

# Outsourcing Strategy in Avionics Manufacturing in Indian DPSUs

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**Abstract:** The Avionics manufacturer DPSUs is a high end technology oriented which involve in complex integration among their supplier & vendors. The global competition of DPSUs not only related the manufacturing facility & technology but also their supply chain. This research paper point out the outsourcing as a strategic tool for economic growth of DPSUs. In this paper researcher discuss the present challenges in supply chain for avionics manufacturer DPSUs and GOI policy for outsourcing. Researcher discuss different strategic methodology of outsourcing for avionics manufacturer DPSUs which application enhances their performance. The existing Defence production process & feasibility of outsourcing is major focus area of this research work and finally concluded with the standard process on the same which is useful of DPSUs for their economic & work culture development.

**Keywords:** Avionics. Strategic Outsourcing, Supply Chain & Risk.

## 1. Introduction:

Defence & Aerospace sector is expanding globally and India is emerging as one of the largest defence markets. To boost the growth of Indian defence & aerospace industry, Government has simplified Licensing policy for manufacturing of defence products and raised FDI limit to 49%. In this regard the Manufacturing capability of avionics articles is very critical indeed so as to minimize unit production cost while maintaining the required quality standards as its airworthiness requirement.

The global competition of Indian DPSUs not based

anymore on a challenge between manufacturing companies but mainly on a challenge between manufacturing companies' supply chain, which consists in focusing on rapid response to customers' needs at low costs. Therefore, in order to stay competitive in reaching the wide spread customers in an effective and cost efficient way, more importance has to be given to the area of supply chain. Managing the supply chain aims at challenging constantly the corporate strategy by setting a new environment where cost savings must be done whenever an opportunity appears. Consequently costs which do not add any value to the final product have to be chased and reduced: outsourcing has become a widely accepted practice as companies concentrate on their core activity, savings in inventory holding costs are performed through smaller stock levels, deliveries from the supplier to the point of use must be optimized, etc.

Outsourcing is adopted by Avionics Article Manufacturer Indian DPSUs as a Business Strategy to develop state of- the-art technologies with long term vision to attain self-reliance by strengthening partnership with Indian Private Industry. This will propel, Indian DPSUs to become internationally competitive in the long run. The DPSUs are identifying their core and strategic operations and outsource the non-core activities to Indian Private Industry and also core activities wherever feasible.

### 1.1 Problem Statement:

The research work able to resolve following issues of outsourcing in Indian DPSUs:

1. Recommendation to made a better outsourcing policy in DPSUs for Avionics TOT projects which can run up to the whole life of the aircraft along with its repair-overhaul.
2. Outsourcing as a strategic tool for competitive development of Indian DPSUs.
3. Identification of strategic element in Outsourcing for Indian DPSUs.

## 1.2 . Objective:

Under the topic " Outsourcing Strategy in Avionics Manufacturing DPSUs" author establish different facts of outsourcing which make it strategic tool in project management. The objective of this research paper is to find challenges in Avionics Manufacturer DPSUs which can be resolved by healthy outsourcing policy. The existing Defence production process & feasibility of outsourcing is major focus area of this research work. With the exploratory study of outsourcing strategy author has develop a standard process on the same which is useful of DPSUs for their economic & work culture development.

## 1.3 Scope

**1.3.1 Research Limitation:** The research design used will be exploratory and causal in nature. The research is applicable for Indian Defence Public Sector Units & avionics articles related projects. Due to confidentiality of information, the data collection from DPSUs to reach final conclusion is for limited scope. From the existing project of avionics articles in different PSUs, we tried to collect data and explore gaps along with procedural weakness in outsourcing strategy.

**1.3.2 Practical Implication:** The procedural issues in Government owned Public Sector Units is one of the major obstacles to implement outsourcing. Since the activity is related to security of nation in DPSUs , there is risk of leakage of confidential information, so different check points at every stage of outsourcing make the existing outsourcing policy ineffective. For competitive growth and cultural improvement in Indian DPSUs , the outsourcing taken as a strategic tool in project management.

