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Supplier Capability Maturity Model - Case Study at DivgiWarner

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ABSTRACT

This case study covers the supply chain management experience of a leading Drivetrain System Solution Provider in India. They have a global supplier base of 121 suppliers spread over 12 countries, handling different commodities like castings, forgings, machined parts, sheet metal parts, electrical and electronics parts and powder metal parts.

Supply Chain Management is vital in sustaining competitiveness in a global market. A committed supply chain is an integral part of the overall value chain of an organization. Intent of the supply chain management is to utilize systems and processes to develop, monitor and control supplier performance.

Divgi-Warner Pvt. Ltd. based in Pune, India, has developed a framework called *Supplier Capability Maturity Model, Supplier CMM.* The primary objective of this framework is to improve capabilities of suppliers and to meet customer expectations by focusing on the level of knowledge, skills and process abilities. This paper will describe Divgi-Warner's experience and techniques associated with the Supplier Capability Maturity Model over the last seven years. It touches upon the key steps to achieve business excellence in Supply Chain Management.

It includes:

1. Supplier Selection Process (Plan)
2. Supplier Development Process (Do)
3. Supplier Performance Monitoring Process (Check)
4. Supplier Up-gradation Process (Act)

The Supplier Capability Maturity Model methodology, delivered the following benefits for Divgi-Warner to fulfill its vision of product leadership:

- Practices are repeated and reproduced across the entire supplier community.
- Best practices are transferred rapidly across suppliers for maximum benefits.
- Variations in performing best practices are reduced, and
- Practices are continually improved with quantitative feedback to enhance their capabilities.

INTRODUCTION

The Supplier Capability Maturity Model, Supplier-CMM, is a guideline for implementing supplier development practices. These practices continuously improve the capability of the supplier base and sustain the capability at World-Class levels. Supplier CMM establishes an integrated system of quality practices that matures through increasing alignment with customer's business objectives, performance, and changing needs. Supplier CMM aims to improve the overall supplier standard which also includes improving its Product Quality which is very significant but it is merely a part of the overall development. These capabilities can be the level of knowledge, skills and process abilities available for performing activities that fulfill a Customer's supply needs. Besides this, the work ethics and business approach that a customer follows also play an important role in defining its capability. Though these factors seem insignificant, they actually assist a supplier to meet his time deadlines.

In order to measure and improve capability, the supplier-base must be divided into constituent competencies. Each competency represents a unique integration of knowledge, skills, and process abilities acquired through specialized education and work experience. Each Customer needs to design its supply-chain to include these competencies required to perform its business activities. The competency can be characterized by its capability - the profile of

knowledge, skills and process abilities acquired or developed by the customer.

The Supplier CMM discussed in this paper follows the framework of TS 16949-based Quality Management System. It describes an evolutionary improvement path intended to achieve a mature infrastructure of practices. It focuses only on those vital set of practices that provide the next foundational level for upgrading the supplier-base. By working diligently to install them, the customer can steadily improve its supply-chain and make lasting gains in performance and competitiveness. Strategic implementation of this model draws attention even towards those practices that are minute yet generally overlooked although they affect the performance substantially.

The Supplier CMM described here aims to attain certain predefined aspects of maturity. These will act as the benchmark as well as motivational guidelines in framing the structure of the model. These maturity aspects, when very broadly classified can be described as:

- Repeatability & Reproducibility
- Disciplined Foundation To Repeat Good Practices
- Documentation & Integration of Identified Good Practices
- Performance Monitoring (Quantitative)
- Deployment of Corrective Actions

Therefore, Supplier CMM is a tool to attain these goals systematically. Since this cannot be done overnight, Supplier CMM introduces concepts and practices in stages making them easier to implement and monitor. Each progressive level produces a unique transformation in the Supply Chain culture by making it more powerful for developing, motivating, organizing, and upgrading its supplier base. To be very brief, the various stages or tiers of implementing the Supplier CMM are:

Stage 1. Suppler Selection

Stage 2. Supplier Development

Stage 3. Supplier Monitoring

Stage 4. Supplier Up-gradation

Although the steps involved in these stages can be described here, they can be subjected to modifications based on the needs of the organization involved.

NEED FOR SUPPLIER CMM

It was seen that improved practices cannot survive unless the organization's behavior is changed to support the development. Consequently, a framework was designed to enable an organization to achieve continuous process improvement. This can be described as an integration of the following 5 aspects:

Repeatability & Reproducibility

At the initial level, the organization typically does not provide a stable environment for developing new products. The development process is unpredictable and unstable because the process is constantly changed or modified as the work progresses. A fundamental premise of the process maturity framework is that, *a practice cannot be improved if it cannot be repeated. REPEATABILITY AND REPRODUCIBILITY are the hallmarks of a mature organization.*

During the least mature state of an organization, proven practices are repeated only sporadically. The most common impediment to repeatability is a committed delivery date & uncontrolled change of requirement changes. The first step in helping an organization is to help it to remove impediments that keep them from repeating successful development practices.

Disciplined Foundation to Repeat Good Practices

This aspect of maturity stresses that the organizations must establish a foundation on which they can deploy common processes across the organization. A stable environment is essential for advanced practices. The primary objective is to enable people to repeat practices (e.g. a standardized RFQ process with suppliers) they have used successfully. To enable this repeatability, managers must get control of commitments and baselines. To establish a repeatable capability is to establish basic management practices within each unit or project. Only when this management discipline is established, will the organization have a foundation on which it can deploy its common processes.

Documentation & Integration of Identified Good Practices

The focus here is on documenting the standard processes, integrating them into a common process, and training the entire organization. (For example, the Supplier Manual)

Measures of the critical practices are defined and collected into a repository for analysis (again, say, the Supplier Performance Measurement System). When the organization defines a standard process, it has laid the foundation for systematic continuous improvement. These processes are used to help the managers, team leaders, and development team members perform more effectively.

Setting the Goal & Performance Monitoring (Quantitatively)

This factor ensures that the organization establishes metrics for products and processes and measures results. Projects

achieve control over their products and processes by narrowing the variation in their process performance to fall within acceptable boundaries. The development process is also made predictable because the process is measured and operates within measurable limits. When these limits are exceeded, action is taken to correct the situation. Customer and the Supplier begin managing their relationship through data that describes the supplier's performance. The performance of the supplier is trended over time (say a six-month rolling average) so that historical performance of the process can be used to predict and manage its future performance.

