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PROJECT LOGISTICS AND CONTRACT ADMINISTRATION

BY

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UNIT ONE

OVER VIEW OF PROJECT LOGISTICS AND CONTRACT ADMINISTRATION

Objective of the chapter:

At the end of this chapter, students will be able to:

- ✓ **Define logistics in general and project logistics in particular**
- ✓ **Identify the inputs, methodology and outputs in the procurement management process**
- ✓ **Understand the issues of contract administration and its linkage to the procurement management process**

1.1. Introduction to Project Logistics

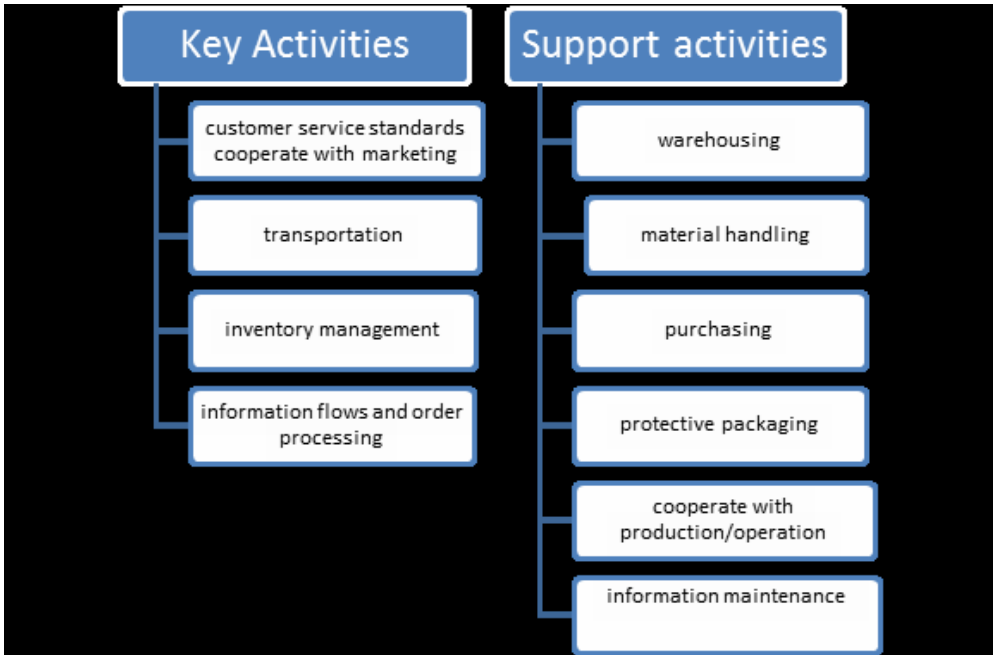
Logistic is the function that enables the flow of materials from suppliers into an organization through operations within the organization out to the customers. It is derived from the Greek word "logistikos' which means 'to reason logically' It is basically consists of all operations required for goods (both tangible and intangible) to be made available in markets or at specific destinations. According to Council of Logistic Management (USA) "Logistics us the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption for the purpose of conforming the customer requirements".

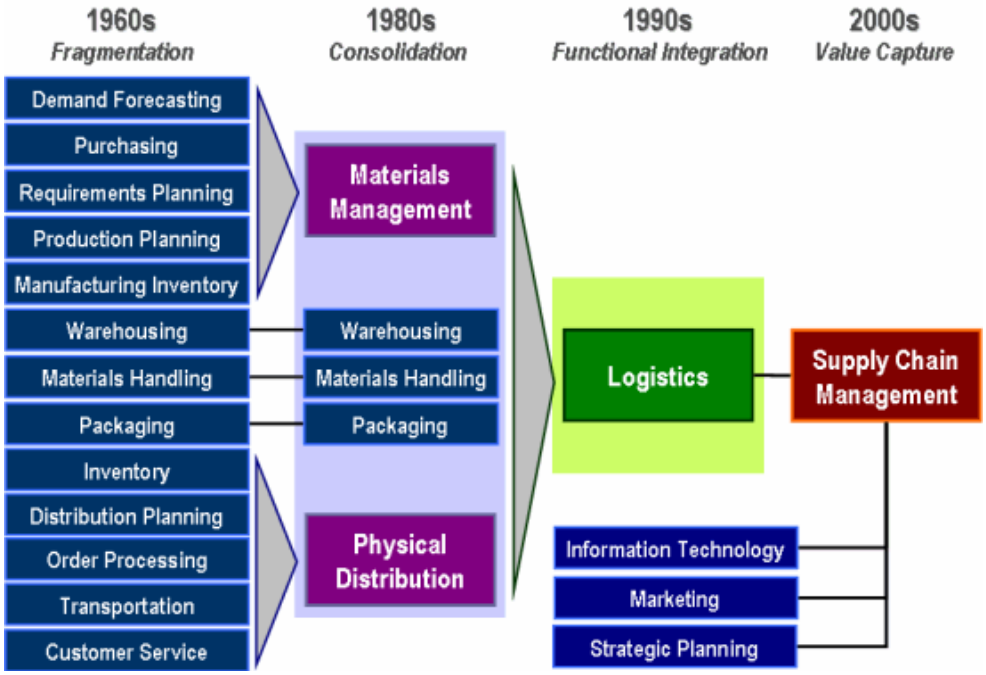
A logistics project can be defined as a complex, special and unique sets of activities which can be described by technical and economic parameters and is determined by cost, time, and scope in order to aid logistics management in enterprise/supply chain. Controlling of the logistics project is process of measuring progress toward an objective, evaluating what remains to be

done, and taking the necessary corrective tasks to achieve or exceed the objectives of the logistics project.

1.2. Logistics Activities

Logistics is responsible for the movement and storage of material as they move through the supply chain. When the material moving through an organization one can see the following activities are normally included in logistics.





1.3. Project Procurement Management

Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team to perform the work. This chapter presents two perspectives of procurement. The organization can be either the buyer or seller of the product, service, or results under a project.

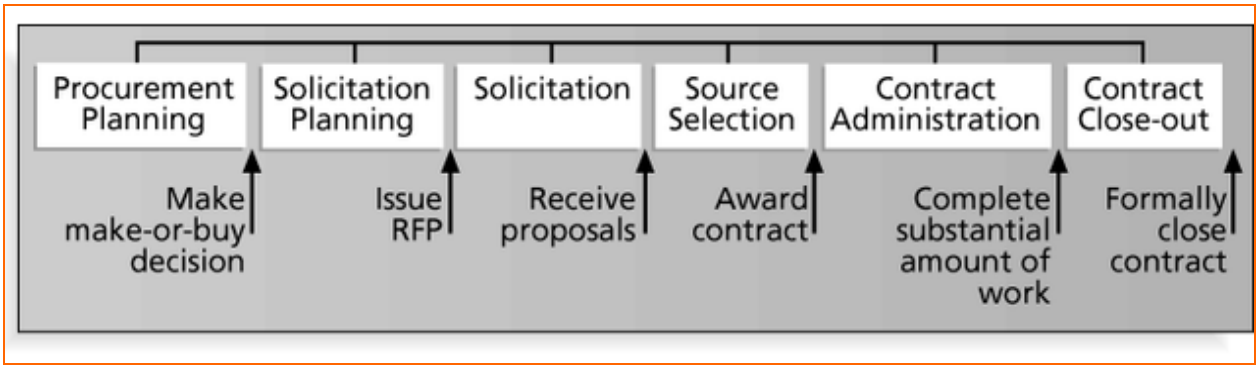


Figure: Project Procurement Management Processes and Key Outputs

Project Procurement Management includes the contract management and change control processes required to develop and administer contracts or purchase orders issued by authorized project team members. Project Procurement Management also includes administering any contract issued by an outside organization (the buyer) that is acquiring the project from the performing organization (the seller), and administering contractual obligations placed on the project team by the contract. Project Procurement Management processes which include the following:

1. **Plan Procurements**: The process of documenting project purchasing decisions, the approach, and identifying potential sellers.
2. **Conduct Procurements:** The process of obtaining seller responses, selecting a seller, and awarding a contract.
3. **Administer Procurements:** The process of managing procurement relationships, monitoring contract performance, and making changes and corrections as needed.
4. **Close Procurements:** The process of completing each project procurement;

These processes interact with each other and with the processes in the other Knowledge Areas. Each process can involve effort from one or more persons or groups of persons, based on the requirements of the project. Each process occurs in one or more project phases, if the project is divided into phases. Although the processes are presented here as discrete components with well-defined interfaces, in practice they overlap and interact in ways not detailed here. The Project Procurement Management processes involve contracts that are legal documents between a buyer and a seller. A contract

represents a mutually binding agreement that obligates the seller to provide the specified products, services, or results, and obligates the buyer to provide monetary or other valuable consideration. A contract is a legal relationship subject to remedy in the courts. The agreement can be simple or complex, and can reflect the simplicity or complexity of the deliverables and procured effort.

A procurement contract will include terms and conditions, and may incorporate other items that the buyer relies upon to establish what the seller is to perform or provide. It is the project management team's responsibility to make certain that all procurements meet the specific needs of the project while adhering to organizational procurement policies. Depending upon the application area, a contract can also be called for example, an agreement, an understanding, a subcontract, or a purchase order. Most organizations will have documented policies and procedures specifically defining the procurement rules and specifically prescribing who has delegated authority to sign and administer such agreements on behalf of the organization.

Although all project documents are subject to some form of review and approval, the legally binding nature of a contract usually means that it will be subjected to a more extensive approval process. In all cases, the primary focus of the review and approval process ensures that the contract language describes the products, services, or results that will satisfy the identified project need. The project management team may seek support early from specialists in the disciplines of contracting, purchasing, law, and technical. Such involvement can be mandated by an organization's policies.

The various activities involved in the Project Procurement Management processes form the life cycle of a contract. By actively managing the contract life cycle and carefully wording the terms and conditions of the procurements, some identifiable project risks can be avoided or mitigated or transferred to a seller. Entering into a contract for products or services is one method of allocating the responsibility for managing or sharing potential risks.

A complex project can involve managing multiple contracts or subcontracts simultaneously or in sequence. In such cases, each contract life cycle can end during any phase of the project life cycle. Project Procurement Management is discussed within the perspective of the buyer-seller relationship. The buyer-seller relationship can exist at many levels on any one project, and between organizations internal to and external to the acquiring organization.

Depending on the application area, the seller can be called a contractor, subcontractor, vendor, service provider, or supplier. Depending on the buyer's position in the project acquisition cycle, the buyer can be called a client, customer, prime contractor, contractor, acquiring organization, governmental agency, service requestor, or purchaser. The seller can be viewed during the contract life cycle first as a bidder, then as the selected source, and then as the contracted supplier or vendor.

The seller will typically manage the work as a project if the acquisition is not just for shelf material, goods, or common products. In such cases:

- ✓ The buyer becomes the customer, and is thus a key project stakeholder for the seller.
- ✓ The seller's project management team is concerned with all the processes of project management, not just with those of this Knowledge Area.

Terms and conditions of the contract become key inputs to many of the seller's management processes. The contract can actually contain the inputs (e.g., major deliverables, key milestones, cost objectives), or it can limit the project team's options (e.g., buyer approval of staffing decisions is often required on design projects).This chapter assumes that the buyer of items for the project is within or assigned to the project team and that the sellers are organizationally external to the project team. It also assumes that a formal contractual relationship will be developed and exist between the buyer and the seller. However, most of the discussion in this chapter is equally applicable to non-contractual inter-divisional work, entered into with other units of the project team's organization which can best be, or must be, met by acquiring products, services, or results outside of the project organization, versus those project needs which can be accomplished by the project team. This process involves consideration of whether, how, what, how much, and when to acquire outside support. When the project obtains products, services, and results required for project performance from outside the performing organization, the processes from Plan Procurements through Close Procurements are performed for each item to be acquired. The Plan Procurements process also includes consideration of potential sellers, particularly if the buyer wishes to exercise some degree of influence or control over acquisition decisions. Consideration should also be given to who is responsible for obtaining or holding any relevant permits and professional licenses that may be required by legislation, regulation, or organizational policy in executing the project. The requirements of the project schedule can significantly influence the strategy during the Plan Procurements process. Decisions made in developing the procurement management plan can also influence the project schedule and are integrated with Develop Schedule, Estimate Activity Resources, and make-or-buy

decisions. The Plan Procurements process includes consideration of the risks involved with each make-or-buy decision, and also includes reviewing the type of contract planned to be used with respect to mitigating risks, sometimes transferring risks to the seller.

I. PLAN PROCUREMENTS

A. Plan Procurements: Inputs

1. Scope Baseline

The scope baseline describes the need, justification, requirements, and current boundaries for the project. It consists of the following components:

- **Scope statement.** The project scope statement contains the product scope description, service description and result description, the list of deliverables, and acceptance criteria as well as important information regarding technical issues or concerns that could impact cost estimating. Examples of constraints are required delivery dates, available skilled resources, and organizational policies.
- **Work breakdown structure (WBS).** The project's WBS provides a pictorial display of the relationships among the components of the project and the project deliverables.
- **WBS dictionary.** The WBS dictionary and related detailed statements of work provide an identification of the deliverables and a description of the work in each WBS component required to produce each deliverable.

2. Stakeholder Requirements Documentation: Stakeholder requirements documentation may include:

- Important information about project requirements that is considered during planning for procurements.
- Requirements with contractual and legal implications may include health, safety, security, performance, environmental, insurance, intellectual property rights, equal employment opportunity, licenses, and permits-all of which are considered when planning for procurements.

3. Teaming Agreements

Teaming agreements are a legal contractual agreement between two or more entities to form a partnership or joint venture, or some other arrangement as defined by the parties. The agreement defines buyer-seller roles for each party. Whenever the new business opportunity ends, the teaming agreement also ends. Whenever a teaming agreement is in effect, the planning process for the project is significantly impacted. Thus whenever a teaming agreement is in place on a project, the roles of buyer and seller are predetermined, and

such issues as scope of work, competition requirements, and other critical issues are generally predefined in a teaming arrangement.

4. **Risk Register**

The risk register includes risk-related information such as the identified risks, risk owners, and risk responses.

5. **Risk-Related Contract Decisions**

Includes agreements for insurance, bonding, services, and other items as appropriate, that are prepared to specify each party's responsibility for specific risks, should they occur.

6. **Activity Resource Requirements:** Contains information on specific needs such as people, equipment, or location needs.
7. **Project Schedule:** Contains information on required timelines or mandated deliverables dates.
8. **Activity Cost Estimates:** Estimates are used as a basis on which to regard bids.
9. **Cost Performance Baseline:** Provides detail on the planned budget over time.
10. **Enterprise Environmental Factors:** The enterprise environmental factors that can influence the Plan Procurements process include but are not limited to:

- Marketplace conditions, and
- Products services and results those are available in the marketplace, the supplier, past performance of suppliers, under what terms and conditions.

11. **Organizational Process Assets:** The Organizational process assets that influence the Plan Procurement process include but are not limited to:

- ✓ Formal procurement policies, procedures, and guidelines. Most organizations have formal procurement policies and buying organizations. When such procurement support is not available, then the project team will have to supply both the resources and the expertise to perform such procurement activities.
- ✓ Management systems that are considered in developing the procurement management plan and selecting the contract types to be used.
- ✓ Organizations will sometimes have an established multi-tier supplier system of pre-qualified sellers based on prior experience.

B. Plan Procurements: Tools and Techniques

1. Make-or-Buy Analysis

A make-or-buy analysis is a general management technique used to determine whether particular work can best be accomplished by the project team or must be purchased from outside sources. Sometimes a capability may exist within the project organization, but may be committed to working on other projects, in which case the project may need to procure such effort from outside the organization in order to meet its schedule commitments. Any budget constraints are factors which may influence make-or-buy decisions. If a buy decision is to be made, then a further decision of whether to purchase or lease is also made. A make-or-buy analysis should consider all related costs; both direct costs as well as indirect support costs. For example, the buy-side of the analysis includes both the actual out-of-pocket costs to purchase the product, as well as the indirect costs of supporting the purchasing process.

2. Expert Judgment

Expert technical judgment will often be used to assess the inputs to and outputs from this process. Expert purchasing judgment can also be used to develop or modify the criteria that will be used to evaluate seller proposals. Expert legal judgment may involve the services of legal staff to assist with unique procurement issues, terms, and conditions. Such judgment, including business and technical expertise, can be applied to both the technical details of the procured products, services, or results and to various aspects of the procurement management processes.

3. Contract Types

Although the firm-fixed-price type of contractual arrangement is typically the preferred type which is encouraged and often demanded by most organizations, there are times when another contract form may be in the best interests of the project when considering all factors. If a contract type other than fixed-price is intended, it is incumbent on the project team to justify its use. The type of contract to be used and the specific contract terms and conditions fix the degree of risk sharing being assumed by the buyer and seller. All legal contractual relationships generally fall into one of two broad families, either fixed-price or cost reimbursable. Also, there is a third hybrid-type commonly in use called the time and materials contract. The more popular of the contract types in use are discussed below as discrete types, but in practice, it is not unusual to combine one or more types into a single procurement.

- **Fixed-price contracts.** This category of contracts involves setting a fixed total price for a defined product or services to be provided. Fixed-price

contracts may also incorporate financial incentives for achieving or exceeding selected project objectives, such as schedule delivery dates, cost and technical performance, anything that can be quantified and subsequently measured. Sellers under fixed-price contracts are legally obligated to complete such contracts, with possible financial damages if they do not. Under the fixed-price arrangement, buyers must precisely specify the product or services being procured. Changes in scope can be accommodated, but generally at an increase in contract price.

- **Firm Fixed Price Contracts (FFP):** The most commonly used contract type is the FFP. It is favored by most buying organizations because the price for goods is set at the outset, and not subject to change unless the scope of work changes. Any cost increase due to adverse performance is the responsibility of the seller, who is obligated to complete the effort. Under the FFP contract, the buyer must precisely specify the product or services to be procured, and any changes to the procurement specification can increase the costs to the buyer.
- **Fixed Price Incentive Fee Contracts (FPIF)**: This fixed-price arrangement gives the buyer and seller some flexibility in that it allows for deviation from performance, with financial incentives tied to achieving agreed to metrics. Typically such financial incentives are related to cost, schedule, or technical performance of the seller. Performance targets are established at the outset, and the final contract price is determined after completion of all work based on the seller's performance. Under FPIF contracts, a price ceiling is set, and all costs above the price ceiling are the responsibility of the seller, who is obligated to complete the work.
- **Fixed Price with Economic Price Adjustment Contracts (FP-EPA**): This contract type is used whenever the seller's performance period spans a considerable period of years, as is desired with many long-term relationships. It is a fixed-price contract, but with a special provision allowing for pre-defined final adjustments to the contract price due to changed conditions, such as inflation changes, or cost increases for specific commodities. The EPA clause must relate to some reliable financial index which is used to precisely adjust the final price. The FP-EPA contract is intended to protect both buyer and seller from external conditions beyond their control.
- **Cost-reimbursable contracts**: This category of contract involves payments (cost reimbursements) to the seller for all legitimate actual costs incurred, plus a fee representing seller profit for completed work. Cost-reimbursable contracts may also include financial incentive clauses whenever the seller exceeds, or falls below defined objectives, such as costs, schedule, or technical performance targets. Three of the more common types of cost-reimbursable contracts in use are Cost Plus Fixed Fee (CPFF), Cost Plus Incentive Fee (CFIF), and Cost Plus Award Fee (CFAF). The cost reimbursable contract gives the project the needed flexibility to redirect a seller whenever the scope of work

cannot be precisely defined at the start and needs to be altered, or when high risks may exist in the effort.

- **Cost Plus Fixed Fee Contracts (CPFF):** Seller is reimbursed for all allowable costs for performing the contract work, and receives a fixed fee payment calculated as a percentage of the initial estimated project costs. Fee is paid only for completed work, and does not change due to seller performance. Fee amounts do not change unless the project scope changes.
- **Cost Plus Incentive Fee Contracts (CPIF)**: Seller is reimbursed for all allowable costs for performing the contract work and receives a predetermined incentive fee, based upon achieving certain performance objectives as set forth in the contract. In CPIF contracts, if the final costs are less or greater than the original estimated costs, then both the buyer and seller share costs from the departures based upon a pre-negotiated cost sharing formula, e.g., an 80/20 split over/under target costs.
- **Cost Plus Award Fee Contracts (CPAF):** This is a cost reimbursement contract whereby the seller is reimbursed for all legitimate costs, but the majority of fee is only earned based on the satisfaction of certain broad subjective performance criteria, as defined and incorporated into the contract. The determination of fee is based solely on the subjective determination of seller performance by the buyer, and is generally not subject to appeals.

- **Time and Material Contracts (T&M).** Time and material contracts are a hybrid type of contractual arrangement that contain aspects of both cost-reimbursable and fixed-price type arrangements. They are often used for staff augmentation, acquisition of experts, and any outside support when a precise statement of work cannot be quickly prescribed. These types of contracts resemble cost-reimbursable type arrangements in that they can be left open ended and may be subject to cost growth for the buyer. The full value of the agreement and the exact quantity of items to be delivered may not be defined by the buyer at the time of the contract award. Thus, T&M contracts can increase in contract value as if they were cost-reimbursable type arrangements. Many organizations require not-to-exceed values and time limits placed in all T&M contracts to prevent unlimited cost growth. Conversely, T&M contracts can also resemble fixed unit price arrangements when certain parameters are specified in the contract. Unit labor or material rates can be preset by the buyer and seller when both parties agree on the values for specific resource categories, for example senior engineers at so much per hour, or categories of materials at specified rates per unit.

C. Plan Procurements: Outputs

1. Procurement Management Plan

The procurement management plan describes how the procurement processes will be managed from developing procurement documentation through contract closure. The procurement management plan can include guidance for:

- ✓ The types of contracts to be used;
- ✓ Whether independent estimates will be used and if they are needed as evaluation criteria;
- ✓ Those actions the project management team can take unilaterally, if the performing organization has a proscribed procurement, contracting, or purchasing department;
- ✓ Standardized procurement documents, if they are needed;
- ✓ Managing multiple suppliers;
- ✓ Coordinating procurement with other project aspects, such as scheduling and performance reporting;
- ✓ Any constraints and assumptions that could affect planned procurements;
- ✓ Handling the required lead times to purchase items from sellers and coordinating them with the project schedule development;
- ✓ Handling the make-or-buy decisions and linking them into the Estimate Activity Resource and Develop Schedule processes;
- ✓ Setting the scheduled dates in each contract for the contract deliverables and coordinating with the schedule development and control processes;
- ✓ Identifying requirements for performance bonds or insurance contracts to mitigate some forms of project risk;
- ✓ Establishing the direction to be provided to the sellers on developing and maintaining a work breakdown structure (WBS);
- ✓ Establishing the form and format to be used for the procurement/contract statements of work;
- ✓ Identifying pre-qualified sellers, if any, to be used; and
- ✓ Procurement metrics to be used to manage contracts and evaluate sellers.

A procurement management plan can be formal or informal, can be highly detailed or broadly framed, and is based upon the needs of each project. The procurement management plan is a subsidiary component of the project management plan.

2. Procurement Statements of Work

Each procurement statement of work (SOW) defines for those items being purchased, only that portion of the project scope that is to be included within the related contract. The SOW for each contract is developed from the

project scope baseline. The procurement SOW describes the procurement item in sufficient detail to allow prospective sellers to determine if they are capable of providing the item. Sufficient detail can vary, based on the nature of the item, the needs of the buyer, or the expected contract form. Procurement SOW describes the products, services, or results to be supplied by the seller. Information included in a SOW can include specifications, quantity desired, quality levels, performance data, period of performance, work location, and other requirements.

The procurement SOW is written to be clear, complete, and concise. It includes a description of any collateral services required, such as performance reporting or post-project operational support for the procured item. In some application areas, there are specific content and format requirements for a contract SOW. Each individual procurement item requires a SOW. However, multiple products or services can be grouped as one procurement item within a single SOW. The procurement SOW can be revised and refined as required as it moves through the procurement process until incorporated into a signed contract award.

3. Make-or Buy Decisions

Make-or-buy documents the decisions of what project products, services, or results will be acquired from outside the project organization, or will be performed internally by the project team. This may also include decisions to buy insurance policies or performance bond contracts to address some of the identified risks. The make-or-buy decisions document can be as simple as a listing that includes a short justification for the decisions. These decisions can be altered as subsequent procurement activities indicate a requirement for a different approach.

4. Change Requests

Change requests to the project management plan, its subsidiary plans and other components may result from the Plan Procurements process. Change requests are processed for review and disposition through the Perform Integrated Change Control process.

5. Procurement Document Packages

Procurement documents are used to solicit proposals from prospective sellers. Terms such as bid, tender, or quotation are generally used when the seller selection decision will be based on price (as when buying commercial or standard items), while a term such as proposal is generally used when other considerations, such as technical capability or technical approach are paramount. Common terms are in use for different types of procurement documents and may include request for information (RFI), invitation for bid (1FB), request for proposal (RFP), request for quotation (RFQ), tender notice,

invitation for negotiation, and contractor initial response. Specific procurement terminology used may vary by industry and location of the procurement.

The buyer structures procurement documents to facilitate an accurate and complete response from each prospective seller and to facilitate easy evaluation of the responses. These documents include a description of the desired form of the response, the relevant procurement statement of work (SOW) and any required contractual provisions. With government contracting, some or all of the content and structure of procurement documentation can be defined by regulation. The complexity and level of detail of the procurement documents should be consistent with the value of, and risks associated with, the planned procurement. Procurement documents must be sufficient to ensure consistent, appropriate responses, but flexible enough to allow consideration of any seller suggestions for better ways to satisfy the same requirements. Issuing a procurement request to potential sellers to submit a proposal or bid is normally done in accordance with the policies of the buyer's organization, which can include publication of the request in public newspapers, in trade journals, in public registries, or on the Internet.

6. Source Selection Criteria

Selection criteria are often included as a part of the procurement solicitation documents. Such criteria are developed and used to rate or score seller proposals, and can be objective or subjective.

Selection criteria can be limited to purchase price if the procurement item is readily available from a number of acceptable sellers. Purchase price in this context includes both the cost of the item and all ancillary expenses such as delivery. Other selection criteria can be identified and documented to support an assessment for a more complex product or service or results. Some examples are:

- ✓ **Understanding of need-** How well does the seller's proposal address the procurement statement of work?
- ✓ **Overall or life-cycle cost-** Will the selected seller produce the lowest total cost (purchase cost plus operating cost)?
- ✓ **Technical capability-** Does the seller have, or can the seller be reasonably expected to acquire, the technical skills and knowledge needed?
- ✓ **Risk-** How much risk is embedded in the statement of work, and how much risk will be assigned to the selected seller?
- ✓ **Management approach-** Does the seller have, or can the seller be reasonably expected to develop, management processes and procedures to ensure a successful project?

- ✓ **Technical approach-** Do the seller's proposed technical methodologies, techniques, solutions, and services meet the procurement documentation requirements or are they likely to provide more than the expected results?
- ✓ **Warranty-** at does the seller propose to warrant for the final product, and through what time period?
- ✓ **Financial capacity-** Does the seller have, or can the seller reasonably be expected to obtain, the necessary financial resources?
- ✓ **Production capacity and interest-** Does the seller have the capacity and interest to meet potential future requirements?
- ✓ **Business size and type-** Does the seller's enterprise meet a specific type or category of business, such as small, women-owned, or disadvantaged small businesses, as defined by the buyer or established by governmental agency and set-forth as a condition of contract award?
- ✓ **Past performance of sellers-** at has been the past experience with selected sellers?
- ✓ **References-** Can the seller provide references from prior customers verifying the seller's work experience and compliance with contractual requirements?
- ✓ **Intellectual property rights-** Does the seller assert intellectual property rights in the work processes or services they will use or in the products they will produce for the project?
- ✓ **Proprietary rights-** Does the seller assert proprietary rights in the work processes or services they will use or in the products they will produce for the project?

II. CONDUCT PROCUREMENTS

Conduct Procurements is the process of obtaining seller responses, selecting a seller, and awarding a contract. In this process the team will receive bids or proposals and will apply previously defined evaluation criteria, as applicable, to select one or more sellers who are both qualified to perform the work and acceptable as a seller? Many factors can be evaluated in the seller selection decision process, for example:

- ➢ Price or cost can be the primary determinant for a standard off-the-shelf item, but the lowest proposed price may not be the lowest cost if the seller proves unable to deliver the products, services, or results in a timely manner.
- ➢ Proposals are often separated into technical (approach) and commercial (price) sections, with each issue evaluated separately. Sometimes, management sections are required as a part of the proposal and also have to be evaluated separately.
- ➢ Multiple sources could be required for critical products, services, and results to mitigate risks that can be associated with issues such as delivery schedules and quality requirements. The potentially higher cost associated with such multiple sellers, including any loss of possible

quantity discounts, and replacement and maintenance issues, are considered.

The tools and techniques described here can be used alone or in combination to select sellers. For example, a weighting system can be used to:

- ✓ Select a single seller that will be asked to sign a standard contract, and
- ✓ Establish a negotiating sequence by ranking all proposals by the weighed evaluation scores assigned to each proposal.

On major procurement items, the overall process of requesting responses from sellers and evaluating sellers' responses can be repeated. A short list of qualified sellers can be established based on a preliminary proposal. A more detailed evaluation can then be conducted based on specific and comprehensive requirements document requested from the sellers on the short list.

A. Conduct Procurements: Inputs

1. **Procurement Management Plan:** The procurement management plan should describe how the remaining procurement processes (from solicitation planning through contract close-out) will be managed.
2. **Procurement Document Package:**
3. **Source Selection Criteria:** Source selection criteria can include information on the supplier's required capabilities, capacity, delivery dates, product cost, life-cycle cost, technical expertise, and the approach to the contract.
4. **Qualified Sellers List:**
5. **Seller Proposals:** Seller proposals prepared in response to a procurement document package form the basic set of information that will be used by an evaluation body to select one or more successful bidders (sellers).
6. **Project Documents:** To the extent that project documents are available, they are considered during the Select Sellers process.
7. **Make or Buy Decisions:**
8. **Teaming Agreements:** Whenever a teaming agreement is in place, the buyer and seller roles will have already been decided by executive management. In some cases the seller may already be working under some form of interim contract funded by the buyer or jointly by both parties. The effort of the buyer and seller in this process is to collectively prepare a procurement statement of work and plan which satisfies the requirements of the project. The two parties will then negotiate a final contract for award.
9. **Organizational Process Assets:** Elements of the organizational process assets that can influence the Conduct Procurements process include but are not limited to:

- ✓ Listings of prospective and previously qualified sellers, and

- ✓ Information on relevant past experience with sellers, both good and bad.

B. Conduct Procurements: Tools and Techniques

1. **Bidder Conferences:** Bidder conferences (sometimes also called contractor conferences, vendor conferences, and pre-bid conferences) are meetings with all prospective sellers and buyers prior to submittal of a bid or proposal. They are used to ensure that all prospective sellers have a clear and common understanding of the procurement (both technical and contractual requirements), and that no bidders receive preferential treatment. Responses to questions can be incorporated into the procurement documents as amendments. To be fair buyers must take great care to ensure that all prospective sellers hear every question and answer from any individual seller.
2. **Proposal Evaluation Techniques:** On complex procurements, where source selection will be made based on seller responses to previously defined weighted criteria, a formal evaluation process will be defined by the buyer's procurement policies. The evaluation committee will make their selection for approval by management prior to award.
3. **Independent Estimates:** For many procurement items, the procuring organization may elect to either prepare its own independent estimate, or have an estimate of costs prepared by an outside professional estimator, to serve as a benchmark on proposed responses. Significant differences in cost estimates can be an indication that the procurement statement of work was deficient, ambiguous, and/or that the prospective sellers either misunderstood or failed to respond fully to the procurement statement of work.
4. **Procurement Negotiations:** Negotiations clarify the structure and requirements of the purchases so that mutual agreement can be reached prior to signing the contract. Final contract language reflects all agreements reached. Subjects covered should include responsibilities and authorities, authority to make changes, applicable terms and governing law, technical and business management

approaches, proprietary rights, contract financing, technical solution, overall schedule, payments, and price. Contract negotiations conclude with a document that can be executed by both buyer and seller that constitutes the contract. For complex procurement items, contract negotiation can be an independent process with inputs (e.g., issues or an open items listing) and outputs (e.g., documented decisions) of its own. For simple procurement items, the terms and conditions of the contract can be prefixed and non-negotiable, and only need to be accepted by the seller. The project manager may not be the lead negotiator on procurements. The project manager and other members of the project management team may be present during negotiations to provide assistance, and if needed to add clarifications of the project's technical, quality, and management requirements.

5. **Expert Judgment:** Expert judgment may be used in evaluating seller proposals. The evaluation of proposals may be accomplished by a multi-discipline review team with expertise in each of the areas covered by the procurement documents and proposed contract. This can include expertise from functional disciplines, such as contracting, law, finance, accounting, engineering, design, research, development, sales, and manufacturing.
6. **Advertising:** Existing lists of potential sellers can often be expanded by placing advertisements in general circulation publications such as selected newspapers or in specialty trade publications. Some government jurisdictions require public advertising of certain types of procurement items; and most government jurisdictions require public advertising of pending government contracts.
7. **Internet Search:** The Internet has a major influence on most of the project procurements and supply chain acquisitions in organizations. A vast majority of commodities, components, shelf-items can be quickly located and secured at a fixed-price on the Internet. However, while the majority of purchased items may be obtained using the Internet, the high-risk, highly complex, procured effort that must be closely monitored cannot be obtained by this means.

Conduct Procurements: Outputs

1. **Selected Sellers:** The sellers selected are those sellers who have been judged to be in a competitive range based upon the outcome of the proposal or bid evaluation, and who have negotiated a draft contract, which will become the actual contract when an award is made. Final approval of all complex, high-value, high-risk procurements will generally require organizational senior management approval prior to award.
2. **Procurement Award:** A procurement contract is awarded to each selected seller. The contract can be in the form of simple purchase order, or a complex document. Regardless of the document's complexity, a contract is a mutually binding legal agreement that obligates the seller to provide the specified products, services, or results, and obligates the buyer to compensate the seller. A contract is a legal relationship subject to remedy in the courts. The major components in a contract document will vary, but will sometimes include the following:

- ✓ Statement of work or deliverables,
- ✓ Schedule,
- ✓ Performance reporting,
- ✓ Period of performance,
- ✓ Roles and responsibilities,
- ✓ Sellers place of performance,
- ✓ Pricing,
- ✓ Payment terms,
- ✓ Place of delivery,
- ✓ Inspection and acceptance criteria ,
- ✓ Warranty,
- ✓ Product support,
- ✓ Limitation of liability,
- ✓ Fees and retainage,
- ✓ Penalties,
- ✓ Incentives,
- ✓ Insurance and performance bonds,
- ✓ Subordinate subcontractor approvals,
- ✓ Change request handling, and
- ✓ Termination and alternate disputes resolution mechanisms.

3. **Resource Calendars:** The quantity and availability of contracted resources and those dates on which each specific resource can be active or idle are documented.
4. **Change Requests:** Change request to the project management plan, its subsidiary plans and other components, such as the project schedule and procurement management plan, may result from the Select

Sellers process. Requested changes are processed for review and disposition through the Perform Integrated Change Control process.

5. **Project Management Plan Updates:** Elements of the Project Management Plan include but are not limited to:

- ✓ Cost Baseline,
- ✓ Scope Baseline,
- ✓ Schedule Baseline, and
- ✓ Procurement Management Plan.

6. **Project Document Updates:** Project documents that may be updated include but are not limited to:

- ✓ Stakeholder requirements documentation,
- ✓ Requirements Traceability Documentation, and
- ✓ Risk Register.

Administer Procurements

Administer Procurements is the process of managing procurement relationships, monitoring contract performance, and making changes and corrections as needed. Both the buyer and the seller will administer the procurement contract for similar purposes. Each must ensure that both parties meet their contractual obligations and that their own legal rights are protected. The Administer Procurements process ensures that the seller's performance meets procurement requirements and that the buyer performs according to the terms of their legal contract. The legal nature of the contractual relationship makes it imperative that the project management team is aware of the legal implications of actions taken when administering any procurement. On larger projects with multiple providers, a key aspect of contract administration is managing interfaces among the various providers.

Due to varying organizational structures, many organizations treat contract administration as an administrative function separate from the project organization. While a procurement administrator may be on the project team, this individual typically reports to a supervisor from a different department. This is usually true if the performing organization is also the seller of the project to an external customer.

Administer Procurements includes application of the appropriate project management processes to the contractual relationship(s), and integration of the outputs from these processes into overall management of the project. This integration will often occur at multiple levels when there are multiple sellers and multiple products, services, or results involved. The project management processes that are applied may include, but are not limited to:

- ✓ Direct and Manage Project Execution to authorize the contractor's work at the appropriate time;
- ✓ Report Performance to monitor contractor cost, schedule, and technical performance;
- ✓ Perform Quality Control to inspect and verify the adequacy of the contractor's product;
- ✓ Perform Integrated Change Control to assure that changes are properly approved, and that all those with a need to know are aware of such changes; and
- ✓ Monitor and Control Risks to ensure that risks are mitigated.

Procurement administration also has a financial management component that involves monitoring of payments to the seller. This ensures that payment terms defined within the contract are met and that seller compensation is linked to seller progress, as defined in the contract. One of the principal concerns when making payments to suppliers is that there be some close relationship of payments made to the work accomplished.

The Administer Procurements process reviews and documents how well a seller is performing or has performed based on the contract and established corrective actions when needed. Also, the performance is documented as a basis for future relationships with the seller. Seller performance evaluation by the buyer is primarily carried out to confirm the competency or lack of competency of the seller, relative to performing similar work on the project or other projects. Similar evaluations are also carried out when it is necessary to confirm that a seller is not meeting the seller's contractual obligations, and when the buyer contemplates corrective actions. Administer Procurements includes managing any early terminations of the contracted work (for cause, convenience, or default) in accordance with the termination clause of the contract. Contracts can be amended at any time prior to contract closure by mutual consent, in accordance with the change control terms of the contract. Such amendments may not always be equally beneficial to both the seller and the buyer. J

Administer Procurements: Inputs

1. **Procurement Documents**
2. **Procurement Management Plan.**
3. **Selected Sellers**
4. **Performance Reports:** Seller performance-related documentation includes:
    - ✓ Seller-developed technical documentation and other deliverable

information provided in accordance with the terms of the contract; and

- ✓ Seller performance report: The seller's performance reports indicate which deliverables have been completed and which have not.

5. **Approved Change Requests:** Approved change requests can include modifications to the terms and conditions of the contract, including the procurement statement of work, pricing, and description of the products, services, or results to be provided. All changes are formally documented in writing and approved before being implemented.
6. **Work Performance Data:** Work performance data , including the extent to which quality standards are being satisfied, what costs have been incurred or committed, which seller invoices have been paid, are all collected as part of project execution.

Administer Procurements: Tools and Technique

1. **Contract Change Control Systems:** A contract change control system defines the process by which the procurement can be modified. It includes the paperwork, tracking systems, dispute resolution procedures, and approval levels necessary for authorizing changes. The contract change control system is integrated with the integrated change control system.
2. **Procurement Performance Reviews:** A procurement performance review is a structured review of the seller's progress to deliver project scope and quality, within cost and on schedule, as compared to the contract. It can include a review of seller-prepared documentation and buyer inspections, as well as quality audits conducted during seller's execution of the work. The objective of a performance review is to identify performance successes or failures, progress with respect to the procurement statement of work, and contract non-compliance which allows the buyer to quantify the seller's demonstrated ability or inability to perform work. Such reviews may take place as a part of project status reviews which would include key suppliers.

3. **Inspections and Audits:** Inspections and audits required by the buyer and supported by the seller as specified in the procurement contract, can be conducted during execution of the project to verify compliance in the seller's work processes or deliverables. If authorized by contract, some inspection and audit teams can include buyer procurement personnel.
4. **Performance Reporting:** Performance reporting provides management with information about how effectively the seller is achieving the contractual objectives.
5. **Payment Systems:** Payments to the seller are typically processed by the accounts payable system of the buyer, after certification of satisfactory work by someone on the project team. All payments should be made in strict accordance with the terms of the contract.
6. **Claims Administration:** Contested changes and potential constructive changes are those requested changes where the buyer and seller cannot reach an agreement on compensation for the change, or cannot agree that a change has even occurred. These contested changes are variously called claims, disputes, or appeals. Claims are documented, processed, monitored, and managed throughout the contract life cycle, usually in accordance with the terms of the contract. If the parties themselves do not resolve a claim, it may have to be handled in accordance with alternate disputes resolution (ADR) typically following procedures established in the contract. Settlement of all claims and disputes through negotiation is the preferred method.
7. **Records Management System:** A records management system is a specific set of processes, related control functions, and automation tools that are consolidated and combined into a whole, as part of the project management information system. A records management system is used by the project manager to manage contract and procurement documentation and records. The system is used to maintain an index of contract documents and correspondence, and assist with retrieving and archiving that documentation.

Administer Procurements: Outputs

1. **Procurement Documentation:** Procurement documentation includes but is not limited to the procurement contract with all supporting schedules, requested unapproved contract changes, and approved change requests. Procurement documentation also includes any seller-developed technical documentation and other work performance information, such as deliverables, seller performance reports, warranties, financial documents including invoices and payment records, and the results of contract-related inspections.
2. **Organizational Process Assets Updates** Elements of the organizational process assets that may be updated include but are not limited to:

   Correspondence: Contract terms and conditions often require written documentation of certain aspects of buyer/seller communications, such as the need for warnings of unsatisfactory performance and requests for contract changes or clarifications. This can include the reported results of buyer audits and inspections that indicate weaknesses the seller needs to correct. In addition to specific contract requirements for documentation, a complete and accurate written record of all written and oral contract communications, as well as actions taken and decisions made, are maintained by both parties.

   Payment schedules and requests: All payments should be made in accordance with the procurement contract terms and conditions.

   Seller performance evaluation documentation: Seller performance evaluation documentation is prepared by the buyer. Such performance evaluations document the seller's ability to continue to perform work on the current contract, indicate if the seller can be allowed to perform work on future projects, or rate how well the seller is performing the project work. These documents can form the basis for early termination of the seller's contract, or determining how contract penalties, fees, or incentives are administered. The results of these

performance evaluations can also be included in the appropriate qualified seller lists.

3. **Change Requests:** Change requests to the project management plan, its subsidiary plans and other components, such as the project schedule and procurement management plan (Section, may result from the Administer Procurements process. Change requests are processed for review and approval through the Perform Integrated Change Control process. Requested changes can include direction provided by the buyer, or actions taken by the seller, that the other party considers a constructive change to the contract. Since any of these constructive changes may be disputed by one party and can lead to a claim against the other party, such changes are uniquely identified and documented by project correspondence.
4. **Project Management Plan Updates:** Elements of the Project Management Plan that may be updated include but are not limited to:

   Procurement management plan: The procurement management plan is updated to reflect any approved change requests that affect procurement management, including impacts to costs or schedules.

   Baseline schedule: If there are slippages that impact overall project performance the baseline schedule may need to be updated to reflect the current expectations.

Close Procurements

Close Procurements is the process of completing each project procurement. It supports the Close Project or Phase process, since it involves verification that all work and deliverables were acceptable. The Close Procurements process also involves administrative activities, such as updating records to reflect final results and archiving such information for future use. Close Procurements addresses each contract applicable to the project or a project phase. In multi-phase projects, the term of a contract may only be applicable to a given phase of the project. In these cases, the Close Procurements process closes the procurement(s) applicable to that phase of the project. Unresolved claims may be subject to litigation after closure. The

contract terms and conditions can prescribe specific procedures for contract closure.

Early termination of a contract is a special case of procurement closure, which can result from a mutual agreement of both parties, from the default of one of the parties, or for convenience of the buyer if provided for in the contract. The rights and responsibilities of the parties in the event of an early termination are contained in a terminations clause of the contract. Based upon those procurement terms and conditions, the buyer may have the right to terminate the whole contract or a portion of the project, for cause or convenience, at any time. However, based upon those contract terms and conditions, the buyer may have to compensate the seller for seller's preparations and for any completed and accepted work related to the terminated part of the contract.

Close Procurements: Inputs

1. **Procurement Management Plan**
2. **Procurement Documentation**

Close Procurements: Tools and Techniques

1. **Procurement Audits:** A procurement audit is a structured review of the procurement process originating from the Plan Procurements process through Administer Procurements. The objective of a procurement audit is to identify successes and failures that warrant recognition in the preparation or administration of other procurement contracts on the project, or on other projects within the performing organization.
2. **Negotiated Settlements:** In all procurement relationships the fmal equitable settlement of all outstanding issues, claims, disputes, by negotiation is a primary goal of the project. Whenever settlement cannot be achieved through direct negotiation, then some form of alternate disputes resolution (ADR) like mediation or arbitration may be explored. When all else fails, litigation in the courts is the least desirable option.

3. **Records Management System**.

Close Procurements: Outputs

1. **Closed Procurements:** The buyer, usually through its authorized procurement administrator, provides the seller with formal written notice that the contract has been completed. Requirements for formal procurement closure are usually defined in the terms and conditions of the contract and are included in the procurement management plan.
2. **Organizational Process Assets Updates** Elements of the organizational process assets that may be updated include but are not limited to:

   Procurement file: A complete set of indexed contract documentation, including the closed contract, is prepared for inclusion with the final project files.

   Deliverable acceptance: The buyer, usually through its authorized contract administrator, provides the seller with formal written notice that the deliverables have been accepted or rejected. Requirements for formal deliverable acceptance, and how to address non-conforming deliverables, are usually defined in the contract.

   Lessons learned documentation: Lessons learned analysis, what has been experienced, and process improvement recommendations, should be developed for the project file to improve future procurements.

Summary of the Chapter

- Project procurement management involves acquiring goods and services for a project from outside the performing organization. Processes include:
  - Plan procurement management
  - Conduct procurements

- Control procurements
- Close procurements

More specifically, the issues in detail are as follows:

- Procurement planning: Determining what to procure and when. What to outsource, type of contract, creating statement of work and procurement management plan
- Solicitation planning: Documenting product requirements and identifying potential sources. Writing Request for Proposal (RFP) and developing evaluation criteria
- Solicitation: Obtaining quotations, bids, offers, or proposals as appropriate. Advertisement, holding bids, and receiving proposals or bids
- Source selection: Choosing from among potential vendors, negotiating contracts, and awarding the contract
- Contract administration: Managing the relationship with the vendor. Monitoring contract performance, making payments, awarding contract modifications
- Contract close-out: Completion and settlement of the contract. Product verification, formal acceptance, and closure

CHAPTER TWO

ESSENTIALS OF PROJECT PROCUREMENT POLICY

Objective of the chapter:

At the end of this chapter, the students will be able to:

- ✓ familiar with the different procurement policy issues
- ✓ identify the possible project procurement structures
- ✓ identify the different factors that would affect the project procurement structures
- ✓ identify the advantages and disadvantages of formulating project procurement policy

2.1. Policy Issues

The term policy includes all the directives, both explicit and implied, that designate the aims and ends of an organization and the appropriate means used in their accomplishment. Policy refers to the set of purposes, principles, and rules of action that guide an organization. Rules of action refer to standard operating procedures along with any rules and regulations. Although, policies are usually documented in writing, unwritten or informal policies can also exist. Informal policies are understood over time and eventually become part of an organization's culture.

The ability of the organization to develop and apply effective purchasing policy depends partly on the perceptions of managers at all levels. The manager charged with the development of a policy should recognize that these perceptions are affected by the existing company structure, the quality of its internal communication system, the past experience of the company and its managers, and the resources available. As has been suggested earlier, the development of a policy involves company-wide considerations. These considerations differ by industry and by company. What should be

common, however, is the need to develop advantages over the competition and use them effectively. The ability of the organization to develop and apply effective purchasing policy will be conditioned by several factors, and there are roles for a purchasing manager that relate to the development of policy. Among these are:

- Generating alternative solutions to procurement problems,
- Protecting the cost structure of the organization,
- Minimizing purchasing costs,
- Assuring long-range sources of supply, and
- Maintaining good relationships with suppliers.

Each of these has a strategic as well as an operational facet. This emphasises the important point that development of a policy necessitates a coordinated operational response. It is of little use defining and developing a policy unless the day-to-day actions of the organization are geared to the strategic approach. This is a deceptively simple concept, for it is not uncommon to find companies that purport to have policies where the behaviour of managers is contradictory to the stated approach.

2.2. Structure of Purchasing Organization

An essential part of policy development and selection is to devise an organization to carry out the activities embodied in the policy. Classical management writers have emphasised the importance of the activity of organising as a key function of management. Whilst their views have been modified in many respects, this function is still important and, therefore, the purchasing manager should pay close attention to the development of the organizational structure for the purchasing function. Organization is concerned with the division of work and the delegation of authority and responsibility in such a way that the objectives of the organization can be achieved. It also involves defining the duties of personnel and the relationships between them.

The task of developing an organization structure has become a complex one, and there is no longer a simple prescriptive model that can be applied in all situations. The business environment is now populated by a wide variety of different types of organization. It is recommended, therefore, that an organization structure should be tailored to the particular circumstances of the particular organization. What is suitable for one organization would not necessarily be copied by another. In discussing organizational problems for purchasing management, it is essential to take into account some of the important differences. Of course, the development of an organization for the purchasing function is but part of a general problem of developing an organization structure for the organization as a whole. Thus, purchasing considerations will reflect the needs of this broader framework as well as internal factors.

2.3. Structure of the Purchasing Function in Simple Organizations

In this example it is necessary to concentrate upon the organization of a centralized purchasing function within a relatively simple, single product, single site firm; assess the advantages of specialisation and then map out the possible range of activities that could be included. Having portrayed a typical structure diagrammatically, the place of the purchasing manager within the overall management structure of the organization will be examined.

Benefits of a Centralized Purchasing Function

In very small firms the scope for specialisation is limited and purchasing activities would not be sufficient to occupy a person full time. Once a firm employs around a hundred or above, however, it should be possible to introduce purchasing as a specialist job. As the volume of work expands so the number of purchasing personnel will grow and the opportunities for specialisation within the function increase. Parallel with this growth, therefore, the problem of organization assumes greater importance.

The introduction of a specialist department to handle purchasing activities means that its members see purchasing as their major responsibility and can develop expertise in conducting their work. Previously, purchasing jobs were done by other people for whom purchasing was a major activity for which they had no particular skills. Thus, full-time specialists can develop their abilities and use progressive purchasing techniques to obtain better value for money. The department can coordinate the previously fragmented purchasing pattern and can introduce a common system of procedures. Knowledge of supply markets can be built up, an efficient record system introduced and negotiating skills can be applied. What may have started as a simple clerical function can become a sophisticated independent department.

The basic argument for the development of the centralized function rests upon the point that efficiency in controlling the flow of inputs to the firm is increased by the application of specialist expertise. The opportunities to make such improvements in efficiency can be found in different types of organizations in all sectors of the economy. Most large organizations already appreciate the advantage to be gained by effectively controlling purchasing activities, but many medium and small organizations have yet to reap the full rewards because insufficient recognition has been given to this function. The purchasing function can make a major contribution towards the achievement of corporate objectives in both the public and private sectors.