**1.3.3 Social Implication:** This finding of this research work confirm that Indian DPSUs may come forward to

implement outsourcing aggressively. It not only in the benefit of the organization but also create job opportunity in the market. Outsourcing from big unit may also fruitful for development of small units when they get outsourced job.

## 2. Literature Review:

[2] Paper discuss detail about India's Defence Industry from last 10 years, the Policy Framework, Dispute Resolution Mechanism, Key Provisions In The Union Budget for Indian defence Industry and Major Developments In The Defence Sector.

[3] It raise the Supply chain management as new key to productivity and competitiveness of manufacturing and service enterprises. SCM is strategic and systematic effort of various business activities within and outside organization to improve long run performance of organization. This paper focuses on important areas or significant issues in supply chain management and SCM paradigm in PSU in India.

[4] The paper had find out the recent development in Supply Chain Management (SCM) , they point out that powerful information systems is one of the essential precondition for the implementation of SCM. This paper discuss logistic module, ERP and APO and finally give overview of the most valuable online resources dealing with SCM.

[6] It discuss that global purchasing in SCM has become more risky, visible and productive position within many organizations. The paper recommended just-in-time and operations improvement strategies, the importance of developing and managing the suppliers emerges as critical outsourcing strategies in SCM.

[12] This paper made a systematic literature review to throw light on the importance of SC coordination. The objectives of this paper are to: Report and review various perspectives on SC coordination issues, understand and appreciate various mechanisms available for coordination and managing SC uncertainty and identify the gaps existing in the literature.

[1] & [7] Discuss the TOT projects in Make in India concept and generated tabulated data for technology available in India in compare to world market for

avionics articles and try to fill the technological gap of Indian Manufacturing Company by Make In India-TOT project concept. In 2012 recommended different Engineering Methodology like Reliability Engineering, Maintainability Engineering, Human Factors Engineering, Manufacturing and Production Engineering to narrow down gap between best practices recommended by Licensor & actual practice running in production line in Avionics TOT projects of Indian DPSUs.

### 3. Methodology

The paper opted for an exploratory study using the open-ended approach of grounded theory, including depth interviews and one expert group discussion with employees representing middle and senior management having mainly a project management of avionics articles under transfer of technology. The data were complemented by documentary analysis, both quantitative and qualitative in nature along with its confidentiality due to its relation from DPSUs.

### 4. Discussion

#### 4.1. Outsourcing as Tool of Strategic Management

Outsourcing is nothing but 'strategic partnership which is nothing but formal alliance between two commercial enterprises usually formalised by one or more business contracts but falling short of legal partnership or agency or corporate affiliate relationship. The DPSUs may adopt 'outsourcing' as its business strategy for one or more of the following reasons:

- Cost minimization,
- Resource access,
- Resource leverage, and
- Risk diversification.

The outsourcing practice, however does have certain inherent disadvantages including getting exposed to

the risk of market forces, eventual loss of skills and core competence, the complications and difficulties in maintaining quality assurance, the need for sophisticated management techniques without having the privilege of formal control on the supplying agencies and the risk of reducing market base over a period of time. The decision of Outsourcing form DPSUs for Avionics article is not a easy decision , since it link with the National Importance & confidential information of fighter aircraft of IAF.As broad guidelines for DPSUs, the possibilities of outsourcing can be explored in those areas of low cost high volume items, dual use technology of items/areas, and heavy and complex system where subsidiary technology or items can be obtained through more competitive process from the market.

On the other hand outsourcing may not be practicable in the restrictive and sensitive items or areas due to security reasons, restrictive volume of demands to sustain the line of production or profitability for the suppliers, high and complex technology area of purely military nature, and the items where quality assurance and management without control of source and chain of supply would be difficult.

