with the cooperation of both client and QuEST which may ultimately help in reducing the costs incurred in prototypes or issues in actual build
- Study of scalability of the improved process to other service areas like routers, CMM programming, CNC machine programming is likely to be taken up by exploring the technology front rather than managerial activities

Using the new work stream, the QuEST team has successfully completed more than 150 SOPs with about 20,000 hours of authoring experience in SOPs. Going forward, use of the current SOP generation factor as an estimation tool will be tried, and the factor will be fine-tuned and converted to a robust estimation model based on the analysis of differences. This will help in accurately quoting prices to customers. As the knowledge of tool assembly time develops, the currently treated, Time and Measurement (T&M) project will be converted to a fixed bid project. Once T&M projects are converted to fixed bid type, productivity improvements will help improve the margins.

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Author Profile

Satyanarayana H.N

Satyanarayana H.N. has an overall experience of 28 years in the industry, with over 20 years in manufacturing of bearings, office automation and auto component industries. For the last 8 years, he has worked in the engineering services industry. A significant contributor at QuEST, he is also a certified lead auditor for ISO 9001:2008 quality management systems. His technical proficiencies include gear and bearing design, FMECA, DFM assessments, tolerance analysis and QMS auditing.

Amongst his significant achievements, Satyanarayana has:

- Handled full cycle development projects on'ruggedization' of computing projects for a US based client
- Handled full cycle development projects on gear drives and special purpose bearings for MOCVD equipment used in semiconductor growth that demanded operations in elevated temperatures of 1300°C
- Published/presented papers on low cost automation, alternate energy, reverse engineering techniques, DOE for defect analysis at internal forums and at centres of learning like IISc
- Successfully guided three master's projects for MSRSAS and Symbiosis on concurrent engineering and defect analysis

Satyanarayana holds a Bachelor of Mechanical Engineering with an MBA in Operations Management. Currently, he is Principal Engineer at QuEST Global. He is responsible for reviewing estimates and working products for first-off projects, participating in and facilitating corrective and preventive actions for repeated defects (internally identified and client reported), arranging and delivering technical trainings, and guiding projects on technical solutions.

He lives in Belgaum with his wife and son.

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The author wishes to thank Adarsh Singh, Ajeya Sunkad, Anjana Angadi, Deepak Munoli, Hariom Baghel, Maruti Kunnurkar, Mayuri Velangi, Pramod Nayakawadi, Premanand Dundur, Rangaswamy C Poojar, Shivanand Yadawad, Victor Wassef, Vineeta Yadav, Sandesh Shirodker and Dennis Devaraj for their contributions without which this whitepaper would not have taken shape.

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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