Activities in the Purchasing Function

A wide variety of arrangements can be found concerning the activities that should be included under the control of the purchasing manager. The most effective pattern is one in which the purchasing manager is given authority for all those activities which lead to the supply of goods and services to user departments. Such a range might include:

- **Categories of goods purchased**: With reference to basic categories of goods purchased by an organization we can point out that the area of authority concerning this range varies in different organizations. In manufacturing companies, the purchase of industrial materials is

regarded as the major area of expenditure to be controlled, but many purchasing managers have no control over the purchase of plant and equipment at all. In spite of this difference in delegation of authority, the arguments in favour of the application of specialist purchasing skills are relevant to all purchases. It follows that the purchasing department should be given responsibility for purchasing all bought out goods that are required. This does not mean that other departments should be excluded from the decision-making process, but that the purchasing department should contribute its commercial expertise to this process to complement the technical skills of the other departments. A purchasing research team should also be attached to the buying area to provide information to the buyers, which may include cost analysis.

- **Progressing or expediting**: An essential phase in the purchasing process, for the more important needs at least, is the progressing activity, to ensure that goods arrive at the desired time. The organizational problem here revolves around whether buyers should also progress the orders they have placed or whether a specialist or specialist team should be formed to carry out these duties. The division of work between buying and progressing sections allows each to develop its own particular skills for the different activities. The buyer can concentrate attention on market analysis and contract negotiation and the expeditor can build up contacts and persuasive skills to obtain deliveries from suppliers. On the other hand, others argue that having to do the progressing work helps to discipline the buyer in selecting reliable suppliers. On balance, the first approach is preferable (as long as the workload is sufficient), as long as the buyers are informed about poor delivery performance.
- **Purchasing in distributive organizations:** Whilst the principles of purchasing management apply equally to the wholesale and retail sections of industry as to manufacture, procedures differ. Because there are normally no production processes involved (the raw material stockholder may offer a cutting or shearing service), sales and

purchasing personnel are involved in product selection and programming as a total merchandising operation. Many large organizations are headed, as far as supplies are concerned, by a merchandise executive or director, who is responsible for sales and purchasing, and who organises and coordinates the expertise and information available to both. In a dynamic, consumer-demand situation, such as retail multistores or supermarkets, purchasing requirement forecasting and expenditure based on product sales, subject to changing preferences, promotions, and seasonal peaks and troughs, require continuous updating to data and flexible purchasing arrangements. Product knowledge, ability to interpret sales data, short and long term, allied to continuous supply market research, are essential to successful buying for direct resale to the consumer.

- **Stores and stock control, including goods receiving:** It can be argued that there are advantages to be gained by grouping stores and stock control activities under the control of the purchasing manager. The achievement of the objective of lowest cost of supply implies that both purchasing and stock control considerations are relevant in deciding how many and when to purchase goods required to reprovision the stores. It is easier to develop an integrated system of procedures and exchanges of information in a unified purchasing organization than it is to develop them in two separate departments. Goods receiving activities complete the purchasing cycle and transfer the purchases to user departments or, more frequently, to the stores. These, too, should be integrated into the purchasing organization.

It can be seen from the foregoing information that the structure of the purchasing department can be varied to give an assortment of different configurations.

2.4. The Position of Purchasing Management in the Organization

Where there is an integrated supplies organization or, indeed, where there is a significant purchasing team, a case can be made out for the purchasing manager or director of purchasing to have a high position within the management structure. This allows the manager and his or her department to give full weight to commercial aspects of purchasing decisions. If the purchasing manager is subordinate to the production manager, there is a danger that too much importance will be attached to technical matters. As an independent department, the supplies department can make its full contribution towards the achievement of corporate objectives. It can be argued, therefore, that the purchasing manager should be a member of the senior management team, with a direct reporting responsibility to the general manager. The purchasing manager may also be a member of the board of directors.

The position of the purchasing manager within the organization hierarchy is an important determinant of the impact that the department can have. A high position and high status enables an effective, progressive approach to purchasing work to be implemented. Support from the general manager helps to increase recognition for the function and to encourage good horizontal relationships with other departments. In the 21st century we should have more purchasing managers at board level. In the last analysis, however, it is successful performance that earns the respect of others in the organization.

2.5. Structure of the Purchasing Function in Complex Organization

The emergence of large multi-product, multisite organizations, and marketing strategies that can alter product as they seek growth; they have, therefore, moved away from the relatively simple situation of operating one production site to manufacture one product line. Thus, some have diversified into other product areas on one or more sites and others have duplicated

production facilities by opening establishments in different geographical locations. Policy decisions that have brought about these transformations have also influenced the development and adoption of different organizational structures to cope with the added complexity. We have also seen the emergence of huge multinational conglomerates, in which international differences magnify the problems of geographical dispersion. One of the major organizational innovations of the 20th century has been the introduction of the multidivisional structure

In the simple organization, the basic breakdown of tasks was achieved by splitting work up according to the main functional activities in the multidivisional organization function tasks are grouped around different product lines. Thus, several quasi-independent organizations are created and each has a reporting relationship to a central headquarters organization. Each product organization might be a separate limited company, with as headquarters a holding company. In others, each division and the head office may all be part of the same legal entity.

Each division may have a management structure, and the same functions may be present at head office level to act in a coordinating capacity. However, the extent of head office activities of the divisions tends to vary. Some multilevel organizations are relatively centralized and head office personnel play a detailed part in the activities of the divisions. Other decentralized arrangements, however, give more autonomous powers to the divisions. These are established as separate profit centres, with minimal interference from headquarters, and the relationship between the division and the headquarters is mainly a financial one. The division is responsible for achieving satisfactory profit figures and must apply for approval of corporate plans and investment finance. It can be argued that, the more unrelated in terms of technology, materials requirements, and markets the divisions are, the more decentralized should be the method of control. There is little scope for central coordination as each division operates in an entirely different sphere.

The opportunities for central coordination are greater in situations when organizations are manufacturing the same product or offering the same service at multiple locations. Production technology, marketing problems, and purchasing problems are similar and there is potential for more centralized control of operations. In this multilevel situation, therefore, more power and more activity will be located at headquarters. Indeed, some of the functions can be located solely at head office.

2.6. Alternative Structures for the Purchasing Function in Complex companies

There are three possible solutions to the problem of organising the purchasing function in complex organizations. Each will be examined in turn to establish the advantages and disadvantages inherent in each solution. The three solutions are as follows:

- **Complete centralization**: one central purchasing department controls the purchasing of all supplies for various scattered units or factories.
- **Complete decentralisation**: each separate unit or factory has its own purchasing department and is responsible for obtaining its own requirements.
- **Multilevel structure**: each unit has its own purchasing department, but a central purchasing department has some powers to coordinate the activities of the local departments.

Advantages of Centralisation:

The advantages to be gained from the establishment of one central purchasing department are as follows:

- Economies of bulk buying of items commonly used at each unit. The central department can negotiate cheaper prices on the basis of total consumption throughout the company.

- Avoidance of “competitive” buying by individual departments of materials in short supply.
- Opportunities for development of greater knowledge about products be-cause buyers can specialise in a narrower range of commodities which can be handled more expertly (i.e., buyers place orders for the whole company for a small range of products), whereas local buyers have to handle a more general range of local requirements.
- Savings in operating costs. Fewer, but larger orders are placed and hence a reduction in administrative costs can be made.
- Development of common procedures, forms, standards, and specifications.
- Simpler relationship with suppliers as a result of single, direct contact.
- Investigations of new products and materials can benefit all units in the company.
- Centralisation of stock control can reduce overall stock levels through greater flexibility and establishment of strategic reserves (i.e., flow of stocks between factories to meet shortages).
- Development of improved support services made possible (e.g., purchasing research and statistical information services).
- Enhanced importance of the supplies department and higher position of the supplies manager in management hierarchy.
- More scope for purchasing strategy and contribution to corporate plans.
- More scope for manpower planning in the function and development of training programmes.

Advantages of Decentralisation

The advantages of decentralisation can be seen as a remedy for the weaknesses of centralisation. The main advantages are as follows:

- Closer coordination with local organization and buyers can build up

close contacts with other departments.

- Buyer is in direct touch with the problems where they arise and can handle emergencies more easily than a distant office.
- Local buyers are better informed about local markets that may offer possibilities to a local customer which could not be offered on a national basis.
- Clear responsibility of buyers to local management.
- Local plants may need a different range of products, and thus a local buyer may have a more specialised knowledge of these.

2.7. A Multilevel Structure for Purchasing Management

The multilevel approach attempts to obtain the advantages of both the previous models. The division of duties between the two levels which is designed to achieve this as follows.

Central Office:

The following tasks may be allocated to the central office:

- Determination of purchasing strategies and development of purchasing policies
- Standardisation of procedures, specifications, codes and forms
- Negotiation of contracts for commonly used items against which local departments can place delivery orders for supplies as required
- Purchase of major plant and equipment
- Importation of supplies from overseas
- Responsibility for legal matters
- Interplant stock transfers and stocking policy
- Responsibility for training
- Research and information service

Local Offices:

Responsibility of placing orders for “noncontract” items

- Place delivery orders for contract items: In this group purchasing system, the manager at the local level would be responsible to his or her local line management. The manager at the central office would usually act in a staff capacity; that is to say, the latter would not have executive authority, as such, over the local manager, but would act in an advisory capacity.

A number of difficulties can arise in this multilevel approach. First, there is a danger that local initiative will be stifled by having group contracts imposed by a remote head office. The relationship between the two levels may be difficult to control. The local department may resent interference and there may be a conflict of interest between local interests and head office views. The staff/line division of responsibilities does not successfully resolve the problem of the local purchasing manager who has dual responsibilities to his local management team and to the group purchasing manager, when the latter has a more senior position, but no executive authority.

In spite of these problems, however, where a large range of items are commonly used, the benefits of having a central office outweigh the difficulties. When the range of commonly used items is small, other methods of achieving a common approach have been devised. These methods do not involve the formation of a permanent central department as such.

Sourcing Form:

Whatever the form of organization, the choice of sourcing is a complex issue. Arguably there are contingencies such as the individual, markets, products and organizations; there are criteria such as economic, power, risk and social factors; the contingencies and criteria prevailing at the decision point will result in single of multiple sourcing.

2.8. Other Methods of Achieving Coordination

Several other approaches have been developed to take advantage of the purchasing power of large companies without developing a central purchasing office. These include the use of a "lead buyer" strategy and the use of committees of local purchasing managers.

- Lead buyer contracting. The essential feature of this strategy is that the major user division or factory negotiates a contract, which is made available to the other parts of the company to use if they wish to do so.
- Committee of purchasing managers. Regular meetings of Purchasing Managers can be held to discuss common problems and to coordinate activities. Tasks of negotiating bulk-contracts can be allocated to individual departments.
- Informal communication. Informal communication between local departments can also lead to the formation of common policies.

These three approaches can be seen as being of a less formal kind than setting up a permanent central office. They also lack the scope of the central office for providing all the additional services indicated previously. In some cases local purchasing departments may be large enough to afford some of the specialisms we have given to head offices.

2.9. The Selection of an Appropriate Structure for Particular Circumstances

There is no single method of organising the purchasing function that is appropriate for all complex organizations. In developing a suitable structure, it is important to analyse the circumstances of the particular organization for which it is intended. Perhaps the key question that needs to be asked is how common are the purchasing problems that have to be faced at each site. The greater the similarity of purchases the

greater is the potential for centralising control. Conversely, the greater the variety; the greater the opportunity to decentralise activities.

Four different situations are worth examining:

- ✓ Single Product/Multisite operations
- ✓ Multiproduct/Multisite operations in which products are related
- ✓ Multiproduct/Multisite operations in which products are unrelated
- ✓ Very large multiproduct/multisite operations in which there is scope for multilevel structures in each division

2.9.1. Single Product/Multisite Operations

Where each factory is concerned with manufacturing the same products, the purchasing requirements are the same. Demand arises for the same products that are purchased from the same markets. There is scope for a fully centralized purchasing function, therefore, to gain the maximum benefit of the purchasing power of the company and to provide common solutions to common problems. In the tertiary sector, a central purchasing department would be able to control the purchasing for individual branches of a retail or distribution network and organise central storage points from which supplies of many items could be delivered. Buying consortia for several local authorities base their arguments on such a premise.

2.9.2. Multiproduct/Multisite Operations in Which Products are Related

In organizations that have several product divisions but whose products are related, in the sense that similar technology and similar materials are used, a multilevel purchasing system could be used. Sufficient common items and associated purchasing problems exist for a central department to make a valuable contribution, whilst local supply departments maintain close contact with local factories.

2.9.3. Multiproduct/Multisite Operations in Which Products are Unrelated

Conglomerate or diversified organizations may consist of manufacturing divisions that are entirely different in terms of technology and materials used. In such a situation, few common problems arise and there is little to be gained, therefore, from having a central department. Each divisional purchasing manager, how-ever, should be given a high position of responsibility within the divisional management structure and should play a significant part in the planning process for the division.

2.9.4. Very Large Multiproduct/Multisite Operations

In very large organizations, individual divisions may themselves have a multilevel organizational structure. In such a situation, there may be local purchasing departments under the control of a divisional purchasing manager. On top there may be a corporate purchasing department to coordinate the activities of the divisions, depending on how similar their needs are.

2.9.5. Multinational Supplies Structures

The multinational character of big organizations creates additional complications. Wide variations in terms of political, economic, social and industrial conditions may exist in the countries in which operations are located. It may be necessary, therefore, to allow a local purchasing department wider latitude in determining its own supply policy and controlling its own supplies. Nevertheless, if there are opportunities to be gained from closer coordination, such objectives should not be ignored and the local department should be encouraged to follow group policy. The central office could be used to organise the supply of goods being imported into other countries for local factories.

2.10. Total Procurement

For many years Procurement has been an undervalued activity in its contribution to corporate performance improvement and value for money management. Inadequate planning, poor communication between departments involved in the procurement of materials and equipment, and weak performance measurement have resulted in delays and compromise on materials acquisitions. The acceptance of total procurement as a business process that embraces all disciplines involved in the activities of the company, directly addresses these issues.

A significant consideration in the change from the traditional approach to materials supply to the concept of total procurement is the recognition that the value generated by a purchase can be enhanced through effective management of the process. Moreover the cost of owning materials or services is always more than simply the purchase price.

Benefit only accrues to the owner of purchased materials or services if the value added to the business, while in use, exceeds the cost of ownership. Good procurement should therefore aim to target both sides of the profit equation, by maximising the ability of an item to contribute revenue on the one hand, and by minimising the cost of owning it on the other. Clearly, competitive advantage is only gained in this process if these related objectives are achieved more effectively by the company than by our competitors. Benefit of ownership is only achieved if:

Increasing the Value of Ownership

The principal target on the revenue side is availability, both in terms of on-time delivery and of continuity of service. The duration of the acquisition process can often be a critical success factor. For example, the need to bring production on stream at the earliest possible moment can be a major element in determining the return on capital employed. Time wasted by a maintenance technician waiting for spare parts impacts operational costs. Consideration of all the elements of total procurement allows the balancing of price with the potential added value brought to the business during the use of a resource.

For instance, additional expenditure to ensure the necessary delivery may be fully justifiable on this commercial basis.

Continuity of service itself has two aspects: first, freedom from deficiency in terms of an item meeting its specification, and secondly the assurance of resupply of materials (often spare parts). This can have measurable impact on both cost and reliability of operations.

Reducing the Total Cost of Ownership

The cost of manufacturing an item or supplying the labour component of a service is embraced to a greater or lesser extent in the contractual price. The cost of acquisition, however, begins with in-house design and specification and ends with delivery to the user. The cost of installing, operating, maintaining and finally decommissioning, are all associated with the life span of these items or services. The three components of price, acquisition activity cost and life cycle cost represent the Total Cost of Ownership.

The objective of procurement therefore is to minimise this total cost of ownership by addressing each of these components. Some activities within the procurement process are clearly more capable of contributing to cost reductions than others. For example, a team effort at the design stage between the various disciplines involved in the acquisition part of the process will often lead not only to a lower price being paid but also to the possibility of reduced costs associated both with the preparation of the specification and the requisition and even the later installation and operation. The total cost of ownership can sometimes be further reduced by involving the supplier in design and in eliminating unnecessary or redundant acquisition activities.

Continuity of Supply

To achieve advantage in this wider view of procurement, we need to recognise the wider range of competition that exists:

- Not only direct competitors but also the increasing array of international organizations
- Other companies not directly in our sector but who share similar needs either for a commodity or for manufactured supplies and with whom we must directly compete in times of short supply

Both of these types of competitor may attempt either to monopolise or at least to gain priority access to a supplier's resources, research, and development. This, allied to the constant terrorist threat, means appropriate relationships must be developed with suppliers so that our strategic requirements are recognised by them as being paramount.

Profitability

Most capital expenditure and an increasingly significant proportion of operating expenditure involves procurement activity, whether managed through an established procurement function or devolved to individual profit centres and line managers. The opportunity to improve performance in the hitherto undervalued area is substantial and can produce value for money improvement on all expenditure with third parties with a direct contribution to bottom line profits.

Reduced Acquisition Activity Cost

The principal component of the procurement process, which can be directly influenced by the procurement function, is the cost of acquisition. This need to achieve ongoing performance improvement will only be met by a reconsideration of the process, particularly in contracting, and must be a high priority. A principal aim must also be to reduce acquisition time.

This will involve a fundamental review of resent business practices involved in the procurement of goods and services, and re-engineering the process to the most cost effective in the industry. Areas for attention include vendor stocking programmes, e-business and the associated electronic funds

transfer, Just-in-Time contracts, and statistical process control to eliminate both rejects and inspection costs.

Summary of the chapter

Understanding policies and procedures is essential for understanding how organizations operate and work. Policy is based on the idea that guidelines are documented and applicable to all the internal and external relations of an organization. A policy prescribes methods of accomplishment in terms broad enough for decision makers to exercise discretion while allowing employees to render judgment on an issue. Well formulated policies and procedures support efficient, effective, and consistent project procurement operations. On the other hand, policies and procedures that are out of date, require unnecessary actions, or do not address current issues or topics will not support effective purchasing operations. As projects become expand their global sourcing activity, they are increasingly revisiting their procurement policies and procedures, to ensure that they are keeping up with the rapid set of changes their professional associates are facing in their work lives.

CHAPTER THREE

STRATEGIC SOURCING IN PROJECTS

Objective of the chapter

At the end of this chapter, readers will be able to:

- ✓ Understand the implications of Kraljic's positioning matrix;
- ✓ the four key project sourcing configurations;
- ✓ Understand the implications for choosing and applying appropriate sourcing strategies to commodity, product and service groups
- ✓ Identify the different project sourcing strucutres.

3.1. Introduction

The terms 'strategic sourcing' and 'sourcing strategy' are in wide use in sourcing circles, but there is little shared understanding of precisely what they mean. The result is not just linguistic confusion. By not clearly identifying and distinguishing what makes an approach genuinely strategic, companies run the risk of ending up with a series of tactical operating models that may deliver short-term cost benefits but that lock in existing inefficiencies and fail to address the root causes of poor performance.

The strategic approach in contrast results in an alignment between sourcing options and business objectives, and in our experience, it leads to more significant and sustainable benefits for the company. This paper describes strategic sourcing, proposes a standard set of definitions, explains what distinguishes strategic from tactical sourcing, and indicates why we think that the former approach can be a significant differentiator for companies as they strive to enhance their competitive advantage.

3.2. Defining Strategic Sourcing

Sourcing decisions and purchasing activities serve to link a company with its supply chain partners. Sourcing decisions- High level, often strategic decisions regarding which products or services will be provided internally and which will be provided by external supply-chain partners. Sourcing decisions are high-level, often strategic decisions that address: What will use resources within the firm? What will be provided by supply chain partners? In-sourcing: the use of resources within the firm to provide products or services. Outsourcing: The use of supply chain partners to provide products or services. Once the decision has been made to outsource a product or service, firms will typically use a process known as strategic sourcing to

decide to whom to outsource the product or service, as well as the structure and type of relationship that should be established. The strategic sourcing decision is typically made by a cross-functional team, composed of sourcing professionals, operations managers, finance, or other stakeholders for the product or service.

It can be defined as 'satisfying business needs from markets via the proactive and planned analysis of supply markets and the selection of suppliers with the objective of delivering solutions to meet pre-determined and agreed business needs'. Strategic sourcing requires the application and interpretation of sophisticated strategic sourcing tools and techniques such as relationship management, by suitably authorized and competent professionals.

Strategic Sourcing- the collaborative and structured process of critically analyzing an organization's spending and using this information to make business decisions about acquiring commodities and services more effectively and efficiently. It is a disciplined analysis of purchases, markets and suppliers to identify opportunities for savings by negotiating contracts and employing new tools and practices that lowers costs and/or adds value while maintaining goods and services.

Strategic Sourcing Primary Objectives

- ✓ Reduce the costs of goods and services
- ✓ Capture resulting savings
- ✓ Create contractual alliances with suppliers to support the long-term goals of the organization.
- ✓ Maintain and improve product quality
- ✓ Improve business functions
- ✓ Optimize the total purchasing process

Activity 3.1. Dear learners take about 20 minutes to do this activity. Discuss how the concept of supply strategy relates to supply chain configurations. What is the first step in the sourcing strategy? Why sourcing taken as a strategic decision? How strategic sourcing affects project performance?

3.3. The Sourcing Strategy

The definition of sourcing strategy (Weele, 2009: 10):

"Identifies for a certain category from how many suppliers to buy, what type of relationship to pursue, contract duration, type of contract to negotiate for, and whether to source locally, regionally or globally."

By Weele's (2009) definition, sourcing strategy mainly concerns developing the most appropriate supplier strategy for a certain commodity or product category; "*A sourcing strategy describes how many suppliers the company favors for that commodity or category, what type of relationship to pursue and what type of contract to negotiate for.*" (Weele, 2009:10).

This definition of sourcing strategy is quite coherent with the way Harwood (2009) is conceptualizing sourcing strategy. "*Not only is a strategic view taken of suppliers relations, but also of the materials / services being sourced, which together allow sourcing strategies to be developed which should improve security of supply" (Harwood,2009: 5).*

We can summarize the main issues in sourcing strategy as follow (Baily and Farmer, 1982 in Hines, 1995:19):

"If a buyer gives all his business to one supplier, does he get a better and more economic service than when he splits the order between two or more? Does he lose his competitive position by, in effect, creating a monopolistic source? If, on the other hand, he uses more than one supplier is he dissipating his purchasing power, or is he protecting himself against shortage, fire, and strike?"

Business Requirement Analysis: The first step when developing a sourcing strategy is to fully understand the purchase requirement relative to the business unit objectives. Also involved in this step is a thorough supplier spend analysis to determine past expenditures for each commodity and supplier, as well as the total expenditures for the commodity as a percentage of the total. Once the team have educated themselves to the point that they feel they know enough about the supply market conditions, the forecasted spend, and the user stakeholder requirements, they are faced with a different challenge. The team must convert all of this data into meaningful knowledge and apply some meaningful tools to structure the information so that it will render an effective decision. Two tools are most often used in this process: a portfolio analysis matrix (sometimes called the strategic sourcing matrix), and the supplier evaluation scorecard.

A firm can organise its supply process using a variety of sourcing strategies. The choice of these different approaches is contingent upon a variety of factors, such as the importance of a good or service to the firm and the competitiveness of the supply marketplace. Firms must also consider the technical complexity of the product.

To help Buyers formulate appropriate sourcing and competitive strategies, Kraljic (1983) developed a simple positioning matrix based on these factors. Virtually every Purchasing department and consultancy firm uses this matrix today and it is the main strategic positioning tool for thinking about supply management decisions. While this model is widely used it is not without its problems

The matrix's simplicity belies its power and usefulness to supply professionals when formulating optimal procurement approaches. Kraljic identified four key purchasing approaches or strategies (see Figure below).

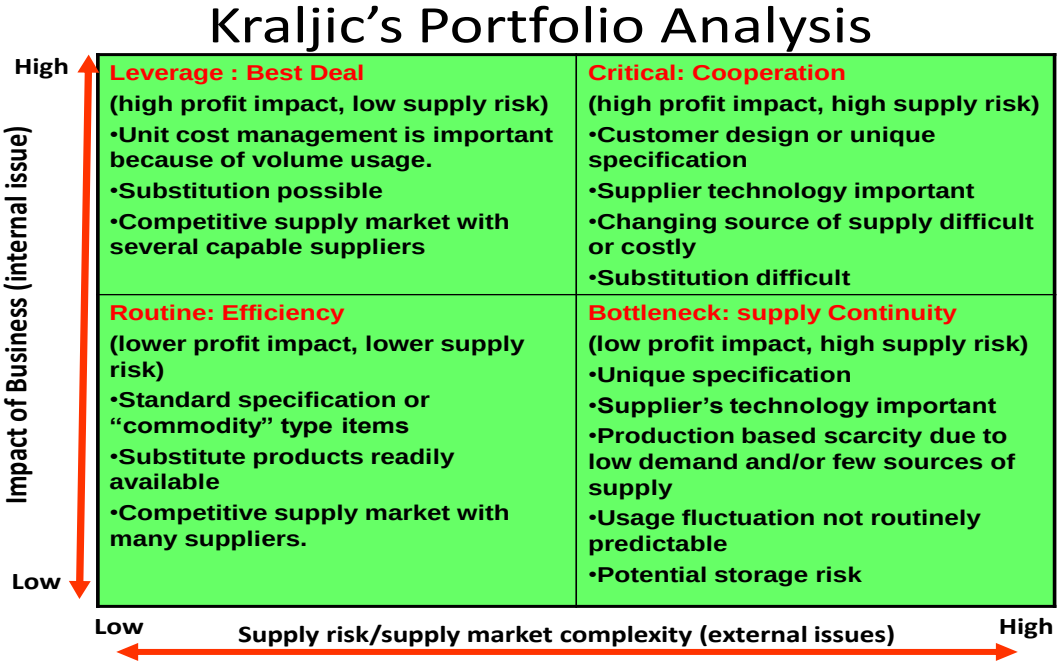


Fig. 3.1. Kraljic product and service positioning matrix

He suggested that selecting the best supply strategy is a function of the level of supply exposure, technical risk and the strategic nature of the product or service (i.e. its value or cost to the buying firm). The Figure also maps the type of products and services supplied (also known as 'sourcing groups') to particular sourcing strategies.

Supply market complexity: The horizontal axis is concerned with the supply-side risk that occurs due to external supply market issues and the complexity of the market. Supply Strategists should consider factors such as power relations, the availability of supply and substitution possibilities that will have a fundamental effect on risk. Porter's (1980) five forces model gives a good indication of the factors causing rivalry (or competition) in an industry. The key elements of Porter's model all have an influence on the amount of supply-side risk and complexity in a given marketplace.

Barriers to new entrants- are concerned with the costs of investment of entering a marketplace. This might be because market channels are expensive, logistics networks are required or there is a substantial amount of investment in tooling, machinery and processes that needs to be made. This will restrict suppliers (if the barriers are high) or allow them to enter the marketplace and will therefore have an impact on the level of risk of trading in this supply market.

Power of buyers- is influenced by the relative concentration of buyer firms in a market. If there is a high concentration of buyers relative to the number

of suppliers, then buyer power is likely to be low; if there are only a few major buyers in the marketplace and a large amount of supply, then buyer power is likely to be high. Naturally there are also equilibrium and a range of other points on the concentration scale. The point is that buyer (and indeed supplier) firms should consider the market structure when thinking about managing their sourcing (or customer) relationships.

Substitutes- refer to replacement goods or services. These can be created by new or disruptive technologies, e.g. a new material could be developed which means that buyers will switch from one type of production method to another. New products or services entering the market and replacing existing technologies and services will tend have a major effect on the competitive structure of that industry and in turn will affect the supply-side risk of the buyer firm.

Power of suppliers- is inversely related to the 'Power of buyers', i.e. when one is high the other tends to be low. If either party can maintain a dominant power position in the marketplace, they can extract competitive advantage from that market, usually in the form of higher prices.

Industrial rivalry- refers to the level of competition within an industry. Internal competition can be considered in terms of industry growth and exit barriers from the market. Where industry growth is low and exit barriers are high the market is stable and therefore complexity is low.

Impact on business: The vertical axis of Kraljic's matrix is fundamentally concerned with the impact on profit or the value obtained from the sourcing group. Whereas the horizontal axis shows market exposure risks that are 'external' to the firm, the impact on business factors can be thought of as 'internal' to the firm. Determining what product and service categories fall into this group is reasonably difficult, owing to the contradictory nature of the terms on this axis; for example, a product could be low cost, but high value. An example would be specialised bolts which are used in the aircraft industry to secure the gearbox housing on military and commercial helicopters. Compared to the total cost of the aircraft these are relatively cheap, but if they were to come off in-flight the results would be disastrous. Therefore, their relative *value* is high. Most consultancy firms, when conducting the initial positioning of products and services, would tend to use the cost category first and then sort by relative value and risk.

The cost approach to product and service positioning tends to use Pareto analysis. Pareto was an economist and sociologist who died in 1923. He discovered a phenomenon which exists in much of the natural environment. It became known as the 80/20 rule. This rule can be applied to a wide range of business situations, for example 20 per cent of the products used to build a car will make up 80 per cent of the costs. In other words, there are a small number of high-cost items and a large number of low-cost items. This is known as ABC analysis. 'A' items account for 80 per cent of cost and 20 per cent of volume, 'C' items represent low cost and high volume and B items

are in the middle. This analysis tells us that we must pay careful attention to the 'A' items, with ascending priority down to 'C' items.

Pareto's method allows firms to classify their products and services into A, B and C class items. Naturally an 'A' item would be placed in the high area of the spectrum, a 'B' class item somewhere in the middle, and a 'C' item at the low end.

The second stage of analysis is to decide on the level of sourcing risk (external), which then gives the coordinates to place it in the positioning matrix. Calculating risk, and indeed value, is much more difficult. In practice, the firm generally positions based on the ABC analysis described above. It would then go back through these items and decide what level of (internal) risk they might represent. Internal risk needs to be defined by the firm and may vary depending on what type of firm it is and what it sees as important to its business. For example, an automotive firm may decide that something is high risk if it is going to have an adverse impact on the production schedule. An aerospace firm might consider something to be high risk if its failure would cause a catastrophic effect in the aircraft, e.g. the earlier bolt example.

Strategic directions for managing category spends

The matrix itself forces firms to consider categories of spend based on their level of supply market exposure and internal risk and cost. It is worth emphasising at this point that the matrix does *not* allow for the positioning of companies, but rather spend categories. These categories may well be spread across a range of suppliers. The model offers buyer firms four distinct strategies that they can follow:

Strategy 1: Routine. This strategy is aimed at a spend category known as *routine* items. The recommended approach here is to follow a strategy based on *efficiency*. This quadrant contains products or services of low value or cost and low technical or supply risk. The recommendation is that these should be sourced from the most efficient suppliers. Examples of low-level parts or commodity products include nuts, bolts or rivets in manufacturing or an administrative item such as stationery or low-level temporary labour. The objective is to pay the most competitive price for the product, whilst maintaining delivery and quality standards. As switching costs are low and the market is highly competitive, buyers would negotiate on price.

Strategy 2: Bottleneck. This strategy is aimed at the spend category known as *bottleneck* items. These are items that can seriously affect the delivery of the buyer firm's product or service. They tend to be relatively low value but are relatively rare in terms of the supply market. A good example of this may be computer chips. These don't cost a great deal compared to the total unit price, but they are essential to the running of the product. Here the strategy is to maintain supply continuity by, for example, establishing long-term contracts containing liquidated damages clauses. The buyer will tend to focus on total cost rather than simply on purchase price.

Strategy 3: Leverage. This strategy is aimed at the spend category known as *leverage*. The focus of this strategy is to obtain the best deal possible. This strategy occurs when the buyer perceives market exposure to be low yet the cost or value of the item is high (e.g. foam for car seats at an automotive assembler). The buyer can obtain the best deal by using 'leverage' strategies (Porter, 1980) where the buyer power is high and the supplier power is low. Leveraging involves pulling together a range of similar products-sometimes the same product bought at different locations throughout the firm-to increase contract size and therefore buyer bargaining power. An automotive manufacturer might source two models of car seat using a single supplier rather than multiple suppliers. This may achieve economies of scale for the buyer, providing a stronger negotiation position.

Firms pursuing a cost reduction strategy consistently follow this strategy. A development of this is to split a requirement three ways- giving each of two suppliers one-third of the business on a long-term contract, the remaining third being available to the more competitive of them on a shorter-term basis. This approach to purchasing can, and often does, change the nature of supply market exposure. Supply market exposure increases as a buyer moves from several suppliers to one major source. A dependency relationship may result from the leverage strategy, often without the buying company knowing. Companies pursuing cost minimisation programmes in the late 1990s sometimes hastened large-scale consolidation of their supply markets, ultimately requiring transition to the final 'critical' box of Kraljic's matrix.

Strategy 4: Critical. This strategy is aimed at the spending category known as *critical*. The suggested strategy for buyers in this quadrant is 'cooperation', because these suppliers are both high risk and can have a high impact on the buyer firm's profitability. Suppliers that fall into this segment of the model provide products or services which are characterised by high supply risk and having a high impact on the business in terms of value or cost. These suppliers tend to fall into the top 20 per cent of suppliers account for 80 per cent of the cost. These are firms' strategic suppliers. These relationships tend to be single or sole sourced due to the large amount of investment required; switching costs are generally very high, with mutual dependencies. They need to be managed very carefully since they are often long-term and the focus tends to be on collaboration and mutual development, as opposed to price reduction and short-term aggressive strategies.

Activity 3.2. Dear learners take about 30 minutes to do this activity. Apply Kraljic's positioning matrix to a company of your choice, identifying suppliers that fall into each category within the matrix. Using case studies give examples of the four key sourcing configurations. Discuss examples (good and bad) of the application of different sourcing strategies to commodity, product and service groups.

Supply Structure and Design

Each quadrant of the Kraljic matrix suggests a sourcing *strategy* which in turn dictates a related sourcing or supply *structure*. It is important to choose the structure that is suitable for the strategy and the sourcing category. There are four primary sourcing structures that can be used (with some amount of variation): single, multiple, delegated and parallel.

The complexity of the various sourcing approaches ranges from the simplest structure, single or sole sourcing, to the more complex structures of delegated and parallel sourcing. It is the role of the Supply Strategist to decide when and where to apply each of these structures. This decision will be dependent upon the needs and wants of the firm, the type of relationship desired the acceptable level of dependency for both buyer and supplier and the nature of market-based competition. Note that the most dependent relationship is found in the simplest structure, i.e. the sole or single sourced arrangement. Each of these sourcing configurations will be discussed in turn.

Single sourcing: This structure characterises a buyer with only one source of supply for a particular good or service, as can be seen in Figure 3.2. It may be the result of a deliberate choice by the Buyer, perhaps because of the high cost of the item or its strategic importance to the end product. Alternatively it may occur because the final customer has explicitly required the firm to work with a particular sub-supplier's product in the completed product. For example, many customers of personal computers demand the Windows Operating System, thereby forcing manufacturers to source exclusively from Microsoft. There may also be only one source of supply.

According to the Kraljic strategic positioning model, this sourcing strategy is likely to be prevalent in either the critical or bottleneck quadrants of the model. While single sourcing may appear to have negative connotations, there are advantages to managing this type of relationship. For example, buyers and suppliers working in a single-sourced scenario often report that it is easier to exchange ideas (knowledge exchange for new product development), have a clear understanding of cost structures (move towards cost transparency) and look for ways to redesign or enhance the product and processes. By definition these relationships tend to be much more long term in focus, allowing firms to spend time focusing on the development of the relationship, i.e. a feeling that they are both committed.

Fig. 3.2. Single sourcing Structure

The disadvantages of this sourcing configuration, is that, firstly there is only one source of supply, which could put the buyer in a position of weakness if the relationship is not managed properly, i.e. the buyer becomes overly reliant/dependent on the supplier. Alternatively, if the supply source were to cease doing business suddenly, the customer would be highly exposed in the marketplace. Secondly, if the buyer is 'locked' into a sole sourcing relationship with the supplier, this may restrict the buyer's flexibility to acquire new technologies or innovations that exist within the wider network. This could mean that the buyer's market position and therefore the firm's competitiveness is jeopardised. It is important to remember that the market dynamics (i.e. competitive-dynamic or uncompetitive-stable) will influence the optimal buying sourcing configuration.

Multiple sourcing: Multiple sourcing describes securing multiple supply sources to supply the product or service. In this model competition is based on price, with many suppliers guaranteeing a market price for the good or service. The structure is often used to maintain competition in a given supply market.

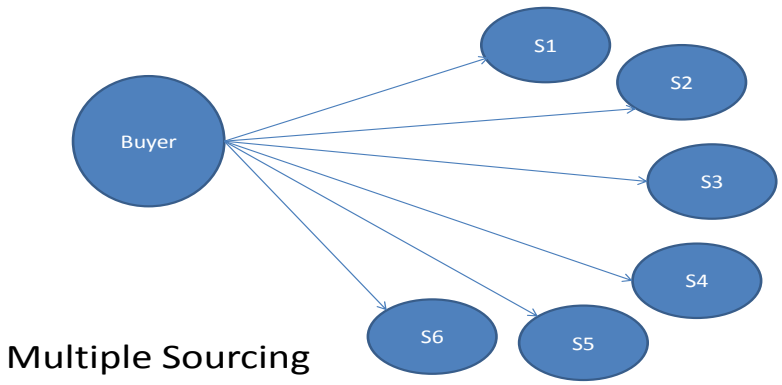


Fig. 3.3. Multiple Sourcing Structure

The Buyer will have a range of suppliers to choose from, and will carefully balance capacity constraints with individual supplier performance when placing orders. The old adage, 'don't put all your eggs in one basket', is often used to describe this supply structure. Buyers will also frequently use so-called 'Dutch auctions' to play suppliers off against each other to achieve the best price. This is often viewed as an adversarial approach and prevails in marketplaces where there are a high degree of competition, low switching costs and low levels of technological competence. This structure would tend to appear in the 'Routine' quadrant of the strategic positioning matrix and applies to the low-level type of purchase. Buyers using this structure will tend to focus on purchase price rather than total cost. This approach maintains continuity of supply in the short term, whilst enabling the buyer

to achieve price reductions. Sometimes, however, the market suffers from collusion and prices rise on average. There is unfortunately little opportunity for the buyer to use strategic tools. Although this model has traditionally been the mainstay of procurement strategy, it is being replaced by more sophisticated and value-adding approaches such as delegated and parallel sourcing.

Delegated sourcing strategy: Delegated sourcing strategies have grown in popularity since the mid-1990s, across a wide range of industries. The structure was first pioneered in the aerospace and automotive industries (see Womack, Jones and Roos, 1990; Lamming, 1993) as a way of more efficiently managing supply. This sourcing configuration involves making one supplier responsible for the delivery of an entire sub-assembly as opposed to an individual part. The customer delegates authority to a key supplier who becomes known as a first-tier supplier. The customer's objective is to work with one supplier; the supplier in turn works with all other suppliers that provide parts to complete the product.

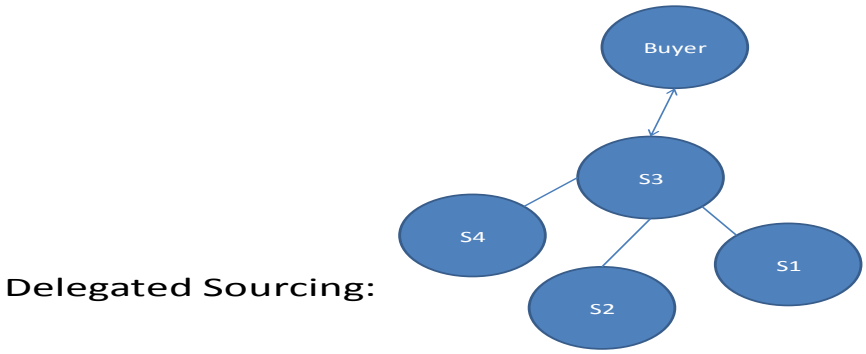


Fig. 3.4. Delegated Sourcing Structure

Delegated sourcing has a number of advantages for customer and supplier. Focusing on one supplier enables the Buyer to work closely with that one supply source to reduce day-to-day transaction costs. The increased dependence on one supplier results in the buyer and supplier exchanging more detailed information, particularly around cost issues. The buyer tends to transfer capabilities and technologies that enable that supplier to produce the required sub-assembly. The buyer thus becomes a major player for the supplier, increasing the supplier's dependence on the buyer, whilst simultaneously giving the supplier more authority and control over the delivery and production of the sub-assembly.

The process of delegated sourcing tends to create 'mega' suppliers that may evolve into a potential threat. Suppliers can become very powerful and exert their power over the buyer, usually in the form of price increases. It is vitally important for the buyer to understand and manage all the dependencies when these arrangements are put in place. This strategy is often found initially in the 'leverage' quadrant of the matrix, moving to 'critical' quadrant

in the medium term due to the high dependency and high switching costs. This strategy tends also to be followed by firms that are trying to optimise and/or reduce their supply base. As we discussed earlier in this chapter, delegated sourcing allows a firm to reduce the number of 'direct' suppliers without necessarily reducing the total amount of supply. In effect, it is a different way of coordinating the supply network.

Parallel sourcing: The concept of parallel sourcing is a little more complex (see Figure 3.5). Richardson (1993) developed the concept using game theory to optimise supply for the buyer (see also Axelrod 1984, 1987). Richardson suggests that the supply structure provides the buyer with the advantages of sole and multiple sourcing whilst excluding the disadvantages of these strategies. Parallel sourcing allows the buying firm to work on a single or sole-sourced basis with each component supplier within a product group while maintaining a multiple-sourced relationship across product groups. This allows the firm to maintain price competition, reduce complacency, and protect against capacity constraint issues while at the same time working more closely with suppliers within the model groups. This may involve sharing cost information and design specifications and embarking on process improvement initiatives.

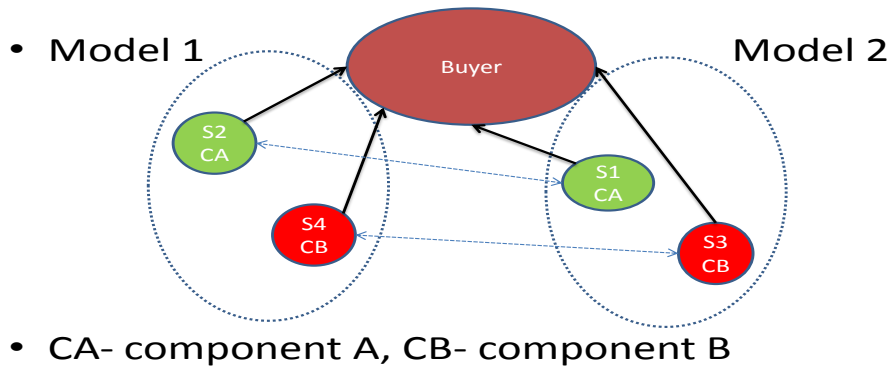


Fig. 3.5.Parallel sourcing structure

Although the model looks complicated at first glance, the principle is quite simple. Assume that the buyer (the customer) is making two products: product 1 and product 2. For example, it might be a vehicle manufacturer making two models of car. Each product (model of car) requires two components, A (the gearbox) and B (the braking system). For product 1, the customer sources the gearbox from supplier A1 and the braking system from supplier B1. For product 2, the buyer sources the gearbox from another supplier A2 and the braking system from yet another supplier B2. Therefore there are two suppliers of brakes and two suppliers of gearboxes. While each supplier supplies into a separate product group (sole sourced), the buyer has alternative sources of supply if necessary (multiple sourced).

Furthermore, the buyer can compare the price, delivery and quality of goods across different suppliers but for similar components. This makes comparison easier and more meaningful than for completely different products.

Sourcing structures provide the means for implementing supply strategy. As such, they must be aligned to the requirements of the organisation. For these strategies to work effectively they need to sit within an appropriate organisational structure and be measured in the correct manner. The various sourcing structures can be mapped to the Kraljic matrix to portray those strategies most appropriate to a particular commodity grouping. Mapping the sourcing configurations to the various supply strategies allows us to understand the most appropriate configurations for managing within each of the quadrants within Kraljic's matrix.

3.4. The Strategic Sourcing Plan

Developing a strategic sourcing plan is driven by the recognition that tactical sourcing will no t succeed in developing a supply base that will yield the benefits of collaborative relationship and alliances. This chapter presents a generic road map that details how supply management can develop a strategic souring plan that will enable supply management to discover, evaluate, select, develop and manage a viable supplier base. The road map is presented as follows.

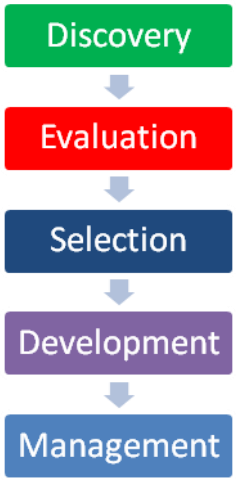


Figure 3.6: Strategic sourcing plan stages/processes

Activity 3.3. Dear learners take about 15 minute to do this activity. Discuss the strengths and weaknesses of the following sources of information that may be used to evaluate a supplier: information from suppliers, supplier visits, supplier performance measures.

3.4.1. Discovering Potential Suppliers

Prior to the information age and globalization of markets, the discovery process for potential suppliers was greatly limited. Today, suppliers throughout the globe can be found by simply typing several key words in to a worldwide web search engine or letting suppliers find your company

through a variety of posting methods. While the opportunities to source via the web are amazing, supply managers should not ignore other sources of information and the maintenance of existing information in soft and hard copy media. The following information sources should prove helpful to a supply manager in establishing a robust list of potential suppliers.

Supplier Web Sites: Today, most suppliers have websites that provide detailed information about their products and services. The sites usually are registered with search engine providers.

Supplier Information Files: Supply management departments should keep supplier information files on past and present suppliers which includes the name of each supplier, a list of material available from each supplier, the supplier's delivery history, the supplier's quality record, the supplier's overall desirability, and general information concerning he supplier's plant and management.

Supplier Catalogs: Because catalogs are a commonly used source of supplier information, many supply management departments maintain a hardcopy catalog library.

Trade Registers and Directoreis: They contain information on the addresses, number of branches, and affiliations of all leading manufactures.

Trade Journals: They are another excellent source for obtaining information about possible suppliers. Advertisements in trade journals are often a supply manager's first contact with potential suppliers and their products.

Phone Directories: It can serve as a useful starting point if other sources have proved fruitless or if local sources are desired.

Filing of Mailing Pieces: These should be given a file number, dated, and indexed by the name and number of each publication. When supply managers seek a new source, they can then refer to the index and review the appropriate brochures and booklets.

Sales Personnel: They are excellent sources for information about suppliers and materials.

Trade Shows: Regional and national trade shows are still another way by which supply managers learn about possible sources of supply. Trade shows provide an excellent opportunity for supply managers to see various new products and modifications of old products.

Company Personnel: Personnel from other departments in a supply manager's firm often can provide supply management with helpful information about perspective suppliers.

Other supply Management Departments: Supply management departments in other firms can be helpful sources of information regarding suppliers. Information exchange among individuals from these departments can be mutually beneficial for all participating companies; therefore, this source of information should be actively developed.

Professional Organizations: Local supply management associations can also provide information.

The previous list for discovering new potential suppliers leaves out the possibility that an existing supplier could be developed as a new potential supplier.

3.4.2. Evaluating Potential Suppliers

After developing a comprehensive list of potential suppliers, the supply manager's next step is to evaluate each prospective supplier individually. The type of evaluation required to determine supplier capability varies with the nature, criticality, complexity and dollar value of the purchase to be made. The evaluation also varies with the supply manager's or souring team's knowledge of the firms being considered for the order.

Approach to Evaluate Suppliers:

Supplier Surveys: A survey should provide sufficient knowledge of the supplier to make a decision to include or exclude the firm from further considerations.

Financial condition Analysis: preliminary investigation of a potential supplier's financial condition often can avoid the expense of further study. A qualified supply manager or professional from the finance department conduct these investigation.

Third Party Evaluators: Independent third-party firms can be hired to conduct many of the analyses given in this section.

Evaluation Conference: For an extremely critical purchase, a supplier evaluation conference is frequently held at the supply manager's plant to discuss the purchase.

Facility Visits: By visiting a supplier's facility, the sourcing team can obtain first-hand information concerning the adequacy of the firm's technological capabilities, manufacturing or distribution capabilities, and its management's technical know-how and orientation.

Quality Capability Analysis: The firm's quality capability is a critical factor to examine. If the prospective supplier's process capability is less than the buying firm's incoming quality requirements, the supplier typically is not worthy of further investigation.

Capacity Capability Analysis: Ensuring continuity of supply is one of the most fundamental objectives of supply management. A supply manager is rarely noticed if materials arrive on time; but if materials are late such that expensive operations grind to a halt, the supply manager can become infamous and perhaps unemployed.

Management Capability Analysis: Evaluating an organization's management style and compatibility usually required several visits to the potential supplier's facility. A quick way to draw conclusions that will often hold true is to evaluate the management capability of the firm by evaluating the sales representative, facility grounds, and even the parking lot.

Service Capability Analysis: "Service" is a term that varies in meaning depending on the nature of the product being purchased. Specifically, good service always means delivering on time, treating special orders specially, filling back orders promptly, settling disputes quickly and fairly, and informing supply mangers in advance of impeding price changes or developing shortages.

Flexibility Capability Analysis: one issue that emerged from the stock market declines of 2001 was the importance of supplier flexibility to adjust production volumes with short notice and to remove inventory out of the chain.

Information Technology Capability Analysis: Information sharing is a key enabler of effective supply chain management. Information sharing does not require technology, but technology is increasingly being used as the "vehicle of use."

The analyses given above should not necessarily be limited to potential first-tier suppliers. Today's supply chains have multiple tiers which may be critical to analyze. A common approach to summarizing the analyses given above or to conduct them on an individual basis is a weighted-factor analysis. The analysis requires the development of a spreadsheet and calls for two activities: (1) the development of factors (selection criteria) and weights and (2) the assignment of ratings. The first step, identification of the key factors to be considered in the selection decision, along with their respective weights, typically is accomplished by a committee of individuals involved in evaluating the suppliers. Step 2 requires the assignment of numerical ratings of each of the competing firms. These assessments are based on the collective judgments of the evaluators after studying all the data and information provided by the potential supplier, as well as that obtained in field investigations.

Activity 3.4. Dear students take about 5 minute to do this task. What are the criteria used in evaluating a supplier? Who is/are supposed to develop the evaluation criteria?