The objective of outsourcing by Avionics Manufacturing DPSUs is to implement procurement and vendor operating strategies that streamline material/service flows, reduce manufacturer and supplier costs, improve quality and customer service, and create long-term buyer/seller partnerships along with confidentiality of sensitive information. The DPSUs has to be shift their strategy in a similar way from vertical integration business model to system integration business Model. By adopting such a strategic shift, avionics manufacturer in India can serve their ultimate customer IAF in a better way. The

outsourcing effort by DPSUs will add to their capacity enhancement, attain cost effectiveness and improve competitiveness in global market. The other significant objective of this outsourcing is to build a manufacturing eco-system in the country to attain self-reliance for defence avionics manufacturing. On the other hand, participation of Indian Private Industry will be an enabler in building technological and manufacturing capability inside the country. There are some outstanding advantages of strategic outsourcing for the manufacturers:

- Suppliers play a significant role in the production, delivery, and service of competitive quality products. Purchased materials and services represent up to 80% of total product costs in most high-technology avionics industries.
- Former procurement practices have focused on obtaining the lowest unit prices; the trade-offs of poor quality, erratic delivery performance, and the other problems have been buffered by inventory cushions, quality control personnel, and multiple vendors with short-term interests.
- Unlike efforts to reduce labor and general overhead costs, reductions in raw material costs result in financial transactions that improve a company's profits and cash position.

Because of these factors, a significant cost reduction opportunity exists in both the direct material and material and service overhead categories (i.e., purchasing and material planning administration, freight, receiving, incoming inspection, material handling, warehousing, inventory variances, packaging, etc.).

#### **4.2. Defence production process — value and supply chain**

The various stages in the process value addition include design, development, manufacturing and integration, airworthy testing and evaluation, product support and the service life of equipment.

Coordination and integration of supply chain practices and processes has assumed paramount importance in defence avionics supply chain. In the current environment, increasing competition, cost pressures, rising energy costs and high raw material prices for avionics article manufacturing are key challenges for DPSUs. To combat these challenges, manufacturers, OEMs and tier-I suppliers are leveraging the advantages arising from the globalization of the supply chain. The DPSUs are witnessing outsourcing of elements of technology, design and component/subassembly manufacture. This transformation provides an opportunity for those vendors/ suppliers who can innovate, adopt high-level technologies, implement best practices and invest in change.

#### **4.3. Definition & Measurement of Outsourcing**

The outsourcing contribution is measured in terms of financial value. The formula to measure the Outsourcing content of a DPSUs/OFB can be derived as :

$$VoO = VoP - DI - RM - IVA \text{ \% of } VoO = VoO / VoP \times 100$$

Where,

VoO : Value of Outsourcing

VoP : Value of Production

DI : Value of Direct Import

RM : Value of Raw Materials purchased from domestic market

IVA : In-house Value Addition (In terms of money value) for conversion of Raw Materials & components

to saleable Product. Value Addition will not only cover manufacturing but also the services which adds into value of production.

#### **4.4. Scope and Feasibility of Outsourcing in DPSUs**

In order to attain higher level of outsourcing by each DPSU/OFB, the most significant step is to identify categories of Goods and Services in their yearly manufacturing program which can be considered for outsourcing. Possible categories of items may be broadly classified as under:

(i) The first category of items will be the items which are low in cost, generic in nature and less technology intensive e.g. Screw, Rivets, Bush, Bearings, Rubber items, Springs, Wire harnessing, PCBs, Electrical motors, Filters, Transformers etc. They must be considered for outsourcing to private vendors/SMEs. The Know-how & Know-why available with DPSUs/OFB for such items are to be shared with Indian Private Vendors. It may not be economically viable for DPSUs/OFB to manufacture these items, therefore, these items must be assigned to private industry. PSUs/OFB shall not make future investment in manufacturing of such category of items, if capability and capacity is available with Indian Private Industry.

(ii) The second category of items will be the items which are manufactured by DPSUs/OFB under Transfer of technology from Licensors/OEMs. Such items may need special manufacturing processes. The items may be Sub-system or System or higher assembly. Many Sub-systems or Systems are strategic in nature and in consideration of this, they may not like to outsource the entire Sub-system or System. However, machining & other operations which are not strategic in nature may be outsourced to Indian vendors. The necessary technical assistance like manufacturing drawings, 3D model, process

documentation, quality process etc. may be shared by them with potential vendors for initial learning and operational acquaintance.

