A

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For the Degree of Vidyavachaspati (Ph.D.)

(Doctor of Philosophy) in the

MANAGEMENT OF SUPPLY CHAIN IN SMALL SCALE MANUFACTURING UNITS

(WITH SPECIAL REFERENCE TO AHMEDNAGAR MIDC AREA)

under the

Faculty of Management

by

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CERTIFICATE

This is to certify that the thesis entitled "**Management of Supply Chain in Small Scale Manufacturing Units (with special reference to Ahmednagar MIDC area)**" which is being submitted herewith for the award of the Degree of Vidyavachaspati (Ph.D.) in **Management** of **Tilak Maharashtra Vidyapeeth**, Pune is the result of original research work completed by **Shri Satish Shrawanrao Ubale** under my supervision and guidance. To the best of my knowledge and belief the work incorporated in this thesis has not formed the basis for award of any Degree or similar title of this or any other University or examining body upon him.

Research Guide

Place:

Date:

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Satish S. Ubale

DECLARATION

I hereby declare that the thesis entitled "M**anagement of Supply Chain in Small Scale Manufacturing Units (with special reference to Ahmednagar MIDC area)**" completed and written by me has not previously formed the basis for the award of any Degree or other similar title upon me of this or any other University or examining body.

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ABSTRACT

The small scale manufacturing units has lately come into the limelight, with increased focus from several government institutions, corporate bodies and banks, and is viewed as agents of growth. Apart from the policy focus and government's thrust towards promoting this segment, globalisation and India's robust economic growth has opened several latent business opportunities for this segment.

The major challenges in front of small scale manufacturing units are to develop proper distribution channels, spend major portion of profit for marketing, to cope severe international competition, to have a proper balance between quality and price, develop brand loyalty, transport goods to the market with required specification and to promote product through new innovative ideas. These are the fields where small scale manufacturing units has to work with top priority.

Globalisation has accelerated the application of supply chain management as a mechanism to enhance corporate performance. However, there is a serious lack of structured supply chain management activity in small scale manufacturing units. A sincere attempt to fulfil this shortcoming is made by the researcher to undertake this exercise.

This thesis investigates the application and implications of supply chain management as a modern management in regulating purchasing, logistic and outsourcing activities within the Small Scale Manufacturing Units.

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LIST OF ABBREVIATIONS

ABC	-	Always Better Control
AP	-	Account Payables
AR	-	Account Receivables
BID	-	Board of Industrial Development
CP	-	Cost of Production
CRM	-	Cost of Raw Material
CS	-	Cost of Sales
CV	-	Coefficient of variation
DC	-	Distribution Cost
DFG	-	Days of Finished Goods
DIC	-	District Industries Centre
DRM	-	Days of Raw Material
DWIP	-	Days of Work In Process
EDI	-	Electronic Data Interchange
ECR	-	Efficient Consumer Response
ERP	-	Enterprise Resource Planning
FG	-	Finished Goods Inventory
FSN	-	Fast Slow Non moving
ICC	-	Inventory Carrying Cost
INV	-	Inventory
ITR	-	Inventory Turnover Ratio
IT	-	Information Technology
JIT	-	Just-In-Time
JITD	-	Just-In-Time Distribution
NS	-	Net Sales
POS	-	Point of Sales
RFID	-	Radio Frequency Identification Device
RM	-	Raw Materials Inventory

ROA	-	Return on asset
ROI	-	Return on Investment
SCM	-	Supply Chain Management
SCC	-	Supply Chain Management Costs
SCI	-	Supply Chain Inefficiency Ratio
SDE	-	Scarce Desirable Essential
SFG	-	Semi-Finished Goods Inventory
SKU	-	Stock-Keeping Unit
SSMUs	-	Small scale manufacturing units
SWC	-	Supply Chain Working Capital
SWCP	-	Supply Chain Working Capital Productivity
TQM	-	Total Quality Management
VED	-	Vital Essential Desirable
VMI	-	Vendor Managed Inventory

CHAPTER-1
INTRODUCTION

1.1 MIDC - THE STATE'S INDUSTRIAL CATALYST

The BID (Board of Industrial Development) framed the legislation and it was introduced before the state legislation and passed in the form of "Maharashtra Industrial Act" which gave birth to MIDC, as a separate corporation on August 1, 1962. The BID was the first personnel strength of MIDC.

A small ceremony at Wagle Estate Thane, under the Chairmanship of the Chief Minister Shri Y.B. Chavan, marked the birthday of MIDC on August 1, 1962. The Board of Industrial Development during its existence between October 1, 1960 and August 1, 1962 has done enough spade work to identify the locations for setting up industrial areas in different parts of the state. Thus, right in the first year of establishment MIDC has come up with 14 industrial areas, to initiate action for infrastructure and help entrepreneurs set up the industrial units in those areas.

Maharashtra Industrial Development Corporation is the nodal industrial infrastructure development agency of the Maharashtra Government with the basic objective of setting up Industrial areas with a provision of industrial infrastructure all over the state for planned and systematic industrial development. MIDC is an innovative, professionally managed, and user friendly organization that provides the World Industrial Infrastructure. MIDC has played a vital role in the development of industrial infrastructure in the state of Maharashtra. As the state steps into the next millennium, MIDC lives up to its motto ‘Udyamat Sakal Samruddhi’ i.e., Prosperity to all through industrialization.

Indeed, in the endeavour of the state to retain its prime position in the industrial sector, MIDC has played a pivotal role in the last 35 years. MIDC has developed 268 industrial estates (major & mini) across the state which spread over 52653 hectares of land. The growth of the Corporation, achieved in the various fields, during the last three years, could be gauged from the fact that the area currently in possession of MIDC has doubled from 25,000 hectares in 1995.

Maharashtra Industrial Development Corporation is the premier body for the development of IT Industry in Maharashtra. The MIDC has constructed 15 IT Parks in the state. The Government of India in 1988 announced a scheme for development of growth centres covering each District of the State. Out of these growth centres, 61 have been notified and in 24 growth centres, the land is already in possession and in 17 growth centres, MIDC has already started allotment of plots.

The State Government has also announced a programme of establishment of 140 mini industrial areas at Taluka levels. This work has also been entrusted to MIDC. Among 102 areas, land is already in possession 90 industrial areas and plots have already been allotted to small scale entrepreneurs.

MIDC is also a “special planning authority” for all its industrial areas for various functions such as selection of land, planning, development and management of industrial parks. Other objectives are

- Development of industrial areas by acquiring land.
- Preparing layout with suitable grouping of plots of various sizes and allotment of plots on leasehold basis.
- Construction of roads, drainage system and provision of street lights in the industrial areas.
- Planning, implementation and managing water supply schemes.
- Establishing common facility centers (CFC) by providing accommodation for bank, post office, telecom facilities, police station, fire station, medical facility, canteen, etc.
- Establishment of effluent collection and disposal systems for chemicals zones.
- Implementing government/semi government projects.

1.1.1 Achievements at a glance

Since its inception, MIDC has established at least one industrial area in every District of the State.

- 225 industrial areas (including Major, Mini, etc.) are functioning out of 268 notified industrial areas by the Government.
- 52653 hectares of land in possession out of 86822 hectares planned.
- 44598 plots (including Industrial, Commercial, amenities, residential, etc.) are allotted out of 54304 plots demarcated.
- 3199 kms. length of pipeline constructed by MIDC.
- Construction and maintenance of airstrips and helipads.
- MIDC has developed five star rated industrial areas with state-of-the-art infrastructure at nine strategically located centres in Maharashtra.
- MIDC has acquired 90,000 hectares of land for industrial development.
- 2,235 kms of road has been laid by MIDC as a part of infrastructure facilities on offer.
- 1,300 industrial units already operating in MIDC parks-another 3887 units are under Implementation.

Development of 5-star industrial areas at 9 centres:

1. Butibori (Nagpur)
2. Mahad (Raigad)
3. Kagal- Hatkangale(kolhapur)
4. Sinnar (Nashik)
5. Indapur (Pune)
6. Shendre (Aurangabad)
7. Nivli Phata(Ratangiri)
8. Krushnoor (Nanded)
9. Nandgaon Peth (Amaravati)

are the top quality infrastructure is being developed by MIDC.

1.1.2 Ahmednagar MIDC

Ahmednagar Industrial area was established by MIDC in the year 1972. The area is well developed with quality infrastructural facilities such as roads, water supply and street lights. Many renowned industries are operating from this area.

MIDC had acquired 591 hectares of land for the area. Recently, MIDC opened a software park for the IT industry and also constructed an IT Tower here. Besides, MIDC has developed a residential zone for the employees and owners of the companies.

Objectives of MIDC are

- Rapid and orderly establishment and growth of firms in the entire area to achieve balanced industrialization.
- To achieve balanced industrial development of Ahmednagar with an emphasis on developing parts and underdeveloped parts of the firms.
- Facilitate entrepreneurs in setting up firms at various locations in MIDC.
- Infrastructural development in setting up firms at various locations in MIDC.

Following are the activities efficiently carried out by MIDC

- Developing industrial areas through acquisition of appropriate land.
- Planning and developing industrial parks, providing basic infrastructure such as roads, drainage systems, power and water in the industrial parks.
- Planning, implementing and managing water supply schemes.
- Co-ordinating with other infrastructure providers for electricity, telecom, connectivity, etc.
- Establishing common facility centres by providing banks, post offices, telecom facilities, police stations, fire stations, medical facilities, canteens, etc.
- Establishing effluent collection and disposal systems for chemical zones.
- Providing residential areas for housing industrial workers.

The Ahmednagar MIDC has been declared as an agent of the State Government for carrying out the activities within the framework of the MID Act and the MID Rules. These activities can be divided under following three broad categories

1. ***Acquisition & disposal of land***: The land for industrial areas is acquired by the Government of Maharashtra under Chapter VI of the MIDC Act. 1961 and handed over to the Corporation for further disposal. Likewise, wherever available, the Government land is also handed over to the Corporation as an industrial area. The Government pays for the compensation for the private land from its own fund. The Corporation in turn plans the area and disposes the land in suitable plots by leasing out for 95 years.

   For this purpose the Corporation recovers the premium lease money at different rates for different industrial areas. Also the Corporation constructs built-up accommodations like Sheds and Flatted units and sale them out to the prospective industrialists together with the land there under on lease basis. As on 31.3.2002 the Corporation has planned 673.72 (Hectares) of land against which 591.02 Hectares of land has already come in possession of the Corporation.

2. ***Provision of infrastructure facilities****:* In terms of the provision of the MID Act, 1961 and the relationship prescribed by the government in that regard, the corporation is required to provide infrastructure facilities like roads, streetlight, drainage, water supply schemes and buildings for common facilities like post & telegraphs, canteen, bank, and telephone etc. The corporation meets the expenditure on such works (facilities) generally from the premium lease money received by it from the allottees.

   The relationship further prescribes that the industrial area, after it is fully developed, should be returned back to the Government/handed over to such agency or authority as the State Government may directs, after striking out the account of the industrial area concerned. The surplus/deficit generated out of such operations is to be made good to or recovered from the state government as the case may be. As the development of an industrial area is a long process and instant objective, the government has prescribed certain scale of interim

annual payments which are termed as on account advance payment to government.

In this connection it may stated that the powers to fix the rates of premium for land for different industrial areas rest with the corporation. Since it is the aim of the government and the corporation to achieve a balanced development of the entire State with special emphasis on the development of backward regions of the state, the Corporation follows a policy of cross subsidization rate structure on A B C D zones pattern, in that the rates of land premium in developed and semi developed parts of the State are higher compared to the rates in developing and backward regions.

3. ***Providing of services***: The Corporation provides the following services to the units in its industrial areas:-

a) *Assured Water Supply*: From among the various services provided by the Corporation, an assured pure water supply can be regarded as a unique specialty of the MIDC. The investment on the water supply scheme (Head works) made by MIDC as on 31st March, 2002 is over Rs.5 crores with installed capacity of water supply of 25 MLD. For the purpose of regulating the water supply operations of the Corporation the Government of Maharashtra has prescribed a legal and financial relationship between the Government and the Corporation.

b) *Maintenance of Industrial Areas*: This is a municipal function requiring the Corporation to maintain the Roads, Street lights, Fire stations (in few areas) during the transitory period up to handing over of the industrial area either to Government or other agency as the Government may decide. The MIDC Act, vide Section 56, provides for the exits policy after the purpose of industrial development as contemplated in the Act is fulfilled.

However, this has seldom become possible in the absence of a substitute agency to take over the responsibility, except in few cases like that of Marol, Wagale

Estate, Pimpri Chinchwad etc. where the Corporation could hand over only the roads and street lights to local Municipal Corporations. In other areas, the Corporation carries on this function as a committed obligation. For this purpose the Corporation recovers service charges to defray the expenditure on such services.

c) *Drainage (effluent disposal) and CETP Schemes*: The Corporation has effluent disposal (drainage) schemes only in selected Industrial areas having chemical industries. Such schemes are designed to collect and discharge the treated effluent only. In such areas the Corporation recovers drainage cess to defray the expenditure on maintenance and to partially recover the capital cost. Also with a view to arrest pollution, the Corporation has started the operations like Hazardious waste Management and common effluent plants on Joint venture basis with the help of local industries associations.

d) *Other Services*: Theses include providing and maintaining Common Facility Centers like P&T, Banks etc. Though the Corporation does not levy any specific cess for the purpose, the C. F. C. building is subject to rentals. Such rental together with other miscellaneous income from the area covers the maintenance cost of such CFCs.

The policy decisions taken by Ahmednagar MIDC certainly changed the social economic scenario of the city as its activities spread in the interior. The important policy decision of setting up "independent filtered /potable water supply system of adequate capacity" as essential infrastructure for industrial development was the most intelligent step taken by Ahmednagar MIDC right in the beginning. It stabilized the population base near the industrial areas. The strategically wise decision taken simultaneously to provide water supply to nearby domestic population from the capabilities created by Ahmednagar MIDC of their own water supply system resulted in a phenomenal urban growth in the nearby small towns and villages.

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1.2 SMALL SCALE MANUFACTURING UNITS IN INDIA

With the advent of planned economy from 1951 and the subsequent industrial policy followed by Government of India, both planners and Government earmarked a special role for small scale manufacturing units in the Indian economy. Due protection was accorded to this sector, particularly from 1951 to 1991, till the nation adopted a policy of liberalization and globalization. Certain products were reserved for small scale manufacturing units for a long time, though this list of products is decreasing due to change in industrial policies and climate.

Small scale manufacturing units always represented the model of socio-economic policies of Government of India which emphasized judicious use of foreign exchange for import of capital goods and inputs; labour intensive mode of production; employment generation; non concentration of diffusion of economic power in the hands of few (as in the case of big houses), discouraging monopolistic practices of production and marketing; and finally effective contribution to foreign exchange earning of the nation with low import-intensive operations. It was also coupled with the policy of de-concentration of industrial activities in few geographical centres.

It can be observed that by and large, small scale manufacturing units in India met the expectations of the Government in this respect. Small scale manufacturing units developed in a manner, which made it possible for them to achieve the following objectives:

- High contribution to domestic production
- Significant export earnings
- Low investment requirements
- Operational flexibility
- Location wise mobility
- Low intensive imports

- Capacities to develop appropriate indigenous technology
- Import substitution
- Contribution towards defence production
- Technology – oriented industries
- Competitiveness in domestic and export markets

At the same time one has to understand the limitations of small scale manufacturing units, which are

- Low Capital base
- Concentration of functions in one / two persons
- Inadequate exposure to international environment
- Inability to face impact of WTO regime
- Inadequate contribution towards R & D
- Lack of professionalism

In spite of these limitations, the small scale manufacturing units have made significant contribution towards technological development and exports. Small scale manufacturing units have been established in almost all-major sectors in the Indian industry such as *food processing, agricultural inputs, chemicals & pharmaceuticals, engineering, electrical, electronics, electro-medical equipment, textiles and garments leather and leather goods, meat products, bio-engineering, sports goods, plastics products, computer software, etc*.

1.2.1 Small scale manufacturing units in Maharashtra

Since its inception in May 1960, (and even earlier as a part of 'Bombay State') Maharashtra has been in the forefront of industrialization. The state has always followed progressive industrial policies and industry – friendly measures. Through a network of District Industries Centre's (DICs), it offers maximum guidance and assistance to small scale manufacturing units. Many small scale manufacturing units promoted by local entrepreneurs as also by NRIs and foreigners have come up in Maharashtra covering a broad spectrum of industrial activity. The quality of

products of small scale manufacturing units from Maharashtra is high. Some of them have acquired technology from abroad. Adequate budget is provided for R & D operations. Many units are promoted by techno-entrepreneurs. In view of the objective of the study, it was considered necessary to undertake a survey of small scale manufacturing units from major parts of Maharashtra covering following sectors:

Engineering, Electrical, Food Processing, Chemical and Pharmaceutical

1.2.2 Small scale industrial undertakings

The following requirements are to be complied with by an industrial undertaking to be graded as Small Scale Industrial undertaking w.e.f. 21.12.1999

"An industrial undertaking in which the investment in fixed assets in plant and machinery whether held on ownership terms on lease or on hire purchase does not exceed Rs10million."

(subject to the condition that the unit is not owned, controlled or subsidiary of any other industrial undertaking)

Explanation

a. "owned" shall have the meaning as derived from the definition of the expression "owner" specified in clause (1) of section 3 of the said Act;

b. "subsidiary" shall have the same meaning as in clause (47) of section 2, read with section 4, of the Companies Act, 1956 (1 of 1956);

c. the expression "controlled by any other industrial undertaking" means as under:-

   i. where two or more industrial undertakings are set up by the same person as a proprietor, each of such industrial undertakings shall be considered to be controlled by the other industrial undertaking or undertakings,

   ii. where two or more industrial undertakings are set up as partnership firms under the Indian Partnership Act, 1932 (1 of 1932) and one or more partners

are common partner or partners in such firms, each such undertaking shall be considered to be controlled by other undertaking or undertakings,

iii. where industrial undertakings are set up by companies under the Companies Act, 1956 (1 of 1956), an industrial undertaking shall be considered to be controlled by other industrial undertaking if:-

a. the equity holding by other industrial undertaking in it exceeds twenty four percent of its total equity; or

b. the management control of an undertaking is passed on to the other industrial undertaking by way of the Managing Director of the first mentioned undertaking being also the Managing Director or Director in the other industrial undertaking or the majority of Directors on the Board of the first mentioned undertaking being the equity holders in the other industrial undertaking in terms of the provisions of the following items (a) and (b) of sub-clause (iv);

iv. the extent of equity participation by other industrial undertaking or undertakings in the undertaking as per sub-clause (iii) above shall be worked out as follows:-

a. the equity participation by other industrial undertaking shall include both foreign and domestic equity;

b. equity participation by other industrial undertaking shall mean total equity held in an industrial undertaking by other industrial undertaking or undertakings, whether small scale or otherwise, put together as well as the equity held by persons who are Directors in any other industrial undertaking or undertakings even if the person concerned is a Director in other Industrial Undertaking or Undertakings;

c. equity held by a person, having special technical qualification and experience, appointed as a Director in a small scale industrial undertaking,

to the extent of qualification shares, if so provided in the Articles of Association, shall not be counted in computing the equity held by other industrial undertaking or undertakings even if the person concerned is a Director in other industrial undertakings or undertakings;

v. where an industrial undertaking is a subsidiary of, or is owned or controlled by, any other industrial undertaking or undertakings in terms of sub-clauses (i), (ii) or (iii) and if the total investment in fixed assets in plant and machinery of the first mentioned industrial undertaking and the other industrial undertaking or undertakings clubbed together exceeds the limit of investment specified in paragraphs (1) or (2) of this notification as the case may be, none of these industrial undertakings shall be considered to be a small scale or ancillary industrial undertaking.

Note-

(a) In calculating the value of plant and machinery for the purposes of paragraphs (1) and (2) of this notification, the original price thereof, irrespective of whether the plant and machinery are new or second hand, shall be taken into account.
(b) In calculating the value of plant and machinery, the following shall be excluded, namely:-

i. the cost of equipments such as tools, jigs, dies, moulds and spare parts for maintenance and the cost of consumable stores;

ii. the cost of installation of plant and machinery;

iii. the cost of research and development equipment and pollution control equipment;

iv. the cost of generation sets and extra transformer installed by the undertaking as per the regulations of the State Electricity Board;

v. the bank charges and service charges paid to the National Small Industries Corporation or the State Small Industries Corporation;

vi. the cost involved in procurement or installation of cables, wiring, bus bars, electrical control panels (not those mounted on individual machines), oil circuit breakers or miniature circuit breakers which are necessarily to be used for providing electrical power to the plant and machinery or for safety measures;

vii. the cost of gas producer plants;

viii. transportation charges (excluding of sales tax and excise) for indigenous machinery from the place of manufacturing to the site of the factory;

ix. charges paid for technical knowhow for erection of plant and machinery;

x. cost of such storage tanks which store raw materials, finished products only and are not linked with the manufacturing process; and

xi. cost of fire fighting equipments.

(c) In the case of imported machinery, the following shall be included in calculating the value, namely:-

i. import duty (excluding miscellaneous expenses as transportation from the port to the site of the factory, demurrage paid at the port);

ii. the shipping charges;

iii. customs clearance charges; and

iv. sales tax.

Every industrial undertaking which has been issued a certificate of registration under section 10 of the said Act or a license under sections 11, 11A and 13 of the said Act by the Central Government and are covered by the provisions of paragraphs (1) and (2) above relating to the ancillary or small scale industrial undertaking, may be registered, at the discretion of the owner, as such, within a period of one hundred and eighty days from the date of publication of this notification in the Official Gazette.

1.2.3 Ancillary industrial undertakings

The following requirements are to be complied with by an industrial undertaking for being regarded as ancillary industrial undertaking: -

An industrial undertaking which is engaged or is proposed to be engaged in the manufacture or production of parts, components, sub-assemblies, tooling or intermediates, or the rendering of services and the undertaking supplies or renders or proposes to supply or render not less than 50 per cent of its production or services, as the case may be, to one or more other industrial undertakings and whose investment in fixed assets in plant and machinery whether held on ownership terms or on lease or on hire-purchase, does not exceed Rs 10 million.

1.2.4 Tiny enterprises

Investment limit in plant and machinery in respect of tiny enterprises is Rs 2.5 million irrespective of location of the unit.

A small scale industrial unit/ industry related service or business enterprise, managed by one or more women entrepreneurs in proprietary concerns, or in which she/they individually or jointly have a share capital of not less than 51% as Partners/ Shareholders/ Directors of Private Limits Company/ Members of Cooperative Society.

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1.3 SUPPLY CHAIN MANAGEMENT

The term “supply chain management” arose in the late 1980’s and came into widespread use in the 1990’s. Prior to that time, business used terms such as “logistic” and “operation management” instead some broader definitions of supply chain as well as supply chain management are preferable, if one wants to maximize the opportunity to improve performance of an organization. According to Stock & Lambert (2001), “supply chain integrates the key business processes of an organization from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders”.

Mohanty and Deshmukh (2004) describes, “A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products and the distribution of these finished products to customers. Supply chain exists in both service and manufacturing organization, although the complexity of chain may vary greatly from industry to industry and firm to firm.”

The supply chain encompasses all activities associated with the flow and transformation of goods from the raw material stage, through to the end user as well as the associated information flows. Supply chain management is the integration of these activities through improved supply chain relationships, to achieve a competitive advantage. A supply chain extends from customer’s customer to supplier’s suppliers.

In today’s rapidly changing business environment, ever-greater demands are being placed on business to provide right products and services quicker with greater added value to the correct location with no relevant inventory position.

A supply chain consists of all the activities starting from sourcing of raw materials or components till delivery of the finished products to the customer. Supply chain management is, therefore, the management of these activities so as to maximize the

benefit to the organization. Supply chain management takes a holistic view of the working of an organization, without getting unduly obsessed with the performance of the chain of activities, the primary driving force being delivering value to the customer. A schematic representation of the supply chain is given in the figure 1.

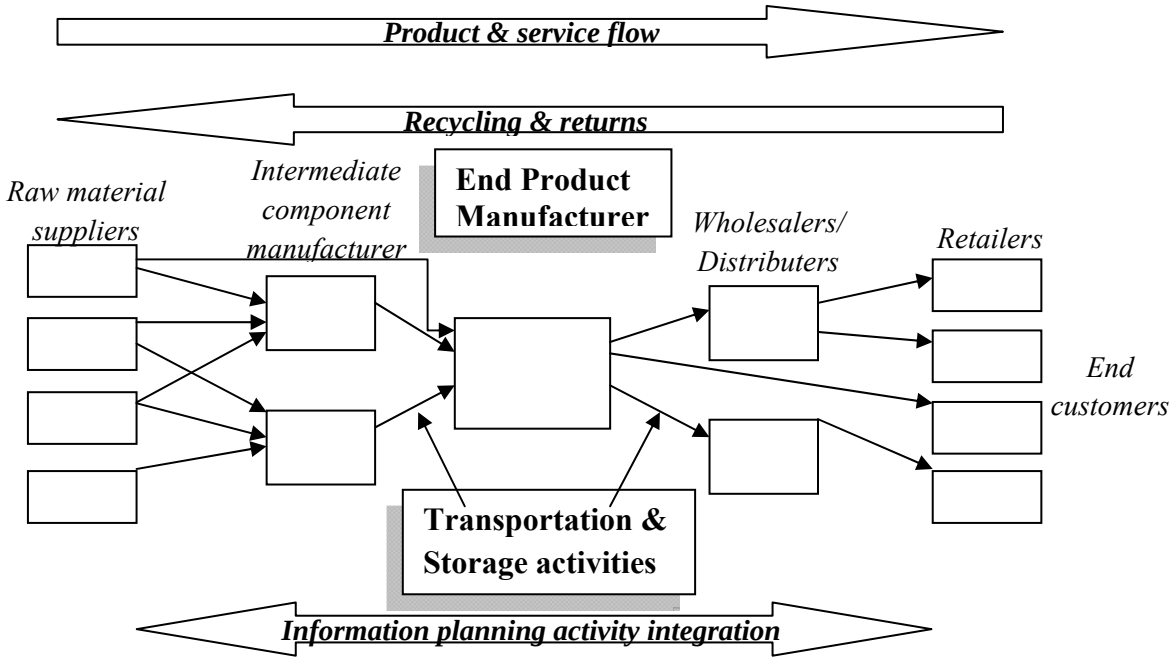


Figure 1– A supply chain network

Kotler (1998) defines customer delivered value as the difference between total customer value and total customer cost. And total customer value is the bundle of benefits customers expect from a given product or service. According to him, customer added value is a set of product value, service value, personnel value, and image value; total customer cost is composed of monetary price, time of value delivery system. Value delivery system depends on the combinative capabilities of product delivery and service delivery processes.

Gattorna and Walters (1996) have extended this concept to the design of supply chain. The supply chain is the network of organizations that are involved through upstream and downstream linkages in the different processes and activities that produce value in the form of products and services in the hands of ultimate

customers (Christopher, 1998). Lalende and powers (1993) mentioned that value delivery system defines the relationships between organizational entities in the supply chain. Hoover et al (2001) mentioned that in a turbulent market environment, the ways companies make, adapt, sell and distribute define the characteristics of a value delivery system and such a system is turning into a major source of competitive edge. According to them, the order-to-payment process is the company's value chain and is much broader than the supply chain depicts a value chain.

What is supply chain management?

The supply chain encompasses all activities involved in the transformation of goods from the raw material stage to the final stage, when the goods and services reach the end customer. Supply chain management involves planning, design and control of flow of material, information and finance along the supply chain to deliver superior value to the end customer in an effective and efficient manner.

Evolution of Supply Chain Management

The evolution of supply chain management has been a gradual process. Over the last century, there have been three major revolutions in the field of supply chain management and we examine each of them in the context of the broader evolution in the economic and technological environment. Consider the following statement made by the chief executive of an automobile firm:

Our aim is always to arrange the material and machinery and to simplify the operations so that practically no orders are necessary.
Our finished inventory is in transit. So is most of our raw material inventory. Our production cycle is about eighty - one hours from the mine to the finished machine (automobile) in the freight car.

It is clear from this statement that this firm had a well-integrated supply chain in place that allowed it to minimize cost and maximize asset productivity. Most

people, including students and business executives, are surprised to learn that the company that achieved this did so almost a century ago. Indeed, this statement came not in the 1960s or 1970s. Rather, Henry Ford achieved this fine balance in the 1910s with the Ford Motor Company. Clearly, this achievement set the standard for all managers the world over. There have been three major revolutions along this journey

The First Revolution (1910-1920): The Ford Supply Chain

The first major revolution was staged by the Ford Motor Company where they had managed to build a tightly integrated chain. The Ford Motor Company owned every part of the chain right from the timber to the rails. Through its tightly integrated chain, it could manage the journey form the iron ore mine to the finished automobile in 81 hours. However, as the famous saying goes, the Ford supply chain would offer any colour, as long as it was black; and any model, as long as it was Model T. Ford innovated and managed to build a highly efficient, but inflexible supply chain that could not handle a wide product variety and was not sustainable in the long run.

General Motors, on the other hand, understood the demands of the market place and offered a wider variety in terms of automobile models and colours. Ford's supply chain required a long time for set-up changes and, consequently, it had to work with a very high inventory in the chain.

Till the second supply chain revolution, all the automobile firms in Detroit were integrated firms. Even traditional firms in India, like Hindustan Motors, were highly integrated firms where the bulk of the manufacturing was done in-house.

The Second Revolution (1960-1970): The Toyota Supply Chain

Towards the end of the first revolution, the manufacturing industry saw many changes, including a trend towards a wide product variety. To deal with these changes, firms had to restructure their supply chains to be flexible and efficient.

The supply chains were required to deal with a wider product variety without holding too much inventory. The Toyota Motor Company successfully addressed all these concerns, thereby ushering in the second revolution.

The Toyota Motor Company came up with ideas that allowed the final assembly and manufacturing of key components to be done in-house. The bulk of the components were sourced from a large number of suppliers who were part of the *keiretsu* system. *Keiretsu* refers to a set of companies with interlocking business relationships and shareholdings. The Toyota Motor Company had long-term relationships with all the suppliers. These suppliers were located very close to the Toyota assembly plants.

Consequently, set-up times, which traditionally used to take a couple of hours, were reduced to a couple of minutes. This combination of low set-up time relationships with suppliers was the key feature that propelled the second revolution-and it was a long journey from the rigidly integrated Ford supply chain. The principles followed by Toyota are more popularly known as lean production systems.

The Toyota system, involving tight linkages, did get into some problems in the later part of the century. Gradually, when Toyota and other Japanese firms tried to set up assembly plants in different parts of the world, they realized that they would have to take their suppliers also along with them. Further, they found that some of the suppliers in *keiretsu* had become complacent and were no longer cost competitive.

With the advent of electronic data interchange (EDI), which facilitated electronic exchange of information between firms, it was possible for a firm to integrate with the suppliers without forcing them to locate their plants close to the manufacturer’s plant.

In actual practice, the Toyota supply chain also had certain rigidities, such as a permanent relation with suppliers, which could become a liability over a period of time. This, in turn, led to the third revolution spearheaded by Dell Computers, which offered its customers the luxury of customization with loosely held supplier networks.

The Third Revolution (1995-2000): The Dell Supply Chain

With advances in information technology (IT), Dell Computers allowed customers to customize their computers. Dell allowed customers to configure their own PCs and track the same in their production and distribution systems. Unlike the Toyota supply chain, Dell did not believe in long-term relationships with suppliers. Dell believed in working with world-class suppliers who would maintain their technology and cost leadership in their respective fields. Dell maintained medium-term relationships with suppliers, where the suppliers were always on test. Because of advances in IT, Dell could integrate the suppliers electronically, even if they were partners only for a medium term.

At Dell, the trigger for supplier orders was the actual orders by customers, and not forecasts. This helped Dell in reducing the inventory significantly, allowing them to respond to any changes in the market place. Since their suppliers were electronically integrated and as they did not want rigidity in the chain, Dell did not see any advantage in locating suppliers close to their assembly plants.

With increased use of IT in supply chain management, it became possible to achieve operational integration even with those suppliers with whom a firm may not have long-term relationships. Essentially, on the product-variety front, firms have progressed from a single product to a wide variety and from a wide variety to customization. Similarly, on the chain – ownership front, firms have progressed from vertically integrated firms to long-term partnerships with chain partners and from long-term partnerships to loosely held networks.

Advances in IT have fuelled the third revolution, and the exact contours of the third revolution are still being defined. It will probably take a couple of years before we understand the model fully and apply it to all industries.

As established in this discussion, the three major revolutions in supply chain management have been fuelled by a dynamic economy and market. Rapid advances in technology, changing economic policies and similar factors have spurred growth and expansion. This has forced firms to find better and more efficient ways of supply chain management. With this backdrop in mind, let us look at key supply chain concepts and try to understand why a supply chain has become such a critical success factor in most industries

Why supply chain?

Companies across the world are looking forward to value innovation as the strategic logic for high growth. World-class value adding performance outputs are as follows:

Quality: the quality of products and services should be virtually defects-free line. (In some cases, 10 or fewer defective parts per million (PPM). At many firms, over 50% of all quality defects can be traced back to purchased materials.

Cost: the supply chain management function must focus on strategic cost management: the process of reducing the total cost of acquiring, moving, holding, converting and supporting products containing purchased materials and services throughout the supply chain.

Time: total cycle time requires the examination of every aspect of the firm's operation, meticulously eliminating all redundant of non-value-added, but time-consuming activities from the process.

Technology: the supply chain management function has two key responsibilities in the area of technology: It must ensure that the firm's supply base provides

appropriate technology in a timely manner, and it must ensure that technology which affects the firm's core competencies (the "thing" that gives the firm its unique reason for being) is carefully controlled when dealing with outside suppliers and customers.

Continuity of supply: monitoring the trends, developing appropriate supplier alliances and taking such other actions as required to reduce the risk of supply disruptions.

Today, it is need of the time that all firms should understand the importance of supply chain management principles can have a positive impact on its overall success. It is one of the major functions common to many types of organizations: the overall goal of supply chain management is to impact the organisation's bottom line in a positive way. While it involves a number of actions, the objectives of supply chain management can be summarized around the following major goals:

- ✓ Provide an uninterrupted flow of materials, supplies and services required to operate the organization.
- ✓ Keeps inventory investment at a minimum.
- ✓ Maintain and improve quality.
- ✓ Find and develop competent suppliers.
- ✓ Purchase required items and services at lowest total cost.
- ✓ Improve the organisation's competitive position.
- ✓ Achieve harmonious, productive working relationships with other functional areas within the organization.
- ✓ Accomplish the purchasing and marketing objectives at the lowest possible level of administrative costs.

Traditionally marketing, distribution, planning, manufacturing and the purchasing organizations along the supply chain operated independently. These organizations have their own objectives and these are often conflicting. For example, high

customer service and maximum sales objectives of marketing may conflict with manufacturing and distribution goals. Many manufacturing operations are designed to maximize output volumes and lower costs with little or no consideration for the impact on inventory levels and distribution capabilities.

Purchasing contracts are often negotiated with very little information beyond historical buying patterns. The result of these conflicting objectives is that there is not a single, integrated picture of the organization as a whole. Hence, there is a need for an integrated picture through which these different functions can be integrated together. Today, it is indeed possible through IT (information technology) to achieve this type of integration. Supply chain management is the combination of art and science that goes into improving the way your company finds the raw component it needs to make a product or service, manufacture that product or service and delivers it to customers.

The following are the basic components for supply chain management:

1. ***Plan***: this is the strategic portion of supply chain management. One needs a strategy for managing all the resources that go towards meeting customer demand for product or service. This may include developing a set of metrics to monitor the supply chain so that it is efficient, cost less and delivers high quality and value to customers in the most cost effective manner.

2. ***Source***: One has to choose the suppliers that will deliver the goods and services needed to create final product or service. This involves developing a set of pricing, delivery and payment processes with suppliers and metrics for monitoring and improving the relationships. This also involves putting together processes for managing the inventory of goods and services from suppliers, including receiving shipments, verifying them, transferring them to manufacturing facilities and authorizing supplier payments.

3. ***Make***: This is the manufacturing step. This involves making schedule for the activities necessary for production, testing, packaging and preparation for delivery. This phase is the metric-intensive portion of the supply chain, as it requires measurement of quality levels, production output and worker and asset productive.

4. ***Deliver***: Generally, this is referred to as "logistics". This involves the co-ordination of receipts of orders from customers and setting up an invoicing system to receive payments.

5. ***Return/Reverse Flow***: This refers to the reverse flow of goods from customer back to the manufacturer. This involves creating a network for receiving defective and excess products back from customers and supporting customers who have problems with delivered products. The payment/discounts procedure needs to be established.

The importance of the supply chain

In the past, customers were not very demanding and competition was not really intense. As a result, firms could afford to ignore issues pertaining to the supply chain. Today, firms that do not manage their supply chain will incur huge inventory costs and eventually end up losing a lot of customers because the right products are not available at the right place and time. The following are the five major trends that have emerged to make supply chain management a critical success factor in most industries.

1. ***Proliferation in product lines***: Companies have realized that more and more product variety is needed to satisfy the growing range of customer tastes and requirements. This is evident from the fact that every time a customer walks into a neighbourhood store, he or she is bound to discover a couple of items on the shelf that he or she had not seen during his or her last visit and that he or she has more varieties to choose from now. Every time you walk into a

neighbourhood store, do not be surprised to find that even a simple product like toilet soap has 50-odd varieties.

We define stock-keeping unit (SKU) as a unit of variety. For example, the same brand of soap may be offered in varying colours and sizes. Each variety is treated as a separate SKU. Companies like HUL, in their personal care products, manage, on an average, 1,200 SKUs. Chains line Food world, manage about 6,000 SKUs. With increasing product variety, it becomes rather difficult to forecast accurately. Hence, retailers and other organization involved in the business are forces to either maintain greater amount of inventories or lose customers.

2. ***Shorter product life cycles***: With increased competition, product life cycles across all industries are becoming shorter. For example, the PC industry works with a life cycle as short as 6 months. So a firm like Dell, which has, on an average, just 7 days of inventory, as compared to the industry average of 35 days, does not have to worry about product and component obsolescence. Its competitors with higher inventories end up writing off huge amounts of stocks every year as obsolete.

   In the past, in developing countries where inflation was a way of life, higher inventories used to be a major source of profits for the firm. With inflation in control and shorter product life cycles, firms have had to change the way they manage their inventories. Also, with shorter product life cycles, there is not much data available for demand forecasting. Most of the technology firms find that 50 per cent of their revenue comes from products that were introduced in the last three years.

3. ***Higher level of outsourcing***: As discussed the section on “Evolution of Supply Chain Management”, firms increasingly focus on their core activities and outsource non-core activities to other competent players. Michael Dell, CEO of Dell Computers, had mentioned that if his company was vertically integrated, it

would need five times as many employees and would suffer form a drag effect. Apart from primary activities in the value chain, even support activities that were usually done in-house are outsourced in a big way now. Bharti Tele-Ventures, India number one private telecom service provider, has outsourced network-management services, IT services and call centre operations. This trend towards outsourcing is irreversible but a higher level of outsourcing makes supply chains more vulnerable, thereby forcing firms to develop different types of supply chain capabilities within the organization.

4. ***Shift in power structure in the chain***: In every industry, the entities closer to customers are becoming more powerful. With increasing competition, a steadily rising number of precuts are chasing the same retail shelf space. Retail shelf space has not increased at the pace at which product variety has increased. So there have been cases of retailers asking for slotting allowance when manufacturers introduce new products in the market place. Savvy firms have started talking about trade marketing and treating dealers and retailers as their customers while simultaneously trying to woo the retailers aggressively. There is a clear shift in the power structure.

   Retailers have realized that they are powerful entities in the chain and hence expect the manufacturers to be more responsive to their needs and demands. Discount retailers like Wal-Mart have been asking their suppliers to replenish the supplies on a daily basis based on actual sales data from their point-of-sales systems. In general, manufacturers are forced to respond more quickly to the customer's demands, because of changes in the power structure within the chain.

5. ***Globalization of manufacturing***: Over the past decade, tariff levels have come down significantly. Many companies are restructuring their production facilities to be at par with global standards. Unlike in the past, when firms use to source components, produce goods and sell them locally, now firms are integrating

their supply chain for the entire world market. For example, companies like ABB have developed some global centre of excellence for each of their product lines that take care of the global market.

General Motors is talking about a world car and has been designing a few cars for global markets. In the telecommunications and electronics industry, companies usually get their chips from Taiwan, test them in Europe and finally integrate them with other products in the United States of America to sell in the international market. This has made managing supply chains extremely complicated. Unlike information and finance flow, which can be managed electronically, materials and products have to move physically, and as this movement can even be across continents, managing supply chains is now an extremely complex issue.

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1.3.1 Strategic decisions in Supply Chain Management

Strategy is generally associated with long-term decisions. Choosing the timing, the location, and the scale of construction of new manufacturing facilities are typical long-term manufacturing and operation strategy decisions. Making these decisions requires information about the forecast for new and existing products, and changing characteristics of the market place, and changes in the costs and availability of resources.

Supply chain strategy must address the groundwork for building the proper channels for sales and distribution as well as facilities design and development. Time horizons affect the impact of decisions, the uncertainties surrounding those decisions, and the penalty for wrong decisions. Short time horizons involve many decisions, each of whose impact may be small, but cumulatively can make a difference.

Typically the decisions for supply chain management can be organized into broad categories- strategic, tactical and operational. As the firm implies, strategic decisions are made typically over a longer time horizon. These are closely linked to the corporate strategy, and guide supply chain policies from a design perspective.

On the other hand operational decisions are short-term, and focus on activities over a day-to-day basis. The tactical decisions are in between these two. The effort in these types of decisions is to effectively and efficiently manage the material flow and information flow in the “strategically” planned supply chain. Strategic supply chain management is directly related and draws strengths from the business strategy of an organization. As a matter of fact, the supply chain strategy is developed from business strategy.

On the strategic level, long-term decisions are made. These are related to location, production, inventory, and transportation. Location decisions are concerned with the size, number, and geographic location of the supply chain entities, such as

plants, inventories, or distribution centers. The production decisions are meant to determine which products to produce, where to produce them, which suppliers to use, from which plants to supply distribution centers, and so on. Inventory decisions are concerned with the way of managing inventories throughout the supply chain. Transport decisions are made on the modes of the transport to use.

Decisions made on the strategic level are, of course, interrelated. For Example, decisions on mode of transport are influenced by decisions on geographical placements of plants and warehouses and inventory policies are influenced by choice of suppliers and production locations. Modeling and simulation is frequently used for analyzing these interrelations and the impact of making strategic level changes in the supply chain.

On the tactical level, medium term decisions are made; such as weekly demand forecasts, distribution and transportation plan, production planning, and materials requirement planning. The operational level supply chain management is concerned with the very short term decisions made from day to day. The border between the tactical and operational level is vague.

The supply chain strategy to be developed should be fully aligned. Alignment means that it should pursue the same goals and objectives as laid under the business strategy. There cannot be departures or deviations as otherwise negative results can emerge, entities frittered away and resources spent wasted. Generally, there are four major decision areas in supply chain management:

- **Location decisions**: The geographic placement of production facilities, stocking points and sourcing point is the natural first step in creating a supply chain. The location of facilities involves a commitment of resources to a long-term plan. Once the size, number, and location of these are determined, so are the possible paths by which the product flows through to the final customer. These decisions are of great significance to a firm since they represent the basic

strategy for assessing customer markets, and will have a considerable impact on revenue, cost, and level of service. These decisions should be determined by an optimization routine that considers production costs, taxes, duties, and duty drawback , tariffs, local content, distribution costs, production limitation, etc. although location decisions are primarily strategic, they also have implications on an operational level.

- ***Production Decisions***: The strategic decision include what products to produce, and which plant to produce them in, allocation of suppliers to plants, plants to DCs, and DCs to customer markets. As before, these decisions have a big impact on the revenues, costs, and customer service levels of the firms. These decisions assume the existence of the facilities. But determine the exact path (s) through which a product flows to and from these facilities- and this largely depends the degree of vertical integration within the firm. Operational decisions focus on detailed production schedules, scheduling production on machines, and equipment maintenance. Other considerations include workload balancing, and quality control measures at a production facility.

- **Inventory Decisions**: These refer to means by which inventories are managed. Inventories exist at every stage of the supply chain as either raw material, semi-finished or finished goods. They can also be in process between locations. Their primary purpose is to buffer against any uncertainty that might exist in the supply chain. Since holding of inventories can cost anywhere between 20 to 40 percent of their value, their efficient management is critical in supply chain operations. It is strategic in the sense that top management sets goals. However, most researchers have approached the management of inventory from an operational perspective. These include deployment strategies (push versus pull), control policies- the setting safety stock levels at each sticking location. These are critical, since they are primary determinants of customer service levels.

- ***Transportation Decisions***: The mode choice aspects of these decisions are the more strategic ones. These are closely linked to the inventory decisions, since the best choice of mode is often found by trading-off the cost of using the particular mode of transport with the indirect cost of inventory associated with that mode. While air shipments might be fast, reliable and warrant lesser safety stocks, they are expensive.

  Shipping by sea or rail may be much cheaper, but they necessitate holding relatively large amounts of inventory to buffer against the inherent uncertainty associated with them. Therefore customer service levels and geographic location play vital roles in such decisions. Since transportation is more than 30 percent of the logistic costs, operating efficiently makes good economic sense. Shipment sizes (consolidated bulk shipments versus lot-for-lot), routing and scheduling of equipment is key in effective management of the firm's transport energy.

The strategic decisions are, for the most part, global or "all encompassing" in that they try to integrate various aspects of the supply chain. Consequently, the models that describe these decisions are huge, and require a considerable amount of data. Often due to the enormity of the data requirements, and the broad scope of decisions, these models provide appropriate solutions to the decisions they describe. The operational decisions, meanwhile, address the day-to-day operation of the supply chain. Therefore the models that describe them are often very specific in nature. Due to their narrow perspective, these models often consider great detail and provide very good, if not optimal, solutions to the operational decisions.

Successful supply chain management involves several decisions with varying time frames. Supply chain design (network design) or strategic decisions involve the following critical issues:

- ✓ What activities should be carried out by the nodal firm and what should be outsourced?
- ✓ How to select entities / partners to perform outsourced activities and what should be the nature of the relationship with those entities? Should the relationship be transactional in nature or should it be a long-term partnership?
- ✓ Decisions pertaining to the capacity and location of the various facilities.

Given the demand forecast and the business strategy of the firm, decision related to procurement, production, planning, distribution and transportation have to be integrated with customer order processing and inventory management decisions. Relationship management essentially involves the alignment of incentives to the various entities in the chain so that the overall supply chain performance meets customer requirements at the lowest cost.

Though not so obvious, the supply chain has also to be integrated with other important functions of the firm, for example, customer relationship management and new product development. Since customer relationship creates demand, the supply chain must ensure that it is in a position to fulfill the demand created by customer relationship management in a profitable way. Well managed firms integrate their customer relationship and supply chain activities. Similarly, while designing new products, well-managed firms ensure that supply chain issues are kept in mind at the design stage. Firms have to find a way in which the new products can use the existing product platforms and components, so as to minimize the supply chain costs for the product family as a whole.

Business strategy

Once an organization has settled in its mission, managers can turn their attention to developing the business strategy. These include:

- ✓ Clearly identify the firm's targeted customers, and broadly indicate what the operations and supply chain functions will need to provide value to those customers.
- ✓ Identify and support the development of core competencies in the operations and supply chain areas. Core competencies represent one way in which firms can build a sustainable competitive advantage.
- ✓ Set time frames and performance objectives that managers can use to track the firm's progress towards fulfilling its business strategy.

Executing successful supply chain strategies really translates into choosing and implementing the right mix of these elements. Effective operations and supply chain strategies accomplish the following things:

- ✓ They ensure that the firm's operations and supply chains excel on the performance dimensions that are valued by the firm's targeted customers.
- ✓ They ensure that the firm's operations and supply chain decisions are strategically aligned with the firm's business strategy
- ✓ They help develop core competencies in the firm's operations and supply chains.

The following guidelines are proposed to evolve a supply chain strategy.

- ➢ ***Planning***: many companies develop plans to help guide what they hope to achieve in their supply chain business process. The problem is that many companies believe having a plan is the same as having a strategy. Just having a business plan is not enough to ensure success.

- ➢ ***Pro-activeness***: one of the reasons Indian companies have fallen behind foreign competitors is that supply chain management has taken a subordinate role to marketing and finance function. This means SCM is always reacting to decisions by other units of the company and is always concerned with the short-

term issues. To be pro-active, companies must anticipate the potential of new practices and technologies and make sure that managers are involved in major engineering and marketing decisions.

- ***Pattern of actions***: While it is important to have a SCM plan, what counts is the real life actions and decisions made by the management. These actions will determine whether a supply chain strategy is successful or not. The pattern of actions of a company reveals the real strategy of the firm.

- ***Portfolio of supply chain capabilities***: these are the special abilities that a company has in managing its supply chain. Some examples of capabilities include cost, quality and performance. Managers should emphasize those capabilities because of which the company excels. For example, if the company has the ability to make products more cheaply than competitors, that ability should be exploited.

- *Programs of improvement*: These are the programs that the companies develop to improve capabilities needed to succeed in the market place. For example, the company may need to find ways to cut costs in manufacturing if competitors can offer less expensive products in the market place.

- *Performance measurement*: Managers need to find ways to evaluate how their company is doing at meeting its strategic goals. For example, a business that stresses a rapid delivery performance within the company.

Supply chain strategy need to be viewed from a broad perspective. Companies that develop such a perspective will be more successful in the global marketplace. Supply chains helps firms to provide products or services that someone values.

To begin, most customers evaluate products and services based on multiple performance dimensions such as functionality, delivery speed, after sales support, and cost. The organization that provides the best mix of these dimensions will be

seen as providing the highest value. Supply chains can have an enormous impact on many performance dimensions. Experience suggests that there are four performance dimensions that are particularly relevant to supply chain strategies. These are:

- ***Quality*:** The concept of quality is a broad one that can be sub-divided into the following categories:
  - ✓ *Functionality*: What are the characteristics or features of a product or service that determine how well it works? Products with many features or services that provide superior performance are often thought of a being of " higher quality"
  - ✓ *Conformance*: Was the product made or the service performed to specification? Examples of conformance quality include degree of purity, the weight of a product, and the amount of time it takes to perform a service.
  - ✓ *Reliability*: will a product work for a long time without failing or requiring maintenance? Does a service operation perform its task consistently over time?
  - ✓ *Durability*: can a product withstand adverse conditions, such as temperature extremes or rough handling? What is its "expected life"?
  - ✓ *Safety*: Was the product or service designed to be safe?
  - ✓ *Serviceability*: If necessary, can the product be easily repaired or services?
  - ✓ *Aesthetics*: Does the product or service appeal to the senses? Fresh-baked cookies or a shiny paint job are obvious example.

  The relative importance of these quality dimensions will differ from one customer to the next. One buyer may be more interested in reliability and serviceability, another in performance and aesthetics. To compete on the basis of quality, a firm's operation and supply chain must consistently meet or exceed customer expectations or requirements on the most critical quality dimensions.

- ***Delivery***: Delivery performance has two basic characteristics: speed and reliability. Delivery speed is the elapsed time from the receipt of an order to final delivery. A firm with superior delivery speed can "deliver more quickly than its competitors or meet a required delivery date when only some or even none of the competition can do so".

  Typical strategies for improving delivery speed include streamlining the order entry process, holding inventory at key points in the supply chain (in stores or regional warehouses), maintaining excess capacity with which to meet "rush" orders, and using faster transportation. Delivery reliability refers to the ability to deliver products or services on time. Note that a firm can have long lead times yet still maintain a high degree of delivery reliability.

  Typical measures of delivery reliability include the percentage of orders that is delivered by the promised time and the average tardiness of late orders. Delivery reliability is especially important to companies that are linked together in a supply chain.

- ***Flexibility***: Many supply chains compete by responding quickly to the unique needs of different customers. Both manufacturing and service firms can demonstrate flexibility. Manufacturers distinguish among several types of flexibility, including: mix flexibility, or the ability to produce a wide range of different products; changeover flexibility or the ability to begin production of a new product with minimal delay; design flexibility, or the ability to change the design of a product to accommodate specific customers; volume flexibility or the ability to produce whatever volume the customer needs.

  Different types of flexibility may require different operations and supply chain solutions. Firms must decide which types of flexibility are important to their customers and adjust their operations and supply chain efforts accordingly. Flexibility has become particularly valuable in new product development. Some

firms compete by developing new products or services faster than their competitors, a competitive posture that requires operations and supply chain partners that are not only flexible, but willing to work closely with designers, engineers, and marketing personnel.

- **Cost**: Cost is always a concern, even for companies that compete primarily on some other dimensions. In fact, in some industries, competition is so intense that firms are experiencing unrelenting pressure to reduce cost, even as their performance improves in other ways. Because operations and supply chain activities often accounts for most of the organisation's cost, they are natural targets n cost reduction efforts. Cost is such an important performance dimension that we will refer to it.

Trade-offs in SCM

Trade offs are forever in supply chain. Companies must select some performance attributes to favor at the expense of others. Most fundamental trade-off in a supply chain is between efficiency and flexibility. A highly efficient chain is between efficiency and flexibility. A highly efficient chain necessarily uses its capacity to the utmost, minimizes inventory at each location, and streamlines operation to achieve economies at scale at every link. By contrast, a flexible chain must maintain reserve capacity and inventory to respond quickly to anticipated demand; it must be able to produce and deliver products in varying quantities with short lead-time. Such requirements inevitably compromises efficiency.

The choice between efficiency and flexibility is not all or none. Rather, it's a matter of degree, with each company finding its own best balance between these conflicting goals. A company that competes primarily on price has little choice but no sacrifice flexibility in search of efficiency, while a company that differentiates itself on quality of service must usually have a very flexible chain. Companies that differentiate based on the products require flexible chain to handle uncertain

demand, while mature products call for efficient chains to hold down costs. Uncertainty is certain. Web communication only removes some of the uncertainty. As long as some remains, countermeasures (buffers in the form of inventory) may be needed. Inventory is a visible and significant asset in most of the companies- often the largest. One can visualize trade-offs of the following types:

- ✓ Lot size (inventory) trade- off inventory- Transportation cost trade-off
- ✓ Lead time- Transportation trade off
- ✓ Product variety- Inventory trade-off
- ✓ Cost-Customer service trade off

We may not be able to reduce inventory to zero and have fast response, unless we have a huge amount of excess capacity in the production-distribution system. It may be more appropriate to have excess capacity if inventory is relatively expensive, especially for high-tech products. Trade-offs often is complicated, and involves several terms, not just two. Different parameters are important in different situations, but trade-offs should consider at least the cost dimensions associated.

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1.3.2 Outsourcing: Make versus Buy

The decision of a firm to perform its activities internally or get those activities done from an independent firm is known as the make versus buy decision.

This make versus buy issue is strategic in nature and involves the following key decisions: What activities should be carried out by the firm and what activities should be outsourced? How to select the entities / partners to carry out outsourced activities and what should be the nature of the relationship with those entities? Should the relationship be transactional in nature or should it be a long-term partnership?