3.4.3. Selecting Suppliers

After one or more potential suppliers have passed the evaluation process, the selection process must begin. The supply manager or the souring team will now invite potential suppliers to submit bids or proposals. A decision must be made as to whether to use competitive bidding or negotiation (or combination of the two) as the basis for source selection.
Strategic supplier selection involves four main stages:

1. Initial supplier qualification;
2. Agree measurement criteria;
3. Obtain relevant information;
4. Make selection.

Initial supplier qualification: Supplier qualification is the first step towards supplier selection. The goal is to identify suppliers who meet the requisite product and process standards and are capable of supporting the buyer's long-term objectives. Because organisations are resource constrained, qualification helps to reduce the pool of potential suppliers to a more manageable number for detailed evaluation and selection.

The precise criteria used for qualification will vary between firms and industries. However, buyer firms will usually wish to assess two categories:

1 Manufacturing capabilities: Manufacturing capabilities are best conceived as stocks of strategic assets that are accumulated through a pattern of investments over time and cannot be easily imitated, acquired by trade, or substituted (Dierickx and Cool, 1989). Thus, capabilities such as low cost, quality, flexibility and delivery performance are stocks of strategic

assets that the supplier has accumulated over time. Of course, it is difficult to directly measure overarching concepts such as cost, quality, flexibility and delivery. Instead, buyer firms ask the supplier questions about their use of standards (such as ISO 9000 and 14000), techniques (such as continuous improvement, statistical process control and vendor managed inventory), and systems (such as electronic data interchange (EDI) or MRP).

2 Financial viability: Buyer firms also need to assess the long-term financial health of the suppliers. This is especially important for strategic items where the development of long-term relationships and investment in relationship-specific assets can make switching suppliers problematic. This third-party report evaluates suppliers across a number of categories to produce ratings for risk, financial stability and business performance.

Suppliers that meet the minimum standards set by the buyer firm for each of these measures may then be included within the detailed selection procedure explained in the next three steps.

Agree measurement criteria: The strategic selection process continues with identifying relevant and appropriate selection criteria. We use the words relevant and appropriate deliberately to emphasise the need for criteria that are specific to the particular product purchased and that do not create unnecessary effort within a resource-constrained organisation. Unfortunately, far too many businesses throw measures at supplier selection and evaluation without considering why the measures are necessary and what value they will add. Recent research by two of the authors demonstrates that high performing firms are likely to have a smaller number of measures than low performers but that these measures will be more relevant to the context (see Cousins and Lawson, 2007).

The most significant trend within selection criteria has been the move away from price and towards a total cost approach. Price is immediately visible because it will be the bottom line of any supplier bid or quote. However, price rarely reflects the total costs of doing business. Buyers should also factor in the costs of poor quality, late delivery, environmental penalties and poor innovation to develop a more complete picture of total unit cost. More specifically, the criteria could include the following:

- **Cost**: Unit price, Pricing terms, Exchange rates, taxes and duties.
- ***Quality****:* Quality system certification, Quality circles, Continuous improvement, ISO 9000 series.
- ***Delivery****:* On-time performance, Lead-time Delivery frequency, Minimum lot size, inbound delivery cost, Location.
- ***Flexibility****:* Supplier flexibility
- ***Others****:* Financial risk analysis, Ethical analysis, Environmental analysis, E-commerce capability, Reputation, Diversity of ownership, Innovation capability.

Obtain relevant information: The third stage in the process is obtaining the information used to compare suppliers across criteria. It is important that the information is comparable across suppliers so that, for example,

information on quality from supplier A can be compared to information on quality from supplier B. Information should also be timely and accurate. The supplier selection procedure relies on having up-to-date information that provides an accurate representation of suppliers. Supply Strategists can obtain information from a variety of sources, including information from suppliers, supplier visits and supplier performance measures.

Make selection:

A range of models has been developed to assist the Supply Strategist in making the final selection between potential suppliers. Selection models range from the highly quantitative (such as fuzzy set theory) to the highly qualitative (such as categorical methods), and from the very simple (such as eyeballing RFQ data) to the much more complex (such as artificial intelligence based models). The model and the amount of effort put into the final selection should reflect the impact on the business and market complexities:

a) Impact on the business

For low-value products, selection may involve little more than a comparison of the information contained within the responses to the RFQ or RFP. For high-value, strategic products, selection should be more complex and will often involve the use of multi-criteria decision-making models.

b) Market complexity

For products with few alternative sources of supply, selection should be comprehensive because the possibility of substitution is low. For products with many alternative sources of supply, selection can be less comprehensive.

3.4.4. Developing Suppliers

Not all suppliers need development, but to reach the lofty status of a world-class collaborative relationship, development is needed. Even suppliers recognized as the "best of the best" require investment on the part of the buying firm to realize the full benefit of the collaborative relationship.

3.4.4.1. A Process Map for Supplier Development:

After reviewing the strategies for more than 60 organizations, professionals have developed a generic process map for deploying a supplier development initiative. Although many organizations have successfully deployed the first four stages of the process, some have been less successful in implementing the latter four stages.

Step 1: Identify Critical Commodities for Development

Not all organizations must pursue supplier development. An organization may already be sourcing from world-class suppliers due to its existing strategic supplier selection processes, or it may buy external inputs only in a very small proportion to total costs or sales. Therefore, supply managers must analyze their own individual sourcing situations to determine if a particular supplier's level of performance warrants development, and if so, which specific commodities and services will require attention.

Senior supply managers should thoroughly consider the following questions to determine if a given supplier warrants development effort. A "yes" response to a majority of these questions suggests a need for supplier development.

- ✓ Do externally purchased products and services account for more than 50% of product or service value?
- ✓ Is the supplier an existing or potential source of competitive advantage?
- ✓ Do you currently purchase or plan to purchase on the basis of total cost versus initial purchase price?
- ✓ Can existing suppliers meet your competitive needs five years from now?
- ✓ Do you need suppliers to be more responsive to your needs?
- ✓ Are you willing and able to become more responsive to your suppliers' needs?
- ✓ Do you plan to treat suppliers as partners in your business?
- ✓ Do you plan to develop and maintain open and trusting relations with your suppliers?

A corporate-level executive steering committee should then develop an assessment of the relative importance of all purchased goods and services to identify where to focus any supplier development efforts. The result of this assessment is a portfolio analysis of those critical products or services that are essential for marketplace success. This discussion is an extension of the company's overall corporate-level strategic planning process and must include participants from other critical functions affected by sourcing decisions, including finance, sales and marketing, information technology, accounting, engineering, production, and design.

Step 2: Identify Critical Suppliers for Development

The supply base performance assessment system helps identify those suppliers within a commodity group that would be targeted for development. A common approach involves a routine analysis of current supplier performance. As shown in Exhibit 9.7, leading companies regularly monitor supplier performance on a facility by- facility basis and rank suppliers from best to worst. Suppliers failing to meet predetermined minimum performance standards in quality, delivery, cycle time, late deliveries, total cost, service, safety, or environmental compliance are potential candidates for elimination from the supply base. If the supplier's product or service is essential, it should be considered for supplier development. Those suppliers that meet minimum requirements but do not provide world-class performance are the most likely candidates for development efforts. Benchmarking and Pareto analysis are two sourcing tools that can assist in the identification of possible supplier development targets.

Step 3: Form Cross-Functional Development Team

Before approaching suppliers and asking for improved performance, it is critical to develop cross-functional consensus and support from within for

the initiative. Supply management executives continually emphasize that supply base improvement begins from within through buyer-focused activities—that is, the buying company must have its own house in order before expecting commitment and cooperation from suppliers. Development teams typically include members from engineering, operations, quality, and supply management.

Step 4: Meet with Supplier's Top Management Team

Once the development team's charter is established and an appropriate supplier has been identified for improvement, the team should approach the supplier's top management team and establish three relational building blocks for seeking supplier improvement: strategic alignment, measurement, and professionalism. Strategic alignment requires a business and technology alignment between the companies. It also requires alignment about key customer needs throughout the supply chain. Measurement requires an objective means of accurately assessing development results and progress in a timely manner. By approaching the supplier's top management with a solid and mutually beneficial business case for improvement, the demonstrated professionalism of all parties helps to establish a positive tone, reinforce collaboration, foster two-way communication, and develop mutual trust.

Step 5: Identify Opportunities and Probability for Improvement

At these meetings with the supplier's senior management, supply management executives should identify areas earmarked for improvement. Companies adopting a strategic approach to supply base development can usually agree upon the areas for improvement. In some cases, such areas are driven by final customer requirements and expectations.

Step 6: Define Key Metrics and Cost-Sharing Mechanisms

Development opportunities, although not necessarily specific improvement projects, are evaluated next in terms of project feasibility and potential return on investment. The parties jointly determine if the opportunities for improvement are realistic and achievable and, if so, then establish measures and improvement goals. The buyer and seller must also agree on how to divide or share the costs and benefits from the development project. A common sharing arrangement is 50/50, but the actual cost/ benefit sharing must take each party's level of investment into consideration.

Step 7: Reach Agreement on Key Projects and Joint Resource Requirements

After identifying specific improvement projects to pursue, the parties must identify the resources necessary to carry out the project or development effort and make the commitment to employ them. The parties also need to reach agreement regarding the specific measures and metrics that will demonstrate success. These measures may include a defined percentage improvement in cost savings, quality, delivery or cycle time, or any other

area relevant to supply chain performance. The most critical component of supplier development is that it must contain realistic and visible milestones and time horizons for improvement. What gets measured is usually what gets accomplished. The agreement should also specify the role of each party, who is responsible for the outcomes of the project, and the manner and timing for deploying already agreed-upon resources.

Step 8: Monitor Status of Projects and Modify Strategies as Appropriate

Progress must be monitored routinely after initiating a development project. Moreover, an ongoing, two-way exchange of information is needed to maintain project momentum. This can be achieved by creating visible milestones for objectives, posting progress, and creating new or revised objectives based on actual progress. Ongoing project management may require modifying the original plan, applying additional resources, developing new information, or refocusing priorities depending on events.

3.4.4.2. Overcoming the Barriers to Supplier Development

Barriers to supplier development fall into three classifications:

- ✓ Buyer-specific barriers,
- ✓ Buyer-supplier interface barriers, and
- ✓ Supplier-specific barriers.

Companies can use a variety of approaches to overcome barriers to supplier development. In general, these approaches fall into one of three categories:

•Direct-involvement activities (hands-on): Companies often send their own personnel in to assist suppliers. These efforts are characterized as hands-on activities, where the buyer's representatives are directly involved in correcting supplier problems and increasing capabilities. An example would be the buyer assigning one of its process engineers to the supplier's facility to assist in physically rearranging its equipment to be more efficient.

• Incentives and rewards (the "carrot"): Companies also use incentives to encourage suppliers to improve, largely by means of their own efforts. For example, a buyer might agree to increase future order volumes if the desired performance improvement takes place within a specific time, or it could hold an annual award ceremony to recognize the best suppliers.

• Warnings and penalties (the "stick"): In some cases, companies may withhold potential future business if a supplier's performance is deemed unacceptable or if a lack of improvement is evident. Buyers may also use a competitive marketplace to provide a viable threat or incentive to a poorly performing supplier.

In many cases, organizations employ a combination of these three strategies to drive supplier improvement as quickly as possible, applying them judiciously in response to a particular supplier's capabilities and needs. The following sections address barriers to supplier development that are

internal, external, or interface based, and provide examples of how leading companies overcome these barriers.

Buyer-Specific Barriers

A buying company will not engage in supplier development unless senior management recognizes the need for or the benefits to be gained from an investment in supplier development. Moreover, if supply management personnel have not already rationalized and optimized its supply base as discussed above, the volume of purchases with any particular supplier will likely not justify the joint investment. In addition, there may be a lack of top-level support for financing supplier development efforts in terms of both dollars and time.

Buyer-Supplier Interface Barriers

Barriers to supplier development may also originate in the interface between the buyer and supplier in areas such as open communication, alignment of organizational cultures, and trust. A reluctance to share sensitive information about costs and processes on the part of either buyer or supplier is one of the more significant interface barriers.

Supplier-Specific Barriers

Just as buyers sometimes fail to recognize the potential benefits accruing from supplier development, a lack of recognition by the supplier may also keep its top management from fully committing to the joint effort. This lack of commitment may result in a failure to implement improvement ideas or to provide the technical and human resources necessary to support the development process. In addition, appropriate supplier follow-up may not take place once the development project has been completed, and the supplier's performance may revert back to its previous level.

3.4.5. Manage Suppliers

The challenging issue of managing supplier is dealt with in several parts of this module. At this point, however, it is essential to recognize that the supply manager has many responsibilities associated with the management of his or her suppliers. Satisfying these responsibilities should ensure that suppliers perform as required or that appropriate corrective action is taken to upgrade or eliminate them from the firm's supplier base. In addition, supply management must, on a periodic basis, analyze its suppliers' abilities to meet the firm's long-term needs. Areas that deserve particularly attention include the supplier's general growth plans, future design capability in relevant areas, the role of supply management in the supplier's strategic planning, potential for future production capacity, and financial ability to support such growth. If present suppliers appear to be unlikely to be able to meet future requirements, the firm has three options:

- It may assist the appropriate supplier(s) with financing and technological assistance,
- It may develop new sources having the desired growth potentials, or

- It may have to develop the required capability internally

3.5. Project Procurement issues

Purchasing has been defined as: the process by which organizations define their needs for goods and services, identify and compare the suppliers and supplies available to them, negotiate with sources of supply or in some way arrive at agreed terms of trading, make contracts and place orders, and finally receive the goods and services and pay for them, (Baily 1987).

It is in the details of this process that project purchasing differs from purchasing for batch production or continuous production, rather than in the aims and objectives. The aims and objectives at their most basic are to arrange for the supply of goods and services of the required quality at the time required from satisfactory suppliers at an appropriate price. But to achieve these basic aims, purchasing departments may need to engage in a variety of activities aimed at subsidiary objectives, including purchase research, supplier development, and so on.

Project purchasing has two main subdivisions: buying parts and materials, and placing subcontracts. Closely associated with these buying activities are the related activities of expediting (or progressing), which is intended to ensure delivery on time, and inspection and quality control, which are intended to ensure delivery to specification, together with stores management and stock control.

Some Special Characteristics of Project Purchasing

Differences between project purchasing and purchasing for other operations are most noticeable on large projects. Small projects do not differ much in their purchasing requirements from jobbing production or (if they are undertaken on a regular and frequent basis) batch production. Differences exist in:

- ✓ the way specifications are arrived at (with a single client playing a dominant role); the way suppliers are identified and compared (with

the client often involved and sometimes insisting on the use of particular sources of supply); the often complicated details of cash flow and payments in and out.

- ✓ Project production is essentially discontinuous, in comparison with batch production and continuous production. Even though the company concerned may expect to undertake a series of projects of similar type, nevertheless each project stands on its own. It is therefore very important to devise and negotiate terms and conditions of contract which are appropriate for the individual project and which so far as possible cover all eventualities.

Differences also exist in the way the purchasing people, and those on associated activities, are slotted into the organization structure. For large projects, the project manager may have full-time staff, including a purchase manager, attached to the project for several years. Much has been written about matrix organizations, which do not comply with classical organization theories because senior people answer to at least two bosses. The project purchasing manager, for instance, would be responsible both to the project manager and to the purchasing director in the permanent organization structure. He or she would in principle have line responsibility to the senior project manager and functional responsibility to the purchasing director: one would be concerned with $what$ is to be done and $when$, while the other would be concerned with how it should be done. In practice things are not always quite so clear-cut, which is why people in matrix organization structures have to be able to cope successfully with fluid situations, political pressures, uncertainty and conflicts of interest.

An important responsibility of such a project purchasing chief for a very large project would be manpower planning, which would, of course, be done in consultation with his or her immediate bosses. Some purchasing staff would be seconded to the project for the whole of its duration or at any rate the greater part of it. Others would be attached for a shorter period. It might be necessary to cope with peak workloads by hiring outside personnel on short contracts. At the other extreme, some of the purchasing work could

be dealt with no doubt by permanent staff who had not been attached to the project full time, as part of their normal work.

Subcontracting in Projects

Large projects are usually the subject of one main contract between the client (or customer, purchaser or employer if these terms are preferred) and the main contractor. The main contractor will then place a number of subcontracts, which themselves constitute contracts between it and the subcontractors. The client is not legally a party to these subcontracts, but will usually take part in the process of awarding them, deciding on the subcontractors, approving the terms and conditions, and so on. In effect the client is subcontracting part of its purchasing activity to the main contractor and will naturally want to keep an eye on things (except in turnkey contracts) and perhaps also to stipulate that certain preferred firms should be used as subcontractors.

Suppliers have a long way to go between finding a possible customer and actually getting the business. Quality capability is important. Track record is very important. At the time the British offshore oil and gas industry was getting under way, the government set up the Offshore Supplies Office (OSO). This was established to ensure that available business was not pre-empted by overseas-based organizations which had built up track records in offshore work in South America, North America and other parts of the world to the exclusion of home-based organizations which were trying to break into new market opportunities. A voluntary agreement between the Offshore Supplies Office and the operators included, for example, the following clauses:

1. All potential suppliers selected to bid are given an equal and adequate period in which to tender, such period to take into account the need to meet demonstrably unavoidable critical construction or production schedules of the operator.
2. Any special conditions attached to the materials, the source of supply of components and materials, and the inspection of goods are stated in the

specification or enquiry documents.

3. Stated delivery requirements are not more stringent than is necessary to meet the construction and/or production schedules of the operator.
4. Where the requirement includes the need to develop equipment or proposals in conjunction with the operator, all bidders are given equal information at the same time.
5. When the operator is unable to identify a reasonable number of suitably qualified suppliers for its invitation to tender, it will consult the OSO before issuing enquiries.
6. The enquiry documents require the potential bidders to estimate the value of the content of the goods and/or services to be supplied.
7. When the operator has determined its decision for the award of contract, in the case of non-Ethiopian award it will inform the OSO prior to notifying selected suppliers and will give the OSO a reasonable time, in the circumstances applying, for representation and clarification. This procedure will be followed in the case of subcontracts referred by main or subcontractors to the operator for approval. Where the operator does not intend to call for prior approval of subcontracts, the procedure for adherence to the Memorandum of Understanding and this Code of Practice will be agreed between the operator and the OSO. Where this gives the OSO access to the operator's contractors and subcontractors, this procedure will not diminish the direct and normal contractual relationship between the operator and its suppliers. The principle will be adopted that following disclosure of prior information to the OSO on intended awards no subsequent representation to the operator by a potential supplier, other than at the request of the operator, will be entertained.
8. To satisfy the OSO that full and fair opportunity is being given to UK suppliers operators will, on request, make available to officers of the OSO such information as they may reasonably require about: the programme of intended enquiries to industry necessary to implement the anticipated overall programme of exploration and/or development

to the extent that this information has not already been made available to the Department of Energy. (The operators may supply this information in any format convenient to themselves provided it is sufficiently comprehensive to enable the OSO to assess the potential opportunity for industry.)

The Purchasing Cycle

Conventional notions of the purchasing cycle which apply in batch production, mass production or in merchandising are less appropriate to the realm of the complex project. Large complex projects, such as the construction of complete factories, fully equipped hospitals and offshore oil rigs, are carried out all over the world. Purchase departments are involved on both sides of the contract: on the client's side, in obtaining and helping to analyse tenders and in contract negotiation; and on the contractor's side, in obtaining information from subcontractors and suppliers that is needed in preparing the bid or tender. Once the contract is settled, a large number of orders and subcontracts need to be placed by the contractor's purchase department, usually with the approval of the client.

It is often desirable to use the expert knowledge and experience of contractors in converting the preliminary functional specification into the final build specification. Two-stage tendering is sometimes used for this purpose. There are several versions of this. The World Bank, in its booklet *Guidelines for Procurement under World Bank Loans,* suggests that the first stage could be to invite unpriced technical bids. Based on these, a technical specification would be prepared and used for the second stage, in which complete priced bids are invited.

It is difficult to reconcile the public accountability requirement that all tenderers have equality of information and are bidding for the same specification with the common-sense purchasing principle that exceptional expertise on the part of a supplier should be used in preparing the specification. To expect a contractor with unique design and construction ability to tell the client the best way to do a job, without payment, and then

in the second stage to lose the contract to a low bidder with less design capability, seems unlikely to work out. Such firms sometimes insist on some version of the cost-plus contract or on negotiated contracts.

Once the contract has been signed, purchasing work goes ahead on placing the subcontracts. Specifications are prepared, possibly in consultation with vendors and incorporated in the Request for Quotation documents. Normal practice is to allow a month for quotations to be submitted, although on bigger subcontracts running into millions of pounds' worth of work more time may be necessary. Further discussion with suppliers may take place after receipt of tenders, to clarify matters, before the bid analysis is prepared for discussion with the client.

A bid analysis provides columns in which to list the bids received, allowing comparisons with budget, freight and duty, escalation and other extras. The form also includes a questionnaire on the vendor selected, in which explicit reference must be made to its past record, experience, shop facilities, test equipment and other important aspects of vendor selection.

Whatever procedure is adopted, it is unusual for a bid for a major subcontract to be accepted exactly as made, despite the parity of tender principle. Several meetings between the buyer and the preferred bidder (or bidders) may be required to negotiate aspects of the specification and commercial terms and conditions. After all bids have been received and appraised, with perhaps only one bidder still in the running, detailed negotiations still continue to establish identity.

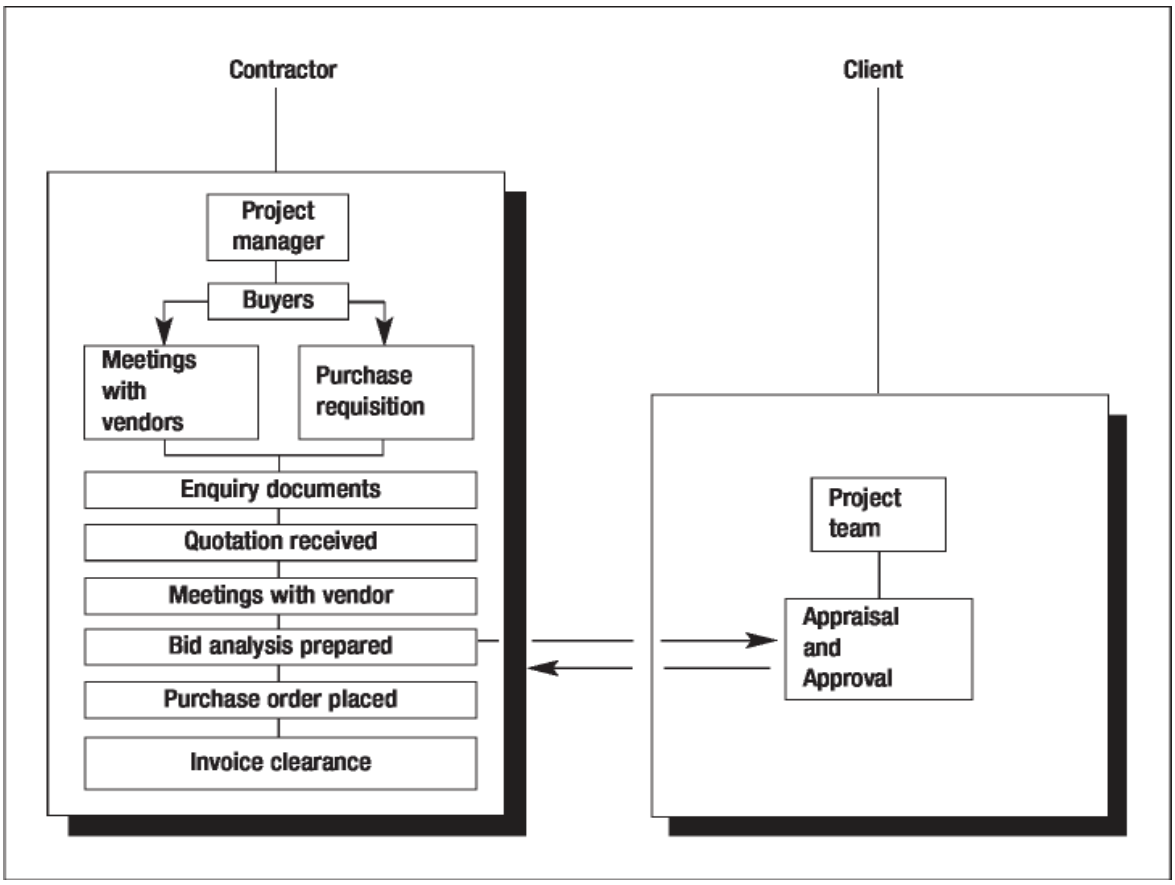


Figure: Subcontracting procedure for a large project

This diagram illustrates the respective roles of the project manager and client at the time of bidding view between the parties. This should not be seen as an attempt by the buyer to squeeze more concessions out of a supplier who has already put in its final price. Given the timescale, bidders have to concentrate their effort on specification, price and completion date. Selection of a subcontractor can be made on this basis, but buyers will still want to hammer out the commercial terms and technical people may still want to tinker with the design.

Delay in finalizing contract terms or specification details leads to the use of letters of intent. These simply say 'we intend to place the contract with you' and in English law they are not binding on either party. Consequently, they may not have the desired effect of enabling work to start unless the

contractor is able to trust the purchaser. An unconditional letter of acceptance, on the other hand, sets up a binding contract between the parties. Somewhere between the two is the instruction to proceed which authorizes the contractor to start work on specified parts of the contract and possibly states an upper limit to

Purchased Materials and Equipment

Projects vary enormously in size, complexity, duration and the nature of their location (a factory in Russia, a hospital in the Middle East, a bridge over the Bristol Channel, a tunnel joining two islands). Some are less innovative and more routine than others but most require the procurement of materials and equipment such as pipe, valves and cables, none of which was designed specially for the project and the acquisition of which falls more into line with routine purchasing. All must be available on time. All must meet specification. All must be suitably priced if the project costs are to stay within budget.

Even in large projects such purchases may be handled in the purchasing department by staff not attached to the project, but who make such purchases as part of their normal work. (It may be better to second such staff to the project team if the work involved occupies them full time for significant periods.) Getting deliveries in on time, product guarantees and fixed prices, together with the legal, commercial and financial complications of operating on a world scale, can provide a variety of challenges to the purchasing staff affected.

Price Analysis and Cost Analysis

In the consideration of quotations, some form of price analysis is always used. Sometimes a more specialized technique is brought into play to support, for example, negotiations about cost-based pricing. This technique is cost analysis. Price analysis attempts, without delving into cost details, to determine if the price offered is appropriate. It may be compared with other price offers, with prices previously paid, with the going rate (if

applicable) and with the prices charged for alternatives which could be substituted for what is offered. Expert buyers deal with prices daily and, like their opposite numbers on the other side of the counter, they acquire a ready knowledge of what is appropriate. When considering something like a building contract, which does not come up daily, they refer back to prices recently quoted for comparable buildings. When several quotations are received, some will be above the average and some below it. Any prices well below the norm should be examined with care. If a supplier is short of work, a price may be quoted which covers direct labour and materials cost without making the normal contribution to overheads and profit. Accepting such an offer can be beneficial to both supplier and purchaser, but it may be prudent to ask why the supplier is short of work. It can happen to anyone, of course, but in this instance have customers been 'voting with their feet' because the supplier's work is not satisfactory?

Low prices may be the result of a totally different position: a seller may have enough work on hand to cover overheads (that is, expected sales revenue already exceeds break-even point), and is consequently able to make a profit on any price which is above direct cost. Such offers are not necessarily repeatable; next time round the price quoted may be higher to cover full costs.

Low prices may also be quoted as special introductory offers to attract new customers, giving them in effect a fair trial of the goods or services. This can be regarded as a form of compensation to the purchaser for the risk which it incurs in switching to an untried source. Some buyers do not like accepting such offers, regarding the arrangement as opportunism. Building long-term working relationships with proven suppliers matters, of course, more than a single purchase at a cheap price, but this does not exclude acceptance of special offers in all cases. Management may be pleased with the immediate cost reduction resulting from a one-off low price purchase, but there is a danger that they will expect the buyer to do even better next time. This problem can be overcome if it is made clear that special offers are, as their

name implies, special to the particular occasion: they cannot be made the basis for standard price expectations.

Low prices can also be quoted simply through a mistake of the supplier or through its incompetence. Suppliers should be given the opportunity to correct such mistakes or withdraw their offers if the price appears to be suspiciously low (say more than 25 per cent below the price which would normally have been expected). Insistence on a contract at low quoted prices has led to bankrupt suppliers and unfinished contracts, and thus to additional costs for the purchaser, when this point has been ignored.

High prices may be quoted as a polite alternative to refusing to make any offer by sellers with full order books. Buyers should not write off such suppliers as too expensive since next time round they could well submit the lowest bid if conditions have changed. High prices may also be quoted because a better specification, more service, prompter delivery, etc. is offered. Obviously such offers should be considered with care. The best buy, not the cheapest price, is the buyer's objective.

Cost analysis examines prices in quite a different way from price analysis. It concentrates only on one aspect, namely how the quoted price relates to the cost of production. When large sums are involved, and a considerable amount of cost analysis needs to be done, full-time estimating staff or cost analysts may be employed for the purpose by the purchase department. These people are as well qualified to estimate a purchase price as their opposite numbers in suppliers' sales departments are to estimate a selling price: they have the same qualifications, engineering experience and costing knowledge plus specialist knowledge of sheet metal processing, light fabrication, electronics or whatever is relevant. Usually suppliers are asked to include detailed cost breakdowns with their price quotations. Some are reluctant to comply, but if one supplier does, others find it hard not to follow suit. Differences between a supplier's cost breakdown and the purchaser's cost analysis can then be examined one by one to arrive at a

mutually agreed figure. Cost analysis is also used by purchasing management to set negotiating targets for buyers.

Cost analysis is a useful technique for keeping prices realistic in the absence of effective competition. It concentrates attention on what costs ought to be incurred before the work is done, instead of looking at what costs were actually incurred after the work is completed. This seems more likely to keep costs down (as well as less expensive to operate) than the alternative of wading through a supplier's accounting records after contract completion, probably employing professional auditors to do it.

Amendments to Purchase Orders

It is sometimes unfortunately necessary to amend or even cancel purchase orders. This should, of course, be avoided if possible. Good practice is for buyer and seller to agree on all details of specification, price, terms and delivery when the order is placed, and for both parties to comply with the agreement as it affects them. Buyers do not always seem to be aware that if their purchase order constitutes a contract, they have no legal right to amend or cancel it without the seller's consent, since a contract is equally binding on both parties. In the interests of goodwill, however, suppliers are usually willing to accept amendments. Changes to specification, programme changes, increases or reductions in the quantity required, and changes from the buyer's own customers are reasons why buyers may seek to amend purchase orders.

Any amendment incurs the risk of delay and confusion. To avoid confusion it is necessary to ensure that an amendment is notified not only to the seller, but also to each internal department that received copies of the original order. One way to do this is to give details of the amendment on the same form as is used for purchase orders. If the original purchase order was numbered 7300, for example, the amendment form could be numbered 7300A. Some firms prefer to use a specially printed form. This should have the same number of copies as the purchase order form and should be distributed in the same way. Even if these methods are not used and the

amendment is notified to the supplier by letter, it is important to ensure that every person who received one or more copies of the original purchase order also receives copies of all subsequent amendment letters, and files these with the order copies.

Bidding

The previous chapters focused on the contractual issues more from the client's perspective. This chapter is concerned with the process suppliers of goods and services will typically go through when they are asked to submit a price for undertaking a piece of work. In order for a project to be undertaken goods and services must be procured by the client organization. Just as the client will have a strategy for procuring these goods and services, the supplier will have a similar strategy to win a particular contract.

Suppliers are not simply passive players waiting for clients to contact them. They are actively involved in creating opportunities and develop quite complex procedures to obtain the more lucrative contracts. In this chapter we examine the entire bid process from when a supplier is first considered for a particular piece of work to when contracts are signed between the client and the supplier.

Managing the Bid Process

If companies are not successful in submitting winning bids their workload will soon dry up. Therefore considerable attention is required to manage the bid process. It is common for a proposal manager to oversee the entire process. The proposal manager is the project manager for the bid process. He or she should treat the bid process like a project and plan and manage it like any project. The proposal manager will require support from a number of people including account managers who may have particular knowledge of the client and technical managers with detailed knowledge of the tasks to be undertaken during the potential implementation of the project. In larger organizations there may be a business development manager who is often an experienced project manager in his or her own right and is now using

that experience to win more work for the company. The people required to support the proposal manager can be identified in a responsibility chart.

The bid process is managed as a single entity within the bidding organization but the activities that take place are often delegated to separate units within it. The reason for this is that the process, while seeming superficially quite simple, is actually complex. Bidding for a piece of work represents a considerable amount of investment for an organization and with a typical success rate of 1 in 5 there is constant pressure to improve this ratio and keep the costs of bidding as low as possible. As shown in the flow chart in Figure 8.1, the bid process has three stages which will now be considered in more detail.

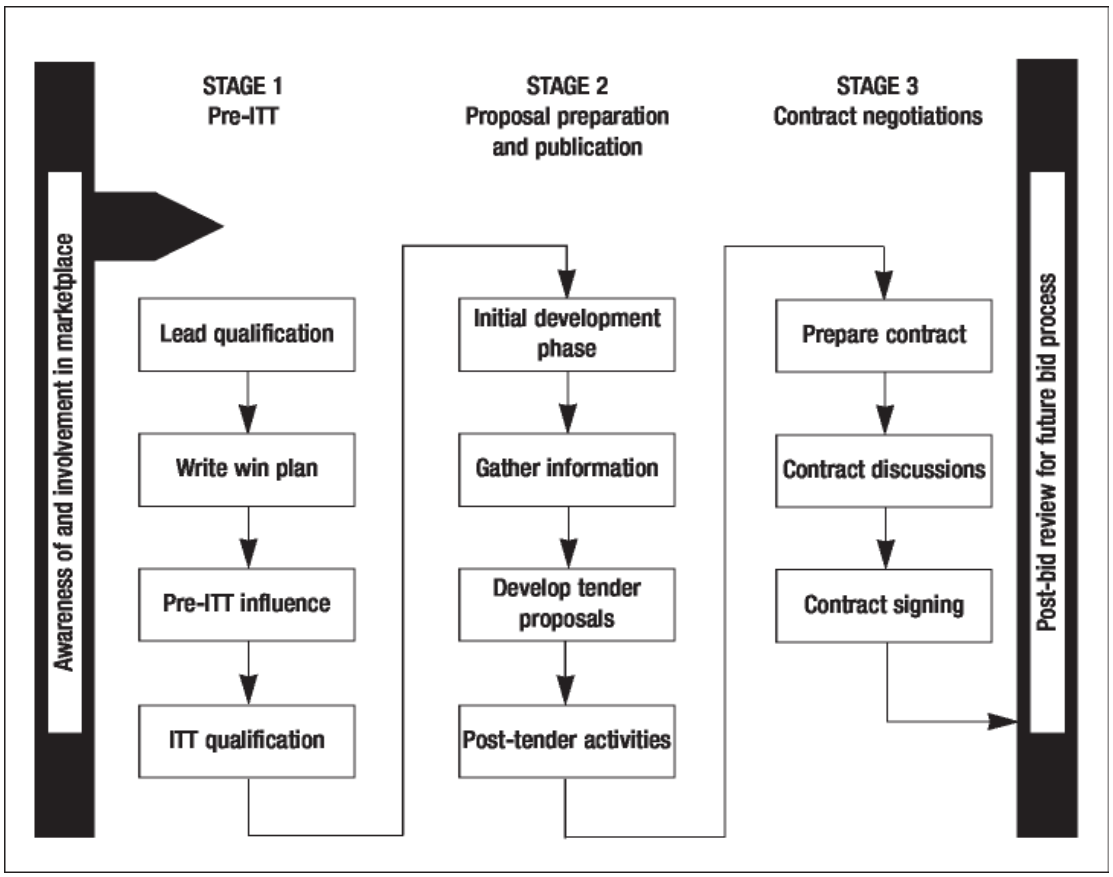


Figure: Main activities in the bid process

THE BID PROCESS

The bid process is the process that the supplier will undertake in order to arrive at a successful bid which secures a contract with the client. It contains activities which start as soon as a lead has been detected, continue with the response to the invitation to tender (ITT) and finish after winning or losing the opportunity. The process can be divided into three stages:

Stage 1: Pre-IT. Suppliers try to influence the client or organization writing the ITT and to define their strategy after reception of the ITT. The goal in this stage is to establish yourself as the proactive bidder in the client's mind and where possible influence the writing of the ITT so it fits your company's profile the most appropriately. This could be where your company has access to a particular technology or skill that is not widely available elsewhere.

Stage 2: Proposal preparation and publication. The supplier creates a proposal which is 100 per cent compliant with the ITT, develops a proposal presentation and executes the post-tender submission strategy defined in the win plan. The goal of these activities is to become the preferred supplier.

Stage 3: Contract negotiations. An implementation agreement is reached with the most favourable terms and conditions for the supplier. The ultimate goal of this phase is a contract for the implementation of the client's requirements. Some of the activities that need to take place within these three stages are shown in the flow chart in Figure 8.1 and are discussed below.

STAGE 1: PRE-ITT

This stage is concerned with actually getting on the bidding list that a client is putting together. Clients will typically select only a few firms, perhaps three to five, to submit bids for their project. One of the initial difficulties clients face is how to pick the suppliers that will be invited to bid.

Lead qualification: To be invited to submit a pre-qualification ITT the supplier must be active in the marketplace. This will typically involve not only undertaking work in a particular business activity, but also ensuring that personnel are involved in business development with current and potential future clients. Whilst most organizations will have about two-thirds of their business as repeat work, they are constantly losing clients for a variety of reasons and have to seek out new opportunities. It is during this phase that a decision must be made as to whether a bid will be submitted. It may happen that whilst a bid sounded attractive in its outline form, the pre-qualification documentation may show that the project is not suited to the supplier. Once a decision has been made to submit a pre-qualification bid a strategy will need to be developed to submit a winning bid.

Write win plan: The areas that need consideration to decide if the supplier should bid or not are essentially the ones that also need considering in writing a bid plan. The supplier needs to put itself in the client's position and ask why it should be given the work. A lot of suppliers use a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis in this respect. The supplier has made a positive decision to bid for the work and will commit resources to this bid. If unsuccessful, the supplier should be able to identify some benefit of having undertaken the bid and this also needs to form part of the win plan.

For our organization:

- Do we have the resources available to prepare the tender?
- Do we have the resources available to undertake the project if we win the work?
- How strong is the competition?
- Do we have a solution to offer the client?
- Does the project offer us the business opportunity in which we are interested?
- What standards do we have to comply with?
- Are we strong in this area or is it an area we wish to develop?
- What are our potential contractual obligations and can we fulfill them?

For our subcontractor suppliers:

- What is their position in relation to this project?
- Do they have a solution?
- Are they known to be favoured by the client?

For the client:

- Does the client have a budget and do we know what it is?
- Has the client clearly articulated what it wants?
- In the client organization who is for and against us and what is their relationship with the project?
- Has the client undertaken a similar venture before and who with?

Figure: Typical questions considered in decision to tender at the pre-qualification stage

Pre-ITT influence: Whilst developing the pre-qualification bid, the supplier is normally allowed direct contact with the client organization. This opportunity should be used to maximum effect. The supplier should be asking pertinent questions that demonstrate its expertise in the area of interest. In some instances, it may be possible to suggest to the client that a supplier's technology is the only one to use and try to gain an advantage over other technology. During the client meetings, it should also be possible to determine who are the key decision-makers in the organization and which of these are for or against the supplier. Effort can then be directed towards trying to win over the latter people whilst supporting those who favour the supplier.

ITT qualification: The pre-qualification bid has been submitted and the supplier has been successful in going forward to the next stage. The supplier needs to reflect on its performance for further bid opportunities as well as prepare it for moving into the next stage. If a supplier is unsuccessful at pre-qualifying, most clients are willing to provide a debriefing session which allows the supplier the opportunity to find out what went wrong, which areas it needs to work on and, for future market intelligence, who won through to the next stage.

STAGE 2: PROPOSAL PREPARATION AND PUBLICATION

This stage is concerned with putting together tender documents which not only comply with the client's requirements, but also demonstrate the supplier's competence in the tendering process. The tendering process is quite an investment in resource typically adding some 5 per cent to the cost of most contracts.

Initial development phase

The pre-qualification document will form the basis of the tender and act as a structure on which to build. The first task is to check that all the tender documentation has been received and that the supplier understands what needs to be delivered. It may be that the scope of work has been changed

since the qualification stage and this needs to be studied to ensure that the supplier is still interested in submitting a bid.

Gather information

Once the requirement is understood, an appropriate solution can be developed. Information to develop the solution needs to be gathered and, if required, expertise outside the organization sought. The information gathering exercise is crucial as it generally takes some time and whilst it is still ongoing people have to make decisions based on what is currently available.

Develop tender proposals

This is where the bulk of the work lies. The supplier has to develop its proposals to a stage where it is confident that they meet the client requirements and in such detail that accurate cost and programme estimates can be made. The amount of detail involved is generally not far short of what is required to actually execute the project. Once again, the supplier will generally be liaising with the client, trying to find out if there are any preferred solutions and obtaining feedback on suggestions being put forward.

Post-tender activities

After the tender has been submitted, the supplier will generally be invited to discuss its proposals with the client, once the client has had time to analyse them. Normally the client will wish to clarify various aspects of the tender and investigate if there is any room for negotiation over aspects of the proposal.

STAGE 3: CONTRACT NEGOTIATIONS

Once the tender has been accepted, a formal contract needs to be drawn up which sets out the obligations of the supplier and client in the execution of the project. While the outline of the contract will have formed part of the tender documentation, the exact details are often subject to negotiation after

the tender has been awarded. For instance, the exact starting date of the project will need to be set.

Prepare contract

A contract that reflects the type of relationship the two parties want to enter into needs to be drafted. Some industries, such as construction and building, have a wide range of standard forms of contract (see Chapter 4). Alternatively, clients may have their own standard forms. In all circumstances, a contract has to be drawn up which states the intentions of the parties and accurately reflects both the client's requirements and the supplier's tender. During this phase, the supplier also needs to think about what its stance will be during the contract discussions. There may be a particular point which is important to the supplier and to get agreement on this it will be willing to sacrifice some other detail. These items need thinking about so that the personnel undertaking the negotiations know what approach to take on crucial issues.

Contract discussions

This is where the finite detail of the client–supplier relationship is dealt with. Both sides have invested considerable resources to reach this negotiation stage. However, both sides also want to try to negotiate the most favourable conditions for themselves. In construction it is not uncommon for contractors to commence building on-site whilst still negotiating the details of the contract. This is obviously not a desirable situation and the contract should be signed prior to any work commencing on the project. Ultimately both parties have to sign the document and so there must be agreement on the terms and conditions set out in the contract.

Contract signing

The actual act of signing can in some circumstances be rather a show-piece with the press invited to a ceremonial signing of the contract. In most circumstances, the signing of the contract is undertaken by management,

typically at board level. These people will normally have not been involved in the negotiation of the contract so will be trusting that their negotiating staff have done an appropriate job.

POST-BID REVIEW

Once the contract has been signed, the supplier then concentrates on actually delivering the goods and services that the client requires. As part of the bidding process a review of the bid should be undertaken to identify lessons learned for use in the next exercise. Topics to be addressed might include the following:

1. Why did the client choose our company?
2. Was the client completely satisfied with our presentation and proposals?
3. Was our approach the right one or just the best of a bad bunch?
4. Was the offered solution correct or did protracted negotiations have to take place to hone the requirements?
5. Were our cost and programme appropriate to meet the client's needs?

While the bid process should be evaluated immediately after the successful signing of the contract, it may also be useful to hold a review once the project is complete. A post-project review can provide an insight as to the accuracy of the tender put forward measured against the executed costs. This can provide input into future tenders and adjustments made to future bids accordingly.

In general: For suppliers the bidding process consists of three stages:

1. Pre-ITT.
2. Proposal preparation and publication.
3. Contract negotiations.

While the supplier's aim is to win the contract, it does not want to do so at any price. The supplier has to be able to influence the client to the extent that the client wants the supplier to win the contract as well. In these circumstances, the supplier will be able to negotiate quite favourable terms

for itself. Bidding is concerned with predicting the future since the supplier has to commit to a price and time framework before the work is undertaken. Because of this the supplier has to build up an accurate database of information drawn from previous contracts and evaluated against the bids for those contracts. The post-bid review is vital in assisting this feedback. Suppliers have to become experts in preparing and submitting winning bids if they are to survive and grow in an increasingly competitive market.

3.6. Negotiation On Project Procurement

3.6.1. What is Negotiation

In a general context, negotiation is a bargaining process between two or more parties, each with its own viewpoints and objectives, seeking to reach a mutually satisfactory agreement on, or settlement of, a matter of common concern. Negotiation is a part of everyday life. People have to negotiate all the time, for example at work to increase salary, in business to make a contract etc. Effective negotiation skills are the basic means for people to achieve what they intended. It is a type of communication which enables us to reach an agreement in the situations when people have different or even the same opinions. The negotiation process precedes almost every important decision and it plays a significant part in the business world. Bargaining is a core activity of executives, consultants, salespeople, brokers, administrators, lawyers and all people who are involved in the business sector. In today's world, business controls almost everything and all its elements, including negotiation, are leading topics among managers. Recently, business has become much more profit-oriented and negotiation is the best way how to achieve such a positive profit. If an executive knows and is able to use negotiation strategies and tactics effectively, it increases the prospects of earning a lucrative deal.

Negotiation is a discussion or dealing in order to reach an agreement. Some also use the following definition: "a process through which parties move from their initially divergent positions to a point where agreement may be reached." People negotiate in everyday life to achieve their goals, for example

at work, in family, in business etc. The word negotiation is derived from the Latin word negotiates which means to carry on business, and the process of negotiating is mainly connected with business and commerce more than with other fields. Practically every business cooperation should be managed via negotiation. Effective negotiation is the main concern of all executives, leaders and managers in the business world. At all times their negotiation skills should be improving. Negotiating is not an ability which an individual is born with but the ability which can be learned and developed during the life. The only key to become a successful business negotiator is the learning of negotiation skills and continuously improving them.

3.6.2. Negotiation in Project Management

A project needs various goods and services to deliver its final product. For this purpose the project needs to procure such goods and services. According to the PMBOK by PMI "When a project obtains products and services from outside the performing organization the processes of Solicitation Planning, Solicitation, Source Selection, Contract Administration and Contract Closeout will be performed." Hence a need for negotiation will arise since, according to the guideline, negotiation is one of the tools used for source selection. Some other reasons that call for negotiation include

- There is no alternative for the product or service
- When the supplier is powerful
- When there are few suppliers
- When price is not the most important factor
- When variations to the contract are contemplated, it will be necessary to negotiate the terms and conditions for the variation.
- To clarify issues between the parties.
- To develop relationship and deepen understanding between the parties.
- To improve on the current offer (e.g. price, conditions, service levels).

- Where unusual or complex circumstances exist, and these need to be explored by the parties.
- When substantial risks are involved in the procurement and parties look to reduce or transfer the risk exposure.
- During the operation of a contract
- When there are concerns over supplier performance, it is preferable to negotiate and solve the problem

3.6.3. Negotiation styles

In the business world, there are five negotiation styles or so-called approaches which are used in the process of negotiating. Despite this fact, most of business negotiators use only one or two negotiation styles. Nevertheless, a successfully experienced negotiator knows all of these negotiation approaches and he can choose to apply the most appropriate one which would comply with the type of negotiation. It is an effective skill to adapt the style to the elements of negotiation. The most common division of negotiation styles is: competing, accommodating, collaborating, avoiding and compromising.

- **The Competing Style**

The competing style is used when negotiators need to get quick results. This style is based on the expected result I win – You lose. Lum (2010) states that "a person showing a competing tendency is focused on the substantive outcome of a negotiation more than the relationship. A competitor would assert his/her own interests and offer options that are more favorable for him/her." The competing style is distinguished by the effort to deceive and persuade the other party and by the usage of power to find out and exploit the other party's weakness. (Volkema 1999, 61) The disadvantage of this style is the possibility of meeting two high competing approaches. In this case, the negotiation often ends in deadlock.

- **The Accommodating Style**

The accommodating style is the opposite of competing style. It means that it is based on the preservation of relationships between two parties or individuals. This style presupposes the result I lose – You win. The accommodating style usually symbolizes enduring harmonic relationships, but there are also several weak points. If the accommodating style is used against high competing style, it will result in the domination of the high compete negotiator who will see the other side's generosity as a sign of weakness. Volkema (1999: 62) points out that the accommodating style involves some tendency to help the other party even if it means giving up your own needs and also to focus on issues that both sides agree on rather than those of disagreement.

- **The Collaborating Style**

"Collaboration involves exploring individual and mutual interests in an effort to satisfy everyone's needs," (Volkema 1999, 63). This negotiation style usually results in I win – You win. It is based on meeting of all needs and on the creation of mutual value. The collaborating style is the basic style which should be used to achieve the goals in business negotiation. There are also some assumptions which must be met to be an effective collaborative negotiator. These are: an effort to build trust and to satisfy the needs of both parties, searching for creative solutions that make both parties winners, listening to the other person's ideas etc. (Volkema 1999, 63) Collaboration is very often the best choice but it should not be used with a competitive negotiator. Another disadvantage of the style is the condition that the negotiators must be aware that they share information at the same level. If not, one side can be exploited and the other side can be advantageous.

- **The Avoiding Style**

Volkema (1999, 63) explains that the avoiding style is avoiding not only issues or the other party but negotiation itself. It presupposes the loss of both parties, so the result is I lose – You lose. The avoiding is used in the situations when the issue of negotiation is irrelevant for both sides of negotiation. It is usually applied as an effective defense against the

competing style. It is quite difficult negotiation style because the aim of this style is to avoid conflict but more often the avoiders get themselves into conflict.

- **The Compromising Style**

"Compromising is a partial-win, partial-lose proposition, where you get something what you want but not everything, and likewise for the other party." (Volkema 1999, 63) According to Lum (2010, 151), the compromise is based on fairness, mutually sufficient solutions and rationality. The compromising negotiation style is usually confused with the definiton of negotiation but in fact, compromising is just bargaining. This style is applied mostly in the situations when business negoatiators are dealing with someone who they know and trust. The most important fact in the compromising is to realize that the negotiator wins something but also loses something. It is difficult to be aware that he lost what he intended. According to the negotiation instructors, the compromising style requires the best quality of negotiation training.

3.6.4. Negotiation types

The essential thing in the negotiation process is to know two basic types of negotiation: distributive negotiation and integrative negotiation. The types differ mainly in the kind of relationship between negotiators. Distributive negotiation is mostly based on the impersonal nature of negotiation and it is not usually used to build a relationship. On the contrary, integrative negotiation is based on the creation of benefits for both parties which can contribute in creating a long-term relationship.