(iii) The third category of items will be the items which are not so technology intensive but imported by PSUs/OFB. Such items shall be identified and assigned to Indian vendors for indigenous development. DPSUs/OFB must extend technical assistance to vendors to develop such import substitution items. If required, financial assistance shall also be extended to the potential vendors during developmental phase. Suitable schemes may be drawn up by the DPSUs/OFB with the approval of their respective Boards/competent authority. Indigenous development of such items will reduce the import content and in due course of time, Indian industry will attain process capability in manufacturing of such items.

(iv) The fourth category of items will be those which are technology sensitive, strategic and complex in manufacturing. Invariably, Transfer of Technology is denied by OEMs/Licensors for such critical systems & subsystems. Many such systems & sub-systems (Mainly Electronics & software oriented) also become obsolete and licensor/foreign OEMs refuse to support repair & maintenance for entire product life cycle. Even if they agree to support, they demand exorbitant support price. Hence, it becomes absolutely essential to develop/co-develop and indigenise these items within the country to achieve self-reliance. If required, financial assistance shall also be extended to the potential vendors during developmental phase. In order to attain self-reliance, there is a need to develop/co-develop and manufacture these systems and sub-systems in the country jointly by DPSUs/OFB and Indian Private Industry.

**4.5. Decision for Outsourcing in DPSUs & Its Analysis:**

Most of the avionics article manufacturing DPSUs have their robust procurement process. However, in a SWOT analysis the supply chain would emerge as one of the weakness. They have a long procurement cycle time which has resulted in high levels of inventory. DPSUs’s value of procurement exceeds our value of consumption which is resulting in the increase of our inventory every year. In aerospace industry wherein the lead time can exceed a year, a higher inventory is the way to mitigate the supply chain risk. However, by implementing effective supplier management techniques, it would be possible to achieve on time supplies and shifting the supply chain risks to the suppliers. On average DPSUs procurement throughput time exceeds 6 months. A study of the data would reveal that 50% of the procurement throughput time is the ordering time. By managing the ordering time, we would be in a position to effectively manage the supply chain. The basis of this model is to classify the procurement according to potential supply risk and profit impact. The items are classified us under

**4.5.1 Strategic Items**

These items have a high impact on the product cost and are having a high supplier risk. Most of these items are single source. The buyer and supplier have to work in a collaborative approach. Management of these items would require the involvement of the top management.

**4.5.2 Bottleneck Items**

These are ordered in small quantities and the buyer is in a weak position for negotiation. The common way to manage these items is to keep the inventory.

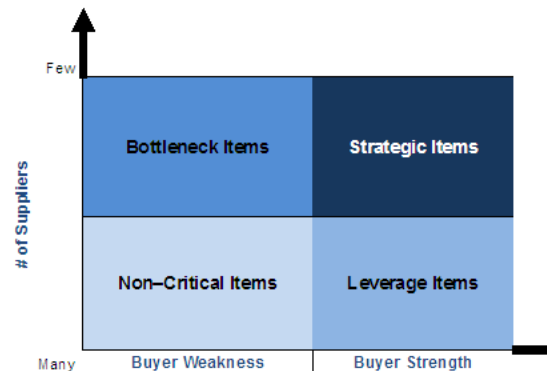
**4.5.3 Leverage Items**

They are easy to manage, however have a major impact on the product cost. Multiple suppliers are