Identifying core processes

The mere decision to focus the resources on core activities to match capabilities with the best-in-class performance is not enough; firms must strive to be the best in the world in that specific area. In these areas they can invest in people, equipments and R&D. Such a focus will also help the firm in attracting the best talent from that field. Many corporations have realized that they can never hope to attract the best talent in IT; hence, they have decided to depend on their outside partners for the IT support required for business application.

The business process route

For any firm, three core and high-level business processes include *customer relationship, product innovation and supply chain management*. Customer relationship focuses on acquiring new customers and building relationships with existing customers. Product innovation focuses on fulfillment of customer orders. It is possible to un-bundle the three business processes and a firm can afford to outsource two of these business processes.

The product architecture route

In the product architecture approach, the focus is on sub-systems and components and the make or buy decisions are made at that level. A product like a car can be

divided into sub-systems such as engine, chassis and transmission. The engine sub-system can be divided into components such as power cylinder, fuel system and engine electronics. In a product, first the sub-systems are classified as strategic and non-strategic. A sub-system is strategic if it involves technologies that change rapidly, if it requires specialized skill and technologies and if it can significantly impact the performance of the product on attributes that are considered important by the customer.

By keeping these strategic sub-systems internal, a firm can ensure that it can offer differentiated products and can avoid being commoditized. Further, within a sub-system, the same kind of analysis has to be done for all major components. All those components where the firm is technologically ahead of potential suppliers or can hope to achieve a leadership position with some investments are kept internal to the firm. In case the suppliers have a huge technological lead, which will be impossible to bridge in the foreseeable future, or if the time and investments required for catching up may not be worth the effort, then the component should be outsourced and the supplier should be treated as a strategic partner

The Make-versus-Buy continum

We started out by exploring two extreme positions: (a) make an input or buy an input using the market and (b) vertical integration versus market, where the buyer has an arm's-length relationship with the suppliers. There are several alternative ways in which the exchange can be organized. In this section, we discuss two important alternatives:

1. Tapered integration, where a firm both makes and buys a given input.
2. Collaborative relationship, which could be a formal contractual relation or a long-term informal relationship, based on trust. In some cases, it can lead to alliances or joint ventures.

Sourcing strategy: Portfolio approach

Firms buy a large number of components and services and, of course, not all of them should be handled in same way. The popular portfolio approach developed by Kraljic (See Figure 2) classifies items based on the importance of the item in terms of value of purchase (high versus low) and associated supply risk in the supply market. Supply risk captures two dimensions: number of suppliers in the market and the demand-supply gap in the supply market. If an item has very few suppliers who have monopoly in the market and supply is less than the demand, the buyer faces a significant supply risk.

In supply markets where there are large numbers of players and there is surplus capacity in the market, the items bought will be classified as low-supply-risk category items. Packaging material and transport service markets come in this category and represent low-risk items. Diesel engines, diesel fuel systems and proprietary technology items have few suppliers, so they represent the high-risk-supply category. For example, Bosch has a market share of 81 per cent in the fuel-injection equipment market, so obviously it comes under the high-risk category. Similarly oil and steel in the early part of the 21st century represented the high-risk category because demand outstripped supply.

There was a strong demand for steel and fuel in India and China and, as a result, demand outstripped supply. Because of the supply uncertainty created by the disturbances in Iraq, the supply risk for oil increased significantly after the interventions by the United States of America in Iraq. Classifying items on their purchasing value is a straightforward issue because it just needs internal data and growth projections at the firm level. Supply risk, on the other hand, represents a more sophisticated analysis because the focus is on the supply markets, and in the case of many commodities, the supply markets are global in nature. So firms

should either develop adequate capability in this area or should take help from experts for carrying out this exercise.

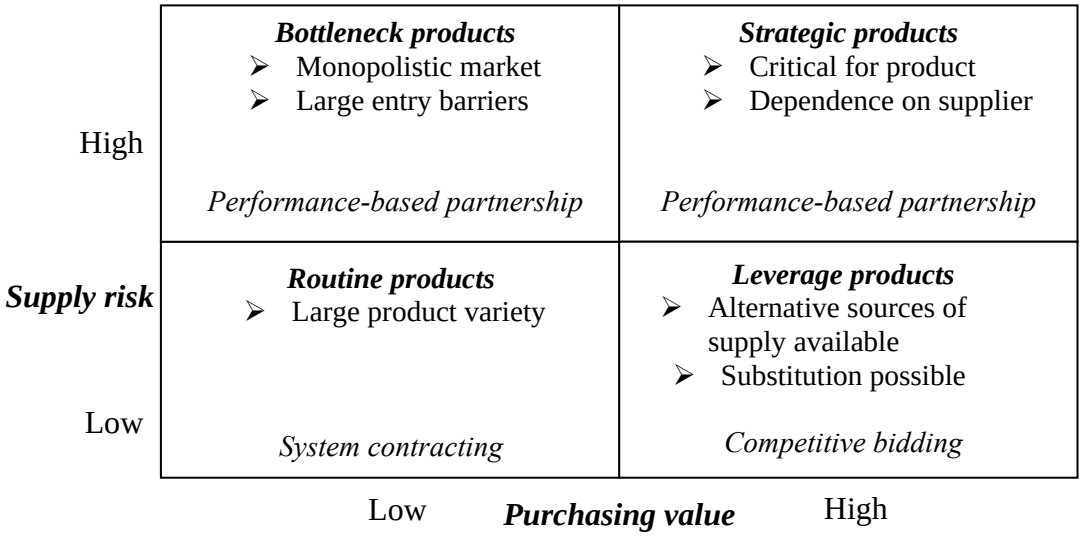


Figure 2- Purchasing portfolio analysis

As shown in Figure 2, the four quadrants are named as follows: routine products, leverage products, strategic products and bottleneck products. We take each category and discuss the sourcing strategy.

- ***Routine products***: This quadrant represents significant opportunity. The focus is on reducing the number of parts and the number of suppliers. The aim is to reduce administrative and logistics complexity. The time saved here is used to focus on strategic suppliers and bottleneck suppliers. The focus is on moving to system buying rather than component buying.

  A large number of items and suppliers come in this quarter, which represents a non-critical, low-valued supply. Unfortunately, managers end up spending much energy in this quarter. Ideally, the purchasing department should not waste its energy on small items. Rather, it should aggregate components into systems and start sourcing the systems. This issue is discussed in greater detail in the section titled “Reconfiguration of the Supply Base”.

- ***Leverage products***: This quadrant consists of high-value, standard products. These items provide an opportunity for leveraging buying power in low-supply-risk situations. In these supply markets, there are a large number of suppliers and switching costs are low. So firms should be aggressive in their attempts to encourage competitive bidding in offer to leverage their position. Most of the benefits obtained by firms in reverse auctions have been in this category. A firm can reduce the number of suppliers and focus on operational-level integration so that apart from purchasing costs inventory and administrative efforts can also be reduced.

- ***Strategic products***: This quadrant represents high-value products with high supply risks. This quadrant usually accounts for less than 5 per cent of the items and for almost 40 per cent of purchase value. Items in this quadrant are treated as strategic items, and a firm must work towards establishing collaborative, long-term relationships with suppliers in this quadrant.

  Firms must create opportunities for mutual cost reduction by working together on all aspects, including product design. Because fewer parts and suppliers are involved, firms can invest in building collaborative relationships. The top management of firms should get actively involved in devising a strategy for this category of items.

- ***Bottleneck products***: These items represent relatively low value, but a firm is vulnerable on this front because of the supply risk inherent in this market. Since a firm is likely to be buying relatively smaller value, it is also unlikely to have much clout with suppliers. Here, the focus is on securing supply, and a firm should actively keep looking at alternative sources of supply. If possible, the firm should also look at substitutes that are from low-risk supply markets. For example, in the diesel fuel system, there may not be too many suppliers of the required capability and competence. A firm might try and develop a better

understanding of supplier priorities and their planning systems so that it can align its buying plan with the suppliers' operating plans. For example, some steel producers produce certain grades of steel only once in a year. If an interested firm knew of their internal processes, it might be in a better position to obtain reliable supply. If required, the firm should also be willing to pay a premium for a reliable source of supply.

In doing the above-mentioned analysis, firms seem to focus on items involved in direct purchases or those that affect the cost of goods sold. But firms buy a huge quantity of indirect goods and services, such as travel, advertising, IT and human-resources-related purchases, which have rarely come under the radar of sourcing executives.

Impact of the internet of sourcing strategy

Some years back there was the view that the Internet will fundamentally alter the sourcing strategy of firms. A large number of researchers and practitioners argued that with the advent of the Internet, firms can source from anywhere is the world and that old ideas of sourcing will not be valid in the virtually connected world. During the days of the dotcom bubble, some analysts expected the three big auto companies GM, Ford and Chrystler to save to the tune of $2,500 per $19,000 vehicle, using the electronic collaborative exchange. In the post-dotcom-bubble era, firms have realized that the fundamentals of sourcing strategy remain valid in the post-Internet era also.

Ideally, firms prefer to evaluate a large number of potential suppliers, as a broadening range of suppliers will definitely help the firm in lowering the price at which it will buy the item. Also, a larger number of potential suppliers will reduce the risk of opportunistic behaviour, inherent in situations involving bargaining among a few parties that are highly dependent upon each other. Unfortunately, the costs involved in locating and evaluating the right supplier and the interactions are

strictly the function of the number of suppliers included in the search process. Consequently, a firm determines the optimal number of suppliers by trading of the cost of further searches against the expected benefit from identifying a better supplier. Since search and evaluation costs are lower for suppliers in the geographical neighbourhood, most of the firms traditionally work with a limited number of suppliers located in their geographical proximity. Internet technology has changed the nature and extent of costs involved in the search and evaluation process.

Because of advances in IT in general and the Internet in particular, costs related to computer-aided information search and coordination have declined, averaging 25 per cent per year. It was argued that the optimal number of suppliers in the consideration set is bound to increase as the Internet lowers search and evaluation costs. Further, suppliers in the consideration set will be globally distributed and not limited to the geographical neighbourhood of the firm. Also, the Internet fuelled a lot of electronic public market exchanges and industry sponsored exchanges where information about suppliers can be obtained without much effort.

These developments raised serious discussions among scholars and practitioners about the direction of evolution of the buyer-supplier relationship. There was also concern about whether we are going back to an era in purchasing where the only thing that mattered was the price.

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1.3.3 Inventory management in Supply Chain

The term supply chain refers to the complex sequence of activities, information and material flows involved in producing and distributing a company's outputs. Supply chain consumes vast amounts of capital in the form of plant, equipment and inventories and is responsible for most of a firm's cost of goods and operating expenses. Supply chains create significant value and ultimately determine a company's ability to satisfy the demands of its customers. As a result, effective supply chain management is a major strategic challenge for most companies. But formulating effective strategy requires a good understanding of what drives cost and service in a supply chain. Inventories drive the cost of a company and customer service level very significantly.

Definition of inventories

Inventory can be defined as a stock of commodity which has got some economic value, but withdrawal of which requires an authorization. This definition has the following implications:

- ✓ A detailed, itemized list, report, or record of things in one's possession, especially a periodic survey of all goods and materials in stock.
- ✓ The process of making such a list, report, or record.
- ✓ The items listed in such a report or record.
- ✓ The quantity of goods and materials on hand, stock, or in pipeline.
- ✓ The evaluation or a survey, as of abilities, assets, or resources.
- ✓ To make an itemized report or record.
- ✓ To include in an itemized report or record.

The amount of raw materials, work in process and finished goods being held for sale at a given time. Inventory is generally the least liquid item listed by a firm in the current asset account of its balance sheet.

Importance of inventory management in the Supply Chain

Managing inventory has become very important. This is due to the following factors.

- ✓ Resource availability (such as that of finance and space) has forced management to consider how best to lower the levels of inventory within the supply chain management systems in order to maintain margins
- ✓ The changes in manufacturing philosophy, concepts like just-in-time applications (JIT) and lean manufacturing have reduced the need for inventory as an insurance buffer within the overall logistic activity.
- ✓ The realization by companies that a greater return on investment (ROI) can be obtained by developing the core business, and that investment is working capital items, such as inventory and debtors, returns far less I comparison to other initiative.
- ✓ The developments on the front of information technology (IT), which provides a potential tool to reduce the inventory. Inventory and information can be traded. The better the information lower is the need for inventory. Information systems such as POS (point of sales), ERP (enterprise Resource Planning systems) can significantly reduce the inventory.

The importance of controlling inventory vis-à-vis customer service decisions is important. Typically, the following reasons may justify inventory:

- ✓ Enhance customer service, through a supporting role to marketing which, once having created demand, requires availability if goods if sales are to be affected.
- ✓ Leverage economies of scale by producing in large volumes (typically unit costs are lowest when product is a manufactured in long production run at constant quantities).

- ✓ Similar to above, exploit economies of scale in purchase and transportation based on the notion that both product procurement and transportation cost will be reduced if lot sizes are large.
- ✓ Inventory provides hedges against price changes: especially in India, observe the tendency to hoard commodities in anticipation of price rise just before the budget (in the month of January/February, just before the financial budget). This suggests that volume purchased will minimize the impact of supplier's price increases.
- ✓ Inventory protects against demand and lead-time uncertainties. For example, consider the problems which confront logistic system when both customer demand pattern and suppliers replenishment lead times are not known with a reliable degree of certainty. It follows that if service is to be maintained at acceptable levels to customers then an investment in 'safety stock' (as inventory) would be necessary.
- ✓ Inventory also provides hedges against contingencies. For example, natural calamities such as cyclones, fires, floods, and other exogenous variables can create problems. To protect against these, one may be motivated to keep inventory.

Imbalance in a Supply Chain

Basically, the primary motive behind carrying inventory in a supply chain is to eventuate a balanced transaction between supply and demand. However, only when we have full information about the supply and demand side, we can eventuate a balanced transaction. In reality, the supply and demand side may take three states of nature. Depending upon the combination of the state of nature, the size and location of inventory are normally decided. The inventory in a given location in a particular supply chain acts like and engine flywheel, which acts as the balancing mechanism to meet the fluctuations resulting in either supply or demand side or both. In real life, things are not quite that simple. Indeed, the real key to

understanding inventory cost and service is to understand what causes imbalances in supply and demand in the first place.

Supply/Demand uncertainties

A cause of supply/demand imbalances is uncertainty. We will focus on demand uncertainty since it is arguably the dominant form of uncertainty in most supply chains, but similar ideas apply to supply uncertainty. Why does demand uncertainty cause a problem?

Because the demand process is uncertain, the demand on the inventory during the review period is also uncertain. If demand is weaker than expected, we can end the period with excess inventory; if demand runs unexpectedly high, we may end the period with significant number of back-orders. Note the periodic review introduces cycle stock, since we must order on average enough products to satisfy average demand in a period.

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1.3.4 Vendor Managed Inventory systems

In the traditional replenishment process, the customer has to create an order for the vendor at every step in the supply chain. The customer does not give prior notification of requirements which, means that the vendor is compelled to store safety stock that acts as a 'buffer' for all eventualities. The customers also have safety stock available of the same items as a protective mechanism in case they do not receive the required stock. This procedure leads to a larger amount of stock in the entire goods supply chain.

Through vendor managed inventory programs, manufacturers can offer their customers a value-added service by performing the replenishment-planning task for their business partners. Besides giving the manufacturer increased visibility into actual consumer demand, VMI also recognizes that often vendors may have better decision-support systems in place and more knowledge and control over the logistical processes. By increasing visibility into actual consumer demand as well as customers inventory levels, VMI programs allow manufacturers to make better decisions on how to deploy goods across various customers, which leads to increased customer service levels, lower transportation costs, reduced inventory levels and lower sales cost. Both parties benefit from reduced cycle times and lower overhead, since the process can be highly automated. With VMI, the vendor specifies delivery quantities sent to customers through the distribution channel using data obtained from EDI.

Vendor Managed Inventory, Just-in-Time Distribution (JITD) and Efficient Consumer Response (ECR) all refer to similar concepts, but applied tend to use ECR, whereas the automobile industry tends to use VMI and JITD. VMI reduces stock-outs and reduces inventory in the supply chain.

Some features of VMI include:

- ✓ Shortening of the supply chain

- ✓ Centralized forecasting
- ✓ Frequent communication of inventory, stock-outs, and planned promotions. Electronic Data Interchange (EDI) linkages facilitate this communication.
- ✓ Trucks are filled in a prioritized order. For example, items that are expected to stock out have top priority, then items that are furthest below targeted stock levels, then advance shipments of promotional items (promotions allowed only in transition phase), and finally items that are least above targeted stock levels.
- ✓ Relationship with downstream distribution channels.

Result of VMI is inventory reduction and stock-out reduction.

Challenges of VMI implementation

VMI can be made to work, but the problem is not just one of logistics. VMI often encounters resistance from the sales force and distributors. Some issues are roles and skills, trust, and power shifts. Some of the sales force concerns are

- ✓ Loss of control
- ✓ Effect on compensation – incentive bonuses may depend on how much is sold, but sales force has less influence under VMI.
- ✓ Possible loss of job
- ✓ Skepticism that it will function well – technical problems.
- ✓ Concern that reduced inventory will result in less shelf space and therefore loss of market share. This concern can be addressed by filling the shelf space with other stock-keeping units from the same vendor.

Distributors also may have concerns about vendor managed inventory, including

- ✓ Inventory will be pushed on them.
- ✓ No more promotions, discounts, and forward buying.
- ✓ With fewer inventories, more risk of disruptions due to strikes, adverse weather, etc.

- ✓ The vendor enjoys the benefits while the distributor gives up its only lever of power – data on what the retailers want.
- ✓ Danger of being replaced – vendor may decide to forward integrate.

For a VMI system to work, the concerns of distributors and the sales force must be addressed. They can be at least partially addressed by the following

- ✓ Transform the sales role into one of marketing. For example, bonuses can be given based on the number of new clients.
- ✓ Distributor skepticism can be addressed by implementing a pilot program with vendor-owned warehouses in order to demonstrate that the system works. Introduce system in distributor-owned warehouses on a pilot basis.
- ✓ Engage a neutral consultant in meetings among the vendor, distributor, and sales force.
- ✓ Allow some manufacturer promotions in the transition.
- ✓ Extensively simulate the system off-line before implementing.
- ✓ Don't exaggerate the benefits of VMI; otherwise, any delay in realizing the benefits may cause the supply chain to lose faith in the system.

The aim of Vendor-Managed Inventory (VMI) is to integrate key customers in supply chain planning. It is particularly advisable to implement VMI in the following circumstances

- ✓ If key customers constitute a high percentage of the vendor's sales figures, if the products are standardized and requested repeatedly.
- ✓ If product growth is not excessive, meaning that the requirement patterns are stable and one can assume that requirements will not occur spontaneously.
- ✓ If the transaction costs for order processing and production planning are high.

Inventory performance measures

Performance measures are recognized as an improvement element. Managers and supervisors directing the efforts of an organization or a group have a responsibility to know how, when and where to institute wide range of changes. These changes cannot be sensibly implemented without knowledge of the appropriate information upon which they are based, and there is currently no standardized approach to developing and implementing performance measurement system. Performance measures quantitatively tell something about products, services and the processes that produce them. They are a tool to help understand manage and improve what organizations can do.

Customer service and satisfaction are the two most important attributes in the supply chain. Enhanced competitiveness depends on factors such as: identifying the important measures of performance for a given strategy; understanding the inter-relationships of these measures; and focusing on measures which truly predict long term financial success of the business. The performance measures in supply chain should be encouraged based on negotiation between finance, sales, developments and manufacturing. In the design of performance measures the following considerations are to be kept in mind:

- ✓ The performance indicators must be realistic and representative, so that the gathered information reflects reality. The measurements must be performed consistently, in order that they are defined and quantified in the same way throughout the entire supply chain.
- ✓ The performance indicators must relate to the commercial and distribution process between producer and customer. The performance indicators should not only be expressible in physical units, but also in financial terms. The performance indicators must be able to make costs transparent and to provide a basis for investment decisions. The performance indicators must reflect the responsibilities of the managers involved in the supply chain.

There are a number of indicators that suggest to management that inventory management techniques could be improved. Some of these indications are:

- ✓ Increasing customer and distribution complaints accompanied by a high rate of customer and distributor turnover and order cancellation.
- ✓ Increasing level of stockholding and decreasing stock turn performance
- ✓ Increasing level of backorders
- ✓ Periodic excesses and shortages of storage space
- ✓ Increasing level of stock obsolescence
- ✓ Increased investment in dead/slow items
- ✓ Increased space used by dead/slow items

In order to maintain the inventory investment at a cost-effective level, a number of measures should be introduced. These are financial and operational performance features

- ➢ ***Financial Performance***
  - ✓ Return on inventory investment
  - ✓ Inventory investment/working capital investment
  - ✓ Percentage of inventory increase (decrease) versus percentage of sales increase (decrease)
  - ✓ Percentage of inventory increase (decrease) versus percentage of cost of sales increase (decrease)
  - ✓ Stock ‘write-off’ per period
  - ✓ Level of capital consumed by dead/slow items

- ➢ ***Operational Performance***
  - ✓ Customer service levels over time
  - ✓ Inventory turnover performance; product groups, region wise, rate of sales categories, etc.
  - ✓ Inventory accuracy; actual count/indicated

- ✓ Number of customers not supplied from stock
- ✓ Number of units out of stock/number of day's product/segment wise
- ✓ Number of stock outs per year (or other significant period)
- ✓ Profitability of stock out/product groups, rate of sale categories, etc.
- ✓ Percentage of demand supplied from stock

Inventory turnover ratio (ITR)

Inventory turnover ratio (ITR) is defined as the ratio of Cost of Goods Sold from stock sales during the year to the Average Inventory Investment during the year. While considering, ITR only consider cost of goods sold from stock sales, which are filled from warehouse inventory. Non-stock items and direct shipments are not included. The cost of goods sold includes transfers of stocked products to other branches and quantities of these products used for internal purposes such as repairs and assemblies.

As one determines inventory turnover goals, consider the average gross margin one can receive on the sale of products. Most distributors who have 20% - 30% gross margins should strive to achieve an overall turnover rate of five to six turns per year. Distributors with lower margins require higher stock turnover. If a company enjoys high gross margins, one can afford to turn inventory less often (which may be difficult to realize in these days of competitive scenario).

A turnover rate of six turns per year doesn't mean that the stock of every item will burn six times. The stock of popular, fast moving items should turn more often (up to 12 times per year). Slow moving items may turn only once or not at all. The ITR is calculated separately for every product line in every warehouse. This will allow one to identify situations in which inventory is not providing an adequate return on investment. To improve inventory turnover, consider reducing the quantity one normally buys from the supplier. ITR will improve when one buys less of product, more often. Thus in JIT the ITR will be high.

Framework of performance indicators

The framework within which the performance indicators in supply chain are described is based on the hierarchical structure. In this framework, a hierarchical categorization is made, using an increasingly detailed description (Figure 3). The performance is evaluated on five important links of the supply chain management system: (a) Inbound logistics, (b) manufacturing, (c) Outbound logistics, (d) marketing and (e) service after sales. These links are to be evaluated on the following metrics

- ✓ Quality
- ✓ Inventory
- ✓ Customer service
- ✓ Cost
- ✓ Flexibility
- ✓ Time
- ✓ Productivity

Inbound Logistics	The link between supplier and operations is provided by the inbound logistics. The inventory policies for raw material, their location, transportation etc., will decide the strength of inbound logistics.
Operations	The operations functions will include evaluation of facilities, WIP inventory policies and communication within the operations domain.
Marketing/Sales	This will include the dealer network, sales strategies (workforce, advertisement campaign, etc.)
Outbound Logistics	This will include logistic from plant to customer via distribution channel and will cover issues like transportation, inventory and distribution network comprising ware houses, deports, etc.
Service after Sales	This function will evaluate the most important element in the supply chain: Customer. This relationship will be evaluated based on flexibility, terms of payment, quality of service, after sales, etc.

Figure 3-Various Links in the SCM

At the next level, the performance of a specialized function or department is analyzed within each ink. Functions, which can be considered for the producer, wholesaler and retailer, are for instance, a purchasing function, a distribution function and a marketing or sales function. A department in a company is regarded as the customer of another department. These performance indicators are useful at a tactic level. At this level, the performance of a subsystem within each function within a certain link is considered.

The supply chain function can be differentiated along other subsystems, namely the inventory control of finished products, the warehouse function and the transport function. At the next level the operational decisions are to be taken. At this most detailed level, the performance of each activity within a subsystem is considered. For the warehouse function, handling-in storage and handling-out are distinguished at this level.

For the external transport function, a categorization is made concerning the activities of loading, driving and unloading/waiting. First, the primary process that needs to be controlled is to be described and the system boundaries are to be determined. Second, the information that is necessary for the determination of the performance indicators is to be gathered and/or measured. In addition, the real performance indicators are to be compared with the planned performance indicators. If a variation between reality and norm is observed, these variations need to be analyzed and possibly corrective action should be taken.

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1.3.5 Transportation management in the Supply Chain

Transportation is the movement of products from one node in the distribution channel to another. By providing for the swift and uninterrupted flow of products back and forward through the distribution channel, transportation provides companies distinct markets on an equal footing. Transportation also permits wider and deeper penetration of new markets far from the point of production. In addition, by maximizing vehicle and materials handling capacities and cargo requirements, effective transportation permits distributors to leverage economies of scale by lowering the per unit cost of transporting the product.

Efficient transportation enables distributors to reduce the selling price by holding costs down, thereby providing for more competitive product positioning. Finally, transportation provides other business function with essential information concerning products, market place and time utilities and transit costs, and capabilities necessary for effective enterprise planning and operational execution. The first step in the transportation management process is to establish the cost effectiveness of private transportation fleets and the search for and selection of public carriers. The goal is to ensure the highest level of customer service at the lowest possible price. The second step involves the ongoing choice of selected transport mode to meet daily transportation requirements. Modes should be chosen that will perform the service for the cost, satisfy any special needs required by the customer, exceed the rates and services offered by competing carriers and minimize the likelihood of loss, damage or delivery delay.

Once the mode and carrier has been selected, suppliers as a third step must work with carriers to establish an effective schedule and the proper vehicle routing to ensure timely customer delivery. The fourth step of the process is the preparation and completion of the necessary transportation documentation. Finally, manages must be diligent in developing transportation performance measurements that will

provide them with quantifiable data necessary for increased productivity and competitive advantage.

Strategy

Transportation is a very key element of the logistics process and the supply chain which runs from vendors through operations to the customers. It involves the movement of product, service/speed and cost, which are the critical issues in effective logistics. It also impacts with the other two logistics – movement of information and integration within and among suppliers, customers and carriers. A transportation strategy, to be effective in supply chain management, is not one carrier against another. It is not negotiating down rates. Rather it is a way to respond to the dynamics of the business, its customers, suppliers and operation function.

The strategy, must acknowledge the following elements

- ***Customer requirements***: The supply chain involves continuous and efficient movement of product from vendor to manufacturer to customer. Therefore the transportation program must reflect and meet the customer's needs. The time and service aspects of transportation are vital.

- ***Timely delivery***: Customers demand their supplies be delivered as they require – on the date needed, by the carrier preferred, in the proper packaging method and delivered good order. Being able to have a transportation program which can do this provides customer satisfaction and can give an organization a sustainable competitive advantage.

- ***Mode selection***: How to move the product, i.e. by air versus surface? What roles do transit time play in supply chain? How will the inventory and service impacts be measured as compared to the freight charges?

- ***Carrier relationships***: Volume creates carrier/forwarder attention. Even if you have no strategy, the number of carriers trying to meet with you will make you develop one. The carrier attention with volume creates a competitive interest in any business. But there is another side to this attention, business cannot be divided among many carriers. This may be due to the fact that as one fractures one's business, the negotiating or leverage position is also affected and one will not be able to develop carrier alliances needed to meet the supply chain service requirements.

- ***Measurement***: One needs to evaluate how well the strategy and carriers are performing. This takes two approaches. One is measuring. Measuring means comparing performance versus standards. What is the actual delivery to customer performance, on a macro basis, carrier and customer-by-customer basis? A macro measure can hide a problem even if the overall measure is good. With integrated supply chain management, one is focusing on each customer and delivery locations. Costs should be measured. What is the total transport bill? How well it is being spent? Freight cost data tied with sales and transportation data makes a good database for budgeting and managing costs. It provides data for negotiations, developing good freight costs for sales and accounting, for studies and other purposes.

  Benchmarking may help in this matter. Benchmarking means learning what other companies do – the best practices. Very often benchmarking is not done with a company in one's industry. Competitors are not likely to share information. And best practices are not the exclusive of one industry or company.

- ***Regulatory impact***: Regulatory changes can change, for better or worse. This may affect the strategy formulation. The recent regulations in Delhi (and now in

Mumbai) about CNG vehicles have affected the transportation scenario in a significant manner.

- ***Flexibility***: Change is happening. It is not a question of whether or not it happens. The only question is how quickly it occurs. The strategy has to be ready to change. New customers, New products, New businesses, New suppliers, New corporate emphasis, Each of these can dramatically change the way strategy is formulated and implemented, Accordingly, the transportation has to respond to these changes.

Transportation selection

Transportation selection decisions are not usually taken solely on minimizing per unit costs, but aim to reduce total logistics costs. Therefore, to optimize relationships with forwarders, shippers need to employ supply chain management processes to co-ordinate their operations with all parties in the chain.

- ***Responsiveness***: Due to the importance of time-based competition in today's JIT oriented markets, responding to customer requirements quickly enables the traditional service-cost trade-off to be eliminated. To achieve this time compression, the agile approach is gaining much recognition – examining the supply chain from the customer's viewpoint, transferring information back to decision-makers at all levels. Accordingly, the SCM is embracing the concept of "tailored" or segmental logistics. This means different groups of customers have different logistical requirements and need policies tailored to their needs. Hence, transportation is a crucial component of agility providing the time-specific links between assembly lines and customers.

  However, the performance capabilities of transport modes and operators are not sufficient. When information precedes the flow of physical stock, companies can achieve more consistent throughput. It has been stated that it is throughput,

not speed per se, which minimizes cost. Accordingly, the product moves through the supply chain through a seamless process without stopping.

- ***Reliability***: Shorter transit time result in lower inventories, while more reliability causes lower stock-out costs. Consequently, it the transit time is not consistent, the customer must increase inventories above the level that a consistent transit time would require. The extended lead times involved in long sea passages are forcing companies to use the more expensive air freight option, but in the context of inventory holdings costs, potential lost revenue and market flexibility, the increased freight charge may be a worthwhile expense. To achieve the benefits of a reliable transport operation, there is agreement that closing the "lead-time gap" is vital.

- ***Relationships***: The traditional functional approach to transport has resulted in firms separating demand-generation activities, such as advertising and promotion, from supply activities, such as manufacturing and transport. However, there is an agreement that this separation has allowed transport management to remain focused on functional efficiencies in isolation from benefits derived from integration with the rest of the supply chain.

Modes of transportation

Carriers vary considerably in their characteristics. Speed ranges from the supersonic in the air to a leisurely 5-10 kilometers per hour by river route. Shipments can vary in size from 150 tons in a rail to only 10 tons transported by truck. A broad spectrum of equipment is available depending on the type of products carried. Prices also vary, as do the types of service offered. The supply chain manager, thus, has a lot to think about while selecting a mode of transportation for the products. The following issues need to be resolved.

- ✓ Negotiating rates and routes.
- ✓ Selecting routes and carriers.

- ✓ Appearing before regulatory agencies to support or protest a change in rates affecting the company.
- ✓ Evaluating carrier performance.
- ✓ Analyzing transportation costs and services.
- ✓ Operating company-owned means of freight and passenger transportation.
- ✓ Filling loss and damage claims.
- ✓ Auditing freight bills to ensure that the proper charges were paid to carriers.

Carriers can be grouped into the following major categories:

- ✓ Common carriers, which hold out their services to all who wish to use them.
- ✓ Contract carriers, who haul freight for individual companies on a contract basis.
- ✓ Private carriers tend to be the most closely regulated by public authorities, contract carriers less so, with private and exempt carriers enjoying the most freedom from economic regulation.

All types, however, must observe the laws and regulations governing safety.

- ***Rail***: Rail has pride of place in the history of transportation of almost every country of the world. One of the major advantages of rail is the ability to haul large quantities of products over long distances. Several technological innovations in recent years have greatly improved rail service. For example, cold carriages were introduced by Indian Railways to carry refrigerated items. These innovations are especially helpful considering the type of product carried on most rail shipments.

  Majority of all the freight hauled by rail is coal. Another major class of goods consists of agricultural products. Any important improvement in service eventually translates into rupees saved through lower freight rates and less costs to shippers in better handling of their products. The rail, of course, is not without its problems. When revenue runs low, economies are obtained in

operating costs by slighting the maintenance of way and equipment. Still, rail reigns supreme as an economic and efficient hauler of bulky items over long distances.

- ***Motor Carriers***: Motor carriers can be divided into categories according their legal status:

  - ✓ Common carriers, who must serve all who ask their services (provided, of course, the carrier has the necessary equipment).
  - ✓ Contract carriers, who haul freight for individual shippers under specific written agreements.
  - ✓ Private carriers, who own the freight they haul.
  - ✓ Exempt carriers, who haul farm products, fish or livestock, or who operate within the confines of a single city. Note that any carrier becomes exempt while hauling the named products.
  - ✓ Brokers, who own and operate no equipment but bring together those who wish to ship freight and those who wish to haul it.

- ***Oil Pipelines***: Not all pipelines, of course, carry petroleum products. Slurry pipelines, for example, carry a pulverized product (such as coal or grain) suspended in water, while the natural pipelines supply our furnaces and air conditioners. Pipelines are not especially fast and, in fact, rank last in speed of the major modes of transportation sine they move their content at less than five miles per hour.

  One of the major issues in pipeline transportation is shrinkage of the product, due mostly to evaporation. Crude petroleum can lose up to one-quarter of a percent of its volume in transit through the line, while a refined product such as petrol or kerosene can lose up to one percent. Another problem is the sheer size of the investment required to build the line.

- ***Water Transportation***: Water transportation within the nation travels along the rivers and canals. Speed is slow and made even slower when ice or floods clog the waterways; but water can carry large bulky cargoes. This bulk cargo consists mainly of coal, petroleum, grain and iron ore. The capacity of some modes of water transportation is quite large. Weather presents a continuing problem. Ice can bring shipping to a complete halt, thus requiring companies that rely on water transportation to maintain enough inventories on hand to last through the icing season. Storms can be sudden and severe enough, with savage winds and high waves, to sink heavily laden vessels.

- ***Air Transportation***: Air freight has never enjoyed the glamour accorded to passenger aircraft, although many passenger airplanes are able of handling a considerable amount of freight in the cargo holds beneath the passenger compartments. Many jet aircraft can function in a dual capacity. Air, by whatever type of airline, is generally considered a premium means of transportation. Air transportation is fast, but the freight rates are correspondingly high. Unless speed is an important factor in delivering parts to prevent the shutdown of an assembly line or to meet a delivery date to a valued customer, some less expensive means of transportation will usually suffice.

- ***Other Modes of Transportation***: Other modes of transportation include the freight forwarder who accepts small shipments and charges less carload (or less truckload or less planeload) rates and consolidates the small shipments into carload truckload, or planeload lots, which are then sent by the lower quantity rates. Frequently, the freight forwarder acts as a traffic department for small companies, which usually ship in less carload lots. Shippers' cooperatives offer much the same services as the forwarder in consolidating small shipments into larger ones, except that the profits of the business are returned to the members of the cooperative. Small packages can also be sent via speed post, and can use some of the expedited delivery services the Indian Post System now offers.

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1.3.6 Customer relationship management (CRM) strategy

CRM- as a new approach, a new technique, a new management concept for managing customers – focuses a business on creating a technological environment that integrates marketing, sales, service and back-office and supply chain functions in order to allow an enterprise to take a 360-degree view of its customers. CRM fosters an environment where the automation of customer –facing processes and the integration of historically isolated customer databases help a business to focus on doing business with the right customers. At the same time, a business can provide personalized, individualized attention- regardless of who the customer is interacting with or where that employee resides within the business. This is CRM strategy.

As we mentioned, CRM is the new management concept that relies heavily on technology and process automation to create its environment. However, to create such an environment will entail change: change in processes; change in people; change in technology; change in management styles; and the change in the overall way a business looks at and conducts business eith its customers. Introducing this level of change into any business can create turmoil among employees if not introduced and implemented carefully and with a purpose. In order to bridge a gap between the elements of CRM that have been discussed into actual daily use, a new type of customer champion, a "customer leader", is needed. Therefore, for supply chains to become strategic; the following elements are necessary:

- ***Technology***: The customer relationship in the supply chain must be a champion of technology. Leaders and businesses that do not aggressively permeate the entire organization with information technology will increasingly inhibit their frontline employee's ability to manage customer relationships effectively. We are entering a new era in which total customer care transitions from slogan to reality, a reality enabled by advancements in infrastructure technology (internet, EDI) that connects the various systems and databases associated with managing

the customer from “cradle to grave”. In doing so, front-line employees are being empowered through up-to –date and comprehensive information. Combining information access technology with online analytical processing tools and knowledge, employees are becoming a potent recipe for delivering total customer satisfaction and loyalty.

From a customer’s perspective, effectively identified and implemented technology can help employees directly match customer desire for customization in the product and services they seek and provide after-sales service and support based on customer profile data. From a business standpoint, technology can help identify the most valuable customer relationships and equipped employees with abundant and relevant information about those customers in order to provide most effective sales and service.

In effect, SCM technology can integrate the enterprise, fostering an environment of shared customer knowledge and focusing the right employees on serving the right customers. The new leader recognizes that SCM technology is strategic. SCM technology must become a central part of the performance equation. An effective leader will ensure that SCM technology is embraced by the entire organisation to drive its overall success in term of: reducing supply chain costs; improving product margins; lowering inventories; increasing manufacturing throughput; and maximizing returns on assets.

- ***Organizational Environment***: Most observers of modern organizations agree that the global reach and speed of modern business demands a more decentralized approach to decision making. Focusing the right employees on the right customers will be critical to fulfill a SCM vision. Placing top employees with the top customers creates a synergetic environment of achievement and fulfillment, thus aiding in the struggle to retain top talent. In short, customer-interacting employees that work in a localized atmosphere of

action will be advantageous position to directly meet customer's needs for personal relationships.

- ***Atmosphere of Innovation***: Innovation allows companies to race ahead of competitors and thus builds costly competitive entry barriers that discourage competitors. Creating an atmosphere of innovation is direct result of an environment that encourages entrepreneurial thinking at the local level. A forward-thinking customer relationship leader fosters an atmosphere of innovation and encourages employees to remove barriers that inhibit effective SCM.

Innovations in SCM must lead in the following dimensions:

- ✓ Reduced inventory at all sites of the supply chain.
- ✓ Reduced costs.
- ✓ Faster processing speeds.
- ✓ Reduced lead times.
- ✓ Reduced warehouse costs.
- ✓ Reduced obsolescence.
- ✓ Greater responsiveness to customer changes.
- ✓ Electronic links to customers and suppliers.
- ✓ Continuous flow of products and information.
- ✓ Speeding up the development cycle.
- ✓ Continuous flow (not overload).

One of the best ways to gather relevant data about customers is to ask questions in a brief survey. Your overall goal is to find out how satisfied your customers are and whether they would recommend you to others. This information can be obtained by various means, such as a paper form, a website survey or an e-mail. Try to minimize survey questions to get the best possible participation. Consider providing an incentive for answering a survey--for instance, the chance to win one

of your products. Have a plan for aggregating the data collected so it can be sliced and diced in various ways and integrated into your customer database.

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1.3.7 Information Technology in Supply Chain

The focus of management has changed over time. Earlier, strategic planning and product portfolio approach drove business thinking. Success depended on the ability an organization to meet demand at the lowest cost, leading to an “economies of scale” approach. The 80s exposed the weakness of this approach and saw an upsurge in quality consciousness, leading to an increased emphasis on TQM, product reliability and customer satisfaction.

In recent year conducting business has become increasingly complex. The various factors leading to this development are increasing product variety and volumes, increasing competition, shrinking product life cycles and growing customer demands. To manage this complexity effectively on a real time basis for a business, information sharing across functions and locations has become critical. Flexibility and responsiveness have become key business drivers forcing business to orient themselves along process instead of functions. It is in this aspect of management that the use of information technology assumes a greater significance in managing the supply chains.

Supply chain management, enabled by advances in technology, aims to develop an effective infrastructure linking technology and people, in an effort to align advances in information technology with the capability of the organization for facilitating customer satisfaction. This integration is aimed at leveraging information tools to address the following business concerns: Flexibility and variety, quality, responsiveness and edging toward agility.

One of the main objectives is to increase the efficiency and effectiveness of working so that we get quantum improvements performance measures. In this scenario, IT through automation and computerization plays an important role. Rapid developments and diffusion of IT through computers and telecommunications have enabled changes in various facets of life. What was not

feasible in the past, has become feasible today due to technological innovation. For example, dramatic reductions in technology costs (e.g. low cost of PCs and networking) have resulted in the proliferation of computer power throughout the organization and a trend towards the decentralization of information resource. This has resulted in new possibilities and opportunities for the effective functioning of organization to support organizational objectives. IT can be perceived as the set of task that encompasses structure, processing and communication of information. It also includes the manner in which these resources are organized into a system capable of arranging out a task or set of tasks.

We visualize that IT will impact the following sub systems:

- ***Planning*** is concerned with the setting of objectives and establishment of standards for every objective. In order for planning activities to be carried out, relevant information needs to be collected, organized and stored. IT can be used to facilitate the acquisition, organization and strategic use of information as well as provide support for diagnosis and forecasting.

- ***Monitoring*** is concerned with observations of behaviors and measurements of outputs to ensure compliance with standards. Since monitoring is usually labour intensive, the use of IT support in monitoring activities can reduce administrative levels by enabling greater span of control. IT enables better control of resources, the use of IT in automation (bar coding, etc) would produce significant increase in productivity. With the use of IT, there would be less need to monitor.

- ***Evaluation*** is concerned with assessment of the performance of individuals or groups against pre-established goals and standards. Administration needs to evaluate not only the effectiveness of current strategies but also the changes in environment that can influence strategy.

Typical IT solutions

The developments in IT have resulted in many possible alternative solutions for managing the supply chain effectively. Some of the major developments in IT which are transforming the supply chains today are as follows:

- ✓ Electronic Data Interchange (EDI)
- ✓ Intranet/Extranet
- ✓ Data warehouse/Data mining/Data marts
- ✓ e-commerce/e-procurement
- ✓ Bar Coding Technology
- ✓ Other technologies (such as Smart cards, Radio Frequency Identification Device (RFID), etc)

IT Element	Operation	Results in
EDI	Inter-organizational exchange of business documentation	Reduced transactions costs and time. Optimize inventory. Improved decision making. Increase accuracy. Improved customer service.
Intranet	Distribution of information within an organization	Common process for multiple functions. Two-way communication between different parts of the plant.
Extranet	Information transaction among the clients, partners, customers and suppliers.	Enhance overall performance. Real time feedback.
E-commerce/e-procurement	Information related to cash cycle, accounts payable/receivables, etc. Purchasing operations	Create new revenues streams and grow sales. Trim both transactional and overhead costs. Improve customer service and satisfaction. Increase return on Capital investment. Elimination of paper work. Elimination of some intermediaries.
Bar Coding	Use of standardized bar codes.	Reduction in paper work. Error reduction. Better tractability.
Smart card	Accounts payable/receivables.	Helps in eliminating errors. Better transparency.
RFID	Tracking of items.	Error reduction. Better tractability.

Figure 4- Benefits of various IT elements

Information Technology has helped in making the supply chain faster, flexible and responsive. An organization needs to invest in IT carefully to make its supply chain more responsive. Various flows in supply chain such as material, information and money can be effectively managed through IT. Specifically

- ✓ Strategic decisions on supply chain design can increase customer satisfaction and save money at the same time – a classic win-win situation.
- ✓ By sharing information, supply chain partners are able to respond more rapidly to known demand and to do so with less inventory in the system as a whole and hence at lower cost.
- ✓ Reduction of operating costs by proper coordination of the planning of various stages of the supply chain is enabled through IT.
- ✓ By minimizing the need for excess parts and simplifying the overall design, it will be easier for companies to customize or vary the product according to each customer's needs and requirements.
- ✓ Rapid introduction of new or modified product is possible through IT.
- ✓ Greater product customization, or manufacturing to order, would come at relatively low unit cost through IT.
- ✓ There is sharing of planning and scheduling information due to collaboration and integration among departments within the company and outside departments, something that is highly correlated to supply chain performance.
- ✓ Effective inventory management, having just the right amount of the right merchandise on the shelves for the just right amount of time, minimizes overstocking and markdowns, and so boosts profitability. This is possible through IT.

E-procurement makes the supply chain leaner, faster and responsive. The requirement is of matching technology, market initiative, consumer confidence and maturity and developing a regulatory framework for such solutions to mature. This

can bring a revolutionary change in the way business is done in that consumer has access to all the manufacturer/suppliers at his desktop/ palm top/mobile and the manufacturer has an instantaneous access to all the consumers irrespective of geographical boundaries.

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1.3.8 Supply Chain strategy and performance measures

A firm's supply chain strategy should ensure that its supply chain provides superior value to the end customer in an efficient manner. Value offering (bundling of goods and services) to a customer should be available at a reasonable price. In almost all product categories, customers want more variety and quicker services at lower prices. Firms must recognize the nature of trade-offs between customer service and costs and arrive at an optimal decision on this front. If various processes and decisions within the chain are not aligned to suit a company's business strategy, it obviously cannot remain competitive in the long run. The firm has to understand the relationship between business strategy and supply chain decisions and how different business environments pose different kinds of challenges to the supply chain.

Although at any given point managers need to understand customer service and cost trade-offs, in the long run firms will have to find a way of improving performance on both cost and service fronts. Because of the nature of competition, customers will demand better services at lower prices over a period of time. Progressive firms resolve this paradox through various supply chain innovations. To enhance supply chain performance, firms have to identify the right kind of initiatives to help improve both costs and customer service simultaneously on an ongoing basis.

Supply Chain responsiveness

Responsiveness captures the firm's ability to handle the uncertainty of market demand. In addition to delivery lead time, supply chains have also been characterized on the basis of the nature of demand uncertainty faced by products in the market place. Based on the nature of demand uncertainty, products can be classified as functional products or innovative products.

Functional products (grocery) are those that satisfy the basic needs of a customer and therefore have low variety, stable and predictable demand, long life cycles and low profit margins. Innovative products (fashion and technology products) are those that try to satisfy a broad range of customer's wants and have the following features: high variety, unstable and very-hard-to-product demand, short life-cycles, high profit margins and frequent stock-outs and markdowns.

Most firms often fail to take this into account when they introduce changes in their product lines / offerings. For example, firms operating in the innovative products space would have usually started their business with functional products and therefore would have focused on logistics efficiencies. As they grew, they would have introduced innovative products to compete effectively in the market but may not have changed their supply chain structure and processes. This would naturally result in a mismatch between the product characteristics and the supply chain.

As shown in Figure 5, firms must ensure an appropriate match between the type of supply chain and the nature of product characteristics. Demand unpredictability could occur either on the volume side or on the product-mix side. In some instances, it is difficult to estimate the overall volume is predictable but predicting demand at the individual variant level is extremely difficult, leading to product-mix uncertainty. For example, when it comes to new technology products, firms face volume uncertainty.

While in the case of some innovative products, where the overall category is at a mature stage (garments, jewellery), firms usually face product-mix uncertainty. Within the life cycle of products, they are likely to face high volume uncertainty at the growth stage. Thus, during the growth stage firms need to work with responsive chain, and over a period of time, at the mature stage, firms required an efficient chain.

Efficient Supply Chain	Functional products Match	Innovative products Mismatch
Responsive supply chain	Mismatch	Match

Figure 5 - Matching SC with product

For innovative products, like fashion products, demand is inherently unpredictable at the final customer end. Risk mitigation strategies involve buy back contracts, postponements or innovations in a supply chain design that enhance flexibility. So far we have focused our attention on demand uncertainty.

However, a firm could also face uncertainty on account of supply in the chain. Unlike demand uncertainty, supply uncertainty has not received enough attention in supply chain literature. Unlike demand, a firm can exercise greater control on supply and the popular view was that uncertainty in supply can be handled by choosing appropriate partners in a chain. Thus, traditionally, the focus has been on supplier selection and supplier development rather than on the management of supply uncertainty. The terrorist attack in September 2001 forced firms to look at their supply chain vulnerabilities, and firms have realized that they need to focus on both demand uncertainty and supply chain disruptions. Managing supply chain disruptions involves managing certain events that have a low probability of occurrence but have a high impact on supply chain performance.

Delivery reliability

Delivery lead time is an important dimension of customer service, and delivery reliability essentially captures the degree to which a firm is able to service its customers within the promised delivery time. Delivery reliability measures the fraction of customer demand that is satisfied within the promised delivery lead

time. Given the nature of demand and supply uncertainty, it is obviously more expensive to provide higher levels of service. Essentially, firms have to trade-off inventory costs and stock-out costs to arrive at the optimum service level. In general, firms will have to arrive at an optimal trade-off between cost (costs related to high inventory and slack capacity) and service level while deciding on this issue. In the industrial products category, performance on the delivery reliability front is monitored and the supplier is usually chosen based on performance on this front.

Product variety

The quantum of variety offered by a firm is an important dimension of customer service. In the past couple of years, a "variety explosion" has taken place in most product categories. Higher product variety offers greater choices to the customer who is likely to get a product that fits closest to his or her actual requirements. Some firms like Dell Computers and National Panasonic go to the extent of allowing their customers to design their own products. Obviously, higher variety would lead to greater complexity, resulting in higher supply chain costs. Some firms have found that variety explosion has affected firm profitability in an adverse way. Firms like P&G have worked on product rationalizations and have reduced overall product variety. While deciding the optimum level of product variety, a firm has to manage trade-offs with other dimensions of customer service like order lead time.

Supply Chain performance measures

Among various sets of supply chain performance measures discussed in the literature, we focus on a set of performance measures that have been most widely accepted in the industry. Supply chain performance measures fall under the following four broad categories:

- Cost
- Assets

- Reliability
- Flexibility

Supply Chain Performance Using Financial Data

Though supply chain benchmarking has received much attention, we have found that firms face multiple sets of problems while carrying out this exercise. Most firms suffer from the problem of data availability. Even if the relevant data are available, one is not sure of the validity and reliability of the data. It is difficult to get financial databases that are reliable.

One can calculate the following three performance measures:

- ***Total length of the chain***: The total length of the chain is arrived at by adding up the days of inventory for raw materials, work in progress and finished goods. The firm that has the minimum total length of the chain is said to have the best performance.
- ***Supply chain inefficiency ratio***: This ratio measures the relative efficiency of internal supply chain management. The ratio will be low for the firms with better performance.
- ***Supply chain working capital productivity***: The analysis of firms on this metric will also be based on the levels of inventory, accounts receivable and accounts payable. Firms with efficient supply chains will usually have high supply chain working capital productivity.

CRM	Cost of raw material	RM	Raw materials inventory
CP	Cost of production	SFG	Semi-finished goods inventory
DC	Cost of distribution	FG	Finished goods inventory
CS	Cost of sales	AR	Account receivables (excluding loans & advances)
NS	Net sales	AP	Account payables
INV	Inventories (inclusive of raw materials, semi-finished goods and finished goods)		

Figure 6 - Data to be used from financial statements

1. Calculating length of various stages of the chain

The following formulae are used to calculate the length of the various stages in the supply chain:

DRM, DWIP, DFG = *Days of raw material*, *work in process* and *finished goods*, respectively

DRM = RM x 356 / CRM

DWIP = SFG x 365 / CP

DFG = FG x 365 / CS

Total length of chain in days = DRM + DWIP + DFG

The duration of time taken by the material flow is captured by this measure. Firms like Dell Computers perform very well on this dimension.

2. Evaluating The Efficiency of Supply Chain Management

The internal supply chain inefficiency ratio is measure of the efficiency of internal supply chain management. To calculate this ratio, we consider total inventory carrying costs and the distribution costs to be components of the internal supply chain management costs. We calculate the internal supply chain inefficiency ratio as follows:

SCC = DC + INV x ICC

SCI = SCC / NS

Where SCC is the *supply chain management costs*, ICC is the *inventory carrying cost* and SCI is the *supply chain inefficiency ratio*.

The inventory carrying cost for most firms is estimated to be in the range of 0.15 – 0.25. In the absence of any data, one can work with an inventory carrying cost of 0.2. The supply chain inefficiency ratio (the lower the better) provides an insight into the internal supply chain management efficiency of the firm. This measure is termed the supply chain inefficiency ratio since the supply chain cost will be higher

if there are inefficiencies in the system. Firms with efficient supply chain systems will have relatively lower scores on this performance measure.

3. Supply Chain Working Capital Productivity

The supply chain working capital productivity is calculated using the following formula:

$$SWC = INV + AR – AP$$

Where, SWC is the *supply chain working capital*

$$SWCP = NS / SWC$$

Where, SWCP is the *supply chain working capital productivity*.

A firm can compare its own performance with that of its competitors and the industry aggregate in order to ascertain where it stands in terms of supply chain performance. Using benchmarking data, a firm can also map a supply chain profile that allows it to effectively capture both the dimensions of time and cost in one diagram. Further, a firm can also compare its own profile with that of its competitors in order to ascertain where it stands in terms of costs and length of time in the chain. Benchmarking is a useful tool for comparing the performance of competing firms so as to identify areas of improvement for further detailed investigation, which may lead to process improvements. Once a firm has identified gaps, it should try and carry out a process benchmarking exercise.

Linking Supply Chain and business performance

Any supply chain initiative that results in an improvement in some aspect of supply chain performance must ultimately get translated into improved business performance. In the final analysis, each firm is primarily interested in improving its return on assets (ROA). The impact of various supply chain initiatives can be estimated in terms of costs and benefits using the following broad groupings:

- Cost reduction is achieved by
  - ✓ Reducing inventory
  - ✓ Reducing logistics expenses
  - ✓ Reducing direct material expenses
  - ✓ Reducing indirect material expenses

- Improving revenue and profitability by
  - ✓ Selling higher margin products
  - ✓ Achieving higher market share
  - ✓ Reducing backorder and lost sales
  - ✓ Attracting new markets
  - ✓ Decreasing supply time to market

- Improving operational efficiency by
  - ✓ Reducing procurement expenses
  - ✓ Increasing assets utilization
  - ✓ Delaying capital expenditure

- Reducing working capital by
  - ✓ Reducing inventory
  - ✓ Reducing accounts receivables

Finally, what we need is a single framework to integrate various related costs and benefits.

Enablers of Supply Chain performance

Managing supply chains is becoming increasingly complex. Despite this, firms have actually managed to reduce their logistics costs. For example, a country like the United States of America, logistics costs used to account for 15 per cent of the gross domestic product (GDP) in the 1980s. Today, because of innovations in technology and management practices, logistics costs account for about 8.5 per

cent of their GDP. Three major enablers that have helped firms and nations in reducing supply chain costs are briefly discussed below.