Deployment of Corrective Actions

Here, the entire organization is focused on continuous process improvement. Now, the organization has the means to identify weaknesses and strengthen the process proactively, with the goal of preventing the occurrence of defects. Customer and the supplier organization would use their profound, quantitative knowledge to make continuous improvements in their interactive and overlapping processes. Based on data, they can identify which processes can benefit the most from the improvements. These improvements can involve actions ranging from adjustments to existing processes to the deployment of new technologies. In addition, the supplier organization uses its data to identify its most persistent defects. The root causes of these defects are analyzed and actions are taken to eliminate their occurrence with verification review by the customer.

After highlighting the necessity for Supplier CMM model, let us discuss in details the four stages of this model.

STAGE 1- SUPPLIER SELECTION PROCESS

Supplier selection is the starting process of the Supplier CMM and being the first phase, it serves as the platform for the next phases. The intention behind supplier selection process is identifying the best supplier on the basis of quality, cost and the process requirement. It is extremely important to select the best supplier from the beginning because the groundwork done in the initial stages help in reducing the workload in the development and up-gradation stages later.

The supplier selection process starts with identification of the part that has to be outsourced. The next step is making a list of the potential suppliers for the above mentioned part. All the potential suppliers are invited to participate in the quoting process. Suppliers are required to use the forms supplied in the Request For Quotation (RFQ). The RFQ form aims at providing required information about the product to be outsourced along with annual demand and other terms. This gives a brief idea to the supplier about the business they are about to undertake. Besides this, the form intends to seek details of the product cost with the provided split-up format. These are some of the basic checkpoints for comparing the quotations. In addition to the above requirements, the suggestions for cost reduction are also welcome in the RFQ form. These forms follow specific standard formats and it is expected from the supplier to comply with them and provide the necessary information without failure.

On the basis of quotations received, a supplier is shortlisted. If the selected supplier happens to be a new supplier he has to perform a self assessment process by using the following:

(1) Questionnaire Form (2) Supplier Risk Assessment Form (3) EHS System Assessment Form

1) Questionnaire Form

The questionnaire form consists of details regarding the company profile, principal suppliers, customers, project & process planning, quality standards, internal PPM, customer complaints, process capability, continuous improvement programs and some other relevant details. This helps in deciding whether the supplier would be able to perform the assigned task within the stipulated time while maintaining the quality standards. It also indicates the work culture and ethics which are also important aspects that affect the product quality.

2) Supplier Risk and Quality System Assessment Form

It is an in-depth assessment of the quality procedures followed, the risks involved and the current financial position of the supplier. The analysis takes into account features like quality systems, resource management, preventive & predictive maintenance, timely process audits etc. Each parameter is judged on a scale of 0 to 3 where a score of 3 means proper evidence of compliance. A score of 2 stands for evidence with minor non-compliances and 1 with major non compliances. While a score of 0 says that no evidence of compliance exists.

To assess the financial status of supplier organization, a Z-score (financial score) is calculated which indicates that the company is either safe, needs monitoring or risky. A Z-score >=2.9 indicates that the company is safe while a Z-score between 1.22 and 2.89 means monitoring is required while a Z-score <=1.21 indicates that high risk is involved.

3) EHS System Assessment Form

Environment Health & Safety (EHS) ensures whether the processes carried out by supplier are environment friendly and as per the health & safety norms. The EHS policy of the supplier is observed and a score is calculated. On the basis of the score a risk rating is assigned and the supplier is asked to

take corrective action to bring the suspected process within the desired norms.

After the supplier self assessment of newly identified supplier is complete, a decision is taken whether onsite assessment is required or not. If the decision is "YES" then the onsite assessment is carried out in a way similar to that done by the supplier in the self assessment process. Subsequently a rating is done on a scale of 3 and if the score calculated is >=2 the supplier is approved. If the score is < 2, the supplier is asked to undertake corrective actions to improve the score by providing appropriate suggestions. After verification of the effective implementation of the corrective action, the supplier is included in the vendor list.

The next step is carried out for both, the old and the new supplier, which involves Feasibility Review and Supplier Team Feasibility Commitment. This ensures that the supplier is capable of delivering the desired product & the customer requirements are communicated properly.

Refer Appendix 1 *for Supplier Selection Process Flowchart.*

STAGE 2- SUPPLIER DEVELOPMENT PROCESS

The supplier development process follows the supplier selection process and is extremely important as the part outsourced is developed in this step. The main function of the supplier development is to ensure that the part is manufactured while keeping all the quality standards in mind and as per the given specifications. It is a very long process and requires periodic reviews & communication between the two parties. Advanced Product Quality Planning (or APQP) process is followed for new product development with the suppliers. Before moving ahead with the development process, it is better to have a brief flash on APQP model.

Advanced Product Quality Planning (or APQP) is a framework of procedures and techniques used to develop products in industry, particularly the automotive industry. APQP serves as a guide in the development process and also a standard way to share results between suppliers and automotive companies. APQP covers three aspects: Development, Productionization and Product Launch.

APQP checks the feature like design robustness, design testing & specification compliance, production process design, quality inspection standards, process capability, production capacity, production part approval, product packaging, product testing and operators training plan. APQP model utilizes five major phases:

a. Plan and Define Program

b. Product Design and Development

c. Process Design and Development

d. Product and Process Validation

e. Production

The first step of the supplier development process is to finalize the APQP time plan with the supplier and review it periodically. Once APQP timeline and plan is finalized, Team Feasibility Commitment is done and the supplier is asked to submit the balloon drawing with the ISIR format (without inspection results) covering all the specifications mentioned in the technical drawing. This ensures that the supplier has understood the customer requirements. After the Team Feasibility Commitment, the supplier starts process design and development, and submits 3 samples within the agreed time-plan along with the balloon drawing and completed ISIR. ISIR stands for Initial Sample Inspection Report which gives a detailed inspection result of all the specifications as mentioned on technical drawing of the samples submitted. It also checks whether the sample is within the desired specification limits or not. Ballooning is a method of assigning a unique number to a characteristic mentioned on the product drawing. It acts as an input for an ISIR. Ballooning makes it easy to trace dimension/characteristic on the drawing and ensures that all the design requirements are measured.

The in-house cross verification of the samples is done by the customer to ensure the samples meet the design requirements. The acceptance norms and gauging requirements are also finalized at this stage. If the samples do not meet the design specifications, the supplier is asked to correct/ revisit his internal processes and advised to take appropriate corrective measures. The initial batch is called PPAP, (Production Part Approval Process) batch. Clearance for this PPAP production is given, if the samples are found okay the self assessment for readiness of PPAP is performed. For this assessment a special kind of check sheet, WAR (We Are Ready) is used which indicates the readiness of PPAP and evaluates whether onsite assessment of PPAP is required or not. The intent of WAR is to verify production readiness of a supplier prior to the start of production. It also understands, identifies open issues and sets action plans for them. It verifies whether the supplier has met all the 5-M i.e. Man, Material, Method, Machines & Measurement requirements to start the production successfully. This also covers packaging, work instructions & documentation etc. clearing even the smallest doubts. A detailed introspection of processes is done by using PPAP checklist. The checklist consists of design records, design FMEA, process flow diagrams, process FMEA, measurement, process capabilities and other relevant details. After satisfactory compliance to all 19 quality documents (mentioned in PPAP) the production process is validated & approved by signing the Part Submission Warrant (PSW).