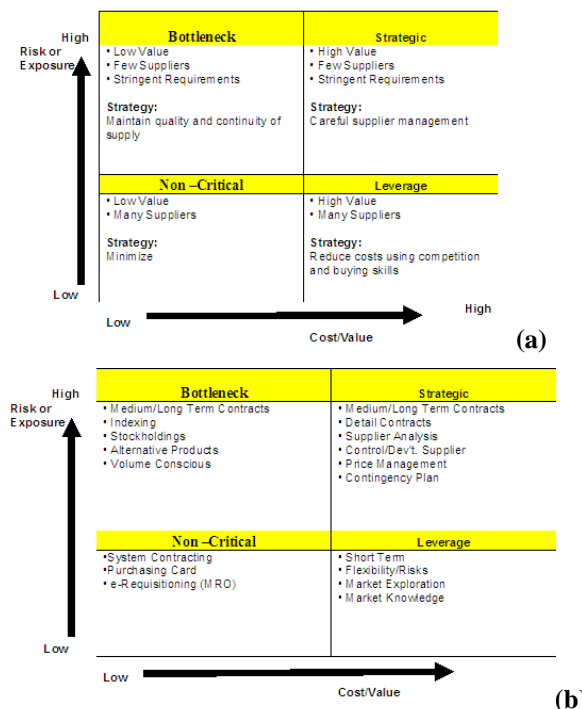
available for these items. The buyer has a reasonably good bargaining power. Parallel sourcing is a way to obtain optimum leverage for these items.

**4.5.4 Non-Critical Items**

These items are best suited for Vendor Managed Items and automatic replenishment. Consolidation of requirements over a larger planning horizon would yield better bargaining power for the buyer.



**Figure-1:** Pictorial View of Classification of Item for Outsourcing & Buyer-Supplier Status



**Figure-2 (a & b) :** Analytical View of Outsourcing & Recommended Strategy by Segmentation Characteristics for DPSUs

#### 4.6. Strategic Elements Of Outsourcing for DPSUs

Some strategic points of outsourcing for Indian DPSUs. The most successful avionics manufacturers (like Honeywell, Rockwell Collins, Thales Group, GE Aviation Systems etc) have developed sourcing strategies with their vendors that produce shared opportunities. They have created formal strategic alliances bound by homogeneous goals, investment, obligation, and mutual trust. The most common strategic elements of outsourcing are as follows which can be observed by Indian DPSUs as per their requirement:

##### 4.6.1 Global Strategies That Impact Outsourcing:

In an outsourcing program, the firm management must understand the global strategic issues and the external and internal drivers that impact sourcing decisions.

On the external side, it is particularly important to understand the avionics industry structure, there are some definitions about the suppliers such as defining the suppliers in the industry, analyzing the supplier's bargaining power, selecting the emerging technologies and substitute products, forecasting the new entrants may enter the market, analyzing the customers' bargaining power.

On the internal side, it is important to understand the company's strategic direction and the tactical actions that are being pursued in the areas of technology development, engineering, materials management, manufacturing, distribution, and field service.

An outsourcing program should be designed around a company's overall corporate strategy so that products can be brought to the marketplace at the right time, at a competitive quality and price, and with a reliable level of performance.

**4.6.2 Procurement Specifications:** Procurement objectives should be developed around considerations such as facility locations and focus, vertical integration, technology life cycles, and other related elements of the total manufacturing infrastructure. In addition, the metrics of competitive performance must also be considered as part of a JIT purchasing program. For example, competing on the basis of cost, delivery, quality, flexibility, or innovation may have a major impact on procurement objectives and the subsequent daily activities of buyers.

**4.6.3 Supplier Management Plan:** During this task the best sources are determined and the vendor base is consolidated. Manufacturer/supplier relationships are established and the purchasing objectives are communicated and agreed upon. The vendors chosen are integrated into the manufacturing process through:

- Joint training and education activities aimed at learning each other's products, manufacturing processes, and customer service issues (within security limitations of the industry)
- Long-term contracts and blanket orders with multiple release dates
- Joint involvement in product/process design, value analysis, quality improvements, and cost reductions
- Open exchange of information such as schedules, design data, quality results, and cost structures
- Formal vendor evaluation that incorporates in-process controls, multiple measurements, continuous feedback, and joint corrective action.

**4.6.4 Quality Commitment:** The objective of quality commitment is to push incoming inspection activities back to the supplier where it is controllable and correctable. Being the airworthy quality requirement

of avionics article the quality checks play important for selection of vendor & suppliers.