1. ***Improvement in communication and IT***: Computing power has become cheaper and communication costs too have come down. This has helped firms in coordinating global supply chains in a cost-effective manner. Advances in enterprise resource planning (ERP) systems have helped firms in automating several business processes resulting in seamless information flow throughout the company across different functions. The way ERP systems have changed the nature of information flow within organization. Internet technology is likely to change the nature of information flow in inter-firm transactions. Companies are realizing that they can replace physical inventory by information. To really exploit their IT investments, companies need to re-engineer their supply chain and other supporting organisational processes and try to replace physical inventory with information.

   Unfortunately, many Indian companies have invested in information systems have not made the corresponding changes in their supply chain systems and processes, which has resulted in the company failing to exploit the information system to its full potential. For example, a company with multiple plants can work with a common pool of safety stock of raw materials and does not need to have safety stocks for each individual plant.

   Similarly, on the order-processing side, companies can offer greater customization as compared to the past because their order-processing system can be designed to handle customized orders and their manufacturing and distribution system would allow them to track these customized products in the system. In the absence of an information system, this would not have been possible at all. But unfortunately a significant number of companies have used IT to just automate the existing supply chain systems and processes. Companies

that have successfully exploited IT have made major changes in their supply chain structure, systems, processes and strategy.

2. ***Entry of Third – party Logistics Providers***: Traditionally, many firms have been managing their logistics activities internally. Lately, companies have realized that they need to focus their energies on managing core business activities, and hence have been exploring the possibility of outsourcing logistics activities to third-party logistics (3PL) service providers. In developed countries almost 90 per cent of the logistics activities are outsourced and are managed by 3PL companies. Apart from bringing in the much needed professional to the field, 3PL companies have economies of scale as they are able to pool demand across customers. In developed markets, global firms would like leading 3PL companies to go beyond the traditional role and play the role of a fourth-party logistics (4PL) company that can integrate the capabilities, resources and technology so as to provide comprehensive supply chain solutions to its customers.

   Currently, the 3PL industry in India is still in its infancy. Two sets of companies have emerged in this field. One set of companies involves traditional transporters, shippers, warehouse service providers and freight forwarders, who want to offer value-added services and would like to see it they can develop competencies and become a 3PL company. The second set of service providers comprises international 3PL companies that have come to India along with their global MNC customer. For example, when Toyota wanted to set up a manufacturing plant in India, it asked its logistics service provider Mitsui and Co. to come to India to take care of its logistics requirements.

   Currently, not many companies in India employ the services of other 3PL companies. However, with the evolution of the Indian market, new MNCs and progressive Indian companies operating in the mid-volume, mid-variety segment have started using the services of 3PL companies. Over a period of

time, the 3PL companies would not only develop the competence required to function smoothly in the Indian context but also take care of the logistics requirements of the bulk of the industries in India as well.

3. ***Enhanced Inter-firm Coordination Capabilities***: Successful coordination across a global network of companies has been a comparatively new phenomenon in the corporate world. It has been realized that for a network to function meaningfully one needs a firm to play the role of the strategic centre. Many companies, like Nike, Benetton, Nintendo, Sun and Toyota, have successfully managed complex networks, played the part of the strategic centre and hence, have emerged as role models to other companies.

   While each company in the network focuses on its core competencies, the strategic centres function as a leading and orchestrating system. Consequently, supply chains become more efficient and responsive. However, there have been a large number of failures also, where firms within the chain could not align their interests, and as a result the network could not function effectively. The industry is still on the learning curve in this matter, but better understanding and coordination of issues would greatly help in diffusing the third supply chain revolution across all industries.

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CHAPTER-2
LITERATURE SURVEY

This literature survey extracts information from some of the literature available on this subject. It does not claim to be complete nor does it take a position towards the opinions expressed in these articles. The information is grouped along the two discussion lines:

1) International Literature Survey
2) National Literature Survey

2.1 INTERNATIONAL LITERATURE SURVEY

1. ***Supply chain coordination via mediated constraint relaxation*****,** J. Christopher Beck & Mark S. Fox, ***Research Paper***, Toronto, Ontario (M5S 1A4), May 15, 1994.

   Coordination of the participants in the supply chain of a manufacturing enterprise is a key to agile reaction to unexpected events. As a starting point, we take a mediated approach to coordination: a single agent is responsible for recovery of the supply chain from a disruptive event. This mediator gathers commitment information from other agents and forms a constraint graph. If the event is truly disruptive, this graph will reflect infeasibility: a subset of agents can no longer meet commitments. Repair of the graph is done via constraint relaxation controlled by the mediating agent. We present a schema for constraint relaxation algorithms and experimental results on Partial Constraint Satisfaction Problems (PCSPs). We sketch the coordination protocol that is being developed.

2. ***Supply chain design: capacity, flexibility and wholesale price strategies*****,** Brian T. Tomlin, ***Thesis***, Alfred P. Sloan School of Management, Massachusetts Institute of Technology, November 15, 1999.

   Increasing recognition is being placed, both in industry and in academia, on effective supply chain management. The term supply chain management

presupposes that there exists a supply chain to be managed. With a focus on supply chains in which demand uncertainty is the key challenge, this dissertation develops strategies and models to aid in the design of certain supply chain features, namely capacity, flexibility and wholesale price schedules.

Firstly, this dissertation studies capacity investments in single-product supply chains in which the participants make investments to maximize their individual expected profits. Using a stylized game theoretic model of a supply chain comprising a supplier and a manufacturer, simple non-linear wholesale price schedules, whether they be quantity premium or quantity discount schedules, are shown to outperform simple linear schedules in terms of the total supply chain profit achieved. Next, this dissertation then extends the work of Jordan and Graves (1995) so as to develop process flexibility strategies for multiple-product multiple-stage supply chains. Finally, this dissertation studies the capacity decision in multiple-product multiple stage supply chains. Solution approaches to the capacity investment problem in which there is either an expected shortfall bound or a service level bound are developed.

3. ***Supply Chain Management in India: problems & challenges*****,** Prem Vrat, ***Paper***, Supply chain management for global competitiveness, Macmillan India Limited, 1999, SBN 0333932366.

   This paper outlines the need for effective management of supply chain in Indian context and brings out the problems and challenges of logistic system and lists strengths, weaknesses, opportunities and threats in each with specific thrust on the role of IT & communication in supply chain management. A number of stories are indicated along with the need to look at supply chain from a system point of view and use OR/ MS techniques in design and operation of logistics systems.

4. ***Corporate profitability and supply chain*****,** Shobha Seturam, ***Paper***, Supply chain management for global competitiveness, Macmillan India Limited, 1999, SBN 0333932366.

   The dual pressures of global competition and high returns have shifted the paradise of strategic competitive advantage from physical distribution management to integrated logistics management, finally moving over to supply chain management. Conventionally corporate profitability is a function of cost, capital employed, revenue and customer service. The article gives an insight into the effect of supply chain management on each of the above variables. It traces its impact on the spiraling effect on corporate profitability and the means of measuring supply chain effectiveness financially. Information technology tools from the basis of supply chain optimization in this context of ever increasing demand for dynamism in business decision, giving rise to a new era of virtual supply chain and naturally aligning supply chain system.

5. ***Transportation logistics in India- problems, issues and strategies for competitive advantage*****,** T.A.S.Vijayaraghavan, ***Paper***, Supply chain management for global competitiveness, Macmillan India Limited, 1999, SBN 0333932366.

   In this paper, the role and the importance of transportation as key a process in the integrated logistics management is stressed initially. The problems and issues faced by the policy makers, industries, shippers, suppliers, regulatory agencies and the end users are highlighted in greater detail. The present efforts by our government and the possible fall outs are discussed and towards the end, the strategies for a powerful tool aligning with the IT advantage are discussed.

6. ***Agent-oriented Supply-Chain Management*****,** Mark S. Fox, Mihai Barbuceanu, and Rune Teigen, ***Research Paper*** ,Ontario, Canada, The International Journal

of Flexible Manufacturing Systems, 12 (2000): 165–188, Kluwer Academic Publishers, Boston. Manufactured in The Netherlands.

The supply chain is a worldwide network of suppliers, factories, warehouses, distribution centers, and retailers through which raw materials are acquired, transformed, and delivered to customers. In recent years, a new software architecture for managing the supply chain at the tactical and operational levels has emerged. It views the supply chain as composed of a set of intelligent software agents, each responsible for one or more activities in the supply chain and each interacting with other agents in the planning and execution of their responsibilities. This paper investigates issues and presents solutions for the construction of such an agent-oriented software architecture.

The approach relies on the use of an agent building shell, providing generic, reusable, and guaranteed components and services for communicative-act-based communication, conversational coordination, role-based organization modeling, and others. Using these components, we show two nontrivial agent-based supply-chain architectures able to support complex cooperative work and the management of perturbation caused by stochastic events in the supply chain.

7. ***Environmental Supply Chain Management: using life cycle assessment to structure supply chains*****,** Geoffrey J.L.F. Hagelaar and Jack G.A.J. Vander vorst, ***Research Paper***, IAMA, Sydney, Australia, 2001.

   Recently more attention is given to Environmental Supply Chain Management (ESCM). One of the supporting instruments of ESCM is Life Cycle Assessment (LCA). The idea of integrating LCA into supply chains is gaining more support among research institutes and companies. However, we conclude that there are no guidelines for this integration. In this paper we argue that in line with a differentiation in environmental care chain strategies and in environmental chain performances, a differentiation in types of LCA’s should be made; the

compliance-, process- and market-oriented LCA. To execute these different types of LCA, the chain structure should be attuned to meet the specific requirements of these types. In an overview we will show that the integration of the types of LCA in a chain, bring along different chain structures.

8. ***The conception & development of 'visibility' in transportation process of MYSAP SCM through "analytics*"** Sreedhar Kandagatla (Matrl nr:216308) ***Thesis***, Heidelberg,19 June, 2005.

   Over the past decade a combination of economic, technology and market forces has compelled companies to examine and reinvent their supply chain strategies. Some of these forces include the globalization of businesses, the proliferation of product variety, increasing complexity of supply networks, and the shortening of the product life cycles. To stay competitive, enlightened companies have strived to achieve greater coordination and collaboration among supply chain partners in an approach called "supply chain integration." Visibility in these Supply Chains means "Firms will complete Supply Chain to Supply Chain", according to new study.

   In an era of global supply chains, companies will effectively compete for survival with their competitors through achieving higher levels of visibility into their supply chains and the actionable information that come out of it, according to "From Visibility to Action," the 13th annual report on trends and issues in logistics and transportation issued jointly by Capgemini U.S. LLC and Dr. Karl Manrodt.

9. ***Integrated production-distribution scheduling in supply chains*****,** Guruprasad Pundoor, ***Thesis,*** Graduate School of the University of Maryland, College Park, 2005.

   The primary difference between analyzing a supply chain and analyzing a production system or a distribution system is that in a supply chain, we may

have to simultaneously consider different and sometimes conflicting objectives from different participants, or different departments within the same participant. For example, minimizing production costs at the production department may have to be carried out by taking into account the distribution costs at the distribution department.

Similarly, minimizing distribution costs at the distribution department may have to consider the delivery lead time performance. Or, optimizing the distribution costs at a supplier by sending large shipments may have to put up with an increase in the inventory holding costs at the warehouse. Though production scheduling and distribution scheduling have separately been studied extensively, very little work has been done that integrates these two operations in supply chains. Supply chain level decision making is very crucial for most of the businesses that exist today. This opens up a very promising area of research.

10. ***Logistics collaboration in supply chains – a survey of Swedish manufacturing companies*****,** Erik Sandberg, ***Thesis,*** Logistics Management Department of Management and Economics, Linkopings University. LiU-Tek-Lic-2005:35, Thesis No. 1180, ISBN: 91-85299-80-4.

    The purpose of this thesis is to describe logistics collaboration in supply chains. During the past two decades, a new trend towards integration and collaboration in supply chains has been recognised among researchers as well as among business practitioners. This philosophy is called supply chain management and has received enormous attention in logistics research.

    Collaboration based on supply chain management is expected to reduce total cost and improve service towards the supply chain’s end customers at the same time. The argumentation in existing literature is however seldom underpinned by more rigorous empirical material and becomes therefore conceptual and superficial. Furthermore, it is incongruous about what actually is done when

companies collaborate and what more specific effects are achieved. Therefore more research, especially survey based, is needed in order to verify existing literature. In this thesis the perspective of a focal company is taken in order to concretise the ideas from supply chain management and investigate what it means for an individual company.

11. ***Strategic partnership within supply chain-a pragmatic model for Volvo power train corporation*****,** Siamak Zarrin Ghalami, ***Thesis,*** Management School Blekinge Institute of Technology, July 2006.

One of the widespread conclusions in supply chain management research is that huge benefits can be achieved if suppliers are involved in the OEM's product development process as early as possible, since suppliers often possess vital product and process technology leading to significant improvements in product design and new product development process. The issue is a need for a model of supplier selection to support the contribution of suppliers in product development processes; whilst supplier attributes or performance metrics for traditional supplier selection do not seem to include specifications that are usually required in close relationships. What practitioners need in practice, is a simple-to-use methodology with producing logically precise results.

The purpose of this study is developing a model of supplier selection to support the contribution of suppliers in product development processes, and eventually, developing a strategically integrated supply base for Volvo Power train Corporation (VPT). Among the first part of this study, a model of supplier evaluation and selection has been developed, considering attributes and success factors for integration with suppliers, and also examined in VPT with the aims of achieving mutual success in both products and commerce for VPT, as the focal company, and its supply chain members. The second part of this study presents a model to boosting the integrated partnership established on the basis of the first part endeavour.

12. ***Strategies for sustainable Supply Chain Management: supplier interaction devices*****,** Shannon E. Fitzgerald, Estela Luck A., Anne L. Morgan, ***Thesis,*** School of Engineering Blekinge Institute of Technology Karlskrona, Sweden 2007.

    In a competitive business environment that requires strategy and innovation to improve the bottom line, supply chain management has been vital in creating competitive advantage. Increasingly, companies are also identifying sustainability as an opportunity to create competitive advantage. This project explores supply chains as a leverage point in advancing sustainable development. Corporations have developed different tools to interact with their suppliers on sustainability. Three of these devices were analyzed against a framework for strategic sustainable development to identify some of their strengths and weaknesses. A general set of criteria for sustainable supply chain management devices that employs a strategic, whole-systems perspective was then developed.

13. ***Building competitive advantages through supply chain management: a case for Biotech sector*****,** Dr. Samar Roy Chowdhary, Dr. Supriya Patil, Atish A Chintamani, ***Research Paper***, International Conference on Global Meltdown, Opportunities and Challenges, Himalaya Publication House, 2009, ISBN 978-81-8488-279-7.

    The paper deals with the unique characteristics of Biotechnology sector and issues related to managing the supply chain for a biotech company. The authors have discussed the special characteristics of biotech products and challenges in handling and transporting them. The significant costs involved in transporting and handling the biotech products make it an area of focus for the biotech companies. By managing their supply chains effectively, the biotech companies can achieve competitive advantage and ensure overall saving to the customer resulting in customer satisfaction.

14. ***Development of supply chain performance measurement system for the leading softdrink distributor in Nagpur*****,** Dr. V. S. Deshpande and Prof. Rupesh Pais, ***Research Paper***, International Conference on Global Meltdown, Opportunities and Challenges, Himalaya Publication House, 2009, ISBN 978-81-8488-279-7.

    With rapidly increasing competition and changing market forces, supply chain performance measurement is a critical area for companies to help sustain and gain competitive advantage. This paper presents the development of supply chain performance measurement system for the leading soft drink distributor in Nagpur. On the basis of framework developed, the hierarchy of metrics approach is used for the development of performance measurement. At the highest level, the performance measurement system defines the metrics which measure and verify the supply chain goals. At lower level a balanced set of metrics are identified which are mapped to supply chain functions and the processes.

15. ***An exploration of the execution of software system project for supply chain management in practice,*** Hsin-Hui Huang, ***Thesis***, [2009]

    The advantages of adopting a new software system for Supply Chain Management (SCM) enable the organization to enhance work efficiency as well as customer satisfaction in the supply chain network. These advantages make enterprises update their SCM system through project as a method of realize their strategic change.

2.2 NATIONAL LITERATURE SURVEY

1. ***Supply Chain Management of perishable items: channel dynamics and integrated decision making*****,** Narasimha Kamath B., ***Research Paper***, Indian Institute of Management Calcutta, 2005.

   Managing perishable items pose a significant challenge in the supply chain environment. Food stuffs, dairy products, green vegetables, fruits are all items of daily human consumption. These perishable items have a finite usable lifetime, and pass many hands during its movement from source to destination.

   The study of the supply chain of perishable products is particularly important because they account for more than 50% of supermarket sales, and the potential for extra profit from managing these items has been estimated at 15%. This thesis evaluates the channel dynamics and builds decision making models for supply chain of perishable items. To gain a primary understanding of the perishable item supply chain, the bakery supply chain of

   the 'Monginis' brand is studied. This is provided in the form of a case, the analysis of which is also provided. A framework for classification of the supply chain management (SCM) problems in literature is established. Theoretically this work can be seen as an amalgamation of two complementary fields, SCM and perishable inventory.

   On account of high complexity and dynamic environment, chain dynamics are investigated through experiments, macro aspects (long term decisions) are evaluated using system dynamics models and micro structures (short term decisions) are optimized using mathematical models. Coordinated decision making is shown to be cost effective vis-à-vis individualistic views. The holistic supply chain is modeled using system dynamics formalism, specifying the dominant cycles of spoilage loop that drive the chain dynamics. The information feedback view of the system is used to identify and modify the

loops yielding better capacity augmentation decisions in short lifecycle products. This thesis demonstrates the presence of bullwhip effect for perishable item supply chain as well, and shows that it has lesser amplification and stabilizes faster when compared with non-perishable item. ANOVA results show a significant difference in performance metrics under various demand patterns and, to a certain extent, with the item type. An experimental method in the form of "Cake Game" is used to report the macro dynamics arising from the microstructure in a common managerial context.

2. ***Knowledge management based supply chain: an evolution perspective*****,** S. Wadhwa and Avneet Saxena, ***Research Paper***, Global Journal of e-Business and Knowledge Management, 2005, Vol. 2, No.2 , pp 13-29.

   The present industrial era can be characterized as knowledge based competitive era. Knowledge Management (KM) is an effective approach used by world-class organizations. One of the key challenges involves effective supply chain management under a globalization context. Global supply chains are more complex and involve multiple autonomous players with varying technical cultures (affects knowledge mindsets), managerial background (affects decision knowledge) and SCM exposures (affects knowledge sharing attitudes).

   With increasing global outsourcing these supply chains are based on core competency of firms to achieve best value for the customers. Knowledge management has immense potential to offer expedient opportunities to create and retain greater value in this context. This includes the implementation of KM enriched supply chains by judicious use of information technology (IT). The development of knowledge based supply chain depends on the nature of knowledge flow in the entire chain.

   Timely sharing of decision knowledge amongst the chain partners can be very useful. However this requires change in managerial mindsets. Thus there is a

need to develop demo models that can encourage chain managers towards collaborative-knowledge sharing in the supply chains. This paper presents the application of one such model based on decision knowledge sharing (DKS) for improved supply chain management. Its application across dynamic SCM networks reflects the benefits of integrating knowledge, which is actually spread across various components of the supply chains. We suggest efforts to improve effective KM based supply chain thinking and aim to promote collaborative knowledge sharing for performance improvements. There is a need for greater industrial research leading to the evolution of KM based supply chain management domain as it promises enormous benefits. Our research is continuing in this direction.

3. ***Flexible supply chains: a context for decision knowledge sharing and decision delays*****,** Prof. Subhash Wadhwa, Mr Bibhushan & Mr. Avneet Saxena, ***Paper,*** Global Journal of Flexible Systems Management Year : 2006, Volume : 7, Issue : 3&4 Print ISSN : 0972-2696.

   Building supply chains as flexible system represents one of the most exciting opportunities to create value. This requires integrated decision making amongst autonomous chain partners with effective decision knowledge sharing between them. For any decision process, one of the main inputs required is the available knowledge. Hence, it is important to have the actual real time knowledge for the decision process.

   Knowledge sharing has immense potential to offer, expedient opportunities to create and retain greater value for supply chains. In this context, knowledge management (KM) can be used as an effective approach to achieve knowledge sharing and decision synchronization in supply chains. To explore this in greater extent, we propose a decision knowledge sharing (DKS) framework based on decision and knowledge sharing in dynamic flexible supply chain environment. By exploiting DKS and flexibility in supply chain structures,

better operational performance can be achieved. Considerable research efforts have been devoted to development of decision knowledge sharing framework in flexible supply chains (FSCs) environment, especially at operation levels, wherein decisions and knowledge delays have implicitly been assumed to be significant. Thus, there is need to model significant knowledge sharing delays in the decision process at the critical decision stages.

In this paper, we focus on the knowledge, knowledge sharing, and decisions to study the impact of the decision flexibility, DKS and delays on the performance of the flexible supply chains. It is important because of relationship between control decisions and availability of knowledge in any DKS based FSCs. There is further a need to evolve a judicious use of decision flexibility at selected chain stages. Thus, a careful analysis of the chain with a focus on integrated decision is useful to ensure success. This paper presents this endeavor and highlights the key insights.

4. ***A study of several privacy-preserving multiparty negotiation problems with applications to Supply Chain Management*****,** Sumit Chakraborty, ***Thesis,*** Global Indian Institute of Management Calcutta, 2006.

   Negotiation is a means for a group of decision-making agents to reach mutually beneficial agreement through exchange of strategic information. But, the decision makers are often reluctant to share their private information with others. The primary contribution of this thesis is to study various scenarios of multi-party negotiation in the areas of supply chain management, e-markets and auctions in order to suggest appropriate privacy models for these problems and finally to develop privacy-preserving coordination mechanisms and/or protocols for these situations by applying the concept of secure multi-party computation to the underlying problem, which is more often than not an optimization problem in a distributed setting where parties are connected over

an insecure medium such as internet. Specifically, four problems have been tackled in the thesis:

- ✓ Collaborative supply chain planning
- ✓ Discriminatory price negotiation in an e-market
- ✓ Combinatorial reverse auction and 1-n-p negotiation protocol
- ✓ Multi-objective group decision making and group buying.

5. ***Auto motive coating industry in India—learning's from Global Supply Chain*****,** Nikhil Sangwai & Deepthy Raghvendra, ***Research Paper,*** Global Supply Chain Management: Role of Emerging Economies, IMR conference, December 22–24, 2008.

The colour of the car is the most important attribute at the point of sale. The paper focuses on problems with automotive coating suppliers in India. In spite of the robust growth of the auto sector at more than 12% average in last four years and inflow of almost all leading global firms, the automotive coating industry seems to be lagging in basic strategic requirements.

- ➢ Resources: There are only two major and two small capacity players who could be approached as vendors. The production capacity, raw material procurement and R&D competencies are nowhere close to global standards. With different technologies prevalent in other parts of the world, the service and technological know-how in automotive coating is lagging behind.
- ➢ Capabilities: With the colour life cycle of automobiles being as short as six months, the colour suppliers must be equipped with new colour variants. Time to market needs to be faster.

With the absence of global standards and compatible technologies in this technologically intensive sector, it becomes increasingly difficult for the companies to ensure customer satisfaction and survival in healthy business

relationship. This paper suggests immediate steps to handle the crisis situation in the automotive coating sector and provides clues from global supply chain initiatives of global players for long term sustainability of the business. Strategic alliances between the major and minor players across the industry could lead to demand fulfilment. This will provide synergies in coupling competencies across the value chain for most of the suppliers. Such an alliance will fulfil just-in-time and Kanban requirements of Japanese suppliers. Since it is a medium to low clock speed industry, technological front strategic alliances will last longer.

The alliances can evolve further to joint ventures and takeovers which will combine the competencies of different organisations across the value chain. A one stop shop for automobile marketing executives could be an added attribute which can be associated with this industry.

6. ***Global Supply Chain Management—a case study of TCL*****,** Rajesh K, Mohana Krishna V, & Vignesh M, ***Research Paper,*** Global Supply Chain Management: Role of Emerging Economies, IMR conference, December 22–24, 2008.

   Supply Chain Management (SCM) is the key to success in today's competitive global environment for any business organisation. The objective of this paper is to understand the inland Logistics and SCM of TCL Consumer Electronics Pvt Ltd, within India. TCL India Holdings Pvt Ltd is a subsidiary owned by TTE, which has been operating in India for the past ten years. The company was started in China and spread across the globe with a strong logistics control. Other than exploring implementation of the Logistics and SCM of TCL Consumer Electronics, this paper explores the current market channels of distribution of goods from the supplier's supplier to the customer's customer and focuses on the TV segment. This paper is exploratory and descriptive in nature.

7. ***Impact of lean manufacturing on Global Supply Chain— going lean with SAP LPO (Lean Planning And Operations)*****,** Sumanta Chakraborty, & Satya Narayan Sahu, ***Research Paper,*** Global Supply Chain Management: Role of Emerging Economies, IMR conference, December 22–24,2008.

   Variability induces disturbances across the supply chain and reduces the performance of the supply chain in terms of high inventory, wasted capacity and/or reduced customer service. Research has benchmarked business processes in detail for several years, finding a clear correlation between leadership in the use of demand-driven principles and tools and higher financial metrics.

   Lean manufacturing being a demand driven approach uses techniques such as demand smoothing/production levelling and material pull. Levelling smoothens the system and reduces the bull-whip effect, whereas the material-pull allows to produce as per the customer demands. It thus creates a value stream precisely from the perspective of the end customer and eliminates waste.

   SAP LPO the latest offering from SAP on Lean Manufacturing, built on Toyota Production System—is a user friendly application—with powerful 'what-if-planning' and exceptional management capabilities. One of the key functionalities of the SAP LPO is the pacemaker operation. It sets up the rhythm of the factory which creates levelled production schedule for the plant using sophisticated algorithms. SAP LPO solution ensures that there is no unnecessary inventory buildup or shortages created. Spikes in demand or upstream material shortages are planned early without sacrificing customer delivery commitments. It provides Heijunka levelling which levels the demand based on capacity and mix to maintain optimum EPEI (every part every interval/ period).

   The supermarket component of SAP LPO makes recommendations on the number of kanbans for each item, and provides real time visibility to the kanban

levels based on changes in demand and execution. SAP LPO can also help in solving some of the problems faced by manufacturing companies with their Lean initiatives. Lean initiatives often fail due to the lack of support to manage a portfolio of products in a systematic way and sustaining such methodologies across the enterprise. Other challenges to Lean include manual Kanban with printed cards, which while working well within contained environments encounter major difficulties when extended across plants and suppliers. With SAP LPO, the above issues can be eliminated and Lean initiatives can extend and scale across the supply chain.

8. ***Collaborations in internet enabled supply chains- value of information sharing*****,** N Mehta, ***Thesis,*** Indian Institute of Management, Vastrapur, Ahmedabad 380015, 2008.

   The traditional supplier-customer relationships within a supply-chain have undergone radical changes in recent years. Similarly information sharing has been proposed as one of the possible solutions to reduce the bullwhip effect, i.e. the increase in demand variability as one move up the supply chain and its impact on the supply-chain performance in terms of total costs, inventory levels, customer service levels, etc. Collaboration in a supply-chain allows information sharing of important sales data between trading partners within the supply-chain, and incorporates collaborative handling of inventories, promotions, orders shipments etc.

   With the advent of Internet, the costs associated for sharing of supply-chain information between members have reduced drastically. We seek to develop inventory policies to investigate the impact of sharing information on supply-chain performance in terms of total costs, inventory levels, customer service levels etc.

We propose to consider multiple-retailers, one-distributor setting, where stationary/ non-stationary consumer demand is faced by the retailers and different levels of collaboration exists between retailers and the distributor in terms of the extent of information shared. The amount and nature of information shared increases as the level of collaboration increases.

Our research would evaluate the optimality of the inventory policy for different collaboration levels and identify the trade-offs between inventories, service levels and information. We would measure the impact of collaboration in terms of performance-oriented measures related to supply chain costs, inventory levels, customer service levels and also in terms of reduction of the bullwhip effect and its impact. An information technology (IT) strategy would be formulated on the role of IT in enabling collaboration between supply-chain partners and the IT implementation issues with respect to adoption of various collaborative programs.

9. ***An example of a supply chain involving multi modal containerised transport*****,** Narayan Rangaraj & N. Viswanadham, ***Research Paper***, Industrial Engineering and Operations Research, Indian Institute of Technology, Bombay, India.

   This paper describes a stream of physical activities, involving multiple modes of transport and handling, and multiple actors – in the context of supply chain management. Part 1 is a general introduction to the area of multimodal transport and containerised movement of goods. Part 2 provides an analysis of one particular channel through which containerised movements through rail and road move through one of the major ports in India.

   The main focus is to map the flows of material, information, finance and transactions in this supply chain and see how the management of these flows fit in with supply chain objectives. This has implications on the planning and use of IT for this purpose and the way the actors involved in this chain organise

themselves. This is elaborated for two of the major actors in this: Container Corporation of India (Concor) and Indian Railways (IR).

10. ***Performance measures and performance models for supply chain decision making*****,** Y Narahari and Shantanu Biswas, ***Research Paper***, Supply chain performance measurement and improvement, pp 98-119.

    Numerous models, algorithms, and tools have been deployed in supply chain modeling and decision making. These are based on stochastic models, optimization models, object oriented models, and simulation. This paper provides an expository introduction to decisions, performance measures, mathematical models, and software models in supply chain networks.

11. ***The next generation supply chains – integrated and profit maximized*****,** Dr. Siddhartha SenGupta & Sudhir Shina, ***Paper***, Tata consultancy services.
    Advanced supply chains are equally well planned at all three levels – strategic, tactical and operational. Large capital intensive Chemical & Petroleum industries have traditionally been leaders in institutionalizing strategic planning that optimized their Net Present Value (NPV). Yet, like many other industries, at tactical and operational levels,they continue to be driven by cost minimization of independent sub-processes.

    This paper highlights the improvement opportunities in real world tactical and operational planning, especially when such planning is automated through modern Advanced Planning and Scheduling (APS) systems that employ sophisticated quantitative tools. Alternate approaches are necessary when packaged APS systems do not fit the details of a planning process. The progression to holistic or enterprise-wide planning, which can provide additional benefits has also been indicated. The difference between cost minimized and profit maximized planning are next illustrated through typical examples from two stages of the Supply Chain. Recent Market Surveys have

identified the most critical and widely adopted Supply Chain Technologies. This paper identifies which of these planning processes could be given an integrated profit orientation. Finally, it is pointed out that when dealing with the Customer-Chain, profit metrics become essential elements of Supply Chain Operating Reference templates. As every business has to be market facing, this profit theme will permeate through all planning phases.

Apart from these details of national and international literature survey researcher has also referred details of conferences held in so many years and few of them are mentioned below:

1) ***A study of the global supply chain with specific reference to the automotive industry***, K Kanthakrishnan, R Muruganandham, R Maheshwar, A Vijay Alagappan, R G Prasanna Kumar & R Hari Krishnan, Thiagarajar College of Engineering, Madurai.

2) ***Innovations in fresh vegetables supply chain—risk reduction as driver of innovations***, M G Subramaniam,D N Suresh, Janat Shah & Uma Kaushik, IIM Banglore.

3) ***Supply chain risk management – a chain is only as strong as its weakest link***, Tobby Simon, Synergia Foundation.

4) ***Effective warehouse management***, R Bragadesh, V Mohana Krishna, S Pradeep Samuel, K Murugan, N Jagannathan & K Ramanujam, Thiagarajar College of Engineering, Madurai.

5) **Understanding supply risk in supply chain—a fuzzy framework**, Kunal K Ganguly & Kalyan K Guin, KIIT School of Management, Bhubaneswar.

6) ***Identification of improvement opportunities in the application of information technology for managing global supply chains—an emerging economics***

perspective, A K Damodaram & K Ravindranath, Sree Vidyanikethan Engineering College, Chittoor.

7) ***Effective talent management in India and its impact on the global supply chain***, Bragadesh R, Jagannathan N, Murugan K, Ramanujam K, Sathish Nataraj S & S Pradeep Samuel, Thiagarajar College of Engineering, Madhurai.

8) ***Role of standardisation and integration in building supply chain integration capability***, Ravi Seethamraju, University of Sydney, Australia.

9) ***Environmental management systems and green supply chain management—complements for sustainability?***, Jagannathan N, Ramanujam K, Bragadesh R, Murugan K & Pradeep Samuel S, Thiagarajar College of Engineering, Madurai.

10) ***The impact of supplier relations on the supply chain performance metrics—a study on the automobile industry in south India*****,** Pushpa Bhatt, V E Mohan & Bhavani H, Bangalore University, Bangalore.

Reference: *Conference proceedings on* ***Global Supply Chain Management: Role of Emerging Economies*** *organized by IIMB Management Review (IMR), the Supply Chain Management Centre, IIMB (SCMC) and the EADS-SMI Chair for Sourcing and Supply, IIMB, December 22–24, 2008.*

11) **Strategic issues in supply chain management: Godrej-GE experience**, V.M.Crishna & A. Tandon, Employees Godrej-GE Appliances Limited.

12) ***Supply chain reconsideration- to suit global and local environment***, M.D. Apte, Member Indian Concrete Institute.

13) ***Supply chain management in the Indian steel industry***, J.S. Charlu, Director Jindal Vijayanagar Steel Limited.

14) ***Best practices in Supply Chain Management at Modi Xerox***, Vibhash Joshi (Logistics and Supply Chain at Modi Xerox ltd) & S.K. Chopra (Equipment Management Group).

15) ***Customer focus in Supply Chain Management***, Anoop Khandelwal (Hewlett-Packard India Ltd.) & Sanjay Nigam (Finland post Limited).

16) ***Demand management in supply chain***, Prasant Yadav & P.A.V. Sridhar ,KLG Systel.

17) **Supply Chain Management-real vendor cost management**, Sunil Kulwal, Vikram Ispat.

18) ***Quality management-inherent link in Supply Chain Management***, S.C. Arora, FICCI Quality Forum.

19) ***Road transportation in India: the untrapped source of profit for business enterprises***, N. Kathuria, ABC Business Solutions Pvt. Ltd.

20) ***Reengineering of supply chain: lessons from case studies***, S.G. Deshmukh (IIT Delhi) & R.P. Mohanthy (ACC Limited).

21) ***Application of knowledge management for effective supply management in a dynamic business environment***, Babu Lal (BHEL), Prem Vrat (IIT Delhi) & sushil (IIT Delhi).

22) ***Enhancing customer relationships through effective supply chain-putting the act together***, G. Shainesh, MDI Delhi.

Reference: *Conference proceedings on* ***Supply Chain Management for Global Competitiveness in India*** *organized by Management Development Institute, Gurgaon, November 20–21, 1998.*

After going through vast literature available on internet, libraries, conference proceedings & theses it is cleared that none of the topics referred so far, has covered the issue of management of supply chain in small scale manufacturing units. Thus researcher has selected this novel topic for his research.

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CHAPTER-3
ORGANISATIONAL PROFILE

In view of the objective of the study, it was considered necessary to undertake a survey of small-scale manufacturing units covering following sectors:

Engineering, Chemical, Manufacturing, Casting/Fabrication, Maintenance/Packaging and Agri Products

The industries in Engineering, Chemical, Manufacturing, Casting/Fabrication, Maintenance/Packaging and Agri Products were contacted during the field survey. A broad outline of these industrial sectors and the list of industries, which were considered for detailed study, are presented in the following sections. This list includes incomplete details of non responding units which numbers to six.

3.1 ENGINEERING UNITS

The engineering industry has been titled the 'engines of growth'. The tremendous impact and influence it has on industrialization and consequently the economy can be clearly seen from the economic scenario the world over. These units have contributed to productive capital, value added products, exports of engineering goods. The engineering units have a history of more than 46 years advancing through technical collaborations, joint ventures and indigenous research and development.

Today, these units have a capacity of manufacturing heavy equipments. These units largely depend on the sugar factories requirements, urban and rural demand. The total units in this sector were scrutinized based on the available data and the following industries were selected for further detailed study & visits:

1. Ahmednagar Steels Pvt. Ltd.
2. Sachin Pattern & Engineering Works
3. Shriram Udyog
4. Super-Tech Heavy Equipments
5. Varun Industries

6. Sahayadri Engineering Works
7. Ashok Projects
8. Mauli Industries
9. Kaushik Enterprises
10.Rajput Engineering Works
11.Mahesh Engineering Works
12. Valancy Compounds Services (P.) Ltd.

Let us see the detailed profile of these small scale units

Ahmednagar Steels Pvt. Ltd.

a) Owners name: *Mr. Vijay Bhagat*
b) Address: *A-24, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777280, 2778994*
d) Year of establishment: *1989*
e) Initial investment: *40 lakhs (approx)*
f) Number of employees: *33*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *90 lakhs (approx)*
i) Raw material: *Plate channel beam*
j) Products: *Sugar & chemical machinery & material handling equipments*
k) Business objectives: *Increase return on investment*
l) Participation by management level: *Director*

Sachin patterns & Engineering works

a) Owners name: *Mr. Sodnar*
b) Address: *B-68, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777274*
d) Year of establishment: *1992*
e) Initial investment: *35 lakhs (approx)*

f) Number of employees: *18*

g) Number of working shifts: *Ist & IInd shift*

h) Annual Turnover: *45 lakhs (approx)*

i) Raw material: *Steel casting*

j) Products: *Sugar machinery gears*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Shriram Udyog

a) Owners name: *Mr. Sunil Kanwade*

b) Address: *G-103, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2416874, 2778516*

d) Year of establishment: *1994*

e) Initial investment: *9 lakhs(approx)*

f) Number of employees: *15*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *39 lakhs(approx)*

i) Raw material: *C. R. Sheets*

j) Products: *Press parts for L&T, Hydraulic power pack*

k) Business objectives: *Increase return on investment*

l) Participation by management level: *Director*

Super-Tech Heavy Equipments

a) Owners name: *Mr. Mahesh Gopalkrishnan*

b) Address: *F-39, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777710, 3294705*

d) Year of establishment: *2003*

e) Initial investment: *31 lakhs (approx)*

f) Number of employees: *28*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *90 lakhs (approx)*

i) Raw material: *M.S., S.S., Casting &Steel casting*

j) Products: *Industrial furnaces & equipments,precious machining jobs*

k) Business objectives: *Increase return on investment*

l) Participation by management level: *Director*

Varun Industries

a) Owners name: *Mr. Vijay Bhagat*

b) Address: *A-26, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2778994, 2777523*

d) Year of establishment: *2000*

e) Initial investment: *34 lakhs (approx)*

f) Number of employees: *15*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *55 lakhs (approx)*

i) Raw material: *M.S. plate, Rods, Sheets, angles etc.*

j) Products: *Sugar machinery & parts*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Sahyadri Engineering Works

a) Owners name: *Mr. P.V. Purkar*

b) Address: *L-254, MIDC,Ahmednagar*

c) Phone nos.: *(0241) 6510576*

d) Year of establishment: *1997*

e) Initial investment: *31lakhs (approx)*

f) Number of employees: *22*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *24 lakhs (approx)*

i) Raw material: *Casting steel*

j) Products: *Machining Precision works*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Ashok projects

a) Owners name: *Mr. Vijay Bhagat*

b) Address: *B-51, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777036*

d) Year of establishment: *2001*

e) Initial investment: *43 lakhs (approx)*

f) Number of employees: *13*

g) Number of working shifts: *Ist shift*

h) Annual Turnover:*22 lakhs (approx)*

i) Raw material: *M.S. plates, gear box, S.S. plates, angles, channels*

j) Products: *Sugar & Chemical machinery, material handling equipments*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Mauli Industries

a) Owners name: *Mr. Santosh Shinde*

b) Address: *G-60/1, MIDC, Ahmednagar*

c) Phone nos.: *9272340250*

d) Year of establishment: *1997*

e) Initial investment: *39 lakhs (approx)*

f) Number of employees: *15*

g) Number of working shifts: *Ist & IInd shift*

h) Annual Turnover: *74 lakhs (approx)*

i) Raw material: *Steel & M.S. plates*

j) Products: *Heavy machines*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Senior Manager*

Kaushik Enterprises

a) Owners name: *Mr. Rajesh Shinde*

b) Address: *B-98, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777705*

d) Year of establishment: *2001*

e) Initial investment: *42 lakhs (approx)*

f) Number of employees: *48*

g) Number of working shifts: *Ist & IInd shift*

h) Annual Turnover: *85 lakhs (approx)*

i) Raw material: *M.S. steel, angles*

j) Products: *Sugar machinery*

k) Business objectives: *Maximise profit*

l) Participation by management level: *General Manager*

Rajput Engineering Works

a) Owners name: *Mr. Rajput A.A.*

b) Address: *A-51, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777935*

d) Year of establishment: *1999*

e) Initial investment: *8 lakhs (approx)*

f) Number of employees: *14*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *28 lakhs (approx)*

i) Raw material: *Steel, Crane parts*

j) Products: *Material handling equipments & crane services*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Mahesh Engineering Works

a) Owners name: *Mr. Sandeep Sali*
b) Address: *G-69, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778191, 5602614*
d) Year of establishment: *2003*
e) Initial investment: *36 lakhs (approx)*
f) Number of employees: *07*
g) Number of working shifts: *Ist shift*
h) Annual Turnover:*21 lakhs (approx)*
i) Raw material: *HSS carbide*
j) Products: *Cutting tools*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

3.2 MANUFACTURING UNITS (OTHERS)

Ahmednagar occupies an important place in both production as well as exports of engineering goods from the country. Manufacturing units in Ahmednagar is highly diversified and produces a large range of parts of industrial machinery to industrial castings and forging.

The Ahmednagar MIDC has a fairly large number of firms in the organized sector possessing world class manufacturing capabilities and cost structures. The major items of production and exports in Ahmednagar are heavy machinery, machinery for sugar factories, chemical plants, tiles construction machinery, accessories, fabricated steel, steel forging, steel castings, stainless steel product, auto parts,

cutting tools, machine tools and mechanical pumps. Total exports of engineering industry in Ahmednagar have been estimated at US$ 3 million during 2007-08. This accounts for over 16 per cent of total export of engineering products in the same year. In overall terms, the export outlook for engineering products is bright.

The total units in this sector were scrutinized based on the available data and the following units were selected for further detailed study & visits:

1. Kirti Galicha Tiles
2. S.B. Precision Springs
3. M/S Swami Tiles
4. Thacker Rubber & Allied Industries Pvt. Ltd.
5. Aayush Kitchen Trolleys
6. D.P. con Engineering
7. Shree Rajlaxmi Industries
8. Sai Links (India) Pvt. Ltd.
9. Sai Plastics

Let us see the detailed profile of these small scale units.

Kirti Galicha Tiles & Marble Company

a) Owners name: *Mr. S.T.Pawar*
b) Address: *G-121, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778485*
d) Year of establishment: *1989*
e) Initial investment: *24 lakhs (approx)*
f) Number of employees: *12*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *28 lakhs (approx)*
i) Raw material: *White & gray cement, mosaic chips & dol powder*
j) Products: *Flooring tiles, pavers & wall ceramic tiles*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

S.B.Precision Springs

a) Owners name: *Mr. Abhishek B. Shinde*

b) Address: *F-23, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777804*

d) Year of establishment: *1995*

e) Initial investment: *41 lakhs (approx)*

f) Number of employees: *09*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *80 lakhs (approx)*

i) Raw material: *Spring Steel*

j) Products: *Precision springs*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

M/S Swami Tiles

a) Owners name: *Mr. Deepak Kshatriya*

b) Address: *D-83, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777424*

d) Year of establishment: *1996*

e) Initial investment: *9 lakhs (approx)*

f) Number of employees: *15*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *24 lakhs*

i) Raw material: *Cement & khadi*

j) Products: *Tiles*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Thacker Rubber & Allied Industries Pvt. Ltd.

a) Owners name: *Mr. Iqbal H. Jindani*
b) Address: *C-34, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778925*
d) Year of establishment: *1999*
e) Initial investment: *36 lakhs (approx)*
f) Number of employees: *29*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *67 lakhs (approx)*
i) Raw material: *Raw rubber & chemicals*
j) Products: *Automobile rubber matting*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Aayush Kitchen Trolleys

a) Owners name: *Mr. Sanjay Kokate*
b) Address: *L-215/2, MIDC, Ahmednagar*
c) Phone nos.: *9422226299*
d) Year of establishment: *2003*
e) Initial investment: *8 lakhs (approx)*
f) Number of employees: *12*
g) Number of working shifts: *Ist & IInd shift*
h) Annual Turnover: *22 lakhs (approx)*
i) Raw material: *Steel rods, M.S. steel*
j) Products: *Kitchen trolleys*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

D.P. con Engineering

a) Owners name: *Mr. Pratap Yashwant Dhamane*
b) Address: *195/3, Saiban, MIDC, Ahmednagar*
c) Phone nos.: *9822741476*
d) Year of establishment: *2004*
e) Initial investment: *26 lakhs (approx)*
f) Number of employees: *14*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *45 lakhs (approx)*
i) Raw material: *M.S. mould & plates*
j) Products: *Gear box*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Shree Rajlaxmi Industries

a) Owners name: Mr. Rajaram Rai
b) Address: *L-215/2, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778232*
d) Year of establishment: *2003*
e) Initial investment: *04 lakhs (approx)*
f) Number of employees: 08
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *09 lakhs (approx)*
i) Raw material: *M.S. Aluminum, anodizing powder*
j) Products: *M.S. flat furniture, Windows, doors*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Senior Manager*

3.3 CHEMICAL UNITS

Ahmednagar MIDC enjoys a competitive advantage in certain chemical units viz. Agro Chemicals, Emulsifier, Pesticides, Pharmaceuticals, Dyes, Plastic Processing specially chemicals and paints. In Ahmednagar MIDC chemical units will continue to remain a crucial segment catering to vital needs of agriculture, household consumption, industrial uses and other strategic and defense requirements. This means that chemicals are inevitable in many respects, but at the same time chemicals are hazardous also in many respects.

The total units in this sector were scrutinized based on the available data and the following industries were selected for further detailed study & visits:

1. Sunil Industrial Corporation
2. Estelle Chemicals Pvt. Ltd.
3. Krishna Chemicals
4. M/S Mahesh Marketing
5. Dulux Polymers

Let us see the detailed profile of these small scale units.

Sunil Industrial Corporation

a) Owners name: *Mr. Sunil Namdeorao Kale*
b) Address: *C-9, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777370*
d) Year of establishment: *1995*
e) Initial investment: *18 lakhs (approx)*
f) Number of employees: 05
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *10 lakhs (approx)*
i) Raw material: *Varnish, turpentine, cashew nut oil*
j) Products: *Red oxide, paint*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Estelle chemicals Pvt. Ltd.

a) Owners name: *Mr. Sudhir Bhagat*

b) Address: *G-20/5, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2779199*

d) Year of establishment: *2003*

e) Initial investment: *45 lakhs (approx)*

f) Number of employees: *18*

g) Number of working shifts: *Ist, IInd & IIIrd shift*

h) Annual Turnover: *90 lakhs (approx)*

i) Raw material: *ST acid, Glycerin, sorbitol*

j) Products: *GMS flakes powder, SMS flakes*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Krishna chemicals

a) Owners name: *Mr. Narang S.K.*

b) Address: *A-29, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777358*

d) Year of establishment: *1990*

e) Initial investment: *22 lakhs (approx)*

f) Number of employees: *18*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *22 lakhs (approx)*

i) Raw material: *Non edible oil, soap stone, powder silicate*

j) Products: *Washing powder & soaps*

k) Business objectives: *Increase turnover (sales)*

l) Participation by management level: *Director*

M/S Mahesh Marketing

a) Owners name: *Mr. Paresh Vijay Bihani*
b) Address: *L-233, MIDC, Ahmednagar*
c) Phone nos.: *9422086964*
d) Year of establishment: *2005*
e) Initial investment: *05 lakhs (approx)*
f) Number of employees: *15*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *35 lakhs (approx)*
i) Raw material: *Acid, chemicals*
j) Products: *Chemicals*
k) Business objectives: *Maximise profit*
l) Participation by management level: *General Manager*

3.4 CASTING/FABRICATION UNITS

The Casting/Fabrication units are an important segment of the Ahmednagar MIDC. The Casting/Fabrication units, which leap-frogged during the period 1990-95 has slowed its pace in the past half decade as, the entrepreneurs have realized that the consumer is yet to familiarize himself with the products available in the market. The products manufactured are supplied throughout India. Products like motor bodies, sewing machine parts, Steel rods, Aluminium casted, Seamless parting, M.S. Ingots & CI Casting are in high demend. Casting/Fabrication units contribute about 42% of Ahmednagar MIDC manufacturing output.

The total units in this sector were scrutinized based on the available data and the following industries were selected for further detailed study & visits:

1. Super-Tech Engineers

2. Chetak Industries
3. Apra Casting
4. Supreme Industries
5. Star Casting (Pvt.) Ltd.
6. Sheetal Foundry
7. Forcas Impex Pvt. Ltd.
8. Utkarsha Industries
9. Shreenivas Fab Innovative Pvt. Ltd.
10. Saee Engineering & Fabricators
11. Guru Engineering Works
12. Manakos Engineers & Fabricators

Let us see the detailed profile of these small scale units.

Super-Tech Engineers

a) Owners name: *Mr. Mahesh Gopalkrishnan*
b) Address: *A-44, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777705, 3291009*
d) Year of establishment: *1999*
e) Initial investment: *34 lakhs (approx)*
f) Number of employees: *56*
g) Number of working shifts: *Ist & IInd shift*
h) Annual Turnover: *70 lakhs (approx)*
i) Raw material: *All kinds of steel*
j) Products: *Fabrication, Machining & special projects*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Chetak Industries

a) Owners name: *Mr. Ajay Muthiyan*
b) Address: *D-103, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777477*
d) Year of establishment: *1998*
e) Initial investment: *21 lakhs (approx)*
f) Number of employees: *14*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *74 lakhs (approx)*
i) Raw material: *Aluminum LM-4, snap chokes, C.I. casting*
j) Products: *Aluminium casting foundry equipments*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Apra Casting

a) Owners name: *Mr. Ajay Nawale*
b) Address: *F-28, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2779853*
d) Year of establishment: *2002*
e) Initial investment: *23 lakhs (approx)*
f) Number of employees: *12*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *60 lakhs (approx)*
i) Raw material: *C.I. scrap & pig iron*
j) Products: *Ferrous & non ferrous casting*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Supreme Industries

a) Owners name: *Mr. Sunil Namdeorao Kale*
b) Address: *L-194, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778362*
d) Year of establishment: *1998*
e) Initial investment: *24 lakhs (approx)*
f) Number of employees: *35*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *90 lakhs (approx)*
i) Raw material: *Pig iron, C.I. casting*
j) Products: *Sewing machine stands*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Star Casting Pvt. Ltd.

a) Owners name: *Mr. Kiran Kathade*
b) Address: *F-46, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778489*
d) Year of establishment: *2002*
e) Initial investment: *43 lakhs (approx)*
f) Number of employees: *31*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *67 lakhs (approx)*
i) Raw material: *C.I. scrap, pig iron, coke, silica sand, bentonik*
j) Products: *C.I. casting*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Sheetal Foundry

a) Owners name: *Mr. Rajesh Jaggi*
b) Address: *C-22, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777268*
d) Year of establishment: *2004*
e) Initial investment: *53 lakhs (approx)*
f) Number of employees: *55*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *65 lakhs (approx)*
i) Raw material: *C.I. casting & pig iron*
j) Products: *sewing machine stand*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Forcas Impex Pvt. Ltd.

a) Owners name: *Mr. Jagtap*
b) Address: *G-18, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777349*
d) Year of establishment: *1999*
e) Initial investment: *39 lakhs (approx)*
f) Number of employees: 45
g) Number of working shifts: *Ist shift*
h) Annual Turnover: 67 *lakhs (approx)*
i) Raw material: *Stainless steelcasting*
j) Products: *Valve components*
k) Business objectives: Increase turnover (sales)
l) Participation by management level: *Director*

Utkarsha Industries

a) Owners name: *Mr. Balasaheb Pokale*
b) Address: *G-66, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778666*
d) Year of establishment: *1998*
e) Initial investment: *14 lakhs (approx)*
f) Number of employees: *13*
g) Number of working shifts: *Ist & IInd shift*
h) Annual Turnover: *09 lakhs & above*
i) Raw material: *M.S. casting, steel*
j) Products: *Fabricated products*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Shreenivas Fab Innovative Pvt. Ltd.

a) Owners name: *Mr. Milind kulkarni*
b) Address: *F-15, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778445*
d) Year of establishment: *2002*
e) Initial investment: *41 lakhs (approx)*
f) Number of employees: *26*
g) Number of working shifts: *Ist & IInd shift*
h) Annual Turnover: *53 lakhs (approx)*
i) Raw material: *S.S. sheets, angles*
j) Products: *Control panels*
k) Business objectives: *Maximise profit*
l) Participation by management level: *General Manager*

Saee Engineering & Fabricators

a) Owners name: *Mr. Barhate Jalindar D.*
b) Address: G-74, MIDC, Ahmednagar
c) Phone nos.: *9225325911*
d) Year of establishment: *2003*
e) Initial investment: *7 lakhs (approx)*
f) Number of employees: *12*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *25 lakhs*
i) Raw material: *M.S. Steel*
j) Products: *Fabricated products*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Guru Engineering Works

a) Owners name: *Mr. Raskar A.L.*
b) Address: *G-47/2, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2779107*
d) Year of establishment: *2003*
e) Initial investment: *7 lakhs (approx)*
f) Number of employees: *09*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *31 lakhs (approx)*
i) Raw material: *Steel, angles*
j) Products: *Fabricated products, machining, job work*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Manakos Engineers & Fabricators

a) Owners name: *Mr. Ashok M. Kore*
b) Address: *A-57, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777905*
d) Year of establishment: *2001*
e) Initial investment: *09 lakhs (approx)*
f) Number of employees: *17*
g) Number of working shifts: *Ist & IInd shift*
h) Annual Turnover: *25 lakhs (approx)*
i) Raw material: *M.S. material*
j) Products: *Fabricated items*
k) Business objectives: *Maximise profit*
l) Participation by management level: *General Manager*

3.5 MAINTENANCE/PACKAGING UNITS

Maintenance and packaging units helps smooth running of all the companies and safe delivery of products into the hands of customers. In Packaging units products like corrugated boxes, sheets, rools, wooden boxes, thermocol, Plastic bags and plastic packing parts are manufactured whereas in Maintenance units job works are done on unit basis.

The total units in this sector were scrutinized based on the available data and the following industries were selected for further detailed study & visits:

1. Abhiruchi Enterprises
2. Cargo Pack Industries
3. Shree Balaji Powder Coating & Anodizing
4. Durga Polytherm Pvt. Ltd.
5. S.S. Suppliers

6. Trimurty Foundry
7. Anand Packaging

Let us see the detailed profile of these small scale units.