- **Distributive negotiation**

Distributive negotiation or also called slicing the pie bargaining or win-lose bargaining is based on the competing style. This type of negotiation emphasizes the distribution or division of a negotiated thing between the parties involved in the process of negotiation. It means that one gets, one

loses, but everyone tries to protect his benefits, and no one looks back to the other party's interests. In the distributive type of negotiation, there are also some proven principles and strategies. "When it comes to slicing the pie, the most valuable information is a negotiator's best alternative to reaching agreement (or BATNA). Nothing can substitute for the power of a strong BATNA. Negotiators can enhance their ability to garner a favorable slice of the pie by engaging in the following strategies: deterring their BATNA prior to negotiations; attempting to improve upon their BATNA; researching the other party's BATNA; setting high aspirations; making the first offer; immediately reanchoring if the other party opens with an "outrageous" offer; resisting the urge to state a range; making bilateral, not unilateral, concessions; using objective-appearing rationales to support offers; and appealing to norms of fairness." (Thompson 2001, 60)

- **Integrative negotiation**

In contrast to distributive negotiation, integrative negotiation or also called win-win negotiation or expanding the pie negotiation is based on the collaborating style. The win-win bargaining maintains some cooperation to achieve the results that both parties can benefit from. This negotiation type requires a high degree of trust and in fact also some kind of relationship. It should end up in the outcome when everybody gets something. In case of integrative negotiation, there are also verified strategies and principles how the negotiation process can turn out to be successful. "The successful creation of win-win negotiation deals involves building trust and sharing information about priorities and preferences; asking diagnostic questions; providing your opponent information about your priorities and preferences ; unbundling issues; making package deals (not single-issue offers); making multiple offers simultaneously; structuring contingency contracts that capitalize on differences in negotiators' beliefs, expectations, and attitudes; and using the pre- and post settlement settlement strategy." (Thompson 2001, 82) According to professional negotiators, this type of negotiation is the best way to create a long term relationship to achieve mutual gain.

3.6.5. Negotiation Framework

The first thing which executives or managers must realize is that negotiation is a process – it has some defined steps and phases which every successful negotiator should go through. In the business world, there are generally thought to be four basic phases which appear in every bargaining. A successful negotiator should know where he is in the process of negotiation, at which stage to perceive his actions and to prepare himself for what comes next. The most important fact is also to complete each phase properly to ensure a better chance of success. These three phases are: the preparation, the bargaining phase and the decision or the finalization of the deal. Some sources divide the bargaining phase into more detailed steps.

- **Negotiation Planning**

Negotiation Planning is an essential assumption for all business negotiations. For a project manager to succeed in the process of bargaining, he must plan for the negotiation. It is the key to be a successful negotiator because an effective preparation is the best advantage in negotiation. The phase of preparation involves three general abilities: self-assessment, assessment of the other party, assessment of the situation. (Thompson 2001, 9-32).

Thompson (2001, 10) explains that before entering negotiations, the most important questions a negotiator needs to ask himself are: “What do I want?” and “What are my alternatives?” Any negotiator needs to determine what develops an ideal situation for him. This step in the preparation is known as a target or aspiration. Another important stage is to set a Best Alternative to a Negotiated Agreement (BATNA). “A BATNA determines the point at which a negotiator is prepared to walk away from the negotiation table. In practice, this means that negotiators should be willing to accept any set of terms that is superior to their BATNA and reject outcomes that are worse than their BATNA.” (Thompson 2001, 11) Knowing his BATNA is the key feature for effective negotiation by a project manager. The step of self-assessment also includes identification of the issues in the negotiation,

the identification of the alternatives for each issue, the identification of packages of offers, dealing with uncertainty and an assurance that a negotiator has an appropriate level of confidence. (Thompson 2001, 15-22)

Once the negotiator (project manager) has gone through the step of self-assessment in the phase of preparation, he can start to judge the other party. The basic point for the negotiators in this assessment is to determine others' interests and position; they need to find out the alternatives and issues preferred by the others. Before a project manager begins negotiating, he should learn everything he can about the other negotiator, including whether he or she is cooperative or competitive. The essential thing is also an effort to reveal the other negotiator's BATNAs. But this step is very often without any results. Both sides are strategic negotiators and no one wants to expose his BATNA.

The last assessment is an assessment of the situation. Negotiators should assess if negotiation is short term, long term or repetitive, if negotiation was developed from necessity or opportunity, or if negotiation must end up in an agreement. Other facts that must be considered by a negotiator are: legality of negotiations, the type of contract (official vs unofficial), the location of negotiations, the character of negotiation (public vs private), the balance of the powers between parties etc. (Thompson 2001, 24-31)

In the phase of preparation, it is also important to set the strategies and tactics which will be used in the process of negotiating. Negotiators can propose an expected course of negotiation, set the arguments which will be used as the first and which will be involved in the end of the negotiation process when the opponent supposes that the negotiator has used up all his possibilities. He can also mark the arguments which will be used in distress.

- The process of negotiation – bargaining

In the second phase, the negotiators are sitting round the table and they are engaged in a preliminary discussion. Both of them are sharing the information which could enable negotiation. The step of sharing information

helps not only to provide the entry points and specific demands of both sides, but the main reason for this step is to start building the relationships between negotiators. Information sharing is crucial in the formation of negotiators' position and also in the strengthening of negotiation as a whole. The type of shared information depends on the nature of negotiation. Information that is shared in most cases include: company activities and market position, opinion on entry points, other side's attitude and engagement, problems, issues or risks, motivational factors etc. (Khelerová 2006, 44-45)

Another step in bargaining is a discussion and proposing. In a discussion, a negotiator is dealing with his counterpart in order to discuss issues within his negotiation. In the proposing step, a negotiator summarizes his wants and claims. Both sides are considering their entry and exit points. In both of these steps, the negotiators have to concentrate on building relationships and trust so they should avoid insults, provocations and threats. They should turn to building a strong relationship based on trust, to sticking to a point of negotiation, to sharing information and to being positive and polite. (Fisher, Ury, and Patton 2004, 28-36)

Negotiation signals are a very important factor in proposing. According to these signals, a negotiator is capable to determine if the counterpart is willing to proceed to a compromise and in which way. This transmission of signals has only one purpose, namely to notify the counterpart of this type of information: "I am willing to concede in this area if you are willing to change your stand-point to this issue." The negotiation signals can be sentences as: "It would be very difficult...", "We know that we have no choice...", "Perhaps under certain conditions..." etc. Nonverbal expressions can be also helpful. These expressions are: discomfiture, strained expectation, pleasure of confirming expectations and nervousness of lying.

- Closing the deal

Closing the deal is the last step in the process of negotiation. In this step, the perfection of the preparation is revealed. After the negotiators reach an

agreement, they close the deal. The phase of closing the deal comes after both sides have achieved what they wanted, after the documentation of the agreement and after the negotiator and his counterpart have agreed on the details of the deal. If all these steps are met, the contract can be signed. As Guasco and Robinson (2007, 132) point out "reaching an agreement at the conclusion of a negotiation is where strategic negotiators shine. They know that they must be precise and clear, making sure that both parties know and understand the terms and conditions of the agreement. Successful negotiators also promptly follow through on getting the written agreement drafted and signed. Delay only provides an opportunity for the deal to be reconsidered and renegotiated. The strategic negotiator understands that closing the deal is all about the details.

3.6.6. Negotiation Strategies and Tactics

Negotiation Strategies

Depending on the intention of negotiators, strategies for negotiation differ. Some of the most widely used strategies are

1. **Know your BATNA**

The essential skill before entering negotiation for all negotiators is to think about their BATNA (Best Alternative to a Negotiated Agreement). Negotiators should not enter into a negotiation without knowing exactly what their BATNA is. Knowing ones BANTA helps the negotiator to decide when to walk away from the negotiation if the interest of his party is not met through the negotiation. If the anticipated result is not better than BATNA, it will be the best way to walk away from the negotiating table. Successful negotiation should end up in the result that is better than predetermined BATNA.

2. **Research the counterpart's BATNA**

After setting a negotiator's BATNA, there is time to determine the other party's BATNA. To be aware of the point when the counterpart should walk away from the table can be extremely beneficial in the negotiation process.

The negotiator should gather as much information as possible about the opponent's alternatives. It is impossible to reveal exact BATNA, but a rough estimate of what he will do if the agreement is not reached can give an advantage for the better bargaining position of the negotiator.

3. Set high aspiration base

In the negotiation process, both sides set the target that would like to achieve. They aspire to the target. The term *aspiration base* indicates the point at which the result of negotiation would be optimally satisfactory. Research has shown that negotiators who set high aspirations end up with better deals than those who set lower targets.

4. First offer

In the business negotiation, the problems like who should make the first offer or how the first offer influences the outcome of negotiation always occur. It is always difficult to decide who should make the opening offer because somebody gains a negotiating advantage by this move. According to the experts in negotiation, the negotiators who make the first offer are at advantage in the negotiation process and often achieve better results than their counterparts. First offers usually anchor your negotiating position.

If the opponent has made the first offer, there is a strategy to counteroffer immediately. The purpose of an immediate counteroffer is to reduce the anchor of the opponent's initial offer and to create a positive climate by showing a willingness to negotiate. (Thompson 2001, 40) A matter of principle that a negotiator must not do is to accept the first offer. A reason why the negotiator never accepts the first offer is the fact that the opponent still has plenty to offer in the negotiation.

5. The power of fairness

To negotiate fairly is not only the way how to empower the negotiator's ethical character but it is also a significant ability to negotiate effectively. A

fundamental strategy in effective business negotiation is to determine which norms of fairness would be most fitting for the situation of negotiation.

6.2 Negotiating Tactics

In almost every negotiation, negotiators meet in addition to strategies also with negotiation tactics. All negotiators should be aware of them. It is important to use them effectively but also to confront them when these tactics are used against a negotiator. The tactics are mostly applied to gain advantage over the other party.

The following negotiation tactics rank among the most common.

1. **Nibbling:** The nibble or also called *add-on* is one of the most popular tactics among sales persons. The nibble is used after a deal was made. The tactic is called *add-on* because of an additional cost item which is added to the deal; for example the price is agreed upon Br.1,000 but suddenly, the information occurs that Br.50 for delivery and Br.70 for installation needs to be added. The nibbling presupposes that after a deal has been made, the counterpart is relaxed and satisfied with the agreement; so he will be sensitive to add-ons.
2. **The use of higher authority:** During negotiation, a negotiator can only negotiate on certain issues and his negotiation power is limited by some higher authority. He can not reveal some information because it is beyond the limit of his competency. He must appeal to the authority that can take final decisions. He can do so by phrases like "Sorry, I do not have the authority to spend..." - "I have to discuss the issue with our general manager." The negotiator should be also aware of the competences of his counterpart. It is very advantageous to know what the other side is able to decide and what it is not.
3. **Walk away power**: Walk away power is also one of the most widespread tactics in business negotiation. However, the negotiators must be very careful in applying this tactic because it can also immediately break down the whole negotiation process. The biggest mistake in negotiation is when a negotiator turns out to be attached in

negotiation and he has nothing to work with in bargaining. He becomes emotionally trapped and he is forced to stay in negotiation. His counterpart feels that the negotiator is forced to stay and he is in an advantage.

4. **The power of legitimacy**: Strategic negotiators are advised to mention the company's prices, conditions etc. in writing rather than in a verbal way. Written words have always been seen as an indication of legitimacy. The power of negotiator increases when he uses standards of legitimacy in order to persuade others. It is always beneficial to prepare the documents which define what goes in and what stays out. The power of legitimacy is set when a negotiator presents something for signature.
5. **Effective body language**: Words and body language are closely linked. All people use their body to communicate. But most of them cannot read the signals which are transmitted by body language. It is very effective to learn these signals, mainly for the negotiators who can correlate their body language with the countepart to create a positive atmosphere during business negotiation. Another reason why negotiators should be aware of using body language in the process of negotiating is to recognize if the other side is willing to reach an agreement or if he is preparing some counter-tactic to mislead the negotiator.

Summary of the chapter

Category management is perhaps one of the most important ways that supply managers create value for their stakeholders. Category teams must effectively scan the market environment, conduct research on suppliers and cost drivers, analyze internal spend characteristics, and establish appropriate strategies for managing these relationships. In doing so, supply managers depict and create insights for stakeholders on key elements of their supply environment that shape their operational, financial, and market planning decisions. Effective category strategies also create the foundation for cost management, contract frameworks, and ongoing

supplier performance management metrics and relationships. Procurements usually evaluate potential suppliers across multiple categories using their own selection criteria with assigned weights. Purchasers that need consistent delivery performance with short lead times to support a just-in-time production system might emphasize a supplier's scheduling and production systems. A high-technology buyer might emphasize a supplier's process and technological capabilities or commitment to research and development. The selection process for a distributor or service provider will emphasize a different set of criteria.

CHAPTER FOUR

WAREHOUSING AND MATERIALS HANDLING IN PROJECT

Objective of the chapter

At the end of this chapter, students will be able to:

- Identify Principles and purposes of warehousing
- Understand Storage and handling system (Palletized and Non Palletized)
- Identify Order picking and replenishment mechanisms
- Know the concepts of Receiving, dispatch and Warehouse design
- Understand Materials handling and packaging systems
- Know the concepts of Warehouse management and information

4.1. Introduction

Businesses and organizations do exist to accomplish their mission. Commercial organizations, among others, do strive to maximize the owners wealth as their primary objectives. To do so, different operational and strategic directions are set. Total value managements and total quality managements are contemporary system management strategies of businesses. Supply chain management is the pillar body of systems and total value managements. The bone of supply chain management is logistics and procurement of which warehousing and material handling system is the most essential for the success and existence of business and projects.

4.2. Principles and purposes of warehousing

Warehousing is one of the pillars of supply chains; good warehousing is a significant factor in the effectiveness of supply chain management (Rushtan A et al 2006). It takes remarkable share of the logistics cost (22%) indicating its efficient management will have great implication on the overall logistics

efficiency (Rushtan A et al 2006). The warehouse structure and site, fire safety, security, loading bays and vehicles are issues to be assessed in order to determine the quality of the structure (Stuart Emmet). Warehouses could be classified based on different types of characteristics (Rushtan A et al 2006).

- by the stage in the supply chain: materials, work-in-progress or finished goods;
- by geographic area: for example, a parts warehouse may serve the whole world, a regional warehouse may serve a number of countries, a national warehouse may serve just one country, or a local warehouse may serve a specific region of a country;
- by product type: for example, small parts, large assemblies (e.g car bodies), frozen food, perishables, security items and hazardous goods;
- by function: for example, inventory holding or sortation (e g as a 'hub' of a parcel carrier);
- by ownership: owned by the user (eg the manufacturer or retailer) or by a third party logistics company;
- by company usage: for example, a dedicated warehouse for one company, or a shared-user warehouse handling the supply chains for a number of companies;
- by area: ranging from 100 square metres or less to well over 100,000 square metres;
- by height: ranging from warehouses about 3 metres high through to 'high-bay' warehouses that may be over 45 metres in height;
- by equipment: from a largely manual operation to a highly automated warehouse.

4.3. Role of Warehouses

The main purpose of warehouses is to facilitate the movement of goods from supplier to customer at different level throughout the supply chain (Rushtan A et al 2006). Holding inventory, consolidation of goods from different sources, break bulk operations and value addition activities need warehousing. Different approaches in the supply chain like just-in-time,

efficient customer response, collaborative planning, forecasting and replenishment are developed in order to reduce need for warehousing. However, in cases where the demand for the product is continual and the supply lead time is greater than the demand lead time; warehousing is a necessary step in the supply chain (Rushtan A et al 2006). Phil A. discussed some more reasons for holding inventory and use warehousing.

- *to provide a buffer to smooth variations between supply and demand*
- *to enable economies of long production runs in manufacturing*
- *to provide a buffer between different manufacturing operations*
- *to enable procurement savings through large purchases*
- *to allow cost trade-offs with the transport system (eg the use of full container loads)*
- *to cover for seasonal fluctuations and peaks, eg the Christmas build-up*
- *to provide a wide range of different products, from different suppliers, in one location*
- *to cover for planned or breakdown production shutdowns*

4.4. Warehouse Operation

The warehouse operation should be organized in a way that the basic storage and flow of goods and materials is efficient and effective. There are a number of functions in the warehouse operation that could be summarized in to four major steps (Emmet S 2005).

1. Goods in or receiving
2. Put away into the storage area/ Storage area
3. Order selection and picking/ packing
4. Goods outward or dispatch.

1. **Receiving/Goods in**: This includes the physical unloading of incoming transport, checking, recording of receipts, and deciding where the received goods are to be put away in the warehouse. It can also include such activities as unpacking and repackaging, quality

control checks and temporary quarantine storage for goods awaiting clearance by quality control.

2. **Reserve Storage**: After products are received their storage requirements will be identified and moved to the reserve or back-up storage area. This area holds the bulk of warehouse inventory in identifiable locations. When required, the goods are taken from reserve storage either directly to marshalling or to replenish a picking location.
3. **Order Picking:** Once orders have been received, the products will need to be picked or selected from the warehouse. See Order Picking and Replenishment section for further details.

   Sortation: For small sizes of order, it is sometimes appropriate to batch a number of orders together and treat them as 'one' order for picking purposes. In this case, the picked batch will have to be sorted down to individual orders, i.e secondary sortation, before dispatch (Rushtan A et al 2006).

   Collation and added value service: After picking, goods are brought together and consolidated as completed orders made ready for dispatch to customers. This can involve packing into dispatch outer cases and cartons, and stretch and shrink-wrapping for load protection and stability. It may also involve final production postponement activities and value added services, such as kitting and labeling (Rushtan A et al 2006).

   Customer Orders: Is specified need of the customer including the picking option (Item/ piece, carton/case or full pallet) (Emmet S 2005)

4. **Goods Outward/Dispatch**: Picked, collated and packed goods are marshaled and loaded to vehicles for onward dispatch to the next node in the supply chain (Rushtan A et al 2006).

There will be no storage function in case of cross-dock warehouse operation. Therefore, the typical functions in cross-dock warehouse operation become receiving, sortation and marshaling and dispatch (Rushtan A et al 2006).

Quality customer service and minimal overall cost/ best cost efficiency in the warehouse system depends on many issues. In general, Sople V (2007), listed the fundamental principles in best practice of the warehouse system include

- Make the best use of available space
- Use a unitized load system suitable for storage
- Minimize goods movement by proper storage area allocation
- Provide flexibility for changing future needs
- Provide safe, secure and clean working conditions

Maximizing effective use of space in the warehouse is necessary. Efficient use of space will reduce cost of the warehouse. Stock access and movement of equipments and persons within the warehouse should be considered to achieve the best use of the warehouse building space. Nature of the product, item turnover and space utilization ratio (utilized space: open space) should also be well thought-out in determining location for goods. Whenever appropriate, random location system enhances the efficient use of space than fixed location system.

Unit load system that assembles goods/materials for efficient and effective handling and storage is preferable. Larger number of goods can be moved, transported and handled at a time using unit loads. It facilitates standardized use of equipment in the warehouse despite the type of the material. Examples include pallets in a range of materials although wood is still the most common, roll cage pallets, post pallets, cage pallets, tote containers whether plastic or steel, and ISO containers.

Movement of goods/materials uses resources and, except for automated systems, involves operating staff time (Rushtan A et al 2004). Warehouse layout and the positioning of the various warehouse operations within the building clearly affect the amount of movement, as does the locating of stock within the storage systems. Ways to minimize movement include:

- locating 'popular' or fast-moving goods close to dispatch to minimize travel distances

- separation of order picking and reserve stock to concentrate picking activity into the smallest feasible area whilst avoiding congestion
- providing handling equipment to minimize manual effort and movement
- computer planning of warehouse movement routes for minimum travel
- movement planning to maximize people and handling equipment utilization and avoid travelling without payloads, e.g. dual cycling, in which both outward and return movements of an item of handling equipment are utilized for carrying goods

Any warehouse installation should also have an effective, fast, accurate and flexible communication and information system. Clean and safe working environment is necessary for effectiveness of workers (Sople V, 2007). The lighting, temperature, humidity and hygiene of the warehouse impact the working environment. Safety has always been of prime importance in warehousing because of the amount of movement, lifting and manual handling involved. The wellbeing of people, products and equipments should be considered in the whole system of warehousing. The design and warehouse management system should consider the environmental issues.

4.5. Storage and Handling System (Palletized and Non-Palletized)

Materials handling is the art and science involving the moving, packaging and storing of substances in any form **(**Bolz, H. A and Hagemann, 1996**)**. The current widely used definition of material handling was presented by Tompkins et al. (1996) as the function of "providing the right amount of the right material, in the right condition, at the right place, at the right time, in the right position, in the right sequence, and for the right cost, by using the right method(s)" The ideal question that comes next might be why for the need to have a good material handling for businesses, projects and so. The following are the goals of having good material handling system:

- To reduce unit costs of production

- To maintain or improve product quality, reduce damages, and provide for protection of materials
- To promote safety and improve working conditions
- To promote productivity
- To promote increased use of facilities
- To control inventory

To achieve these goals good materials handling systems should fulfill the following essential requirements.

i) Efficient and safe movement of materials to the desired place.
ii) Timely movement of the materials when needed.
iii) Supply of materials at the desired rate.
iv) Storing of materials utilizing minimum space.
v) Lowest cost solution to the materials handling activities.

- **Storage and Handling System (Palletized)**

Alan Rushton Phil Croucher Peter Baker (2006) has well-articulated the storage and handling system for palletized and non-palletized storage and handling system. Goods may be palletized at the goods receiving area ready for put-away to storage. The use of wooden pallets enables standard storage and handling equipment to be used for material handling. The exact nature of the equipment will be determined by such factors as the throughput levels, inventory holdings, and the requirements of the wider supply chain.

Figure: Wooden Pallet

a) Pallet Movement

There is a wide range of equipment available for moving pallets around a warehouse, from simple manual aids to sophisticated computer-controlled equipment. Some of the most common types are as follows:

1. ***Hand pallet truck****:* This is a truck with two forks that will fit into the slots of a pallet. The forks can be raised slightly by a simple pump

action to lift a pallet off the floor. The truck can then be pulled manually and the pallet deposited at the required floor location in the warehouse. It is useful for infrequent movements over short distances.

2. ***Powered pallet truck****:* This is similar to the above, except that it is battery powered. The trucks may be pedestrian-controlled or may have a platform or a seat for the operator to stand or sit on.
3. ***Tugs and tractors****:* For long horizontal movements, a tug may be used, towing a number of trailers. This reduces the number of journeys that need to be performed
4. ***Conveyors:*** There are a number of possible conveyor types, with the simplest being gravity roller conveyors.
5. ***Automated guided vehicles (AGVs):*** These are electrically powered driverless trucks, controlled by computer. They normally interface with other handling systems such as conveyors. Typical applications are for the transport of pallets from the goods receiving area to the reserve storage system, or from the latter to the marshalling area. Data may be transmitted to the AGVs by radio frequency signals, whilst guidance of the trucks may be by a variety of means. One method is an under floor wire, which carries an alternating electrical current that induces a magnetic field around the wire. On-board sensors measure the field to detect any deviation from the prescribed path and, in this event, correcting signals are sent to the steering motor to bring the truck back on course. Other systems include magnets buried in the warehouse floor, optical guidance by strips or painted lines and, more recently, laser-guided systems. The vehicles have obstacle detectors on board so that they stop if they detect a person, truck or other obstacle in their path.

In general, the above types of equipment are used solely for horizontal movement. For placing pallets into storage positions, some form of lifting mechanism is also required. These trucks are described in the following section. However, it should be noted that many of these lifting trucks are also commonly used for horizontal movement around the warehouse.

Trucks Commonly for lifting mechanism

The effective storage of goods in a warehouse normally involves the stacking of pallets, either one pallet on top of another or, more commonly, the placing of pallets into some form of racking. In order to achieve this, the truck must be capable of lifting a defined load.

Pallet Stacking Trucks

- ***Stacker trucks***- fairly lightweight battery-powered trucks with maximum capacities up to about 2,000 kilograms.
- ***Counterbalanced fork-lift trucks (CB trucks)***-Counterbalanced fork-lift trucks carry the payload forward of the front wheels
- ***Reach trucks*** -are designed to be smaller and lighter than counterbalanced trucks and to operate in a smaller area.
- ***Other stacking equipment such as*** double-reach trucks, narrow-aisle trucks, and stacker cranes.

  Each of these stacking tracks should be described with the appropriate storage system.

b) Palletized Storage

There are many storage systems available for palletized goods, ranging from simple block stacking to advanced computer-controlled systems. As well as representing a range of technologies, these systems offer various compromises between the very dense storage of pallets with limited accessibility to each pallet and, at the other extreme, individual accessibility to every pallet but taking up a large amount of warehouse space.

These alternative systems are described below.

i) Block stacking

In block stacking, pallets are placed directly on the floor and built up in stacks, one pallet on top of another. No storage equipment is required. Rows of stacked pallets are laid out side by side. When removing goods for use, free access is only to the pallets at the top and front of each row. Typically, block stacking is carried out by counterbalanced fork-lift trucks.

Figure: Block stacking

Block stacking is suitable for that part of the product range where there are few product lines, each with a high inventory level, and where very strict first in first out (FIFO) movement of inventory is not required. The advantages are good use of area (although not necessarily of building height), flexibility to change the layout of the blocks, and quick access to inventory for rapid throughput

ii) Drive-in and drive-through racking

Although this is a racked storage system, it is operationally similar to block storage. It is designed for High Density Storage utilizing the maximum warehouse storage cube while keeping aisle space to a minimum.

The racking structure supports the weight of the pallets, so this system is suitable for high-inventory SKUs, where strict FIFO movement is not required, but where the goods are not strong enough or of regular enough shape to carry superimposed loads. Since pallets are supported by the structure, the height of the installation is not limited by pallet strength or

stability. If access is all from one end, the racking is called 'drive-in', and if pallets are fed in at one end and removed at the other the term 'drive-through' is used.

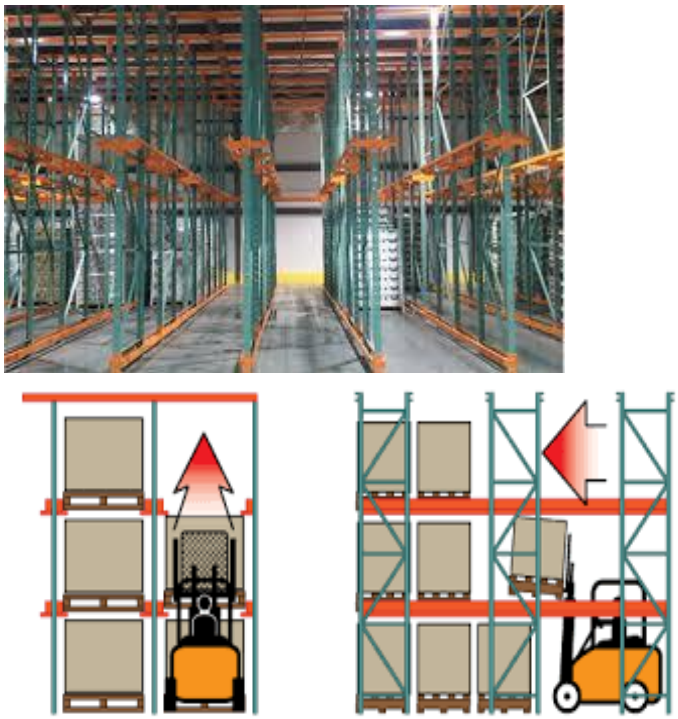


Figure: *drive-in drives through racking*

iii) ***Push-back racking***- Like drive-in racking, this gives high-density storage and can be built to any height up to the maximum lift height of the trucks accessing it. It is a Last-in, first-out high density storage racks. It is an accumulative storage system that allows up to four pallets deep to be stored per level. Push-back is ideal for storing medium-turnover products, with two or more pallets per SKU (using the Last In First Out (or LIFO) system).

Figure: Push back racking

iV) Adjustable pallet racking (APR) - reach truck operation

Adjustable pallet racking offers free access to every pallet held. It can be built to match the lift height of any fork-lift truck. Counterbalanced fork-lift trucks may be used but, owing to the wide aisles required for turning, it is more normal to use reach trucks.

APR is a flexible, versatile storage system, which gives excellent stock access. It is simple in concept and easily laid out, and damaged parts can be readily replaced. It can be suitable for fast-moving and slow-moving inventory. However, APR does not make good use of building volume.

Figure: Adjustable pallet racking

V) Double-deep racking

In double deep, the pallets are stored in to two rows deep instead of one. If some loss of totally free access to stock can be accepted, space utilization can be improved using double-deep racking. This supports pallets on pairs of beams as in APR, but improves space utilization by eliminating alternate access aisles, and using a 'double-reach' fork-lift truck, which can access not just one but two pallets deep into the racking. The price of this space saving is the requirement for double-deep reach trucks to access the stock, more costly than ordinary reach trucks, and some loss of selectivity.

Figure: Double-deep racking

vi) Powered mobile racking

Powered mobile racking is effectively single-deep APR, with the racking mounted on electrically powered base frames, which move on rails set into the floor, as shown in the Figure below. The system allows the operator to open the aisle required with a single command.

Figure: Powered mobile racking

vii) ***Automated*** **storage** ***and retrieval systems*** **(AS/RSs)** is one of the major material handling systems, which is widely used in distribution centers and automated production environments (M. R. Vasili et al). AS/RSs can play an essential role in modern factories for work-in-process storage and offer the advantages of improved inventory control and cost-effective utilization of time, space and equipment. Automated storage and retrieval systems comprise the following components:

- A storage medium, eg pallet racking;
- Storage and retrieval machines that operate in the storage medium;
- In-feed and out-feed systems, eg fork-lift trucks, conveyors, AGVs;
- Equipment control software.

A typical installation consists of high-bay pallet racking, with stacker cranes operating in the racking aisles to put pallets away to stock and to retrieve them.

- **Storage and Handling Systems (Non-Palletized)**

Although pallets are very widely used in warehouse operations, there are many types of product that are not suitable for palletization, because they may be, for example, too small, too large or too long, or because they require lifting from the top. These products may include, for example:

- Nuts and bolts;
- Electronic items;
- Paper reels;
- Machinery;
- Steel bars;
- Carpets;
- Drums;
- Hanging garments.

This section examines the various storage and handling systems that may be applied to such items.

A) Small Item Storage Systems

There is a range of equipment designed for the storage of small items. Some of these are used in combination, and therefore standard sizes and modularity are important. Whatever system is used, it is important that there is a specified location, or locations, for every SKU (stock-keeping unit)

a) Shelving - short and long span

Shelving is generally made from standard modular components that allow installations of different heights, vertical shelf spacing and shelf depths. Shelving can be accessed in various ways - from ground-floor level, from mezzanine levels or from fixed-path or free-path lifting equipment such as narrow-aisle picking trucks and picking cranes.

b) Bins

Tote bins are made in a range of materials such as galvanized steel, polypropylene, wire mesh and fiberboard. They are made in modular sizes that are sub-multiples of standard dimensions, and this facilitates nesting and stacking, and the use of different sizes of tote within one installation.

c) Drawer units

Drawer units can be freestanding or incorporated into shelving modules or stores counters. Sub-dividers are used, which enable particularly good use of drawer space, and there is a range of other fittings suitable for such items as electronic components, machined items and other delicate components. Drawers give very good access to the stock and provide a clean and secure environment.

***d)* Others**

- *Mobile shelving*
- *Flow racks (*live storage systems that holds Small items and cartons)
- *Carousels (*that hold material on shelves, or in tote containers on shelves)

B) **Truck Attachments (for large items)**

For larger items, it may be possible to handle the goods by means of attachments fitted to fork-lift trucks. These attachments may be used for block-stacking the goods or they may be used in conjunction with accessories fitted to adjustable pallet racking. These include:-

- *Clamps (fixed, fasten together)*
- *Rotating head*
- *Load push-pull*
- *Drum tines*
- *Multi forks*
- *Booms.*

C) **Long Loads**

Items such as carpets, linoleum, wood and engineering material (eg bar, rod and tube) are not suitable for the standard types of storage system discussed so far, and require special storage and handling.

Storage methods include:

- *Block storage.*
- *Cantilever racking*
- *'Toast-rack' storage*
- *Pigeon-hole racking*

D) **Cranes** (for heavy loads)

Cranes are used particularly for moving very heavy loads (such as metal bars) within a predetermined area, but may also be used for lighter loads, for example where items may be just too heavy in relation to manual handling guidelines.

Equipment types include:

- *Jib cranes*
- *Overhead travelling cranes*
- *Gantry cranes*

E) **Conveyors**

Conveyor systems are used for moving material between fixed points, for holding material as short-term buffer (i.e. accumulation) and for sortation. Conveyor systems may be suitable where some of the following characteristics apply:

- High throughput;
- fixed routes;
- Continuous (or intermittent, but frequent) movements;
- Uneven floors or split-level operations.

Conveyors are widely used for the movement of pallets, cartons, tote bins and other loads within warehouses, as well as being an integral part of order picking and packing operations. In the latter activities, conveyors may have a specific application as a means of sortation (eg to

bring all goods together for a particular order ready for packing, or to sort to vehicle load

F) **Automated Guided Vehicles**

As well as being used for the movement of pallets (as described earlier), AGVs may be used for transporting large loads such as car bodies and paper reels.

G) **Hanging Garment Systems**

These are specialist systems for storing and handling garments on hangers. It is possible for garments to be transported in a hanging condition all the way from garment manufacturers in source countries such as in the Far East through to shops in, for example, in Ethiopia.

5. Order Picking and Replenishment

Order picking is a key activity in warehousing, having an immediate impact on customer service and accounting for a major part of warehouse costs and operating staff numbers. Consequently, picking systems should be designed and managed with particular care.

5.1. Order Picking Concepts

There are three main picking concepts that may be applied. These are:

- ***Pick-to-order.*** The simplest form of this is where one picker in one circuit of the picking area collects the items required for one order. This may be appropriate when one order will typically fill the capacity of the picking trolley or truck. Another form of pick-to-order is where pickers each pick part of a customer's order, for example where an order may fill several roll-cage pallets.
- ***Batch picking.*** For small orders it is not always economic to pick only one order per circuit. If it is not appropriate to pick multiple orders and to keep them separate during picking, a group of orders can be consolidated during order processing so that a picker assembles all the items required for that group of orders. At the

conclusion of the picking circuit, the bulk-picked items are then sorted down to individual order level.

- ***Pick-by-line or pick-to-zero.*** Under this concept, the exact numbers of cases or items are presented for picking. For example, they may be brought forward from the reserve storage area or they may be specifically ordered from suppliers for cross-docking. In both cases, the unit load of one product line is picked to waiting customer orders (hence pick-by-line) and the picking continues until that line is exhausted (hence pick-to-zero).

There are a number of factors that need to be considered in determining which of the above concepts to use, for example the product range, the size of order, the picking equipment, and the size of unit load or container into which orders are being picked.

Zone picking

This approach is relevant where individual orders are beyond the capacity of one picker to collect in one picking circuit, and where for reasons of meeting dispatch times it is not feasible to pick sequentially until an order is complete. It is also used where there are different zones for products, for example where products are separated for reasons of security, hazard or temperature regime. With zone picking, stock is laid out in zones, each holding a specified part of the product range and staffed by dedicated pickers. Each incoming order is subdivided by zone, and picking then takes place simultaneously in all zones until order completion.

Wave picking

Orders may be released in waves (for example, hourly or each morning and afternoon) in order to control the flow of goods in terms of replenishment, picking, packing, marshalling and dispatch. The use of waves allows for close management control of operations such as sorting and marshalling, which may be limited in terms of how many orders can be handled at the same time.

3.1.1. Order Picking Equipment

There is a wide range of order picking equipment types. Deciding the most appropriate for a given situation will depend on such factors as the types of

product, product sizes and weights, product range (how many stock-keeping units (SKUs)), the picking frequency by SKU, order size range including the number of SKUs per order, number of items per order, and order frequency. There are three categories of methods of picking orders - picker to goods, goods to picker, and automated systems.

Picker to goods - This category involves the order picker travelling to the goods in order to pick them. As with all picking categories, consideration needs to be given as to what storage equipment the picker is picking from (eg shelving, flow racks or pallet locations), what equipment the picker is picking to (eg trolley or powered pallet truck) and what the picker is picking into or on to (eg wooden pallet or roll-cage pallet). The following is a list of common picking equipment types, based chiefly on what the picker is picking to:

- ***Trolleys and roll-cage pallets***. With this method, the picker pushes the trolley (or roll-cage pallet) between shelving or pallet racking in order to access the goods. Generally pickers work from floor level, although in some cases trolley steps or warehouse ladders are used to access higher stock locations.
- ***Powered order picking trucks.*** These are electrically powered trucks that have forks, often carrying two wooden pallets or three roll-cage pallets, on to which picked goods may be placed. It is common to use these for picking from ground-floor pallet locations, either the ground level of wide-aisle adjustable pallet racking or from pallets placed in a forward pick area.
- ***Free-path high-level picking trucks***. For picking higher up from racking or shelving, high-level picking trucks incorporate a rising cab, which can lift the picker to the required levels. These typically operate in narrow-aisle environments, but some are also designed to operate in reach truck, or wider, aisles.
- ***Fixed-path high-level picking trucks.*** Crane technology is also used for picking from narrow aisles, with pickers in crane-mounted rising cabs. Typical applications for this technology are in auto parts

distribution centers holding large numbers of small-sized SKUs on shelving.

- ***Pick cars***. A pick car operates up and down in a racking aisle, and is equipped with a rising cab linked by a hinged joint to an inclined conveyor, which moves up and down with the cab.
- ***Conveyors.*** A number of picking operations make use of conveyors. For example, pedestrian pickers may select the required items from pallet locations, shelving or flow racks and place them on to conveyors to be taken away for subsequent packing and collation into customer orders. Systems are often classified as 'pick-to-tote', whereby the goods are placed in plastic tote bins on the conveyor, or 'pick-to-belt', where the goods are placed directly on to the conveyor belt.

Goods to picker - Various systems have evolved that are designed to reduce the very significant proportion of picker time spent travelling in picker-to-goods systems. Generally, goods-to-picker systems involve significant mechanization and can therefore be linked in to computer control to present pickers with the required goods in the appropriate sequence. These systems are generally suitable for small item picking.

- ***Horizontal and vertical carousels.*** It should be noted that goods are presented at the ideal picking height for the picker in the case of vertical carousels.
- ***Miniloads.*** These may be used for full carton picking or for presenting cartons, or tote bins, to a picker for the picking of individual units. The remaining goods are then returned to the miniload storage location.
- ***Pallet AS/RS.*** These systems may be used in a similar way, as described above, with pallets being presented to the picker. However, care has to be taken that throughput requirements can be met and that storage utilization is not adversely affected by the return of many part-empty pallets.

Automated systems - The picking systems described so far all require a person to pick the individual items that make up an order. However, there

are automated picking systems available that are suitable for certain applications. These include the following:

- ***Layer pickers.*** Cases are normally stacked on to pallets in layers. In some industries, such as fast-moving consumer goods, price differentials are offered to customers based on whether they order in pallet, layer or case quantities. In such cases, it may be beneficial to automate the picking of layer quantities. Typically, a pallet is brought forward from the reserve pallet store (eg by AS/ RS and conveyor) to a layer picking machine. This machine would lift the top layer off (eg by suction pads) and place it on to a pallet that is being assembled for the customer order. The product pallet would be returned to the reserve store and another pallet would be brought forward and the process repeated until the customer pallet was filled with all the layers required.
- ***Dispensers.*** A dispenser normally comprises lines of vertical magazines, on one or both sides of a belt conveyor. The magazines are loaded with SKUs, which need to be in regularly shaped packages for ease of movement down the magazines, and fairly small. As the conveyor moves between the two lines, the required order quantities of the required SKUs are dispensed under computer control, all items for one order being dispensed on to the same section of conveyor. When the accumulated items reach the end of the conveyor, all the items for the order are together and fall off the conveyor into a carton ready to be taken away for packing. An alternative is to have empty cartons or tote bins already on the central conveyor belt, fed on at the upstream end. The picking operation is controlled and carried out by the machine, but there is often a heavy manual input required to keep the individual dispensers replenished as the stock is used up.
- ***Robotic applications.*** The use of robots for the routine stacking and de-stacking of cases on to and off pallets is well established. Robots can be programmed to stack to prescribed patterns, to build up layers on a pallet, and to use different patterns on adjacent rows to assist

pallet load stability. They are often used at the end of production lines for this purpose.

3.1.2. Sortation

If goods have been batch-picked, then they will need to be sorted into the relevant customer orders. This may be undertaken manually (eg sorting to pigeon-hole or to roll-cage pallet) or by automated sortation equipment. Similarly, goods that have been zone-picked will need to be brought together into the relevant orders. Sortation may occur immediately after picking so that items can be assembled into the appropriate orders ready for packing or dispatch. Where there is a separate packing operation, sortation may also occur after packing so that the packed goods can be assembled into vehicle loads. Sortation systems give very high rates of sort/pick, and are used in some crossdocking applications. There are a number of such systems available including:

- ***Sliding shoe sorters.*** There are 'shoes' located at the edge of the conveyor. When the goods reach the appropriate destination point, the shoes slide across to divert the goods down that spur. These are suitable for cartons and tote bins of regular shape and reasonable rigidity.
- ***Tilt-tray sorters.*** Tilting conveyors are usually laid out in horizontal carousel configuration, with a series of tilting trays or slats fitted to a conveying chain, and capable of tipping loads off to left or right to branch conveyors or to off take chutes. The slats can be tilted singly or in multiples according to sizes of load being handled. Tilting conveyors are used for high-speed sortation operations, such as parcel distribution, and for some cross-docking installations.
- ***Cross-belt sorters***. These comprise a series of mini-conveyor belts aligned at 90 degrees to the direction of travel. The appropriate mini conveyor belt starts up when the item reaches the required off-take destination point. This forms a positive movement and is therefore suitable for a wide range of items. Sort rates are similar to those of tilt-tray systems.

3.1.3. Layout and Slotting

The layout of the picking area is critical to achieving high levels of productivity. One of the first decisions that needs to be taken is whether to have separate reserve inventory and picking locations for individual SKUs or to combine all the inventory into a single location. This will largely depend on the total amount of inventory for an SKU. The general principle is that picking stock should be concentrated into the smallest feasible area, so as to minimize travelling time between the SKUs.

3.1.4. Information in order Picking

Accuracy and completeness of order fill, together with timeliness, are key factors in picking performance, and a good information and communication system is a prerequisite for meeting these objectives. This includes appropriate presentation of the correct and sufficient information to the order picking staff, ideally with minimum clerical effort required from them, with the facility for them to communicate back to the managing system in the event of mislocated stock or shortage. There are numerous alternative methods available, supported by varying levels of complexity in information systems:

- ***Pick by label.*** A gummed label is printed for each item to be picked, and the labels for one order are produced on a backing sheet in the sequence in which they are to be picked. The picker attaches the relevant gummed label to each item as it is picked, and any labels remaining at the end of the pick circuit show what shortages have occurred.
- ***Bar codes.*** These are widely used in warehousing. One use is to identify uniquely every storage and picking location in a warehouse, and of course to identify products and product information such as batch identification. In picking operations this can be used to verify pick locations and the items being picked.
- ***Radio data terminals.*** These can provide online communication between designated warehouse workstations and warehouse management computer packages, and as such have an application in

order picking. The terminals may be truck-mounted, waist-mounted, or fitted to the wrists of the pickers. They are often combined with bar-code scanners. For example, a wrist-mounted radio data terminal may be attached to a bar-code scanner fitted as a ring on a finger so that pickers can move goods with both hands free.

- ***Pick by light.*** In these systems, every picking location is fitted with an LED (light-emitting diode) display panel, controlled by computer. A common application is for a plastic tote bin, representing a customer order, to be taken by conveyor to a specific zone of the warehouse. The bar code on the tote bin is read, and the appropriate LED panels illuminate, showing the quantity of items to be picked for all SKUs required for that order. Having picked the items, the picker presses a cancel button and then uses the conveyor to pass the bin to the next zone. This process continues until order completion. This method can give high pick rates and very high levels of picking accuracy.
- ***Put to light***. This is similar to pick by light, except that it is normally used in the sortation process. For example, a picker may undertake a batch-pick and then return to an area of pigeon-hole shelving, with each pigeon-hole representing a customer order. On scanning a particular product, LED panels illuminate, showing the number of items required for each customer order.
- ***Voice technology.*** With this technology, the picker can hear voice instructions from the computer through a headset. The picker then selects the required items and speaks through a microphone to confirm the pick. Frequently, a check digit located at each location needs to be repeated by the picker to ensure that the goods have been picked from the correct location. As with pick to light, this system completely frees the picker's hands and thus facilitates high pick rates.

3.1.5. Picking Productivity

Pick rate should not be the sole measure of performance, and other key indicators to be monitored include accuracy of pick, completeness of order

fill, timeliness of meeting dispatch deadlines, returns and customer complaints, and stock damage during picking.

Other important issues that can impact on the effectiveness of order picking operations include:

- the way stock is laid out within the picking area;
- planning work to eliminate waiting time;
- balancing workloads across the various picking staff;
- ensuring timely replenishment of picking stock as it is used up;
- planning the interface between the picking and any subsequent packing operations;
- elimination of clerical work.

3.2. Replenishment

Picking stock availability is necessary to maintain high levels of order fill. The potential consequences of low availability at the picking face are reduced service levels in terms of incomplete orders, or extra cost because of the need for pickers to revisit picking locations they have already visited and found to be out of stock. Consequently, any order picking system must be backed up by an effective replenishment system.

4. Receiving and Dispatch

Both the receiving and the dispatch areas of a warehouse are critical to its successful operation. Receiving is important, as it forms the basis for all the subsequent activities of the warehouse. For example, goods need to be passed through receiving rapidly so that they are available for picking customer orders, and this must be carried out with a high degree of accuracy to ensure that the correct goods are received and located in their assigned locations. The dispatch activity is critical, as it is the customer-facing aspect of the warehouse and therefore it must operate effectively to ensure that all goods are dispatched to the customers on time. Operational failures in either of these areas will quickly result in service level failures, which may be damaging to the company and may be costly to rectify.

4.1. Receiving Processes

The receipt of goods into a warehouse needs to be a carefully planned activity. Some packages may require some form of processing, such as applying bar-code labels, palletizing, re-palletizing or placing into tote bins. The unit loads then need to be checked, particularly if they are to be put away into an automated storage and retrieval system. For example, pallets may be weigh-checked on a conveyor and then passed through a dimension checking device, which would register any protrusions outside the permitted dimensions by means of photoelectric cells. Any pallets that do not conform are then sent to a reject spur on the conveyor for manual rectification.

When the goods are ready for placing into storage, they may be put away and the computer system advised of the location number or, more normally, the warehouse management system would identify the most appropriate location and issue a put-away instruction. A key objective in designing the receiving process is to enable the goods to be put away to the required location in the warehouse with the minimum handling and minimum delay possible. This often requires close co-ordination with suppliers, in terms of procurement agreements and the timing of deliveries.

4.2. Dispatch Processes

After order picking, the goods for a particular order need to be brought together and made ready for dispatch. This may involve added value activities, such as labelling, tagging, assembly, testing, and packing into cartons. Where production postponement is undertaken, these activities may be quite extensive. The goods then need to be sorted to vehicle loads and placed in, or on to, unit loads ready for dispatch. This may be a conventional operation (eg loading into roll-cage pallets and then using a powered pallet truck to take the goods to the marshalling area) or it may be automated (eg using conveyor sortation and automatically loading tote bins on to dollies, ie wheeled platforms).

4.2.1. Cross-Docking

Cross-docking is an activity whereby goods are received at a warehouse and dispatched without putting them away into storage. The goods may thus be transferred directly from the receiving bay to the dispatch bay. This normally involves some form of sortation. Goods for cross-docking need to arrive by a strict time schedule linked to the vehicle departure times. The outgoing vehicles may be taking a mix of cross-docked goods (eg fresh goods) and stocked goods (eg long-shelf-life items), and thus a great degree of co-ordination is required to ensure that the operation can occur smoothly. If sortation is required, then a pick-by-line technique may be used to pick individual products from incoming pallets and place them on outgoing customer pallets. This may be undertaken manually or by using automated sortation equipment.

Cross-docking has a number of advantages in that it facilitates the rapid flow of goods through the supply chain and can be used as a technique to reduce inventory levels. It is particularly common for fresh and short-shelf-life goods, as well as for goods that are pre-allocated and need to be 'pushed' out to stores, as in the fashion industry.

Whilst there can be substantial benefits from cross-docking, it may not be suitable in every situation, for example:

- Inventory at the warehouse may just be replaced by inventory held upstream in the supply chain to support the cross-docking activity on a just-in-time basis. A holistic view therefore needs to be taken to ensure that total inventory in the supply chain is reduced.
- Goods may be transported in less than pallet load quantities or less than vehicle load quantities, thus increasing transport costs.
- Considerable handling space may be required at the warehouse for the sortation activities.
- Close co-ordination is required with the suppliers (plus high levels of reliability), and this becomes increasingly complex with greater numbers of SKUs and suppliers.

4.2.2. Equipment

The equipment types required for unloading and loading tend to be similar in nature for both receiving and dispatch, and these are therefore described together. Common types of handling equipment include:

- ***Boom conveyors.*** Goods are frequently shipped in loose cartons in ISO containers to save on space in the container, to comply with wood regulations affecting pallets, and to save the cost of pallets that will not be returned.
- ***Pallet trucks.*** Where vehicles are unloaded or loaded from the end, then it is normal for a pallet truck (either hand or powered) to be used.
- ***Fork-lift trucks.*** For side-unloading (eg of curtain-sided vehicles), a counterbalanced fork-lift truck is normally used. These may be fitted with side-shifts so that the pallet can be accurately positioned on the vehicle.
- ***Automated systems.*** There are automated systems available that can unload and load all the pallets on a vehicle simultaneously. These require special trailer units (eg fitted with rollers or tracks) and are therefore best suited to shuttle journeys, for example between a manufacturing plant and its associated distribution centre.

4.2.3. Layouts

The receiving of goods on to the warehouse site begins at the gatehouse. The layout

thus needs to include all the external areas within the perimeter fence, such as:

- ***Vehicle roadways.*** Roadway markings and signage are essential.
- ***Parking areas.*** Adequate vehicle, trailer and swap-body parking needs to be provided.
- ***Ancillary areas.*** Many such areas may be needed, for example fuel points, vehicle washing facilities, weighbridge, generators, empty unit load area, waste compactors, sprinkler tanks and fire assembly points.

- ***Level intake.*** This is where the warehouse floor is at the same level as the external roadway.
- ***Raised dock.*** With a raised dock, the warehouse floor is at the same level as the bed of the vehicle, so that a pallet truck or lift truck can drive directly on to the vehicle by means of a dock leveller.

4.8. Warehouse Design

The design of a warehouse and handling system involves a number of stages. Though the design process seems sequential, it needs to be interactive – checking back against system requirements and assessing the interaction is necessary. The design process requires a range of skills and disciplines, including; operations, construction, materials handling, information systems, personnel, finance and project management. The design process includes the following steps:

a. Define business requirements and design constraints

The wider business requirements set the context and the design requirements for a warehouse. These are likely to include, for example:

- required capacities, in terms of both storage and throughput;
- Specified activities and Service levels to be achieved;

Relevant constraints can include:

- **Time,** eg the facility to be up and running by a specified date;
- **Financial,** eg the limit on capital expenditure available;
- **Technical,** eg to be compatible with existing company technology.