**4.6.5 Schedule Stability:** The impact of schedule changes increases as you move upstream from the ultimate customer. Predictable delivery schedule allows suppliers to implement JIT techniques in their own processes and eliminates costs associated with excess inventory buffers, overtime and expediting. Thus improvements in the supplier's process can be passed on to manufacturers in the form of flexibility and price reductions.

**4.6.6 Long-Term Buyer/Seller Relationships:** Formal linkages evolve between manufacturers and their suppliers through frequent contact, open communication and joint planning sessions involving manufacturing, quality, design, and materials management. Long-term contracts provide an incentive for investment in new equipment to reduce costs and improve quality.

**4.6.7 Procurement Lead Times:** Local sourcing, blanket orders with multiple releases, and paperwork simplification are common approaches for shortening lead times. Some companies have implemented electronic data interchange (EDI) and bar-coding applications to streamline purchasing and receiving administrative tasks. Others have adopted the buyer/planner concept which also shortens the processing cycle by consolidating traditional purchasing and planning tasks into a single function.

**4.6.8 Inventory Buffers:** As supplier quality increases and ship-to-stock programs are implemented, the replenishment pipeline is shortened. In addition, the cooperative manufacturer/supplier relationship evolves to a point where both parties are identifying and solving problems at the source. Over time, raw

material and work-in-process inventory buffers can be reduced as problem areas are exposed and corrected.

**4.6.9 Long-Term Cost Reduction:** The objective of this task is to jointly analyze the supplier's manufacturing process, methods, and equipment, and understand the components of the supplier's manufacturing cost structure. Through this approach, a manufacturer and his suppliers can identify opportunities and implement changes to reduce costs from which both benefit [8].

**4.6.10 Non-product Expenditures:** Traditionally companies are allowed the human resources department to purchase insurance, the engineers to purchase capital equipment, the data processing department to purchase software/hardware, and the maintenance department to purchase construction services. It is becoming less unusual to find purchasing functions within engineering, data processing, or marketing organizations. Companies are beginning to negotiate the scope of services or apply make-versus-buy logic to maximize the benefits of auditing and legal fees. In short, substantial purchasing cost reduction opportunities can be found within nonproduct expenditure areas not traditionally serviced by purchasing professionals.

#### **4.7. Strategic Outsourcing Process in DPSUs:**

**4.7.1 Analyze Market:** The team has to analyze the market in terms of the available sources / vendors capable of taking the task which is to be sourced depending upon the criticality of the component. The capability of vendors in terms of manpower, technology, available resources, list of customers, quality needs to be analyzed before adding the vendor in approved vendor directory.



**4.7.2 Identify Requirements:** Based on need and market analysis you can identify skill sets which can be out sourced to vendors/suppliers to reap maximum benefits.

**4.7.3 Develop strategy:** There is need to have brainstorming sessions with the cross functional teams from various disciplines to frame the strategy for RFP formulation which resulted to form strategic alliance with the supplier to yield maximum benefits.

**4.7.4 Formulation of Strategic Sourcing Cell:** These teams are small groups of people with the charter to examine the sourcing options for the category and to make recommendations to senior Management. Within the sourcing department there is need to have strategic sourcing cell comprising of cross functional team from various departments like design, manufacturing, process planning, sourcing and quality control department. The team has to carry out the analysis for ongoing in house production activities, analyze the bottle necks, carry out the cost analysis with all statistical data like Tact time, lead time, operational efficiency, to decide on make or buy options and seek the possibility of sourcing to the potential suppliers/vendors with associated advantages/disadvantages. In the present context the terms and conditions are being formulated completely in isolation without considering technical and commercial expertise during formation of RFP/RFQ conditions. This results in incomplete or inappropriate contractual conditions which have either resulted into delay in contract signing or non-completion of contract as per anticipated requirement.