Abhiruchi Enterprises

a) Owners name: *Mr. Gandhe Dilip*
b) Address: *G-65, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 6515746*
d) Year of establishment: *2000*
e) Initial investment: *22 lakhs (approx)*
f) Number of employees: *15*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *26 lakhs (approx)*
i) Raw material: *Offset machine, ink, paper*
j) Products: *Offset printing, corrugated boxes, cartons & multicolor printing*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Cargo Pack Industries

a) Owners name: *Mr. Sachin Bora*
b) Address: *D-62, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777502*
d) Year of establishment: *1991*
e) Initial investment: *45 lakhs (approx)*
f) Number of employees: *17*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *89 lakhs (approx)*
i) Raw material: *Craft paper, adhesive, stitching wire*
j) Products: *Corrugated boxes, sheets, rolls*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Senior Manager*

Shree Balaji Powder Coating & Anodizing

a) Owners name: *Mr. Avinash Ranjankar*

b) Address: *G-101, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 23207114*

d) Year of establishment: *2004*

e) Initial investment: *05 lakhs (approx)*

f) Number of employees: *15*

g) Number of working shifts: *Ist shift*

h) Annual Turnover: *18 lakhs (approx)*

i) Raw material: *Anodising powder*

j) Products: *Anodised products & furniture*

k) Business objectives: *Maximise profit*

l) Participation by management level: *Director*

Durga Polytherm Pvt. Ltd.

a) Owners name: *Mr. Sandeep More*

b) Address: *A-16, MIDC, Ahmednagar*

c) Phone nos.: *(0241) 2777399*

d) Year of establishment: *2001*

e) Initial investment: *32 lakhs (approx)*

f) Number of employees: *46*

g) Number of working shifts: *Ist & IInd shift*

h) Annual Turnover: *76 lakhs (approx)*

i) Raw material: *Styromal*

j) Products: *EPS thermocol, block & buffers*

k) Business objectives: *Maximise customer satisfaction*

l) Participation by management level: *Director*

S.S.Suppliers

a) Owners name: *Mr. Sudhir Chopda*
b) Address: *D-61, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777250*
d) Year of establishment: *1983*
e) Initial investment: *22 lakhs (approx)*
f) Number of employees: *15*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *80 lakhs (approx)*
i) Raw material: *Wood, nails*
j) Products: *Wooden pacing & boxes*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Trimurty Foundry

a) Owners name: *Mr. Kantilal Mutha*
b) Address: *A-48, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777829*
d) Year of establishment: *1995*
e) Initial investment: *7 lakhs (approx)*
f) Number of employees: *17*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *26 lakhs*
i) Raw material: *All types of steel*
j) Products: *Powder coating, oven bake painting, steel furniture*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

3.6 AGRI PRODUCT UNITS

There are few Agri Product based units contributing to the total production. Though the contribution is meager but is very important for fulfilling the need of customers. Soya protein, Poultry products, Milk Processing and Agricultural implements, etc. are few products of these units.

The total units in this sector were scrutinized based on the available data and the following industries were selected for further detailed study & visits:

1. Chaitanya Poultry Feeds & Hatcheries
2. J.K. Engineering & Industries
3. Shubham Agro Implement
4. Mahesh Fabrication
5. Indo Farm Agro Industries

Let us see the detailed profile of these small scale units.

Chaitanyan Poultary Feeds & Hatcheries

a) Owners name: *Mr. Santosh A. Kanade*
b) Address: *G-105, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2779177*
d) Year of establishment: *2003*
e) Initial investment: *30 lakhs (approx)*
f) Number of employees: *32*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *54 lakhs (approx)*
i) Raw material: *Eggs, soya & maka*
j) Products: *Feed & cheeks*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

J.K.Engineering & Industries

a) Owners name: *Mr. Ahuja R.K.*
b) Address: *G-23, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2777336*
d) Year of establishment: *2001*
e) Initial investment: *46 lakhs (approx)*
f) Number of employees: *14*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *79 lakhs (approx)*
i) Raw material: *M.S. angles, channels, flat & sheets*
j) Products: *Tractor trolleys, agriculture implements*
k) Business objectives: *Maximise profit*
l) Participation by management level: *General Manager*

Shubham Agro Implement

a) Owners name: *Mr. Ajay Kambale*
b) Address: *F-18, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2778947*
d) Year of establishment: *2002*
e) Initial investment: *52 lakhs (approx)*
f) Number of employees: *34*
g) Number of working shifts: *Ist & IInd shift*
h) Annual Turnover: *78 lakhs (approx)*
i) Raw material: *Steel angles & channel*
j) Products: *Fabricated products*
k) Business objectives: *Increase turnover (sales)*
l) Participation by management level: *Director*

Mahesh Fabrication

a) Owners name: *Mr. Sopan Kharmale*
b) Address: *G-64, MIDC, Ahmednagar*
c) Phone nos.: *(0241) 2779164*
d) Year of establishment: *2004*
e) Initial investment: *45 lakhs (approx)*
f) Number of employees: *14*
g) Number of working shifts: *Ist shift*
h) Annual Turnover: *80 lakhs (approx)*
i) Raw material: *M.S. casting*
j) Products: *Agriculture equipments*
k) Business objectives: *Maximise profit*
l) Participation by management level: *Director*

Despite of all possible and pertinent efforts made by the researcher following small scale manufacturing units didn't participate in discussion and personal interview secessions. Also these firms remain non respondent in filling the questionnaire. The list of such firm is as follows

1. Valency Compunds Services Pvt. Ltd.
2. Sai Links (India) Pvt. Ltd.
3. Sai Plastics
4. Dulux Polymers
5. Anand Packaging
6. Indo Farm Agro Industries

Thus the effective size of the sample is 44 out of 50.

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CHAPTER-4
RESEARCH METHODOLOGY

4.1 INTRODUCTION

In responding to the challenge of globalisation, businesses entities are organised differently compared to the past. Changes have been made to the supply chain in the form of new development such as company organisational structure, just-in time delivery, warehousing and logistics operation. Before, businesses wanted to own all the activities encompassed in their supply chain, but now they only control the strategic core of their supply chain activities and depend more on external business partners.

The present business model, single companies are not able to survive on their own; they can survive only as part of the supply or value chain in an increasingly competitive business environment. It is the supply chain, which will bring true competitive advantage to companies, by satisfying customers' needs and lowering operating costs. Therefore the role of supply chain management is critical in managing issues that arise across organisational boundaries, improving corporate competitiveness and profitability in today's operating environment emphasised that individual businesses no longer compete as solely autonomous entities, but rather as supply chains.

Research is an academic activity and as such the term should be used in a technical sense. Research is an original contribution to the existing stock of knowledge making for its advancement. It is the persuit of truth with the help of study, observation, comparison and experiment. In short, the search for knowledge through objective and systematic method of finding solution to a problem is research.

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically, here we study the various steps that are adopted by researcher in studying research problem along with the logic behind them.

The research aims to study the important contributing factors of supply chains in small scale manufacturing units and its various aspects. The supply chain is often referred to as a value chain. A typical supply chain includes information, funds and physical material flows, which run parallel to the value chain. The management of small scale manufacturing units faces many problems in managing a supply chain, e.g. correct forecasting method, inventory management, make or buy decisions, strategic decisions and evaluating performance of the firm with respect to supply chains, etc.

Researcher feels that small scale manufacturing units can improve profitability by implementing supply chain in a proper manner in their organisations. Researcher's interest is to understand the awareness of SCM practices among small scale manufacturing units.

4.2 RESEARCH TOPIC

"Management of supply chain in small scale manufacturing units (with special reference to Ahmednagar MIDC area)"

4.3 OBJECTIVES OF THE RESEARCH

1. To study the product management and strategic network design for products manufactured in small scale manufacturing units.
2. To study the demand analysis and procurement procedure followed by small scale manufacturing units.
3. To study the outsourcing of procurement of materials and components and its overall distribution planning used to survive in the competitive market.
4. To study the logistics management of small scale manufacturing units.
5. To study the product development for customer satisfaction and to study CRM.
6. To study the overall performance of small scale manufacturing units.

4.4 SCOPE AND LIMITATIONS OF THE STUDY

The scope and limitations of the study are briefly stated below. This research aims at studying the management of supply chain. The research sample selected for this is drawn from industrial area of Ahmednagar MIDC.

1. Research is restricted to small-scale manufacturing units in Ahmednagar MIDC area and no other area will be considered.
2. The research is concerned upon a randomly selected sample to fifty small-scale manufacturing units.
3. The study aims at examining the supply chain management aspect, no other management aspects will be considered.
4. The findings of the study are based on primary and secondary data. The primary data has been collected through responses received from owners, managers and workers working at different levels of organisation.
5. The study is limited to small-scale manufacturing units engaged in manufacturing activities, small-scale units from other fields viz, service sector are not taken in consideration.

4.5 HYPOTHESIS

1. Product management and strategic network design helps small scale manufacturing units to manage their products.
2. Procurement procedure is dependent on demand analysis followed by small scale manufacturing units.
3. The outsourcing of procurement of materials and components decides the distribution policies of small scale manufacturing units.
4. Logistics management has significance with reference to efficiency of small scale manufacturing units.
5. CRM practices of small scale manufacturing units improve customer’s satisfaction.

6. Performance measurements of small scale manufacturing units give direction to supply chain management.

4.6 METHODOLOGY

4.6.1 Collection of data

The sample consists of fifty small-scale manufacturing units from MIDC area of Ahmednagar city which were selected by random sampling from the list of manufacturing units published by MIDC office, Ahmednagar. Despite of all possible and pertinent efforts made by the researcher only 44 respondents extended their cooperation and filled the questionnaire. Thus the effective size of the sample is 44 out of 50.

4.6.2 Primary data

To collect the facts and figures from the sample selected, a pilot questionnaire was prepared and provided to twenty five subjects and was requested by researcher to read the statements and make tick marks for appropriate choice on the questionnaire itself. Researcher got the normal distribution curve on the basis of pilot survey as well as comments from the respondents about the questionnaire. After thorough study and detailed discussion with guide and prominent personalities from the subject field the deficiencies were removed by redrafting the questionnaire and filling the gap to cover all the aspects of supply chain and the data expected and is distributed to the respondents of the sample chosen.

Interview is a direct method of collecting data which involves presentation of oral-verbal stimuli and reply in terms of oral-verbal response. Personal interviews and group interviews were conducted for gathering more correct and confidential information. Researcher got the intimate aspect of individuals on the research topic at the time of the interview.

In order to supplement the information through the questionnaire method, interviews of all the respondents were conducted with the help of an interview guide. To collect various information like product, business objective, outsourced procurement, work procedure, management policy & distribution channels personal interviews of entrepreneurs, was conducted. The interviews stimulated the respondents to express their views and opinions truly and frankly. Thus the tools like, structured questionnaire and interviews were used by the researcher for the purpose of collecting primary data.

Since science begins with observation and must ultimately return to observation for its final validation. Researcher used various types of observation like – *participative and non participative observations*. Efforts were also given by researcher to collect information about facilities received by small-scale manufacturing units in lieu of manufacturing and marketing the product. Trade associations, other knowledgeable professional groups, specialized research and other institutions, specialized agencies such as consultants etc, were also contacted for internal sources such as records reports register etc.

With the help of all these types of observations the researcher collected the information for its validation and objectivity.

4.6.3 Secondary data

Information regarding government orders, rules, schemes to support small scale manufacturing units, through relevant official literature survey was carried out in various libraries, published survey reports, newspapers, magazines, trade journals which were published weekly, fortnightly or monthly was also referred and its outcome was considered while giving recommendations.

4.6.4 Processing of data

The main objective of the present research was to study the management of supply chain of small scale manufacturing units in Ahmednagar city. Thus the data collected was processed with the help of computer and is presented with the help of tables, charts, graphs, bar charts, pie charts. Standard statistical tools were used for the analysis of data. Finally inferences were drawn and these were reported at the appropriate places in different chapters. All these findings are summarised in the last chapter. Bibliography has been given at the end.

To test the hypothesis that "*Logistics management has significance with reference to efficiency of small scale manufacturing units*." the researcher found it difficult to quantify the data for calculations. After discussion with the guide and statistician it was decided to give marks to the choices of the questions related to the logistics and take a total of marks obtained in all the questions and take a percentage of it. It was also decided to take 70% marks as optimum score for small scale manufacturing units.

4.6.5 Statistical methods used for calculation

In order to test the efficiency of logistics in small scale manufacturing units there logistic performances were compared with the overall performance at 70%. t-test and z-test were used.

- t-test is based on t-distribution and is considered an appropriate test for judging the significance of a sample mean or for judging the significance of difference between the means of two samples in case of a small sample when the population variance is not known. The relevant test statistic, t, is calculated from the sample data and then compared with its probable value based on t-distribution (to be read from the table that gives probable values of t for different levels of significance for different degrees of freedom) at a specified

level of significance for concerning degrees of freedom for accepting or rejecting the null hypothesis.

$$\mathbf{t = (X - \pi_o / \sigma) * \sqrt{n-1}}$$

Where, X = mean of the distribution

π_o *= assumed mean (70 in this research)*

σ *= standard deviation*

n = number of observations

- z-test is based on the normal probability distribution and is used for judging the significance of several statistical measures, particularly the mean. The z test statistic is worked out and compared with its probable value (to be read from table showing area under normal curve) at a specified level of significance for judging the significance of the measure concerned.

$$\mathbf{z = (X - \pi_o / \sigma) * \sqrt{n-1}}$$

Where, X = mean of the distribution

π_o *= assumed mean (70 in this research)*

σ *= standard deviation*

n =number of observations

- X^2-test is based on chi-square distribution and as a parametric test is used for comparing a sample variance to a theoretical population variance.

$$\mathbf{X^2 = \sum (O_i^2 / E_i) * N}$$

Where, E_i *= row total * column total / N*

O_i *= observed frequency,*

E_i *= expected frequency*

N = total of frequency

- Measure of central tendency and dispersion was used to compare data and conclusions were given.

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CHAPTER-5

ANALYSIS AND INTERPRETATION OF DATA

5.1 INTRODUCTION

The subject of this research is management of supply chain. The research undertakes to study the issue of management of supply chain in small scale manufacturing units. There are various dimensions to management of supply chain and present study attempts to analyse few of its important aspects.

Supply chain is a complex concept, difficult to quantify and measure objectively. Therefore, in order to facilitate the research, researcher prepared a questionnaire which not only considers objective aspect such as logistics, outsourcing and information transfer but subjective aspect like demand forecasting, material handling and customer relationship management, etc.

The data after collection is processed and analysed in accordance with the outline laid for the purpose at the time of developing the research plan. This is essential for a research and for ensuring that researcher have all relevant data for making comparisons and analysis. The term analysis refers to the computation of certain measures along with searching for patterns of relationships that exist among data groups. In the process of analysis, relationships or differences supporting or conflicting with original or new hypothesis is subjected to statistical tests of significance to determine with what validity data can be said to indicate any conclusions.

Various processing operations were used to represent the raw data in a proper manner. Those are editing, coding, classification and tabulation. The important statistical measures that are used to summarised the research data are measures of central tendency, measures of dispersion, chi square test, t-test and z-test. Interpretations are given after through study of the data.

5.2 TABULATION & GRAPHIC REPRESENTATION

5.2.1 Organisation profile

Gathering basic information like initial investment, turnover, number of workers working, number of working shift, level of management participation and product categories will help in understanding the structure of units under study.

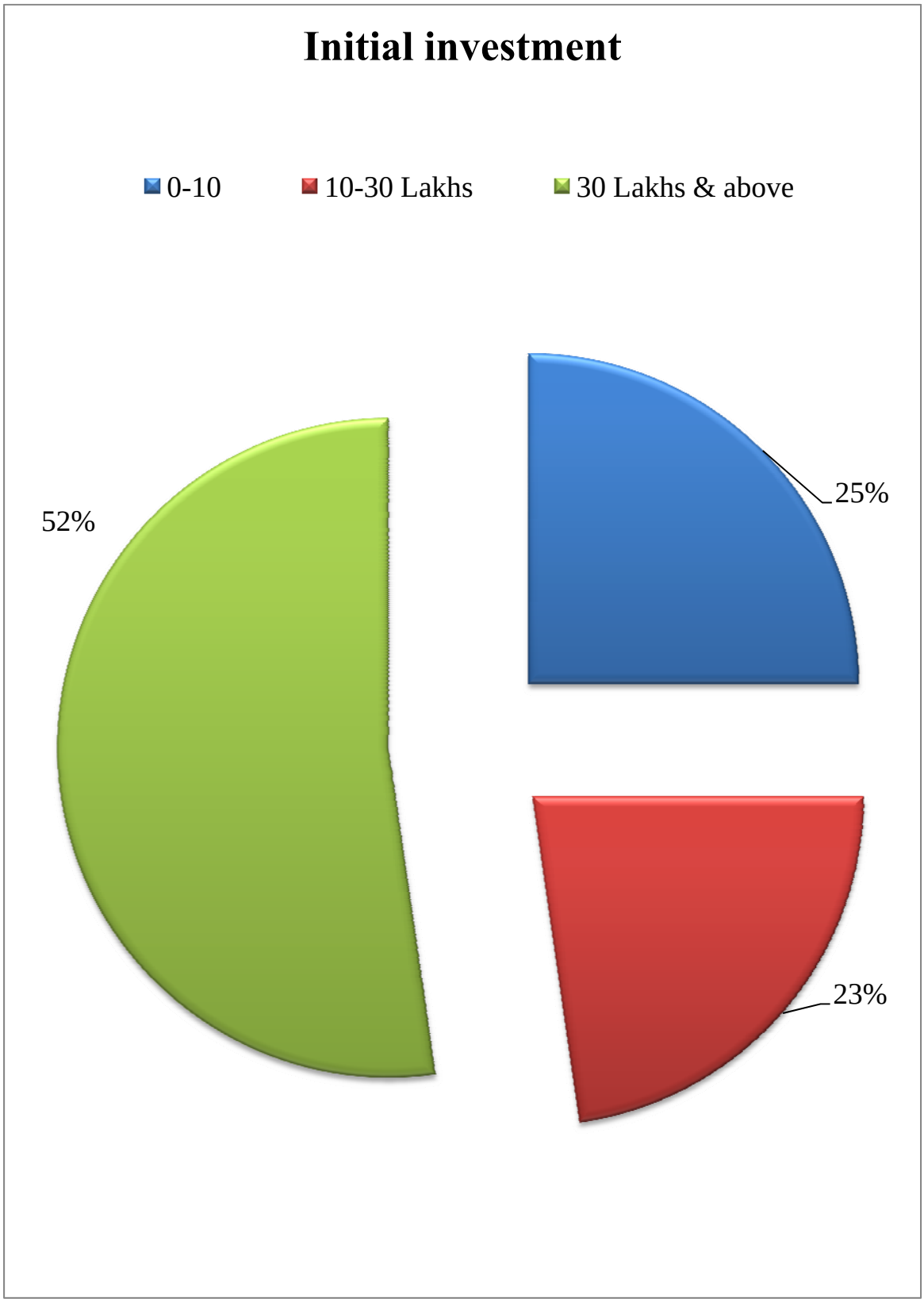
a) Initial investment

The researcher tries to assess the initial investments of the small scale manufacturing units. Initial investment is required to start the business and to purchase plant and machinery.

Sr. No.	Particulars	Frequency	Percentage
1.	0-10 lakhs	11	25
2.	10-30 lakhs	10	23
3.	30 lakhs & above	23	52
Total		44	100

Table 4.1

It is observed that 52% of the firm's investment is more than 30 lakhs, 23% firm's investment is between 10 & 30 lakhs and 25% firm's investment is not more than 10 lakhs.



Graph 4.1

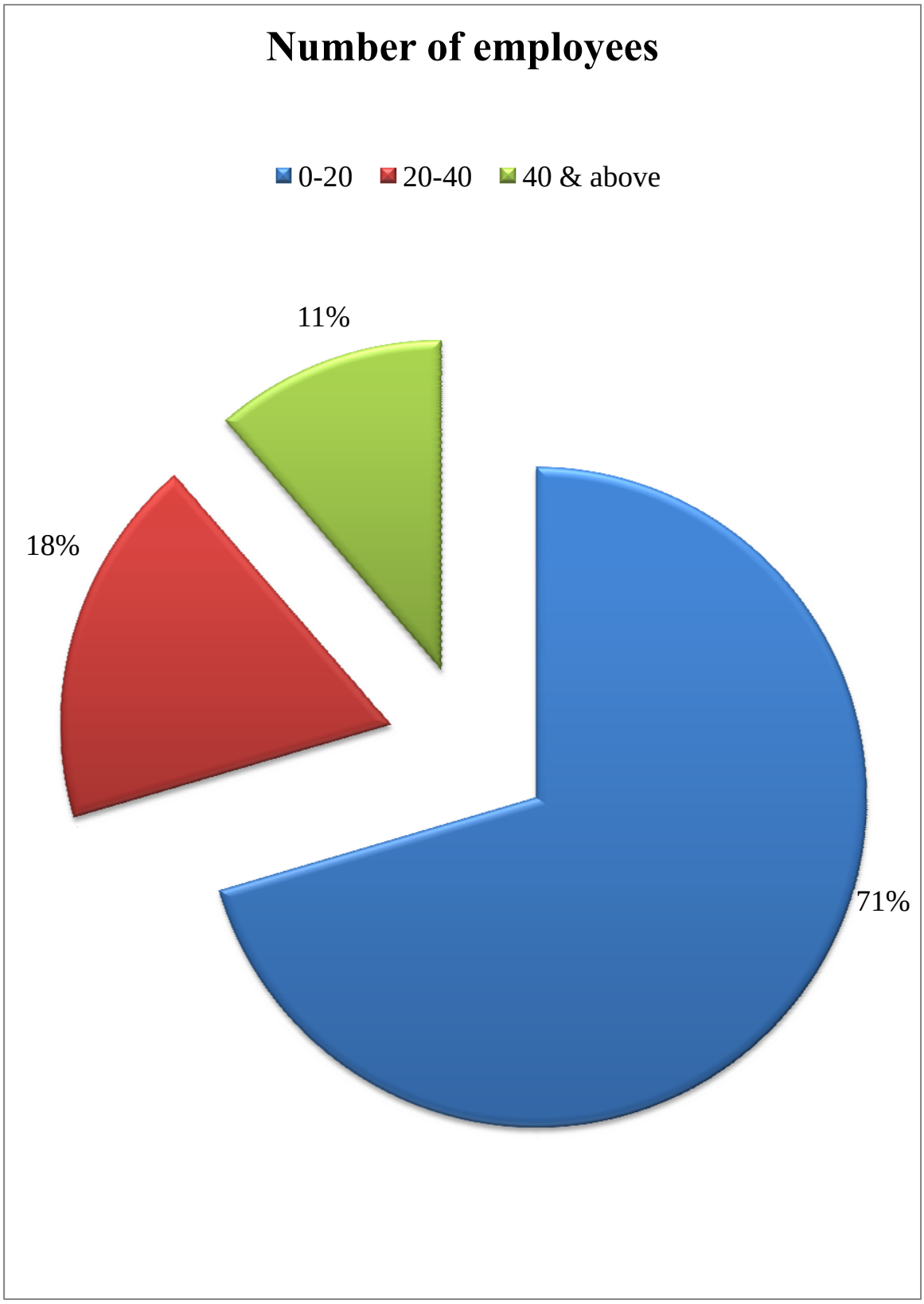
b) Number of Employees

The objective of researcher here is to know the man power requirement which is very essential to run the business and to predict the requirement of man power requirement in similar firms and the complexity of the business.

Sr. No.	Particulars	Frequency	Percentage
1.	0-20	31	71
2.	20-40	08	18
3.	40 & above	05	11
Total		44	100

Table 4.2

It is observed that 71% of firms under study have manpower less than 20, 18% have manpower between 20 to 40 workers and 11% firms have their manpower more than 40 which indicate that the majority of the firms requires less manpower. The functioning of the business is relatively less complex.



Graph 4.2

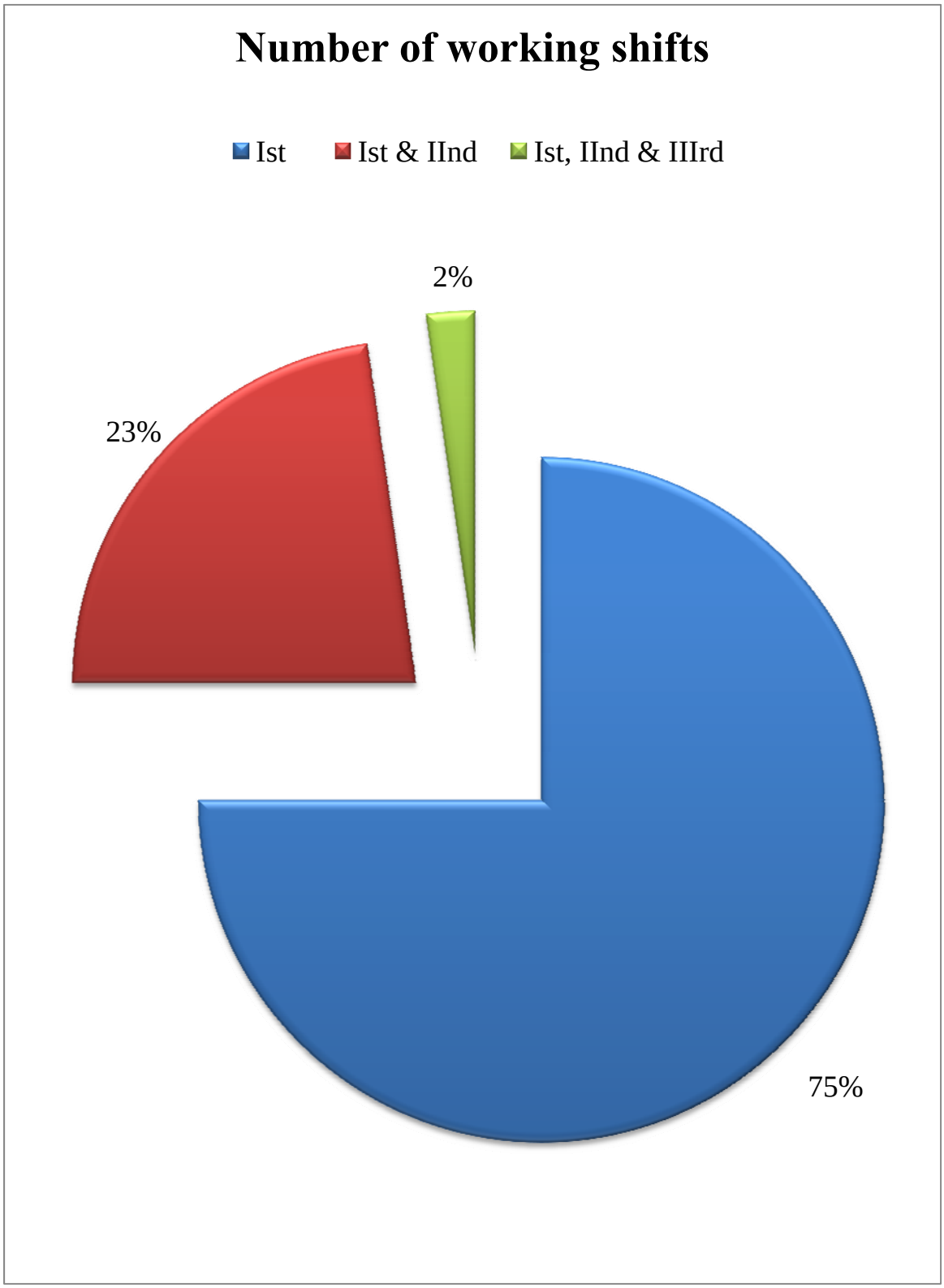
c) Number of working shifts

The researcher wants to know whether the production process is intermittent or continuous. This will help to predict the length of transformation process and amount of material handling involved.

Sr. No.	Particulars	Frequency	Percentage
1.	Ist	33	75
2.	Ist & IInd	10	23
3.	Ist, IInd & IIIrd	01	02
Total		44	100

Table 4.3

From the data it is observed that 75% of the firms run only I^{st} shift, 23% firms run I^{st} & II^{nd} shift whereas only 2% of the firms run all the three shifts. Small scale manufacturing units are engaged mostly in job work which is part of intermittent production process and where they are not required to run all the three shifts.



Graph 4.3

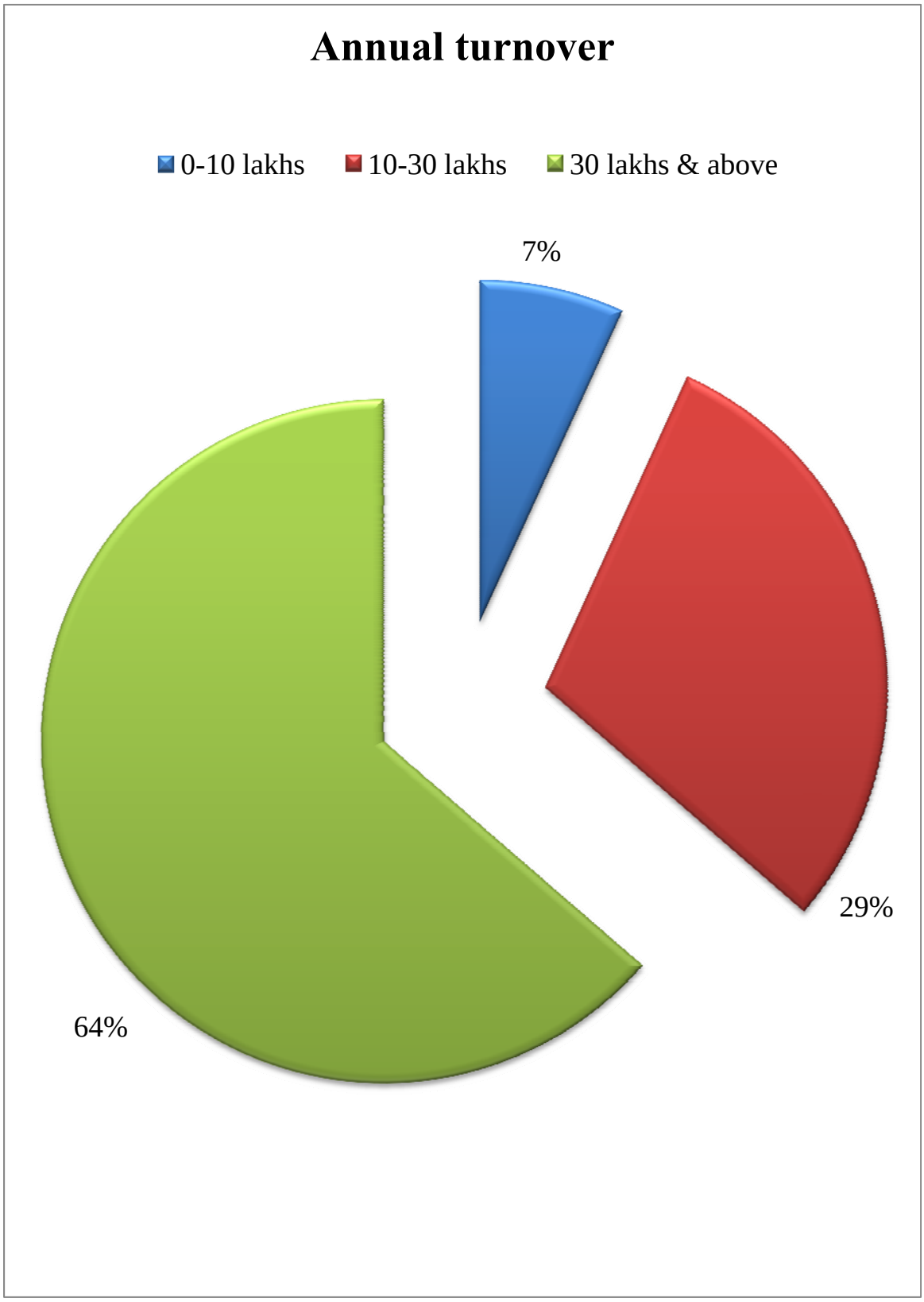
d) Annual turnover

Annual turnover help the researcher to know the size of the firm and business size.

Sr. No.	Particulars	Frequency	Percentage
1.	0-10 lakhs	03	07
2.	10-30 lakhs	13	29
3.	30 lakhs & above	28	64
Total		44	100

Table 4.4

64% of the respondent units have turnover between 30 lakhs and above, 29% of the respondent units have turnover between 10 and 30 lakhs whereas only 7% of the units understudy have turnover between 0 to 10 lakhs.



Graph 4.4

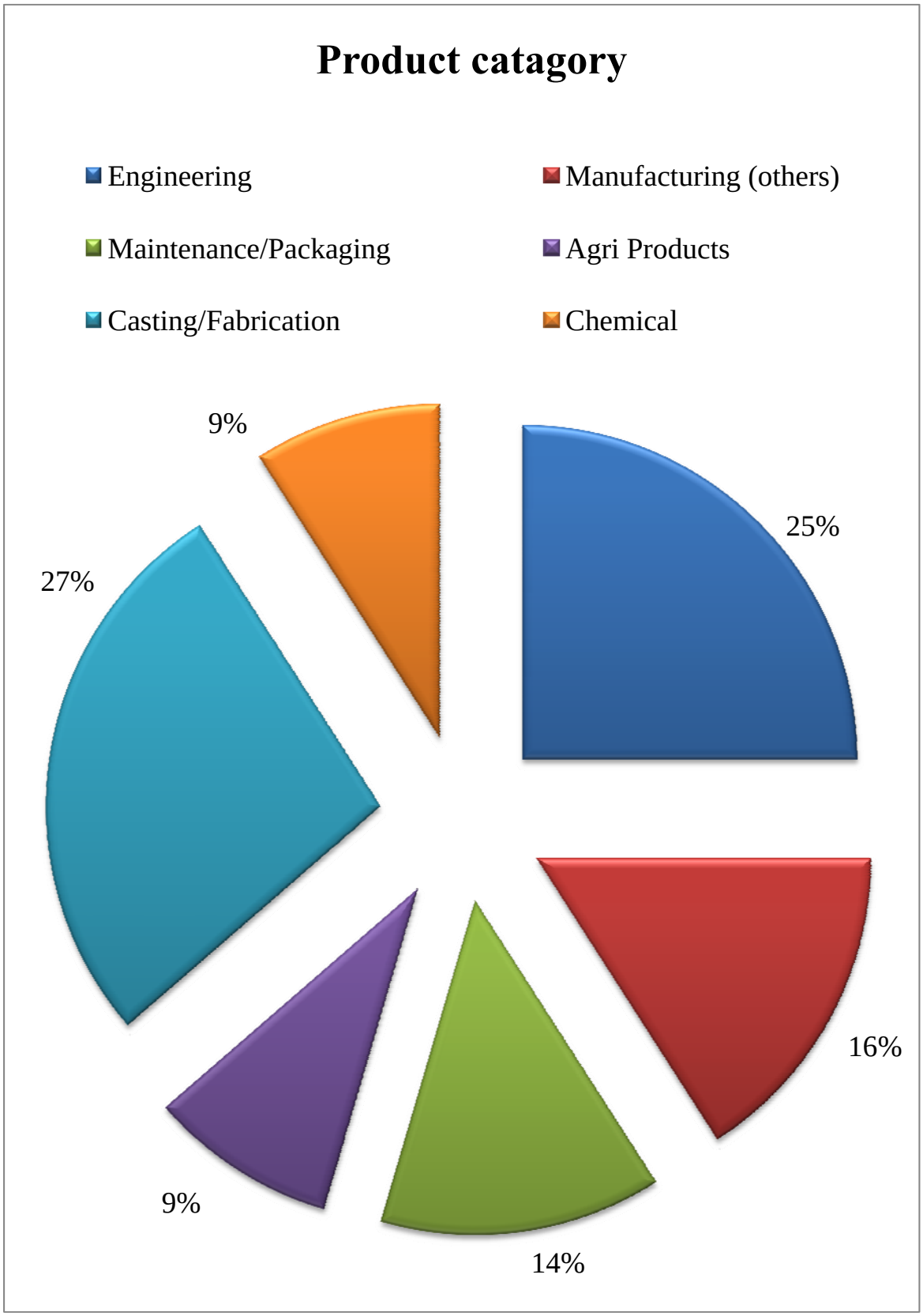
e) Product category

Researcher has divided the sample selected into different product categories to study the differences in the performances of these units, categories wise.

Sr. No.	Particulars	Frequency	Percentage
1.	Engineering	11	25
2.	Manufacturing (others)	07	16
3.	Maintenance/Packaging	06	14
4.	Agri Products	04	09
5.	Casting/Fabrication	12	27
6.	Chemical	04	09
Total		44	100

Table 4.5

27% of the total sample constitutes Casting/Fabrication units, 25% of the sample constitutes Engineering units, percentage of other manufacturing units is 16, percentage of Maintenance/Packaging units is 14, Agri Product units is 9% and Chemical units are 9%.


Product catagory
Engineering
Manufacturing (others)
Maintenance/Packaging
Agri Products
Casting/Fabrication
Chemical
9%
25%
27%
16%
9%
14%

Graph 4.5

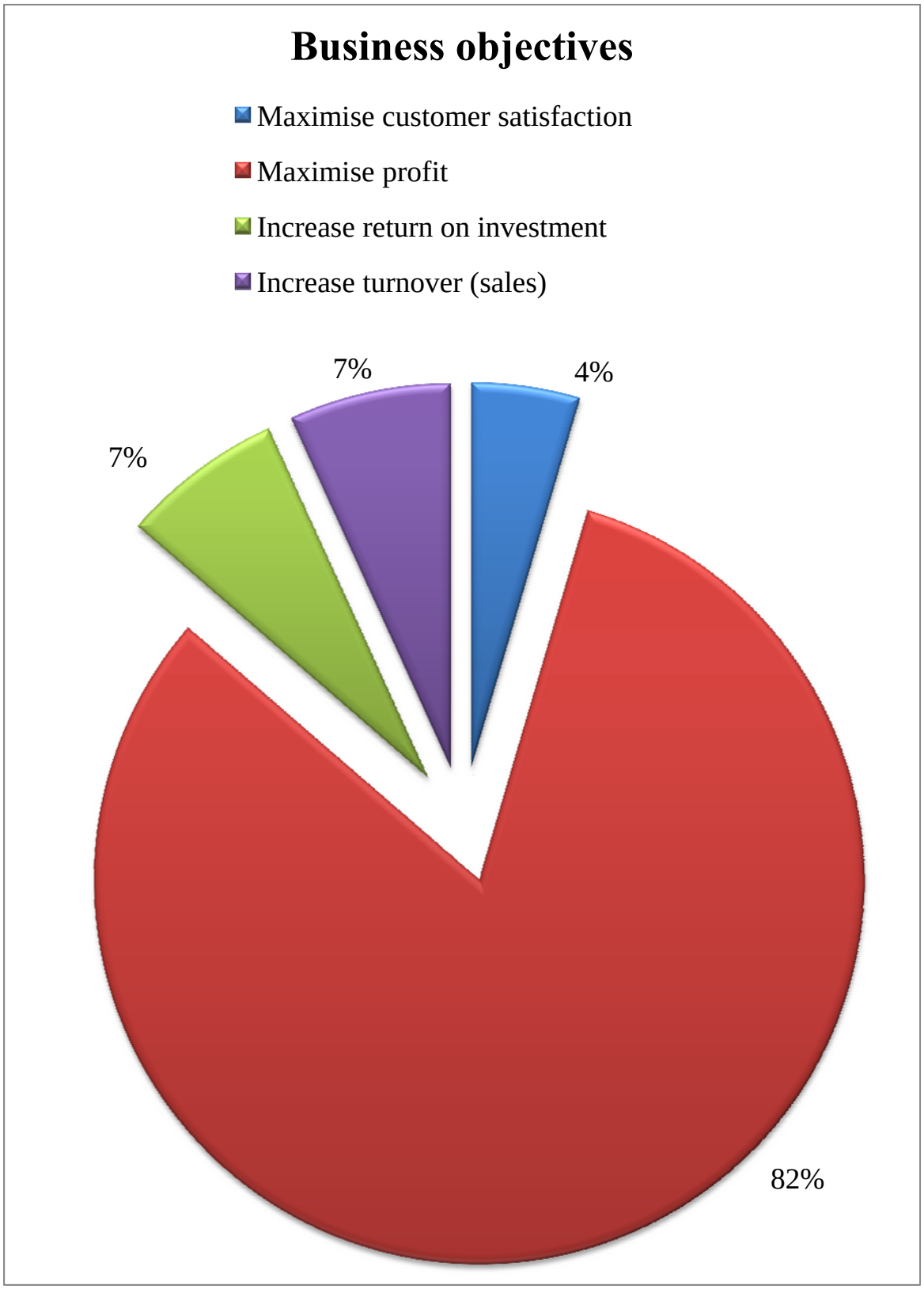
f) Business objectives

To get the idea of firm's objective in running the business, researcher asked the question to respondent.

Sr. No.	Particulars	Frequency	Percentage
1.	Maximise customer satisfaction	02	04
2.	Maximise profit	36	82
3.	Increase return on investment	03	07
4.	Increase turnover (sales)	03	07
Total		44	100

Table 4.6

82% small scale manufacturing units under study indicates that profit maximization is the business objective, 7% indicates objective is to increase return on investment, 7% units have objective as increase in turn over (sales) and rest 4% has objective of maximize customer satisfaction.


Business objectives
Maximise customer satisfaction
Maximise profit
Increase return on investment
Increase turnover (sales)
4%
82%
7%
7%

Graph 4.6

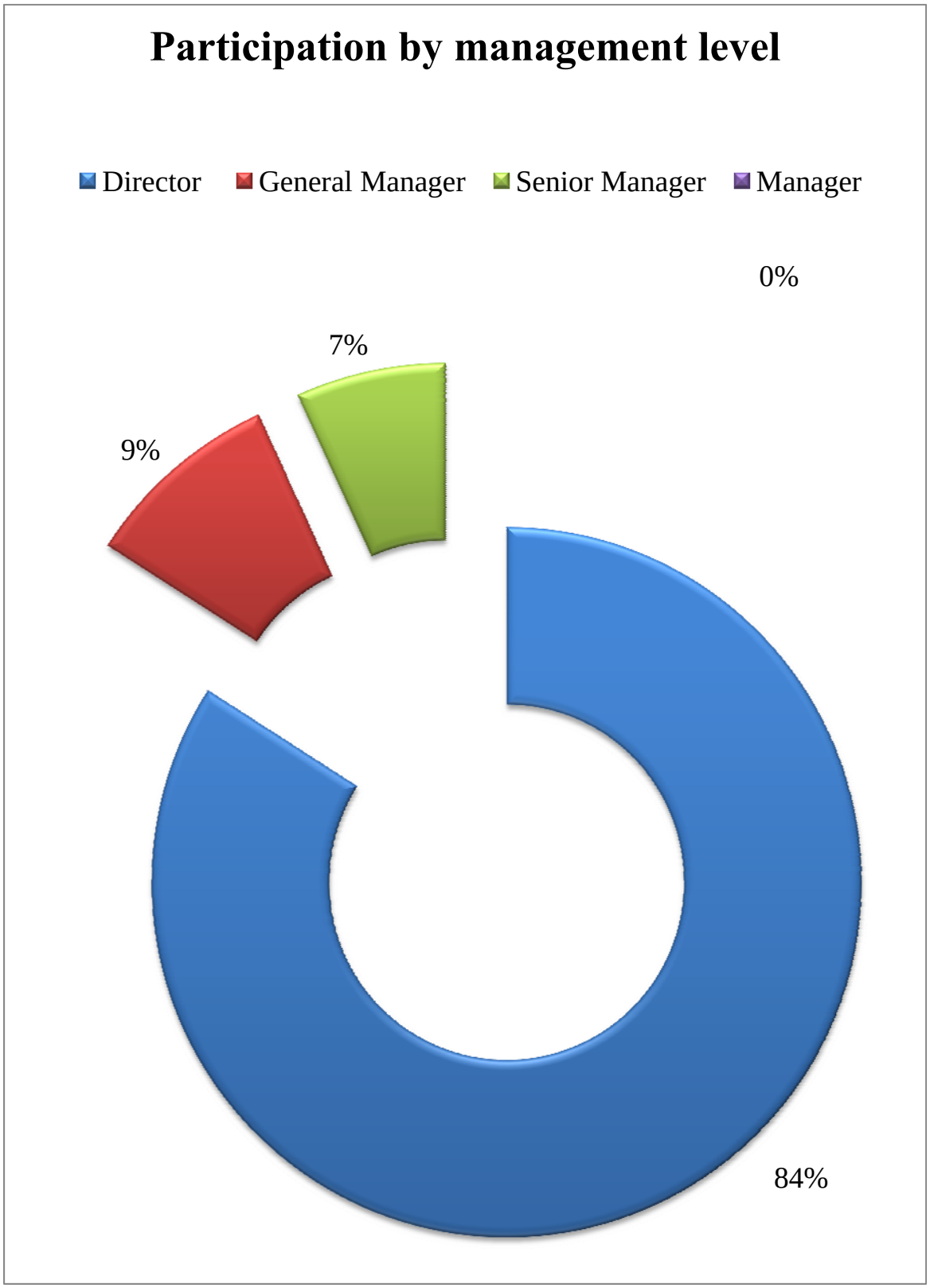
g) Participation by management level

Aim behind asking this question is to check whether responses given is genuine or not. It is assumed that higher the position of the responder in the organizational hierarchy more genuine is the responses.

Sr. No.	Particulars	Frequency	Percentage
1.	Director	37	84
2.	General Manager	04	07
3.	Senior Manager	03	09
4.	Manager	00	00
Total		44	100

Table 4.7

84% of the respondents were Directors of the small scale manufacturer units, 9% were Senior Managers and 7% were General Managers.


Participation by management level
Director
General Manager
Senior Manager
Manager
0%
7%
9%
84%

Graph 4.7

5.2.2 Demand forecasting

Forecasting is unavoidable and is the weakest link of the supply chain. Most of the firms do not like to carry out the exercise of forecasting. Forecasting about demand gives the approximate figure of the quantity which will be demanded thus helps in proper planning of procurement and logistics for the same. This is essential for smooth flow of production.

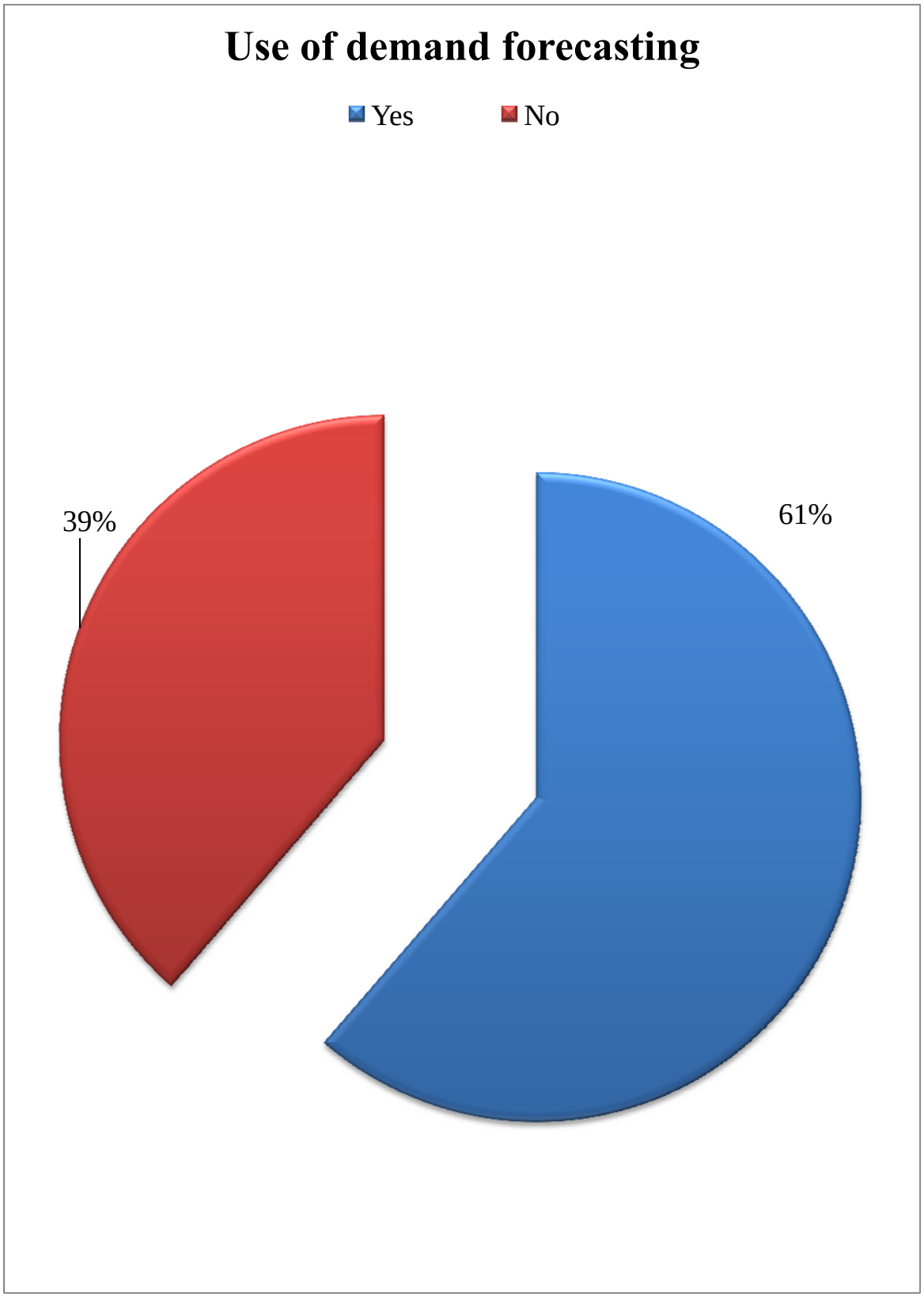
a) Whether you use forecasting of demand for production planning?

Researcher wanted to know whether small scale manufacturing units use demand forecasting for planning purpose or not. Whether they are aware of demand forecasts benefits or not.

Sr. No.	Particulars	Frequency	Percentage
1.	Yes	27	61
2.	No	17	39
Total		44	100

Table 4.8

It is observed by the researcher that 61% of the firms under study use demand forecasting to predict the future demand whereas 39% doesn't use forecasting as a planning tool.



Graph 4.8

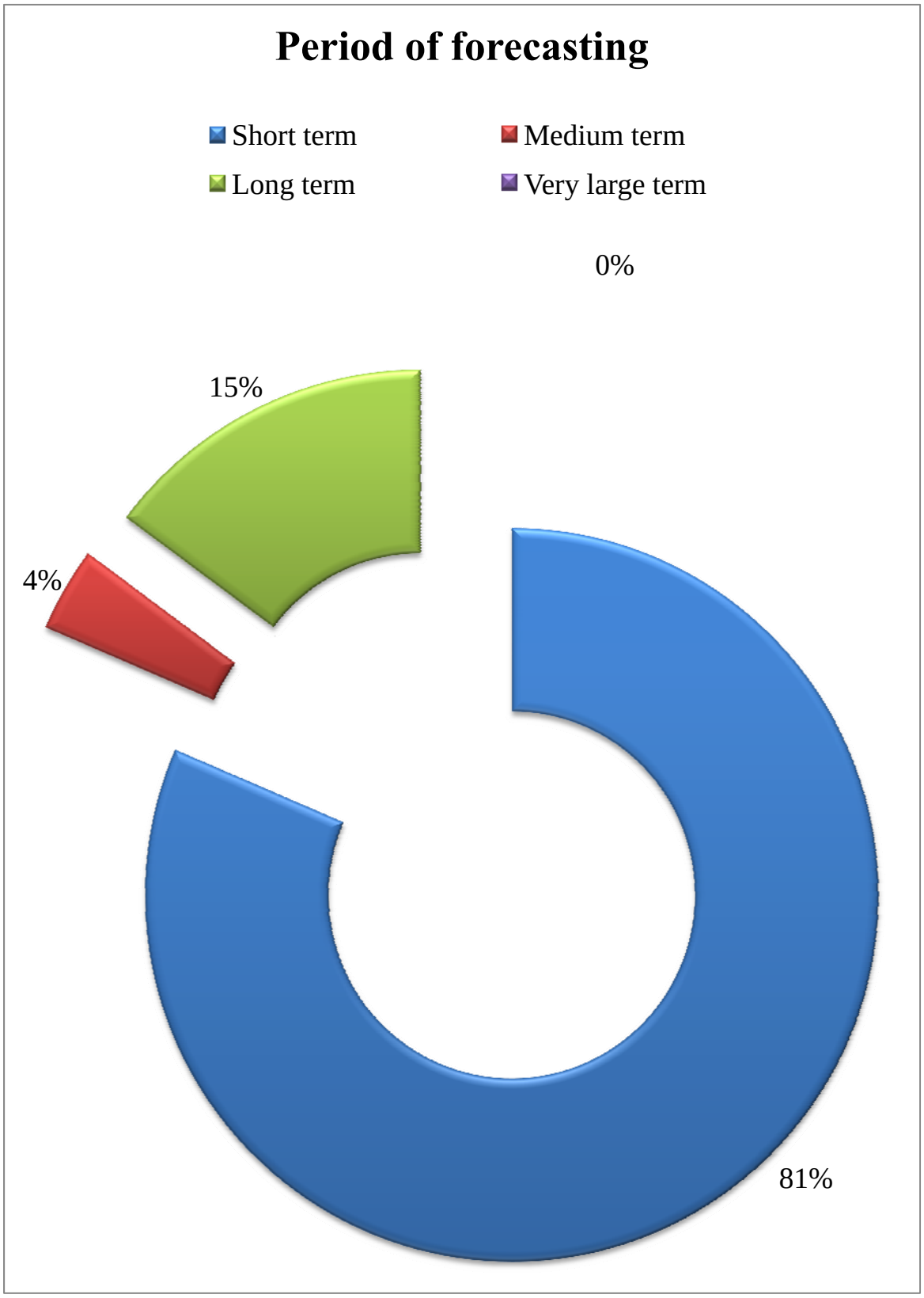
i) What period generally you consider for forecasting?

The key factor in choosing a proper forecasting approach is the time horizon for the decision requiring forecasting. In the competitive market uncertainties has increased which effects the forecast and firm cannot forecast accurately even though it uses the most reliable method. Generally short term forecasting is considered as reliable time horizon.

Sr. No.	Particulars	Frequency	Percentage
1.	Short term	22	81
2.	Medium term	01	04
3.	Long term	04	15
4.	Very large term	00	00
Total		27	100

Table 4.9

Out of 44 respondents only 27 respondents apply the forecasting technique. The above table shows the information relating to those 27 units. It can be observed that 81% of the units under study prefer short term as period of forecasting, 15% prefer long term and only 4% units consider medium term forecasting reliable.