The PPAP is extremely significant as it lays the foundation for smooth running of the serial production processes. The PPAP is a pro-active approach to ensure that suppliers of

components comply with the design specification and can run consistently without affecting the customer line and improving the product quality. PPAP ensures that you will achieve the right quality from the first time itself. Thus in a nutshell, if PPAP is done diligently, then the serial production process becomes free of errors and hassles.

The PPAP review results are communicated to the supplier and if required he is asked to implement corrective actions. Otherwise the PPAP is approved and the consent to start the serial production is given. The performance of the supplier is monitored keeping the quality and delivery aspects in mind for the next six months. This performance report then acts as the guideline for supplier monitoring and up-gradation.

Refer Appendix 2 *for Supplier Development Process Flowchart*

STAGE 3- SUPPLIER PERFORMANCE MONITORING

This is another important aspect of the CMM. The development of supplier is only the initial phase of the CMM. It is equally important to monitor the supplier performance regularly. This ensures consistent supplier performance to match the desired specifications. This process actually consists of rating the suppliers on the basis of their performance and subsequently taking corrective actions if they under-perform. To make it effective, it is necessary to carry out these ratings on a regular basis so as to expose any discrepancy at an early stage.

Refer Appendix 3 *for Supplier Monitoring & Up-Gradation Process Flowchart*

The Supplier Performance Monitoring can be effectively implemented in an industry as a 3-tier system. This 3-tier system comprises of **(i) Regular Supplier Complaints, (ii) Monthly Performance Card** and **(iii) Annual assessments** for chronic aspects.

All these tiers are rather complementary to each other. Let's discuss these aspects individually:

(i) Regular Supplier Complaints:

This is the very basic element of performance monitoring. As non-conformities in the incoming inspection are observed, complaints are raised on the purchased material. Then the supplier is asked to make the root cause analysis and take appropriate corrective actions (CA) by using 8-D problem solving technique. 8-D is a problem solving tool which involves a multi-disciplinary team to identify the root cause and implement CA. *Refer* appendix 4 *for 8D format.* Further, the effectiveness of the CA is verified through the Defect Matrix. The Defect Matrix is a tabular representation of defects and their monthly recurrence. In case, the actions being employed have been effective, the 8-D is closed. The records are of all these activities are maintained for future reference.

In case the Defect Matrix indicates recurrence of the defects then, the supplier or defect is tagged as a chronic. The chronic tag is also given in monthly evaluation. So, the actions that are taken to correct them would be discussed in the Monthly Performance Monitoring Process.

(ii) Monthly Performance Monitoring:

This is the most important aspect of performance monitoring. It is never beneficial to take corrective actions after the supplier has deviated beyond the promised performance. It leads to wastage of time, money and material. Hence, a continuous watch on the supplier performance becomes mandatory. Here, Performance is often ambiguous with the term Product Quality. Although quality is an important aspect, Performance covers overall supplier capability including knowledge & skill levels and work ethics.

In Monthly Performance Monitoring, the data is collected from the MRP (Material Resource Planning) system and based on which a Monthly Report Card and Defect Matrix are prepared for each supplier. The Monthly Report Card monitors the supplier's **Quality, Delivery** and **Value Improvement Points.**

Quality: Quality is given a weightage of 40 points out of 100 in the Monthly Report Card. The number of rejections is used to calculate the PPM defect rate. Further, quality scores are given on the basis of this PPM defect rate.

Delivery: Delivery is also given a weightage of 40 points out of 100. This is calculated on the basis of On Time Delivery Performance which is the ratio of actual quantity and the scheduled quantity for the given period.

Value Improvement: It is given a weightage of 20 points out of 100. This is further divided into 4 sub-levels with equal weightage of 5 points each. These levels are a) Quality System Basics Implementation b) TS-16949 Certification c) On-Time 8-D Response d) Lean Manufacturing Techniques Implementation.

The results thus obtained are communicated to the respective suppliers on or before the 10^{th} day of every month. The score card result alerts the customer as well as the supplier about any minute fluctuation in their performance. This triggers the corrective actions to be taken well in advance to mitigate any further interruptions in the production process. On the basis of these evaluations the suppliers are rated. The suppliers depicting continuous aberrations are tagged as ‘Chronic’.

These chronic suppliers are handled with due care and seriousness. They are provided with the Action Plan for corrective and preventive measures so as to improve their performance. Besides this, they are also identified as the candidates for the annual assessments. In case no improvement is seen, an onsite visit becomes necessary. They are invited to attend Quality System Basics (QSB) training and also shown practical implementation on the customer shop floor for better understanding.

(iii) Annual Assessments:

Annual Assessments are similar to rigorous audits carried out by officials assigned by the company. They are carried out annually and specifically on those suppliers who are tagged as 'Chronic'. Top priority is given to such chronic suppliers. A detailed Audit Plan is made. Then an on-site visit to the supplier production unit is made, where the above plan is implemented. The personal visit helps in gathering root causes for the short comings in the supplier's performance. These evidences are presented in the form of an assessment report, which are communicated to the supplier as well as utilized to frame an effective Action Plan. According to this plan the actual causes of defects are attacked without any ambiguity.

STAGE 4 - SUPPLIER UP-GRADATION

Supplier Up-gradation deals with the efforts put in to improve supplier practices. The quantitative results obtained from the previous phases act as guidelines in this phase. Sometimes, the practices of the supplier improves certain practices of the customer, hence it's a two way process benefiting everyone. Supplier up-gradation is not a single process but a series of practices put in together with varied intentions.

Refer Appendix 3 *for Supplier Monitoring & Up-Gradation Process Flowchart.*

Let us go through some of these practices in detail:

Supplier Training:

It is important to empower the supplier with the latest and proven practices. To ensure this, supplier training sessions are essential. These training sessions are conducted for effective collaboration and healthy customer-supplier relationships.

Each Supplier Training Program focuses on one of the basic aspects such as:

1. Quality: PPAP, SPC, MSA, Control Plan, FMEA etc.

2. Delivery: Lean Manufacturing, JIT (Kanban) etc.

3. Value improvement: TS-16949, 8-D problem Solving, Cost Reduction, RPN, Kaizen, QSB etc.

Only the assigned officials from the supplier's side attend these training sessions. The suppliers are invited in groups for the training in which the first phase is conducted in the class rooms. For better learning, they are shown practical implementation of good practices on the shop floor.