**4.7.5 Vendor Registration Cell & Vendor Directory:** The registration process for vendors of avionics components / sub-components & full assembly shall be different from the regular or non-critical items. The vendors who are manufacturer of

avionics components / sub-components & full assembly should go through a rigorous audit by the cross functional team who should visit and inspect in terms of its manufacturing capability, productivity, quality, financials of the Company and its customer base in detail. Based on the audit the committee should be empowered to register or non-register the vendor in its approved vendor directory. However for regular or items which are not related to aircraft safety or items commercial in nature the vendor registration should be made more simpler than the existing procedure. In such cases only incorporation certificate, PAN details, VAT/TIN details should be more than enough to empanel the vendors.

**4.7.6 Improvements in ERP System:**In ERP system and e-portal the major drawback is that the vendors cannot be searched with respect to their product profile or business. Due to this constraint there may be many vendors who are in approved vendor list but not have been issued RFQ / enquiry. Hence, there is a need to have search engine which can identify the vendors for their product profile which should be categorized into various groups or subgroups.

**4.7.7 E-procurement:** The integration of ERP with e-portal can enhance its usefulness manifolds. In that context e-procurement can not only be used as a tool for e-tendering but it will also provide the real time information to the suppliers like displaying information from PO placement, to supply of material, to the release of payments to the supplier. Hence, e-portal can also be utilized as a tool for supplier relationship Management. The bid clarification process can also be automated in e-portal and can be made more transparent in which any vendor can seek information regarding tender which is equally shared with all the prospective bidders.

**4.7.8 Internal policies and procedures:** In tendering process generally technically acceptable L-1 is the only criteria used for selection of vendor and signing of contract. The items which are very critical and required state of the art technology in such cases other criteria such as R&D expenditure, items indigenized, manufacturing capability, customers in the portfolio of supplier etc should be given utmost importance for selection of vendor. In such cases the committee should be formed who should select or identify such vendors with exceptional capabilities and only among those vendors based on technical and commercial criteria vendor needs to be selected. The open tender in such instances should be avoided otherwise RFP should be formulated with considering such criteria as explained above. In this regard standard conditions for such requirement should be added in the manual to achieve standardization.

There are certain approvals like re-rendering, e-procurement waiver, acceptance of late/delayed offer (in case of proprietary items), sending enquiry to less than 5 sources etc. In such cases which do not require any financial approvals powers should be delegated to head of IMM in place of head of Division to cut short the cycle time required for processing the files.

**4.7.9 Manage the supplier relationship aggressively:** Supplier Management is the area of Strategic Sourcing with the greatest opportunity for both success and failure. Too many companies just sign the contract and forget about the relationship until contract renewal time. To make the relationship a real success and to ensure that the benefits are sustained, both parties must be actively involved in monitoring results, reviewing pre-established performance metrics, partnering on creative ways to mutually lower costs, ironing out any contract or performance

disputes, etc. There is also a need to implement strong payment review system to eliminate the procedural delays. The existing e-portal can also be leveraged as a supplier relationship Management module to display the information from tendering stage to finalization of contract to payment of bills to the vendors. This SRM module not only tells the real time information but also displays the hidden inefficiencies which can be collectively rooted out of the system.

## 5. Conclusion:

Progress towards effective supply chain management can be gradual and we may have to face and surmount many obstacles for implementing these strategies. Therefore in the current scenario we need to enhance our strategic positioning, induce flexibility to the supply chain system which would improve the supply security and lower the procurement costs. In this regard the research paper has reflected the outsourcing as a strategic tool to expand our production set up and as an enabler to meet the Time, Quality and Cost (TQC) requirements of our customers in Indian DPSUs for avionics TOT projects. Outsourcing Managers in DPSUs need to remember that the three TQCs are closely linked to each other and that outsourcing is not an option which will always result in large scale cost reduction. It is almost impossible to transfer all the elements of risk to vendors without any cost to DPSUs. The detail analysis and findings of this research paper give idea for exploration and development of a robust vendor base offering a reduced cost structure compared to in-house manufacture at DPSUs against outsourcing in Avionics TOT projects.

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