Period of forecasting
Short term
Medium term
Long term
Very large term
0%
15%
4%
81%

Graph 4.9

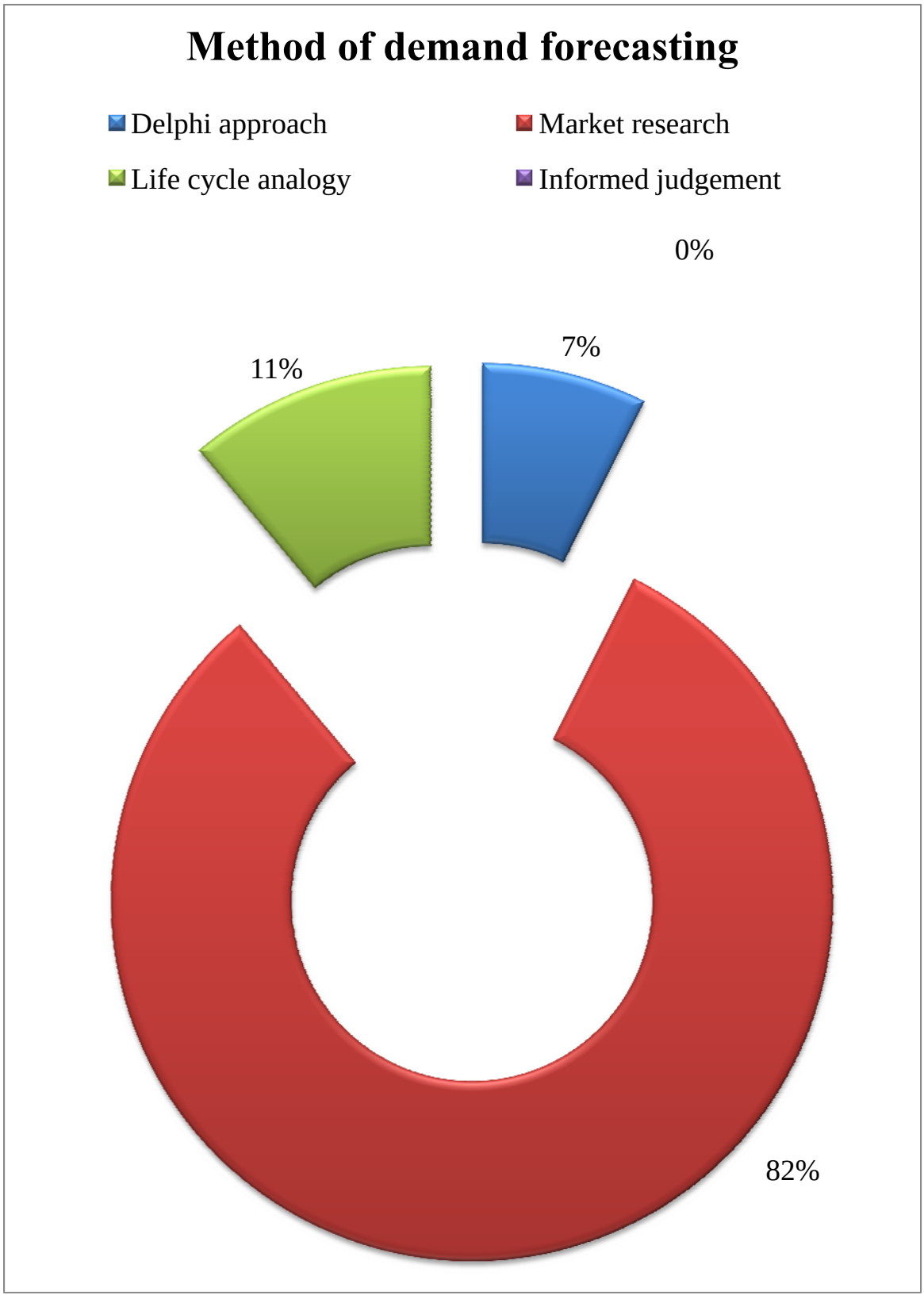
ii) Which method you use for demand forecasting?

Forecasting methods are primarily subjective and they rely on human expertise. Method of forecasting may depend upon the type of the product firm manufactures. Choice of proper method requires knowledge of all the methods available. Delphi method employs a panel of experts in arriving at the forecast and proceeds through a series of rounds. Market research involves estimation of the market size based on testing new products or ideas with a few selected potential customers. Lifecycle analogy is diffusion model, where proportion of innovators, imitators and the overall market size helps firm to distribute demand through different stages of product life cycle. Informed judgement forecast is based on experience and understanding of the situation.

Sr. No.	Particulars	Frequency	Percentage
1.	Delphi approach	02	07
2.	Market research	22	82
3.	Life cycle analogy	03	11
4.	Informed judgement	00	00
Total		27	100

Table 4.10

82% of the units under study uses market research method, 11% uses life cycle analogy and rest 7% uses Delphi approach. Market research is the most preferred method of demand forecasting in majority of the business activities in general and the same is observed in small scale manufacturing units under study in Ahmednagar MIDC.


Method of demand forecasting
Delphi approach
Market research
Life cycle analogy
Informed judgement
0%
7%
11%
82%

Graph 4.10

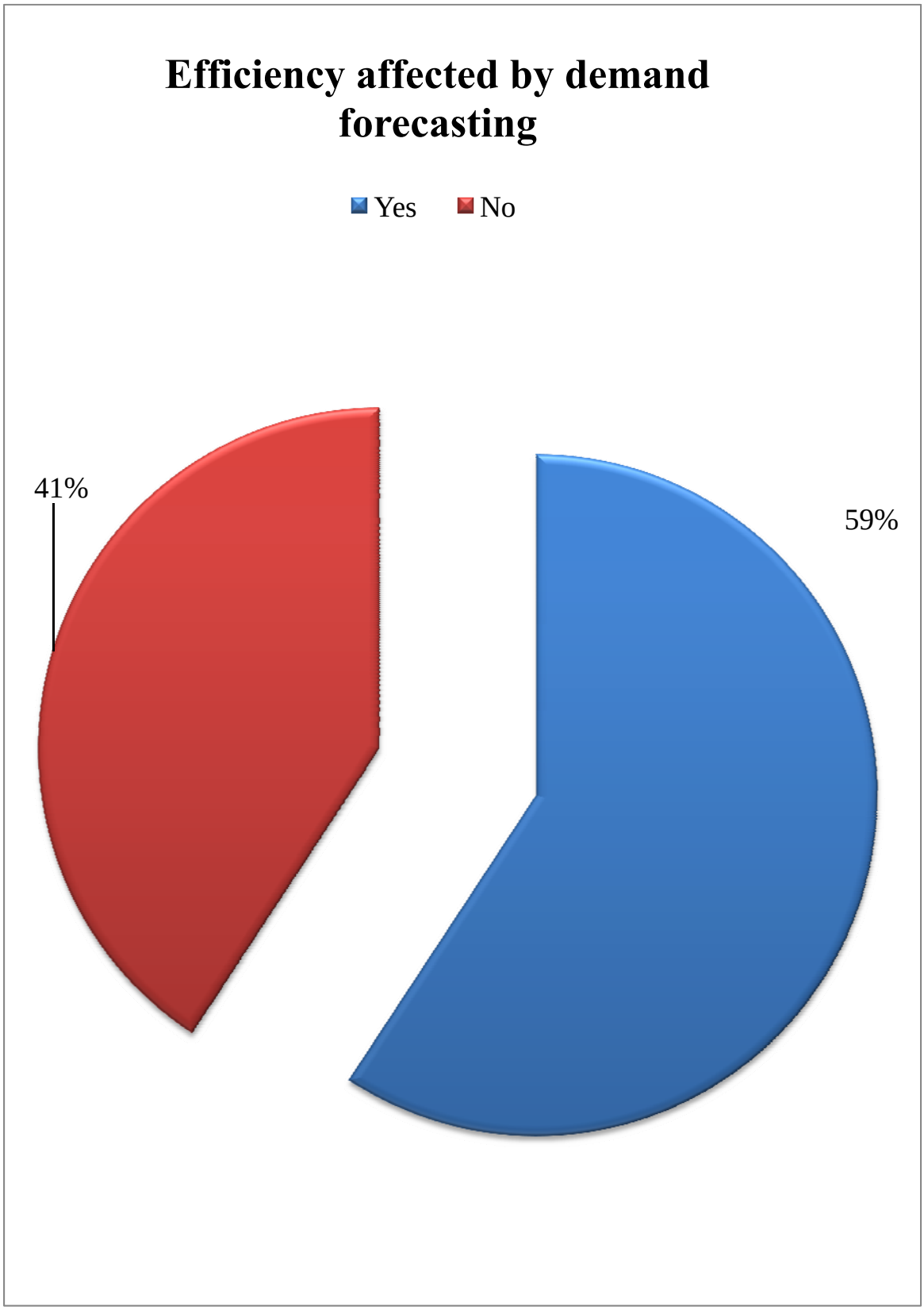
iii) Does demand forecasting methods affects efficiency of forecasting?

Demand forecasting provides critical information to supply chain planning. The right method is key factor to gather the critical information and achieving the efficiency.

Sr. No.	Particulars	Frequency	Percentage
1.	Yes	16	59
2.	No	11	41
Total		27	100

Table 4.11

Out of 27 small scale manufacturing units, 16 units agree that forecasting methods affect the efficiency of forecasting. In totality 59% agrees and 41% disagrees with the statement. Though 59% units under study understand the importance of demand forecasting methods which affects the efficiency, still there is a need to make the rest of 41% units aware of efficiency dependency of demand forecasting.



Graph 4.11

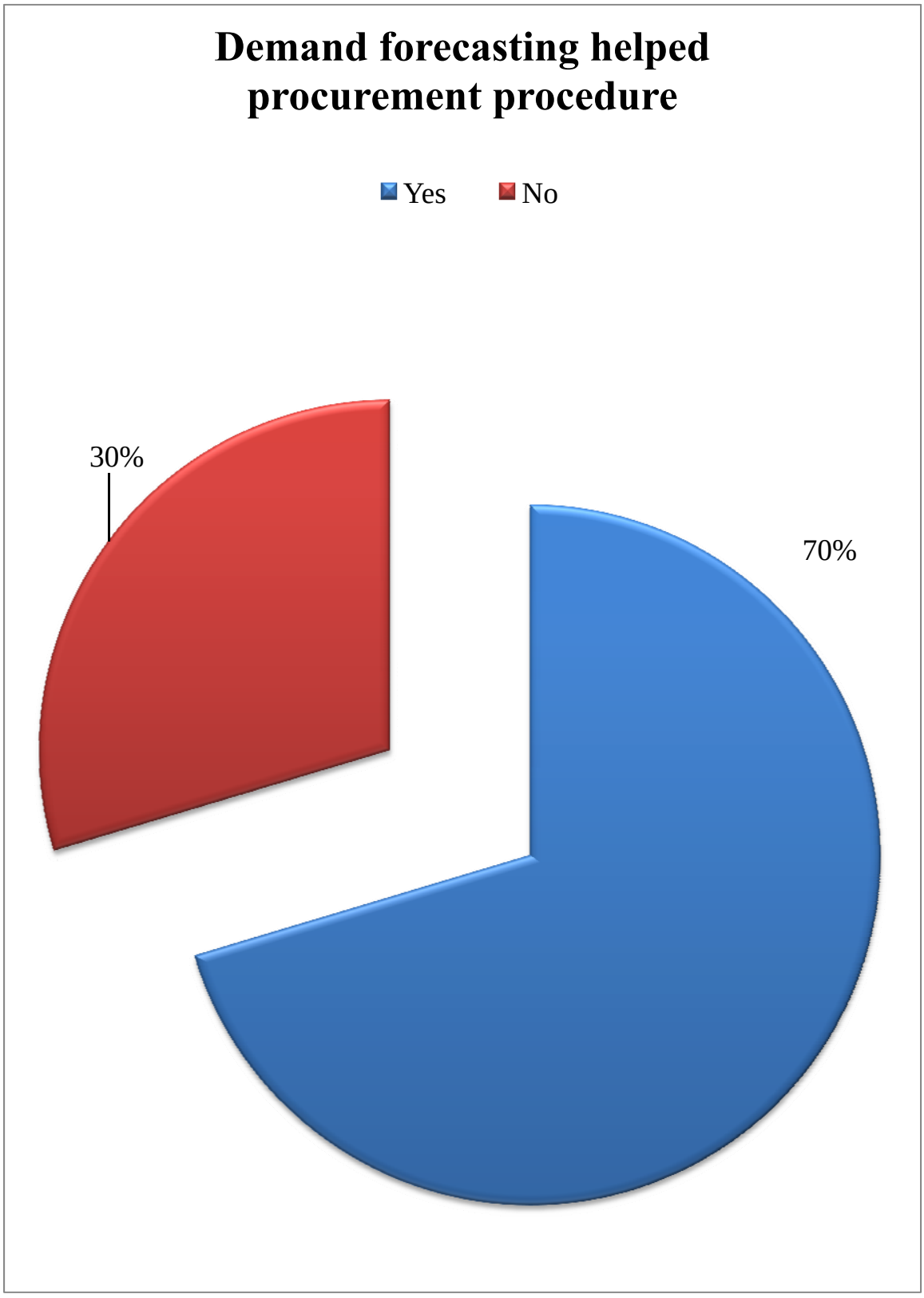
b) Whether demand forecasting has helped your organization in improving procurement procedure?

Forecasting in supply chain context is the art and science of predicting future demand which helps the organisation in improving the procedure used for procurement. Researcher tried to find the opinion of the respondent regarding usability of demand forecasting.

Sr. No.	Particulars	Frequency	Percentage
1.	Yes	19	70
2.	No	08	30
Total		27	100

Table 4.12

In small scale manufacturing units, 70% of the respondents confirmed that demand forecasting has helped them to improve procurement procedure and 30% disconfirmed the statement. The researcher observed that few firms were performing well in terms of purchasing raw material.


Demand forecasting helped procurement procedure
Yes
No
30%
70%

Graph 4.12

5.2.3 Material Resource Planning

Material resource planning is the scientific way of determining the requirements of raw materials, brought out parts and others and ensuring their availability in right quantities, at the right time with minimum capital block up. MRP determines time-phased requirements (period-by-period) for all purchased and manufactured parts such as raw materials, components, parts, subassemblies, etc. Firms using this method get the benefits of better planning in purchasing procedure.

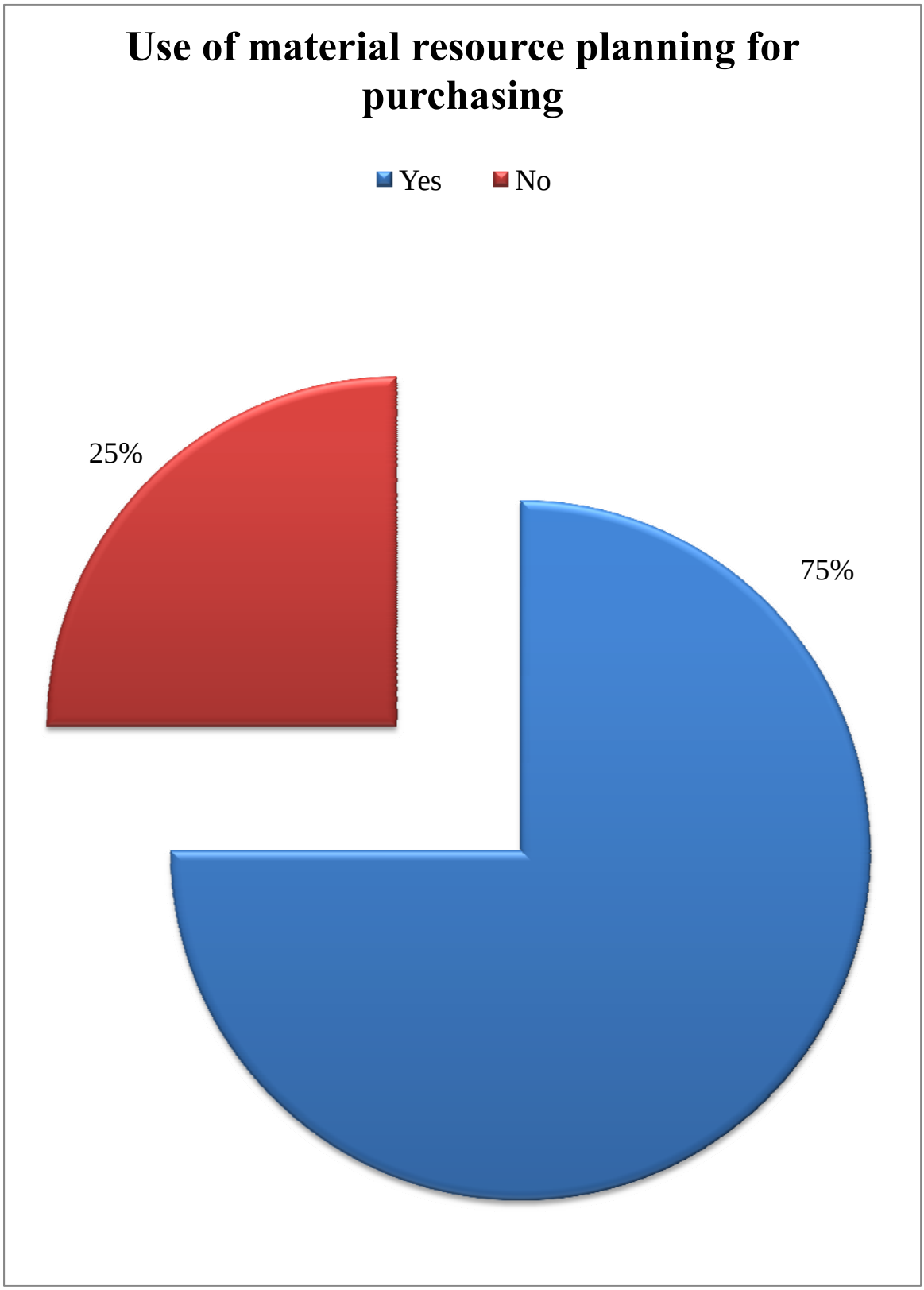
a) Do you use material resource planning while planning for purchasing?

Researcher is interested in knowing the level of planning activities carried by small scale manufacturing units under study.

Sr. No.	Particulars	Frequency	Percentage
1.	Yes	33	75
2.	No	11	25
Total		44	100

Table 4.13

The above statistics clearly indicates that 75% of small scale manufacturing units applies material resource planning for purchase planning rest 25% doesn't apply any such type of methods. 33 out of 44 units under study use MRP and rest 11 they don't.


Use of material resource planning for purchasing
Yes
No
25%
75%

Graph 4.13

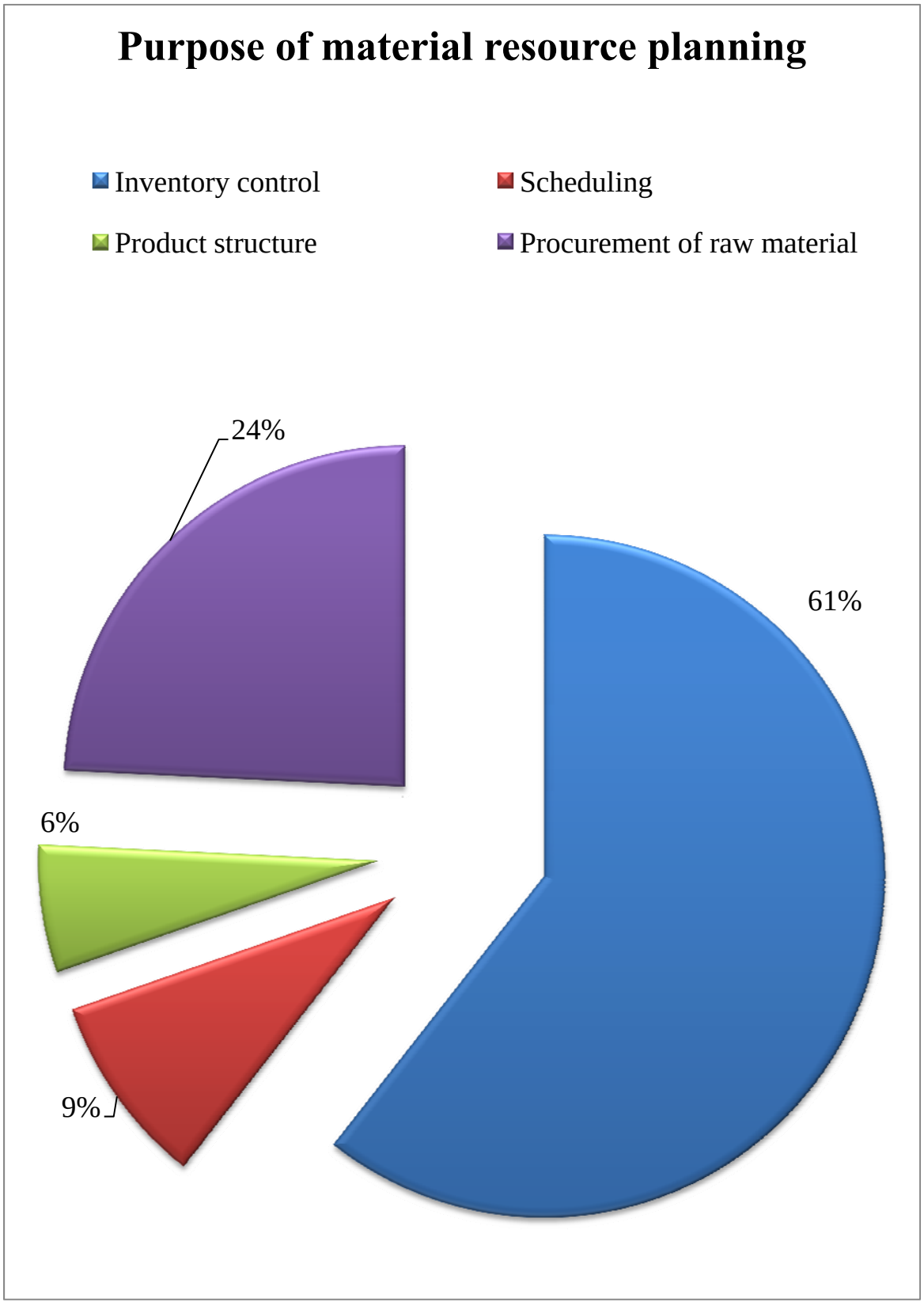
b) Why you use material resource planning?

Absence of use of material resource planning causes ill planed purchasing, unwanted emergency orders and increases work load of the purchase department. Researcher tried to find the interest of firms in using the material resource planning.

Sr. No.	Particulars	Frequency	Percentage
1.	Inventory control	20	61
2.	Scheduling	03	09
3.	Product structure	02	06
4.	Procurement of raw material	08	24
Total		33	100

Table 4.14

61% of the firms apply material resource planning for inventory control, 24% uses it for procurement of raw material, 9% for scheduling and rest 6% use it for product structuring. Material resource planning is done to control inventory for the successful implementation of supply chain management. Though the units under study has given different choices all the alternative choices aims at inventory control.


Purpose of material resource planning
Inventory control
Scheduling
Product structure
Procurement of raw material
24%
61%
6%
9%

Graph 4.14

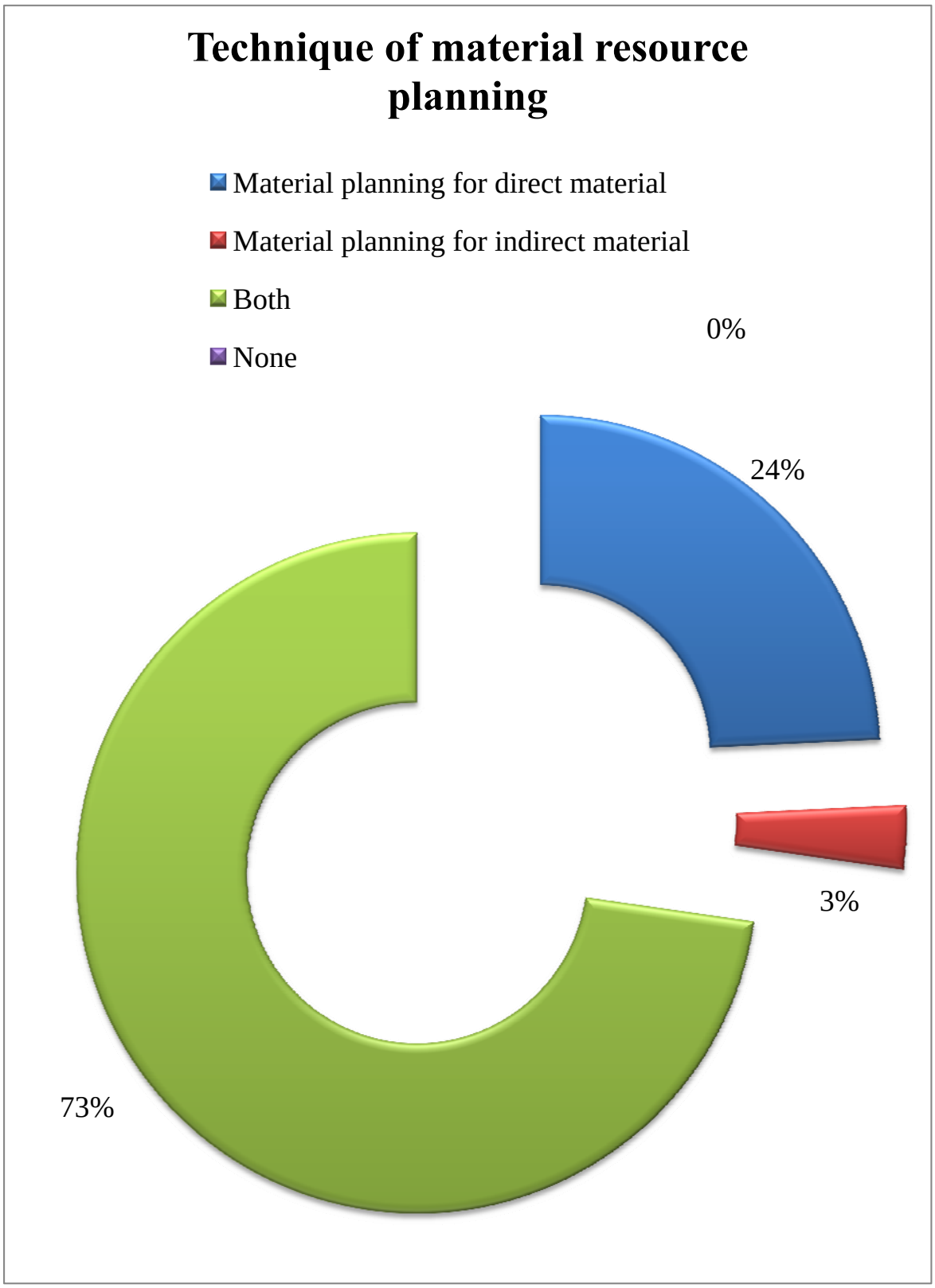
c) Which technique you use for material planning?

Material resource planning may be applied to direct as well as indirect material. Firms may use both the methods to take the advantages of both the methods and improve their performances.

Sr. No.	Particulars	Frequency	Percentage
1.	Material planning for direct material	08	24
2.	Material planning for indirect material	01	03
3.	Both	24	73
4.	None	00	00
Total		33	100

Table 4.15

As expected 73% of the firms apply both the methods, 24% applies only for direct material planning and only 3% applies indirect material planning.


Technique of material resource planning
Material planning for direct material
Material planning for indirect material
Both
None
0%
24%
3%
73%

Graph 4.15

5.2.4 Make or Buy decision

The make versus buy decision evaluates the contribution of each activity. Firms can identify core activities from a strategic perspective either through the business process route or by product architecture route. When a firm decides to outsource some core process, it must keep the necessary architecture knowledge in house.

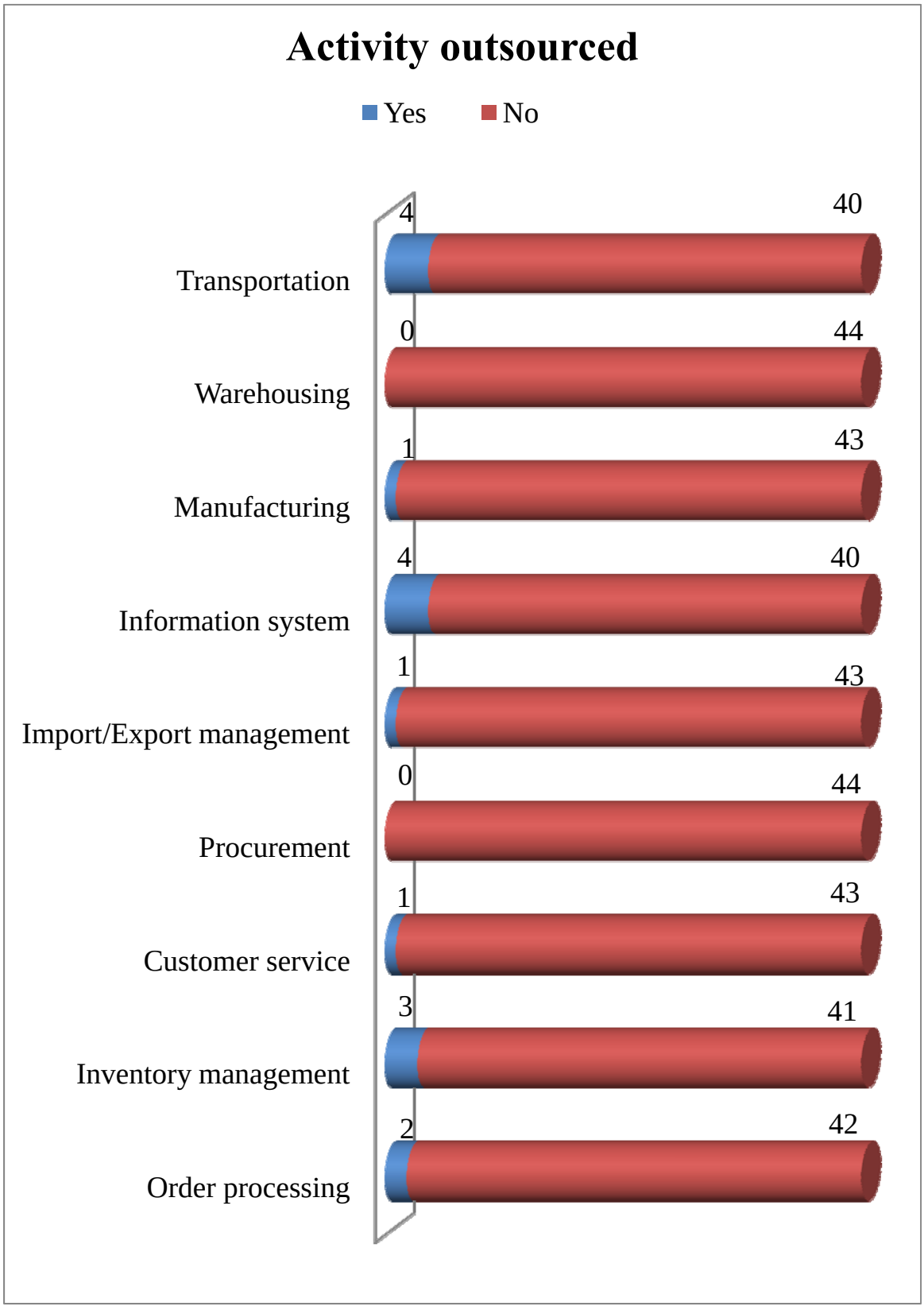
a) Which activities you outsource?

Outsourcing is important factor which will decide the competency of the small scale manufacturing units.

Sr. No.	Particulars	Yes		No	
		Frequency	%	Frequency	%
1.	Order processing	02	05	42	95
2.	Inventory management	03	07	41	93
3.	Customer service	01	02	43	98
4.	Procurement	00	00	44	100
5.	Import/Export management	01	02	43	98
6.	Information system	04	09	40	91
7.	Manufacturing	01	02	43	98
8.	Warehousing	00	00	44	100
9.	Transportation	04	05	40	95

Table 4.16

Outsourcing in SCM is important but the researcher observed that the respondent firms outsource only few activities.


Activity outsourced
Yes
No
Transportation
4
40
Warehousing
0
44
Manufacturing
1
43
Information system
4
40
Import/Export management
1
43
Procurement
0
44
Customer service
1
43
Inventory management
3
41
Order processing
2
42

Graph 4.16

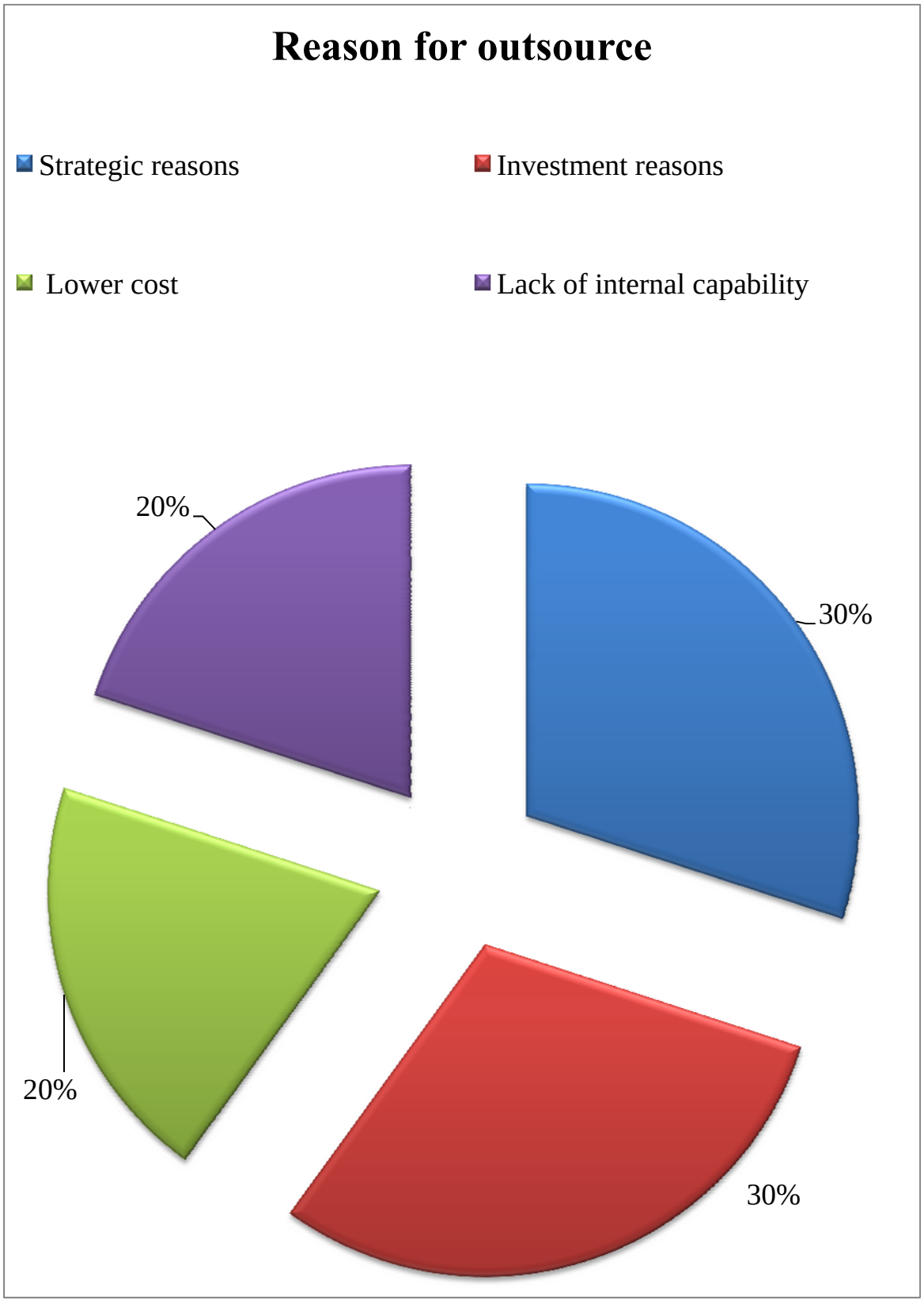
b) What are the major reasons for outsourcing of above activities?

Various reasons can be given for which outsourcing is done in firms.

Sr. No.	Particulars	Frequency	Percentage
1.	Strategic reasons	03	30
2.	Investment reasons	03	30
3.	Lower cost	02	20
4.	Lack of internal capability	02	20
Total		10	100

Table 4.17

Only ten units out of 44 units outsource few activities. It can be observed that 6 out of ten units are outsourcing their activities for strategic and investment reasons and 4 units outsource their activities to lower the cost and due to lack of internal capabilities.


Reason for outsource
Strategic reasons
Investment reasons
Lower cost
Lack of internal capability
20%
30%
20%
30%

Graph 4.17

5.2.5 Purchasing process

It is the procuring of materials, supplies, machines, tools and services required for equipment, maintenance and operation of a manufacturing plant. Purchasing responsibility is to buy materials of the right quality, in the right quantity, at the right time, at the right price, from the right source, with delivery at the right place.

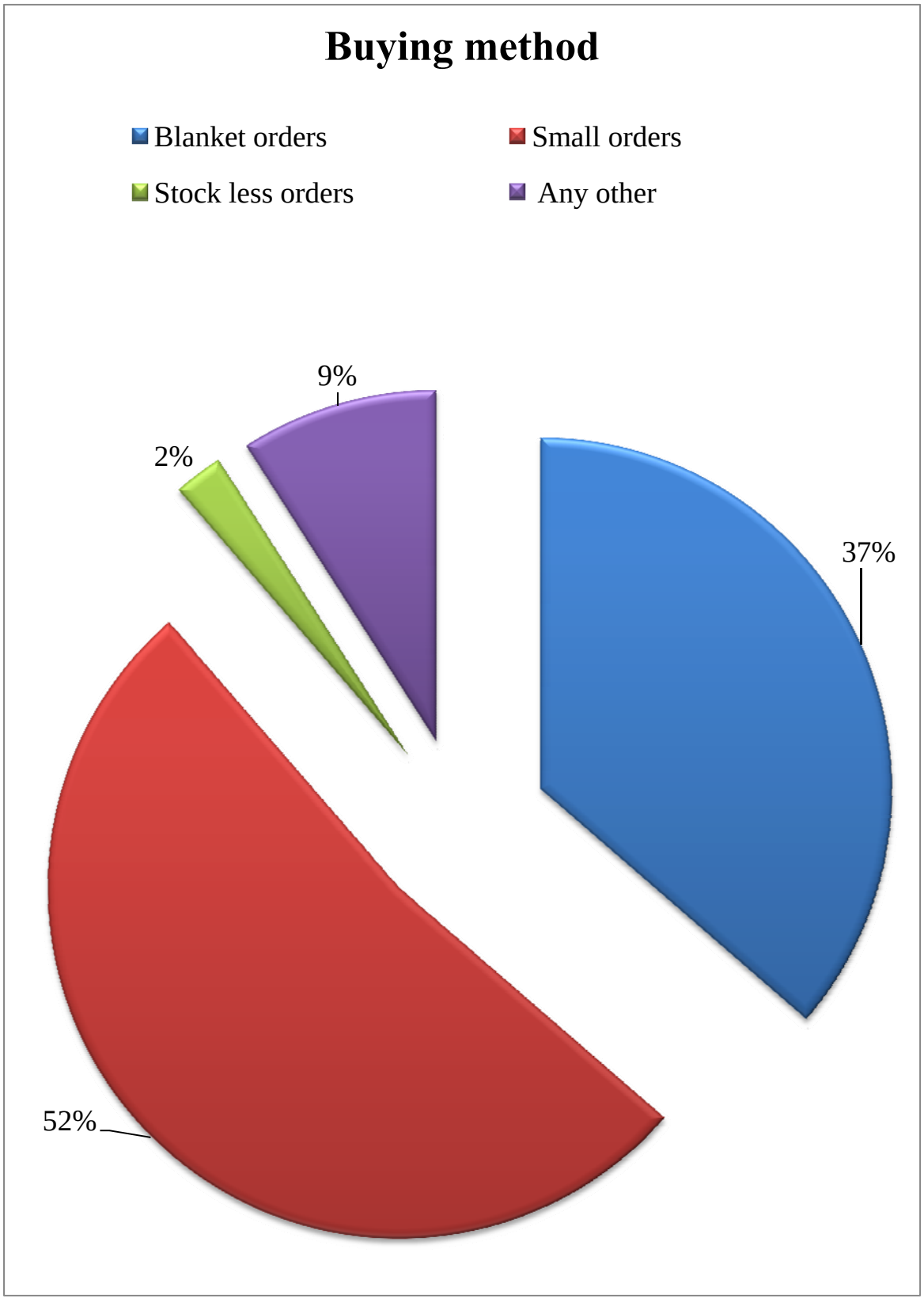
a) Which buying method you use to procure material?

The question was basically asked to quantify the method which is adopted by small scale manufacturing units. This will give idea about their efficiency in purchasing.

Sr. No.	Particulars	Frequency	Percentage
1.	Blanket orders	16	37
2.	Small orders	23	52
3.	Stock less orders	01	02
4.	Any other	04	09
Total		44	100

Table 4.18

Among the respondent firms, 52% firms buy in small orders, 37% buy as blanket orders, 2% buys as stockless orders and 9% uses some other method. Efficiency in purchasing material can be achieved through stockless orders which are not observed seriously by the units under study.


Buying method
Blanket orders
Small orders
Stock less orders
Any other
9%
2%
37%
52%

Graph 4.18

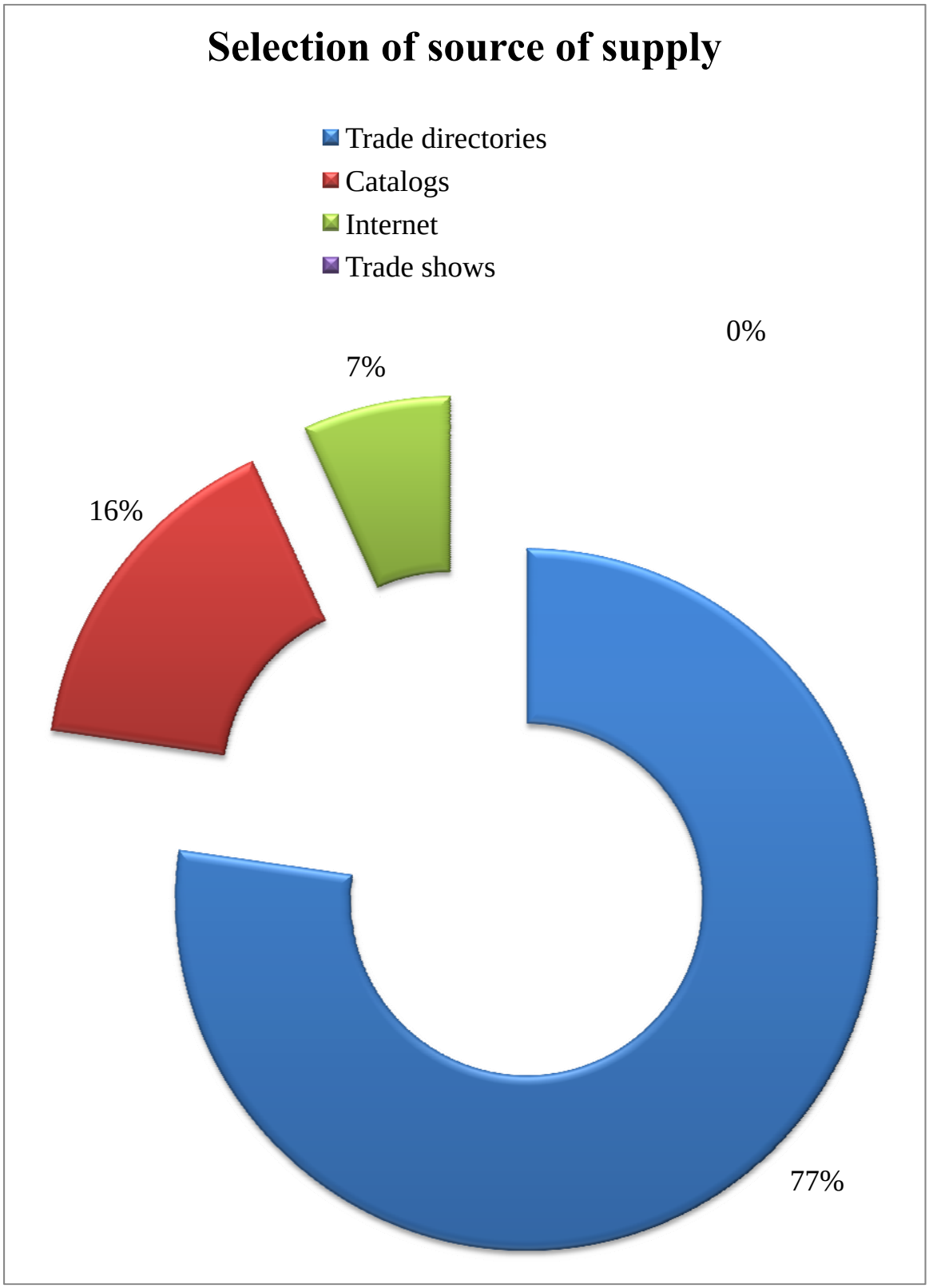
b) How you select sources of supply?

Objective behind asking this question is to know whether small scale manufacturing units uses modern methods of searching the suppliers or not.

Sr. No.	Particulars	Frequency	Percentage
1.	Trade directories	34	77
2.	Catalogs	07	16
3.	Internet	03	07
4.	Trade shows	00	00
Total		44	100

Table 4.19

It can be observed by above data that 77% of respondent firms refer trade directories, 16% refers catalogs, only 7% refers internet and none of the respondent firms participates in trade shows. The units under study hardly use internet facility but are prone to use trade directories.


Selection of source of supply
Trade directories
Catalogs
Internet
Trade shows
0%
7%
16%
77%

Graph 4.19

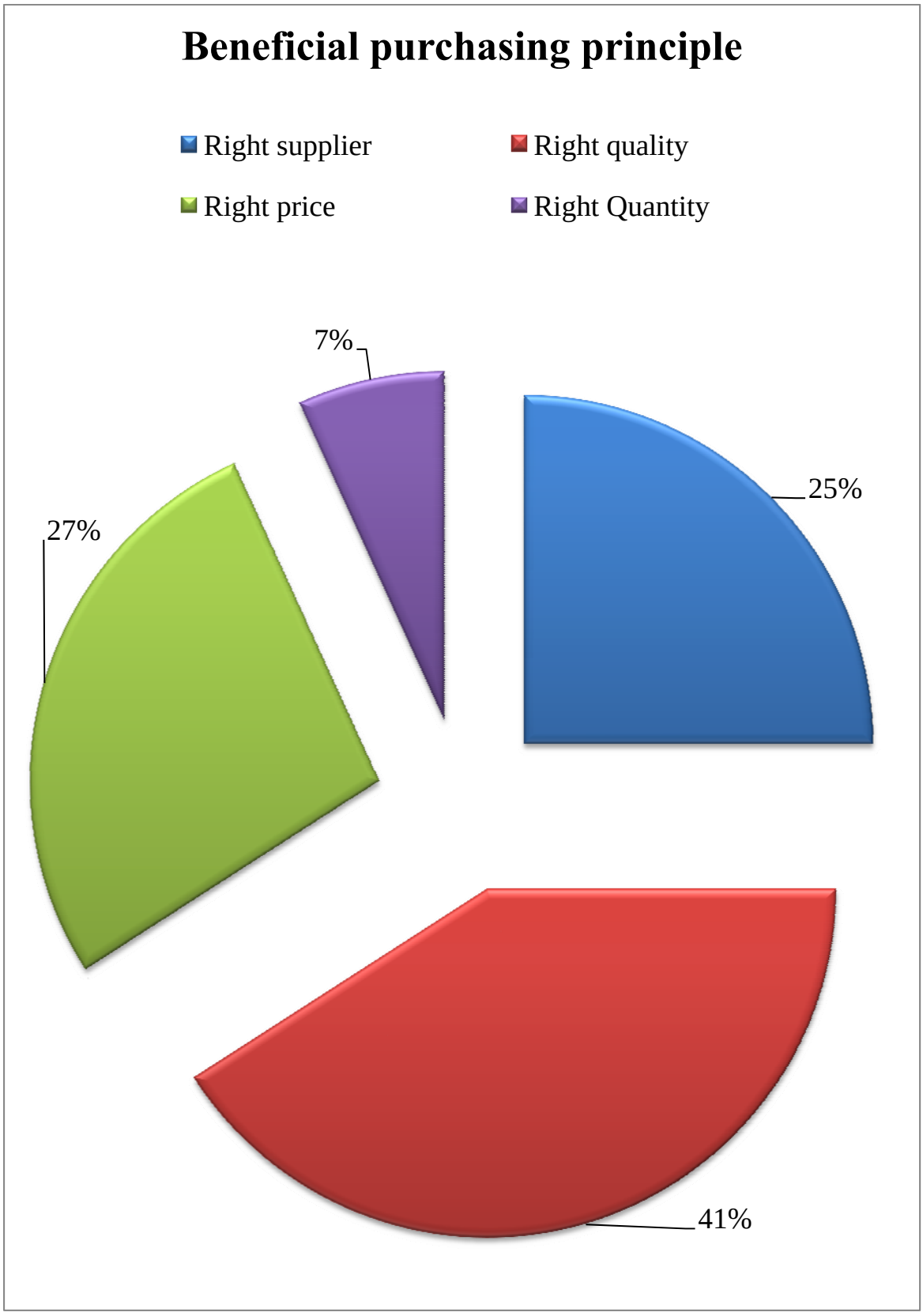
c) Which purchasing principle you find beneficial for application?

The question is asked by researcher to judge the preference of the respondent firms regarding the purchasing principle.

Sr. No.	Particulars	Frequency	Percentage
1.	Right supplier	11	25
2.	Right quality	18	41
3.	Right price	12	27
4.	Right quantity	03	07
Total		44	100

Table 4.20

41% respondent firms selected right quality, 27% selected right price, 25% selected right supplier and only 7% selected right quantity. 68% respondents believe in right principle of purchasing right quality and right price.


Beneficial purchasing principle
Right supplier
Right quality
Right price
Right Quantity
7%
25%
27%
41%

Graph 4.20

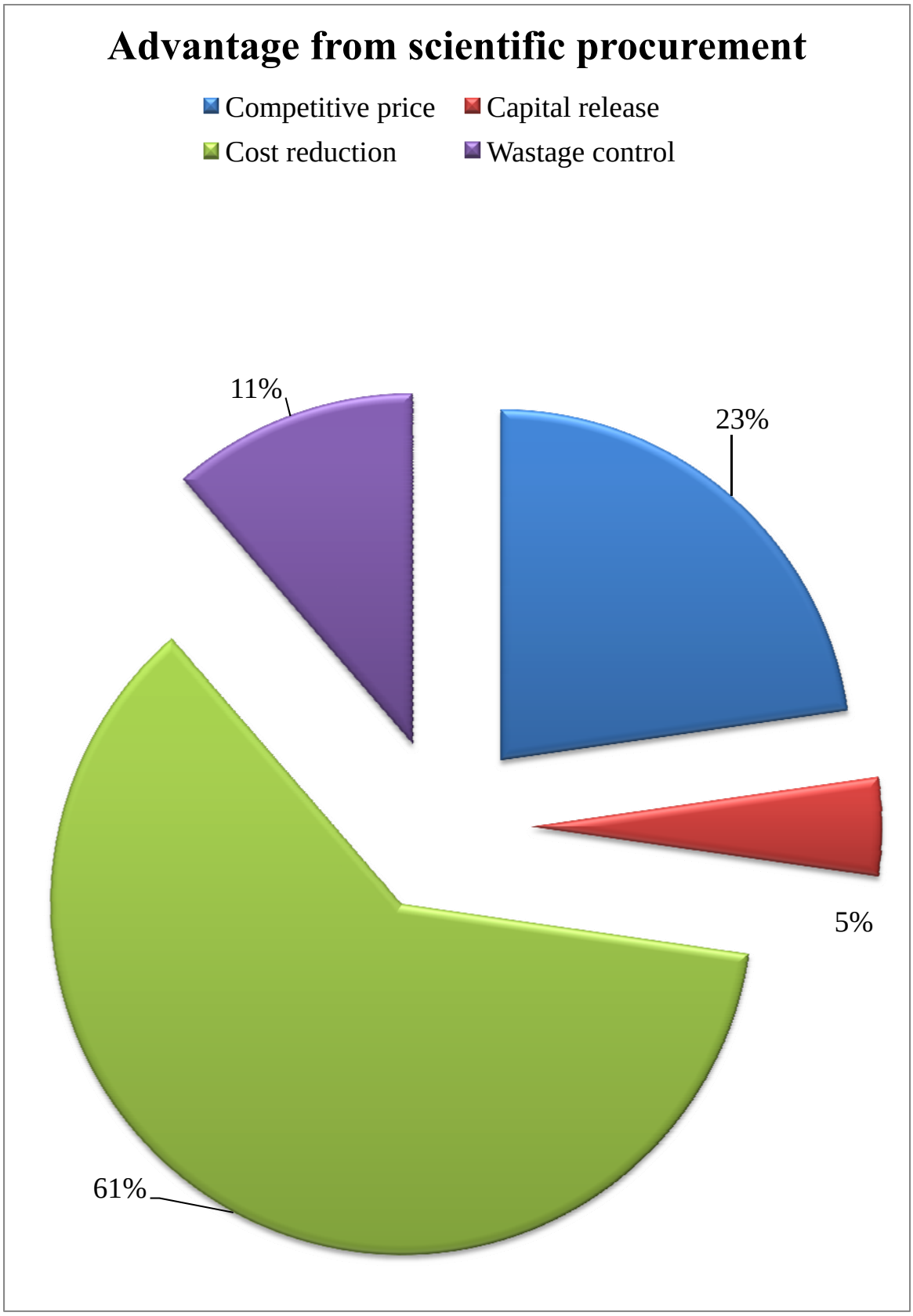
d) How your organisation have benefited from scientific procurement method?

Researcher tried to gather information about benefits gained by scientific procurement process.

Sr. No.	Particulars	Frequency	Percentage
1.	Competitive price	10	23
2.	Capital release	02	05
3.	Cost reduction	27	61
4.	Wastage control	05	11
Total		44	100

Table 4.21

It can be observed that 61% of the respondent firms gained cost reduction, 23% respondent firms gained competitive price, 5% respondents gained capital release and 11% gained wastage control after implementing scientific procurement process.