Then, these practices are effectively transferred to all the supplier's employees. This is assured by providing teaching modules to the participants who attend the training sessions. The suppliers are also provided with useful forms-formats and other resources that are already in use at the customer's end.

One of the significant training sessions is on Quality System Basics (QSB). It incorporates the following 10 key initiatives to establish world class quality.

1. Fast Response Meeting

2. Control of Non-Conforming Product

3. Layered Process Audits

4. Standardized Operations

5. Standardized Operator Training

6. Error Proofing Verification

7. RPN Risk Reduction

8. Contamination Control

9. Supply Chain Management

10. Verification Station

Supplier Quality Improvement Group (SQIG)

A structured approach is essential to accomplish desired results. The first step is to lay down a foundation around which the entire process revolves. This provides stability and the impetus to speed up the entire process. DivgiWarner uses this concept and has designed a multi disciplinary approach for supplier up-gradation.

Supplier Quality Improvement Group (SQIG) is formed for making continuous improvement in the supplier quality. It consists of team members from various departments such as quality, manufacturing, engineering, logistics, supplier technical assistance, supplier development and other relevant fields.

SQIG team meets weekly to discuss

1. Supplier complaints & 8D status

2. Action Plan for chronic suppliers quality, delivery issues.

3. PPAP status of new developments.

4. Review of onsite audit status

Figure 1. Shop floor training of QSB elements

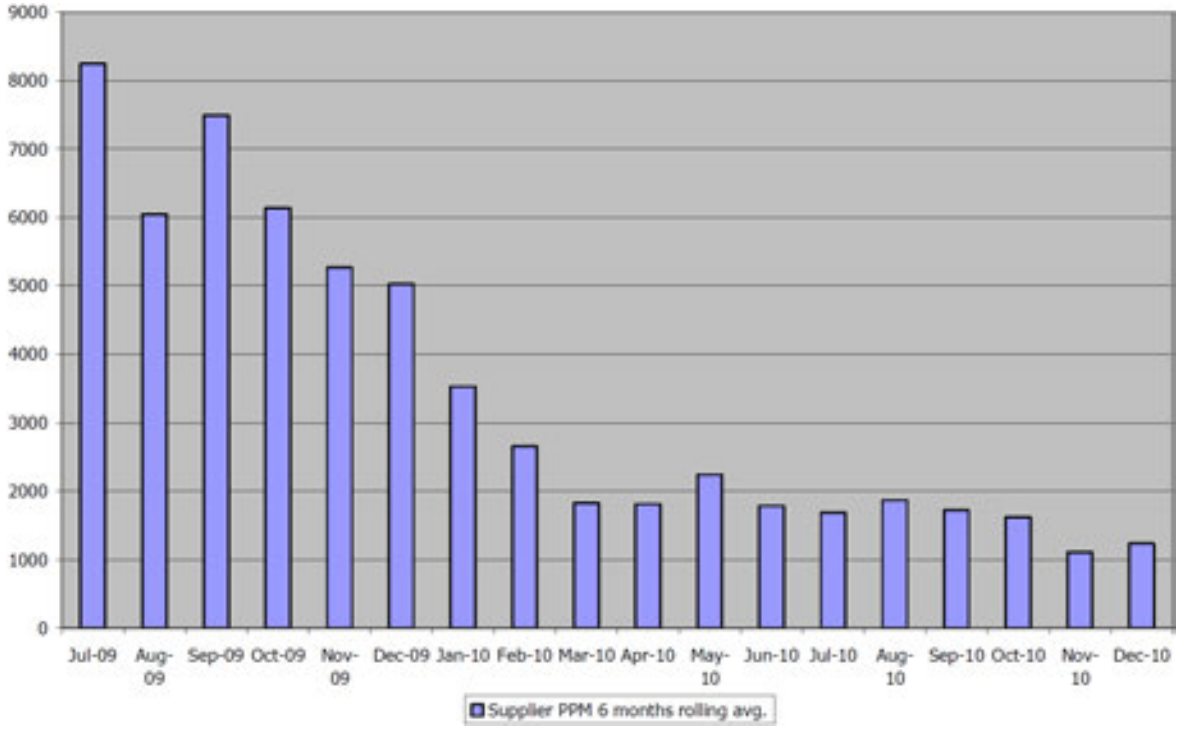


Figure 2. Shop floor Supplier PPM trend chart- 6 months rolling average (Period: July-2009 to Dec-2010)

5. Review of supplier training

SQIG team monitors the supplier PPM and analyzes the top 5 contributors to the PPM defect rate. Action plans are formulated to improve their PPM scores. SQIG team also provides onsite technical assistance and required training to the chronic suppliers.

As a result of the conscious efforts of the SQIG team the PPM defect rate reduced drastically in 2010 as compared to 2009. The PPM rate was 8248 in July 2009 and reduced drastically to 1240 in December 2010.

Annual Supplier Conference

Annual Supplier Conferences are organized to strengthen the relationship between the customer and the suppliers. An