Any design must also comply with local authority and legal requirements, which amongst other aspects can cover building *height constraints*, *limitations on working times*, and *safety legislations.* Insurers also are likely to require measures relating particularly to *fire prevention and control.* The local fire officer will need to be satisfied about the measures for personnel safety and evacuation in the event of fire. Ideally, the local planning authority, local fire officer and insurer should be involved as early as possible in any design project. The impact of current and likely future, environmental legislation also needs to be considered, with regard to such issues as packaging and product recovery. A warehouse is a long-term asset,

with the building often having a prolonged depreciation period. There are ways of reducing the length of this commitment by leasing buildings, renting certain types of equipment, or outsourcing.

In view of the long-term commitment that is normally associated with warehouse design, it is quite likely that a number of business scenarios can be envisaged within this period of time. In fact, it is almost certain that the original business plan will change. It is therefore important to undertake scenario planning so that the most likely future possibilities are identified and the warehouse (or the wider supply chain strategy) can be designed to accommodate these scenarios if and when required. This means incorporating flexibility as an integral part of the design.

b. ***Define and obtain data***

The accuracy and completeness of the data on which any design is based will affect how well the final design meets the specified requirements. It is most unlikely that any design will be based on current levels of business, and it is important to establish anticipated growth and other changes to the business that the warehouse is to be designed to satisfy. Normally, data are collected for the base year (eg the most recent year of the current operation) and then projected forward in line with the business plan to the planning horizon. The data required for warehouse design include:

Products:

- ✓ handling and other relevant characteristics, size, weight, temperature or other constraints;
- ✓ packaging and unit load(s);
    - inventory levels by SKU(stock-keeping unit) (maxima, average, minima and seasonal variations);
    - throughput(rate at which something can be processed) (levels by SKU (maxima, average, minima and seasonal variations),
    - by relevant unit (eg case, pallet or cubic meter) and by value (to relate back to the business plan);
- ✓ Forecast growth trends.

Order characteristics: service levels for time and for completeness of order fill, plus order cut-off times;

- order profile (e.g. lines per order and units per order line);
- order frequency (by season, week, day and time);
- number of order lines for each SKU (to identify pick frequency);
- package and unit load details;
- special or priority order requirements.

Goods arrival and dispatch patterns: vehicle sizes, types (end- or side-load), frequencies and times;

- unit loads to be handled (including activities such as re-palletizing);
- Consignment sizes; own vehicles or third-party; cross-docking profiles (eg quantities, timing and sortation requirements).

Warehouse operations*:* basic operations to be carried out; ancillary requirements, eg packing and packaging store, returns, quality control, battery charging, offices, warehouse cleaning, maintenance workshop, services, stand-by generator, restaurant, locker rooms.

External area requirements: security facilities, including gatehouse; truck parking and maneuvering areas, car parking; vehicle wash and fuelling points.

Site and building (if existing) details: location, size, gradients, access; adjacent activities and scope for expansion, constraints or obstructions; services available**.**

Any existing facilities or equipment that may be used*:* -size, condition, numbers.

Data are not always readily available, and data collection almost invariably takes considerable time. Potential sources include computer records, existing operational records, market forecasts, customers, drawings for site and buildings, equipment records and equipment suppliers, and input from relevant management and staff. Assumptions often have to be made based on informed opinion and experience, and these should be clearly highlighted.

c. Formulate a planning base

The relevant data need to be brought together as a structured planning base, so as to provide the foundation for the designer's proposals for appropriate operating methods and systems, equipment, layouts, staffing levels and costs. The data may be analysed and presented in various ways, including graphs and charts, tables, drawings, statistical analyses, and networks.

d. Define the operational principles

The basic operations that will take place in a warehouse, and how they will be carried out, must be determined before it is possible to specify the equipment, space or staffing levels required for them. These may include vehicle unloading, quality assurance, storage, picking, production postponement, added value service packing, cross-docking, sortation and vehicle loading.

The time available for each activity is an important factor in determining how each should be performed. The choice of unit loads (eg pallets, stillages, roll-cage pallets, skid sheets, tote boxes and hanging garment rails) to be handled and stored in a warehouse is critical and should therefore be established early in the design process.

e. Evaluate equipment types

Being able to specify the appropriate equipment for a particular application clearly requires an awareness of what is available and an understanding of the basic operating characteristics of the different equipment types. For instance, mobile racking or adjustable pallet racking could be considered. Mobile racking is expensive, but the good space utilization might reduce building costs. It provides random access to all pallets, and the inherently slow operation would not be a disadvantage with low throughput products. Adjustable pallet racking, however, would not give such good use of space, but is very much cheaper and gives random access to all pallets. It is also inherently more flexible in the event of future changes to stock or throughput profiles. This sort of argument should be used, selecting equipment with characteristics that most closely match the system requirements, for all warehouse operations.

f. Prepare internal and external layouts

The layout brings together all the components of the warehouse operation inside the building, and also the external site features.

Internal layout issues

The general principles for internal layout include:

- logical flow patterns with minimal cross-flows or backtracking of goods, based on analysis of movements, generally in a rectilinear layout;
- minimizing the amount of movement required for staff and for handling equipment;
- making the best use of building volume;
- good access to inventory (eg through adequate aisle widths);
- safe systems of work including the provision where possible of separate movement aisles and access doors for people and for mobile equipment,

Although the warehouse should be designed around the operational requirements, there is a significant interface at this stage with building design. For example, building spans, feasible floor slab dimensions, and fire officer requirements (eg fire walls) may all be important.

Other layout issues include:

- the use of raised or level docks for vehicle loading/unloading;
- the type of floor and floor flatness tolerances;
- the location of offices for good oversight of operations;
- provision of separate facilities for delivery and collection drivers;
- location of ancillary functions such as the packaging store;
- battery-charging facilities.

Finally, the likelihood of further expansion should be considered, with an internal layout that minimizes disruption if expansion has to be implemented.

External layout issues

The relevant factors that affect the site layout include:

- vehicle access to the site;

- security including barriers, gatehouses and separate access for cars and commercial vehicles;
- internal roads and directions of movement, and one-way or two-way circuits;
- car parking;
- access for fire appliances;
- locating new buildings with potential future expansion in mind.

g. Draw up high-level procedures and information system requirements

Once the equipment and layout start to become clear, it is important to draw up the high-level procedures of how the operation will work. This decision will form the basis of the specification for the warehouse management system and associated information and communications systems.

h. Evaluate design flexibility

The flexibility of the design to the range of business scenarios envisioned during the first stage should be fully evaluated. Even though this would have been considered at each stage, it is important to evaluate in detail to what extent the proposed design is flexible and can therefore meet the requirements of an agile supply chain.

i. Calculate equipment quantities

Based on the warehouse flow diagrams and the equipment choices, it is normally relatively straightforward to calculate the equipment quantities. Handling equipment requirements are based on material movements in the warehouse, including seasonal variations and short-term peak loads, and on operational data, typically from manufacturers' technical data plus operating experience. The number of order picking trucks will depend not only on total warehouse throughput but also on order sizes and frequencies. Data on goods received, including delivery window and times required for vehicle unloading, will dictate receiving dock facilities such as access doors and dock levelers, and the handling equipment for vehicle unloading. Similar considerations apply to dispatch. Space requirements for order

collation and assembly should take account of the working patterns of order arrival at dispatch and the way in which vehicle schedules integrate with these internal work patterns.

j. Calculate staffing levels

The requirements for operating staff are closely linked to the mobile equipment requirements, and in many cases will 'fall out' of the equipment calculations. Allowance needs to be made for absenteeism, sickness and holidays, as well as for shift rotas (eg for 24/7 working).

k. Calculate capital and operating costs

At this stage, the capital and operating costs can be determined. It is often useful to assemble these under the headings of:

- **building,** including land, construction (or leases or rents), local rates or taxes, services and building security and maintenance;
- **equipment,** including static and mobile equipment capital costs (or leasing or rental costs), and maintenance and running costs;
- **staffing,** including management, operatives, clerical staff and maintenance staff;
- **information systems**, including hardware, software and implementation costs.

It is also normal to add a contingency to capital costs for unforeseen events and for the detailed design of equipment (eg side-shifts and flashing lights on fork-lift trucks). Under each of the above cost headings, the capital and operating costs should be calculated. These will represent the actual expenditure by the company on the warehouse.

l. Evaluate the design against system requirements and constraints

The original design objectives and constraints will have defined the commercial, financial and technical requirements to be met by the new warehouse, and these form the principal criteria for assessing the proposed design. The basic requirements for storage capacity, building size, site layout, staffing levels, and capital and operating costs can all be validated at this stage.

It is important not only to ensure that the design works well for 'the business plan', but also to identify how, and at what cost, the various other business scenarios would be accommodated. The use of simulation may well therefore be of benefit again at this stage.

m. Finalize the preferred design

As a design progresses, there will inevitably be a process of iteration, of checking back to the design requirements, and partial evaluation of ideas to assist the process of homing in on the final preferred design. The preferred design should then present the proposed operating processes and methods, services requirements, equipment specifications and requirements, staffing levels, capital and operating costs, and layout drawings. This is then normally put forward to the organization's executive body (eg the board of directors) for approval.

4.9. Packaging and Materials Handling

The major portion of an industrialized society's output must be packaged, to some degree, in order to be handled, stored, transported, and distributed. Packaging and materials handling are inseparable because of their complete interdependency. Both present and evolving conditions place increased importance on the effective interactions between the packaging and materials handling functions. Among the most important are:

1. ***Productivity.*** Packaging and materials handling are components of the system of flows, whereby material moves into a production facility, is converted into a finished product, and that finished product distributed for consumption. As vital parts of that sourcing-production-distribution continuum, packaging and materials handling are expected to contribute toward the improved productivity of the overall system.

2. ***Costs****.* Packaging and materials handling costs, combined, can account for a large portion of a product's selling price. Although indispensable functions, packaging and materials handing are purely expense items. Therefore, systematically managing the amount of packaging and handling performed on a product is a reliable means of decreasing product cost and increasing profit margins.

3. ***Customer Service***. Packaging and materials handling are customer service components that influence product assortment, speed of order picking, and delivery cost, among other important variables.

4. ***Automation***. Productivity can be increased, costs decreased, and customer service made more effective-all with the proper type and amount of automation.

5. ***Imports/Exports.*** Packaging will truly have to be international in terms of its handling characteristics. A move in that direction is the international standardization of pallet sizes and intermodal container dimensions.

Packaging is an activity of large scope, complexity, and potential. However, in order to best utilize packaging, the materials handling professional must have an understanding of the basic nature of packaging, in terms of what packaging is, its various functions, and the different types of packaging materials, as well as the process by which a package is designed and developed.

4.10. Packaging

Definition of Packaging

For different people packing has different meaning. For instance, to the marketing person, packaging is a means for presenting the product in a sales-generating light. To the distribution person, packaging is a means for protecting the product during handling, storage, and transportation. And, to the retail consumer, packaging is a means for deriving product usage satisfaction. While all such definitions are accurate, they are limited in scope, reflecting a particular user's interface with the packaging. The best definition of packaging is that of a system. The system concept of packaging explains it as, not merely the physical container, but an interrelated set of activity components consisting of:

- Basic raw materials (i.e., wood, sand, ore, and chemicals)
- Converting operations that form packaging materials and containers
- Production operations whereby the package is filled, closed, sealed, and quality checked
- Unitizing or other preparations for distribution

- Distribution through channels, involving storage, handling, and transportation
- Emptying of packaging through product usage
- Disposal, reuse, or recycling of the packaging

Three important points concerning systems packaging are worth bearing in mind:

1. As with all systems, the individual components are linked.
2. The parties to the system are numerous and diverse
3. The packaging system itself is a component of the larger system of sourcing, manufacturing, and distributing products.

Functions of Packaging

The four functions of packaging are: (I) containment, (2) protection, (3) communication, and (4) utility. Those functions should be found in all types of packaging, regardless of the product or industry involved.

Containment refers to the package's ability to serve as a receptacle: to hold its contents.

Protection is the function that enables the packaging to shield its contents from various hazards imposed by handling, transportation, storage, and atmospheric conditions.

Communication is the function called upon to convey information and messages through the use of shape, size, color, graphics, symbols, and the printed word.

Utility is the function that facilitates the interaction between the package and those who come into contact with it. Features such as easy opening, re-closability, and convenient dispensing of the contents are examples.

Packaging Materials, Containers, Equipment, Machinery

Diversity is perhaps the best description of packaging materials, containers, equipment, and machinery. The industries are constantly challenging the packaging decision maker with new alternatives from which to meet his packaging objectives. The major groups of packaging materials are: Paper and paperboard, Metal, Glass, Plastics, Wood, Fabrics etc,

The major container categories are: Fiberboard boxes, Folding and rigid cartons, Cans, drums, and pails, Bottles and carboys, Bags, sacks, and pouches, Wooden crates and boxes, Racks, bins, and other durable containers.

Package Development

Package development is the procedural framework through which a package comes into existence. The package development process that is advocated consists of five basic steps: (I) gather information, (2) formulate requirements, (3) design, (4) test, and (5) improve the packaging.

STEP 1. Gather Information.

Successful package development is dependent on accurate and relevant information. Every major function within the company marketing, distribution, finance, manufacturing, engineering, and so on-has requirements and expectations of packaging. Package development should start by receiving the inputs of all concerned and affected parties.

Here are some suggestions for better managing the information gathering stage:

1. Formally establish the lines of communication between the packaging function and the other functions in the company that are served by packaging.
2. Develop comprehensive checklists to lend structure and organization to information gathering.
3. Start the information gathering process early. It is always advisable to pair package development with product development

STEP 2. Formulate Requirements.

The information gathered in step 1 is used to formulate packaging requirements. Requirements state what the packaging must do i.e. containment, protection, communication, and utility in order to eliminate the possibility of assigning packaging a task that it is not equipped to perform.

STEP 3. Design

The choice of materials and the design of packaging to meet requirements is the next logical step. More often, the package developer must choose among competing material and container alternatives.

The following points are important ant points to note at the design stage:

1. The final package is a compromise of many different (and often conflicting) requirements. The package that best meets a set of prioritized requirements must be chosen.
2. Design for simplicity.
3. Be aware of the possible pitfalls of innovation. If a product has a history of acceptance in a certain type of container, switching to a radically different container may cause problems in product recognition and product acceptance.

STEP 4. Test the Packaging

The purpose of testing is to determine packaging performance under specified conditions. These conditions should bear strong correlation to actual "field" conditions. Testing has gained importance as a result of increased government regulations, consumer concerns for product safety, and the costs associated with product loss and damage due to inadequate packaging.

STEP *5.* Improve the Packaging.

The last step is to improve the package in response to changes in information, requirements, materials, processes, regulations, consumer preferences, distribution channels, or a host of other factors.

The Concept of Standardization

Standardization is a highly important determinant of an efficient interface between packaging and materials handling. Standardization denotes an attempt to limit the amount of variability of the packaging. Standardized packaging refers to the physical characteristics of dimensions, shape, and weight, rather than the packaging material.

Packaging standardization takes two major forms:

1) Standardization of auxiliary handling devices (i.e., pallets, skids, slip sheets and durable containers) and

2) Standardization of the individual package (i.e., boxes and barrels) that are placed on or in the auxiliary handling devices.

An evolving trend is the computerized determination of standardized packaging.

Major Components of the Packaging and Materials Handling Interface

This section concludes by discussing the major components of the packaging and materials handling interface: labor, equipment, space, technology, and management.

Labor

The task of moving material throughout the flow cycles is still labor intensive. Labor, an expensive element of flow costs, can be reduced or made more efficient when packaging allows:

- the movement of a given quantity of material through a minimum number of individuals
- for fewer labor-related mistakes and facilitized performance in inspection, order picking, and inventory control activities.
- for the safe interaction with the human element.

a) Equipment

The manner in which equipment is chosen and acquired can affect a company's liquidity, profitability, and competitive position for a long time. The equipment issue, therefore, deserves careful analysis of many factors, not the least of which is packaging.

b) Trucks

The fork truck is inseparably associated with the pallet. There are many opportunities to improve the utilization of trucks with packaging and unitizing that better challenges the lift capacity of the trucks.

c) Conveyors

Packaging, in order to run efficiently on conveyors, must be conscientiously designed to do so. A package too small or too large for the conveyor on which it runs spells trouble. Likewise does a package too light to take the

inclines and declines that a conveyor route may take through a facility, or one too heavy for the drive mechanism that powers the conveyor.

d) Cranes and Hoists

Packaging handled by cranes and hoists must be suitable by providing the means for attaching the slings, for instance.

e) Space

Packages and unit loads occupy space-in storage and in transportation vessels. That truth should be reflected in the determination of what the packaging should be in terms of shape, size, and weight. Simply put, packaging and unitizing should be designed for the efficient use of cube.

f) Technology

Some of the newer technologies upon which industry is spearheading its productivity drive are directly related to the packaging and materials handling interface. Specifically: automated storage and retrieval, optical scanners, automatic guided vehicle systems, and robotics. Optical scanners, in addition to relying on the package to carry the machine-decipherable code, are influenced by the printing quality and contrast of the code, as well as the orientation of the package as it passes the code reader. Automatic guided vehicle systems transport unitized loads. Those loads should be secure, stable, and within stated dimensional limitations so that they do not tilt over, come apart, or otherwise prove incompatible with the method of handling. And robots can be programmed to palletize, load and unload shipping containers, and even perform package testing.

Management

The packaging field is dynamic. New materials, containers, and technology are the rule, not the exception. Here are some checklist items by which to evaluate the management of the packaging and materials handling interface:

- To what degree does the packaging for raw material received from your suppliers facilitate your operations of receiving, unloading, inspection, and movement to storage or production?

- To what degree do captive handling units (i.e., pallets, bins, trays, racks, and hoppers) facilitate in-process storage, inventory control, and production line feeding and out-feeding?
- To what degree does the packaging of the finished product facilitate labor, machinery, materials, and space used in assembling the packaging?
- To what degree does the packaging of the finished product facilitate storage, order picking, loading into transport carrier, and low transportation damage rates?
- To what degree does the packaging of the finished product facilitate your customers' receiving, unloading, inspection, storage, and production operations?
- To what degree does the packaging facilitate disposal, reuse, recycling, and so on?

4.11. Warehouse Management and Information

4.11.1. Warehouse Management

Warehouse management is the art of operating a warehouse and distribution system in an efficient manner. An efficient warehouse management represents an expert know-how having knowledge of the necessary processes, the technically and operationally feasible and successful implementation. (Hompel and Schmidt, 2007). Warehouse involves complex tasks of Receiving; Put away; Storage; Order Picking; Packing; Loading; Counting Stock; Value adding service; and other related activities. As a result, managers need to have a greater understanding of the various roles that warehouses can fulfill and how these affect the business and the supply chain as a whole. (Richards, 2011). Warehouse management has a critical part to play in supply chain management. Hence, it considers the longer strategic aspects of the business i.e. the expected development of the business in terms of the future production, product, suppliers, customers and all the associated product volumes and throughputs (Emmett, 2005).

Warehouse managers and their colleagues need to be better equipped to manage a constantly changing environment, and also need to work closely with their counterparts within their wider supply chains. (Richards, 2011). As one form of management, the conventional management functions of planning, organizing, leading and controlling are also applied in warehouse management. According to Richards (2011), some of the major activities of warehouse management are:

- ✓ Setting the long-term vision for the warehouse in line with the strategic plan;
- ✓ The provision of a responsive and cost-efficient warehouse that is aligned with the current and long-term requirements of the global business strategy;
- ✓ Continuously improving the cost efficiency of the operation;
- ✓ Leading and direction the warehouse team;
- ✓ Safeguarding the human and physical assets employed in the warehouse.
- ✓ Managing projects and introduction of new initiatives;
- ✓ Maintaining strong relation with suppliers;
- ✓ Developing and managing industrial relations with the warehouse environment.

Given the above mentioned activities expected to be performed, a warehouse manager faces the constraints of achieving a high customer-service levels while reducing cost through improved productivity and performance and lower inventory level and ensuring the safety and security of staff, equipment and stock, (Richards, 2011). Warehouse management involves activities of assessing the need for a warehouse, the appropriateness of the location/the place/ for the supply-demand balance, transport, labor and other activity, the level of productivity, the accuracy of communication, and the soundness of the layout plan so as to make important contribution to the decision making process (Emmett, 2005).

Operational Management is one of the key activities of warehouse management. Managing a large distribution requires consolidation of individual order, packing and dispatch. These operational activities need

to be planned at different levels to bring effective result. In the earliest stage, detailed workload planning is required to ensure the availability of sufficient equipment and human resource. In the medium and long term, capacity planning will be conducted to ensure that growth can be accommodated and seasonal peaks can be met at the required service levels. (Rushton, Croucher, Baker, 2006). Operational management is an ongoing process; it requires an ongoing revision and improvement so that the appropriate equipment, staffing, processes and technology match new requirements. (Rushton, *et al.* 2006)

The other key element of a warehouse management is Performance Monitoring. Continually measuring performance is essential to monitor process improvement since warehouse is the last link in the chain involving tight service and cost standards. (Rushton, *et al.* 2006). According to Rushton, *et al.* (2006), the typical kinds of performance indicators used to measure warehouse performance are:

Service Levels: Measures the percentage of orders completed on time, accuracy of order fill, stock availability, the number of outstanding back orders, damaged stock, returns and customer complaints.

Cost Effectiveness: It measures the effectiveness of the costs of staff, building and site, equipment and other resources, maintenance, packing materials and other consumables, and services including any bought-in-service.

Resource Utilization: It measures how effectively the warehouse facilities are being used. It can include utilization of storage facilities, the utilization and availability of handling equipment, and how much availability is lost through maintenance and breakdown.

Safety and the effective use of staff: This includes performance and productivity monitoring such as pick and pack rates and order fulfillment rates. It is also concerned with the monitoring of overtime and absence, the provision of necessary skills and safety training, safe working practices and environment, safety audits and hazard monitoring, identify potential hazards, assess the likelihood of accidents and identify action to eliminate risk.

Stock Integrity: It is concerned with the condition and security of inventory, including minimizing loss, damage and deterioration. Relevant factors can include the control of stock rotation on the basis of first in first out (FIFO), and the meeting of 'sell by' dates and shelf-life constraints.

Meeting Legal Requirements and Local Regulations: These are requirements relating to working environment and safety. Legislations on health and safety, manual handling, lift equipment, working hours and regulations on the products like food and hazardous goods affect warehouse operation. There are also codes of practice that give guidance on warehouse operation activities.

4.11.2. Warehouse Management Information

Information technology plays a very critical role in warehouse. The introduction of technology can significantly improve warehouse productivity, speed, accuracy, increase utilization, reduce costs and increase customer satisfaction. (Hompel and Schmidt, 2007; and Rushton, *et al.* 2006)

Currently, customers are demanding accurate, secure and fast data exchange, and receive instant replies to queries. Companies are now expected to communicate in real-time via electronic data interchange .A Warehouse Management system can be part of this solution. In addition, as the competition becomes more intense, companies need to have the information-technology tools to support the business and build reliability, speed, control and flexibility into the warehouse operation, (Hompel and Schmidt, 2007). Although companies operating with paper-based systems are able to introduce best practice into the warehouse, they can improve even further and become more productive by introducing software technology into the warehouse, (Hompel and Schmidt, 2007).

The potential benefits of having a WMS in place include the following:

- stock visibility and traceability
- accurate stock;
- reduction in mispicks and returns;
- automatic replenishments;

- accurate reporting;
- improved responsiveness;
- remote data visibility;
- improve customer service;
- real-time information and prioritization
- efficient and productive utilization of people and equipment;
- minimize paperwork
- efficient layout and product placement

Before choosing the right WMS, companies need to fully understand the current and the future needs of the company and the key business requirements. They should also keep in mind the company's strategy and ensure that the specific needs (of the company) are met by selecting the solution that best matches the business objectives, (Hompel and Schmidt, 2007). The solution can either be sourced internally by writing own software or in the case of obtaining the system externally; companies need to make sure to choose the right business partner to work with to develop the most effective solution (Hompel and Schmidt, 2007). Business Application Software Developers Association (BASDA) (2009) and Sage Accpac (2005) provide guidelines for selecting the right WMS (Hompel and Schmidt, 2007) These guidelines are:

- Form a project team;
- Define, record, review and improve current processes;
- Create a list of key functions required of the new system;
- Incorporate any future growth plans in your specification;
- List the benefits of a WMS to your company;
- Research and approach a select number of vendors and select a small number with experience of providing solutions for your market sector;
- Visit reference sites to look at operational effectiveness and discuss the benefits the WMS system has brought about since implementation;
- Produce a return on investment (ROI) report on the purchase and ongoing support of the WMS.

According to Hompel and Schmidt (2007), for WMS to be effective, it needs to have the attributes of the following kind:

→ *Ability to interface with other systems*
→ *Accessible*
→ *Ease of operation*
→ *Standard system*
→ *Meets specific needs*
→ *Capable of supporting warehouse best practice*
→ *Reporting capabilities*

Hompel and Schmidt (2007) provided the following rules that need to be followed before implementing new system:

→ Discuss with the business a suitable time to introduce a new system.
→ Agree a realistic implementation plan with the vendor and your project team.
→ Guarantee the availability of key staff during the implementation phase.
→ Propose deadlines you are confident in achieving.
→ Appoint super users from amongst your staff.
→ Develop a training agenda for all staff and include it in your new staff induction program.
→ Don't look to modify the system until it is in place and working as initially specified.
→ Keep reviewing the timeline and act on any slippage.

Summary of the chapter

Warehouse management is a key supply chain activity and involves complex tasks. It requires efficiency, expert know–how, technical and operational feasibility, cooperation and successful implementation. Operational Management and Performance Monitoring are some of the key activities in warehouse management. Operational management is critical to manage the vast operational activities of a warehouse. Performance Monitoring on its part is essential to monitor process improvement.

Materials handling is the provision of the right amount of the right material, in the right condition, at the right place, at the right time, in the right position, in the right sequence, and for the right cost, by using the right method(s). This is crucial for the success of businesses, projects and organizations in their endeavor to achieve goals, and comply with rules and regulations. For this, the design of a warehouse and handling system that involves a number of sequentially set design processes, storages and handling systems, the science and arts of order picking and replenishment ,materials receiving and dispatch, packaging and overall Warehouse management and information are discussed.

Order picking is also a key activity in warehousing, having an immediate impact on customer service and accounting for a major part of warehouse costs and operating staff numbers. Consequently, picking systems should be designed and managed with particular care. Necessary considerations are layout, materials/equipment involved and technology. Key indicators to be monitored for effective performance measure of picking productivity include accuracy of pick, completeness of order fill, timeliness of meeting dispatch deadlines, returns and customer complaints, and stock damage during picking.

Warehouse productivity can be significantly improved using information technology. Due to intense competition and customers' demand for accurate secure and fast information, companies need to have the information-technology tools in their warehouse operation. Choosing the right system has to be done with utmost care so as to bring effective solution.

CHAPTER-FIVE

TRANSPORTATION MANAGEMENT IN PROJECT

Objective of the chapter

At the end of this chapter, the learners will be able to:

- ✓ Identify factors to use the appropriate Modal choice
- ✓ Understand Maritime transport
- ✓ Know Air transport
- ✓ Conceptualize Rail and intermodal transport
- ✓ Identify the different factors for vehicle selection, vehicle costing and panning and resourcing

5.1. Introduction to logistics process

Definition of logistics: In today's complex commercial environment, with its ever-expanding global reach and a focus on process integration between business enterprises, it is hardly surprising that definitions associated with the term "logistics" have likewise evolved. The views of what constitutes the boundaries of the study and practice of logistics are varied.

One definition describes logistics as: The process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfillment or orders.

Modern logistics management will most likely evolve toward a greater use of highly focused and flexible cross-functional and cross-enterprise teams to accomplish its objectives. As a result of this trend, logistics management will receive top management attention, and occupy a strategic focus in the business enterprise. This is an important challenge for logistics management, as not all business enterprises have developed an integrated view toward the study and application of logistics. In this connection, Shipping, transport, and distribution in terms of supply chain management can be grouped under one heading: Logistics. Logistics planning involves not only the transportation side of distribution but also provides the "place element" in the marketing mix by helping to ensure that products arrive in sufficient quantities and in saleable condition at points from which the consumer can most easily buy them.

In assessing the real cost of transportation, you should be concerned with factors relating to reliability, time, and price. Decisions in choosing methods

of transport and distribution therefore will be based on “trade-offs” between these factors. Transportation costs are often peculiar in that they frequently bear little relation to distance. Competition and volume are the key factors in cargo pricing. All transport costs have increased, however, largely due to increased security operations.

Transportation management: is a subset of supply management chain concerning transportation operations. Transportation Management reduces transportation cost and increases delivery reliability through collaboration across all modes and providers.

There are many benefits of effective **transportation management** that manufacturers, distribution companies, and anyone who ships freight realize. An effective transportation management helps companies move freight from origin to destination efficiently, reliably, and cost effectively. Transportation management encompasses solutions for moving freight in all modes and also includes intermodal movements. The transportation management processes include freight transported inbound or outbound, domestically or internationally; using transportation assets owned either by the company or an outside service provider. The freight managed by a transportation management ranges in size from parcels to bulk commodities. There is a particular focus on the degree to which a transportation management can reduce freight spend. Several methods can be used to reduce freight spend, with the different "savings buckets" having different levels of savings.

5.2. Modes of Transportation

Diversity of Modes: Transport modes are the means by which people and freight achieve mobility. They fall into one of three basic types, depending on over what surface they travel – land (road, rail and pipelines), water (shipping), and air. Each mode is characterized by a set of technical, operational and commercial characteristics:

- **Road transportation**. Road infrastructures are large consumers of space with the lowest level of physical constraints among transportation modes. However, physiographical constraints are significant in road construction with substantial additional costs to overcome features such as rivers or rugged terrain. Road transportation has an average operational flexibility as vehicles can serve several purposes but are rarely able to move outside roads. Road transport systems have high maintenance costs, both for the vehicles and infrastructures. They are mainly linked to light industries where rapid movements of freight in small batches are the norm. Yet, with containerization, road transportation has become a crucial link in freight distribution.

- **Rail transportation**. Railways are composed of a traced path on which wheeled vehicles are bound. In light of more recent technological developments, rail transportation also includes monorails and maglev. They have an average level of physical constrains linked to the types of locomotives and a low gradient is required, particularly for freight. Heavy industries are traditionally linked with rail transport systems, although containerization has improved the flexibility of rail transportation by linking it with road and maritime modes.
- **Pipelines**. Pipeline routes are practically unlimited as they can be laid on land or under water. Physical constraints are low and include the landscape and pergelisol in arctic or subarctic environments. Pipeline construction costs vary according to the diameter and increase proportionally with the distance and with the viscosity of fluids (from gas, low viscosity, to oil, high viscosity).
- **Maritime transportation**. Because of the physical properties of water conferring buoyancy and limited friction, maritime transportation is the most effective mode to move large quantities of cargo over long distances. Main maritime routes are composed of oceans, coasts, seas, lakes, rivers and channels. Maritime transportation has high terminal costs, since port infrastructures are among the most expensive to build, maintain and improve. High inventory costs also characterize maritime transportation. More than any other mode, maritime transportation is linked to heavy industries, such as steel and petrochemical facilities adjacent to port sites.
- **Air transportation**: Air routes are practically unlimited, but they are denser over the North Atlantic, inside North America and Europe and over the North Pacific. Air transport constraints are multidimensional and include the site (a commercial plane needs about 3,300 meters of runway for landing and takeoff), the climate, fog and aerial currents. Air activities are linked to the tertiary and quaternary sectors, notably finance and tourism, which lean on the long distance mobility of people. More recently, air transportation has been accommodating growing quantities of high value freight and is playing a growing role in global logistics.
- **Pipeline Transportation for oil and gas:** petroleum products and the other major products like natural Gas are transported by pipeline. Pipelines transportations are owned and operated by private business enterprises. Unlike other modes, there is no empty container that must be returned. Pipelines have the highest fixed cost and lowest variable cost among transportation modes. High fixed costs result from the right of way for pipelines, construction, and other requirements for safety and control.
- **Intermodal transportation**: Concerns a variety of modes used in combination so that the respective advantages of each mode are better exploited. Although intermodal transportation applies for passenger movements, such as the usage of the different, but interconnected modes of a public transit system, it is over freight transportation that the most significant impacts have been observed. Containerization has

been a powerful vector of intermodal integration, enabling maritime and land transportation modes to more effectively interconnect.

5.2.1. Project Transportation Modal choices:

The choice of transport mode is probably one of the most important classic models in transport management. The different transport mode characteristics need to be understood and assessed. Clearly, some transport modes are more suitable to certain types of operational requirements than are others. A series of consignment factors also need to be addressed to ensure that the particular choice of mode is appropriate. For example, an urgent order or consignment should be moved via a fast transport mode. Finally, there is the ever-present and important logistics trade-off between cost and service that needs to be included in the selection process.

General factors to be considered: There are a large number of associated operational factors that need to be considered as a part of the modal selection process. These have been categorized as:

- Those that is external to the direct distribution operation,
- Customer characteristics that need to be taken into account,
- Physical product characteristic and other logistic component.

External factors: Encompassing the many operational factors that may need to be considered are those that are external to direct distribution-related factors. These are particularly relevant when contemplating the international context of modal choice, because from country to country these factors can vary significantly. They include:

The basic infrastructure in the country: Trade barriers: these might include, for example, customs duty, import tariffs or quota payments. These can have a big impact on the overall cost of a product.

Export controls and licenses: with these, there may be implications for the quantity of product that can be shipped in given periods of time.

- Law and taxation
- Financial institutions and services, and economic conditions.
- Communications systems.
- Culture.
- Climate.

Customer characteristics: The main characteristics to take into account are:

- Service level requirements: This may occur when there is a need for delivery to be at a certain time or on a certain date, or when a specific time delivery window is stipulated.
- Delivery point constraints: refers particularly to the physical aspects of delivery, including the location of the delivery point. any access constraints concerning the size of vehicle that can make the delivery and any equipment requirements for unloading.
- Credit rating: The credit rating of a customer may help to impose a limit on route selection and modal choice. New customers and existing customers with a poor credit rating mean that a company will want to be sure that payment is confirmed before delivery is made
- Terms of sale preference: There are a number of different terms of sale that can be used, ranging from ex works (at the supplier factory) to delivered duty paid (at the customer's delivery point).
- Order size preference:
- Customer importance: Most suppliers have 'A' rated customers who are deemed to be their most important and who really must be given a delivery service that does not fail.
- Product knowledge: Some products or orders may necessitate some knowledge transfer to the customer at the time of delivery.

Physical nature of the product: The main factors that need to be considered include:

- Volume to weight ratio
- Value to weight ratio
- Substitutability (product alternatives, etc)
- Special characteristics (hazard, fragility, perishability, time constraints, security).

Other logistic components that might affect route and modal choice may include:

- Supply points: The location of raw material or component suppliers will clearly impact on route and modal choice.
- Production plants: The location of manufacturing and production plants will impact on route and modal choice.
- Warehouse and storage facilities.
- Depots: Inventory and stockholding policy will usually determine where depots are located. The location of depots with respect to their supply points (usually production or warehouse facilities) in terms of distance and geography will have an impact on the choice of transport mode.
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Maritime Transportation

Of the world's international trade 90 per cent is transported by sea. The customs and practices associated with this form of transport have been refined over centuries of worldwide trade. Sending cargo by sea is ideal for high-volume cargoes that are not necessarily time sensitive or have long lead times for delivery. However, this mode of transport is slow and fraught with possibilities for delay. The use of shipping containers has revolutionized the way that cargo is handled and transported.

Structure of the industry

Liner conferences: Liner conferences are formal groups of shipping lines that operate on certain shipping routes that bring together all lines operating in a specific geographic zone. They were first set up to control the trade between colonial powers and their colonies in the 1870s. Today they are seen by many as being a controversial anachronism as they work together to agree tariffs for certain routes. They work fundamentally for the interests of the member shipping lines to help to avoid destructive price competition (as they see it). For their part the shipping lines would argue that there would be much more price and capacity volatility without the stability that the liner conferences provide. The shipping lines have invested huge amounts of capital in the ships themselves and the conference system provides a way of managing forward revenue streams.

Shipping lines: They own and operate the various types of ships in their fleets. Their role is to provide the physical means by which cargo may be safely and efficiently transported by sea.

Ships' agents

They provide services to the shipping lines in the ports where the ships call. A ship's agent will deal with many important and diverse matters on behalf of the shipping line. These services may include: provisioning with food and spare parts; arranging any necessary repairs for the ship; dealing with local port and customs authorities; organizing berths, pilots, tugboats (if required), crew change and refuelling.

Freight forwarders

Often referred to as freight management companies, these days their role is to oversee and manage the movement of the freight from the point of origin

to the point of destination. Freight management companies provide integrated door-to-door solutions for their customers that may include arranging different modes of transport, customs clearance and documentation, arranging port handling and generally supervising all aspects of the movement. In order to do this effectively they usually have worldwide networks of offices, and agents in many countries.

Advantages and disadvantages of Water / Maritime Transportation

Advantages: Can handle very large quantities of bulk commodities and raw materials; relatively low cost per pound

Disadvantages: Limited shipping and receiving points

Seasonal limitations on inland waterways

Slow speed

Potential for natural disasters

Typically requires motor or rail carrier for pickup and delivery

AIR TRANSPORT

Air transport is the mode where freight and passengers are most integrated. Due to the very particular requirements associated with the air cargo business it has developed methods of operation that are unique in the world of logistics. These tend to be most noticeable in the field of cargo handling due to the restrictions imposed by the aircraft themselves. The whole area of safety of operation and security from terrorist attacks significantly impacts the business. The use of air freight as an alternative transport mode has grown rapidly in recent years. Major developments in the areas of integrated unit loads, improved handling systems and additional cargo space, together with the proliferation of scheduled cargo flights, have increased the competitiveness and service capability of air freight.

The major attributes of air freight are as follows:

- ✓ Air freight compares very well with other transport modes in terms of speed over longer international movements. This is because it has very rapid airport-to-airport transit times over these longer distances.
- ✓ Although air freight is very quick from airport to airport, there can be occasions when this speed factor is diminished because time can be lost due to airport congestion and handling, paperwork and customs delays.
- ✓ One particular advantage of air freight is known as 'lead-time economy'. The ability to move goods very quickly over long distances means that it is unnecessary to hold stocks of these items in the countries in question (spare parts, etc). The short lead time required between the ordering and receiving of goods, and the resultant saving

in inventory holding costs give this benefit its name of 'lead-time economy'.

- ✓ The air freighting of products allows for a great deal of market flexibility, because any number of countries and markets can be reached very quickly and easily. This is particularly advantageous for a company that wishes either to test a product in a given area or to launch a new product. The flexibility of air freight means that a company need not necessarily set up extensive stockholding networks in these areas.

- ✓ The movement of goods by air freight can result in a marked reduction in packaging requirements. As a general rule, the air freight mode is not one that experiences severe physical conditions, and so its consignments are not prone to damage and breakages.
- ✓ Air freight transport is very advantageous for certain ranges of goods, compared to many of the alternative modes. This includes those commodities with high value to weight ratios (a lot of money is tied up, therefore an expensive freight on-cost is not significant), perishables (where speed is vital), fashion goods (which tend both to be expensive and to have a short 'shelf life'), emergency supplies (speed again is vital) and finally spare parts (the lack of which may be holding up the operation of a multimillion-pound project).
- ✓ For the vast majority of products, air freight is a very expensive form of transport. This is by far its greatest disadvantage. In some instances, and for some products, cost is of very little consequence, and it is for these types of goods that air freight tends to be used.
- ✓ Air freight has suffered to a certain extent due to security concerns. This is one reason for the increasing trend towards all-freighter aircraft, rather than freight being carried in the belly hold of passenger aircraft (which has generally been the predominant means of air freight).

Air freight pricing

All space on aircraft is limited by not only the total volume of space available inside the cargo hold but also by the size of the access doors and payload restrictions. In addition, the shape of the fuselage also presents challenges for the load masters. Another factor relates to the reality that a large volume of air cargo is carried by passenger aircraft and therefore air cargo may be left off the aircraft due to other priorities such as passenger baggage or balancing the loading of the aircraft for safety reasons. Therefore, air freight is generally the most expensive mode of transport that may be used, when costs per tonne are compared for the same journey using different transport modes between origin and destination. This becomes obvious when it is noted that air freight is generally quoted in costs per kilogramme as compared to road, rail and sea-freight costs, which generally refer to

tonnage. The principles by which air freight prices are calculated can be a little confusing to those who are not directly related to the process.

Air cargo security

The major risks associated with air cargo security and air industry security in general may be summarized as:

- The placing of explosive or incendiary devices inside air cargo prior to being loaded on the aeroplane.
- The undeclared or undetected transport of hazardous material on board an aircraft.
- The possibility of smuggling contraband goods inside air cargo.
- Theft from air cargo.
- Hijackings of aircraft or sabotage by people with access to the aircraft.

These risks may be limited by implementing or improving:

- ✓ Cargo screening and inspection.
- ✓ Improving the physical security of air cargo facilities.
- ✓ 'Known shipper' programmes.
- ✓ Improving staff security training.
- ✓ Restricting access to aircraft and air cargo facilities.
- ✓ Use of the latest air cargo security technology such as tamper-proof seals, blast-resistant hard-sided air cargo containers, biometric data for personnel working with air cargo, and improved air cargo screening systems.

Rail and intermodal transport

Undoubtedly the introduction of unitized loads in the form of International Standards Organization (ISO) containers and pallets revolutionized the movement of freight from the 1960s onwards. A number of ISO recommendations helped the standardization of containers and therefore allowed for interchangeability between different modes of transport around the world:

- ✓ R-668 in January 1968 defined the terminology, dimensions and ratings.
- ✓ R-790 in July 1968 defined the identification markings.
- ✓ R-1161 in January 1970 made recommendations about corner fittings.
- ✓ R-1897 in October 1970 set out the minimum internal dimensions of general-purpose freight containers.

These standards allow the same container to be safely carried by truck, train, deep-sea cellular container ship and aircraft. It should be noted that aircraft have their own special form of shipping container known as unit load devices (ULDs). This removes the requirement for multiple handling of the products, improves security, reduces loss and damage and above all speeds up the whole process of freight transportation. Containers of freight move around the globe with an ease that could only have been dreamt of at the start of the 20th century. It is said that as much as 90 per cent of all international shipments are carried inside containers. This ability to move freight swiftly and safely aids the logistics process, as the elimination of

wasted time is a key objective of logistics management. Containers also have another benefit in that they can be traced through the transport system and their progress monitored.

Intermodal equipment

The following section provides an overview of the various types of equipment specifically used in intermodal transport. The list is not exhaustive but the most common equipment will be identified and described briefly.

Intermodal containers

ISO containers: ISO containers are so called because the ISO has standardized the design of containers to allow for the widest possible use of this equipment around the world. Containers are usually rectilinear boxes constructed of steel. Open-topped versions, which are covered by a fabric curtain, are available for loads that may not fit into a standard container or need to be lifted in from the top. Another common variation is the tanktainer, which is a steel frame that conforms to the ISO dimensions but has a tank container fixed inside the frame. This allows bulk loads of liquids or powders to be carried by intermodal carriers. Refrigerated and flat-rack options are also available.

The most common sizes of container available are 20 feet, 40 feet and 45 feet in length. The height and width dimensions are the same for all lengths at 8 feet wide by 8 feet 6 inches high, although high-cube containers at 9 feet 6 inches high are becoming increasingly common. As with most rules, exceptions do exist, but these are the most commonly used dimensions.

Two acronyms used widely in intermodal circles are TEU and FEU. The initials stand for '20-foot equivalent unit' and '40-foot equivalent unit'. They are often used as definitions of cellular container ship capacities. A ship may be described as being able to carry 6,000 TEU. The 20-foot equivalent unit refers to the 20-foot container. Therefore, two 40-foot containers would equal four TEU or two FEU.

The swap-body: This is a type of container used primarily on bimodal intermodal operations, which use the road and rail modes of transport. The swap-body is a self-supporting body that has supporting legs that may be folded away when not required. Swap-bodies conform to different international standards. There are three standard lengths of 7.15 metres, 7.45 metres and 7.82 metres. These lengths are used because the swap-body will be carried by road transport for part of its journey and must conform to the strict requirements pertaining to vehicle dimensions inside the EU.The swap-body is transferred from road vehicle to rail wagon by means of an overhead straddle crane, which has four arms that locate into slots permanently fixed to the bottom of the swap-body.

A further version of the swap-body is the caisse mobile. This is 12 metres or 13.6 metres long, which conforms to EU dimensions for articulated semi-

trailer lengths. Caisse mobiles do not usually have self-supporting legs but very often are able to be top-lifted in the same way as ISO containers. Unlike ISO containers, most swap-bodies cannot be stacked.

RoadRailer: RoadRailer is the brand name for a method of effectively converting a road-going articulated semi-trailer into a rail-going rail wagon. This is achieved by placing a railway bogie under the rear of a specially designed road semi-trailer. This same bogie attaches itself to the kingpin of the following road trailer (see Figure 26.2). This process is repeated until the train is complete. The road wheels of the semi-trailer are mechanically retracted to prevent them from interfering with the movement of the train. This system does not require specially adapted rail wagons and allows for a more rapid transfer of vehicles from road to rail. It does require that the road vehicles are specially designed for the purpose.

Unaccompanied trailers: Unaccompanied road semi-trailers may be used to send goods by roll-on roll-off sea ferry (RORO). This method does not require any adaptation of the road trailer and avoids the added cost of sending the tractive unit and driver with the trailer. This is important, as tariffs on shipping services usually relate to the length of the vehicle. Therefore, unaccompanied trailers will be shorter and cheaper. The unaccompanied trailers are moved on and off the ferry by means of a motive unit (often called a tug) fitted with a hydraulic mechanism for attaching to the front of the trailer and lifting the semi-trailer without the need to raise the landing legs. This speeds up the operation at both ports.

Another effective use of unaccompanied trailers is called piggyback. This uses the same principle as the road–sea version but applies the principle in a road–rail context. In this situation, unaccompanied semi-trailers are carried on specially constructed rail wagons. Because articulated road semi-trailers tend to be higher at the front than at the rear, a specially constructed well in the rail wagon allows the landing legs to sit at a lower level than the rear wheels. This has the effect of making the trailer sit on the rail wagon with the roof at an overall even height to the ground. The French have dubbed this method 'le kangarou' because of the well being likened to a kangaroo's pouch.

The problems caused by the landing legs and the road wheels are effectively overcome by a relatively recent development known as the spine rail wagon. In this system road trailers are loaded on the rail wagon with the road wheels and landing legs either side of a central spine on the rail wagon. This allows the semi-trailer to sit squarely on the rail wagon and reduces the overall height. The spine wagon is also able to carry ISO containers. In Figure 26.3, the twist locks for securing ISO containers are visible, which demonstrates the versatility of the system.

These methods of unaccompanied transport have been in use for some time and are not always thought about when intermodal transport is discussed. However, they do fit the strict definition of intermodal transport given above and use effectively the road, rail and sea modes.

Intermodal handling equipment

Ship to shore gantry crane (SSGC): These are large devices mounted on rails, which are able to speedily transfer containers from the sea-going vessel to trucks or rail wagons (see Figure 26.4). A large boom spans the distance between the ship's cargo holds and the quayside. The ship to shore gantry crane is capable of moving along the quayside parallel to the ship's side to aid positioning.

Gantry (or portal) crane: Sometimes referred to as a straddle carrier, this is a crane designed to lift containers and swap-bodies. It has four legs, one at each corner, with wheels at the bottom of each leg. It has the ability to straddle rail wagons and road vehicles. It is able to transfer containers and swap-bodies quickly from road vehicles to rail wagons and vice versa. It is equipped with a spreader beam that has a twist-locking device at each corner, which locates in the corner casting of the container. The spreader beam is able to move in several directions to aid accurate location either of the spreader beam prior to picking up the container or when positioning the container on a road vehicle or rail wagon.

Grappler lift

This is a similar handling vehicle to the gantry crane except that it is fitted with four arms and is designed specifically to handle swap-bodies. The arms locate in the special slots built into the bottom of every swap-body. The grappler lift straddles the vehicle, positions the four arms and then lifts the swap-body.

Reach stacker

This is a heavy-duty material handling truck that is fitted with a lifting arm and a spreader beam. It is capable of lifting containers and swap-bodies (only if the swap-body is equipped with twist locks on top). It can be used to load and unload road and rail wagons. It can also be used to stack containers one on top of the other and to reach over a row of stacked containers. Empty containers can be stacked up to eight high using specially equipped lift trucks.

Intermodal vehicles: ***Sea***

The cellular container ship: This is a custom-built sea-going vessel for the carriage of containers. The containers are loaded one on top of the other and guided into position by the means of vertical guides at each corner of the container. This aids the process of loading, as the guides position the container accurately enough to preclude the need for any further manoeuvring once the container is released by the overhead crane. It also eliminates the potential problems caused by the vessel listing or the crane not being accurately positioned. Once in position, the containers are secured together by means of a twist-locking device. The stacks of containers are also secured by means of deck lashings for added stability during the sea journey.

Containers may be stacked four or more high above deck level. This ability is limited by the structure and stability of the vessel. Owing to the cubic nature of the container load, which is at odds with ship design, some vessels carry other cargo in the spaces in the holds created by the squaring-off effect. The service provided by these vessels is sometimes referred to as LOLO (lift on lift off).

The roll-on roll-off (RORO) ferry: This type of sea vessel is designed to carry road vehicles. The vehicles are either driven on to the vessel by the driver or, as in the case of unaccompanied trailers, by port-based vehicles. This allows unaccompanied vehicles or trailers to be delivered to the port of departure and then collected from the port of arrival. Other versions of the roll-on roll-off ferry are specifically designed to carry rail wagons. The decks of these vessels are equipped with railway lines to allow ease of loading rail wagons.

River barges: On large inland waterways such as the Rhine/Danube in Europe and the Mississippi River in the United States, there is considerable use made of water as an artery of transportation. Roll-on roll-off facilities and container transport as well as break-bulk cargo facilities are available and cannot be forgotten when considering long journeys using different modes of transport. This type of transport is useful for non-urgent freight, as it is by definition slower than other modes.

Rail: It should be noted that a movement of freight that uses both road and rail to complete the journey is sometimes referred to as combined transport.

Rolling motorway: This is the rail version of the roll-on roll-off sea ferry. Vehicles are driven on to specially designed rail wagons by their drivers. In some cases the drivers stay with their vehicles and in others they are accommodated in a passenger car for the duration of the journey. This type of system is used in Switzerland to carry trucks between Germany and Italy. Another use of this system is in the Channel Tunnel between the UK and France, where it is known as Le Shuttle.

Double stacking: In some parts of the world, such as the United States and Australia, containers may be carried by rail double stacked, ie one container loaded on top of another (see Figure 26.5 above). This method greatly improves utilization of equipment, especially over the very long distances found in these countries. This method is not practical in the EU due to the restrictive loading gauges.