Advantage from scientific procurement
Competitive price
Capital release
Cost reduction
Wastage control
11%
23%
5%
61%

Graph 4.21

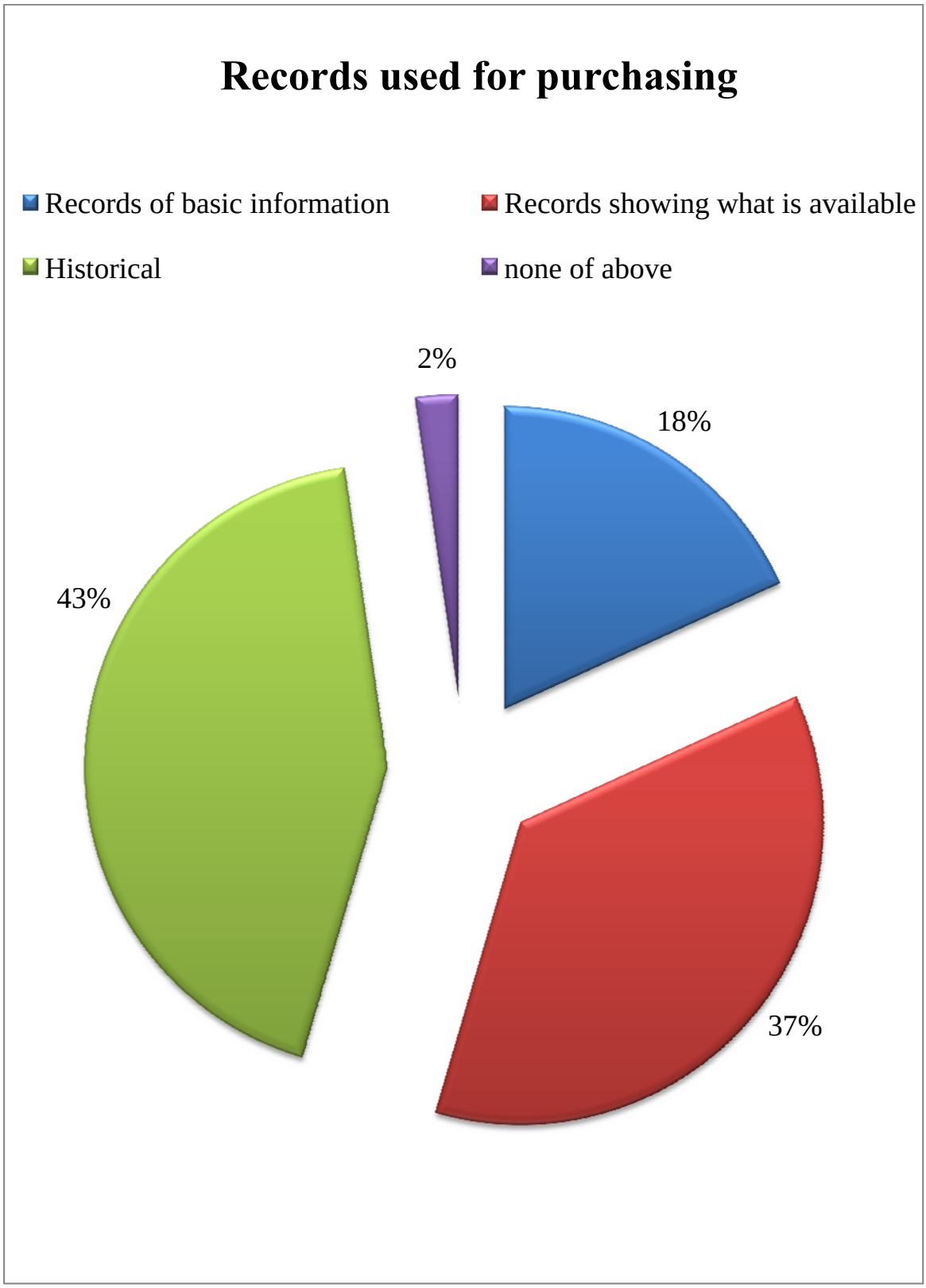
e) What all records you use for purchasing?

Use of secondary data for purchasing gives an idea about awareness of respondents regarding the use of forecasting techniques.

Sr. No.	Particulars	Frequency	Percentage
1.	Records of basic information	08	18
2.	Records showing what is available	16	37
3.	Historical	19	43
4.	none of above	01	02
Total		44	100

Table 4.22

Nearly 43% of the respondent firms refer historical data, 18% respondent firms refer records of basic information, 37% respondent firms refer records of stock available whereas 2% doesn't refer secondary data. Stock of available raw material is of prime importance and can be observed that small scale manufacturing units under study inclination towards this method is less.


Records used for purchasing
Records of basic information
Records showing what is available
Historical
none of above
2%
18%
43%
37%

Graph 4.22

5.2.6 Transportation of raw material

Transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer. Transportation is an important supply chain driver because all the raw material is rarely brought from same location. Transportation is a significant component of costs incurred by most supply chains.

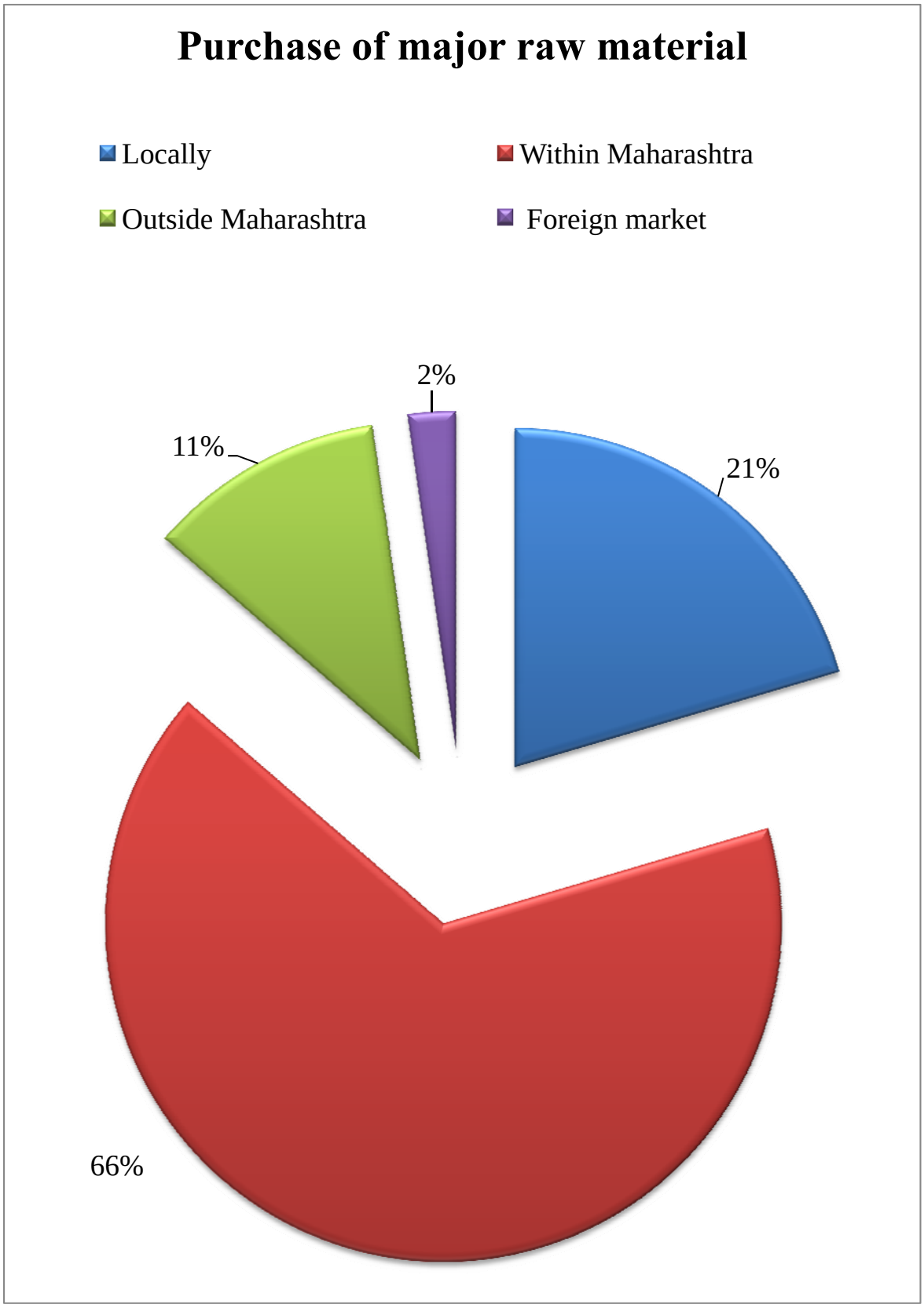
a) From where you purchase major raw material?

Researcher is interested in knowing the lead time involved in purchase of major raw material.

Sr. No.	Particulars	Frequency	Percentage
1.	Locally	09	21
2.	Within Maharashtra	29	66
3.	Outside Maharashtra	05	11
4.	Foreign market	01	02
Total		44	100

Table 4.23

Almost 66% of the respondent firms purchase raw material with in state, 21% respondent firm purchase locally, 11% purchase from outside Maharashtra and only 2% import their major raw material. It is observed that lead time for procurement of major raw material is with in control.


Purchase of major raw material
Locally
Within Maharashtra
Outside Maharashtra
Foreign market
2%
11%
21%
66%

Graph 4.23

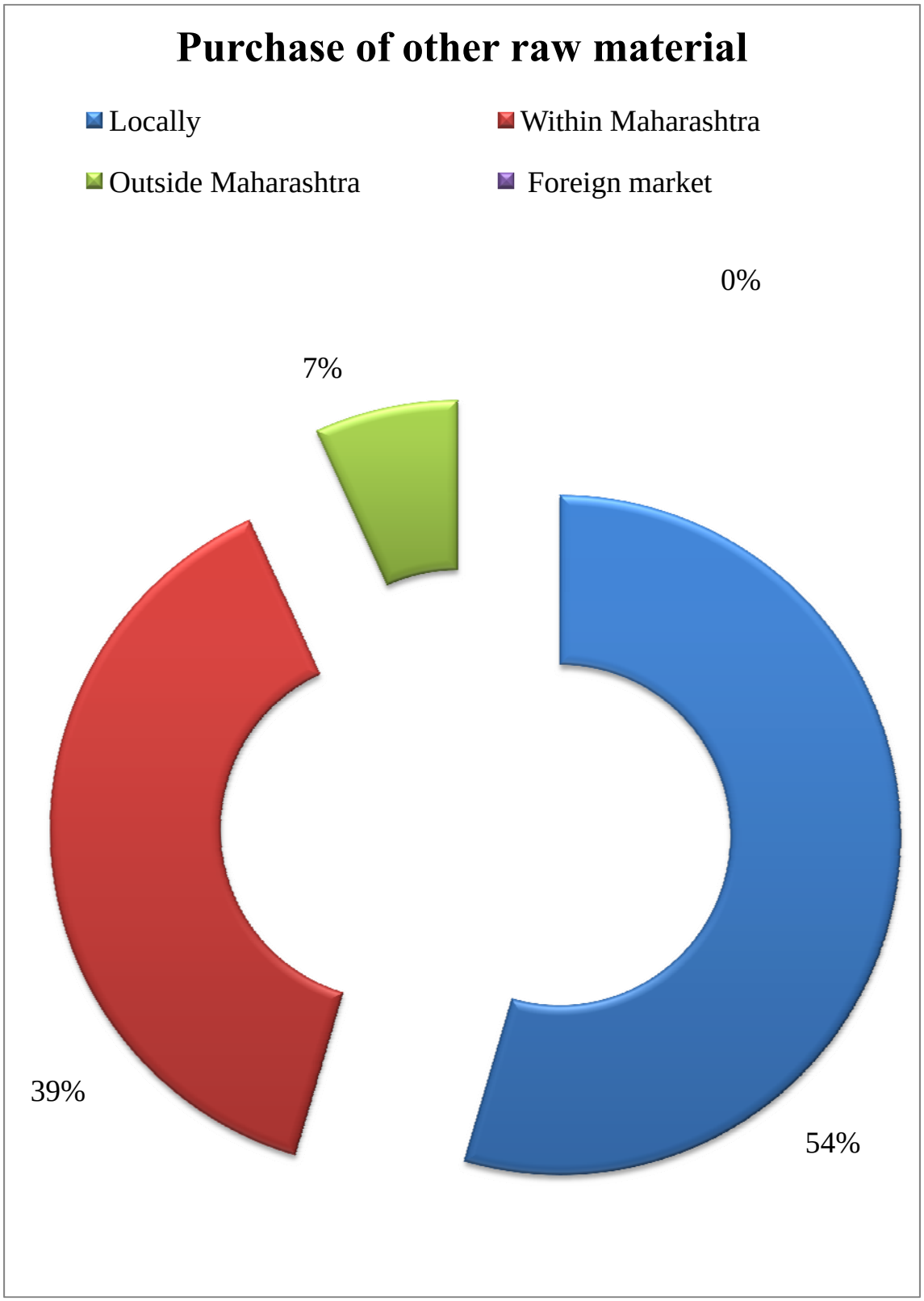
b) From where you purchase other raw materials?

Researcher is interested in knowing the lead time involved in purchase of other raw materials.

Sr. No.	Particulars	Frequency	Percentage
1.	Locally	24	54
2.	Within Maharashtra	17	39
3.	Outside Maharashtra	03	07
4.	Foreign market	00	00
Total		44	100

Table 4.24

Almost 54% of the respondent firms purchase raw material within city, 39% respondent firm purchase from same state, 7% purchase from outside Maharashtra and none of the respondent firms import their other raw material. It is observed that lead time for procurement of other raw material is also with in control.


Purchase of other raw material
Locally
Within Maharashtra
Outside Maharashtra
Foreign market
0%
7%
39%
54%

Graph 4.24

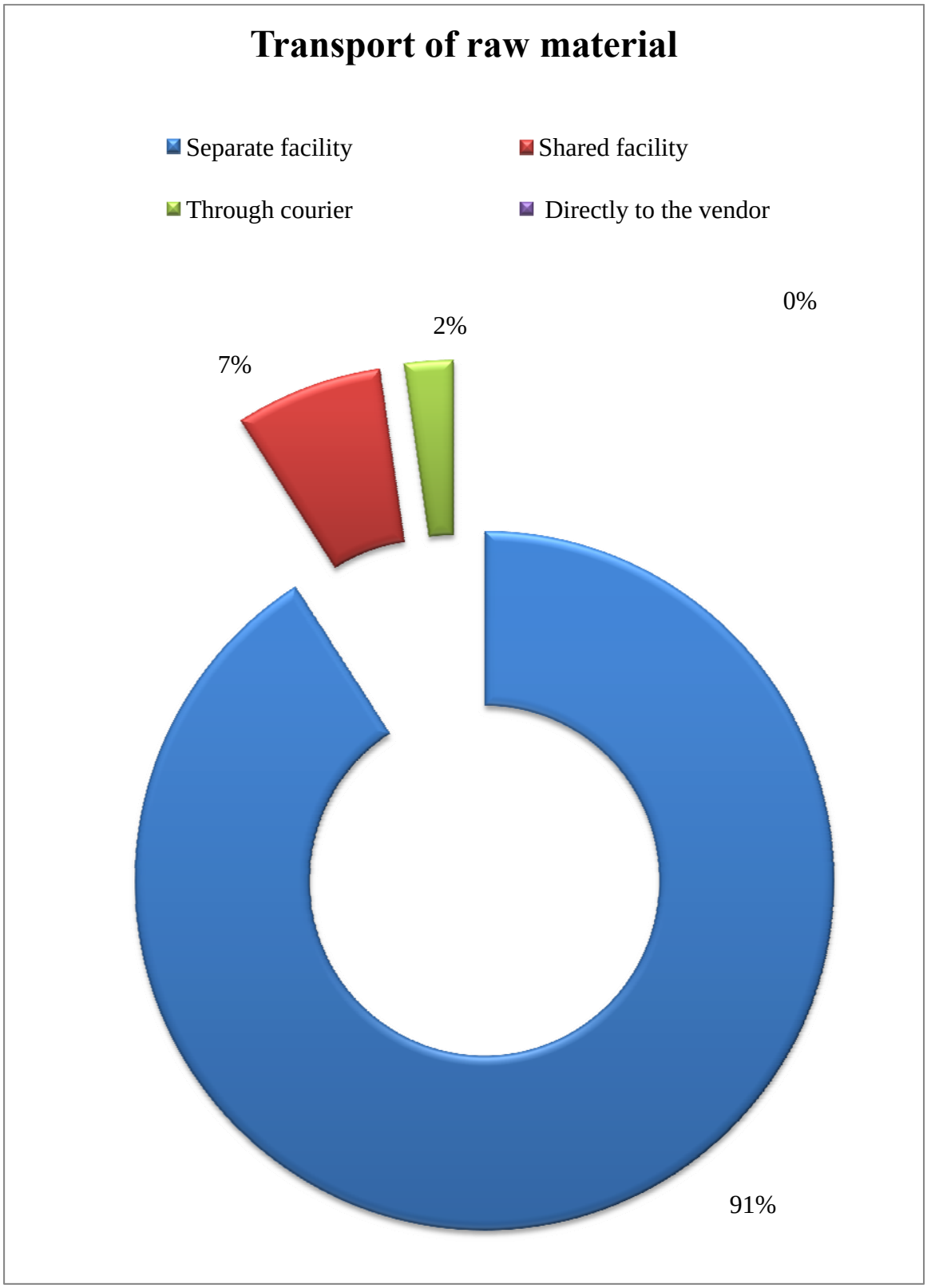
c) How the raw material is transported to the factory?

The information of ownership of transport facility by small scale manufacturing units gives the scope for reducing the capital investment.

Sr. No.	Particulars	Frequency	Percentage
1.	Separate facility	40	91
2.	Shared facility	03	07
3.	Through courier	01	02
4.	Directly to the vendor	00	00
Total		44	100

Table 4.25

91% of respondent firms uses their own transport facility, 7% uses shared facility and only 2% transport through courier. Transport facility is decided by nature of raw material and it varies from unit to unit thus are using the separate facility.


Transport of raw material
Separate facility
Shared facility
Through courier
Directly to the vendor
0%
2%
7%
91%

Graph 4.25

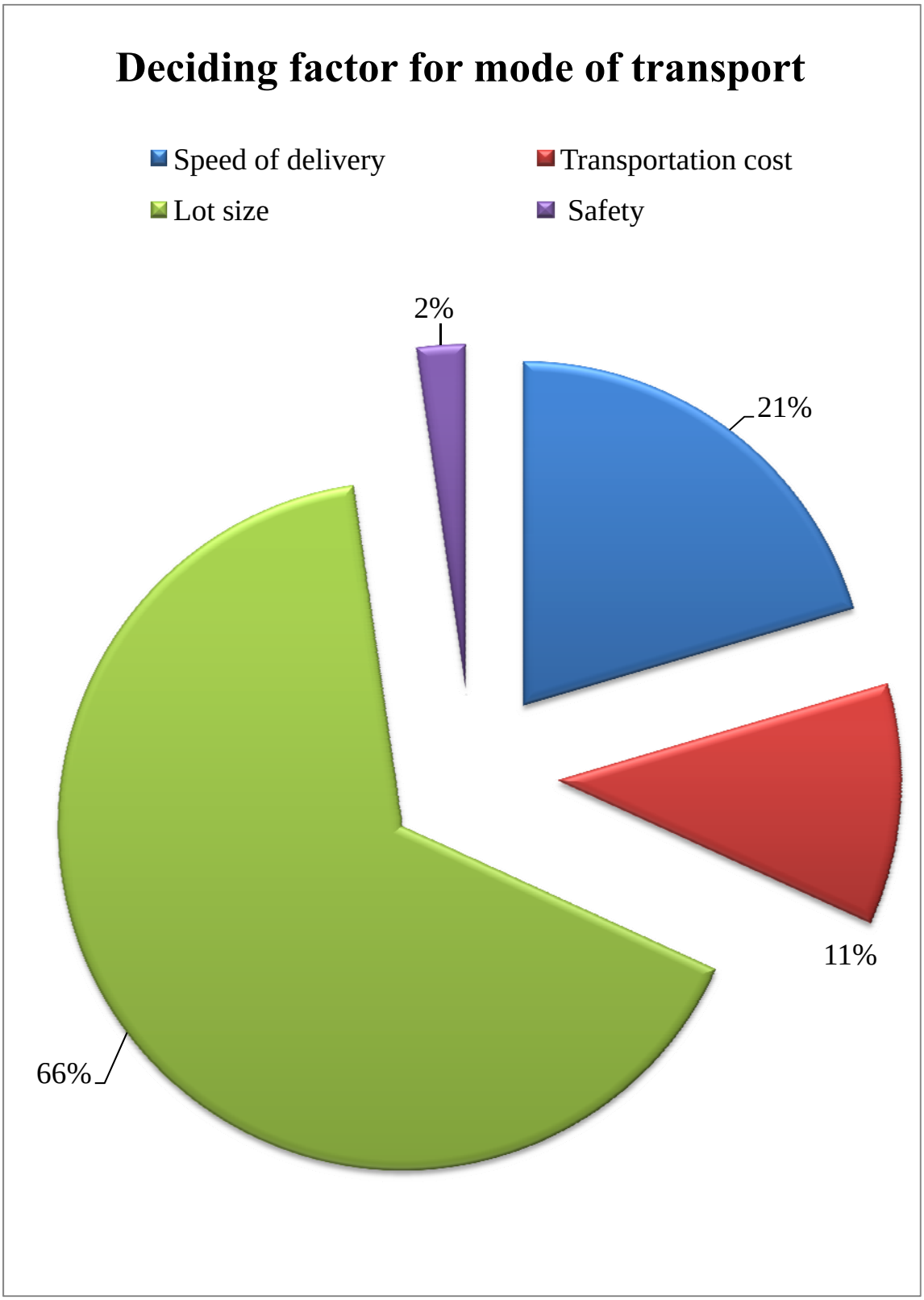
d) How you decide mode of transportation?

Right mode of transportation helps the firms to reduce the transportation cost.

Sr. No.	Particulars	Frequency	Percentage
1.	Speed of delivery	09	21
2.	Transportation cost	05	11
3.	Lot size	29	66
4.	Safety	01	02
Total		44	100

Table 4.26

66% respondents decides mode of transport on lot size, 21% decides on speed of delivery, 11% decides mode of transportation by cost and rest 2% look for safety of material. Basic principles of transportation are used by the units under study.


Deciding factor for mode of transport
Speed of delivery
Transportation cost
Lot size
Safety
2%
21%
11%
66%

Graph 4.26

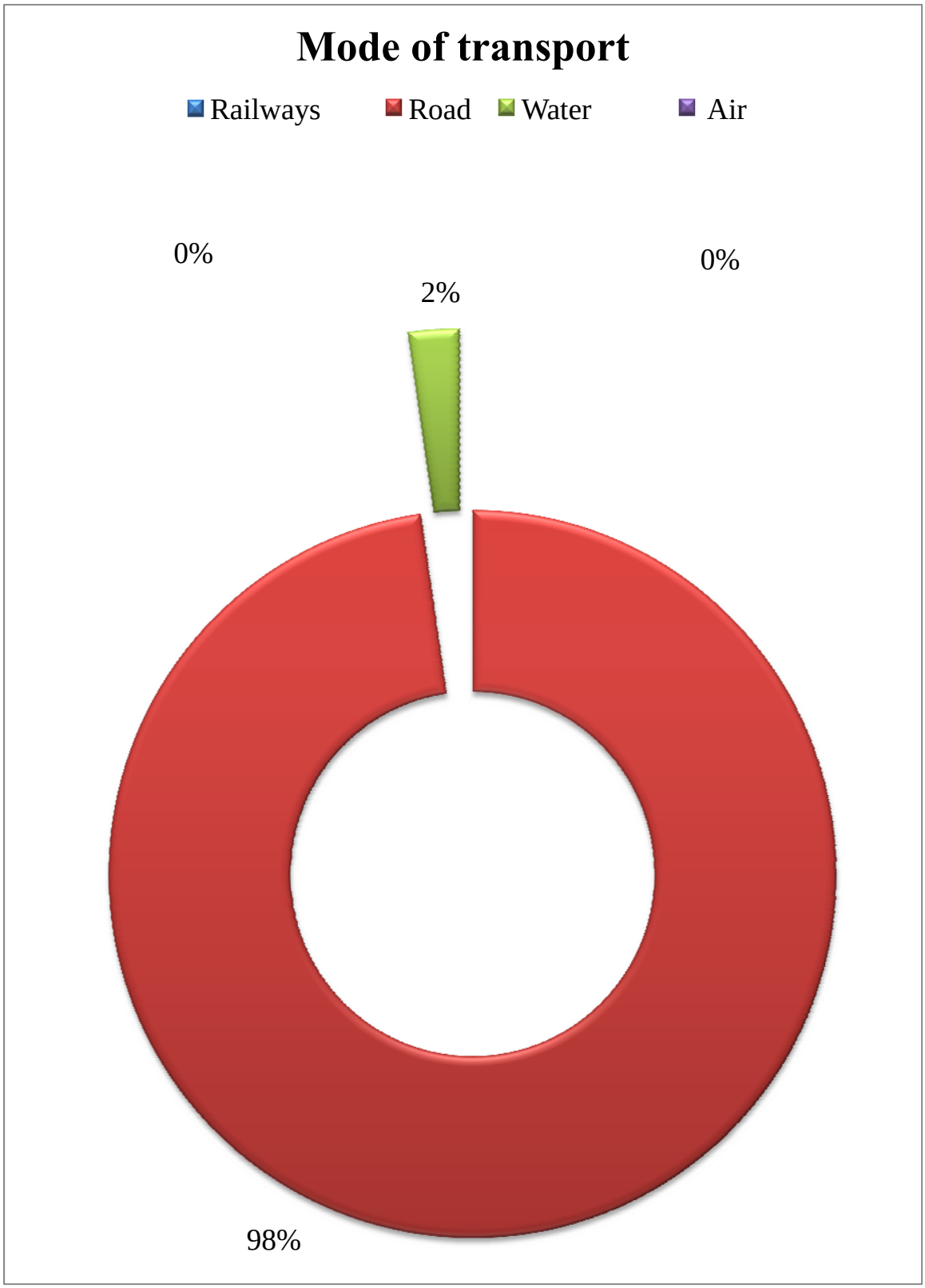
e) Which mode of transportation you use to transport raw material?

Cost can be reduced by choosing right mode of transportation.

Sr. No.	Particulars	Frequency	Percentage
1.	Railways	00	00
2.	Road	43	98
3.	Water	01	02
4.	Air	00	00
Total		44	100

Table 4.27

Maximum number of respondent firms i.e. 98% chooses roadways and rest 2% chooses water ways. Cost effective mode of transport is used by the units under study.



Graph 4.27

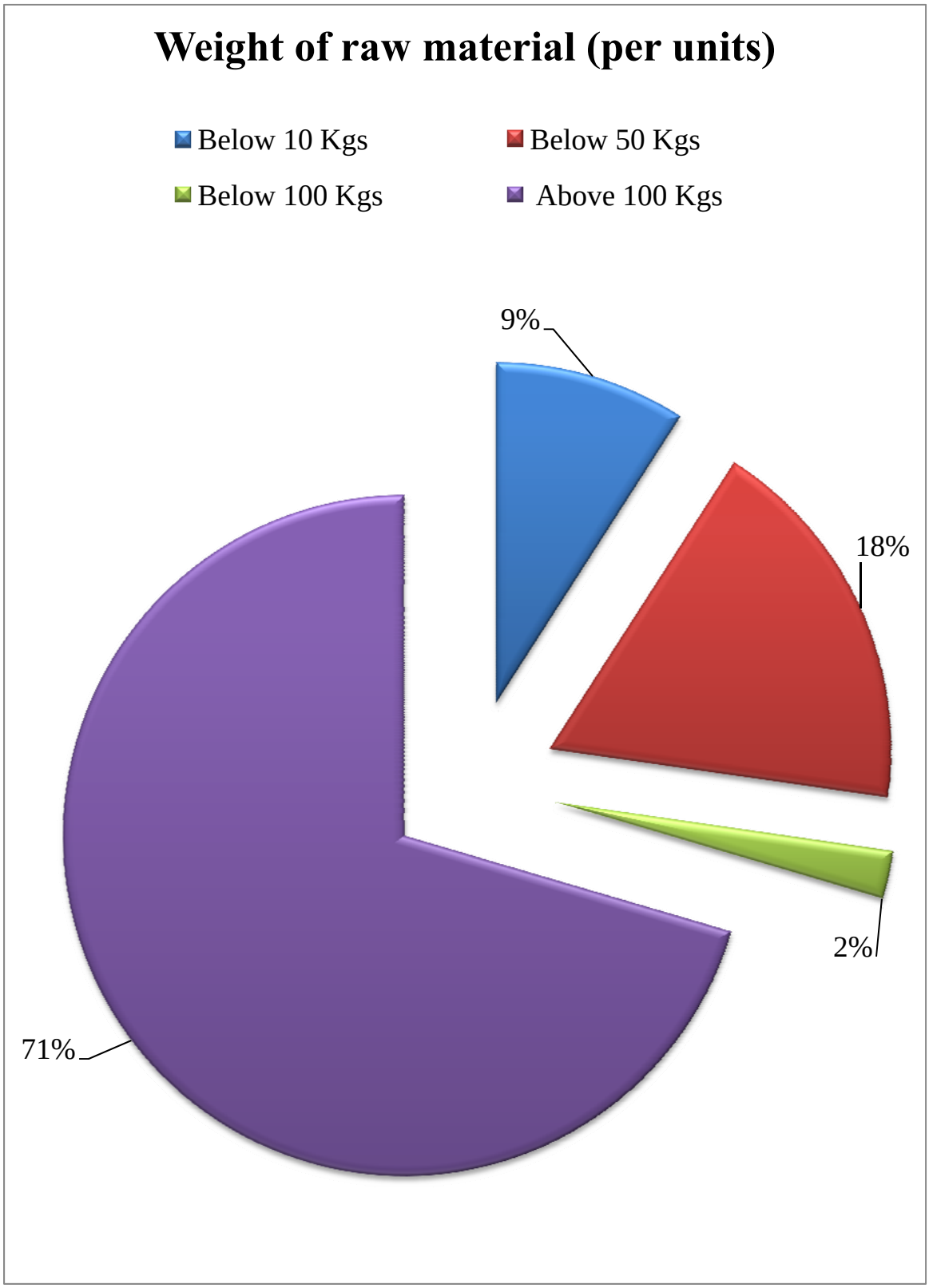
f) What is the approximate weight of raw material (per unit)?

Information weight of raw material can be used to form unit load, which improves the material handling cost effectively.

Sr. No.	Particulars	Frequency	Percentage
1.	Below 10 Kgs	04	09
2.	Below 50 Kgs	08	18
3.	Below 100 Kgs	01	02
4.	Above 100 Kgs	31	71
Total		44	100

Table 4.28

31units under study has per unit weight above 100 Kgs which constitutes 71% of respondent firms, 18% have below 50 kgs, 9% have below 10 kgs and only 2% have weight of raw material below 100kgs indicates no scope to combine the different units to form a unit load.


Weight of raw material (per units)
Below 10 Kgs
Below 50 Kgs
Below 100 Kgs
Above 100 Kgs
9%
18%
2%
71%

Graph 4.28

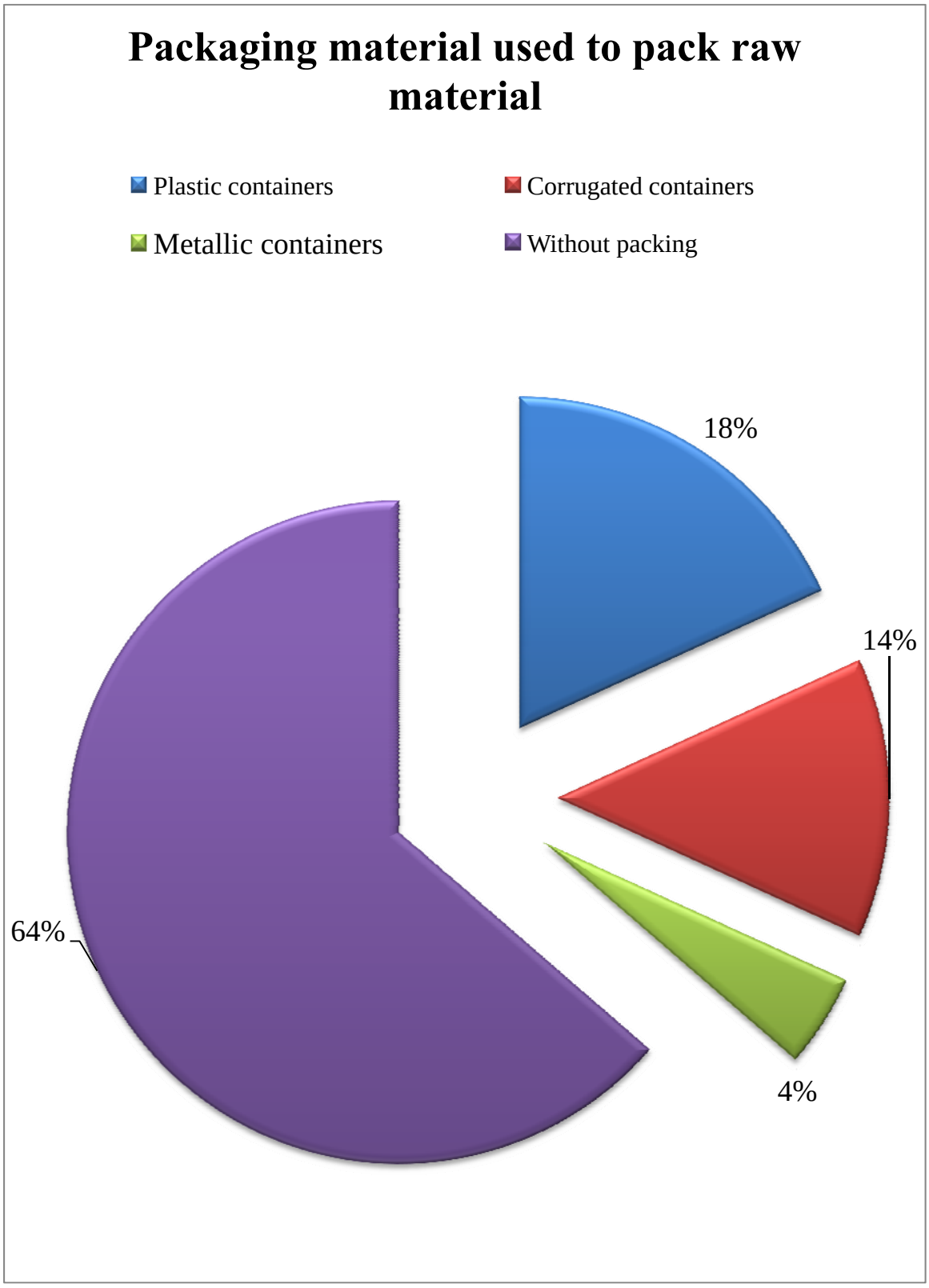
g) What type of packaging material is used to pack raw material?

Packing is essential for the safety for raw material during transit.

Sr. No.	Particulars	Frequency	Percentage
1.	Plastic containers	08	18
2.	Corrugated containers	06	14
3.	Metallic containers	02	04
4.	Without packing	28	64
Total		44	100

Table 4.29

It can be seen from the data that 64% respondent receive the raw material without packaging, 18% receive it in plastic containers, 14% receive it in corrugated containers and only 4% receive it in metallic containers. Though material packaging is important the size of the raw material does not allow the use of any material for packaging.


Packaging material used to pack raw material
Plastic containers
Corrugated containers
Metallic containers
Without packing
18%
14%
4%
64%

Graph 4.29

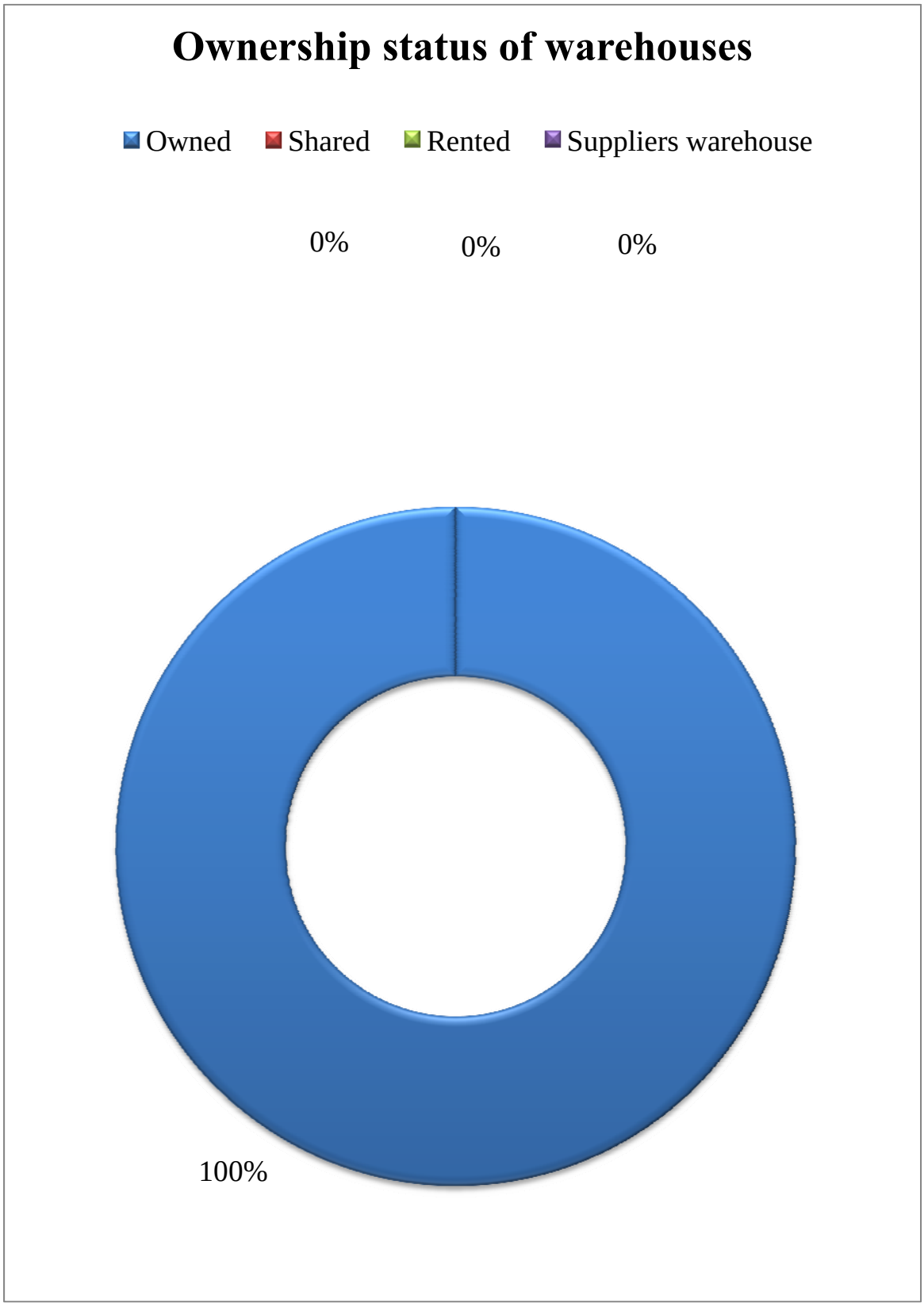
h) Do you store raw material in warehouse?

Owned warehouse costs more and if cost has to be reduced firms must share the warehouses or suppliers ware house should be used.

Sr. No.	Particulars	Frequency	Percentage
1.	Owned	44	100
2.	Shared	00	00
3.	Rented	00	00
4.	Suppliers warehouse	00	00
Total		44	100

Table 4.30

All the 44 respondent units store their raw material in owned warehouses. Researcher also observed during his visit to these units that warehouses are not used to their fullest capacities.


Ownership status of warehouses
Owned
Shared
Rented
Suppliers warehouse
0%
0%
0%
100%

Graph 4.30

5.2.7 Material handling

It may be defined as the art and science of movement, handling and storage of materials during different stages of manufacturing considered as material flow into, through and away from the plant. It is primary activity of every manufacturing company. 15 to 25% of the cost of the product is attributed to materials handling activity. It should be eliminated or at least minimise the need for handling. Cost for handling should be minimised.

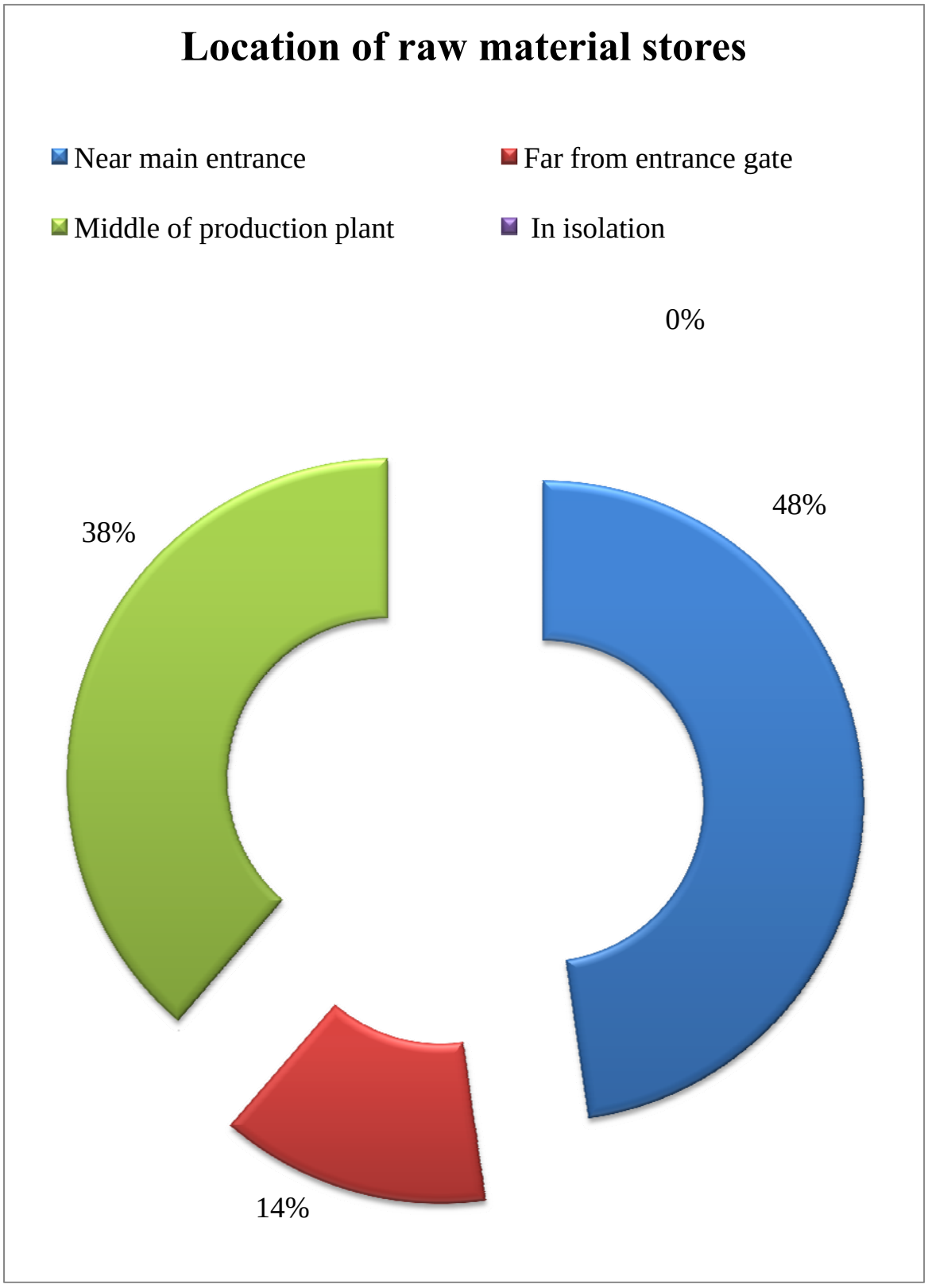
a) Where is your raw material stores situated?

Position of raw material stores plays very important role in effective and efficient transportation and also helps in minimizing handling of raw material. Raw material stores should be stored near to the main entrance of the firm and also the production station.

Sr. No.	Particulars	Frequency	Percentage
1.	Near main entrance	21	48
2.	Far from entrance gate	06	14
3.	Middle of production plant	17	38
4.	In isolation	00	00
Total		44	100

Table 4.31

48% respondent firms have their store department near to main entrance, 38% have their stores middle of production plant and rest 14% has the stores department far from the entrance gate. During the visit to these units researcher observed that the space utilisation was poor and materials were placed in an improper manner in the stores. Location of stores is proper but they lack in store management.


Location of raw material stores
Near main entrance
Far from entrance gate
Middle of production plant
In isolation
0%
48%
38%
14%

Graph 4.31

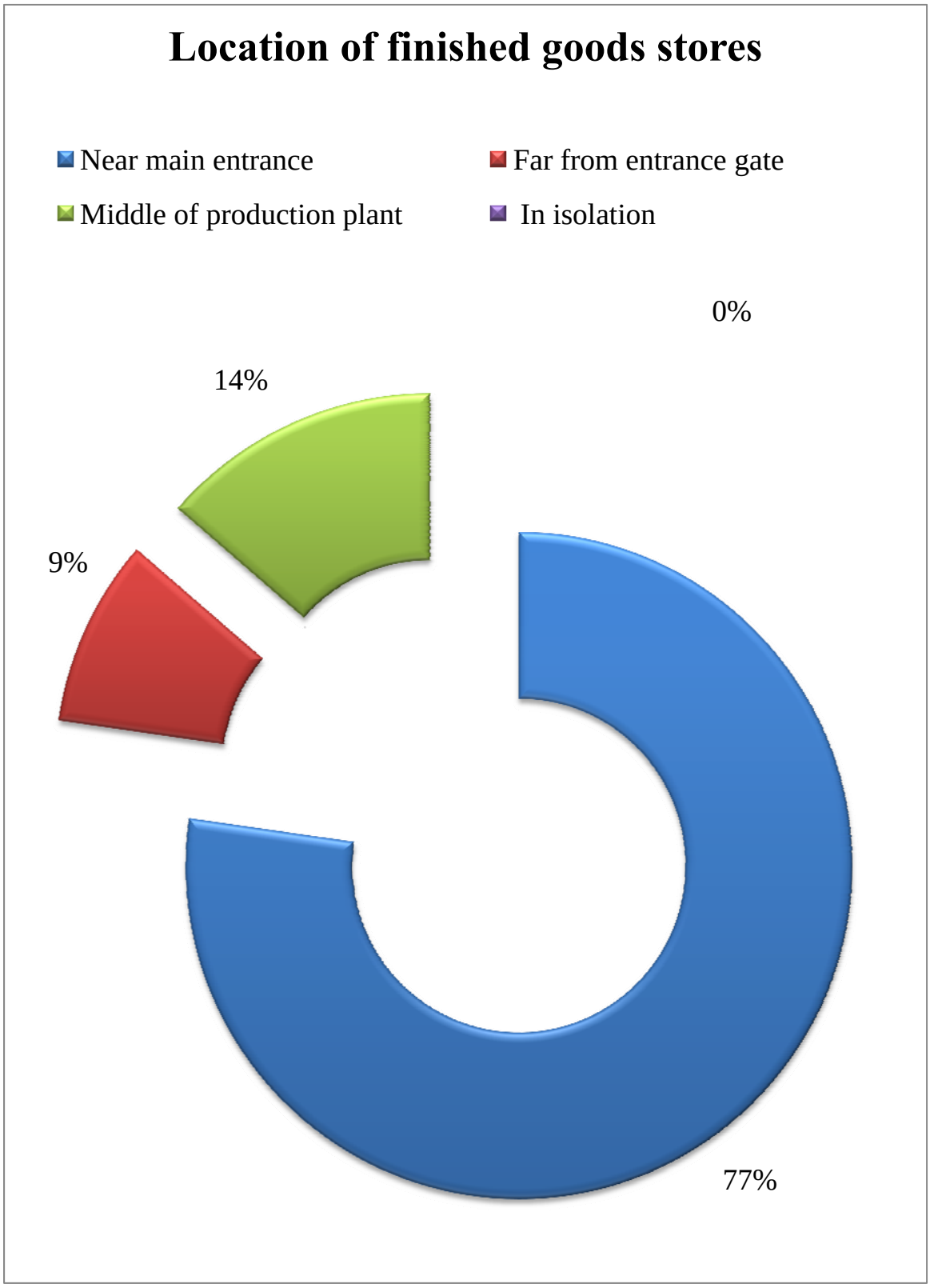
b) Where are your finished goods stores situated?

Position of finished goods store i.e. warehouse, also plays very important role in effective and efficient transportation and helps in minimizing handling of finished goods. Finished goods store should be stored near to the main entrance of the firm and also the production station.

Sr. No.	Particulars	Frequency	Percentage
1.	Near main entrance	34	77
2.	Far from entrance gate	04	09
3.	Middle of production plant	06	14
4.	In isolation	00	00
Total		44	100

Table 4.32

From the data it is clear that 77% of the respondent firms have warehouses near to the main entrance, 14% have placed warehouse in the middle of the production plant where as rest 9% respondent firms have placed it far from entrance gate. Finished goods stores location is proper and in place.


Location of finished goods stores
Near main entrance
Far from entrance gate
Middle of production plant
In isolation
0%
14%
9%
77%

Graph 4.32

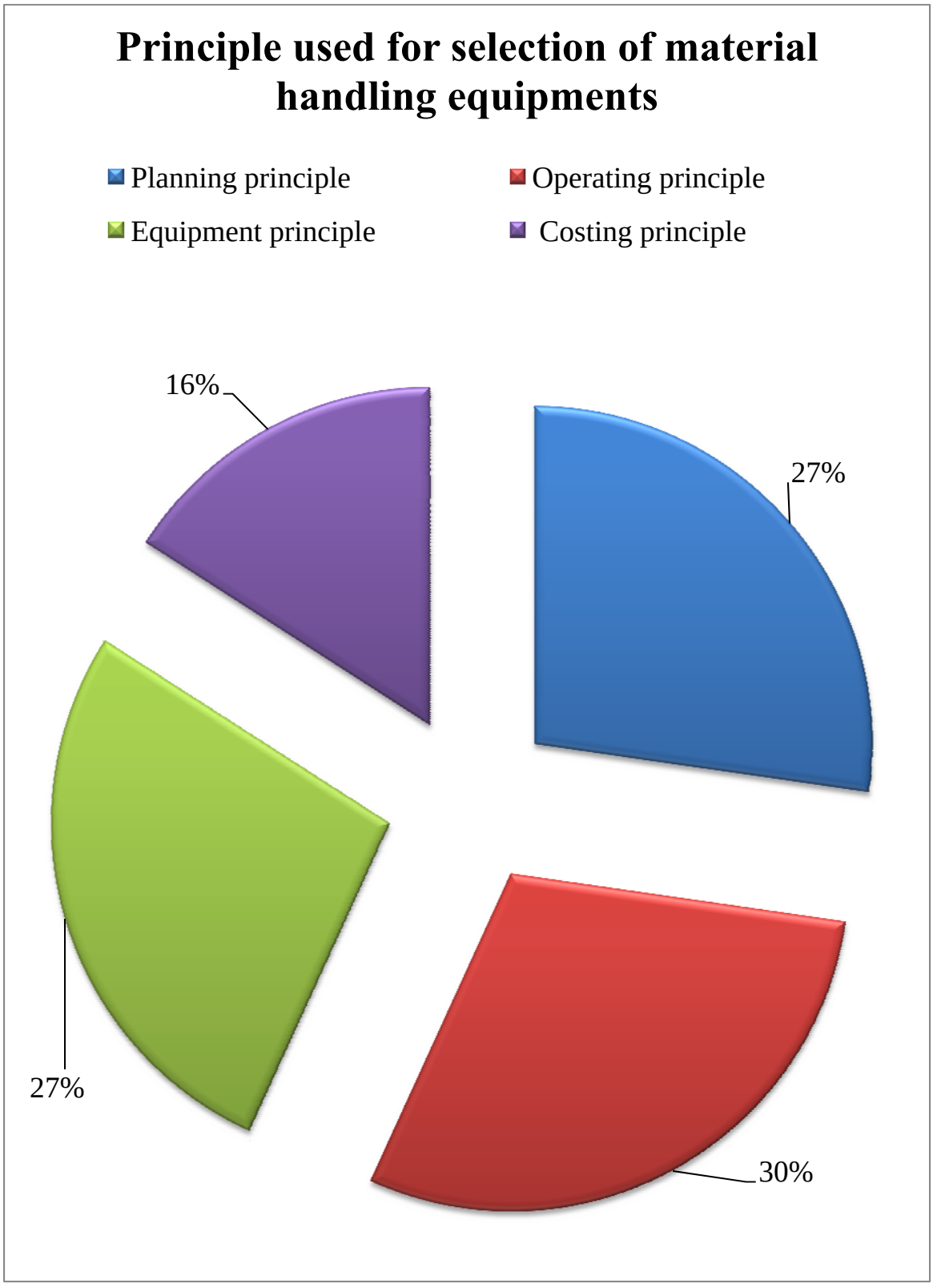
c) Which principle you use to select material handling equipment?

Main purpose of this question is to know which principle influences the buying decision of material handling equipment the most in small scale manufacturing units under study.

Sr. No.	Particulars	Frequency	Percentage
1.	Planning principle	12	27
2.	Operating principle	13	30
3.	Equipment principle	12	27
4.	Costing principle	07	16
Total		44	100

Table 4.33

30% of the respondent firms consider operating principle while selecting material handling equipments, 27% firms consider planning principle as important factor, 27% uses equipment principle and rest 16% considers costing principle as important factor in selecting material handling equipment. According to the researcher priority, the use of costing principle is not observed here where as over all use of principles are in place.


Principle used for selection of material handling equipments
Planning principle
Operating principle
Equipment principle
Costing principle
16%
27%
27%
30%

Graph 4.33

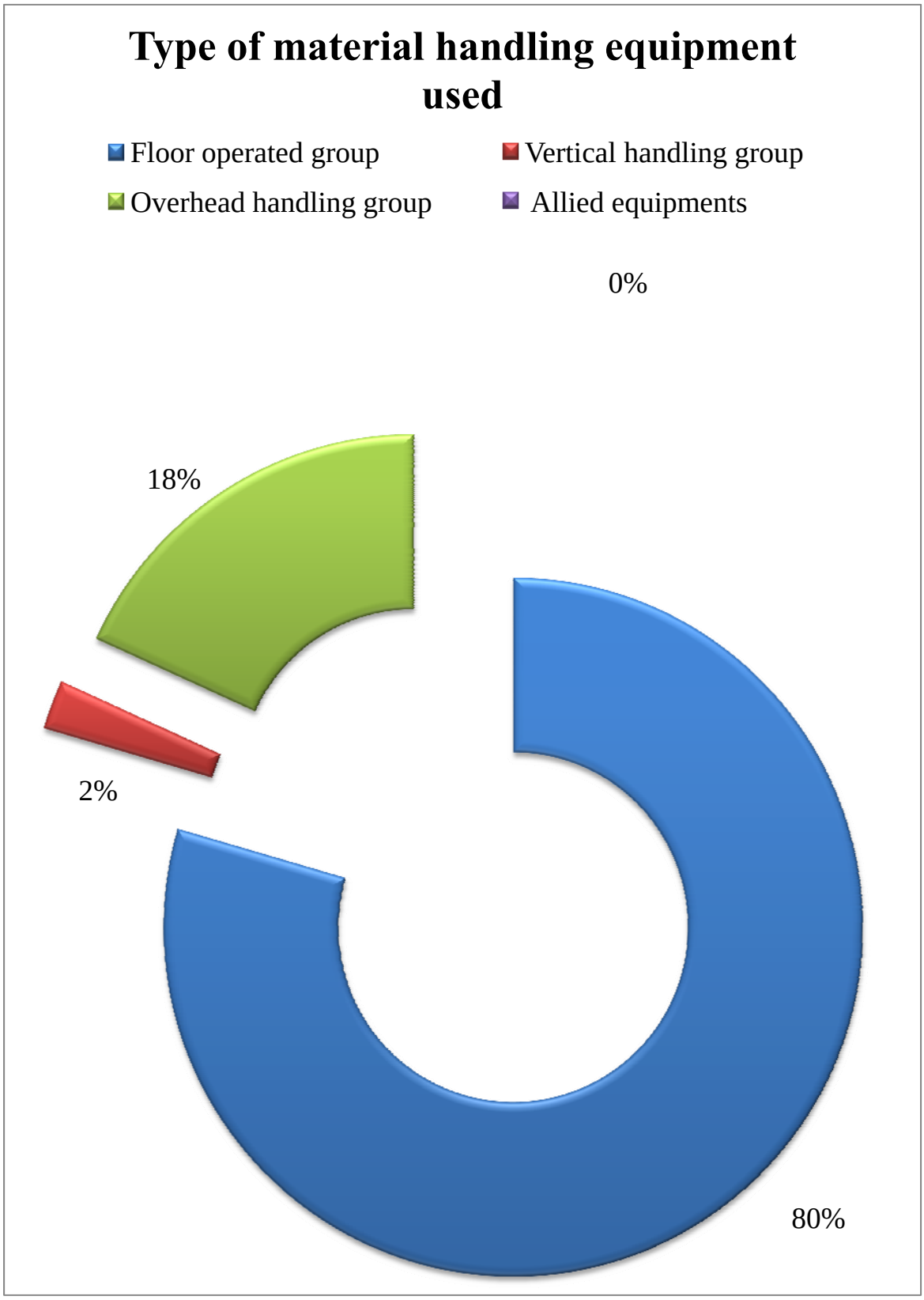
d) Which group of material handling equipment you use?