Figure 3. Annual Supplier Conference

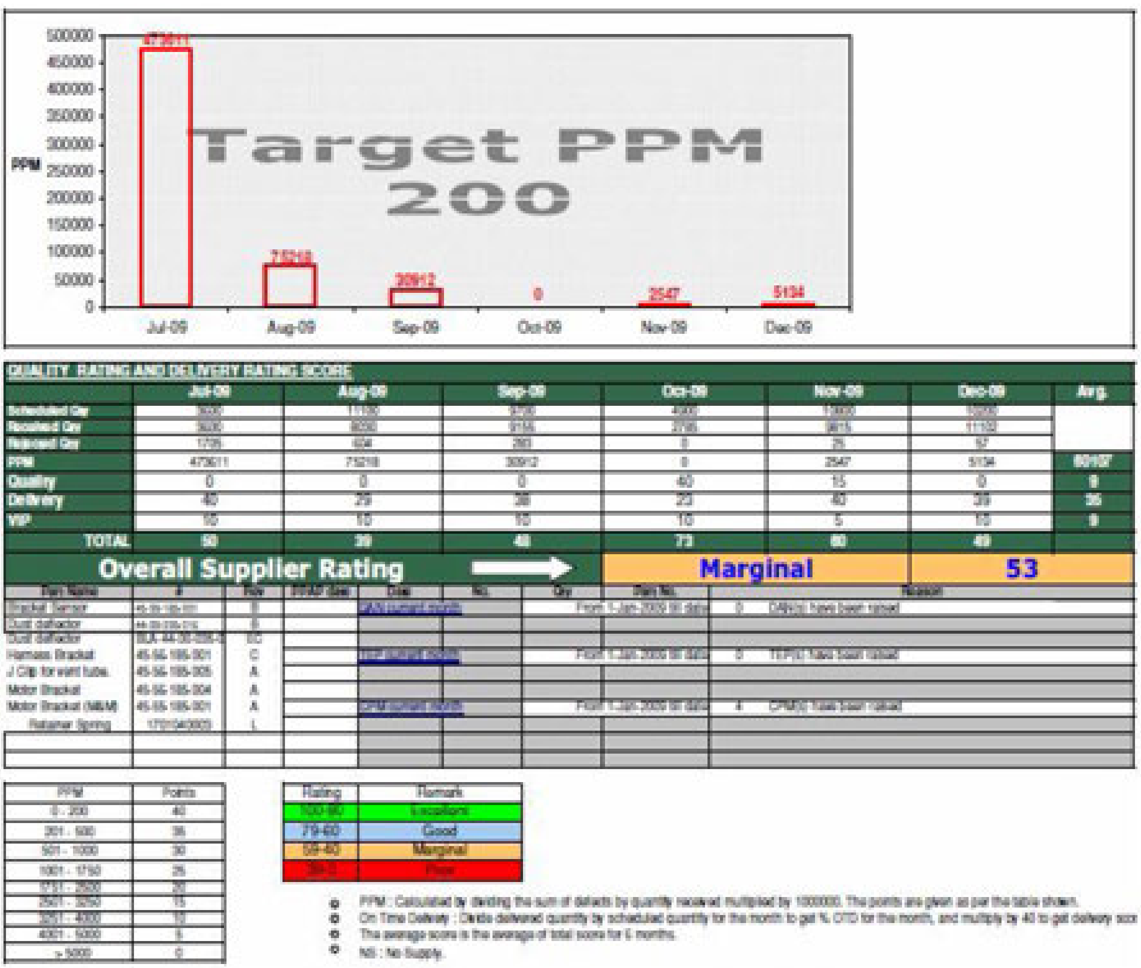


Figure 4. Supplier Scorecard (Jun 2009-Dec 2009)

Period : 01/01/2009-31/12/2009		Jan	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
ELA-44-00-035-011-010	DUST DEFLECTOR													
	Rusty	88												88
44-00-035-016-000	DEFLECTOR DUST													
	Poor Plating					1		1,700		10				1711
	Blistering									55		3		58
	Bend				3					1				4
	Tool mark at face				3									3
	Damage								2					2
45-56-185-005-000	J-CLIP FOR VENT TUBE													
	Bend						4							4
	Part not pressed as per print (Fitment problem)		3											3
	Poor Plating												3	3
	Damage							2						2
45-56-185-001-000	Harness Bracket													
	Heavy burr observed in hole									190				190
	Position not OK					9								9
	Dimension u/s					1						4		5
	Position gauge not ok								1					1
45-56-185-004-000	Motor Bracket													
	Poor Plating							3	600	1				604
	Bend					6				6				12
45-55-185-001-000	Bracket													
	Poor Coating								1	0		17	54	72
	Excess Coating									15				15
	Bend									1				1
	Plating Peel Off									1				1
	Plating washout (removed)											1		1
45-00-185-001-000	BRACKET													
	Poor plating									3	0			3
	Total rejected	88	3	NS	6	17	4	1705	601	283	0	25	57	2792
	Total received	3464	3000	NS	1200	2200	2053	3600	8030	9155	2785	9815	11102	
	PPM	25404	1000	NS	5000	7727	1948	473611	75218	30912	0	2547	5134	

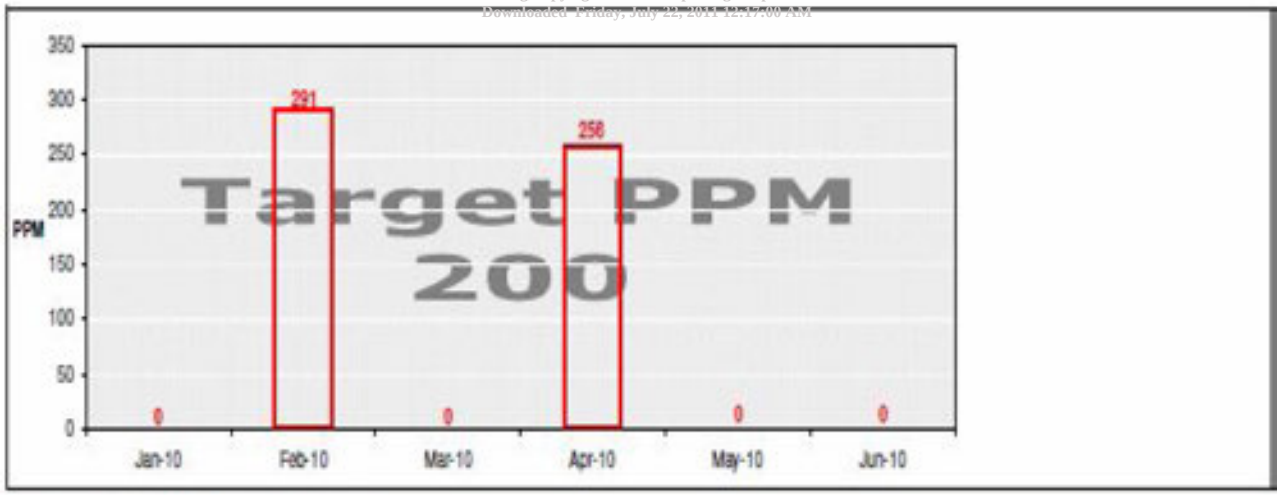
Figure 5. Defect Tracking Sheet-2009

Annual Supplier Conference is conducted every year and best suppliers are recognized & rewarded.

Here, the supplier manual is distributed and best practices are shared using video clips or documentary films. It gives the suppliers an opportunity to incorporate these practices, which adds value to the current process. Further, it increases the profitability of the customer as well as the supplier.

Supplier appreciation is also an important aspect of the supplier conference. The top 3 suppliers are identified on the basis of performance in Quality, Delivery and Value Improvement as per the rolling average scores. They are rewarded for the outstanding work done by them and encouraged to sustain this performance in future.

At the end, they participate in a signing campaign in which the suppliers commit to improve their overall performance. This sets new targets for the suppliers to achieve in the next financial year. It is a mutual agreement which aims at strengthening the relationship between the customer and the supplier.