Multifret wagon: This is a specially designed low-platform rail wagon for use by intermodal trains using the Channel Tunnel.

Ferrywagon: This is a conventional rail wagon that is capable of being loaded on to a train ferry.

European rail containers: These containers are slightly wider than ISO containers, which are 2.4 metres wide. These containers are 2.5 metres wide and are used in the European rail system.

Skeletal trailer: This is an articulated semi-trailer that is designed to carry ISO containers. It is fitted with twist locks at various points on the trailer to allow the carriage of different sizes of container. It is called a skeletal trailer, as it does not have any loading platform as such. It is a framework designed to support containers alone. In effect, the container becomes the body of the vehicle when loaded on to the trailer. Some skeletal trailers are equipped with hydraulic rams to facilitate the tipping of the container. Some granular and powder products may be carried in ISO containers. The product is loaded through the top of the container via a special hatch, and the product is retained by means of a plastic liner inside the container. At the point of delivery the container is tipped up by the hydraulic ram and the product is allowed to flow out of another hatch set in the rear of the container. In some cases this process is assisted through the use of pneumatic conveyance.

Extendable trailers: These trailers are sometimes called 'slider' trailers because of their ability to be extended or shortened depending on the size of the container to be carried. In all other respects they resemble skeletal trailers.

Intermodal infrastructure: The EU and the UK government are committed to the promotion of intermodal transport. They see the removal of certain types of cargo from the EU's roads as an environmentally sound policy. The reduction of road congestion, improvements to urban environments and reduction of harmful gaseous emissions from road vehicles are the objectives. Consequently, considerable investment is being made in intermodal infrastructure.

The Channel Tunnel: The fixed link between the UK and France has opened up new possibilities for the movement of freight by rail. Various distances are cited by railway economists for the point at which movements by rail become profitable. One thing is clear, that rail freight has a greater chance of being profitable if longer distances and full train loads are involved. The Channel Tunnel has opened up the possibilities for much longer journeys into continental Europe. Significant amounts of intermodal traffic pass through the fixed link every day, chiefly accompanied vehicles by Le Shuttle mentioned above but also swap bodies and containers by through trains from and to inland destinations (eg from the Midlands of England directly through to Italy).

Mode shift grant schemes:

Mode Shift Revenue Support Scheme (MSRS): The MSRS scheme provides the financial support to assist companies with the operating costs associated with rail and inland waterway freight transport in place of road.

However, this only applies in a situation where using the rail or inland waterways are more expensive to operate than the road alternative.

Waterborne Freight Grant Scheme (WFGS): This scheme helps companies for a period of up to three years with the costs of operating coastal and short sea-shipping freight transport instead of using road freight but only where coastal and short sea-shipping freight is more expensive than road freight.

Rail transportation-Advantages and disadvantage: There have been many recent developments in rail freight systems, especially the development of intermodal containerized systems using ISO containers as the basic unit load and the introduction of the swap-body concept of transferable road–rail units.

Advantages of Rail Transport

- More conventional rail freight systems have the major benefit of being a relatively cheap form of transport. This is particularly true for bulky and heavy consignments that require movement over medium to long distances and where speed is not vital.
- High average speeds for journeys in the range of 50 to 300 miles.
- Rail in the majority of cases runs from city centre to city centre, which can cut journey times.
- The railway effectively utilizes land space. Over any strip of land of a given width, the railway can carry more passengers and freight than any other land-based system.
- The general public perceive railways as being less environmentally adverse than other forms of transport, both visually and as regards physical pollution.
- The bulk-handling capacity of the railway means they are very cost effective when handling bulk materials in coupled train loads thus relieving the road system of large numbers of heavy trucks.
- The railways are energy flexible and energy efficient. The use of electric traction relieves the railway of reliance on oil for energy.
- The safety record of railways is good, especially for the carriage of hazardous cargo.
- There is great scope for the full automation of the rail network, including the possibility of driverless trains.
- Of all the land-based modes of transport the rail system is the least affected by bad weather.

The principal disadvantages of conventional rail freight are as follows:

- Rail wagons are prone to some very severe shocks as they are shunted around goods yards. Shunting shocks can cause damage to products. To overcome this, costly packaging needs to be used.
- There is a need to double-handle many loads because the first and last leg of a 'through' journey often needs to be by road transport.
- There are a limited number of railheads available at factories and depots, making direct origin-to-destination journeys very rare. Few companies now have railway sidings on their premises due to their high cost of upkeep and operation.
- In general, rail transport is a very slow means of carriage – particularly when the whole journey is taken into account. Many freight trains have to fit their schedules around passenger trains, which take priority. This can cause significant time delays to the rail freight.
- Rail freight transport can be very unreliable. Batches of wagons may arrive at irregular intervals. This can cause further delays for international traffic if a complete shipment is on a single customs document.
- For international movements, there are significant compatibility issues (especially across Europe). These include variations in track gauge sizes, bridge heights and (lack of) electrification.
- The financial viability of any rail network is vulnerable to downturns in economic activity. In recessionary times, the volume of traffic using the system may reduce sharply whereas the fixed costs of operating the infrastructure will remain.
- As the railway has a fixed and therefore inflexible infrastructure it is economically vulnerable to major changes in the industrial and social activity of a given geographical area.
- The railways suffer from the need to trans-ship from rail to other modes of transport for some part of the journey. The result is that rail is efficient over longer journeys when the costs of trans-shipment can more easily be absorbed and where the time element may be less significant.
- As a labour-intensive and often unionized industry any rail network is susceptible to industrial action. Where industrial disputes occur regularly and with little warning this has the effect of discouraging clients from using these services.

Railways are composed of a traced path on which wheeled vehicles are bound. In light of more recent technological developments, rail

transportation also include monorails and maglev. They have an average level of physical constrains linked to the types of locomotives and a low gradient is required, particularly for freight. Heavy industries are traditionally linked with rail transport systems, although containerization has improved the flexibility of rail transportation by linking it with road and maritime modes.

Most rail systems improved passenger and freight services. Where both segments are maintained the railways give priority to passengers, since rail persists as the dominant mode for inter-city transport in much of the developing world. In Europe the national rail systems and various levels of government have prioritized passenger service as a means of checking the growth of the automobile. Significant investments have occurred in improving the comfort of trains and in passenger rail stations, but most notable have been the upgrading of track and equipment in order to achieve higher operational speeds. Freight transport has tended to lose out because of the emphasis on passengers since such systems were optimized for passenger flows. Because of their lower operational speeds, freight trains are frequently excluded from day-time slots, when passenger trains are most in demand. Overnight journeys may not meet the needs of freight customers. This incompatibility is a factor in the loss of freight business by most rail systems still trying to operate both freight and passenger operations.

Intermodal transportation

Intermodal transportation may be defined as the transportation of a person or a load from its origin to its destination by a sequence of at least two transportation modes, the transfer from one mode to the next being performed at an intermodal terminal. The concept is very general and thus, it means many things to many people: transportation of containerized cargo by a combination of truck, rail, and ocean shipping, dedicated rail services to move massive quantities of containers and trailers over long distances, main transportation mode for the international movement of goods, central piece in defining transportation policy for the European Community, trips undertaken by a combination of private (e.g., car) and public (e.g., light rail) transport, and so on. One must therefore start with a few definitions to set the terminology. In one of its most widely accepted meanings, intermodal freight transportations refers to a multi-modal chain of container - transportation services. This chain usually links the initial shipper to the final consignee of the container (so-called door-to-door service) and takes place over long distances. Transportation is often provided by several carriers. In a classical example of an inter-continental intermodal chain, loaded containers leave a shipper's facility by truck either directly to port or to a rail yard from where a train will deliver them to port. A ship will move the containers from this initial port to a port on the other continent, from where they will be delivered to the final destination by a single or a combination of "land" transportation means: truck, rail, coastal or river

navigation. Several intermodal terminals are part of this chain: the initial and final sea-port container terminals, where containers are transferred between the ocean navigation and land transportation modes, as well as in-land terminals (rail yards, river ports, etc.) providing transfer facilities between the land modes. Container transportation is a major component of intermodal transportation and international commerce . Intermodal transportation is not only about containers and inter-continental exchanges, however. On the one hand, a significant part of international trade that is moved in containers does not involve ocean navigation, land transportation means providing the intermodal chain. On the other hand, other types of cargo may be moved by a chain of transportation means and require intermodal transfer facilities,

Container Intermodal Transportation

Although intermodal transportation applies for passenger movements, such as the usage of the different, but interconnected modes of a public transit system, it is over freight transportation that the most significant impacts have been observed. Containerization has been a powerful vector of intermodal integration, enabling maritime and land transportation modes to more effectively interconnect.

Container systems can be viewed as a specialized mode of freight transport, although the container is now a fundamental feature of all the major national and international transport modes – road, rail, sea and air. Containerization makes possible the development of what is known as the 'intermodal' system of freight transport, enabling the uncomplicated movement of goods in bulk from one transport mode to another .

The main attributes of containers and container systems are as follows:

•They enable a number of small packages to be consolidated into large single unit loads.

•There is a reduction in the handling of goods, as they are distributed from their point of origin to their point of destination.

•There is a reduction in individual packaging requirements, depending on the load within the container.

•There is a reduction in damage to products caused by other cargo.

•Insurance charges are lower due to the reduced damage potential.

•Handling costs at the docks and at other modal interfaces are reduced.

•There is a quicker turnaround for all the types of transport used. Port utilization also improves.

•The all-round delivery time is speedier, and so raises service levels.

•Documentation is simpler.

•The concept of 'through transit' becomes feasible, and allows for a truly integrated transport system to be developed.

•In the early days of containerization, the systems that were developed tended not to be well integrated across the different transport modes. This has considerably improved in recent years.

•There is a need for special facilities and handling equipment, and these are very costly. Thus, there are a limited number of transfer points available.

•The initial cost of the containers themselves is very high.

•The return of empty containers can often be an expensive problem. Trade is seldom evenly balanced, so return loads may not be available.

•Containers may leak, thereby causing damage due to rain or seawater.

•Loads may be affected by their position of stow, eg above or below deck.

There are three main conditions that insure that some modes are complementing one another:

•Different geographical markets. It is clear that if different markets are involved, modes will permit a continuity within the transport system, particularly if different scales are concerned, such as between national and international transportation. This requires an interconnection, commonly known as a gateway, where it is possible to transfer from one mode to the other. Intermodal transportation has been particularly relevant to improve the complementarity of different geographical markets.

•Different transport markets. The nature of what is being transported, such as passengers or freight, often indicates a level of complementarity. Even if the same market area is serviced, it may not be equally accessible depending of the mode used. Thus, in some markets rail and road transportation can be complementary as one may be focusing on passengers and the other on freight.

•Different levels of service. For a similar market and accessibility, two modes that offer a different level of service will tend to complement another. The most prevailing complementarity concerns costs versus time

Road freight transport: vehicle selection

To make the most appropriate choice of vehicle for a vehicle fleet, there are a number of aspects that need to be considered. Vehicle selection decisions should not be made in isolation. It is essential that all the various aspects should be considered together before any final conclusions are drawn. There are three primary areas that need to be carefully assessed – efficiency, economy and legality.

- **Efficiency:** in this context, means the most effective way to do the job, based on a number of important factors. The truck should be fit for purpose. These factors might include:

    - The nature of the operation, ie annual mileage, the terrain, climate, etc;
    - The characteristics of the load, ie physical features, weight, etc;
    - The specification of the vehicle, ie engine, gearbox, axle configuration, body, etc.

- **Economy:** the area of economy is concerned with the purchase price and operating costs of different choices of vehicle. There are a number of points that should be taken into account. These should be analyzed and compared with the costs and performance of the various alternative vehicles. The main points concerning economy are:

    - The fixed cost of a vehicle, ie depreciation, licenses, insurance, etc;
    - The variable cost of a vehicle, ie fuel, tires, maintenance, etc;
    - The residual value of a vehicle (some types of uncommon vehicle do not have good resale values);
    - The whole life costs of the vehicle, ie a calculation of the above cost over a given life of the vehicle;
    - Utilization factors, ie fuel efficiency, other costs per mile/kilometre, etc;
    - Vehicle acquisition, ie outright purchase, contract hire, lease, etc.

- **Legality:** the third and final area for consideration in vehicle selection is that of legality. This emphasizes the need to ensure that vehicles are selected and operated within the existing transport legislation. Transport law is complicated and ever-changing, so constant awareness is imperative. The major factors concern:

    - Operator's licenses;
    - Construction and use regulations;
    - Weights and dimensions of vehicles;
    - Health and safety features, ie seatbelts, handrails, walkways, etc;

- Mandatory environmental features, ie airbrake silencers, emission controls, etc.

It has been said that vehicle selection should consider the various aspects in detail. Here come those aspects of vehicle selection that relate to the physical effectiveness of the vehicle for the particular job in hand.

Main vehicle types

There is a variety of vehicle types. It is important to be clear as to the precise definition of each type. There are two main reasons why these definitions have been outlined so carefully. The first is to provide a clear definition of the main types of vehicle available. The second is to differentiate between vehicle types for the purpose of interpreting some of the legal requirements for transport. A goods vehicle is a vehicle or a trailer adapted or constructed to carry a load. The term covers all such vehicles, but there are also distinct definitions that relate to the different weights of goods vehicles.

A trailer is a goods vehicle that is drawn by a motor vehicle. There are two main types of trailer: 1) a draw-bar trailer that has at least four wheels and actually supports its load of its own accord; and 2) a semi-trailer, which is a trailer that forms part of an articulated vehicle. This trailer does not support the load on its wheels, but only when it is standing with the use of legs or jacks at one end.

Types of operation

Goods vehicles are required to undertake a wide variety of jobs. For each of these different jobs, it is important that the most appropriate type of vehicle is chosen. Some jobs or operations may require a vehicle with a powerful engine; others may necessitate a good clutch and gearbox because of high usage. Consideration must therefore be given to the work that the vehicle will be doing for the majority of its working life, and also to the conditions within which it must operate. The most important classifications are described below.

- **Long Distance Traveling:** Vehicles that are required to travel long distances tend to be involved in primary transport (trunking or line-haul) operations. A primary transport (trunking or line-haul) operation is one where the vehicles are delivering full loads from one supply point (eg a factory) to one delivery point (eg a warehouse or distribution depot). Such long-distance journeys tend to include a large amount of motorway travel; thus, the vehicle is often involved in carrying heavy loads at maximum permissible speeds. Further to this, the vehicle may be used throughout a 24-hour, seven-day duty cycle. Clearly, for this duty cycle a very high specification is required if service failures are to be avoided. Professional operators usually deploy their newest vehicles on this duty cycle early in the vehicles' life before 'retiring' them to less critical work. These vehicles are often

large articulated or draw-bar combinations, given that the loads are often full loads moving from point to point and maximum loads bring the best vehicle economy.

- **Middle Distance Traveling:** Vehicles involved in middle-distance runs (ie 100–200 miles/150–300 kilometres per day) are probably delivery vehicles making one or two deliveries per day from a depot to large customers. Typical journeys might involve a mixture of motorway and major and minor roads. The specification of vehicles on this duty cycle must also be reasonably high to avoid in-service breakdowns.
- **Short Distance Traveling:** There are a number of duty cycles that require trucks to travel relatively short distances in a day. The main example is local delivery work or what is often known as secondary distribution. A vehicle involved in this duty cycle will probably be making a large number of deliveries in the day and so may be covering only 40–100 miles/60–150 kilometres. Indeed, in some city-centre areas the mileage may on occasion be even less. This type of operation tends to be concentrated in urban or city centres, although some of the delivery areas may involve rural settings.

Amongst the additional problems that this type of operation encounters are the many constraints on vehicle size. Because of the problems of narrow streets, congestion, bans on large trucks, and limitations on access at some delivery points, it is possible to use only smaller vehicles. The size constraints, the relatively short distances and the 'stop and start' nature of urban driving are the main factors that influence vehicle choice for this duty cycle.

Load types and characteristics

The particular load to be carried is another vital factor to be considered when choosing a vehicle. Once again, it is essential to consider the alternatives with the prime objective of selecting the best chassis and the best body suitable for the load. The principal load features are described below.

- **Light Loads:** light loads are those loads that consist of lightweight commodities that are extremely bulky. There are a large number of examples from the different industries. Some of these are breakfast cereals; tissues; polystyrene products. The important point is that light loads such as these require a large cubic capacity in relation to the weight of the goods being carried. This is known as having a 'high cube factor'. The consequence is that, although a vehicle may have high cubic capacity utilization, it will have very low weight utilization (ie it is not carrying as much weight as it could).

- **Heavy Loads:** heavy loads pose problems for vehicle choice because of the gross vehicle weight restrictions on roads and also because of axle weight restrictions. Some loads are even likely to require special vehicle construction, although special low-loader vehicles are

available. Not all heavy loads are necessarily abnormal loads. For example, machinery that has a total weight within the legal limit can be carried on a standard trailer providing the weight is adequately spread over the axles.

Road freight transport: planning and resourcing

In this topic the emphasis is on the means of planning and resourcing for road freight transport. It is known that road-freight transport resources need to be assessed in two different areas – planning and operational. Planning is where the basic resource requirements for transport are determined by the identification of the appropriate number and type of vehicles and drivers that are needed for the fleet to undertake an operation in the medium or long term. Operational is where the aim is to maximize the utilization and effectiveness of existing resources on a daily basis

Need for planning

There are some very general, as well as some very specific, reasons for carefully planning and managing road-freight transport operations. As has been discussed in previous chapters, one of the real keys to creating an effective logistics operation is to get the right balance between customer service and costs and this applies to an equal extent when considering the transport component of logistics. For road freight transport, some of the key planning aspects that need to be considered include:

- **Assets**: Road-freight transport fleets consist of some very high-value assets, ranging from the tractors, trailers and rigid vehicles themselves to the drivers. It is important that these assets are made to 'sweat' through the development of efficient schedules that keep active the vehicles and drivers on the road, and through the introduction of double- and treble-shifting of vehicles, which maximizes their use
- **Service:** Delivery transport acts as the main physical interface with the customer, so it is important that all customer service requirements are met.
- **Costs:** As well as the major assets discussed above, there are also other costs associated with the operation of the vehicle, specifically the running costs such as fuel and tyres. Good scheduling can also help to keep these costs to a minimum.
- **Maintenance:** It is important to ensure that vehicles are maintained on a regular basis to reduce the occurrence of breakdowns.
- **Driver management:** This can be significantly improved by the use of appropriate tachograph analysis (a device that records the distance and time traveled by a vehicle used to check the drivers' working time).
- **Replacement:** A key decision for any transport manager is to be able to identify when vehicles need to be replaced and also which type of vehicle is the most effective for the particular type of operation that is

being undertaken. A good fleet management system will be able to provide this information.

- **Security and tracking:** Modern technology allows for the real-time tracking of vehicles. This enables up-to-the-minute information to be provided to schedulers and to customers, so can help to improve operational effectiveness, security and service.

Fleet management

It is about the responsibility of the transport manager to monitor, control and administer the transport operation. Several different fleet management information systems have been developed that are aimed at assisting the transport manager in carrying out these activities. These are specialized database packages that are aimed specifically at fleet operations. The main functions covered are as follows:

- **Maintenance scheduling:** This includes the monitoring of the service life of vehicles in a fleet and the scheduling of routine and non-routine maintenance and repairs. Package features include: service history; maintenance schedule reports; workshop costs analysis.

- **Vehicle parts control:** This is the stock control function of spare parts requirements. Features may include: stock enquiry; maintenance of supplier information; stock location; stock reports; the generation of purchase orders.
- **Fleet administration:** Fleet administration packages are used to ensure that vehicles are legal and roadworthy. Package features may include: vehicle license renewal; reports required by government regulations; insurance lapse reports, etc.
- **Fleet costing:** These packages provide detailed information relating to vehicle and fleet costs. They assist the manager by providing analyses and information concerning individual vehicle and overall fleet profitability. Features include: vehicle cost analysis; driver cost analysis; overall fleet costs.
- **Tachographs and tachograph analysis:** The tachograph is used to record the driver's hours of driving, rest and other work as well as vehicle speeds and distance travelled.

Main types of road freight transport

Road-freight transport operations can be broken down into two main types. These are primary transport and secondary transport.

- The primary transport is the movement of full loads on large vehicles with a single delivery point. This may be from plant to national distribution centre (NDC), or from NDC to regional distribution centres (RDC). Primary transport is all about moving the product at minimum cost, which generally involves using as large as vehicle as possible and making sure that the vehicle is filled to capacity.

- The secondary transport is the movement of loads on smaller delivery vehicles from the RDC to retail stores. Deliveries are typically made to several drop points during one vehicle journey. Secondary transport and delivery usually involves direct contact with the customer or end user

Transport resources: requirements and optimization

Transport resources need to be assessed in two key areas: first, to identify the basic requirements that are needed (planning). Basic resource requirements for transport are determined by the identification of the appropriate number and type of vehicles and drivers that are needed for the fleet to undertake an operation in the medium or long term. Second, to maximize the utilization and effectiveness of existing resources on a daily basis (operational). Thus, on a day-to-day basis, the existing fleet of vehicles and drivers needs to be used as effectively as possible. The use of these assets needs to be optimized and costs need to be kept to a minimum.

For planning, the general approach is to identify the requisite base data for delivery demand and vehicle types, and use the manual or computer method to determine specific delivery route requirements (routeing) and then calculate from these how many vehicles and drivers are required to undertake the operation (scheduling).

For operational, the approach is different. Secondary delivery (local delivery) operations require the efficient organization of road transport delivery to the final customer or retail outlet normally from a single depot. These operations are usually undertaken by an existing fleet of delivery vehicles that may vary in size and capacity. Also, the level of demand for products from the depot is likely to vary day by day and week by week.

Vehicle routeing and scheduling issues

Vehicle routeing and scheduling problems are relatively complicated. There are several reasons for this: first, there are many different types of problem that can arise, each of which needs to be understood and approached in a different way; second, there are a number of different methods or algorithms that can be used to produce solutions; and, finally, there are many detailed aspects that need to be taken into account, especially the detailed data requirements which are essential for a successful outcome. Different types of routeing and scheduling problem. The first point, concerning the different types of problem, is now described. There are three planning-related problem types; the other is operational:

1. resource planning;
2. 'what if' planning;
3. planning fixed-route schedules;
4. variable/daily route schedules (operational).

- **Resource planning** refers to the identification of the basic requirements that are needed for a transport fleet. Basic resource requirements for transport are determined in terms of the appropriate number and type of vehicles and drivers that are needed for the fleet to undertake an operation in the medium or long term.
- **'What if' planning** involves the identification and measurement of the effects of change. The development of computer-based modelling techniques, including routeing and scheduling, has significantly increased the opportunity for companies to plan for the future of their operations. Computer routeing and scheduling models can be used to test or simulate the effect of changing demand, new vehicle availability, legislative changes, etc. This is often known as 'what-if' planning.
- **Planning fixed route schedules** involves the mid- to longer-term aspects of vehicle routeing and scheduling, in particular where there is a regular delivery of similar products and quantities to fixed or regular customers. Typical examples are some retail delivery operations, bread delivery and beer delivery to 'tied' houses. The main characteristic is that of a fairly regular demand being delivered to virtually the same locations
- **Variable/daily route schedules** involve the preparation of routes that have to be scheduled on a weekly or a daily basis. This type of scheduling is typically undertaken by retail operations, by parcels delivery companies, by companies supplying spare parts and by contract haulage companies that work for a number of different clients. The major factor of importance is that either the demand (quantity) of goods cannot be estimated (eg it is 'random' demand) or the location of delivery points can vary, or that both of these occur.

Summary of the chapter

When we think of methods to manage the flow of goods, we immediately think of transportation and how we can best move the equipment and materials we need for operations into our facilities, and how we can move the products we make to the consumer. In most cases, the decisions we make are likely based on trade-offs between cost and time; air freight, for example, is faster than ocean vessels but proportionally more expensive. The problems with planning transportation can be enormous, and considerable costs can be concealed (e.g., the costs of out-of-stock positions that cause a business loss, or delays over insurance claims). Transport is clearly a critical function within the overall logistics discipline. It, therefore, is imperative that the selection of the very best transportation service providers has an important impact on successful project strategy.

CHAPTER-SIX

INVENTORY MANAGEMENT IN PROJECTS

Objective of the chapter

At the end of this chapter, students will be able to:

- **Identify the different types of project inventory**
- **Identify the different functions of project inventory**
- **Understand the reasons of holding inventory in projects**
- **Understand the different project inventory controlling methods**

6.1. What it is Inventory?

Inventory: is the raw materials, work-in-process goods and completely finished goods that are considered to be the portion of a business's assets that are ready or will be ready for sale. It includes a small business's finished products, as well as the raw materials used to make the products, the machinery used to produce the products and the building in which the products are made. In other words, anything that goes into producing the items sold by your business is part of its inventory. Inventory management, whereas, is primarily about specifying the size and placement of stocked goods. Inventory management is required at different locations within a facility or within multiple locations of a supply network to protect the regular and planned course of production against the random disturbance of running out of materials or goods.

6.2. Types of Inventory

Inventory is divided into two categories; direct inventory and indirect inventory. Direct inventory is one that is used for manufacturing the product. It is further sub-divided into following groups.

1. Raw material inventories: are the basic inputs to the manufacturing process.

2. Work-in-process inventories: consists of partially finished goods
3. Finished – goods inventory: are the outputs of the manufacturing process.
4. Spare parts inventory

Indirect inventory does not play any role in finished goods product but it is required for manufacturing. Thus, indirect inventory acts as catalyst which only speeds up / down the reaction. The indirect inventory is classified as follows:

1. **Fluctuation inventory**: This acts as equilibrium between sales and production. The reserve stock that is kept to maintain fluctuations in the demand and lead – time, affecting the production of items is called fluctuation inventory.
2. **Anticipation inventory**: This is programmed in advance for the seasonal large sales, slack season, a plant shut down period etc.
3. **Transportation inventories**: The existence of transportation inventories is mainly due to movement of materials from one place to another.
4. **Decoupling Inventories**: These inventories are maintained for meeting out the demands during the decoupling period of manufacturing or purchasing.

6.3. The Functions of Inventory

The basic function of inventories whether they are raw materials, work-in-progress or finished goods, is that of decoupling the operations involved in converting inputs into outputs. This allows the successive stages in the purchasing, manufacturing and distribution process to operate reliance on the schedule of output, of prior activities in the production process. Furthermore, the decoupling function allows both time and spatial separation between production and consumption of products in the operating system. Lastly, inventories can also be used for other purposes

apart from the decoupling functions. For example, when inventories are displayed, they serve as promotional investment.

6.4. Reasons for Holding Stock

Inventories serve a number of important functions in various companies. Among the major reasons for holding inventories are:

1. ***To satisfy expected demand*:** Companies use anticipation stock (buffer stock) to satisfy expected demand, and it is particularly important for products that exhibit marked seasonal demand but are produced at uniform rates. Air conditioner, rain suit manufacturers and children's toy manufacturers build up anticipation stock, which is depleted during peak demand periods.

2. ***To protect against stock outs*:** Manufacturers use safety stock to protect against uncertainties in either the demand or supply of an item. Delayed deliveries and unexpected increases in demand increase the risk of shortages. Safety stock provides insurance that the company can meet anticipated customer demand without backlogging orders. Raw materials and component parts can have safety stocks within the manufacturing plant. Finished goods can have safety stocks throughout the materials flow (at the plant, field warehouses, distribution centers, wholesalers, and retailers).

3. ***To take advantage of economic order cycles*:** Companies use cycle stock to produce (or buy) in quantities larger than their immediate needs. Because of the cost involved in setting up a machine, companies usually find producing in large quantities economical. Similarly, to minimize purchasing costs companies often buy in quantities that exceed their immediate requirements. In both cases, periodic orders, or order cycles, produce more economical overall production costs. The quantity produced is called the economic lot size. The quantity ordered is called the economic order quantity (EOQ).

4. ***To maintain independence of operations*:** The successive stages in the production and distribution system require a buffer of inventories

between them so that they can maintain their independence of operations, for example, the raw materials inventory buffers the manufacturer from problems with a supplier. Similarly, the finished goods inventory buffers factory operations from problems in the distribution system.

5. ***To allow for smooth and flexible production operations*:** A production-distribution system needs flexibility and a smooth flow of material, but production cannot be instantaneous so work-in-process inventory relieve pressure on the production system. Similarly, manufacturers use in-transit or pipeline inventory to offset distribution delays. Both work-in-process inventories and pipeline inventories are part of a broader classification, called movement inventories.

6. ***To guard against price increases*:** Manufactures sometimes use large purchase, or large production runs, to achieve savings when they expect price increases for raw materials or component parts.

6.5. Stock control Methods

There are several methods for controlling stock, all designed to provide an efficient system for deciding what, when and how much to order. One may opt for one method or a mixture of two or more if there is various types of stock. For further information, see the page in this guide on types of stock.

- ✓ Minimum stock level - first identifying a minimum stock level, and re-order when stock reaches that level. This is known as the Re-order Level.
- ✓ Stock review – if there is regular reviews of stock. At every review, one places an order to return stocks to a predetermined level.
- ✓ Just In Time (JIT) - this aims to reduce costs by cutting stock to a minimum. Items are delivered when they are needed and used immediately. There is a risk of running out of stock, so you need to be confident that your suppliers can deliver on demand.

These methods can be used alongside other processes to refine the stock control system. For example:

- **Re-order lead time** - allows for the time between placing an order and receiving it.
- **Economic Order Quantity (EOQ)** - a standard formula used to arrive at a balance between holding too much or too little stock.
- **Batch control** - managing the production of goods in batches. You need to make sure that you have the right number of components to cover your needs until the next batch. If your needs are predictable, you may order a fixed quantity of stock every time you place an order, or order at a fixed interval - say every week or month. In effect, you're placing a standing order, so you need to keep the quantities and prices under review.
- **First- in-first out** - a system to ensure that perishable stock is used efficiently so that it doesn't deteriorate. Stock is identified by date received and moves on through each stage of production in strict order.

Economic Order Quantity (EOQ)

Basic Economic Order Quantity (EOQ) Model or Economic Batch Quantity (EBQ): This is a calculated ordering quantity, which minimize the balance of costs between inventory holding cost and re-order cost.

Assumptions

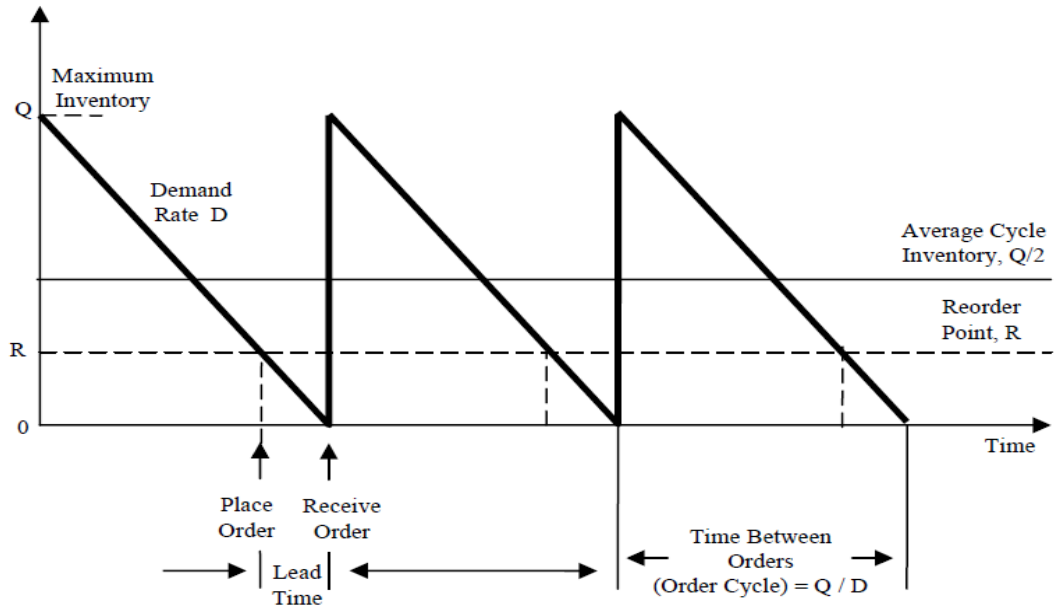
- Demand for the product is known and constant
- Lead time (time from ordering to receipt) is constant
- Price per unit of product is constant
- Ordering or setup costs are constant
- All demands for the product will be satisfied (No shortages are allowed)
- The order quantity is received all at once

Economic Order Quantity (EOQ) Model with Constant Rate of Demand:

The EOQ model is the best known and most fundamental inventory decision model. Although this model is too over simplified to represent most real

world situation, it is nevertheless, an excellent starting point from which to develop complex and more realistic inventory decision models, as is the case with all models.

The following figure shows the graphic depiction of this particular inventory situation. Each inventory cycle begins with the receipt of an order of Q units. i.e Q units are ordered and stocked in the system. Demand is occurring at the rate of D units per time unit during cycle time T. At the reorder point R, when the on-hand inventory is barely sufficient to satisfy demand during the lead time, LT, an order of Q units is placed. Since the demand rate and the lead time are constant, the order of Q units is received exactly when the inventory level reaches zero. This means that there are no shortages.



The inventory level varies from Q to zero, so the average inventory level during the inventory cycle is Q/2. So, the inventory holding cost is obtained by multiplying this quantity with the cost of holding one unit per time unit. Hence, IHC = (Q/2) C_h . This cost is a linear function of Q.

The number of orders placed during the planning horizon would be D/Q and hence the inventory ordering cost OC will be a function of the number of orders placed and the ordering cost per order.

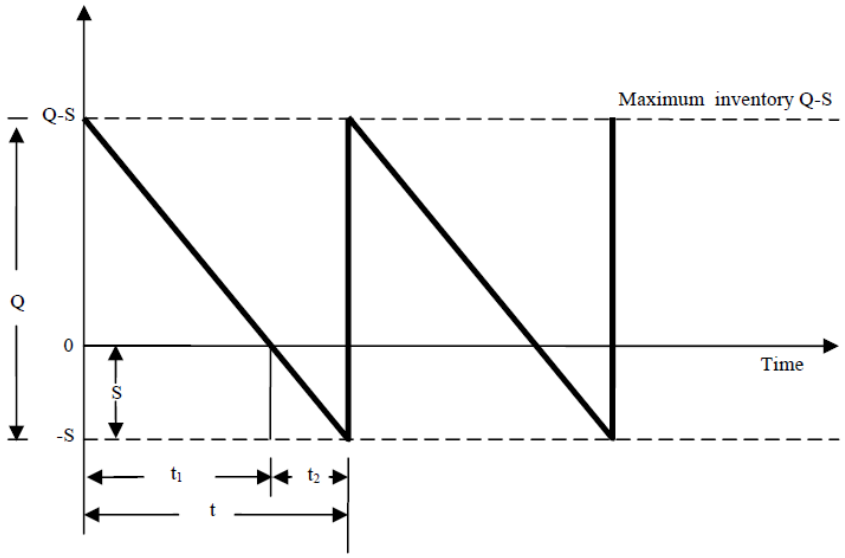
Thus, OC = (D/Q) $C_{o.}$ Because the number of orders made in the planning horizon, D/Q, decreases as the order size, Q, increases, OC is inversely proportional to Q.

Total Inventory Cost TC = Ordering cost + holding cost
TC = (D/Q) C_o + (Q/2) C_h

EOQ Model with constant demand and shortages allowed:

The inventory problem in the above section becomes slightly more complicated when a company permits shortages, or backorders, to occur. However, in many situations shortages are economically desirable. Permitting shortages allows the manufacturer or retailer to increase the cycle time, thereby spreading the setup or ordering cost over a longer time period. Allowing shortages may also be desirable when the unit value of the inventory and therefore the inventory holding cost is high.

In the back order situation customers place an order, no stock is available, and they simply wait until stock becomes available, at which point the order is filled. The company hopes that the waiting period for the back order will be short and its customers will be patient. For this model we will use the assumptions of a known and constant demand rate and instantaneous delivery of goods to inventory like the basic EOQ model. If S represents the amount of the shortage (size of the back order) that has accumulated when the new shipment of size Q arrives, the economic order quantity model with constant demand and permissible shortages has the following major characteristics and graphic depiction.



- When the new shipment of size Q arrives, the company immediately ships the back orders of size S to the customers. The remaining units Q-S immediately go into inventory.
- The inventory level will vary from a minimum of -S units to a maximum of Q-S units.
- The inventory cycle of T units is divided into two distinct parts: t_1 when inventory is available for filling orders and t_2 when inventory is not available, stock outs occur, and back orders are made.

The inventory ordering cost is a function of the number of orders made, D/Q, and the inventory ordering cost per order, C_o.

OC =No. of orders × Cost per order = (D/Q) C_o

Limitations of the EOQ formula

The EOQ formula is derived under several rigid assumptions which give rise to limitation on its applicability.

- In practice, the demand is neither known with certainty nor is uniform over the time period. If the fluctuations are mild, the formula is practically valid; but when fluctuations are wild, the formula loses its validity.

- It is not easy to measure the inventory holding cost and the ordering cost accurately. The ordering cost may not be fixed but will depend on the order quantity Q.
- The assumptions of zero lead-time and that the inventory level will reach to zero at the time of the next replenishment is not possible.
- The stock depletion is rarely uniform and gradual.
- One may have to take into account the constraints of floor-space, capital investment, etc. in stocking the items in the inventory system.

Uncertain Demand and Safety Stock

In practice, the demand or usage of inventory is not generally known with certainty. Usually it fluctuates at a given period of time. In this case formula is (Maximum daily usage rate x Maximum lead time) – (Average daily usage rate x Average lead time).

Reorder Point: The reorder point is the level of inventory at which the firm places an order in the amount of EOQ. If the firm places the order when the inventory reaches the reorder point, the new goods will arrive before the firm runs out of goods to sell. In designing reorder point subsystem, three items of information are needed as inputs to the subsystem.

1. **Usage rate--** This is the rate per day at which the item is consumed in production or sold to customers. It is expressed in units. It may be calculated by dividing annual sales by 365 days. If the sales are 50,000 units the usage rate is 50,000/365 = 137 Units per day.

2. Lead time-- This is the amount of time between placing an order and receiving goods. This information is usually provided by the purchasing department. The time to allow for an order to arrive may be estimated from a check of the company's record and the time taken in the past for different suppliers to fill orders.

3. **Safety stock--** The minimum level of inventory may be expressed in terms of several days' sales. The level can be calculated by multiplying the usage rate and time in the number of days that the firm wants to hold as a protection against shortages.

Inventory Control Subject to Uncertain Demand: In the presence of uncertain demand, the objective is to minimize the expected cost or to maximize the expected profit. Uncertainties are the most important reason to keep inventories. If for example a specific order is delivered exactly according to plan and on the agreed date and time, but the wrong goods are delivered or the delivery is damaged and can therefore not be used. This example illustrates two possible causes of uncertainty. Although a delivery might be perfectly on time (as being identified as the first reason for maintaining stock), there might still be something wrong with the stock as well.

Uncertainties in delivery times may also form a reason to maintain a safety stock, in case a delivery arrives late. If all processes subsequent to a specific delivery are interrupted as well, it may cause major losses in the end. For this reason a stock is usually kept, to cope with unforeseen events that could otherwise prevent the production from moving on. Another important source of uncertainties is caused on the demand side; the expected orders placed by the clients are hard to predict. In order to guarantee deliveries and a certain level of service to the clients also a stock is often maintained to cope with uncertainties on the demand side. To summarize, stocks thus allow for variation and uncertainty in both supply and demand, which lets operations continue smoothly when problems arise.

It may sometimes be cheaper to keep some stock. Economies of scale for example are a reason why inventories are kept. Buying bigger quantities is often more beneficial than ordering small amounts, due to the related discounts. Additionally, ordering one unit at a time that has to be delivered to a specific place every time the user needs it, requires more logistic movements and accordingly raises high costs as well. Also fluctuating prices

may form a reason to keep a stock: buying a product at a low price can provide a benefit. That is off course when the total costs of keeping additional goods in stock is cost-efficient compared to buying at a higher price, otherwise high stocking costs will immediately diminish the intended profit.

Safety Stock:

Buffer Stock or Minimum Stock orSafety stock is a stock allowance to cover errors in forecasting the lead-time or the demand during the lead-time. It is an inventory activity used to prevent stock outs. Stock out stem from factors such as: fluctuating customer demand, forecast inaccuracy, and variability in lead times for raw materials or manufacturing. Some operation managers use feelings to set safety stock level while others base them on the portion of cycle sock level. Safety stock determination is not intended to eliminate all stock outs- just the majority of them. Demand variability is the dominant influence on safety stock requirements. Many companies look at their own demand fluctuations and assume that there is not enough consistency to predict. Then they fall on best guess weeks supply method to manage safety stock. This is less effective to determine inventory levels of safety stocks. The most widely accepted methods of calculating safety stock are statistical model of standard deviation of normal distribution of numbers to show probability. This is effective to determine optimal safety stock level and needs the understanding of statistical theory justifications. The safety stock forms an ultimate buffer to cope with uncertainties (e.g. in delivery times and varying demand). The more reliable the supplier and customer demands are, the lower the safety stocks can be. One way to determine the amount of safety stock is using desired service level (probability of no shortage).

6.6. Inventory Control Models

Two types of inventory control models

- Continuous Review
- Periodic Review:

A. Continuous Review:

Here the inventory level is being monitored on a continuous basis so that a new order can be placed as soon as the inventory level drops to the reorder point. Personals, in practice, make a physical count of inventory at periodic intervals to decide how much of each item to order. Using the continuous review system to determine when to reorder, we review the remaining quantity of an item each time a withdrawal is made from inventory. In practice, operations managers make a physical count of inventory at periodic intervals (daily, weekly, or monthly) to decide how much of each item to order.

Many small retailers use this approach, simply checking the quantities on shelves and in the storeroom on a periodic basis. Another very elementary type of continuous review system is the traditional two-bin system, which sets aside two containers, or bins, to hold the total inventory of an item. Items are withdrawn from the first bin until it is empty, at which point it is time to reorder the quantity that will again fill the bin. The second bin contains enough stock to satisfy demand until the order comes in, plus an extra amount to provide a cushion against a stock out. The continuous review system is also called a reorder point (ROP)system, or a fixed order quantity system.

B. Periodic Review System

This system is also known as the fixed interval system or replenishment inventory system or cyclic review system.
In this system, the size of order quantity may vary with the fluctuation in demand, but the ordering interval is fixed.

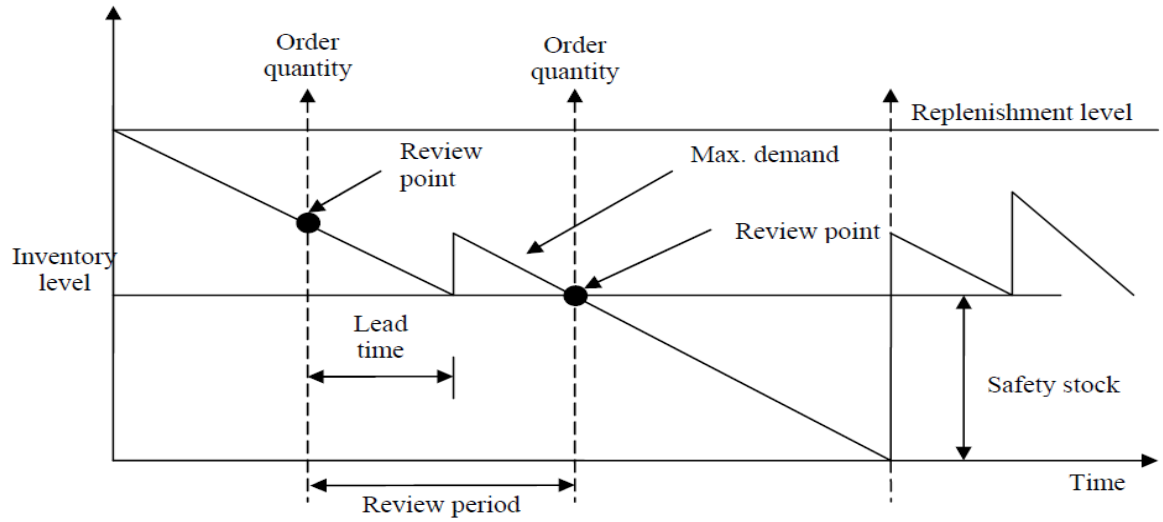
The system is specified for any item by: (1) review period *t*, and (2) replenishment level, or reoder level, *R ;* In this system, the inventory position is periodically reviewed – once, weekly, monthly, quarterly or half-yearly. At each review period, an order is placed for an amount equal to the difference

between a fixed replenishment level and the actual inventory level. The calculation of R is based on the formula:

Replenishment level R = Average consumption during a review period + Lead time + safety stock

Order quantity = Replenishment level – stock available

The following diagram gives the way in which the periodic review system operates.



The order quantity is variable in size from one review date to another.

Stock Control

Stock control is defined as the means by which materials of the correct quantity and quality are made available as and when required, with due regard to economy in storage and ordering costs, purchase prices and working capitals.

Stock control, otherwise known as inventory control, is used to show how much stock you have at any one time, and how you keep track of it.

Objectives of Inventory Control

Inventory control has two major objectives. The first objective is to maximize the level of customer service by avoiding under stocking. Under stocking causes missed deliveries, backlogged orders, lost sales, production bottlenecks, and unhappy customers.

The second objective of inventory control is to promote efficiency in production or purchasing by minimizing the cost of providing adequate level of customer service. Placing too much emphasis on customer service can lead to over stocking, which means the company has tied up too much of its capital in inventories.

The simplest way to manage a stock would be to use a minimum and maximum stock level. A minimum has to be set in order to create a buffer against the various uncertainties that exist. A maximum is set to ensure that not too much stock is kept, because that would be unnecessary. Once the minimum level has been reached, items have to be reordered until the maximum is reached again.

The modern stores have a wide variety of functions that they have to perform as efficiently as possible. The way in which stores management carries out these tasks will be reflected in the overall efficiency of the organization. The Primary concern in the management of stock control must be to provide the right goods in the right condition at the right price in the right place at the right time.

This means that control procedures should:-

i. Retain stock at appropriate levels.
ii. Safeguard stock against loss or misuse
iii. Ensure that stock is properly used in business operations
iv. Ensure that stock is duly accounted for Management must control the procedures for purchasing and controlling sock in such a way that an optimum balance is obtained between efficient control and

economy. Such a system must be designed in the light of the individual needs of the business. From the accounting point of view the criteria to be borne in mind are the value of the stock, its susceptibility to misappropriation and the usable life.

An adequate system of control must aim at achieving the following objectives:

i. Elimination of the Delivery of incorrect stock, as regards type, quantity or quality. All deliveries of goods should be checked against the copy order, which they are received and discrepancies noted. The person ordering the goods is responsible for certifying that they are up to standard.

ii. The reduction or elimination of pilfering. The key factor here is the relationship between unit bulk and bulk. If goods are easily portable, of small bulk and of high value then they should be more vulnerable to misappropriation. Greater security may be exercised on the issue of goods, which fall within this category. Where goods are of high bulk and of little value, free access to their use may be allowed. A physical check of stock may be made at random and at irregular intervals to provide a moral check in pilfering of stock in the same way as the audit may present pilfering of cash.

iii. Control of movement showing sales per product. Regular analysis of sales and purchases will indicate charges in demand. If excess stocks are begin ordered, this can be checked. Excessive analysis should be avoided and a periodic check made to see whether information produced is being used.

iv. Avoiding holding slow-moving stock. This can be obtained by marking on each of the stock record cards a minimum and a maximum quantity. The minimum is the lowest quantity, which the particular line should be allowed to drop if deliveries are to be maintained. On arriving at this figure the factors to be considered are the speed at which it is used or sold, the length of time required for delivery on the

part of the suppliers and the possibility of late delivery or abnormal usage. The maximum is the figure above which it may be considered an excessive stock is being carried, and according to the particular business or article may represent several months' stock.

Where stock moves more rapidly or more slowly, the store or stock keeper is responsible for reporting immediately for the necessary action on the part of the purchasing department. If stock is moving more rapidly, the quantity ordered or put into production can be increased to maintain the stock. Conversely, the purchasing can be reduced and when necessary the stock disposed of as a clearance line.

Importance of an Effective Stock Control System

Because the stock held by an organization represents money, the control of that has serious financial implications for the organization. If the stock is controlled inefficiently it can cause high storage cost, obsolescence and reduction in working capital. Therefore, stock control is very much concerned with ensuring that stock is controlled very carefully. In many situations, the actual level of profit earned by an organization will depend on the success of stock control.

It has been emphasized that service is the principal objectives of the store function, but it is obviously desirable to provide that services economically. The most important consideration here is to maintain the value of the inventory at the lowest practicable level at all times in order to economize in the use of working capital and to minimize the costs of storage. It will be readily understood that there is some conflict between the need to give a good service and the need to economize in stockholding. On the one hand, the more stock held the easier it is to have required items readily available on demand. On the other hand, the more stocks held the greater the cost incurred.

Improving the Control of Stock

In view of the vital importance of stock control, even to the point of organizational survival, improvements in the control of stocks must constantly be sought.

i. Overall reduction of stocks: The removal of obsolete stocks, avoidance of "bargain buy", and standardization of general stocks will assist in reducing the total stocks held. The key to stock reduction is to be ruthless with non-working stocks. There is a tendency for stock for which no immediate use to accumulate.

ii. Staff involvement: It is vital that all members of the organization from the managers/cleaners to management understands and appreciates the implications of poor stock control.

iii. Low cost Computers: The store manager and stock controller must ensure that maximum use is being made of low cost computers in relation to stock control operation.

iv. Stock Levels: The Stock controller must ensure that stock levels are maintained at the lowest possible level encouraging suppliers to hold stocks is one strategy for holding down stock levels.

v. Co-operation: The stock controller, purchasing manager and supplier must co-operate to ensure effective control of stocks, thus improving efficiency and growth.

vi. Forecasting: The use of modern forecasting techniques to accurately establish future stock levels.

vii. Materials Management: A system of materials management could enable the whole materials system to be more controlled, thus reducing overall stock levels.

Stock Control System

Stock control which is described as the operation of continuously arranging receipts and issues to ensure that stock balances are adequate to support the current rate of consumption with due regard to economy. It involves the related process of provisioning, which is the means whereby instructions are given for placing of orders. In some industrial concerns the production Central department may take a large share in provisioning, at least as far as production materials are concerned. Provisioning is the process of determining in advance requirement of materials taking into consideration existing stocks delivery times and rates of consumption so that the amount of stock in hand at any time will be in accordance with the stock control policy.

The two major questions arising in any provisions activities are:

(i) When to order

(ii) How much to order

When the questions have been decided in respect of any particular commodity, the provisioner usually prepares a provision demand document, showing the quality and delivery required and passes this to the purchasing office to take the appropriate action. Having decided to carry stocks and provide storage facilities, the next problem is to control the stocks. The term stock control does not mean stock records or store ledgers – these documents are required by some system for controlling stock but are not required by others.