Researcher is interested in finding the group of material handling equipments used by small scale manufacturers units under study and whether they are using the proper equipment.

Sr. No.	Particulars	Frequency	Percentage
1.	Floor operated group	35	80
2.	Vertical handling group	01	02
3.	Overhead handling group	08	18
4.	Allied equipments	00	00
Total		44	100

Table 4.34

Almost 80% of the respondent uses floor operated material handling equipment, 18% uses overhead handling group, and only 2% firm uses vertical handling group. It can be observed that none of the firms uses allied equipments.


Type of material handling equipment used
Floor operated group
Vertical handling group
Overhead handling group
Allied equipments
0%
18%
2%
80%

Graph 4.34

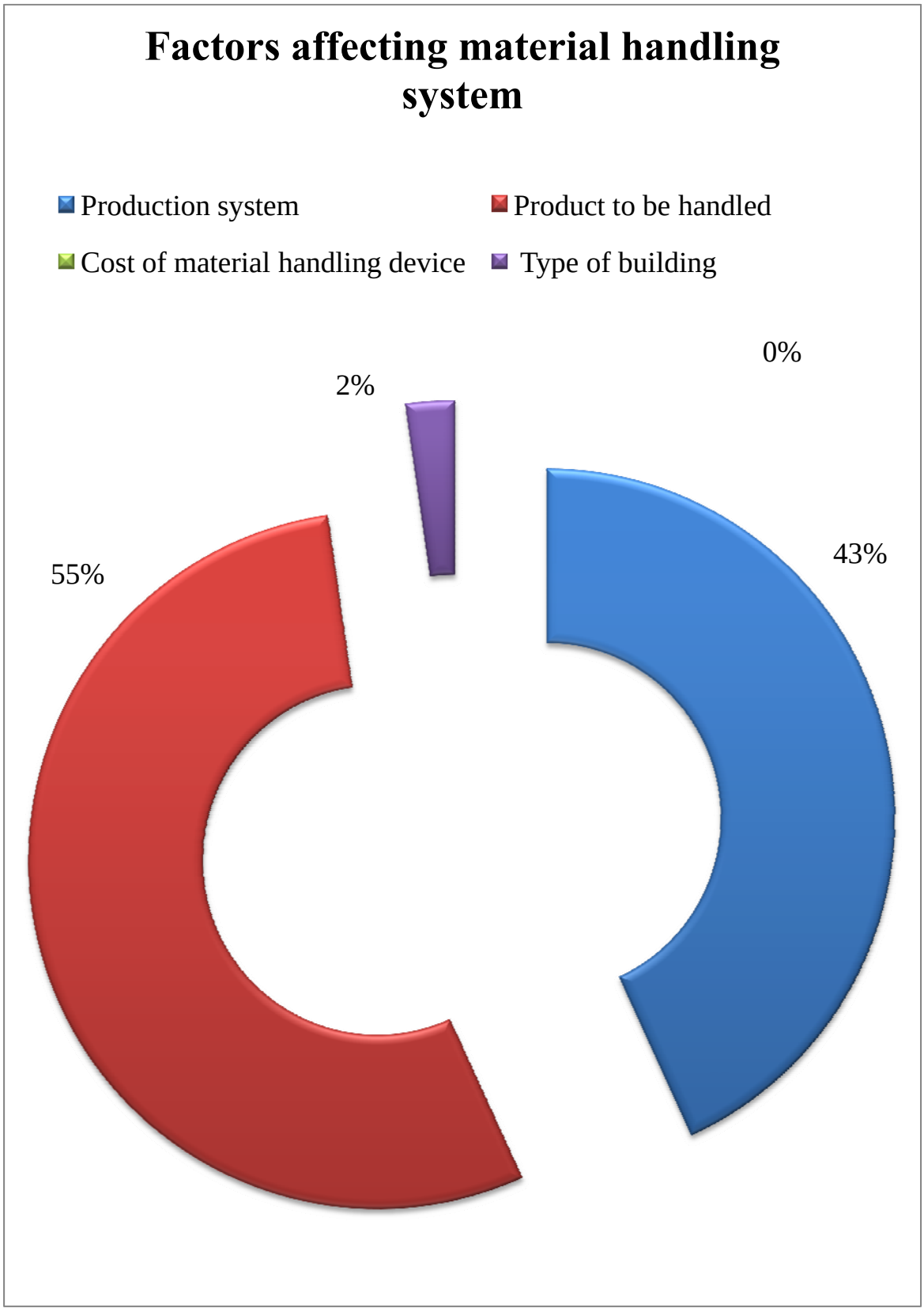
e) What in your opinion are the factors affecting material handling system?

By knowing the factors affecting material handling system researcher can conclude the efficiency of material handling process in small scale manufacturing units.

Sr. No.	Particulars	Frequency	Percentage
1.	Production system	19	43
2.	Product to be handled	24	55
3.	Cost of material handling device	00	00
4.	Type of building in which material is to be handled	01	02
Total		44	100

Table 4.35

Nearly 55% of the respondent firms are of the opinion that material handling system is affected by product to be handled, 43% of the respondent firms say its production system which affects the material handling where as only 2% are of the opinion that type of the building affects material handling. Product and production system are the major factors affecting material handling since the units under study manufactures different products.


Factors affecting material handling system
Production system
Product to be handled
Cost of material handling device
Type of building
0%
2%
43%
55%

Graph 4.35

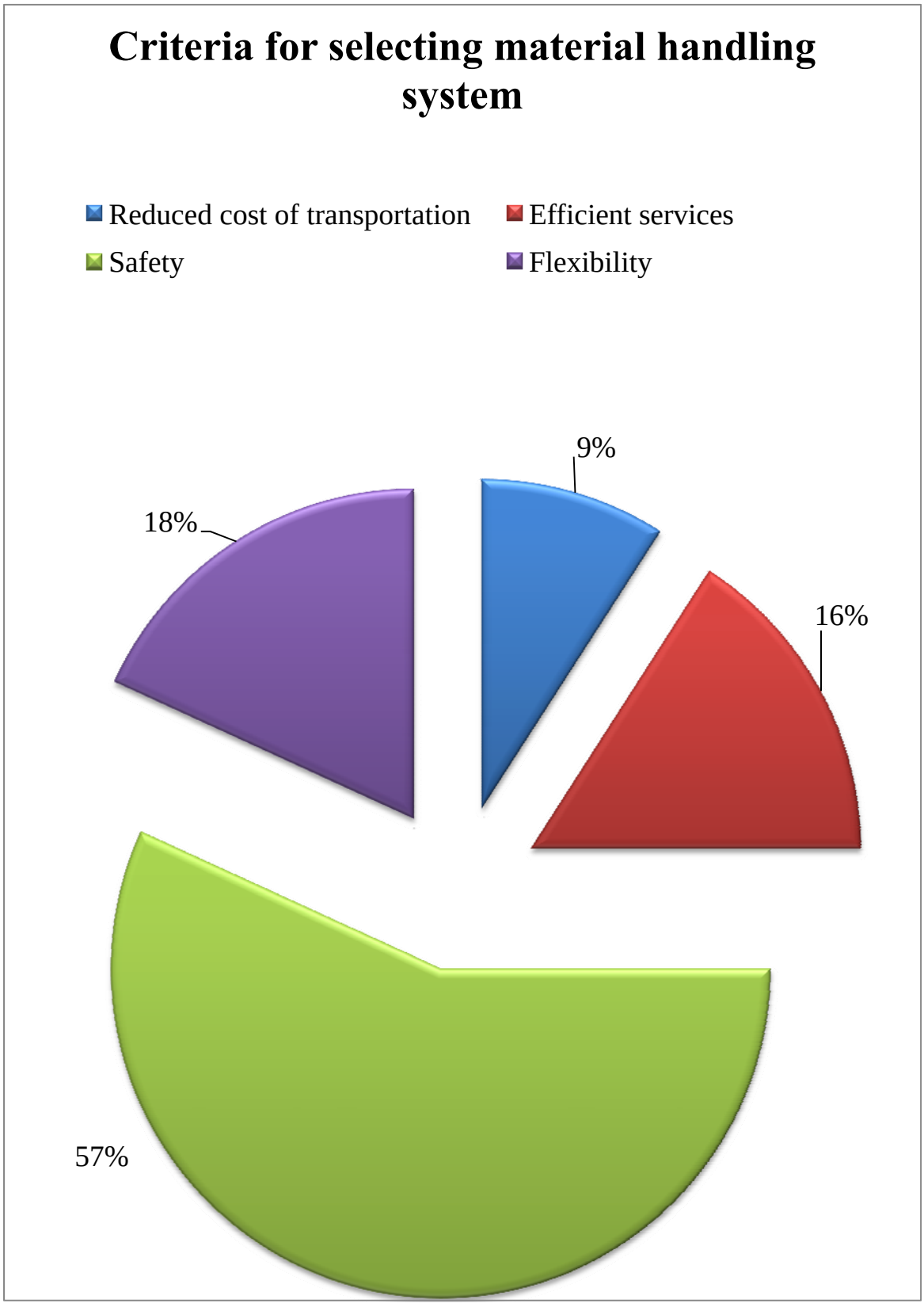
f) What criteria you think is important while selecting material handling equipment?

Safety first is the criteria of today's firms, researcher wanted to judge the awareness of safety criteria among the small scale manufacturing units under study.

Sr. No.	Particulars	Frequency	Percentage
1.	Reduced cost of transportation	04	09
2.	Efficient services	07	16
3.	Safety	25	57
4.	Flexibility	08	18
Total		44	100

Table 4.36

Out of 44 small scale manufacturing firms, 57% i.e. 25 units considers safety as important aspect to choose material handling equipment, 18% chooses flexibility criteria, 16% chooses efficient services as important and 9% considers cost of transportation as the important factor. Units under study are well aware of safety issues while selecting the material handling issues.


Criteria for selecting material handling system
Reduced cost of transportation
Efficient services
Safety
Flexibility
9%
18%
16%
57%

Graph 4.36

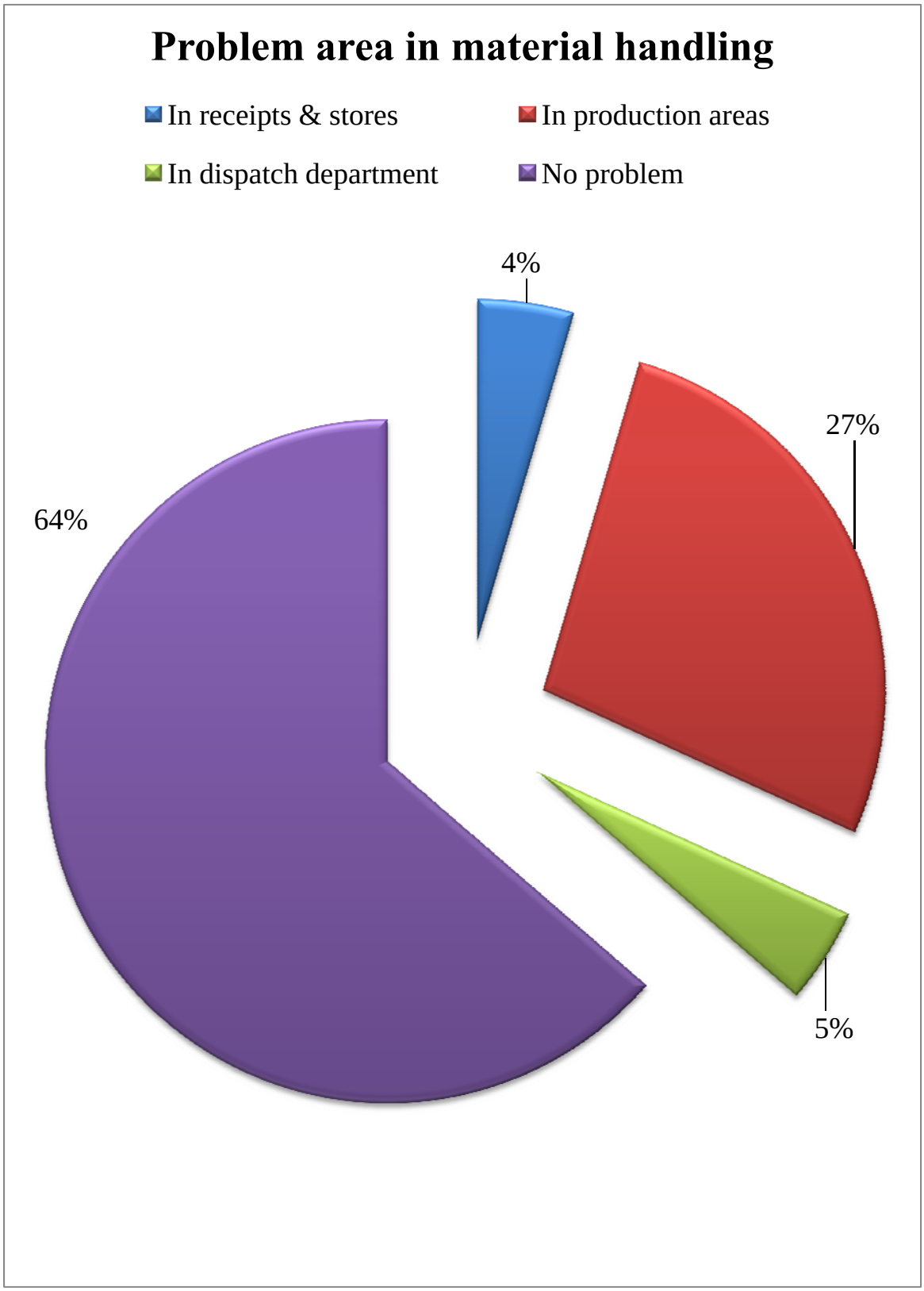
g) Which is the problem area with respect to material handling, in your organization?

Facing problem and to eliminate these problems is the key to success now a days.

Sr. No.	Particulars	Frequency	Percentage
1.	In receipts & stores	02	04
2.	In production areas	12	27
3.	In dispatch department	02	05
4.	No problem	28	64
Total		44	100

Table 4.37

27% of the firms under study faces problem of material handling in production areas, 5% faces problem in dispatch department, 4% faces problem in receipts & stores and 64% respondent firms say they didn't face any problem of material handling. This indicates that 16 firms i.e. 36% units under study out of 44 are still in need of improvement in material handling.


Problem area in material handling
In receipts & stores
In production areas
In dispatch department
No problem
4%
27%
64%
5%

Graph 4.37

5.2.8 Inventory management

It means storing the desired items of required quality and in required quantity and made available to various departments when needed.

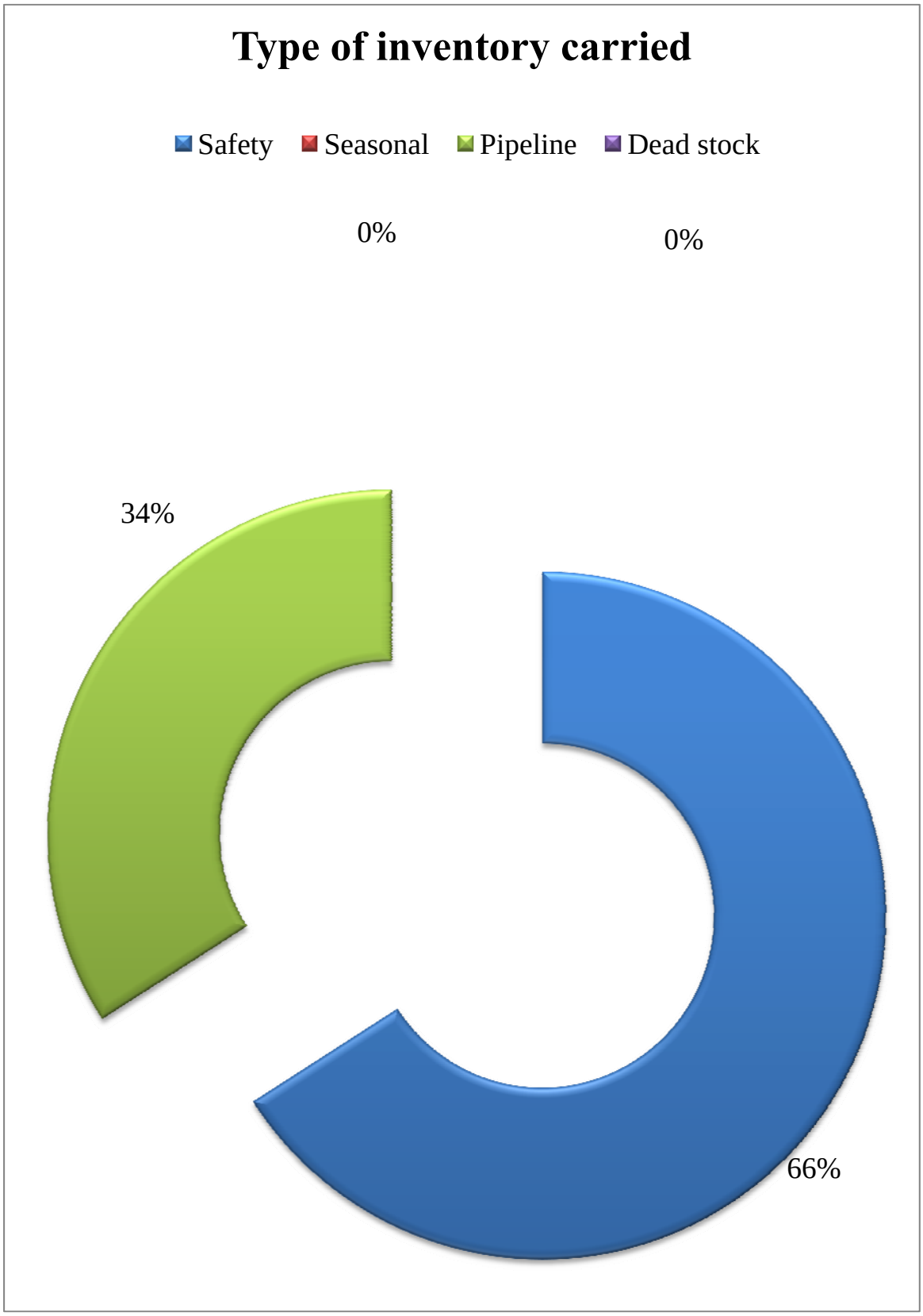
a) What type of inventory is carried by your organization?

Researcher is concerned with the purpose for which inventory is maintained in the manufacturing unit under study.

Sr. No.	Particulars	Frequency	Percentage
1.	Safety	29	66
2.	Seasonal	00	00
3.	Pipeline	15	34
4.	Dead stock	00	00
Total		44	100

Table 4.38

Around 66% of the respondent firm carries safety stock where as 34% firms under study carries inventory in pipeline. In totality the stock in safety and pipeline is the purpose for maintaining the inventory is followed.


Type of inventory carried
Safety
Seasonal
Pipeline
Dead stock
0%
0%
34%
66%

Graph 4.38

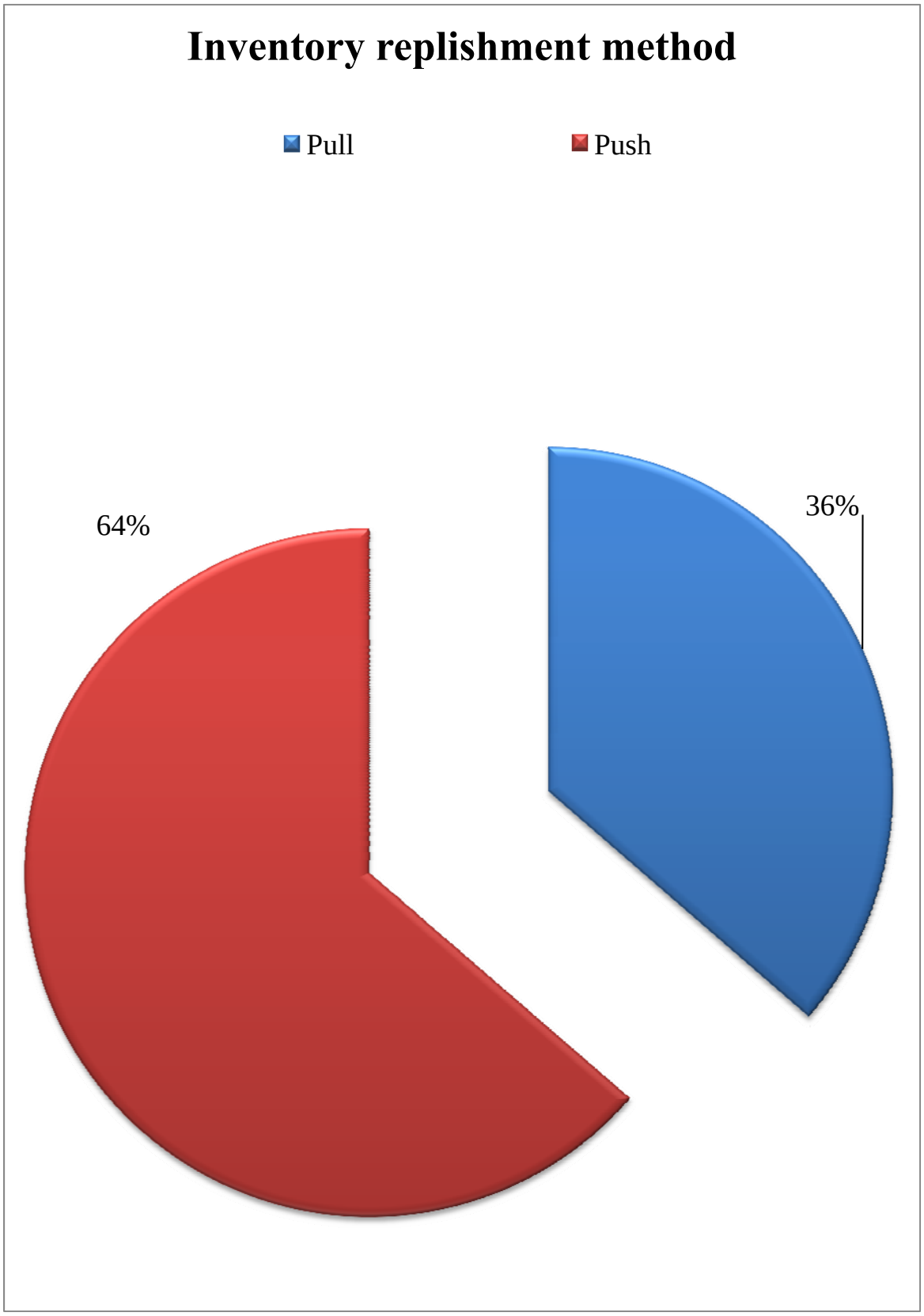
a) Which inventory replishment process you use?

Replishment of raw material should be such that whenever required order should be placed and material should be purchased instead of having huge inventory piled up at stores. First system is called pull and second is called push process of inventory management.

Sr. No.	Particulars	Frequency	Percentage
1.	Pull	16	36
2.	Push	28	64
Total		44	100

Table 4.39

Push strategy of inventory is used by 64% of the respondent firms to replish the stock whereas 36% uses pull strategy. The purpose of maintaining inventory is safety therefore push replishment process is observed in the above table.



Graph 4.39

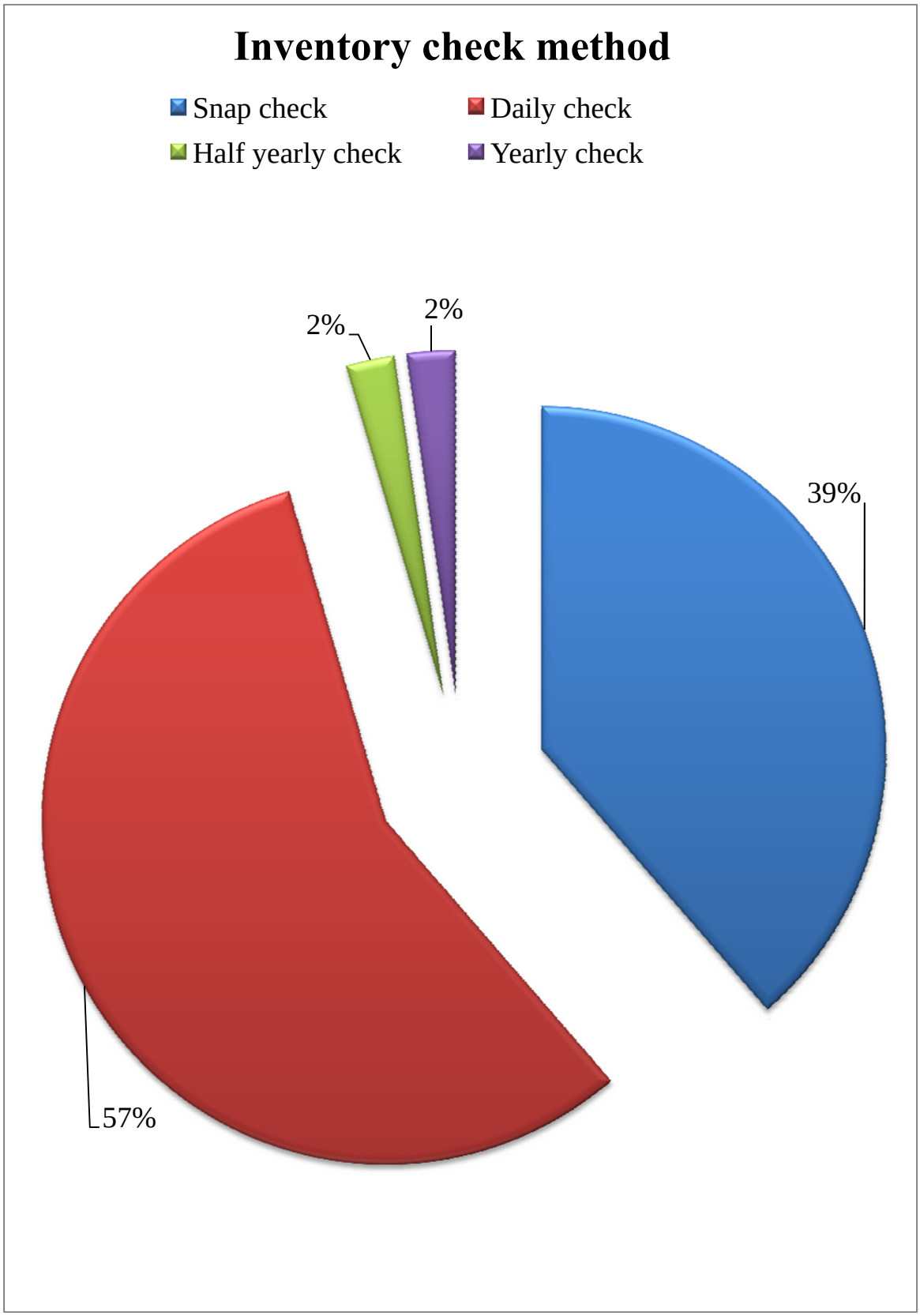
b) Which method you use to check inventory?

Stock taking process is time and money consuming and firms should try to avoid stock checking wherever necessary.

Sr. No.	Particulars	Frequency	Percentage
1.	Snap check	17	39
2.	Daily check	25	57
3.	Half yearly check	01	02
4.	Yearly check	01	02
Total		44	100

Table 4.40

57% of the respondent checks the stock daily, 39% take snap check, 2% uses half yearly checking method and remaining 2% adopt yearly check. Considering the economic and time factor, units under study should give a rethought to the stock taking process.


Inventory check method
Snap check
Daily check
Half yearly check
Yearly check
2%
2%
39%
57%

Graph 4.40

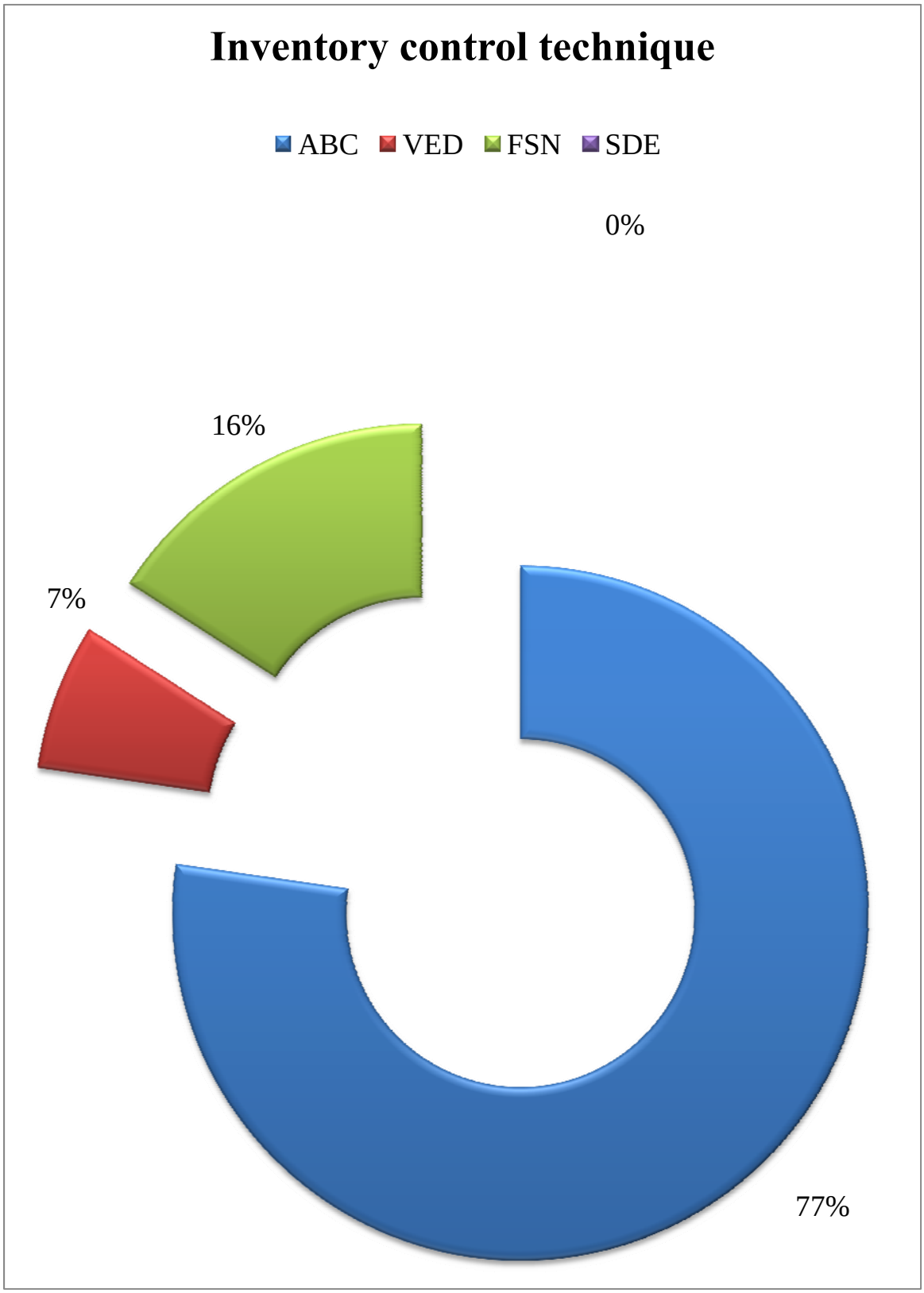
c) Which scientific inventory control technique you use for your organization?

Inventory control is concerned with the control of the quantities and/or monetary values of these items in predetermined level or within safe limits. Selection of proper method for inventory control helps the firm to achieve more benefits.

Sr. No.	Particulars	Frequency	Percentage
1.	ABC	34	77
2.	VED	03	07
3.	FSN	07	16
4.	SDE	00	00
Total		44	100

Table 4.41

Almost 77% of the respondent firms apply ABC technique for inventory control, 16% applies FSN whereas remaining 7% applies VED technique to control the inventory. Scientific methods of selective inventory control are strictly followed by the units under study but it is not observed in over all inventory check as the units are following snap and daily check more frequently.



Graph 4.41

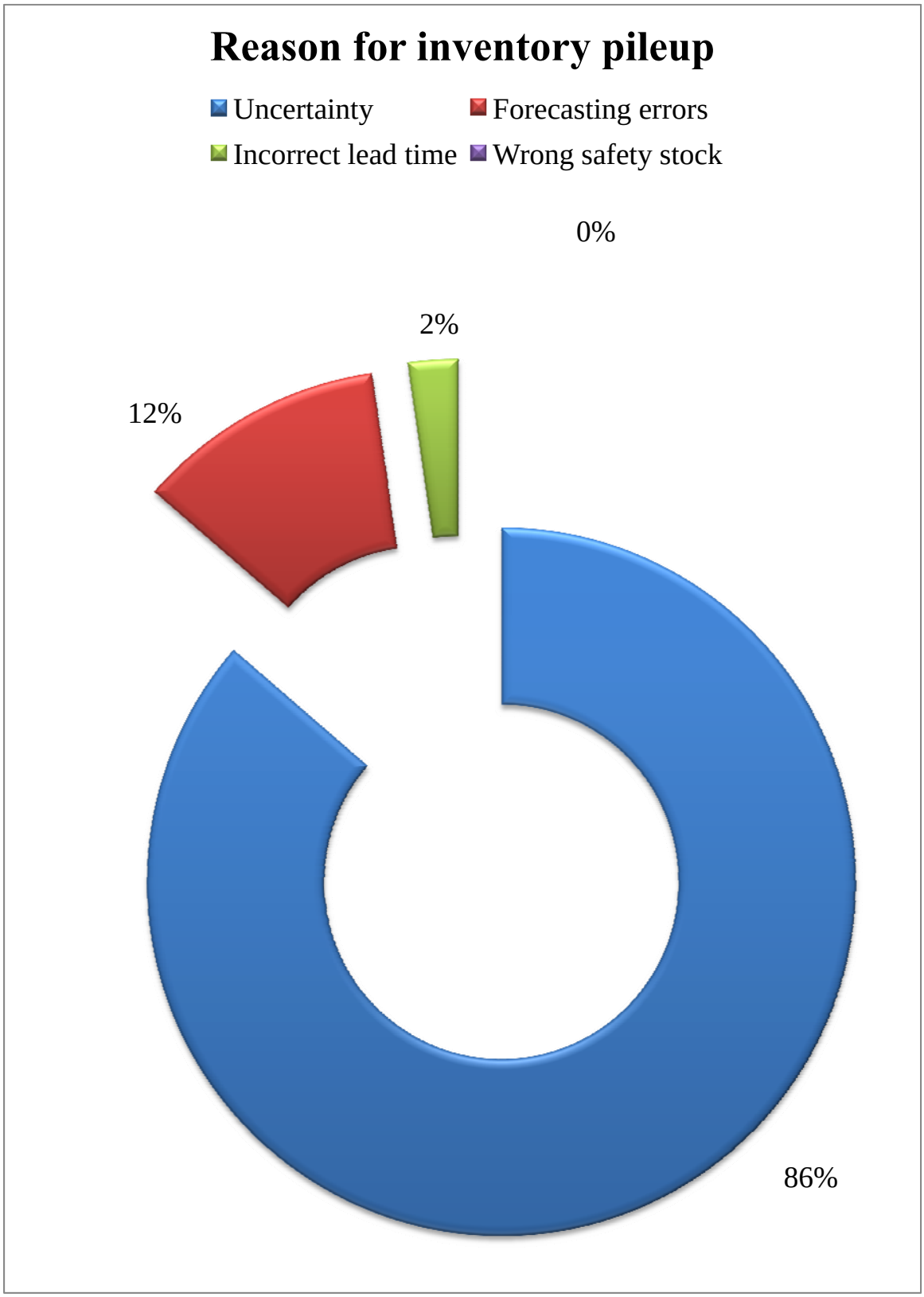
d) In your opinion what must be the reason for inventory pileup?

Excess inventory is called as grave yard and may lead to reduction in profits of any well performing firm. Reasons for excess inventory must be found and effort should be always there to reduce inventory.

Sr. No.	Particulars	Frequency	Percentage
1.	Uncertainty	38	86
2.	Forecasting errors	05	12
3.	Incorrect lead time	01	02
4.	Wrong safety stock	00	00
Total		44	100

Table 4.42

During the visit to the firms it was observed that lot of inventory is piled up, thus when asked for the reason, 86% respondents firms pointed out that due to uncertainties in the market inventory piles up, 12% says forecasting errors is the reason for extra inventory and 2% of the respondent indicates the reason to be incorrect lead time of the procured material.


Reason for inventory pileup
Uncertainty
Forecasting errors
Incorrect lead time
Wrong safety stock
0%
2%
12%
86%

Graph 4.42

5.2.9 Production Planning and Control

Production planning & Control can be defined as the process of planning the production in advance, setting the exact route of each item, fixing the starting and finishing dates of each item, to give production orders to shops and lastly to follow up the progress of products according to orders. PPC helps the firm to achieve the production objectives with respective quality, quantity, cost and timeliness of delivery, to obtain the uninterrupted production flow in order to meet customer varied demand with respect to quality and committed delivery schedule, to help the company to supply good quality products to the customer on the continuous basis at competitive rates.

a) Which type of production layout is used in your organisation?

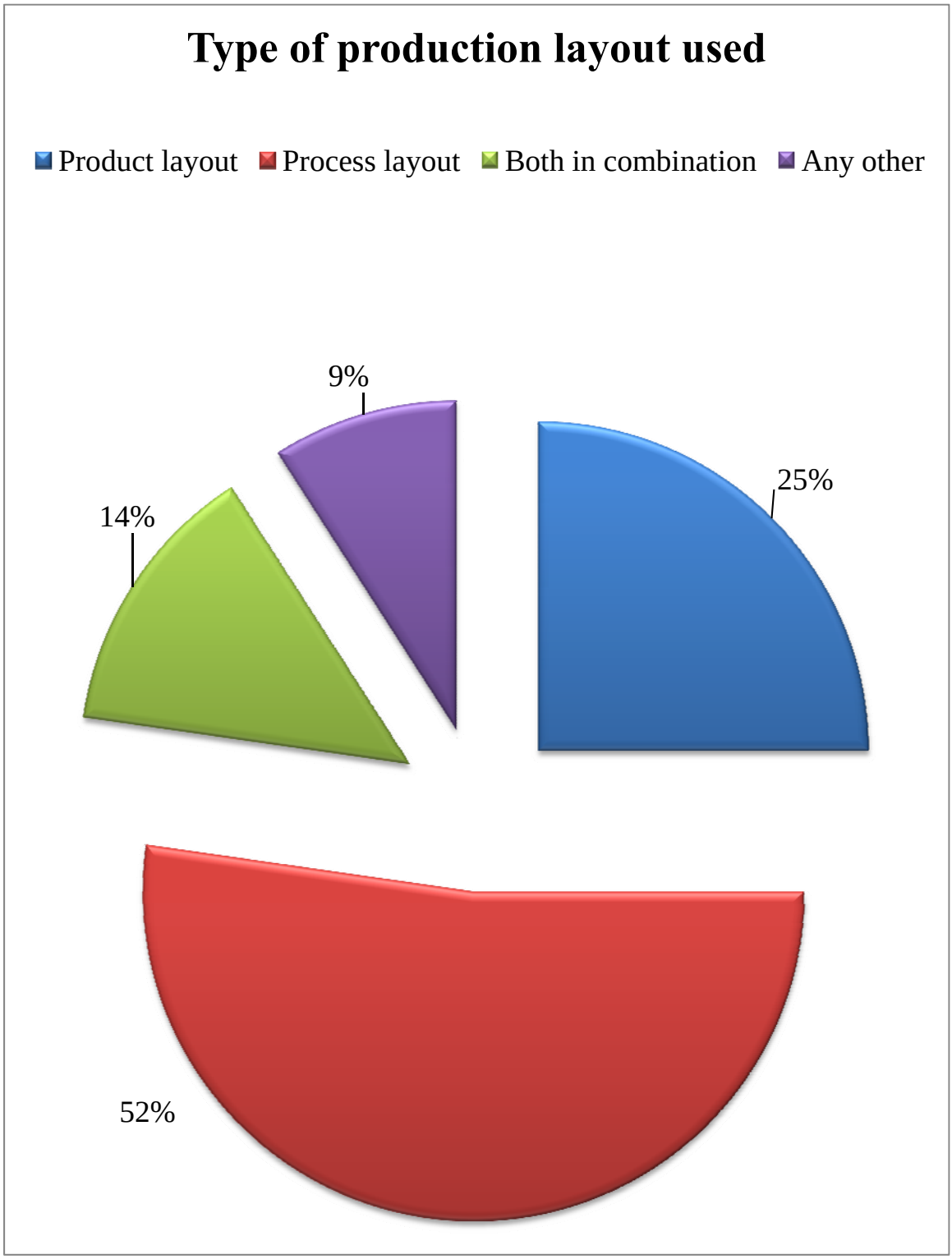
Layout refers to the arrangement of machinery, equipment, workers and other facilities used in the operation. The arrangement should be made in such a way that the production of goods and services can be done efficiently. It should take into consideration the integration of several factors including work station, tool room, store, office, prayer room and toilet.

Sr. No.	Particulars	Frequency	Percentage
1.	Product layout	11	25
2.	Process layout	23	52
3.	Both in combination	06	14
4.	Any other	04	09
Total		44	100

Table 4.43

The nature of small scale manufacturing units under study are of varied nature therefore both in combination type of layout is not observed by the researcher though it is relevant in today's industrial scenario. 23 units under study are using

process layout which is 52% of the total and 11 units i.e. 25% uses product lay out and very few i.e. six units uses both the types in combination.



Graph 4.43

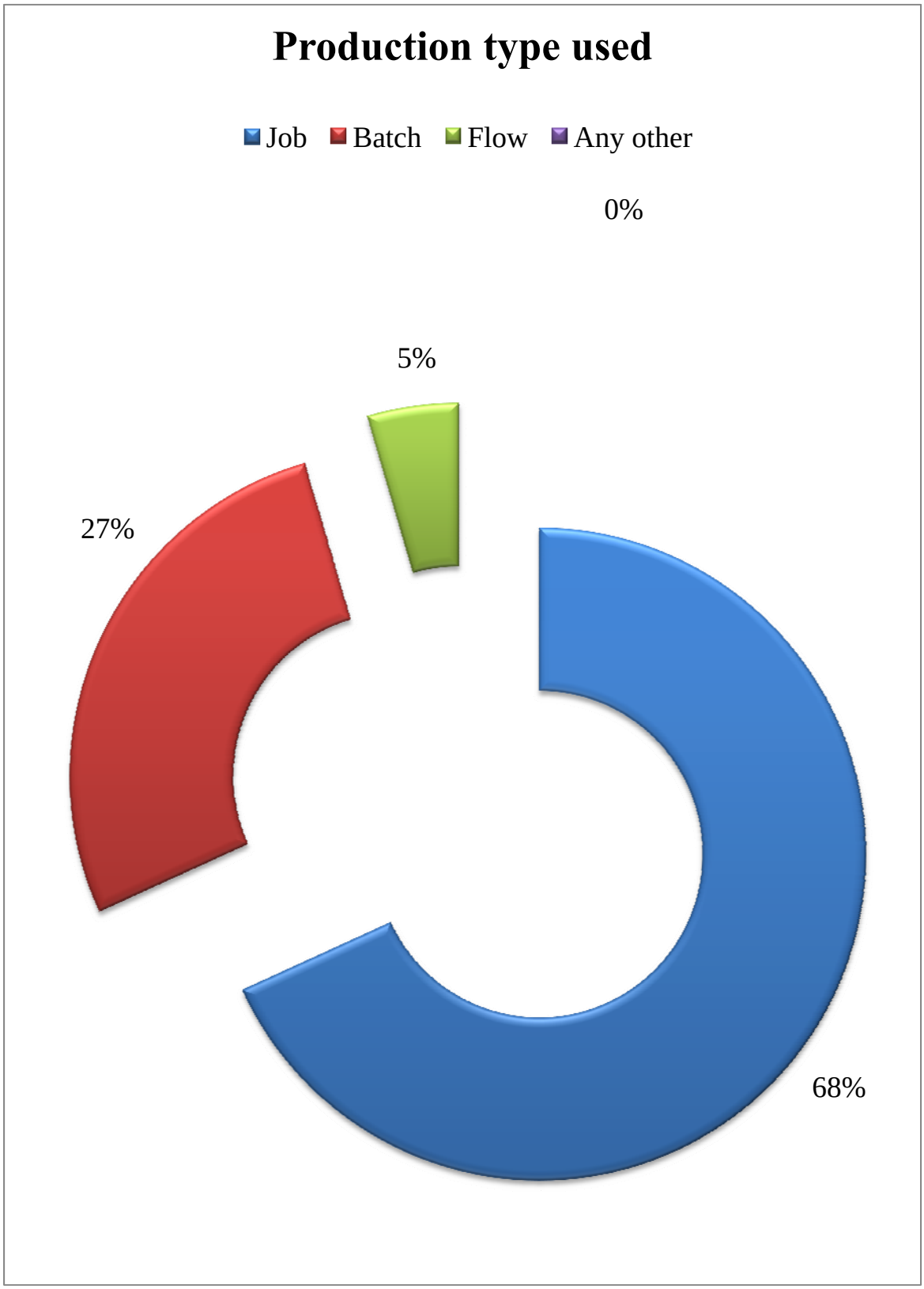
b) Which production type do you use to produce product?

Job Production means one-off production where each item might have particular specifications. Batch Production means each stage of the production process has an operation completed on it before moving on to the next stage and allows modifications to be made to products that otherwise are the same. Flow Production suitable for mass market products that are identical.

Sr. No.	Particulars	Frequency	Percentage
1.	Job	30	68
2.	Batch	12	27
3.	Flow	02	05
4.	Any other	00	00
Total		44	100

Table 4.44

Flow type of production reduces the length of supply chain and it is followed by batch, job and any other type. Data indicates job type of production process is used by 68% of the respondents manufacturing units, 27% uses batch type of production process and only 5% of the units uses flow type of production process which is because of nature of product manufactured by small scale manufacturing units.



Graph 4.44

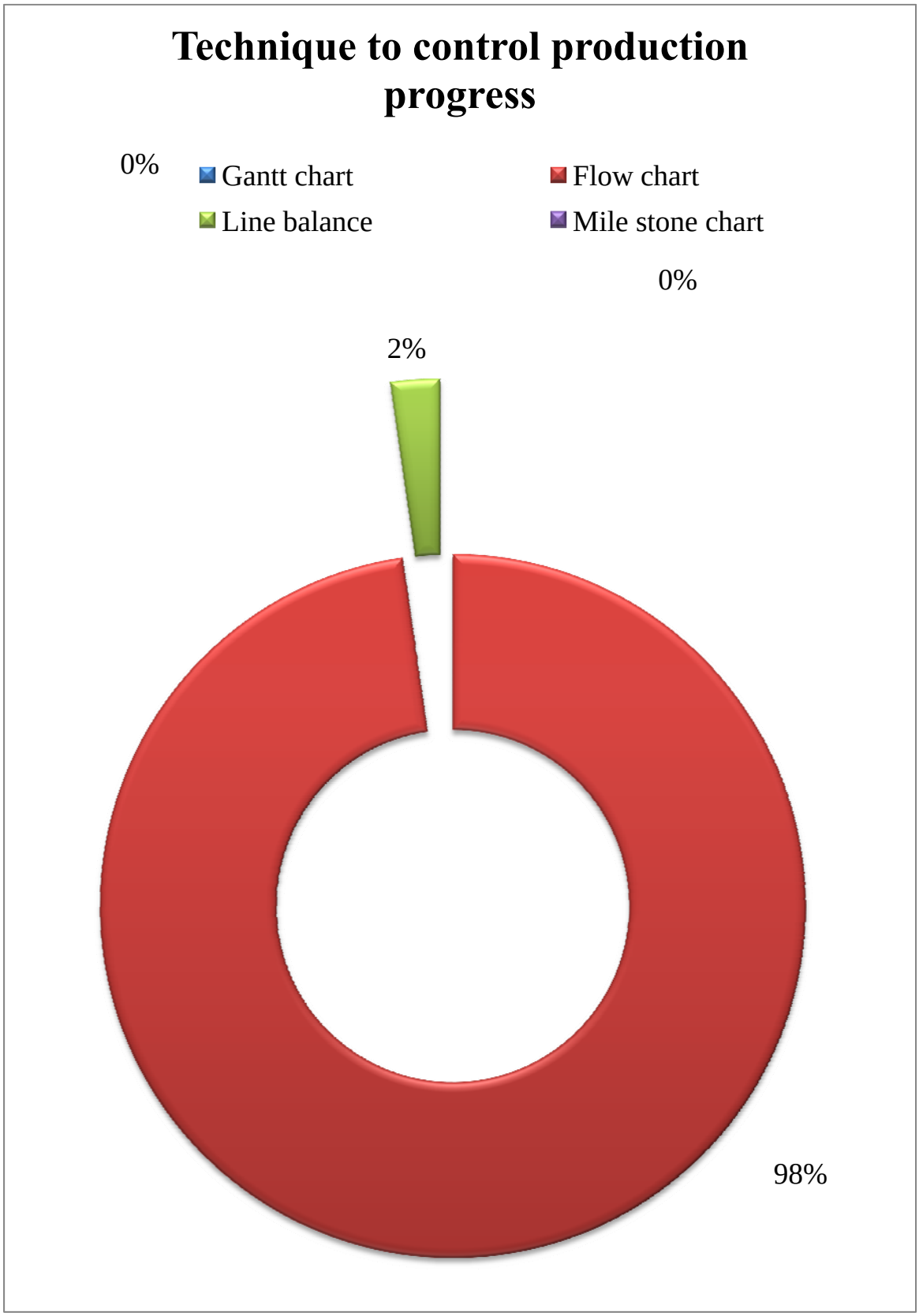
c) How you control production progress?

"First Plan Your Work, Then Work Your Plan" helps the firms to achieve sustainability in fast changing market. Proper planning monitoring and control activities adopted by firms will decide the faith of firms.

Sr. No.	Particulars	Frequency	Percentage
1.	Gantt chart	00	00
2.	Flow chart	43	98
3.	Line balance	01	02
4.	Mile stone chart	00	00
Total		44	100

Table 4.45

Gantt chart should have been the priority as to control production process but the nature of industry being small scale applies to production progress by flow chart and it is obvious. 98% small scale manufacturing units use flow chart where as rest of the firms use line balancing method.


Technique to control production progress
0%
Gantt chart
Flow chart
Line balance
Mile stone chart
0%
2%
98%

Graph 4.45

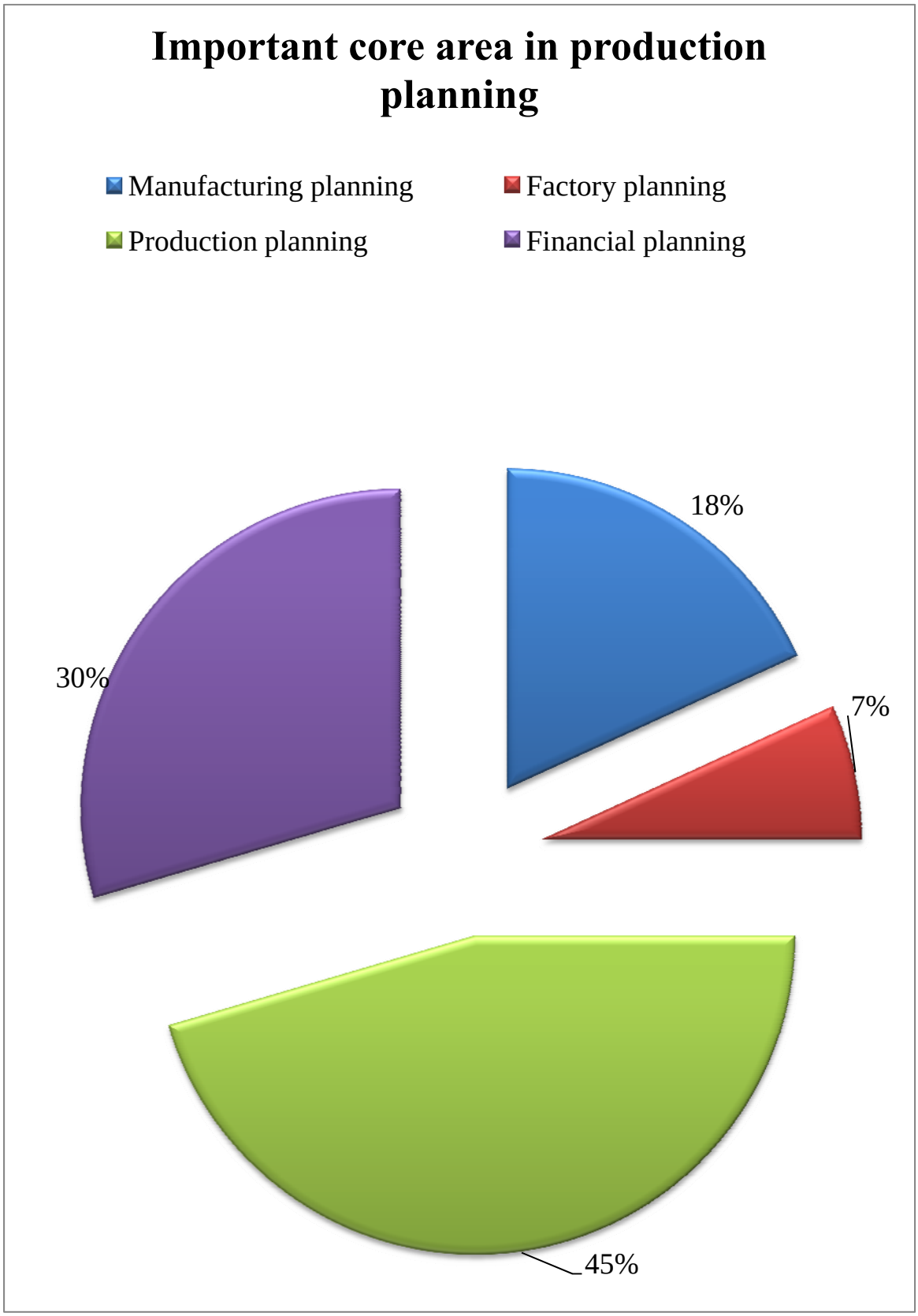
d) Give preference about important core area in production planning?