QUALITY RATING AND DELIVERY RATING SCORE

	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Avg.
Scheduled Qty	17562	8900	10200	7800	7100	8500	
Received Qty	17562	6870	10128	7800	6144	8621	
Rejected Qty	0	2	0	2	0	0	
PPM	0	291	0	256	0	0	70
Quality	40	35	40	35	40	40	38
Delivery	40	31	40	40	35	40	38
VIP	10	10	10	10	10	10	10
TOTAL	90	76	90	85	85	90	

Overall Supplier Rating → Excellent 86

Part Name	#	Rev	PPAP date	Date	No.	Qty	Part No.	Reason
Bracket Sensor	45-00-185-001	B		DAN current month			From 1-Jan-2010 till date	#VALUE! DAN(s) have been raised
Dust deflector	44-00-035-010	B						
Dust deflector	BLA-44-00-035-0	EC						
Harness Bracket	45-56-185-001	C		TEP current month			From 1-Jan-2010 till date	#VALUE! TEP(s) have been raised
J Clip for vent tube.	45-56-185-006	A						
Motor Bracket	45-56-185-004	A						
Motor Bracket (M&M)	45-55-185-001	A		CPM current month			From 1-Jan-2010 till date	#VALUE! CPM(s) have been raised
Retainer Spring	1701040003	L						

PPM	Points
0 - 200	40
201 - 500	35
501 - 1000	30
1001 - 1750	25
1751 - 2500	20
2501 - 3250	15
3251 - 4000	10
4001 - 5000	5
> 5000	0

Rating	Remark
100-80	Excellent
79-60	Good
59-40	Marginal
39-0	Poor

- PPM : Calculated by dividing the sum of defects by quantity received multiplied by 1000000. The points are given as per the table shown.
- On Time Delivery : Divide delivered quantity by scheduled quantity for the month to get % OTD for the month, and multiply by 40 to get delivery score.
- The average score is the average of total score for 6 months.
- NS : No Supply.

Figure 6. Supplier Scorecard (Jan 2010-Jun 2010)

CASE STUDY - SUPPLIER UP-GRADATION

Supplier Up-gradation is a key aspect of supplier CMM. To illustrate the practicality of the up-gradation scheme we are citing a practical example as a case study. The efforts done by DivgiWarner and the supplier are reflected in the shift of the overall supplier rating from marginal to excellent.

The above scorecard illustrates the performance of Supplier X in the period Jul-Dec 2009. The performance of the supplier is quite low in quality while the delivery scores are comparatively better. The low score obtained in Quality decreased the overall supplier rating and it was rated as marginal in the period Jul-Dec 2009.

As the performance of the supplier was consistently hovering in the marginal zone, it was essential to identify the root cause and take corrective action.

The above tabular representation is the defect tracking sheet for the year 2009 for the mentioned supplier. It is clearly evident that plating, rust, dent, damages and burr in parts are the major areas of concern. The DivgiWarner SQIG team collaborated with the supplier and provided technical assistance for various process improvements. The supplier was given extensive training on implementing QSB tools as Quality was identified as the primary area of concern. As a result of the continuous training sessions and the monitoring process, the performance of the supplier started improving slowly.

Period : 1/1/2010-30/12/2010		Jan	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
45-55-185-001-000	BRACKET													
	Poor coating		2											2
	Blistering & poor coating				2									2
45-56-185-001-000	HARNESH BRACKET													
	Dimentionally rejected									1				
	Length US									1				
17-01-040-003-040	RETAINER SPRING H.T.													
	Rust											20		
44-00-035-016-000	Deflector Dust													
	plating- Peel off												100	
	Total Rejected	0	2	0	2	0	0	0	0	2	0	20	100	126
	Total Received	17562	6870	10128	7800	6144	8621	11782	0	11820	0	9000	6302	
	PPM	0	291	0	256	0	0	0	0	169	0	2222	15868	

Figure 7. Defect Tracking Sheet-2010

These are the performance details of Supplier X for the period Jan-Jun 2010. A shift from the marginal zone to the excellent zone can be seen. This shift was only because of continuous focus on supplier up-gradation.

The defect sheet shows a considerable reduction in the PPM defect rate in the year 2010 for Supplier X. The areas of concern identified namely plating, rust dent, damages and burr in parts appear to have reduced drastically.

CONCLUSION

Supplier CMM is observed to be an ideal tool for supplier development and up-gradation. It follows a Plan, Do, Check and Act approach which establishes an integrated system of quality practices and improves the overall supplier standards. This model ensures that these quality practices are repeated, reproduced and rapidly transmitted throughout the supplier community. The Supplier CMM also monitors the variation in performing best practices and strives for their continuous improvement.

Some of the objective benefits of the Supplier CMM can be summarized as:

Structured Approach: Supplier CMM follows a structured approach by forming a multi-disciplinary team like SQIG to resolve supplier problems in an efficient manner.

Standardized Methods: Development of standard forms and flowcharts for example RFQ, supplier selection flowchart; helps in easy implementation and reduces overall development lead-time.

Supplier PPM Reduction: This framework has delivered an 85% improvement in Supplier PPM at Divgi-Warner. It reduced the Supplier PPM drastically from 8248 PPM in July-09 to 1240 PPM in Dec-2010.

Culture of Continuous Improvement: A data driven scheme is followed for periodic tracking and reviewing of the supplier's data using monthly scorecard & defect matrix. This helps in setting better standards and making continuous improvements.

Customer Supplier Relationship: The relation between the customer and supplier is strengthened through collaboration as multi-disciplinary teams interact with their counterparts in the respective organizations.

The supplier CMM utilizes systems and processes to develop, monitor and control supplier's quality & delivery standards. Planning and execution of the entire supply chain process has improved by using the Supplier CMM model. Use of tools and techniques like APQP, PPAP, Scorecard, Defect Tracking Sheet, Supplier Training, Technical Assistance and Timely Supplier Appreciation helps to improve supplier capability & maturity.

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ABBREVIATIONS

RFQ
Request for Quotation

PPM
Parts Per Million

APQP
Advance Product Quality Planning

PPAP
Product Part Approval Planning

ISIR
Initial Sample Inspection Report

8-D
It is an advanced problem solving technique to investigate the root cause and take necessary corrective actions for the same.

Defect Matrix
It is a tabular plot of the PPM rating of the suppliers recorded on a monthly basis.