The basic methods of controlling stock by quantity is by means of fixing for each commodity, stock levels which are noted on the stock record, and subsequently use as a means of indicating when some action is necessary. There are various kinds of stock levels, but the fundamental controls are minimum, ordering, hastening and maximum levels. It does not follow that all these are necessary or even desirable for every item, and they should be employed with discretion, because the fixing of too many levels makes the work of provisioning unduly complicated.

Problems in Accounting for Stock

Problems in determining the value of stock held may arise because of:

(i) Discrepancies between physical stock and stock records. The differences are usually but not invariably unfavorable.

(ii) Differences in the timing of receipts of stock and the timing of receipts of documentation, e.g. invoices may not have been received.

(iii) Errors in accounting or stocktaking.

(iv) Failure to complete stocktaking at the accounting at the accounting period. In this case, the stock can only be calculated by adjusting for subsequent receipts and issues.

Stock Costs:

Whether as a result of deliberate policy or not, stock represents an investment the organization. As with any other investment, the cost of holding stock must be related to the benefits to be gained. To do this effectively, the costs must be identified. There are four categories: - costs of holding stock, cost of obtaining stock out costs, and the cost of the stock itself.

Summary of the chapter

Inventory quantities must be organized and measured carefully. Minimum stocks must be assured to prevent stock-outs or the lack of product. At the same time, they must be balanced against excessive inventory because of carrying costs. In larger retail organizations and in many manufacturing operations, purchasing has evolved as a distinct new and separate phase of management to achieve the dual objective of higher turnover and lower investment. If this type of strategy is to be utilized, however, extremely careful attention and constant review must be built into the management system in order to avoid getting caught short by unexpected changes in the larger business environment. Caution and periodic review of reorder points and quantities are a must. Individual market size of some products can change suddenly and corrections should be made.

CHAPTER SEVEN

PROJECT CONTRACT MANAGEMENT

Objective of this Chapter

At the end of this chapter, learners will be able to:

- **Define contract management**
- **Know the concept of traditional project contract strategy**
- **Identify the roles and responsibilities in the project supply chain**
- **Identify the alternatives project contract strategies**
- **Explain the meaning of management strategies**
- **Familiar with the concept of emerging contract strategies**

7.1. Introduction

First there must be an understanding of what a contract is. **A contract** is a mutually binding legal relationship obligating the seller to furnish the supplies or services and the buyer to pay for them. No organization has all the skills required to do anything but the most simple of projects. Additional skills required for the completion of projects must be bought in from external sources. In this chapter, we consider the roles required throughout the project supply chain, particularly during the design and construction stages, and what contract types are available to provide the additional roles in different ways. The contract is the mechanism by which:

- ✓ the project organization is created;
- ✓ project managers are employed;
- ✓ goods and services are procured;
- ✓ the commercial nature of the project process is defined.

Contract Management: Actions taken to ensure that both the client and the Contractor comply with the requirements of the Contract. Includes

some functions related to solicitation development, and Contract development and close-out, and also includes, but is not limited to, Contract Monitoring, evaluation of deliverables, invoice review, payment approval, progress tracking, regular status meetings, management of state-owned property used in Contract performance, dispute resolution and "day to day" management. It is important for project managers to be aware of how to operate effectively using the contractual procedures to optimal advantage.

7.2. Project Procurement

Ideas for projects arise from many sources, including strategic planning, market forecasts, process re-engineering or suggestion by a speculative developer. A client considers the viability of these concepts to determine the extent to which it wishes to participate. This varies from client to client and project to project, from being a wholly internal, private project executed by direct labour to a public sector concession awarded to an external promoter. Whatever delivery structure is adopted, similar functions need to be undertaken, many of which must be sourced from outside the client's organization. These cascade down from the strategic, market and commercial drivers acting on the client and progress through the various parties in the entire supply chain.

7.3. The Traditional Project Contract Strategy

As a starting point for the consideration of the roles and responsibilities of parties to a project suitable for all types of business, engineering or industry, we consider the traditional structure used extensively in many industries. This involves three parties:

- ✓ A client who initiates and sanctions a project.
- ✓ A consultant who undertakes the feasibility and design.
- ✓ A contractor who is responsible for implementing the project.

Procurement strategies adopted by a project must recognize the prevailing culture and structure of the indigenous construction industry, as these will have a major influence on the effectiveness of any strategy adopted.

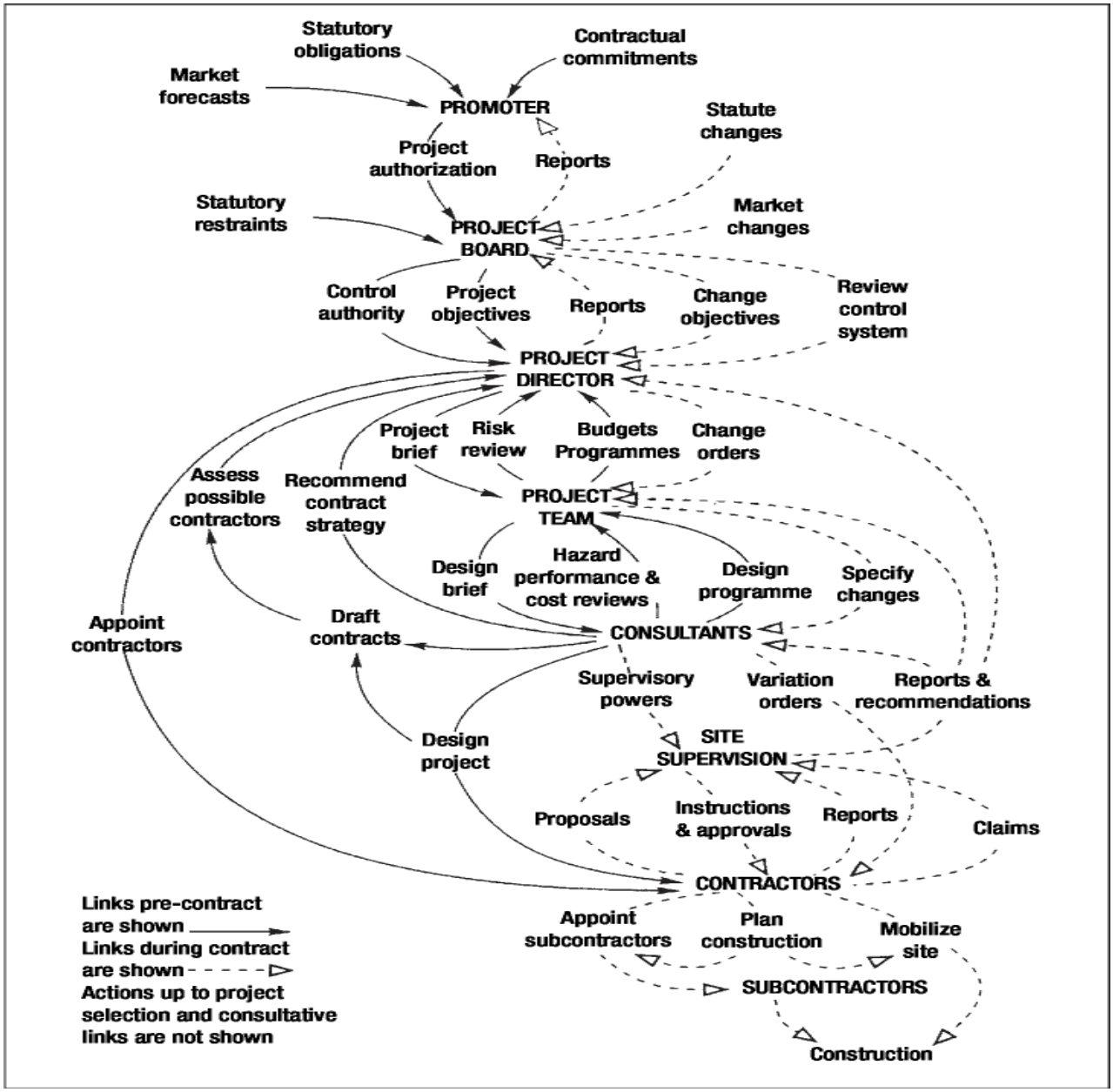


Figure 7.1: Roles and responsibilities in the project supply chain

THE CLIENT:

In the traditional procurement strategy, the client is the organization which desires the project, often owns the site, usually funds the project and is

frequently the end-user. (Often in property development the client is the developer, the eventual owner a financial institution and the end-user an organization that rents the building.) It is also assumed that the client organization will contain the project board and the project manager who will have the authority and expertise to commence the procurement of the design and construction phases of the project. From Figure above, it can be seen that this equates to the internalization of the roles and links associated with Promoter, Project Board, Project Director and Project Team. Nevertheless these functions remain and have to be undertaken effectively.

THE CONSULTANT:

Consultants or consulting engineers are charged with three main functions:

- ✓ Management of the design process.
- ✓ Assistance in tendering and contract administration.
- ✓ Site supervision.

Typically, a design brief or scope of works is prepared by the client organization and consultants are selected on the basis of the quality of service provision and fee competition. The successful consultant will then have direct contact with the client.

THE MAIN CONTRACTOR:

Traditionally, a single main contractor would be appointed, usually after the completion of the design, to undertake construction only. The contractor would have responsibilities for planning the works, mobilization, construction and opening or commissioning. However, the traditional procurement system contains some inherent characteristics that adversely affect and restrict the effective construction of the works. First, by precluding the contractor from the earliest stages of a project, the opportunity to incorporate construction expertise at an early and cost-effective stage is wasted and subsequent changes enforced by requirements of practicability are often costly. Second, the client and consultant may have been working on the project for many months or, on large projects, for a number of years. But at tender stage a contractor is given between eight and

ten weeks to understand the project, to liaise with members of the supply chain, to assess the risk and to produce a tender price. This tender price has to be high enough to protect the contractor from the consequences of risks for which it has responsibility, but low enough to be successful in a competitive tendering system based on the lowest evaluated price being successful. Third, there is often pressure from the client for the contractor to commence work on site at the earliest possible opportunity. This is usually a false economy as a short period of pre-construction planning time can often result in substantial time and cost savings on site. These savings can often be shared in some way with the client.

SUBCONTRACTORS:

In the simplest form of contract, the main contractor may undertake the complete contract. However, it is common practice to make use of specialist subcontractors to undertake sections of the works. The subcontractor will have specific knowledge and expertise, with appropriately trained staff, which enables it to undertake specialist work more competitively than the main contractors. With or without subcontractors, there will also be a supply chain of varying complexity consisting of vendors, suppliers and service providers.

THE PROJECT MANAGER:

So where in the traditional procurement system is the project management expertise? It is common for many organizations to 'manage by projects' and to employ key personnel as project managers. Indeed the client, the consultant, the contractor and the subcontractor may all have project managers. However, in terms of the complete project, it is the client's project manager that is considered to have responsibility for all the phases of a project and to execute the project management function. At some level inside the client organization, possibly the Board of Directors, a decision has to be made to authorize the project and to determine the terms of reference of the project manager.

7.4. THE PROCUREMENT PROCESS

One of the first actions of the project manager, after determining viability and degree of risk, is to determine the project objectives. In all projects the primary targets, time, cost and performance are important. However, it is likely that one will be dominant. There are a host of secondary and tertiary targets which need to be considered. Typically the degree of involvement of the client and/or the project manager, the innovation required, interfaces with external organizations, inclusion of international organizations and many other factors need to be considered to establish the clear aims of the project. Only if the project purpose and objectives can be clearly defined can the most appropriate procurement strategy be identified. However, events might occur that require modifications or changes to the project objectives, and constant monitoring is necessary.

The project manager then has to consider his or her own internal project team and the other main parties, the consultant and contractor. The project team conduct risk analyses and investment appraisal, undertake feasibility studies, develop the project brief and determine the procurement strategy. For each contract the project manager considers the project objectives in terms of the combined selection of an organizational structure, a contract type, a tendering strategy and a model form of contract. In the traditional procurement strategy the consultants are appointed on the basis of a project design brief and competitive tendering. The project team and the consultant will interact during the design process and in the preparation of construction contract documentation. After completion or substantial completion of the design, the contractor is appointed on the basis of a priced bill of quantities and competitive price. It is usual for the project team to have undertaken a prequalification exercise prior to tender.

This is popular with both clients and contractors. Clients favour prequalification because it removes financially or technologically weak organizations and ensures a large competitive 'pool' of contractors, each of which is appointable. It is also popular with contractors because

prequalification removes organizations without the necessary skills, experience and management expertise and allows them to compete with peer group members who will have similar costs and overheads. Interestingly enough the appointment of a subcontractor is more likely to be based on negotiation of the price with the organization identified as being the 'best partner' than on open competition.

As mentioned above, other parties involved in the project may have their own internal staff with the job title project manager. Their role is to act as the point of contact between the client's project manager and the organization's own staff and to manage their own component of the project to meet their predetermined targets and objectives. It is therefore an important part of the project team's brief to try to harmonize the goals of these other project managers with those of the client's project manager and of the project as far as is practicable. The client's project manager has responsibilities, some of which are contractual and others non-contractual. Model forms of contract differ in their structure and in the allocation of risks and obligations. Consequently, the client's project manager could find most of the contractual roles imposed from a contract of engagement or employment and might not have a direct contractual role in the contract between client and contractor, as in the ICE seventh edition *Conditions of Contract* (1999). Alternatively, the client's project manager could have a main contract role with specific obligations and duties, as discussed earlier in regard to the ICE new engineering document conditions of contract (1995).

7.5. ALTERNATIVE PROJECT CONTRACT STRATEGIES

Other established procurement strategies exist in construction and in other sectors and disciplines, but all of these can be examined by comparison with the traditional system.

INTEGRATED STRATEGIES

As the name suggests, the essence of this type of strategy is to integrate roles and responsibilities for phases of the project. In particular the design,

engineering and construction phases are integrated, removing the interface which in practice is often a cause of dispute and conflict. Hence, the client, by giving a single organization responsibility for both phases, transfers the management of interface problems and any associated risks. However, this is offset by the client losing control over a major part of the project life cycle.

If the project life cycle, as shown in figure below, is studied, it is clear that the design and construction phases of the project coincide with the maximum capital investment and thus the roles and responsibilities of the parties at this stage are significant. Although there is a plethora of integrated procurement strategies, they can be considered under three subcategories which reflect the extent of the project life cycle for which a single organization takes responsibility. From interrogation of Figure below, we can identify subcategories, 'design and build', 'turnkey' and 'concession', with responsibilities ranging from part of design and construction phases to almost the whole project cycle.

Design and build

The simplest of the three, the design and build strategy, requires the client, often with a consultant, to complete the usual front-end activities, but instead of appointing a contractor on the basis of a completed design, only an outline design or a design brief would have been prepared. The design and build contractor would then be responsible for the detailed design and the engineering or construction and the management of that interface. These contracts tend to be used for relatively straightforward work, where no significant risk or change is anticipated and when the client is able to specify precisely what is required. Usually but not always the contractor is paid on a fixed price, lump sum basis to provide an incentive for the contractor to be cost-effective and to limit the client's investment.

Turnkey

Turnkey contracts as the name suggests are contracts where the client, on completion, turns a key in the door and everything is working to full operating standards. Consequently, turnkey contractors have responsibility

for the design, construction and commissioning phases of a project. Frequently this will also involve the procurement of all main items of plant and equipment. Under this strategy the client's project manager usually prepares a performance specification and a scope document which determine the performance and the location and design constraints respectively. Due to the increased responsibility the cost of tendering is also increased and hence smaller numbers of bidders are invited. Typically selection is based on the evaluation of a two-package tender submission. Each bidder prepares a technical package containing process design, engineering design, procurement routes, erection and construction schedules and resources, certification and approval and commissioning procedures, and a financial package indicating the lump sum price and such breakdown as is required by the client. Once the contract has been placed the client role is severely limited and the client's ability to make any changes other than a formal contract variation is almost non-existent. The turnkey contractor's project manager has much greater multidisciplinary responsibilities and has to coordinate along the supply chain and across a series of project phase interfaces.

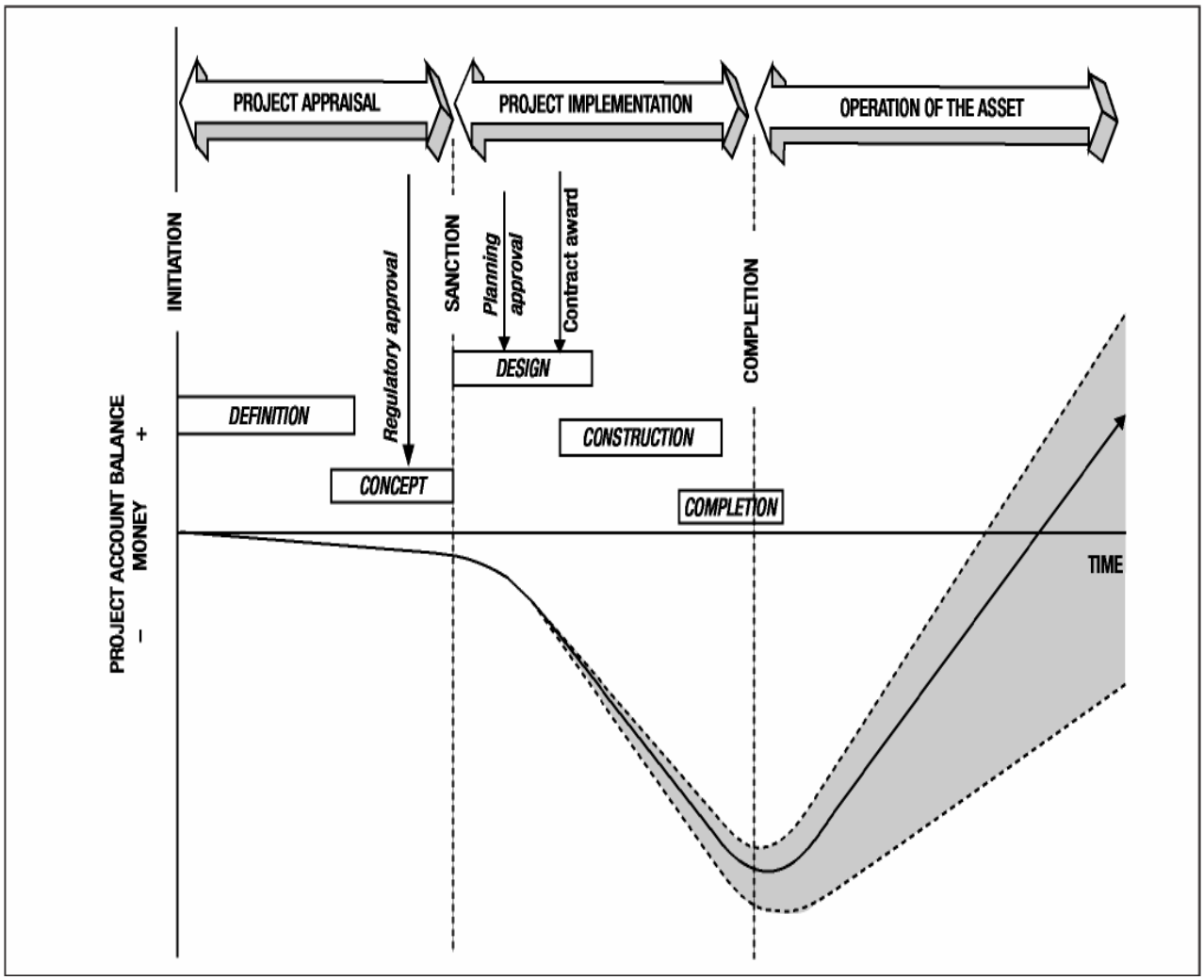


Figure 7.2: Capital expenditure through the project life cycle

Concession

The transfer of almost the entire project is the possibility considered under the concession or Finance–Build–Own–Operate–Transfer (FBOOT) strategy (Smith 1996). This subcategory covers almost all of the project life cycle including operation and maintenance, and the functions, roles and responsibilities of most of the parties identified in Figure 6.1 are integrated into a single organization, usually known as the promoter. The promoter is often a single project joint venture of minimal asset value formed solely for the purpose of undertaking the project. The other principal difference with this type of strategy is that the promoter has to arrange the project financing

and generate a revenue stream sufficient to service the debt, operate the facility and provide an adequate return. In this case, the roles and responsibilities of the client's project manager are also transferred to the promoter's project manager but with the additional complexities caused by the promoter not being a single organization.

7.6. MANAGEMENT STRATEGIES

The key element in this group is the additional emphasis placed on management of the project. The underlying principle is that additional management expertise can be provided to the client and hence provide benefits in terms of fitness for purpose, buildability, performance and risk management that will more than offset the cost of the expertise. This additional management resource is provided to the client when it is required and removed on completion without affecting the number of permanent staff in the client's organization.

The parties operate in a different manner, with the management contractor appearing as a separate entity and working closely with the client's staff and the client's project manager in particular. The management contractor would be appointed at a very early stage in the project. The type of organization operating in this role could be a consultant but is usually a contractor who would be experienced in the type of work and would otherwise be a likely tender bidder. In the role of management contractor a small team drawn from the contracting organization's staff would be selected and engaged usually on the basis of fee reimbursement plus profit margin. Naturally, to avoid possible conflicts of interest, the organization is then excluded from tendering for any of the works contracts. The management contractor works extremely closely with the client's project manager, almost like additional client staff and it would therefore be counter-productive to place harsh or onerous performance terms on the management contractor.

The other parties have slightly modified roles also. The consultant is now engaged by the management contractor and will liaise on buildability and practical issues of design throughout the contract. The other different

feature is that the use of a single main contractor has been replaced by a series of work package contracts. The management contractor selects and manages these contracts, and solves any interface problems which may arise between them. Each contract could vary, with some lump sum fixed price and some cost reimbursable, dependent upon risk and time constraints. By packaging the work into such small components, the contracts can be used to give greater client flexibility to overlap sections of the work and to assist with risk management. Hence to be effective the contract must produce benefits to the project manager in terms of access, flexibility to make change and effective management of construction which are less than the cost of engaging the management contractor team.

Each work package contract is managed by the management contractor in conjunction with the client's project manager on behalf of the client. Consequently, the client has no privity of contract that is no direct contractual relationship with the consultant or works contractors, which places much greater importance on the relationship between the client's project manager and the management contractor. It is important that there is a degree of trust and common commitment if the contract is to be undertaken to reach its maximum potential benefit.

7.7. EMERGING PROJECT CONTRACT STRATEGIES

During the 1990s, there was a clear trend away from adversarial contracting strategies towards collaborative working, which has direct implications for the role and responsibilities of the project manager. In any type of collaborative working, there is a need to align goals, so incentives are often used, and there is a need for new agreements and contracts and a greater requirement for good management practice.

JOINT VENTURES AND PARTNERING

The industry has been accustomed to the use of both horizontal and vertical joint ventures (JVs) and consortia for many years. More recently other forms have become apparent, including the various forms of partnering, such as alliancing, term partnering, project specific partnering, and forms of

collaborative ventures to form promoter groups for Private Finance Initiative (PFI) projects. To operate these forms of procurement requires a culture change within organizations and, more importantly, requires new project management skills to deal with a range of new roles and responsibilities.

PUBLIC PRIVATE PARTNERSHIP (PPP)

Public private partnerships (PPPs) are a separate class of organizations which operate in a variety of ways but share the obvious common feature of having both public and private sector funding. Many projects which are politically desirable, in other words that have a higher social cost–benefit analysis than their financial analysis, cannot be funded by private finance on commercial terms. Their viability is ensured by the public sector reducing project risk to an acceptable level. The use of direct public debt financing is used very much as a last resort and risk sharing, concessions for existing revenue generating facilities and the provision of indirect benefits like tax holidays are more likely to be adopted. Nevertheless, if there is public sector involvement the public sector will want to be included in the project management process. Working within these hybrid organizations, the project manager is confronted by the culture clash between the two types of organizations and yet still has to make effective project decisions.

DISPUTE RESOLUTION

Disputes and more importantly dispute resolution are key issues in any collaborative agreement. Increasingly, the project manager is involved in finding equitable, speedy and cheap methods of resolving disputes and maintaining focus on the project. If disputes are left for any length of time, they can affect trust and commitment to the project, and the long-term stability of the collaborative agreement could be at stake. At the most extreme levels, parties might leave and need to be replaced, an option which should have been foreseen and allowed for by the negotiation of an agreement which allows for equitable withdrawal as well as equitable entry. However, the vast majority of disputes does not fall into that category and are often suitable for alternative dispute resolution (ADR) procedures.

ADR has been adopted in most countries around the world. It can be simplified as a series of six steps. The lower two steps, 'prevention' and 'negotiation', are present in all model forms of contract and are a core part of the traditional roles and responsibilities. Similarly, the final two steps, 'arbitration' and 'litigation', are also available to most contracts, although sometimes they can only be used on completion of the contract and tend to be lengthy and expensive. It is the middle two steps which as compulsory procedures form the basis for ADR, namely 'independent expert' and 'mediation'. Any dispute which cannot be satisfactorily resolved by negotiation, goes to the independent expert. This person, agreed upon before the start of the contract, is provided with both sides of a dispute, usually within specific and fairly limited time periods. The expert then responds within another fixed period of time with an expert opinion of the issues. This is purely an expert view, it is not legally constituted, it is not binding and it need not be equitable, but it does give the parties to the dispute a view of how the matter is likely to be viewed by others. This is sufficient sometimes for one party to accept another view on a dispute. However, if the expert's view does not result in any resolution, then the next step is mediation. A trained mediator, who ideally is not a lawyer, is agreed by both parties and his or her fees are paid jointly by the parties. A mediator tries to establish a middle ground position which is less than either side really wants, but hopefully is close enough to convince the parties to settle with no real winners or losers. Again, this is not mandatory, but the parties are aware that unless a settlement is reached at this stage the next stage will involve legal representation, will be time-consuming and will be expensive.

THE PROJECT MANAGER

Although the role of project manager is similar in any collaborative venture, the longer the duration of the collaborative agreement the more difficult it becomes for the project manager to resolve the dichotomy of working with long-established but time-limited partners. In one sense, the role is facilitated by increased knowledge, understanding, trust and commitment

but complicated by the finite nature of relations and the commercial imperatives of possible future competitive strengths.

Summary of the chapter

Managing by projects is now becoming accepted across all sectors of industry. Even service provider organizations are moving towards the mechanism of internal and external projects as the basis for strategic development, managing change and adopting best practice. The emphasis given to the 'front-end' activities by project management has enhanced its appeal to general business in addition to the more traditionally project-based sectors. This spread of project management is likely to continue. It is interesting to note that European bankers publicized the 'project' to introduce the Euro, a term which would not have been used a few years ago.

It is always difficult to predict the future, but in essence this is what project management is about. Hence to foresee the future of project management itself is even more of a challenge. However, a number of issues stand out. Business in general is moving towards operating the concept of sustainability. This has implications for the wider contractual environment and the role of the public, or society, in projects. Equally people are increasingly concerned about environmental and community issues and the temporary and permanent effects caused by the implementation and subsequent operation of projects. The roles and responsibilities of project managers are likely to be widened to incorporate these additional demands. Indeed, until any project, in any location, at any date can be guaranteed to be completed on time, within budget and to the specified quality there will always be a need for project managers.

CHAPTER EIGHT

CONTRACTS AND PAYMENT STRUCTURES

Objective of this chapter

At the end of this chapter, the students will be able to:

- **Understand the meaning of contract structure**
- **Differentiate the different contract prices**
- **Identify the different terms of payments**

8.1. Introduction

The nature of the contract between the purchaser and the contractor can take one of a variety of forms. The nature of the contract depends on a range of issues, including the scope of the work, the responsibility of the contractor, the risk involved and the urgency. In this chapter we consider the types of contract structures adopted, different pricing regimes and the terms of payments. We also describe the issues to be considered when selecting the different options.

8.2. CONTRACT STRUCTURES

When choosing to use contractors, the purchaser may follow one of several procurement routes, distinguished by the following features:

- ✓ Whether responsibility for the design, procurement, construction and commissioning is placed with one organization, or is to be divided between several, separate organizations.
- ✓ Whether the main contractor will both manage the project and undertake construction, or will be responsible for the management only with the construction work undertaken by others, working either as subcontractors to the main contractor or as separate contractors

employed directly by the client.

- ✓ The basis upon which payment is to be made.

There are several procurement routes commonly in use:

1. **The traditional system:** Used in building and civil engineering contracts where the design responsibility is primarily that of the architect or engineer employed by the client and the contractor or contractors are primarily responsible for construction only. Some design work may be undertaken by specialist subcontractors nominated by the client, but this can raise difficult questions of design responsibility. The client through their architect or engineer retains control of design during construction and of the general management of the contract. When required, they will issue variation orders. A variant of this may be for the appointment by the client of a project manager to provide management services and for the architect or engineer's functions to be limited to design.

2. **The turnkey contract:** This is where a single firm is employed by the client to undertake the design, procurement, construction and commissioning of the entire works, including managing the process. The client is only responsible for the preparation of their statement of requirements which becomes the strict responsibility of the contractor to deliver. This type of contract is used mainly for the design and construction of process plants and for projects financed using non-recourse financing such as one done under the Private Finance Initiative (PFI). The client does not retain an engineer in the traditional sense during construction and the client's functions are limited to those of inspection, payment and ensuring that the works meet their performance guarantees. This type of arrangement is sometimes called Engineering, Procurement and Construction (EPC).

3. **The design and build contract:** Equivalent to two above, in the building and civil engineering industry. Here, the contractor is responsible for design as well as construction. The contractor's detailed

design is often developed from a conceptual design prepared by the client's designers prior to tender and the client's design team are often seconded to work for the contractor after contract award. The client will, however, retain an engineer to protect their interests.

4. **Construction management and management contracting:** Similar to three above, in that the contractor is responsible only for the management of the contract, with all construction work done by others. The distinction is that in construction management the subcontractors engaged to do the work are contractually responsible directly to the client while managed by the construction manager, whereas in management contracting they are employed by the management contractor as subcontractors. Design is often the responsibility of the client through the architect or engineer but the design process is managed by the contractor. Sometimes design is also made the responsibility of the contractor.

5. **Guaranteed maximum price:** Combines construction management with design and build. In outline this is typically as follows. The contractor is initially responsible for the management of the design phase of the contract including programming, coordinating the work of designers, including specialist firms, and tendering for the various packages of work. At a point where a substantial portion of the contract has been tendered for, the contractor agrees a guaranteed maximum price with the client. The contract form for this second phase as well as the contractor's fee for overheads and profit will have been agreed at the time of the contractor's appointment for the first phase.

The appropriate method for a particular project depends on a number of factors including the following:

1. ***The method of financing****:* If the project is financed by non-recourse financing, that is the project itself provides the security for the loans, the banks are almost certain to insist on a turnkey route so the entire design is the responsibility of the contractor and the client's only responsibility is the preparation of their statement of requirements.

2. ***The need to ensure the earliest feasible date of completion****:* The quickest method is construction management with the contractor responsible at least for the management of design. This allows design and construction to proceed in parallel. It does not, however, provide the client at the outset with a firm price.
3. ***The need to ensure the lowest initial capital cost****:* This is most likely to be achieved using the traditional method although there is a risk that the consultant's design may not be the most economic since it will not have been tendered in competition. On the other hand, a contractor's design might not take account of the lifetime costs. There is also the risk of variations and claims which can cause the out-turn cost substantially to exceed the initial estimate.
4. ***Certainty of the out-turn costs****:* This is most likely to be achieved through the use of the turnkey method which is why it is favoured by the banks. Of course, this will only be so if it is feasible for the contractor to provide a total lump sum for the contract, which means that they must be able to obtain the complete information necessary for a firm lump sum tender. Also all the information must be available at the required time. This may increase the time required for tendering. It also means that the client must not change their mind later.

8.3. THE CONTRACT PRICE

There are three main ways in which the contract price may be expressed or calculated:

1. Lump sum.
2. Remeasurement, schedule of rates or bill of quantities.
3. Cost reimbursement.

On a single contract the different ways may be combined. On a building contract, the above-ground element of a building may be on a lump sum basis while the foundations are done on an approximate bill of quantities subject to remeasurement. The supply portion of a chemical plant may be done on a lump sum, while the installation of the plant is on cost

reimbursement, but with the contractor's overheads and profit compounded as a lump sum.

The choice of which way to price the work depends largely on the amount of information the purchaser can provide the contractor at the time of tendering, the conditions under which the work will be carried out, and thus the risk which it is sensible to expect the contractor to accept. A further factor will be the manner in which it is proposed to finance the project. If non-recourse financing is to be adopted, then almost certainly the banks will wish to see the project contracted for on a turnkey lump sum basis.

8.3.1. LUMP SUM

From the purchaser's viewpoint, and that of any financier, the ideal is a firm lump sum with the minimum provisions for variations or claims. It establishes the amount of the commitment in advance, it provides the maximum incentive to the contractor to complete the work on time and it reduces to a minimum the amount of administration involved after the contract has been let. However, these benefits will be obtained only if it has been possible for the contractor to tender realistically. It follows from this that in addition to the general information required by a tenderer, they must be able to assess the following from information provided by the purchaser, their own engineering staff or prior experience of similar work:

1. The ground conditions on the site.
2. Material quantities and specifications. Labour hours and trades both for shop production and on site. This will mean that method statements must have been produced.
3. Descriptions and quantities of bought-out items. This requires decisions to have been taken, for example, on sizes and capacities.
4. Types of constructional plant which will be required and for what periods.
5. The time required by the various categories of design staff involved.

6. The site organization and facilities which will be required and for how long.
7. Factors which will affect site productivity.
8. Geographical and climatic factors as they affect site work.
9. Access to site.
10. Local availability of materials and labour.

For work which is to be subcontracted, the firm must provide similar information to all the subcontractors to enable them to make a similar assessment. The above is a formidable list. It confirms the need for the purchaser to give complete and accurate information before a lump sum price can be produced. It also indicates that for a major project, considerable time and cost will be expended in the preparation of the tender for a lump sum contract. What must be remembered is that every time a tenderer guesses, it may guess wrong, and if the tenderer is successful in obtaining the contract every wrong guess costs someone money. Moreover, if the contractor is to remain in business in the long run, that someone can only be the purchaser whether on that contract or another.

Just as the contractor's problem on lump sum tendering is to assess the risks involved, so the purchaser's problem is the time it takes for the information to be gathered and processed to reduce those risks to reasonable proportions. Some element of risk will always remain; that is the very nature of contracting. The problem of obtaining information in time arises particularly on contracts which involve work below ground, such as foundations for a structure, tunnelling or sinking of shafts. The drilling of extensive boreholes and examining the results takes time which management is frequently not prepared to accept. Even then there is no certainty that the conditions encountered below ground will be as predicted.

8.3.2. BILL OF QUANTITIES

A distinction must be drawn between two ways in which the term 'bill of quantities' is used. In standard forms of building contract, where quantities form part of the contract, the contract price is a lump sum, not for the building as a whole, but for the stated quantities of work described in the bills of quantity. These quantities are an accurate estimation of the work to be performed by the contractor except where any quantity is stated to be approximate. If greater quantities of work are necessary to complete the works, then the contractor is entitled to be paid extra under the variations clause in the contract. The value of work in addition to the stated sum, or for which only an approximate quantity was given in the bills, is determined by measurement and is priced at rates given in the bills. Thus, although the contract starts as a lump sum it is the client who essentially bears the risk that the quantities are not an accurate estimation of the work, although the contractor takes the risk of an error in pricing.

In civil engineering contracts, by contrast, the bills of quantity are only an approximate estimate of the quantities of work to be performed and, unlike a building contract, do not define the work for which a lump sum price is quoted. In a civil engineering contract there is no lump sum price quoted in the standard form of tender and it is stated in the ICE standard conditions 1999 that the price is to be determined by measurement of the work done. The valuation of that work is then made in accordance with the rates given in the bill of quantities, unless, for any item, the difference between the actual quantity and the bill quantity is such that in the opinion of the engineer the bill rate is unreasonable or inapplicable. There is no necessity in this case for the change to have been the result of a variation. It is assumed that the contractor's rates and prices for the work as stated under the contract are correct and sufficient. Thus for a change of rate to be accepted, the change in quantity must be such as to require a change in the method of working requiring different plant or organization or be so excessive as to completely change the scope of work.

In both building and civil engineering forms the contractor when pricing has to estimate the quantity and cost of the materials, labour, supervision and plant which will be required to execute the work. Since the largest elements are usually labour and plant, the assessment of productivity is a vital part of the estimating process. This in turn is closely related to:

- ✓ the physical conditions under which the work will be carried out, due, for example, to the time of year;
- ✓ the possibility of carrying out the work in a planned way with a reasonable degree of continuity, due, for example, to drawings arriving on site well in advance of the scheduled commencement date of construction.

8.3.3. COST REIMBURSEMENT

On some projects, where the facility delivered will earn substantial revenue, finishing by the earliest possible date is regarded as more important than obtaining the lowest capital cost. Yet the extent of the lack of definition of the project or the anticipated risks are such that it is impractical to expect the contractor to assume the risks of even a measurement and value contract of the type just discussed. In these circumstances, the only alternative is some form of cost reimbursement.

The obvious problem is that paying the contractor the actual costs of carrying out the work provides no incentive for the contractor to minimize the costs. Indeed many contractors do not like cost reimbursement because of the inefficiencies which it can breed within their own organizations. Therefore, various types of incentive or target cost contracts have been devised as a means of combining the flexibility and speed associated with cost reimbursement with a measure of financial discipline and an incentive to achieve economy and efficiency. All these forms of contract have certain features in common:

1. The principle of design and construction being conducted in parallel rather than in series.

2. The tendering by the contractor of a target cost either as a series of lump sums for the carrying out of defined packages of work or for a bill of quantities.
3. The tendering by the contractor of its fee inclusive of profit and overheads.
4. The recording of the actual costs incurred by the contractor which should exclude any costs associated with defective work or re-work to remedy defects.
5. At the end of the contract the making of a comparison between the target and the actual costs. For this purpose, the target must be adjusted to reflect any variations or other events for which the contractor is allowed compensation under the terms of the contract.
6. The sharing between the purchaser and the contractor of the difference between the adjusted target and the actual costs in proportions set out in the contract.

Where the forms of reimbursement contract differ is in their treatment of the contractor's management fee. The Engineering and Construction management form (ICE 1995) provides for this to be a percentage of the actual cost and to be included within the comparison between target and actual cost. In other forms the contractor's fee is a lump sum and is not made part of the comparison. Where the management fee is to be a lump sum, the most careful definition is needed of the items to be included in the target cost and those to be included in the management fee. For example, it may be advantageous for the purchaser to include within the management fee if it is to be a lump sum elements such as the costs of the procurement of materials and of the site management staff and facilities. As to the percentage sharing arrangements between the contractor and the employer, various alternatives are available, but it is suggested that these arrangements should be kept as simple as possible and that it is recognized that there are two objectives:

- To provide the contractor with a genuine incentive to complete the

work for a cost below the target.

- To protect the purchaser from the worst effects of a substantial cost overrun.

If time is particularly important, it is possible to build in an additional incentive by varying the share of the savings accruing to the contractor according to whether or not the contract is completed early or late.

There are many problems with target cost contracts:

1. There is the setting of the target itself. The intention must be that the target is realistic and is not to be either beaten or exceeded by significant amounts. It should not be far outside the normal limits of estimating accuracy. However, the target cost form of contract has been chosen because the uncertainties and risks involved in the contract do not allow the tendering of a lump sum price.
2. Because of the risks and uncertainties, including those arising from the lack of design definition, there is a real chance of substantial variations being required during the course of the contract. The effect of variations on the actual cost will be picked up automatically, in that the contractor is to be paid the actual costs of doing the work. However, it is also necessary for the target cost to be adjusted to take account of the variations. While this may be easier if the target costs are contained in comprehensive bills of quantity, the rates may well not be applicable to the change which has occurred, especially if it is of a design nature. Nor is the use of bills of quantity applicable to all types of contracts.
3. The use of a target cost contract imposes a substantial administrative and supervisory burden on the client in checking the contractor's actual costs, in identifying costs which should be disallowed and in negotiating variations to the target so it remains effective as an incentive. If all this is not done, then the contract will simply slide into straightforward cost reimbursement. On the other hand, to do it all in a timely and appropriate manner will add cost for

the employer, who is unlikely to have the resources to do the work involved and will have to engage outside professional assistance probably in the form of quantity surveyors or cost engineers experienced in the type of work in question.

8.4. TERMS OF PAYMENT

Terms of payment are a matter on which the commercial, technical and financial sides of the employer's business may find themselves pulling in different directions. The employer may attain the best commercial and technical result if they offer the tenderers terms of payment which while providing the employer with reasonable contractual safeguards impose the minimum strain on the contractor's financial resources. There are a number of advantages to this approach:

1. The employer avoids having to restrict the tender list to large firms possessing the resources to finance the contract, whose overheads and prices are likely to be higher than those of smaller companies (this assumes, of course, that such smaller companies are otherwise technically and commercially competent to carry out the work).
2. It ensures that the tenderers do not have to inflate their tender prices by financing charges. In many instances, the rate of interest which the contractor has to pay when borrowing will be higher than that paid by the employer.
3. It gives encouragement to and allows the employer to take advantage of firms possessing technical initiative who would otherwise be held back from expanding by lack of liquid cash.
4. The employer minimizes the risk of being saddled with a contractor who has insufficient cash with which to carry out the contract and of having therefore to either support the contractor financially or terminate the contract.

On the other hand, to offer such terms means that the purchaser has to finance the work in progress, tying up their own capital in advance of obtaining any return on the investment. It could therefore be argued that with a project such as a new factory or power plant it would impose the least financial strain on the employer if they could avoid paying anything at all until the project was earning money. There are also two other arguments which are often used to support the case for only paying at the end when the contract is complete:

1. Payment on completion provides the contractor with the best possible incentive to finish the whole of the work by the date for completion. It is far more effective than imposing liquidated damages for delay.
2. Paying monthly as the work proceeds, as is normal in building and civil engineering contracts, has encouraged the establishment of small contractors who do not possess the technical and managerial competence to undertake the work, tender low, uneconomic prices and lack the cash resources to fund the work when they run into difficulties. It is too easy to set up as a builder by hiring labour on a self-employed subcontract basis and the necessary plant, and buying materials on credit terms which mean that they are in fact paid for by the purchaser. Such firms do not last very long, but their presence while they are in business is one of the reasons why tender prices are uneconomic and too low to support the required level of investment, especially in training. They are also a prime cause of the adversarialism and claims culture prevalent in the industry.

There is some truth in both these arguments, but the practice in the construction industry is too well established. Even the Latham Report, *Constructing the Team* (1994), did not recommend the abolition of interim payments, although it did recommend that payments should be related to the completion of milestones or activities. Merely financing the contractor by paying them monthly for the quantity of work performed, whether any item has been completed or not, is not considered to be to the purchaser's advantage. Similarly, waiting to pay until completion of the whole of the

works would lose purchasers the advantages identified at the beginning of this section and would be unlikely to be acceptable to the industry. The contractor when tendering prepares the activity schedule although the purchaser when inviting tenders can state any particular activities which they wish to have priced or any activities which they wish to be grouped together. Each activity or a group of activities is then priced as a lump sum. On each assessment date, say monthly, the project manager determines which activities or group of activities have been completed and the contractor is paid for the completed work. It is important to note that payment is only made for completed activities or, where they are grouped, against completion of the group. There is no payment for a percentage complete. This method is suitable for building, mechanical and electrical engineering and process plant contracts.

However, as noted earlier, not all contracts can be tendered for on a lump sum basis. If it is impracticable to do so because of the uncertainties involved in assessing the quantities, so that a bill of approximate quantities is needed, then it is traditional to pay on a monthly basis the value of work which has been completed. However, the possibility should always be considered of tying in payment with the completion of certain milestones which can be identified from the programme. The milestone could be, for example, the construction of a foundation for a particular item of mechanical plant. Payment would then be made only against completion of that item ready to receive the plant.

Two problems particularly associated with monthly payment of remeasurement contracts are the practice of contractors to over-measure during early months of the contract and to front-end load by artificially increasing the rates for items of work carried out early. The use of an activity or milestone method of payment would overcome the first of these. The second can be avoided by allowing the contractor to identify as an activity, say, the preparation of the site.

DELAY IN PAYMENT

Where the contract provides for payment to be made against some clearly defined event, and for the payment to be within a specified period of that date, there is no excuse for delay in payment. The specified date may be either from the issue by the architect or engineer of a certificate of completion or from receipt by the purchaser of an invoice which the contractor was entitled to submit, depending on the contract. Late payment is quite simply a breach of contract, although one of the commonest committed. Many contracts do in fact provide for the payment of interest on delayed payments. Further, if payment is delayed after notice from the contractor for more than a specified period, the contractor may be entitled to suspend work or even to terminate the contract, although these rights do not exist at common law. If the contract does not provide a substantial contractual remedy for late payment, then the Late Payment of Commercial Debt (Interest) law provides that interest shall be payable at 8 per cent above base rate in respect of late payments. The law is now in force on contracts for the sale of goods or engineering and building works which are between a small business (less than 50 employees) and a large business (more than 50 employees) in respect of payments due from the large business. The law does not specify a mandatory period for payment, although if no period is stated, then the period is 30 days from delivery or performance of the service. In practice a period of 30 days from the certificate of the event having been achieved should be sufficient for any well-organized employer. There is also now a limited right for the contractor to suspend performance of a construction contract under the Construction Industry law if payment is delayed beyond final date for payment and no effective notice to withhold payment has been given.

ADVANCE PAYMENTS

The general rule is that payments made in advance of the contractor starting work or of delivery of equipment to site should be avoided so far as

possible. If for commercial reasons such payments have to be made, then they should always be secured by a bond which is on first demand.

Progress Payments during Manufacture

On contracts which include the manufacture of plant, it is again suggested that progress payments in advance of the actual delivery of such plant to site should be avoided. The primary reason is the purchaser's lack of security for such payments and the difficulties of recovering them if the manufacturer gets into financial difficulties. If for commercial reasons it becomes necessary to make such payments, then:

- ✓ plant to at least the value of the payment should be identified, marked as such, separately stored and the contract should state that on payment it becomes the property of the purchaser;
- ✓ such plant should, however, also be stated in the contract to remain at the risk of the manufacturer until at the earliest it has been delivered to site and may be depending upon the contract until the works as a whole have been accepted by the purchaser.

RETENTION MONEY

With contracts for building and civil engineering works and large contracts for supply and installation of plant and equipment, it is usual for the purchaser to retain a proportion of the contract price until the work has been completed, passed its tests (if any) and accepted by the purchaser. This percentage varies but is usually between 10 per cent and 20 per cent. On acceptance, half of this money is normally released and the balance held during the defects liability period as security for the performance by the contractor under their obligations to make good any latent defects which appear in the work. It is released at the end of this period provided that all defects have been remedied to the purchaser's satisfaction. Contractors often ask for the second half of the retention money to be released to them on

completion against a bank guarantee. There can be no real objection to this, provided again that the bond is payable on first demand.

Summary of the chapter

The nature of the contract between the purchaser and the contractor can take one of a variety of forms. The nature of the contract depends on a range of issues, including the scope of the work, the responsibility of the contractor, the risk involved and the urgency. On a single contract the different ways may be combined. The choice of which way to price the work depends largely on the amount of information the purchaser can provide the contractor at the time of tendering, the conditions under which the work will be carried out, and thus the risk which it is sensible to expect the contractor to accept. A further factor will be the manner in which it is proposed to finance the project. If non-recourse financing is to be adopted, then almost certainly the banks will wish to see the project contracted for on a turnkey lump sum basis. When there is little or no performance risk or the degree of risk can be predicted with an acceptable degree of certainty, a firm fixed price contract is preferred. However, when uncertainties are significant, other types of fixed price or cost type contracts should be considered. To award a fixed price contract when the effort has significant uncertainties may result in an eventual higher price, through later financial claims by the contractor.

CHAPTER-NINE

FARSIGHTED PROJECT CONTRACT MANAGEMENT

Objective of the Chapter

At the end of this chapter, the distance learners will be able to:

- ❖ conceptualize project organization: cooperation or conflict issues
- ❖ understand a theory of contract: incentivation versus governance
- ❖ identify the types and theory of contract
- ❖ Identify the essential elements of a valid project contract
- ❖ Identify the factors that affect the choice of contract types

9.1. Introduction

In the previous two chapters various contract structures and terms of payment were identified. There are three basic project contract structures:

- ➢ Traditional structures;
- ➢ Integrated structures;
- ➢ Management structures; and three basic forms of payment:
- ✓ cost plus;
- ✓ remeasurement;
- ✓ fixed price.

The different circumstances in which these contract structures and forms of payment are used were described earlier parts of this module, where Peter Marsh suggested some criteria for selecting the appropriate form for a given situation. This chapter describes the results of recent research into contract selection and suggests a methodology. The aim is twofold:

1. To develop a cooperative project organization.
2. To appropriately allocate the management of risk.

It is a sad reality that the more common approach to contract management is to develop a project organization based on conflict. The owner and contractor try to outdo each other, to win a greater share of what they see as a fixed-sized cake in a win–lose battle. I think there is no such thing as a win–lose outcome, it is either win–win or lose–lose. The aim should be to develop a cooperative organization in which the owner and contractor work together to manage the risk and achieve a better result for both of them. Projects are temporary organizations to which the owner assigns resources to achieve their development objectives. As with all organizations, it is in the owner's interest that all their 'employees' are motivated to achieve their objectives. It is through the project contracts that the owner employs outside resources to work on the project, and attempts to align the resources' objectives with their own by properly motivating them. This chapter will describe a schema for contracts which judges their ability to align the contractor's objectives with the owner's to create a cooperative project organization.

This *ex-ante* incentivization would be all that is necessary if the project conditions were entirely predictable throughout its life. However, projects are not that predictable. Thus farsighted contracts are necessary; contracts that are able to deal with any new risks or uncertainty that may arise as the project progresses, which are able to deal with unforeseen events, both adverse and beneficial. These farsighted contracts will be unavoidably incomplete; they will not be able to deal with every eventuality. *Ex-post* governance is needed to provide farsightedness and allow adaptation required to deal with incompleteness. A second schema will describe the nature of governance provided by different contract types and their ability to cover farsightedness and deal with incompleteness.

There are two views on risk. The first is that you should use fixed-price contracts on projects with low risk, remeasurement with intermediate risk and cost plus with high risk. However, this is not modern practice. The second is that you should assign risk where it is most appropriately controlled. The problem is that projects are non-linear, coupled systems.

Reducing risk in one area can create an even greater risk in another. Risk needs to be managed as a whole, not piecemeal. This chapter will describe modern practice on choosing contract structures and payment terms to allocate risk on projects.

The next section recalls that a contract is the method by which the owner creates the project organization and that the aim should be to develop a cooperative organization, not a conflict one. It then describes the two schemas for providing *ex-ante* incentivization and *ex-post* governance on projects, and shows how these apply to the different contract structures and forms of payment described in the previous two chapters. It describes modern practice in choosing contract type to allocate risk, and then proposes a methodology to choose a contract strategy based on:

- who controls the risk: the client or contractor, or both;
- the complexity of the project;
- where the risk lies: in the project's product or process, or both.