CPM
Complaints on Purchase Material

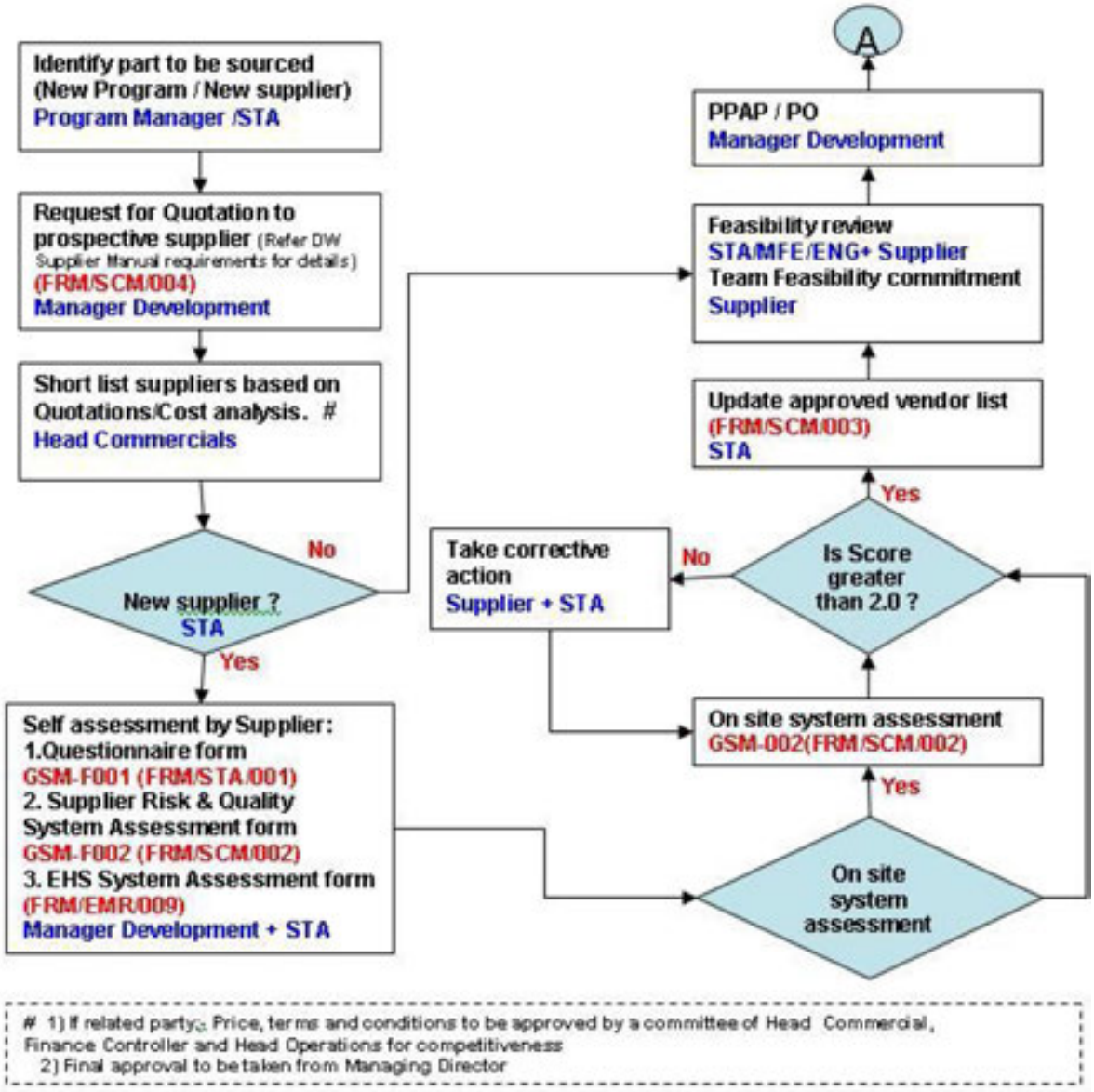
CA
Corrective Action

CMM
Capability Maturity Model

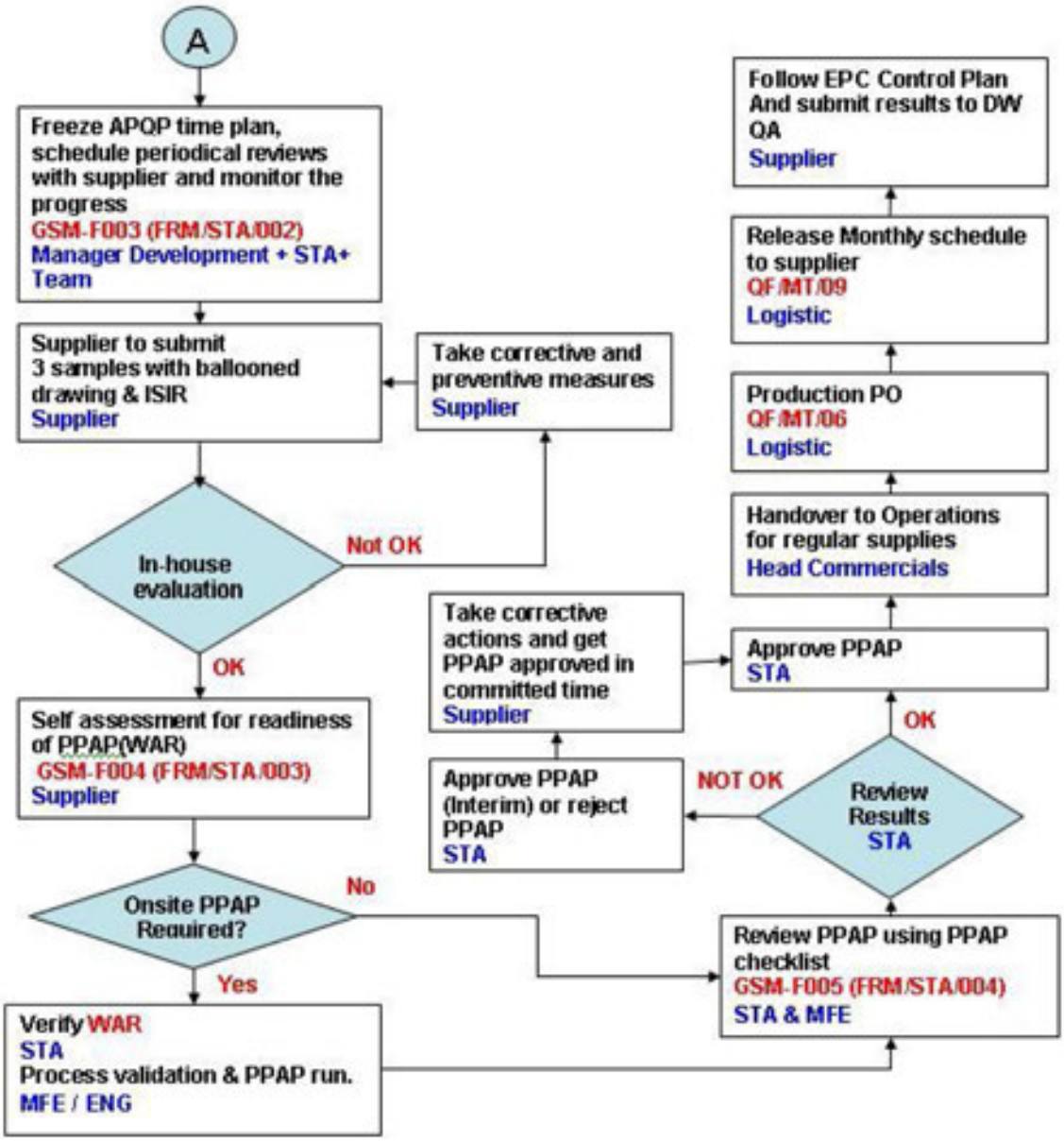
MRP
Material Resource Planning

APPENDIX

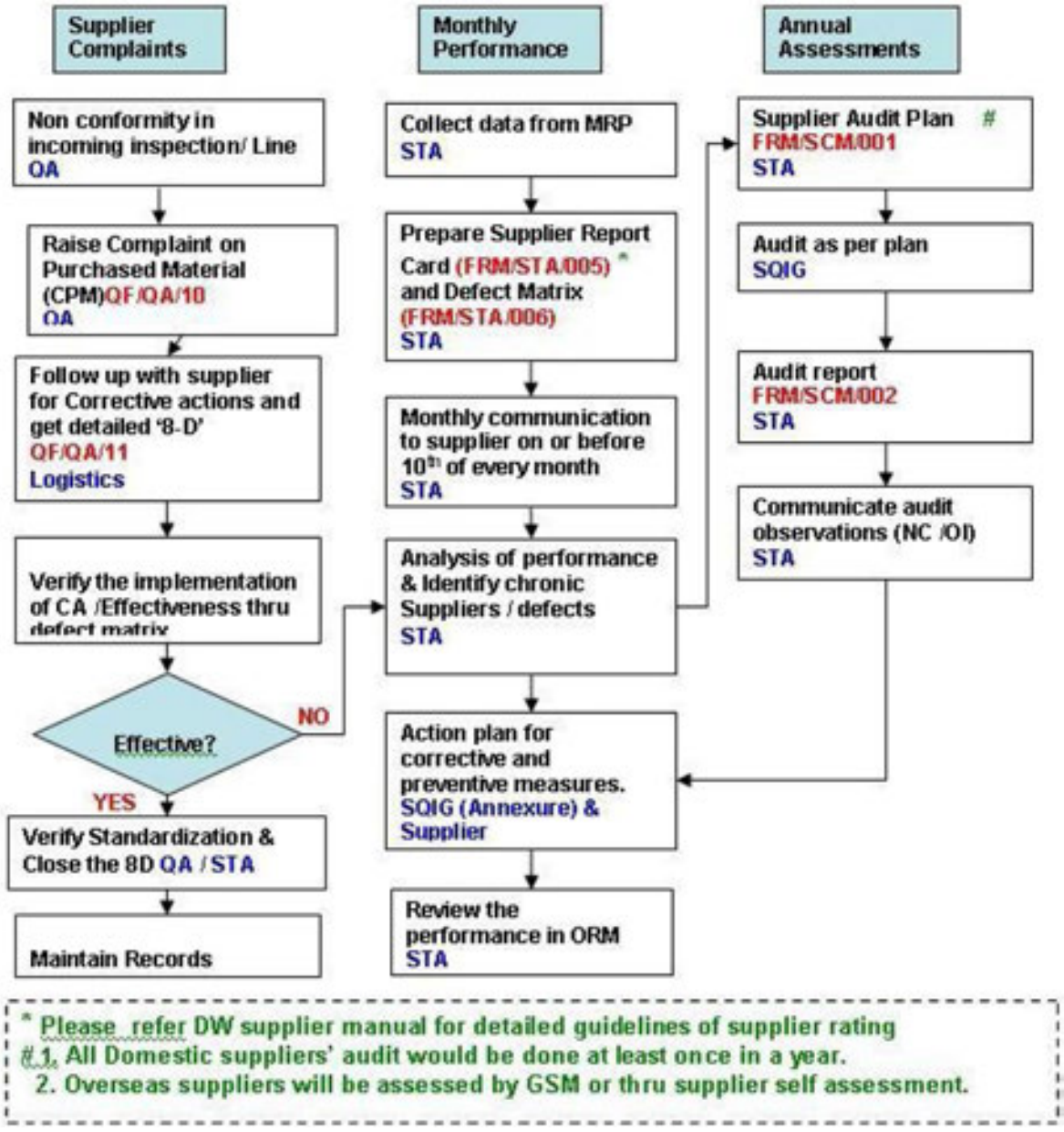
Appendix 1: Supplier Selection Flowchart



Appendix 2: Supplier Development Flowchart



Appendix 3: Supplier Monitoring and Up-gradation



Appendix 4: 8-D Problem Solving Form

8-D Problem Solving Form

Tracking Number:		Open Date	Revision Date	Close Date

Supplier :		BW Customer:	
Part # :		BW Customer P/N:	
Part Name:			
Drawing # & Revision Level:			

1a. Name, Function and Contact Number for 8-D Participants:			2. Problem Definition:	Digital Picture(s), with arrows that point to specific defect
			What:	
			When:	
			Where:	
			How Many:	
1b. Name & Contact # for BorgWarner Contact:				

3. Containment Action(s) : Including Results of Sorting & Dock Audit Action Plans, until 8-D is Completed.	Date:	Results:

4. Root Cause Analysis, using "Five Why" Analysis, or similar Analysis Methods:		
Description of Process Root Cause	Date ID'ed:	Verification of Root Cause:

5. Corrective Action(s): Including Definition of Actions to Change / Improve Process and Verification Results.			
Action	Responsible:	Target Date:	Complete Date:

6.a. Implementation Plan for Permanent Corrective Actions:	Responsible:	Date:

6b. Is SCR Required? Yes ____ No ____	Date SCR Submitted:	Date SCR Approved:

7.a. System Modifications required to Prevent Recurrence.		Responsible:	Date:
PFMEA Update Required?	Yes / No		
Control Plan Update Required?	Yes / No		
Operator Instruction Updates Required? (Gage Instructions)	Yes / No		
Process Print Updates Required?	Yes / No		
PM Schedule Updates Required?	Yes / No		
Tooling Change Frequency Update Required?	Yes / No		
Mistake Proofing To Be Incorporated? (See actions listed above.)	Yes / No		
Other (Describe):	Yes / No		

7.b. Can / were specified changes applied to addition / similar part #'s, or Procedures?

8. Close 8-D and Congratulate the Team

	Supplier 8-D Champion	BorgWarner 8-D Champion	Close Date:
Final Approval of 8-D.			

8-D, SCR, and PPAP Action Plans shall be completed in accordance with instructions included in BorgWarner Supplier Quality Manual.

*this is a single page of the actual format to give a brief idea about its content.

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