9.2. PROJECT ORGANIZATION: COOPERATION OR CONFLICT?

There are two ways of viewing a project organization: the correct way and the normal way, respectively:

- a temporary organization through which the owner assembles resources and motivates them, in a climate of cooperation, to achieve their (the owner's) objectives;
- a marketplace, in which the owner attempts to buy the project's outputs at the cheapest possible price, in a climate of conflict with the contractors, in which one party is going to win and one lose.

In the more common approach, the client adopts the mindset that they are going to buy the project's outputs in the local bazaar, and they must negotiate hard to achieve the lowest possible price from the vendor (contractor). The negotiation is viewed as a win-lose game, in which one will gain the greatest share of a fixed cake. Therefore a climate of conflict

develops where the client and contractor try to outdo each other which then spills over into project delivery, where the climate of mistrust continues. The client mistrusts the contractor throughout, assuming that the contractor is trying to claw back money through the project's delivery. This usually leads to a lose-lose outcome.

The project is a temporary organization, through which the client tries to assemble resources to achieve their development objectives. As in any organization, the owner should view the resources working for them as their employees (albeit this will be a temporary employment relationship), and motivate these employees to achieve their objectives. Because it is a temporary employment relationship, the owner will often employ resources from an agency, and will ask the agency (contractor) to do the work on their behalf. Effectively their 'employees' will be a company (contractor) rather than a person, what the Dutch would call a legal person rather than a natural person. But the owner should view these legal persons as much their employees as natural persons, and motivate them to achieve their project objectives.

Levitt and March (in Williamson 1995) say this about the purpose of organizing: The problem of organizing [is] seen as one of transforming a conflict (political) system into a cooperative (rational) one. A conflict system is one in which individuals have objectives that are not jointly consistent. It organizes through exchanges and other interactions between strategic actors. A cooperative system is one in which individuals act rationally in the name of a common objective. The aim of project organization should be to create a cooperative system in which individuals, legal persons and natural persons work together in a rational way to achieve a common (the owner's) objective. It is through the project contracts that the owner creates the project organization and 'employs' legal persons (the contractors) to work on their projects. Therefore it is through the contracts that the owner should try to motivate the contractors to achieve their objectives, which is best done through a win-win game. Thus, when developing a project contract strategy

the owner should choose a contract type that develops an appropriate social relationship between themselves and the contractor, and provides incentives to motivate the contractor to achieve their objectives.

Because projects are temporary organizations they entail risk and uncertainty (and sometimes opportunity). Thus to provide an appropriate incentive the contract needs to recognize this risk and include appropriate safeguards to protect the contractor (and indeed to enable the owner to share in the exploitation of any opportunities). The contract should be designed to encourage the owner and contractor to act rationally together to achieve their common objectives and the best outcome for both, within the context of the expected risk. However, that rationality is almost certain to be bounded by human frailty (Williamson 1996). It is bounded by the project participants' inability to precisely and unambiguously:

- communicate with each other;
- process information to interpret events;
- foretell the future.

Therefore, not only does the contract strategy need to provide incentives and safeguards to deal with the risks as envisaged in advance (*ex-ante* incentivization), it must be flexible enough to deal with unforeseen circumstances as they arise; the *ex-ante* contract is unavoidably incomplete. In order to maintain a climate of mutual cooperation, the contract needs to be adapted to these circumstances through mutual agreement and cooperation, not through one party using them to make gains over the other party. The contract needs to provide flexible, farsighted *ex-post* governance structure that:

- Allows adaptations through mutual agreement.
- Provides a communication structure to identify how the project is progressing, and to identify any problems that may arise so that they can be dealt with in a cooperative fashion.
- Continues to provide an incentive for the contractor to deliver the client's objectives.

- Does this without either party feeling the need to resort to the law (which automatically is a lose-lose scenario - the 'winning' party just losing less than the other).

9.3. A THEORY OF CONTRACTS: INCENTIVIZATION AND GOVERNANCE

Oliver Williamson (1995, 1996) suggests two schemas or vectors to describe the ability of contracts to provide *ex-ante* incentivization and flexible farsighted *ex-post* governance.

***EX-ANTE* INCENTIVIZATION**

In the first schema, to provide *ex-ante* incentivization (Figure 3.1) the contract is described by three parameters:

- the reward it provides the contractor to share the owner's objectives and perform;
- the associated risk;
- the safeguard provided by the owner through the contract to shield the contractor from the risk.

Where there is no risk present, there is no need for any safeguard and the reward can be low. If there is risk present, there may or may not be a safeguard. If there is no safeguard, the contractor buys all the risk off the owner and a high reward is required. Where there is a safeguard, the owner underwrites the contractor's risk and the incentive can be lower. Note that in some cases the safeguard only provides protection against extreme risk. For lower levels of uncertainty the contractor takes the risk. However, for extreme events, the client underwrites the contractor. This is the case with target price contracts, or where the contractor only claims for variations over a certain size. In these cases, the reward may be less than where there is no safeguard at all.

Williamson is writing about contracts for supply of a large number of units, not for one-off, unique, novel and transient projects. He assumes the cost of works is independent of the contract type, the natural costs associated with

the task. The incentive is part of the transaction costs associated with the contract that is additional costs over and above the basic cost of works (Cox and Thompson 1998). However, we shall see later that on some projects different contract structures and forms of payments can lead to different out-turn costs and the incentive can come from the contractor sharing in savings in the cost of works (even keeping all the savings on fixed-price contracts).

Risk	Present	High incentive	Medium incentive
	Absent	Low incentive	No safeguard or incentive necessary
		Absent	Present
		safeguard	

Figure: A simple contractual schema for *ex-ante* incentivization

FLEXIBLE, FARSIGHTED, *EX-POST* GOVERNANCE

Although the schema above assumes a safeguard risk, it can really only deal with risks that are foreseen. If properly motivated, the project's participants should behave rationally towards a common (the owner's) objective. However, as Williamson suggests, because of human frailty their rationality is bounded mainly by their ability to communicate, to process information and to foresee the future. Thus every project contract is almost certainly incomplete. Farsighted, *expost* governance is required to deal with unforeseen circumstances. Williamson propounds four parameters to describe the ability of a contract form to provide flexible, farsighted, *ex-post* governance:

- the incentive intensity;
- the ease of making uncontested, bilateral adaptations to the contract;
- the reliance on monitoring and related administrative controls (transaction costs);
- the reliance on court ordering.

Incentive intensity Greater incentive intensity will elicit greater performance and sustained effort from the contractor to achieve the owner's objectives, and greater flexibility in accepting changes to adapt to unforeseen circumstances.

Bi-lateral adaptation: This describes the ability of the parties to a contract mutually to accept changes. Some contracts inhibit changes, even if both parties are willing to accept them but others encourage them. Although this is described as 'bilateral adaptiveness', it is not always the case that both parties need to be party to the decision to adapt. It depends on the ability of parties to solve problems. We will see it is often the case that the client can make no contribution to problem solving. What is best for cooperation is to let the contractor get on with it and decide (within the constraints set by the incentive) on the preferred way of dealing with the changes.

Reliance on monitoring and administrative controls: Some contract forms require very intrusive systems for monitoring and control, leading to high transaction costs, while others allow quite light control. On projects, these transaction costs associated with monitoring and control can be small when compared to the savings to the costs of works through appropriate motivation of the contractor. Thus incentive intensity has a stronger impact on project costs than reducing control procedures. However, if appropriate incentives are chosen, there may be no need for monitoring and control procedures since the contractor can be allowed to work unilaterally.

Reliance on court ordering: If the contract discourages cooperation and encourages conflict, then it may be necessary for the client and contractor to settle their differences in court. Reliance on court ordering is a measure of how much the contract encourages client and contractor to cooperate and settle their differences of opinion in ways other than resorting to the law. If it is necessary to resort to the law, then the project has become a conflict system and all parties stand to lose, just some more or less than others.

9.4. CONTRACT TYPES AND A THEORY OF CONTRACTS

Traditional contract forms will now be compared to the two schemas above. We will see that different contract structures attach naturally to forms of payment as we select contract types. The forms of payment considered are:

1. Cost-plus contracts

   - cost plus percentage fee
   - cost plus fixed fee
   - cost plus incentive fee
   - alliance contracts, or cost plus gain share (alliance).

2. Remeasurement contracts

   - ✓ remeasurement based on a schedule of rates , effectively cost plus
   - ✓ remeasurement based on a bill of quantities
   - ✓ remeasurement based on a bill of materials, effectively fixed price plus variations.

3. Fixed-price contracts

   - ✓ fixed-price based on a detailed design , effectively remeasurement
   - ✓ fixed-price design and build based on a scope design
   - ✓ fixed-price design and build based on cardinal points (a functional specification).

4. Others

   - ✓ target cost
   - ✓ time and materials to budget, or guaranteed maximum price.

The incentive profiles of the contract types are summarized in Figure 3.2 and the governance profiles in Figure 3.3. These tables also show the profiles of the traditional contract forms, markets and hierarchies described by Williamson (1995, 1996) for routine supply.

9.4. REMEASUREMENT CONTRACTS

In remeasurement contracts the contractor is rewarded for the amount of work done, according to a pre-agreed formula.

Schedule of rates (SOR) The amount of labour and materials used is measured and the contractor is paid according to agreed hourly and unit rates. This is effectively cost plus. There is no motivation on the contractor to control productivity levels. It suffers from all the problems of cost plus. There is a high safeguard, but the reward is not aligned to the client's performance criteria. There are high transaction costs, but the incentive is not aligned to the client's objectives. SOR should be used where the work and material requirements are very clearly defined, by the client or their design consultant, and contractors then provide agreed amounts of labour and material against industry standard rates.

Bill of quantities (BOQ) Standard work elements are identified and the contractor is rewarded according to the number completed. The contractor is now motivated to control productivity levels. It is appropriate where a project consists of clearly identifiable work elements but the exact number is uncertain at the outset. Again, the client should not expect the contractor to suggest improvements for the benefit of the client, because that will actually reduce their profit. The contractor may try to find ways of improving the delivery of the work elements but will not pass those improvements on to the client. The contractor may even take shortcuts to the client's detriment. So there are medium-level transaction costs, again giving the client little benefit.

Bill of materials (BOM) Standard larger work packages are identified and the contractor is rewarded according to the number completed. In this case, once the price for the work packages has been set the contractor is not motivated to suggest improvements. However, in the early stages of the project the client and contractor can work together to optimize the design of the work packages and the client can ask contractors to bid competitively for

the work package rates. Transaction costs are now lower because there are much larger elements of work requiring less need for monitoring and control.

Remeasurement contracts are the closest in a project context to the market in routine supply, especially in the SOR and BOQ cases. In the former the client is buying labour and bulk materials in the bazaar, and in the latter they are buying standard components. Therefore these will be appropriate where there is low specificity and relatively high competition to provide the labour and materials or supply the standard project components. With the BOM form there will be higher specificity, requiring closer cooperation between client and contractor while the work packages are defined, but enabling lower monitoring and control costs once work starts.

FIXED-PRICE CONTRACTS

Fixed price based on a detail design

The client or their design consultant produces a detailed design of the project's output (facility) which is awarded to a construction contractor for delivery. The construction contract may either be bid under competitive tendering, or it may be awarded according to a standard schedule of rates or bill of quantities. Either way this is effectively a remeasurement contract, since any variations will be completed according to a schedule of rates or bill of quantities. However, variations will be sought by the contractor, since typically these contracts are bid under tight margins and so they will seek to increase their profit through variations. Variations will also equally be resisted by the client. These types of contract can lead to the greatest mistrust between client and contractor.

They are the worst form from the contractor's perspective. There is little reward and no safeguard, but little risk if the design is well done. Because of this, incentive intensity is low. There is little motivation for the contractor to achieve the client's objectives – they are just trying to do the minimum work for the minimum cost. There will be no adaptiveness unless the

contractor sees it as a way of making extra money. Transaction costs are high, to process the variations that arise, and because there is a strong climate of mistrust there is a heavy reliance on the courts.

Design and build based on a scope design

The client, or a design consultant, performs an initial scoping design of the facility and the contractor is required to do the detail design and construction. If the scope of supply also includes commissioning, this type of contract is sometimes called *lump sum turnkey.* It is usually said that this type of contract is appropriate where it is possible to specify the final facility quite tightly and so the risk will be low. However, it can also be used where the facility can be specified quite tightly but there may be some uncertainty in the method of delivery, and only the contractor has the skills to reduce the risks. The client or their design consultant can make no contribution to the delivery of the plant.

If the risks are low, the safeguards will be low and the rewards low. Where risks are low, there will be several contractors able to do the work and so they will all bid with tight margins. The cooperative organization is best served by the client keeping well away from the project during its delivery so that the contractor is free to make whatever adaptations to the process of delivery they see fit. If margins are tight, the contractor may try to claw back additional profit through variations and that will increase transaction costs. However, if the client were to increase the contractor's profit to cover variations under a certain size, which are almost inevitable, transaction costs can be reduced. Built-in incentives to control variations can lead to a cheaper outcome.

Cardinal points or functional specification

The client specifies the functionality and key performance indicators (cardinal points) of the facility to be delivered by the project, but leaves it to the contractor to find the best solution both in terms of the design of the facility to achieve those, and the method of its delivery. This form is best

used where there is uncertainty about how best to deliver the facility, and the client can make no contribution to solving that problem. The contractor buys all the risk through a fixed-price contract, and makes their reward by finding the best solution. This contract form was used in the case of the Botlek Tunnel under the Oude Maas River, part of the Betuweroute (Dutch High Speed Freight Line) from the port of Rotterdam to the German border. It gave the client a price lower than they could get by any other contract form, but still let the contractors make a reasonable reward through the solution they found to the project. They were motivated to reduce the scope of works by the form of contract.

Incentive The contractor's risk is high, but there are suitable rewards. In the case of the project just described, by and large there were no safeguards. The contractors bought all the foreseeable risks but the client, the Dutch state-owned railways, underwrote some further low probability but high severity insurable risks. This enabled the contractors to bid a lower price than if they had underwritten those risks themselves. In the event, the risks were not encountered.

Governance The contractor's incentive comes from their ability to find an effective solution to the problems, and so can be high. The form of contract is very adaptive because the contractor is left to work to find the best solution which means that transaction costs are low. If well formulated, there should be little need for recourse to the courts because the cardinal points can be quite clear. And if the extreme risks are properly underwritten, there should be no need to make claims.

9.5. CHOOSING CONTRACT TYPES

How do you choose the appropriate type of contract for a particular project? Conventional wisdom is that contract type is dependent on the level of risk:

- ✓ At low levels of risk, fixed price is appropriate. The contractor takes little or no risk in buying the project and its associated risk off the

client.

- ✓ At intermediate levels of risk, remeasurement is appropriate.
- ✓ At high levels of risk, cost plus is appropriate. It would be inappropriate to expect the contractor to bear risk which rightfully belongs to the client.

However, Turner and Simister (2001) showed that this does not fit current practice. By investigating a range of large construction and infrastructure projects from several European countries they showed that contract type tends to be chosen as follows:

1. Remeasurement contracts are used on low risk projects, but specifically where the contractor can make no contribution to the improvement of the design through construction knowledge. The client and their consultant complete the design without involving the contractor, and then appoint the contractor to complete the construction works, paying them according to industry standard schedules of rates or bills of quantities. This is the assumption behind the traditional procurement route and the Institution of Civil Engineers standard form of contract (ICE 1995). They tend to be construction only contracts.
2. Fixed-price contracts are used where the client can make no contribution to the delivery of the project and the management of risk. The contractor buys the risk off the client and is then motivated to find the best way of completing the project independent of the client. The contractor can make good profits by finding the best solution, but the client often gets the project more cheaply than they would with other contract forms. They tend to be design and build or turnkey contracts.
3. Cost-plus contracts are used where both the client and contractor can work together to reduce the risk, but specifically the type is the alliance contract. The client and contractor (or contractors – there may be several) together find the best solution of the project. A gain share pot is created so that the client and all the contractors can share in the achievement of the client's objectives (reduced risk, reduced out-turn cost, and the achievement of other performance indicators).

Thus the form of contract is chosen to achieve goal alignment, dependent on who controls the risk: the client, the contractor or both together. Control over the risk tends to be linked to where the risk lies:

- ✓ If the risk lies in the method of delivering the project, then the contractor has best control over it and fixed-price contracts are best. If the product can be clearly specified (especially in the case of cardinal points procurement), and the uncertainty lies in how that product is best achieved, the contractor has control over the risk.
- ✓ If the risk lies in the product to be delivered (which means there will also be uncertainty in the work methods), then the client and the contractor both control the risk, and alliance contracts are best. Client and contractor now need to work together to reduce the risk.
- ✓ If the risk is low, the client and their consultant can develop the design package independently of the contractors and assign a prescribed package of work.

9.6. A STRATEGY FOR PROJECT CONTRACT SELECTION

We can now develop a methodology for project contract selection based on the need to:

- ✓ provide the contractor with incentive to achieve the client's objectives;
- ✓ provide flexible, farsighted governance to deal with incompleteness, but at minimum transaction costs.

The methodology depends on several questions:

1. Who controls the risk?

    - ✓ the client
    - ✓ the contractor
    - ✓ both.

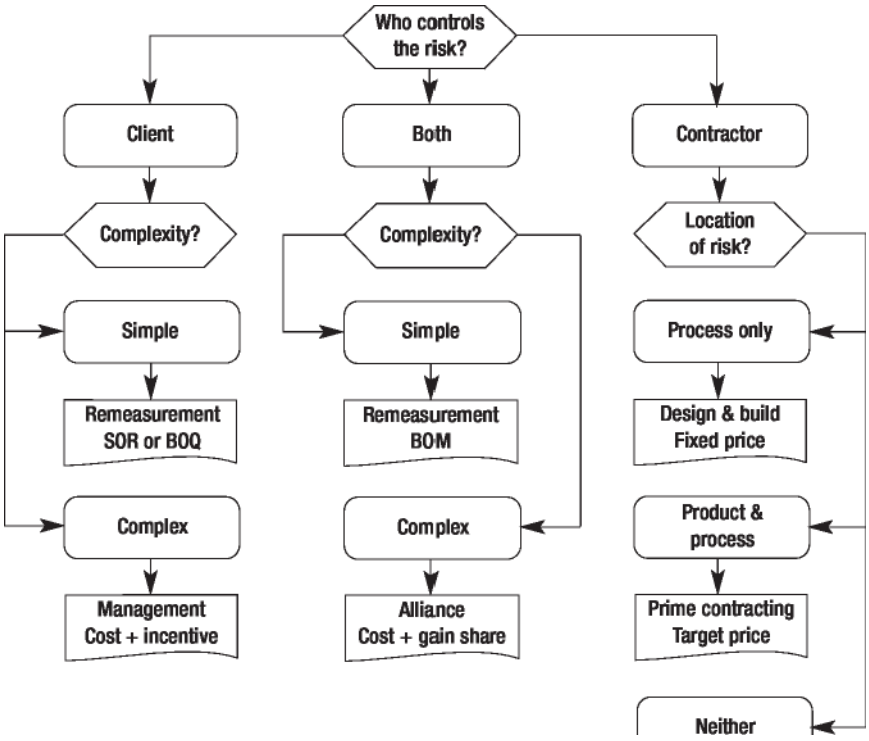


Figure: Methodology for project contract selection

2. The nature of the project?

- ✓ simple
- ✓ large, complex, multi-stage.

3. The location of the uncertainty?

- ✓ in the project's product
- ✓ in the process of delivering the product
- ✓ both
- ✓ neither

9.7. CONTRACT FORMATION

There are four essential elements for a binding contract to be formed between two companies:

1. Offer.
2. Acceptance.
3. The intention to be legally bound.
4. Consideration.

OFFER

An offer in law is both a statement of the terms upon which a party is willing to contract and an expression of willingness to do so if an acceptance is given of those terms. It must be distinguished from an 'invitation to treat' (of which the classic example is the display of goods in a shop window), which is an indication of the terms upon which the seller is willing to do business, but not that they would accept any offer that was made. The commercial significance of this distinction is that a price list issued generally by a seller does not constitute an offer unless it is clearly evident from the terms of the price list that the seller intends to be bound by any order which the buyer places. An offer can be withdrawn at any time before it is accepted unless there is a separate contract under which the seller undertakes to keep it open for a certain period. This is because any promise made by the seller in a quotation to keep the offer open for, say, 60 days would not be binding, because it would not be supported by consideration (see below). However, withdrawal of the offer (revocation as it is often termed) is only effective when it has actually been received by the person to whom the offer was made. Accordingly, if an offer is accepted prior to the receipt of the notice of revocation, then a valid contract exists and the purported revocation is of no effect.

ACCEPTANCE

An acceptance of an offer becomes effective when it has been communicated to the person who made the offer. Assuming the offer has been sent by post, the acceptance has been communicated when the return letter is addressed, properly stamped and posted. Where the acceptance is by e-mail or facsimile, then the timing of acceptance is when the message is received on the machine of the person making the offer during normal working hours for that business. If the message is received outside these hours, it becomes effective at the moment the office reopens. The principal difficulty with acceptance is that to be effective in creating a contract its terms must coincide with those of the offer. Very often this is not the case.

The seller makes an offer on their terms of sale and the buyer purports to accept but on their terms of purchase. In law such an 'acceptance' is classified as a counter-offer which the seller is free to accept or reject. At that stage, no contract exists and there are three possibilities:

1. Nothing is done to resolve the matter but in due course the goods are delivered and accepted by the buyer. By delivering the goods, the seller is regarded as having accepted the buyer's terms by conduct. This would not apply if the goods were accompanied by a delivery note referring to the seller's conditions which the buyer accepted.

2. The supplier returns a tear-off acceptance slip which was part of the buyer's order and which states that the supplier accepts the order on the buyer's conditions. The contract will then be on the buyer's conditions. This will be so even if the seller returns the slip with a letter which refers back to the seller's tender.

3. The seller can only protect themselves by referring in the letter specifically to their acceptance being on their terms of sale. This would then amount to a counter-offer which the buyer could either accept or reject. If the buyer did nothing and there was no further discussion of the terms of contract, then no contract would be formed until there was acceptance by conduct, for example by the buyer taking delivery of the goods.

INTENTION TO BE LEGALLY BOUND

Normally this requirement is easily satisfied where the transaction is between two commercial organizations. The parties may, however, not wish their agreement to be legally binding, and if they state so expressly, then the court will give effect to this. This is rare but it has happened with so-called 'Letters of Comfort' issued by banks when they have not been willing to give a guarantee of financial support.

More common are instances where one of the parties indicates that they have no intention to be legally bound by making their offer 'subject to

contract'. There can then be no binding agreement until the parties have entered into a formal contract and, with sales of land, contracts have been exchanged. Where the parties have left open important matters for future agreement, the court may also decide that the parties did not intend to be bound until such matters had been agreed. Similarly, an agreement to negotiate is not a contract because it is too uncertain to be enforced. To make the agreement binding, it would be necessary to establish in the contract a mechanism for settling the matters left to be agreed by reference to a third party whose decision the parties agree to accept as final and binding.

CONSIDERATION

Consideration is a highly technical concept peculiar to common law. It requires that for a binding contract to arise, an act or promise of one party must have been given in exchange for an act or promise by the other. Note, the consideration must exist; it does not need to be adequate. It cannot be claimed that a contract did not exist because the consideration was not adequate recompense for the offer. Normally there is no problem about consideration in a commercial contract, since the seller undertakes to supply the goods or do the work in consideration of the promise of payment by the purchaser. However, there are four situations in which the doctrine can have commercial significance.

Standing offers

Tenders are sometimes invited for an indefinite quantity of goods which the purchaser thinks they may require over a period of time. Unless the invitation states to the contrary, the purchaser by accepting such a tender does not bind themselves to order anything and is under no liability to the successful tenderer until they actually do place an order. Similarly, unless they have given consideration for keeping their offer open, the supplier may withdraw their tender at any time, but is obliged to fulfil any order which is placed before they do withdraw.

Promises to keep offers open

We saw above that a statement in a tender such as 'our offer is valid for 60 days' is not binding on the tenderer and they may withdraw it at any time before it is accepted. The reason is simply that the purchaser has given no consideration for the promise. It is possible for the purchaser to create consideration and in effect turn the offer into an option. Moreover, since the consideration need not be adequate, the amount could be largely nominal.

Promise post-contract to pay bonuses

The rule has been that when A is bound by a contract to perform certain obligations for B, then A's performance of their obligations could not provide consideration for a promise by B to make additional payments. However, it has now been established that if B's promise to pay is not due to pressure brought by A amounting to economic duress, and B gains practical benefits from the promise, then the promise is enforceable. The practical benefits obtained by B from A's performance on the original contract provide the consideration. This was established in a case in which a subcontractor who was in financial difficulties and likely to complete the work late was promised a bonus if they completed on time. By obtaining completion of the subcontract work to time, the main contractor obtained practical benefits; in particular they avoided having to pay damages for delay.

Payment of lesser sum than a liquidated debt

If one party to a contract agrees to accept a lesser sum in settlement of a liquidated amount which is due to them, then that agreement will not be binding unless supported by some consideration other than the payment itself. Such consideration could be payment at an earlier date than required under the contract or the performance by the debtor of some other obligation of benefit to the creditor. In the absence of any consideration, the creditor can sue for the balance of the liquidated amount. In *D & C Builders* v. *Rees,* a firm of builders in severe financial difficulties accepted a payment of Br.300 in full settlement of the amount of Br.482 which they

were owed. It was held by the Court of Appeal that they were entitled to recover the balance.

LETTERS OF INTENT

Like many other expressions in common commercial use, letters of intent have no distinct legal meaning. In order to determine what the parties meant when issuing and acting upon a letter of intent it is necessary to examine objectively what the parties did and said. The following are therefore only guidelines: Generally a letter of intent does not give rise to any legal obligation on the part of either party. It is simply an expression of present intentions. However, in addition to expressing an intention to award the contract to the supplier, the letter of intent may go on to authorize the supplier pending conclusion of negotiations to do certain work or purchase materials. If the supplier does so, but the contract is never concluded because the parties never reach agreement, then the purchaser is bound to pay a reasonable sum for the work done or materials supplied. However, since there never was a contract between them the supplier is under no contractual liabilities as regards defects in the work or as to the time of its completion.

9.8. INVALIDITY FACTORS AND FRUSTRATION

After its formation, a contract may be upset by one of several factors. These may be conveniently grouped together as:

- mistake;
- misrepresentation;
- duress;
- frustration

MISTAKE

Only very rarely will a contract be held to be void or non-voidable for mistake. The mistake must be something fundamental, such as the existence of the goods, or where there is such confusion between the parties that there

cannot objectively be said to be any agreement between them. A mistake as to quality will only ever upset the contract if it concerns some fundamental quality without which the goods would be essentially different from those which they were believed to be.

MISREPRESENTATION

Although there are four classes of misrepresentation – fraudulent, innocent, negligent and under the Misrepresentation Act 1967 – it is only the last which is of commercial significance in the law of contract. Negligent misrepresentation belongs to the law of tort with which we are not concerned. It is a misrepresentation under the Act if the statement is false and the party making it cannot show that he or she had reasonable grounds for believing it to be true. The other party's remedy is to recover damages.

DURESS

A contract is only valid if is entered into freely and voluntarily. Physical pressure to persuade someone to enter into a contract is fortunately very rare but there is now recognized a new category of duress, namely economic duress. This arises when the will of one party has been coerced by that of the other and the pressure exerted is illegitimate, such as a refusal by one party to carry out the contract unless a new contract is made under which they are paid more money. The effect of economic duress is to make the contract voidable and the innocent party can recover any payments made as a result of the duress. Mere commercial pressure will not be sufficient to constitute duress, nor will the fact that the one party has had to agree to harsh terms because of the weakness of their bargaining position.

FRUSTRATION

A contract will only be considered as frustrated, and therefore at an end, if it becomes impossible for it to be performed by reason of an event beyond

the control of the parties. It is not sufficient that its performance for one party becomes more difficult or more expensive.

Summary of the Chapter

This chapter adopts the premise that the purpose of project organization is to create a cooperative working relationship between all the parties involved, especially the owner and their contractors. The contracts are the method by which the owner creates the project organization and brings the contractors in. Therefore, the contracts should aim to align the contractors' objectives with the owner's, by providing appropriate incentives. A three-dimensional schema (reward, risk, and safeguard) was used to analyse the efficacy of different contract types. Contractors will behave rationally to optimize their economic position, so the owner needs to ensure that all their contractors' economic positions are aligned with theirs. Project contracts are also unavoidably incomplete. Bounded rationality means that people would like to behave rationally, but through human frailty will not do so perfectly. Bounded rationality is caused by an inability to communicate and process all information, and foresee the future. Thus the contracts should also be able to respond to unforeseen circumstance. A four-dimensional schema (incentive intensity, adaptiveness, reliance on monitoring and control, reliance on the courts) analyses the governance efficacy of the different contract types. The results of this analysis suggest a methodology for contract selection, depending on whether the risk is controlled by the client or the contractor, whether the project is simple or complex, and whether the risk is on the project's product, method of delivery or both.

CHAPTER TEN

MANAGING PROJECT VARIATIONS, CLAIMS AND DISPUTES

Objective of this chapter

At the end of this chapter, students will be able to:

- **Conceptualize variations, claims, disputes and adjudication**
- **Identify the different types of dispute settlement mechanisms**

10.1. Introduction:

Like all good relationships, contracts can go wrong. Often we would like to pretend otherwise, to stick our heads in the sand and assume all is and will remain rosy. Usually it will be so, but we must make plans for things going wrong. Most contracts have written into them clauses to deal with the unusual, and that is right and proper. If variations and other disputes are planned for, then their impact and cost will be reduced.

In this chapter we consider how to deal with unplanned or unusual events. We start with variations. Variations are inevitable; we cannot predict the future and plan for every eventuality. Hopefully they can be kept to a minimum, and variations arising from poor quality of design and decision-making avoided; variations will be essential rather than nice-to-have changes or plain mistakes. Many variations will result in a claim for additional payment. Some claims will be accepted, some challenged. If the parties cannot agree a claim, they will go into dispute, and that then needs to be resolved. We consider the impact of the Construction Act 1998 and the Arbitration Act 1996, both of which arose partially out of the Latham Report (1994), and we consider the response of contracting practice to them. Finally, we describe adjudication procedures.

10.2. VARIATIONS

Variations may be described not unfairly as the cancer of contracting. Their cumulative effect can combine to destroy the best of contracts; the habit of ordering them is in itself a disease. What causes this disease? The causes are many but the principal ones are as follows:

1. ***Inadequate allowance for thinking time:*** It is distressing but true that many managers are not convinced that progress is being made unless holes are being dug, equipment is being manufactured or code written, and so start work before the project is properly planned. Morris and Hough (1987) describe how the project manager on the computerization of PAYE resisted starting before he was ready, and the project had a successful outcome; whereas Hougham (1996) describes how, ten years later, the team working on the computerization of London Ambulance started work before they were ready, leading to a national disaster.

2. ***Inadequate specifications:*** One finds a great reluctance amongst people to be completely specific as to what they require, as to the services to be provided by the purchaser and as to the actual conditions under which the work will be carried out.
3. ***Insufficient attention as to whether what the tenderer is offering is exactly what the purchaser wants to buy:*** The tendency is to say 'It seems generally all right; we can sort out the detail later'.
4. ***Lack of discipline:*** In the matter of variations it is often far easier to say 'Yes, while we are about it we might as well have that done', than to say firmly 'No, it's not necessary'.
5. ***Improvements to avoid obsolescence:*** With the rapid rate of technical change taking place today, any major plant or system is likely to be out of date in some respects long before it is completed. This applies particularly to information technology and telecommunications systems. It may well be that some upgrading is essential now but it is often far better to have the system built and installed as it was originally designed and ensure that the facilities exist for later developments. The later the stage in the

project, the more it costs to make changes (Turner 1999), and so you reach a point where changes must be avoided unless they are absolute show-stoppers.

6. ***Genuinely unforeseeable circumstances:*** It would be idle to pretend that no variation is ever justified. There are times when it is essential to vary the works or system. Variations must be allowed for in the original thinking and procedures set in place for their control. Anyone who thinks they can avoid variations completely is a fool or a liar, or both. Therefore variations must be accepted and planned for. It is often not appreciated that even a quite simple change of specification can have a dramatic impact on a contractor, especially if that contractor also has a design responsibility. The change may involve the contractor in:

   - ✓ design work which because of the change is now not needed;
   - ✓ additional design work including studying the consequential effect of the variation on a number of drawings;
   - ✓ cancellation of, or modification to, orders already placed on their own works or outside suppliers;
   - ✓ the placing of new orders;
   - ✓ delay and/or re-phasing of the design and manufacturing programme to accommodate the variation;
   - ✓ delay in delivery of material due to re-phasing of work or concentration of work into a shorter period with consequential overtime costs and loss of productivity;
   - ✓ extending the period of the contract.

Claims for delay and disruption are never easy although those for site work where the facts can often be established from contemporary site records are easier than those for overheads. However, it is important to distinguish between the two bases of claim which the contractor may make for head office overheads and profit. First, there is a claim for overheads only which is based on the additional managerial time and expense required to deal with the problems created by the excessive number of variations. To establish

such a claim the contractor must provide evidence of the additional managerial time expended and not simply add on an arbitrary percentage.

The claim for overheads and profit is for the allegation that by reason of the extended contract period and involvement of their staff, the contractor has been deprived of the opportunity to earn a contribution to its fixed overheads and profit. In the building industry, it is common for the contractor to calculate such a claim by the use of a formula. However, in principle that must be wrong. The formula is only a means of quantification. Before it can be used, the contractor must prove that as a result of the delay, they suffered some loss by showing that the delayed contract deprived them of the opportunity to obtain other work on which a margin for overheads and profit could have been earned. This means that the contractor must prove:

- ✓ there was other work available which would have been profitable;
- ✓ that they did not obtain this work; and
- ✓ that the failure to obtain the work was the direct result of the delayed contract.

It is only when these facts have been proved that the use of a formula as a method of quantification of loss has any validity. The difficulties of proving those facts are recognized. However, the basic principle of English law is that it is for the contractor to prove it has suffered a loss arising directly from the purchaser's actions, and the automatic substitution of a formula which takes no account of actual loss suffered cannot be justified.

10.2.1. PRICING OF VARIATIONS

There are often difficulties in negotiating variations, especially on lump sum contracts where there may be no mechanism for doing so established in the contract itself. The purchaser will think the contractor is taking them for a ride, but may genuinely be unappreciative of what trouble and cost their simple instruction has caused. The purchaser will also be acutely aware that it is impractical for them to get competitive quotations. The contractor may

be anxious to recover any ground lost in post-tender negotiations. Neither side is likely to be in a mood for making concessions but the purchaser is likely to be in the weaker negotiating position.

For contracts priced on a bill of quantities or schedule of rates, the problem is not as great provided that the quantities in the bill are not grossly exceeded or diminished as a result of the variation and the work is being executed under the same conditions. Different conditions may, for instance, be work conducted at a different time of the year than it was anticipated that the original work would be executed.

With lump sum contracts for which there are no rates quoted for individual items of work the problem is more difficult. In the new engineering contract (ICE 1995), a valiant effort has been made to solve this problem by requiring the contractor to quote as part of their tender a schedule of cost components. For the purpose of tender comparison quantities are assumed by the employer and included in the invitation to tender.

This schedule gives the cost components in terms of various categories of labour for design, manufacturing and site work together with related overhead percentages, the costs of materials and plant and other overhead costs. The variation is then priced by making a comparison between the forecast actual cost for the work originally included in the tender and the forecast actual cost arising as a result of the variation together with the contractor's fee. The comparison is specifically not made by deleting the original contract price for the work and substituting the forecast actual cost. It is also made clear that the variation is not to be priced by using any of the rates and prices included in the contract, say, in the bill of quantities.

There are several difficulties with this method apart from its obvious administrative cost and complexity. One is that while one can compare staff and labour rates, and indeed overheads on their own, they mean very little without knowledge of the contractor's productivity. One firm's rates may be higher than another's but this may well be offset by higher efficiency.

10.2.2. TIMING OF PRICE NEGOTIATIONS

A vital factor in the successful control of variation is the timing of price negotiations. Too often because of the pressure for the achievement of physical progress of the work and the complexities in the price change, instructions are given to the contractor to make the change, with the alteration in price to be negotiated later. Ideally the sequence of events should be as follows:

1. The purchaser decides that a particular variation would be desirable.
2. The contractor is instructed to assess the effect of the proposed variation in terms of:
    - price
    - time
    - performance
3. The contractor submits their proposals under these headings.
4. If the purchaser decides to proceed with the variation, then they negotiate with the contractor on the amendments to the price, time for completion and performance requirements.
5. Once agreement has been reached, the purchaser issues a formal variation order in standard form serially numbered.
6. The contractor proceeds with work.

The new engineering contract uses a similar series of steps. It seems a long series and the temptation is to go straight ahead and tell the contractor to start work. Indeed there will be genuine emergencies when it is necessary to do just that and tidy up the paperwork afterwards. But in so doing, not only any possible negotiating advantage is lost, but also any enthusiasm on the part of the purchaser's staff to make variations is removed and financial control of the contract is lost. Except in the case of a real emergency it should be difficult to order variations.

10.3. CLAIMS

Claims can be considered under three headings:

- ✓ ex gratia
- ✓ from excessive ordering of variations
- ✓ default by the client in their obligations under the contract.

10.3.1. EX-GRATIA CLAIMS

These are claims made when the contractor can find no contractual basis for the claim but considers that because of some unexpected event there is a moral or commercial obligation on the client to pay compensation. An example would be a fixed price contract entered into before the huge and unexpected rise in oil prices in the 1970s which could not have been foreseen by the contractor and for which therefore no allowance was made in its price. The difficulty for the contractor is that while it may be true that they suffered losses, there is ordinarily no reason why the client should pay compensation. Payment can only possibly be justified if, in the face of serious and unforeseeable difficulties in the performance of the contract, for which the contract provides no right for additional payment, the contractor made extraordinary efforts to overcome these and completed the work to specification and by the time for completion. Then the contractor may rely on the client's goodwill but on nothing else. Faced with a contractor going bankrupt or completing, it may be cheaper for a client to make an ex-gratia payment.

CLAIMS ARISING OUT OF EXCESSIVE VARIATIONS

These have been discussed above under the heading 'Variations'.

CLAIMS ARISING OUT OF THE CLIENT'S DEFAULT

Under all contracts there are some obligations for the client to perform, for instance in making the site available and supplying information and facilities which if they are not provided on time and to specification will result in the contractor incurring additional costs. A claim for the recovery of those costs is often linked with one relating to the number of variations. The great difficulty for the contractor is that although it may be obvious

that work has been disrupted and delayed, it may also be very difficult to itemize each cause to a specific effect and therefore to additional cost.

It may be possible today for the contractor by the use of an appropriate computer program to use the technique of impact analysis. This establishes the impact of individual causes on a series of logically connected events within the network for the contract. However, the practical application technique requires the knowledge of how the work was programmed, how it progressed, when the delaying events occurred and the interaction between one delay and another. This emphasizes the need for contemporary data and for the work on the analysis to start at the time and not at the end of the contract.

Because of the difficulties of determining the effect of individual events contractors often try to present their claim on a 'total loss', 'global' or 'rolled up' basis. This has the obvious advantage that the contractor does not have to prove the individual loss arising from each event, but only make a broad-brush calculation based on the total cost overrun. From the employer's point of view, the disadvantage is that they do not have particulars of the sums being claimed. Nor do they have the basis on which it is alleged in each instance that they, rather than the contractor, or some external cause, is responsible for the loss in question. The employer's ability to challenge the contractor's claim is therefore much reduced.

From the decisions in English law on the validity of 'rolled up claims', the position is that the contractor must demonstrate that they have made every effort practicable to itemize the causes of delay or disruption and their individual effects. Only where the contractor can show that the complexity of the interrelationship between a number of causes is such that it is impractical to do this is it likely that a court or arbitrator would accept a 'rolled up claim'.

10.3.2. CLAIMS PRESENTATION AND MANAGEMENT

There are a few basic rules to be followed in preparing for and presenting claims:

1. Consider the possible areas of claim from the start of the contract and plan accordingly. Don't wait until they happen.
2. Make sure that all involved know any particular areas of risk which have been accepted under the contract which might normally entitle a claim to be made but would not on this contract.
3. Keep accurate and contemporary records from the start of the contract. A good factual site diary prepared at the time is essential on a construction contract. (The problem is that this does lead to the impression that the first file opened by a contractor on a construction site is the claims file. Unfortunately, it is necessary. However, ensure that it is understood that the purpose of the file is to resolve problems, not make claims.)
4. Where it is considered that a claim may arise in respect of design work, ensure that the records are sufficiently detailed to identify the number of man-hours spent and by whom on the revisions to each drawing or the preparation of new revised drawings, and the reasons for the revisions.
5. Make a record of the requirements for the giving of notice of claims under the contract and ensure that these are followed through in practice.
6. Ensure that all correspondence with and from the client which could have an impact on claims is reviewed as are all minutes of meetings.
7. In presenting the claim make sure that it contains:
   - ✓ a short executive summary;
   - ✓ clear references to the terms of contract on which the claim is based;
   - ✓ all essential data which is required to understand the claim, such as
   - ✓ critical dates, extensions of time applied for and granted, variation orders issued, etc.

10.4. SETTLING CONTRACTUAL DISPUTES

All contracts, no matter how carefully worded and prepared, can be subject to some form of dispute or disagreement. It is virtually impossible to negotiate a contract that anticipates every potential source of disagreement between buyer and seller. Generally speaking, the more complex the nature of the contract and the greater the dollar amounts involved, the more likely it is that a future dispute over interpretation of the terms and conditions will occur. Purchasing managers must therefore attempt to envision the potential for such conflicts and prepare appropriate conflict resolution mechanisms to deal with such problems should they arise. Online Dispute Resolution also describes a more recent application of e-commerce technology, where companies are beginning to use online dispute resolution websites to manage contractual conflicts. The traditional mechanism for resolving contract disputes is grounded in commercial law, which provides a legal jurisdiction in which an impartial judge can hear the facts of the case at hand and render a decision in favor of one party or the other.

10.4.1. Means of Settling Contractual Disputes

A. Legal action-File a lawsuit in a federal/state/local court

B. Non-legal actions:

- ✓ **Arbitration:** Use of an impartial third party to settle a contractual dispute
- ✓ **Mediation**: Intervention by a third party to promote settlement, reconciliation, or compromise between parties involved in a contractual dispute
- ✓ **Minitrial**: An exchange of information between managers in each organization, followed by negotiation between executives from each organization.
- ✓ **Rent-a-judge**: A neutral party conducts a “trial” between the parties and is responsible for the final judgment
- ✓ **Dispute prevention**: A progressive schedule of negotiation, mediation, arbitration, and legal proceedings agreed to in the contract

1. LEGAL ALTERNATIVES

New methods of settling buyer-seller disputes have evolved in the last several years. These techniques, although diverse in form and nature, have a number of similar characteristics:

They exist somewhere between the polar alternatives of doing nothing and escalating conflict.

- They are less formal and generally more private than ritualized court battles.
- They permit people with disputes to have more active participation and more control over the processes for solving their own problems than traditional methods of dealing with conflict.
- Almost all of the new methods have been developed in the private sector, although courts and administrative agencies have begun to borrow and adapt some of the more successful techniques.

Perhaps the simplest method of resolving a contractual disagreement involves straightforward, face-to-face negotiation between the two parties involved. Frequently, there are other factors surrounding the dispute that can be brought into consideration by the parties, even though these factors are not directly involved in the dispute at hand. For example, if the buying and selling parties to a contract disagree on the interpretation of the contract's terms and conditions regarding delivery, then perhaps they might be able to collaborate on other terms and conditions such as price or scheduling. When this alternative is exhausted, both parties may become aware of the fact that it is infeasible to agree on suitable alternatives. In such cases, it may be virtually impossible for the parties to negotiate an acceptable resolution of the dispute on a good-faith basis without additional assistance from outside parties.

2. NONE LEGAL ALTERNATIVES

A. ARBITRATION

The use of an outside arbitrator, or third party, to help settle contractual disputes is the fastest-growing method of conflict resolution among contracting parties, both in the United States and overseas. Because of the parties' inability to reach a negotiated settlement, emotional reactions to the problem (frustration, disappointment, and anger) may prevent rational examination of the true underlying causes of the source of disagreement.

The only solution in such cases may be arbitration, which is defined as "the submission of a disagreement to one or more impartial persons with the understanding that the parties will abide by the arbitrator's decision."11 If set up and handled properly, arbitration can serve to protect the interests of both parties to the dispute because it is relatively inexpensive, less time consuming, private, and typically a reasonable solution for all involved.

When writing and negotiating purchase contracts, many purchasing managers include an arbitration clause in the boilerplate terms and conditions. Such a clause typically spells out how the disputing parties will choose an appropriate arbitrator and the types of disputes for which arbitration will be considered. A good source for commercial arbitrators is the American Arbitration Association, which can also handle the administrative burden of the entire process from an impartial point of view. It is important to ensure that the arbitrator's opinion will be binding on both parties to the dispute. A key point to remember here is that adequate advance planning for potential disputes can prevent significant problems later should an unforeseen conflict arise. Also, it is a good idea to spell out the location and method of conducting the arbitration hearings, particularly if the dispute involves companies or individuals from different states or countries.

When preparing the purchase contract or purchase order, contract managers should consider two factors (in conjunction with the organization's legal counsel), to ensure that the ruling of an arbitrator will be legally binding:

- State statutes must be reviewed to determine whether the state or states in question do in fact have such legal provisions allowing arbitration.
- Wording of the arbitration clause should be developed carefully in accordance with state law, federal law (the Federal Arbitration Act), and the guidelines published by the American Arbitration Association.

Purchasing managers wishing to take advantage of the process in their dealings with suppliers should understand several caveats regarding binding arbitration.

Purchasers cannot rely on an arbitration clause contained in their forms, particularly if the supplier's forms do not contain such a clause. If the supplier's forms contain an arbitration clause that is not in the buyer's forms, and the buyer does not want to follow it, the supplier cannot rely on the presence of such a clause. Finally, if both the buying and selling organizations' forms contain arbitration clauses, arbitration will become an enforceable part of the overall agreement.

B. MEDIATION

An intervention between conflicting parties to promote reconciliation, settlement, or compromise. The mediator's responsibilities include listening to the facts presented by both parties, ruling on the appropriateness of documents and other evidence, and rendering judgment on a solution that reconciles the legitimate interests of both disputing parties. Mediation varies from arbitration in that arbitration is binding on the parties. In the mediation process, however, the disputing parties preserve their right of final decision on the solution proffered by the mediator.

C. MINITRIAL

Is not actually a trial at all; It is a form of presentation, involving an exchange of information between managers from each organization involved in the dispute. Once the executives hear both sides of the presentation, they then attempt to resolve the dispute through negotiation with their executive counterparts. Because minitrials are generally more complicated than other forms of negotiation, they are typically used when the dispute between the

parties is significant and highly complex. One of the benefits of such a process is that it turns a potential legal conflict into a business decision and promotes a continuing relationship between the parties.

D. RENT-A-JUDGE

Is a process by which a court refers a lawsuit pending between the parties to a private, neutral party. The neutral party (often a retired judge) conducts a "trial" as though it were conducted in a real court. If one or both of the parties is dissatisfied with the outcome of the rent-a-judge decision, then the verdict can be appealed through normal appellate channels. In this process, the parties agree to hire a private referee to hear the dispute. Unlike the binding arbitration process, rent-a-judge hearings are subject to legal precedents and rules of evidence.

E. DISPUTE PREVENTION

A key factor in the concept of collaborative business relationships such as long-term contracting, partnering, and strategic alliances; When contracting parties initially agree to dispute-prevention processes, a progressive schedule of negotiation, mediation, and arbitration followed by litigation as a last resort can be defined and delineated in the agreement. The "baring of souls" involved in this type of close, collaborative relationship dictates that the two parties fully recognize and agree upon the mechanisms for dispute resolution that are to be utilized under certain conditions.

Selecting Appropriate Dispute-Resolution Mechanism

There are a number of factors to consider when deciding which dispute-resolution mechanism to use. The first, and perhaps foremost, consideration is the status of the relationship between the parties in the dispute. In cases where the relationship between the parties is ongoing and expected to continue for the foreseeable future, the disagreeing parties will prefer to resolve the contract dispute through means that hopefully will preserve the relationship.

The choice of mechanism should also be based on the type of outcome desired by the purchaser. There may be a need to establish an appropriate precedent to govern the purchaser's actions in future disputes as well as the

one at hand. Another consideration is whether the disputing parties need to be directly involved in generating the outcome or resolution. The presence of the disputing parties is important to successfully resolving disputes using techniques such as negotiation, arbitration, mediation, minitrials, and rent-a-judge proceedings. Active participation by all parties involved in a dispute generally results in a more equitable and harmonious resolution (as opposed to having third parties such as attorneys involved).

The level of emotion displayed by the principals is another important consideration. If emotions such as anger and frustration are high, the total cost of litigation, in terms of time, money, and management effort, may be more significant than originally anticipated.
The harsh experience of a prolonged court battle has convinced more than one set of potential litigants to consider less costly and more timely dispute-resolution alternatives. The importance of speed in obtaining a resolution can be a factor determining whether to litigate, mediate, or arbitrate. In many instances the alternatives to court adjudication are quicker than litigation. Time pressures may force the disputing parties to be more creative and understanding in reaching an appropriate resolution short of meeting in court. There is a direct relationship between the time involved in settling a dispute and the cost involved. Quicker resolution is generally cheaper. The information required to reach a settlement may dictate the mechanism preferred.

The closer the parties come to having the courts settle their dispute, the more formal the information requirements. Strict rules of evidence in the courtroom may not be desirable to parties because of publicity. Companies involved in the dispute may not be willing to spread out their dirty linen or trade secrets in public. In addition, the credibility of experts and other witnesses may be more difficult to achieve or maintain in a trial. All of the conflict-resolution mechanisms or settlement options presented here allow a greater degree of privacy to the parties involved than that which can be attained in a court.

Summary of the chapter

Generally speaking, the more complex the nature of the contract and the greater the dollar amounts involved, the more likely it is that a future dispute over interpretation of the terms and conditions will occur. Project Purchasing managers must therefore attempt to envision the potential for such conflicts and prepare appropriate conflict resolution mechanisms to deal with such problems should they arise. Online Dispute Resolution also describes a more recent application of e-commerce technology, where companies are beginning to use online dispute resolution websites to manage contractual conflicts. The traditional mechanism for resolving contract disputes is grounded in commercial law, which provides a legal jurisdiction in which an impartial judge can hear the facts of the case at hand and render a decision in favor of one party or the other. Due to the uncertainty, cost, and length of time required to settle a dispute in the different contry's legal system, most buyers and sellers prefer to avoid the problems associated with litigation and deal with the situation in other ways. Taking a dispute into the jurisprudence system should be viewed as a last resort, not an automatic step in resolving contractual disputes.