Core areas means profit centre which is related to firms main objective of running the business.

Sr. No.	Particulars	Frequency	Percentage
1.	Manufacturing planning	08	18
2.	Factory planning	03	07
3.	Production planning	20	45
4.	Financial planning	13	30
Total		44	100

Table 4.46

When asked about important core area in production planning 45% of the units chooses production planning where as 30% says it is financial planning, 18% says manufacturing planning and 7% says factory planning is important core area in production planning.


Important core area in production planning
Manufacturing planning
Factory planning
Production planning
Financial planning
18%
7%
30%
45%

Graph 4.46

5.2.10 IT in Supply Chain Management

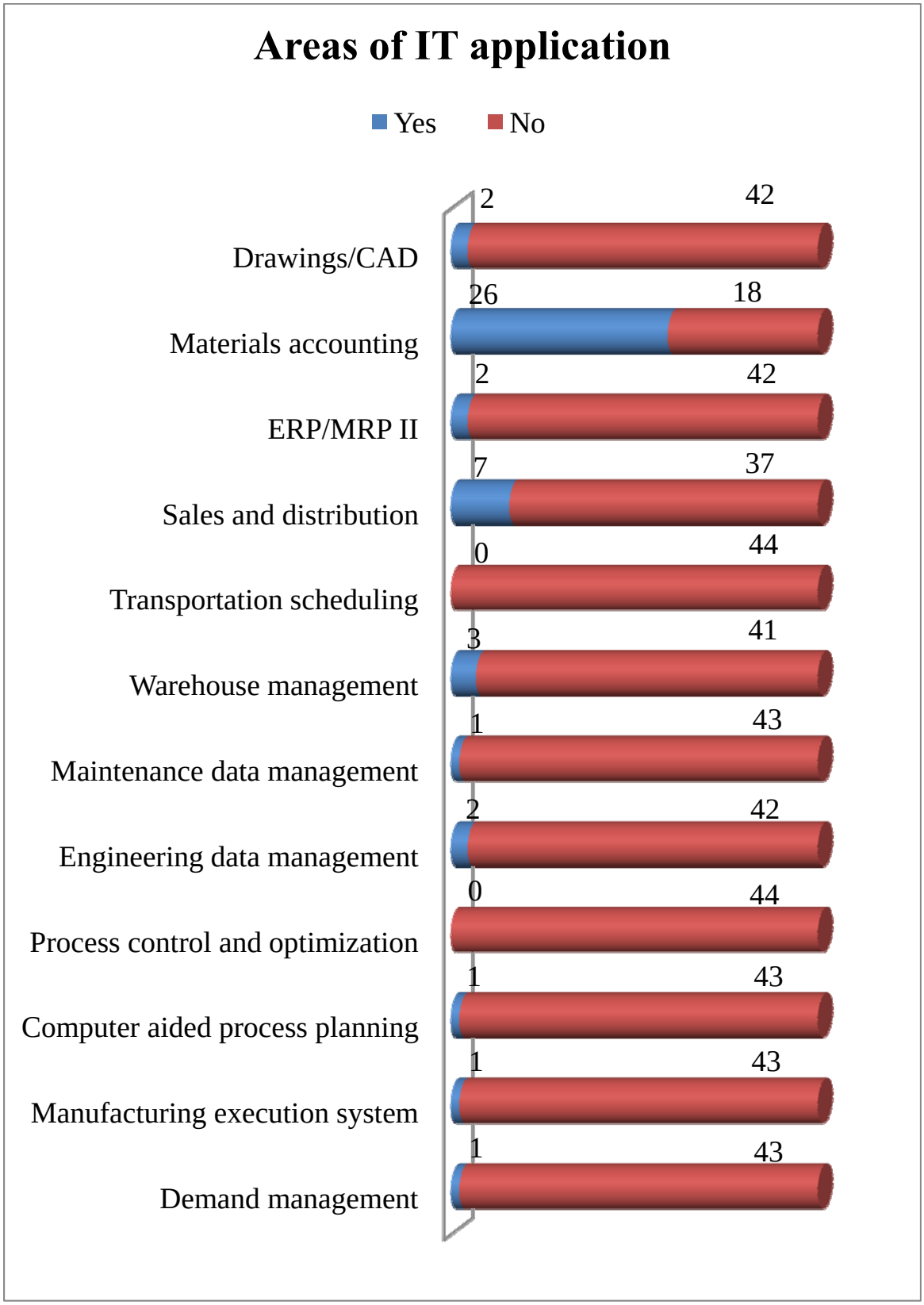
a) What is the usage pattern of IT applications?

IT is the glue that holds the entire supply chain together and allows it to function, making information the most important supply chain driver.

Sr. No.	Particulars	Yes		No	
		Frequency	%	Frequency	%
1.	Demand management	01	02	43	98
2.	Manufacturing execution system	01	02	43	98
3.	Computer aided process planning	01	02	43	98
4.	Process control and optimization	00	00	44	100
5.	Engineering data management	02	05	42	95
6.	Maintenance data management	01	02	43	98
7.	Warehouse management	03	07	41	93
8.	Transportation scheduling	00	00	44	100
9.	Sales and distribution	07	16	37	84
10.	ERP/MRP II	02	05	42	95
11.	Materials accounting	26	59	18	41
12.	Drawings/CAD	02	05	42	95

Table 4.47

It can be observed from the collected data that only few small scale manufacturing units uses IT in their routine activities. It can also be observed that 59% of the small scales manufacturing units under study use IT majorly for material accounting purpose. IT enabled services are costly and are not affordable by the SSMUs. At the time of personal interview with the owners and Managers, it is observed that they are willing to go for these services but lack in funds and will take time to introduce IT enabled services.


Areas of IT application
Yes
No
Drawings/CAD
2
42
Materials accounting
26
18
ERP/MRP II
2
42
Sales and distribution
7
37
Transportation scheduling
0
44
Warehouse management
3
41
Maintenance data management
1
43
Engineering data management
2
42
Process control and optimization
0
44
Computer aided process planning
1
43
Manufacturing execution system
1
43
Demand management
1
43

Graph 4.47

5.2.11 Transportation of finished goods

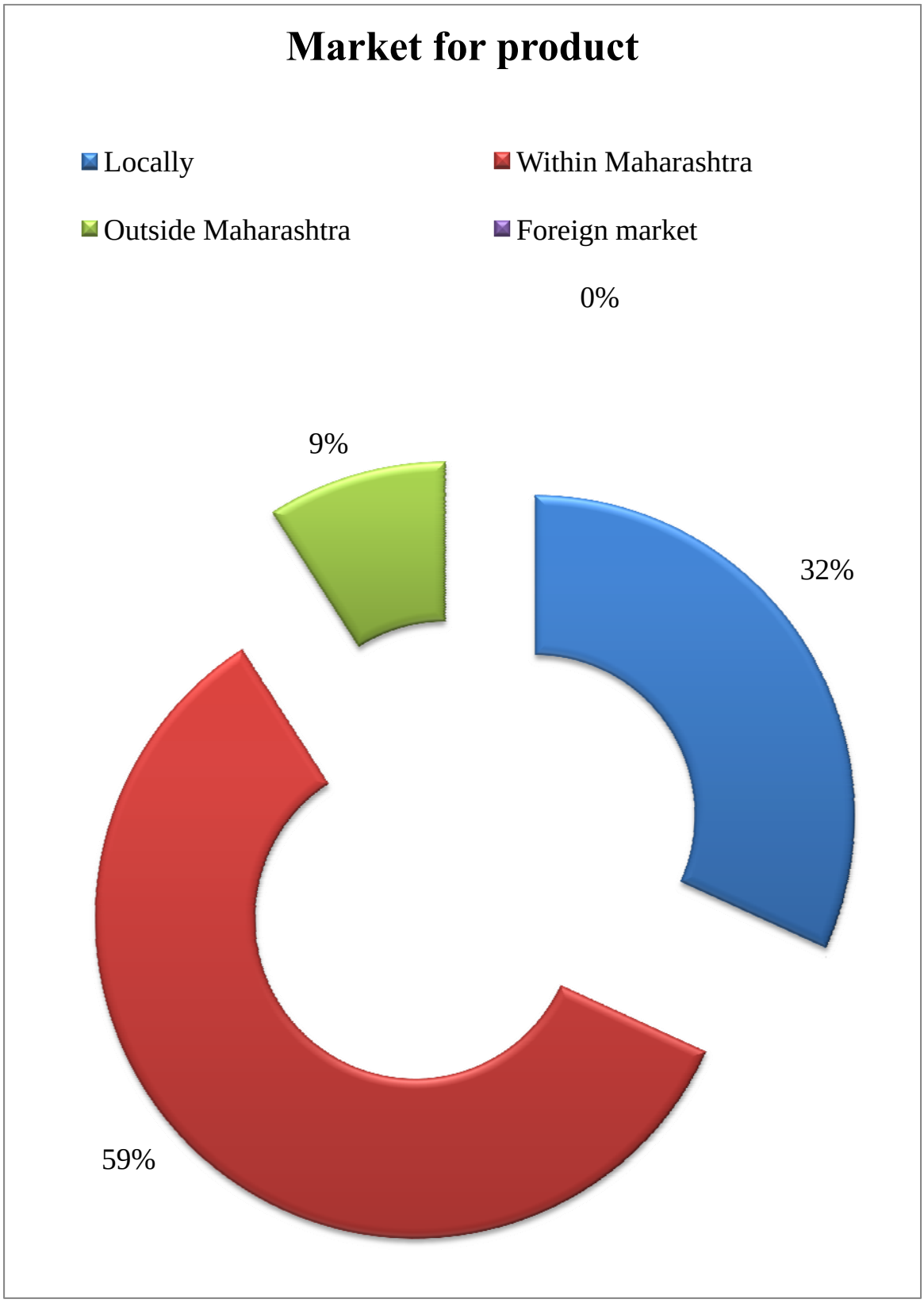
a) In which market you sell your product?

Logistics complexity increases with distance and it become difficult to handle the transportation and routine activities like octroi, toll and interstate taxes which become difficult for small scale manufacturing units to handle and reduces their profitability.

Sr. No.	Particulars	Frequency	Percentage
1.	Locally	14	32
2.	Within Maharashtra	26	59
3.	Outside Maharashtra	04	09
4.	Foreign market	00	00
Total		44	100

Table 4.48

40 units out of 44 under study are the suppliers of finished goods with in Maharashtra. It shows very clearly that 91% of the units under study are either vendors or suppliers with in Maharashtra. At the time of personal interview with the owner managers they commented that they are trying for marketing the product outside Maharashtra but yet they could not achieve success.


Market for product
Locally
Within Maharashtra
Outside Maharashtra
Foreign market
0%
9%
32%
59%

Graph 4.48

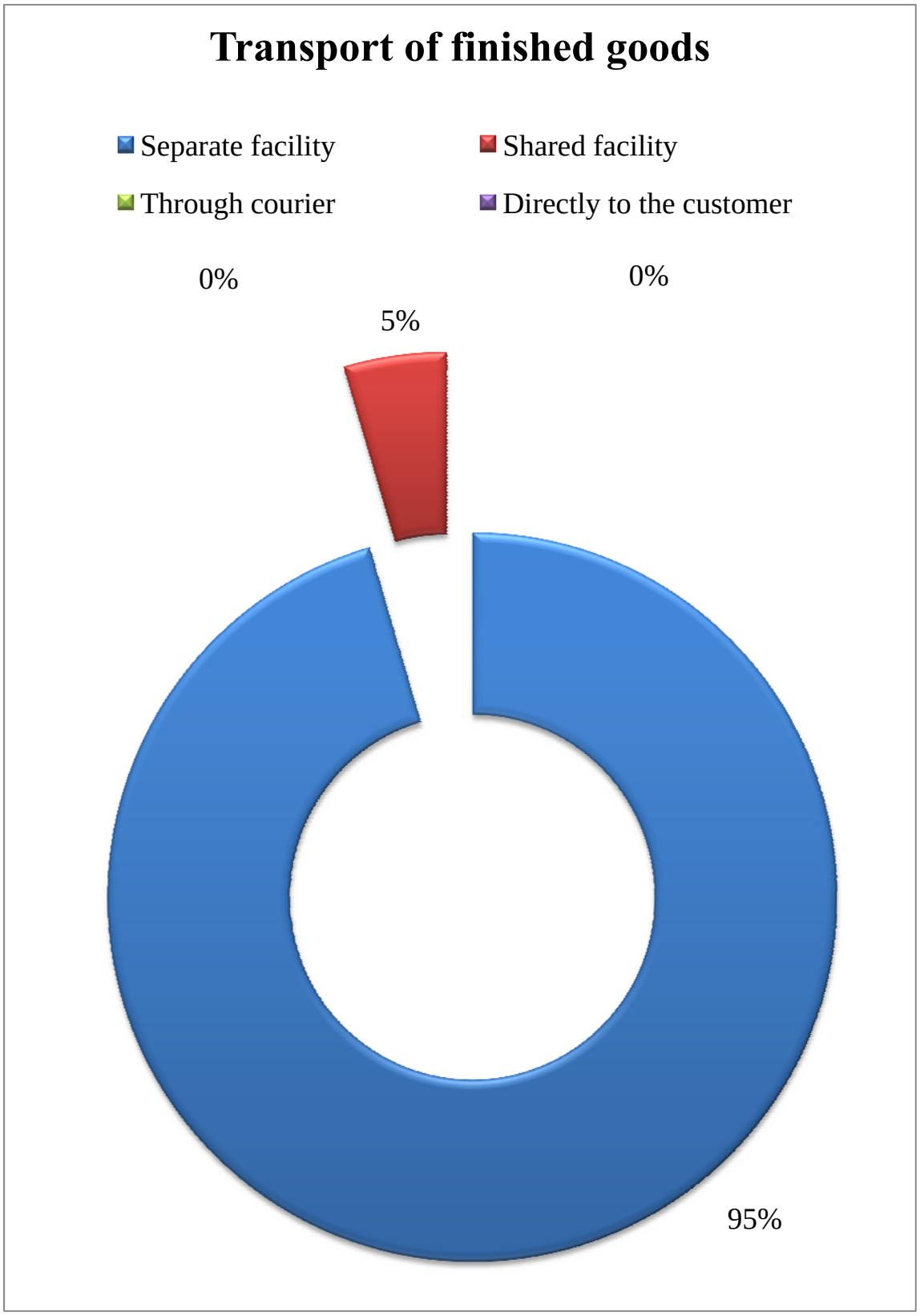
b) How the finished goods are transported to the whole seller/warehouse?

Investment in transport as an infrastructure for small scale manufacturing units is difficult because capital fund is scarce for them.

Sr. No.	Particulars	Frequency	Percentage
1.	Separate facility	42	95
2.	Shared facility	02	05
3.	Through courier	00	00
4.	Directly to the customer	00	00
Total		44	100

Table 4.49

Considering the time and place constraint there is no way out but to go for separate facility for transportation to the whole sellers by the units under study. Separate facility is used by 95% of firms to transport finished goods to the whole seller/warehouse and rest 5% of the small scale manufacturing units share the transportation facility while transferring goods to the whole seller/warehouse.


Transport of finished goods
Separate facility
Shared facility
Through courier
Directly to the customer
0%
0%
5%
95%

Graph 4.49

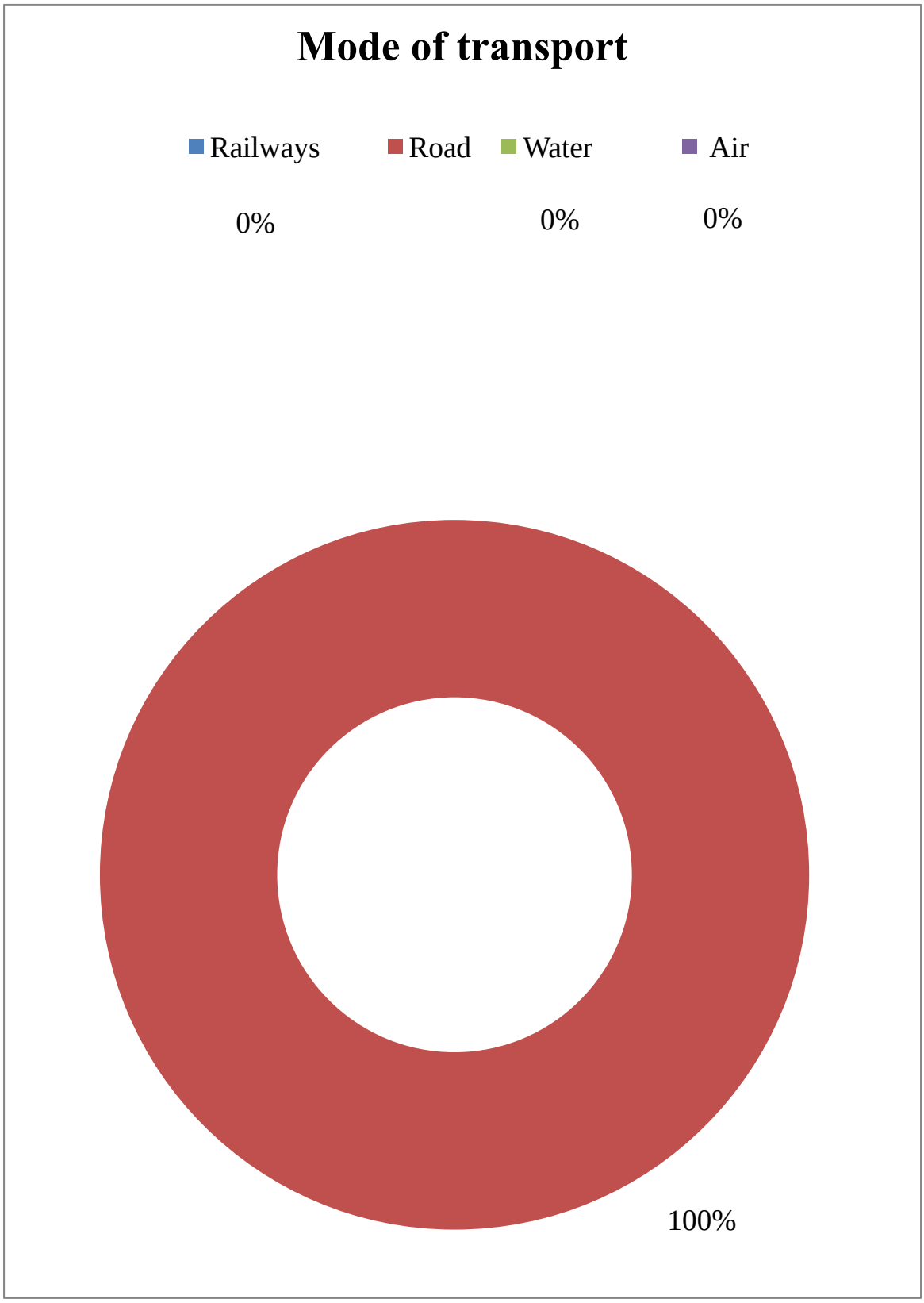
c) Which mode of transportation you use to transport finished goods?

Length of supply chain depends on mode of transportation.

Sr. No.	Particulars	Frequency	Percentage
1.	Railways	00	00
2.	Road	44	100
3.	Water	00	00
4.	Air	00	00
Total		44	100

Table 4.50

All small scale manufacturers units are vendors or suppliers locally and within Maharashtra best suitable mode of transport is road only. It is being observed in the above table that all the manufacturing units considers road as convenient mode of transportation.



Graph 4.50

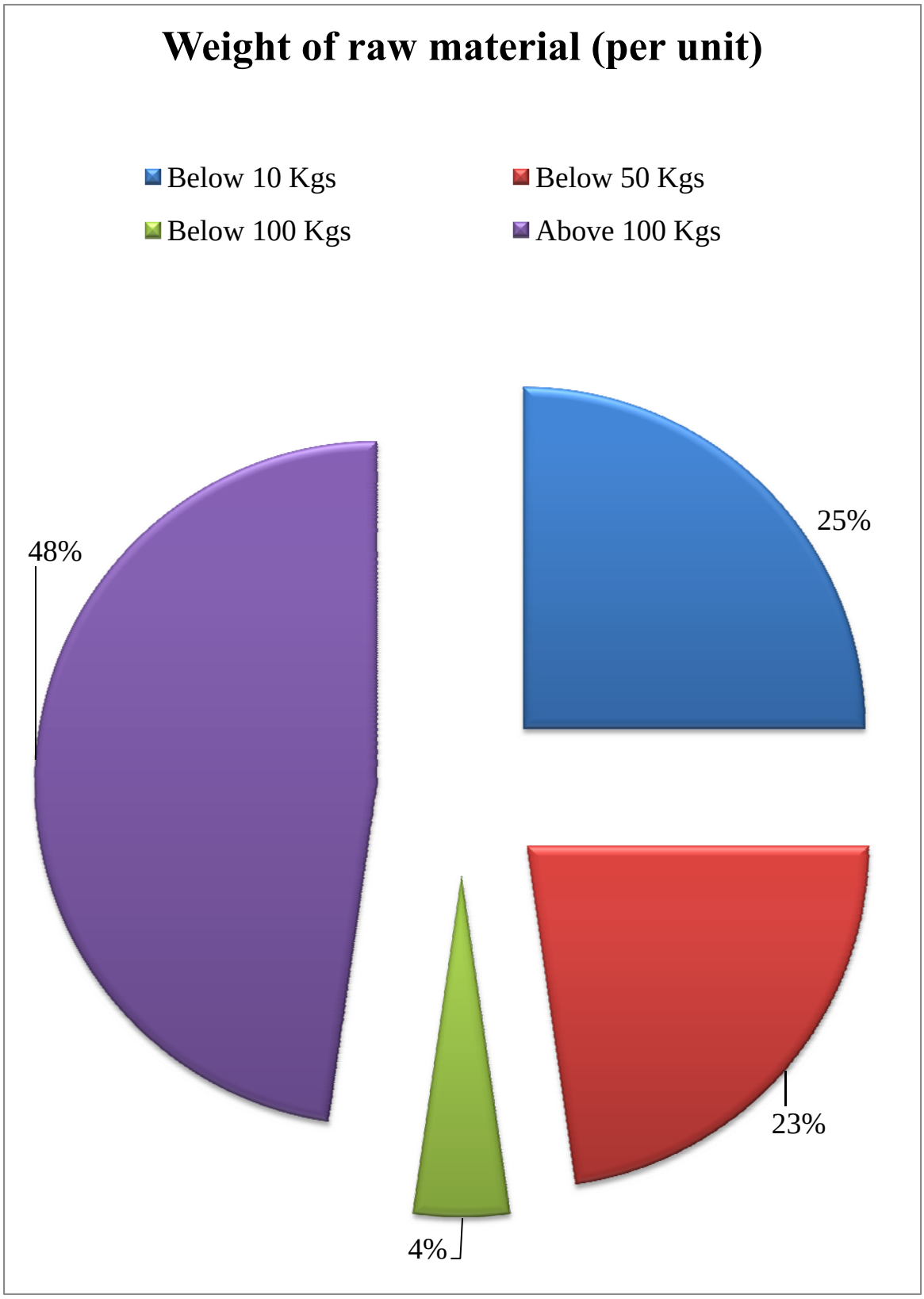
d) What is the approximate weight of finished goods (per unit)?

Unit load can be decided on the basis of weight of finished goods.

Sr. No.	Particulars	Frequency	Percentage
1.	Below 10 Kgs	11	25
2.	Below 50 Kgs	10	23
3.	Below 100 Kgs	02	04
4.	Above 100 Kgs	21	48
Total		44	100

Table 4.51

Product variation leads to difference in per unit weight. In 48% of the small scale manufacturing unit's approximate weight of finished goods is above 100 kgs, in 25% units the weight is below 10 kgs, in 23% units the weight is below 50 kgs and in 4% units the approximate weight is below 100kgs.


Weight of raw material (per unit)
Below 10 Kgs
Below 50 Kgs
Below 100 Kgs
Above 100 Kgs
25%
48%
23%
4%

Graph 4.51

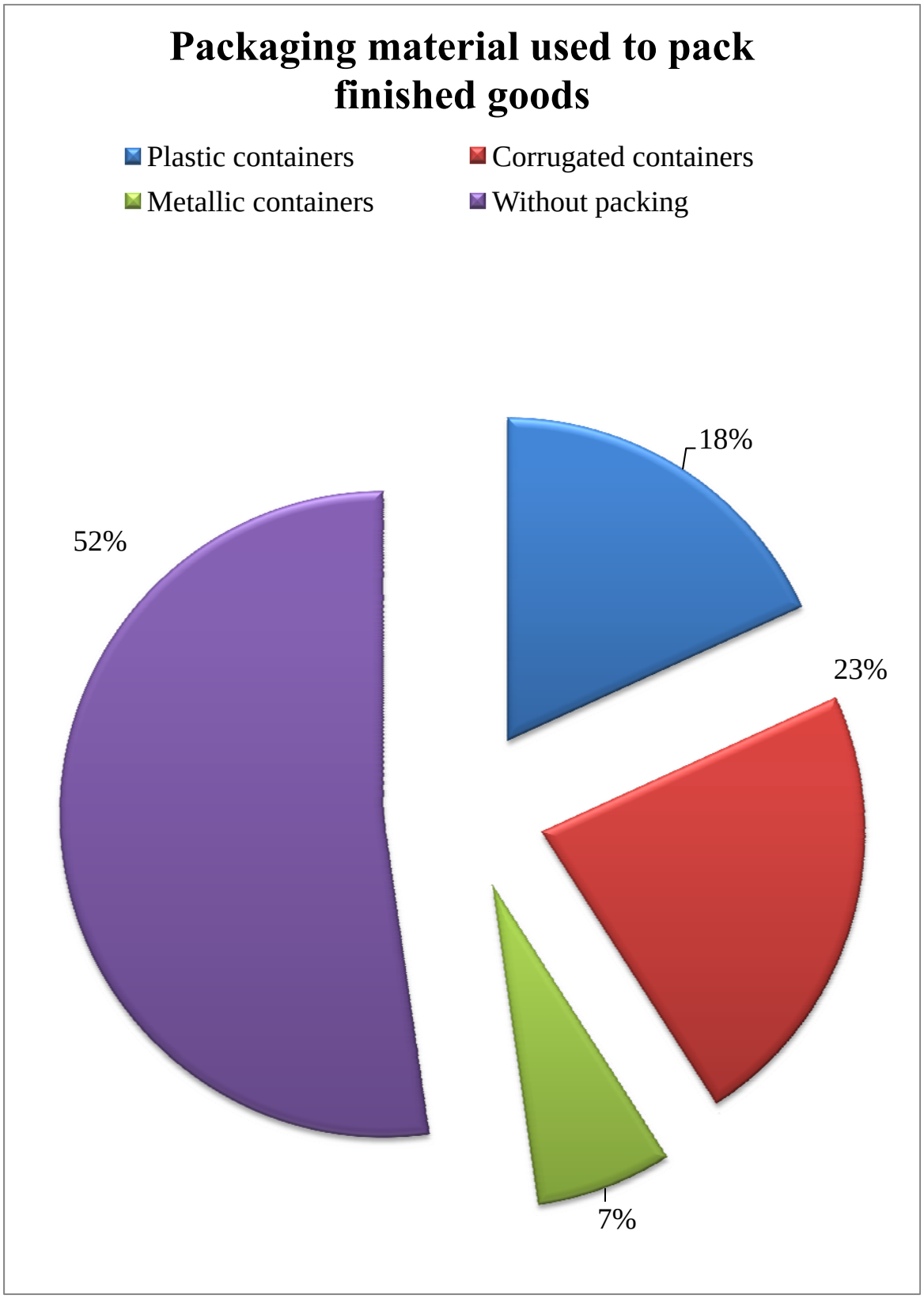
e) What type of packaging material is used to pack finished goods?

For the safety of goods proper packaging is necessary.

Sr. No.	Particulars	Frequency	Percentage
1.	Plastic containers	08	18
2.	Corrugated containers	10	23
3.	Metallic containers	03	07
4.	Without packing	23	52
Total		44	100

Table 4.52

It is observed that packing is absent in 52% of the small scale manufacturing units under study, 23% of the units uses corrugated containers, 18% uses plastic containers and 7% manufacturing units uses metallic containers. Due to huge size of finished products 23 units out of 44 units under study doesn't use packaging material.


Packaging material used to pack finished goods
Plastic containers
Corrugated containers
Metallic containers
Without packing
18%
23%
7%
52%

Graph 4.52

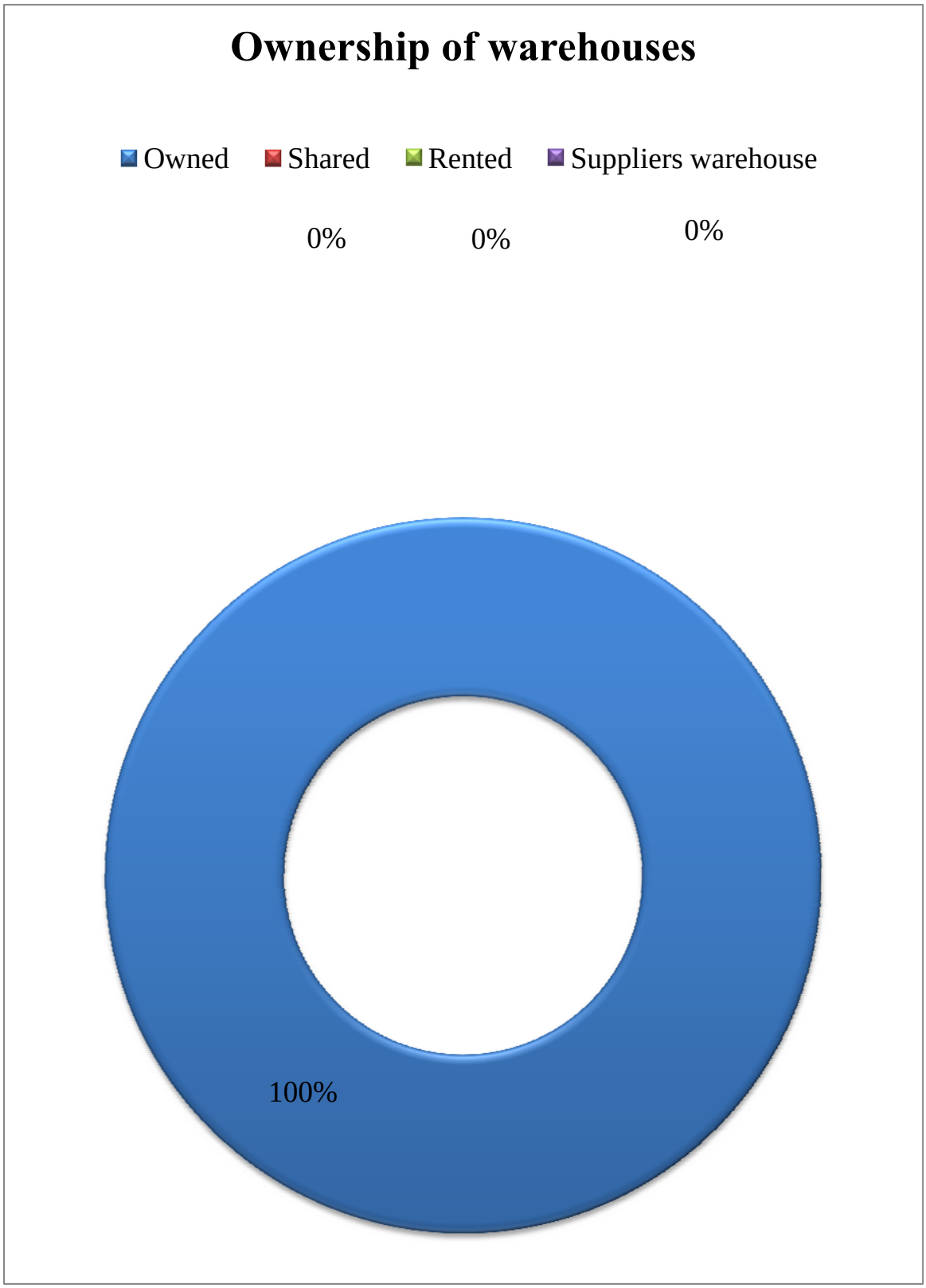
f) Do you store finished goods in warehouse?

Space costs money and high inventory of finished goods also incurs cost, thus it should be reduced to as low as possible.

Sr. No.	Particulars	Frequency	Percentage
1.	Owned	44	100
2.	Shared	00	00
3.	Rented	00	00
4.	Suppliers warehouse	00	00
Total		44	100

Table 4.53

All the respondent units under study store finished goods in their own warehouses. Even though it is desirable to share warehouse it is not feasible for them to share the warehouse because of dispersed location.


Ownership of warehouses
Owned
Shared
Rented
Suppliers warehouse
0%
0%
0%
100%

Graph 4.53

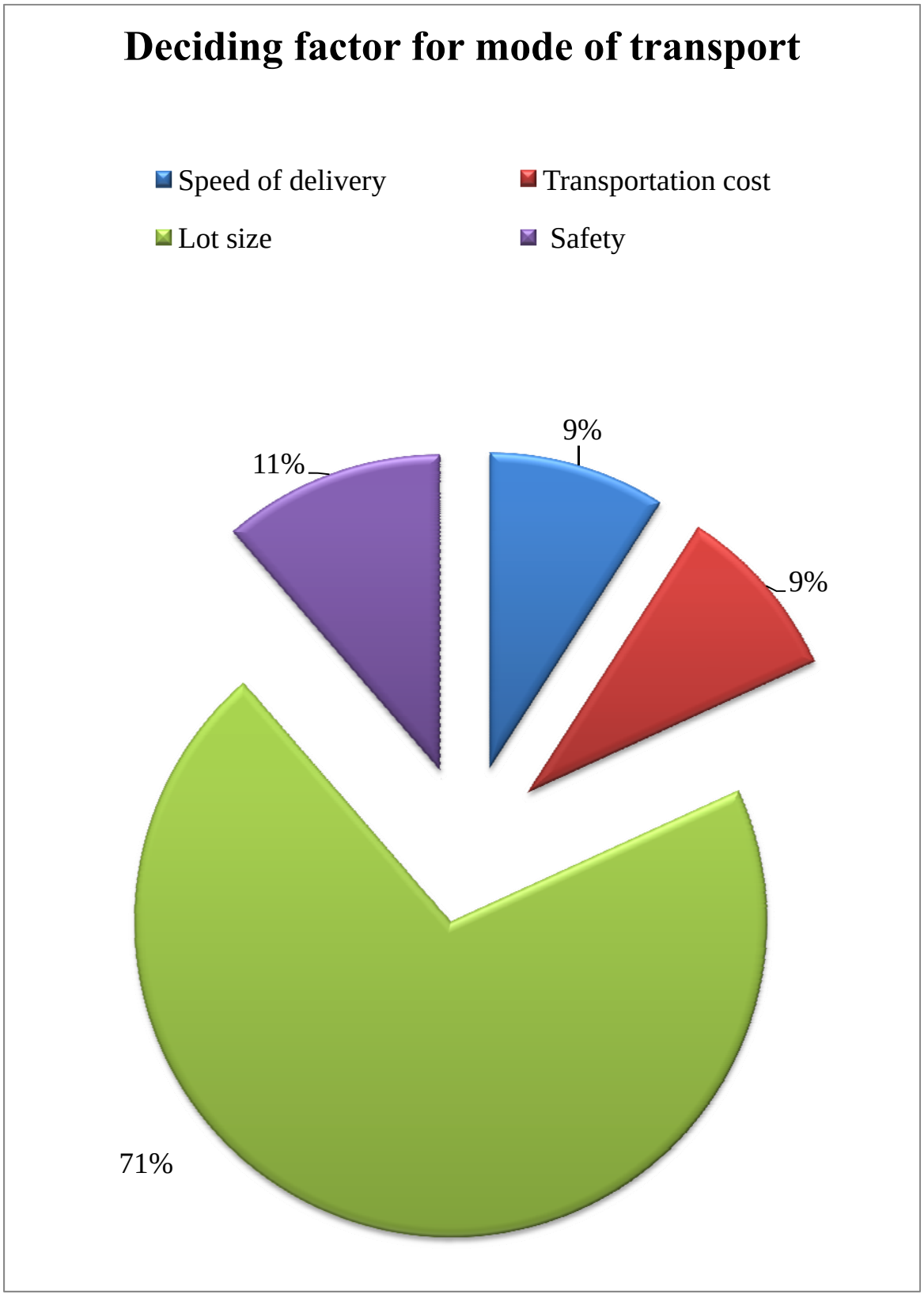
g) How you decide mode of transportation?

Speed of delivery and safety is important aspect in deciding the mode of transport.

Sr. No.	Particulars	Frequency	Percentage
1.	Speed of delivery	04	09
2.	Transportation cost	04	09
3.	Lot size	31	71
4.	Safety	05	11
Total		44	100

Table 4.54

Lot size is the deciding factor for choosing transportation mode which is answered by 71% of respondent firms, 11% says safety, 9% says cost of transportation and rest 9% says delivery speed is deciding factor.


Deciding factor for mode of transport
Speed of delivery
Transportation cost
Lot size
Safety
9%
9%
11%
71%

Graph 4.54

5.2.12 Customer Relation Management

CRM- as a new approach, a new technique, a new management concept for managing customers – focuses a business on creating a technological environment that integrates marketing, sales, service and back-office and supply chain functions in order to allow an enterprise to take a 360-degree view of its customers.

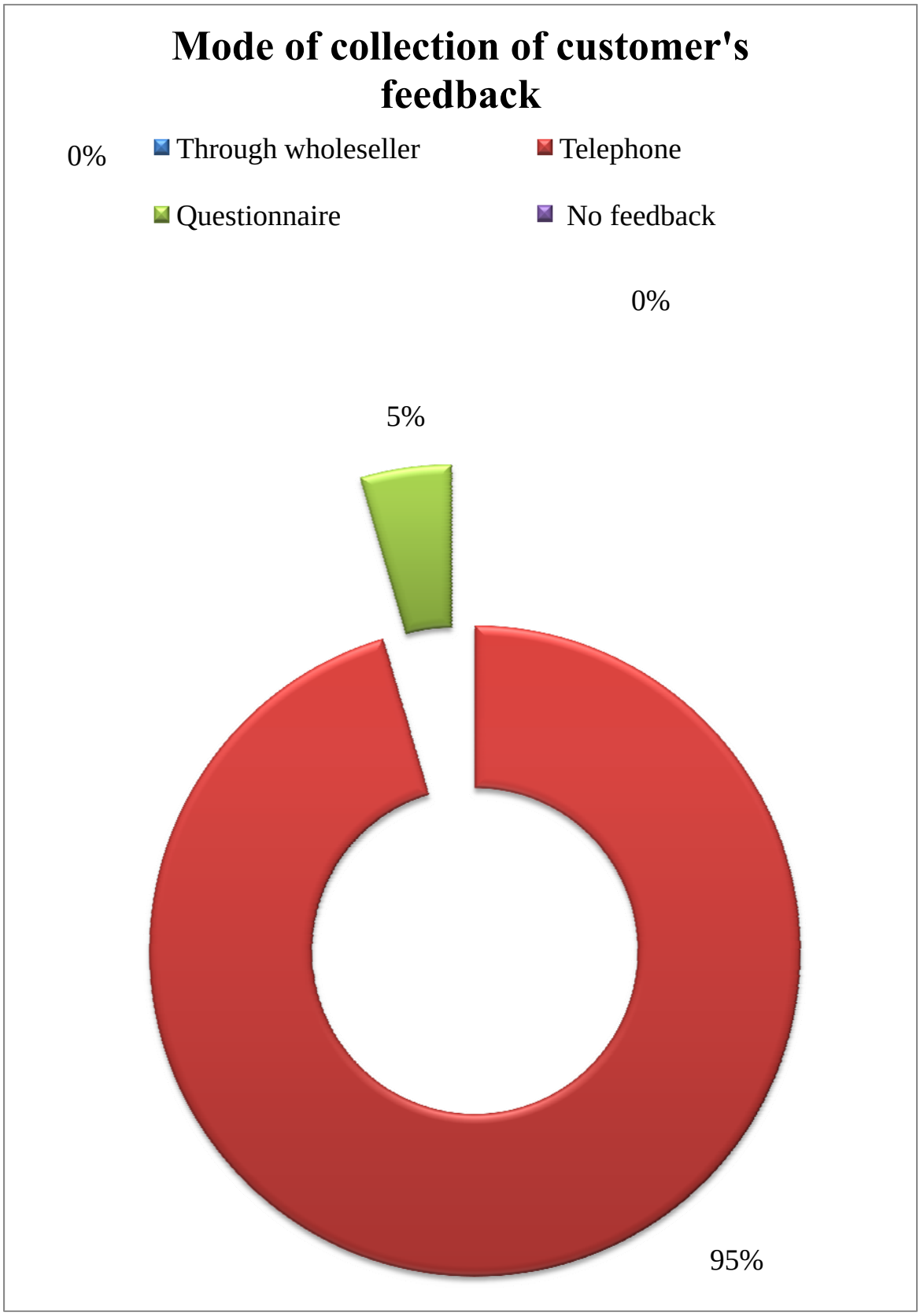
a) How you collect customers feed back?

Feedback should be collected regularly and suggestion given must be implemented to maximize the customer satisfaction.

Sr. No.	Particulars	Frequency	Percentage
1.	Through whole seller	00	00
2.	Telephone	42	95
3.	Questionnaire	02	05
4.	No feedback	00	00
Total		44	100

Table 4.55

CRM is understood by the small scale manufacturers and they know the importance of feedback. Not a single small scale manufacturer found who doesn't take customer feedback. Majority of the respondent units collects customers feed back through telephone and only 5% units says they prepare questionnaire.


Mode of collection of customer's feedback
0%
Through wholeseller
Telephone
Questionnaire
No feedback
0%
5%
95%

Graph 4.55

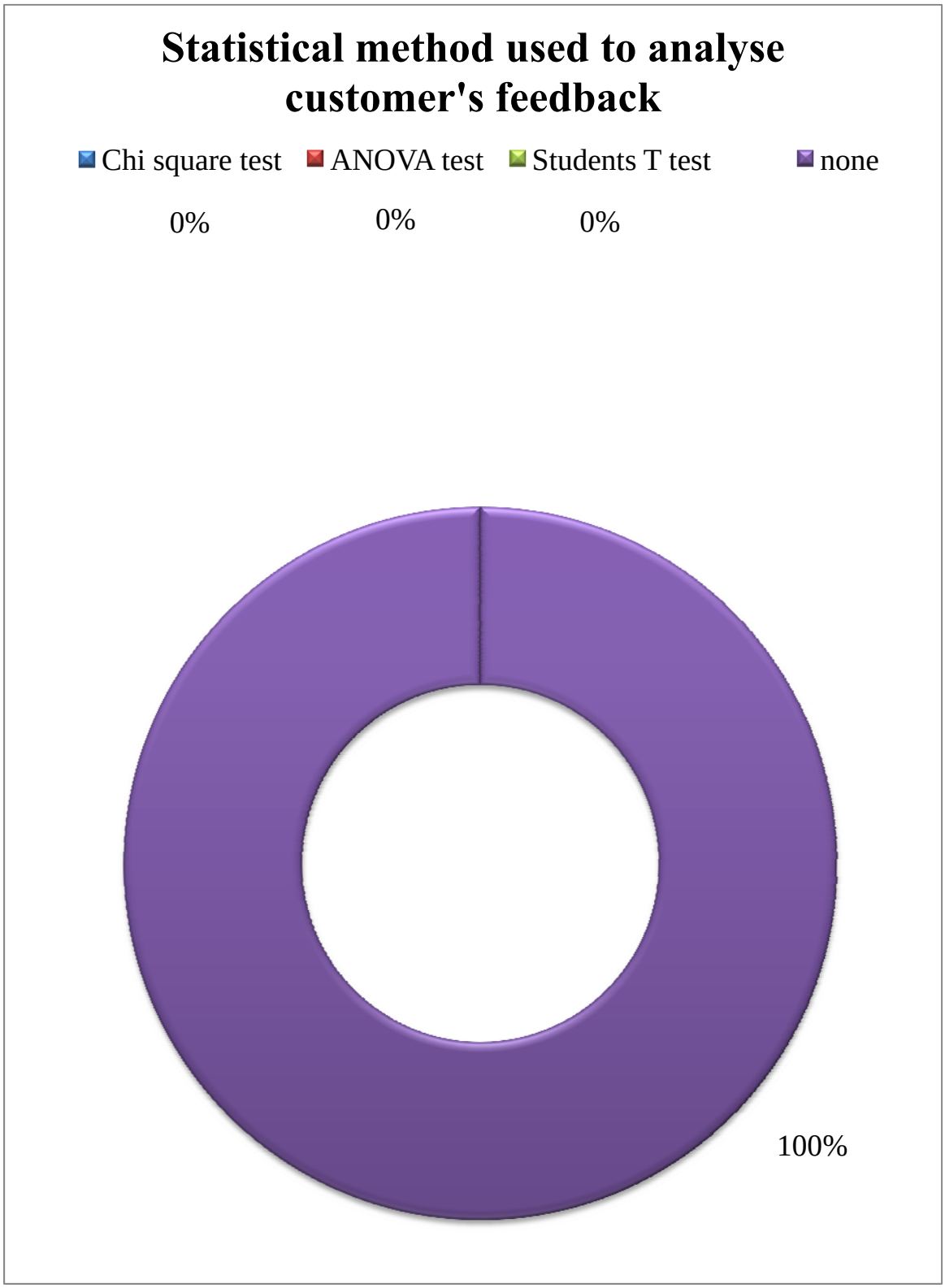
b) Which statistical method you use to analyse collected data?

Researcher is interested to know whether small scale manufacturing units under study uses any statistical method to analyse the collected data or not.

Sr. No.	Particulars	Frequency	Percentage
1.	Chi square test	00	00
2.	ANOVA test	00	00
3.	Students T test	00	00
4.	none	44	100
Total		44	100

Table 4.56

The data clearly indicates that none of the respondent units uses statistical method for analyzing the collected data. Researcher has conducted personal interview with the owner Managers, they showed interest in using the tools but could not make it feasible till date.


Statistical method used to analyse customer's feedback
Chi square test
ANOVA test
Students T test
none
0%
0%
0%
100%

Graph 4.56

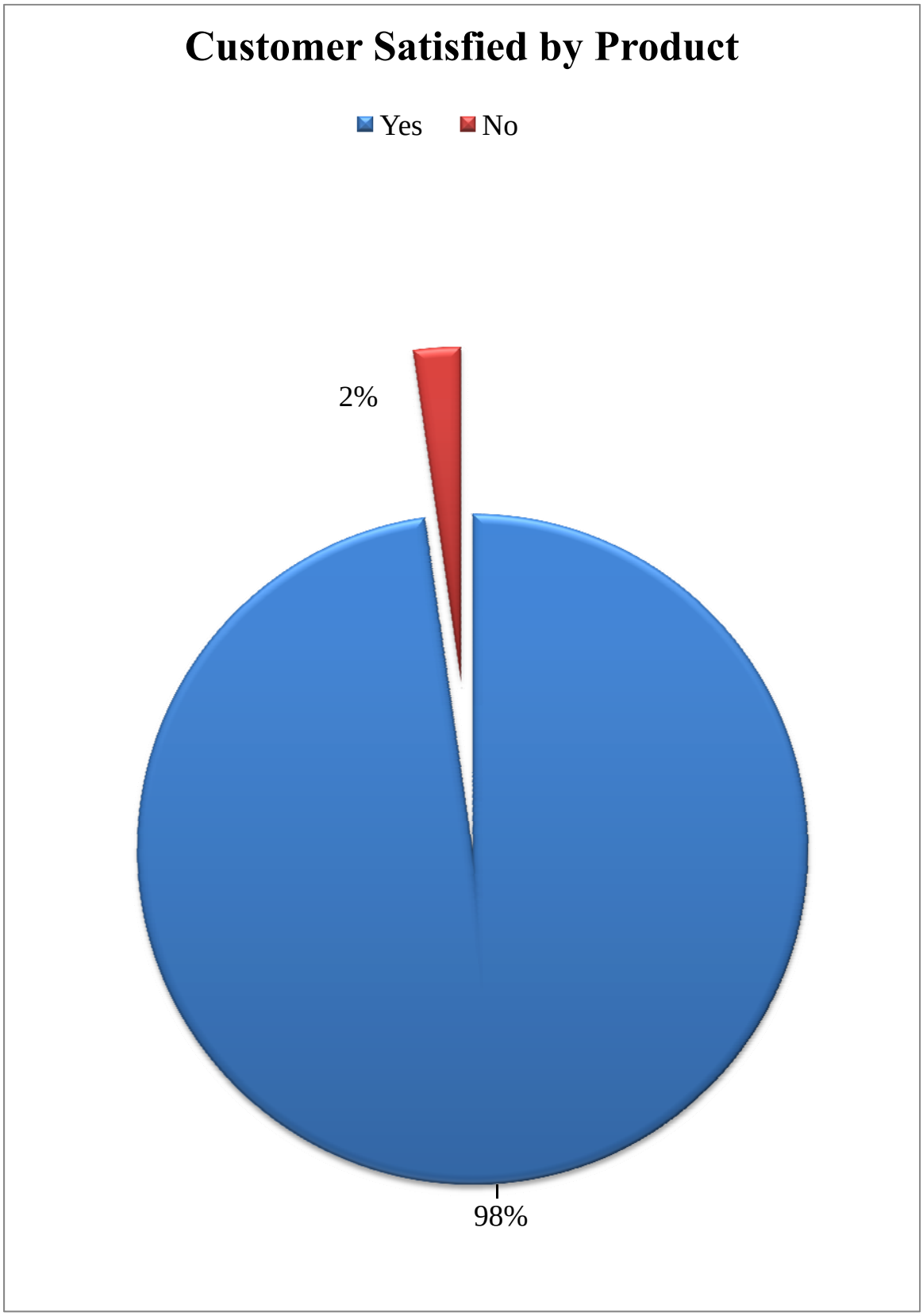
c) Do you think your customers are satisfied with you?

Perception of the firms and sense of self appraisal is the motive behind asking the question by researcher.

Sr. No.	Particulars	Frequency	Percentage
1.	Yes	43	98
2.	No	01	02
Total		44	100

Table 4.57

98% of the small scale manufacturing units under study says their customers are satisfied with them and only 2% units says customer is not satisfied. Quality matter is the reason for dissatisfaction, which is observed by researcher during interviewing the respondent.



Graph 4.57

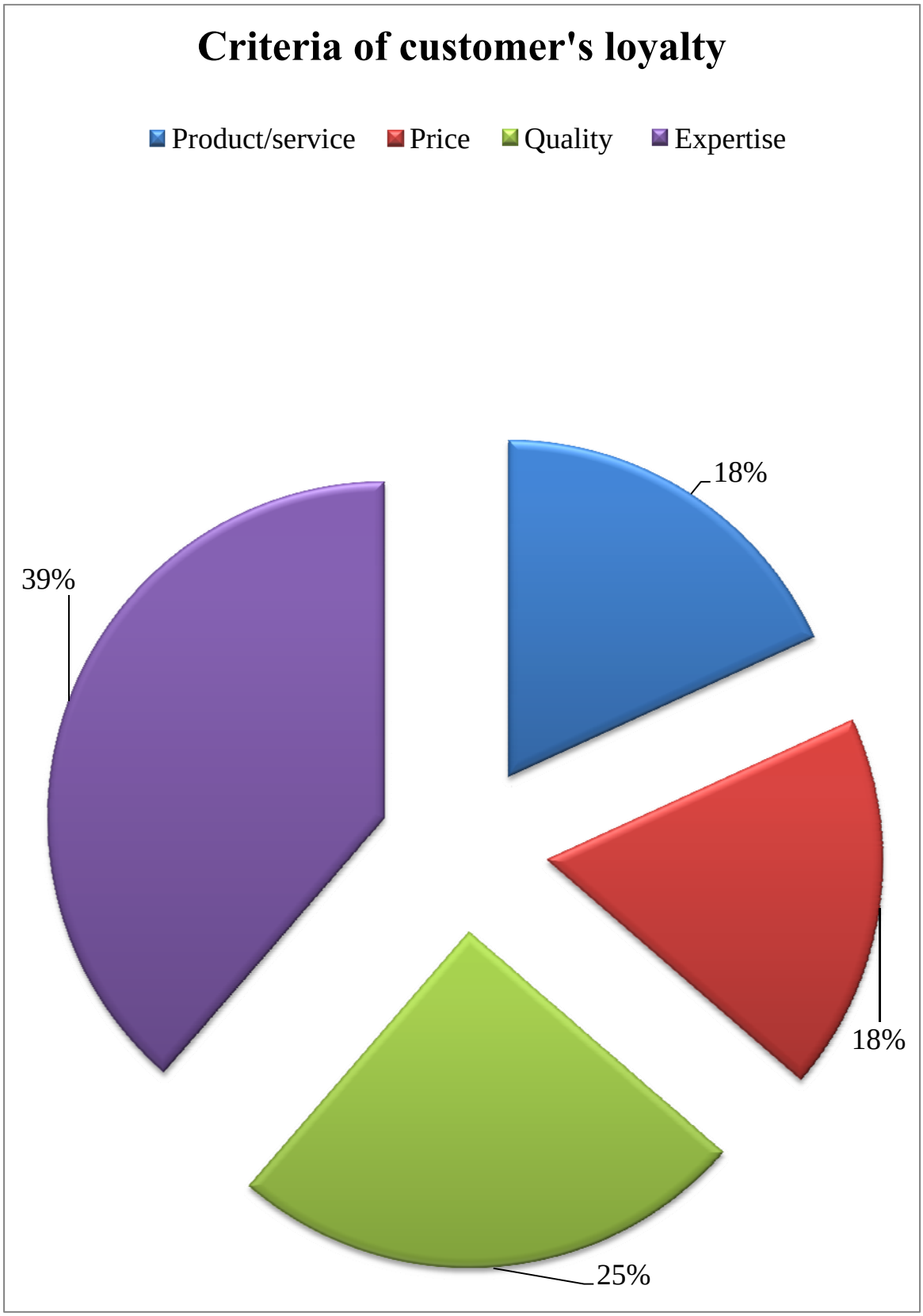
d) What made your current customers decides to do business with you?

Knowing strength of firms which keeps the customer loyal and persuade them for repeat business is the objective behind the question.

Sr. No.	Particulars	Frequency	Percentage
1.	Product/service	08	18
2.	Price	08	18
3.	Quality	11	25
4.	Expertise	17	39
Total		44	100

Table 4.58

39% respondent says their customers decides to business with them because of expertise they have gained in the business, 25% units says quality is deciding factor, 18% units says their product/service makes customer decide to do business with them and rest 18% says price is deciding factor for customer.


Criteria of customer's loyalty
Product/service
Price
Quality
Expertise
18%
18%
25%
39%

Graph 4.58

5.2.13 Network design

Network designs have a significant impact on performance because they determine the supply chain configuration and set constraints with which the other supply chain drivers can be used either to decrease supply chain cost or to increase responsiveness.

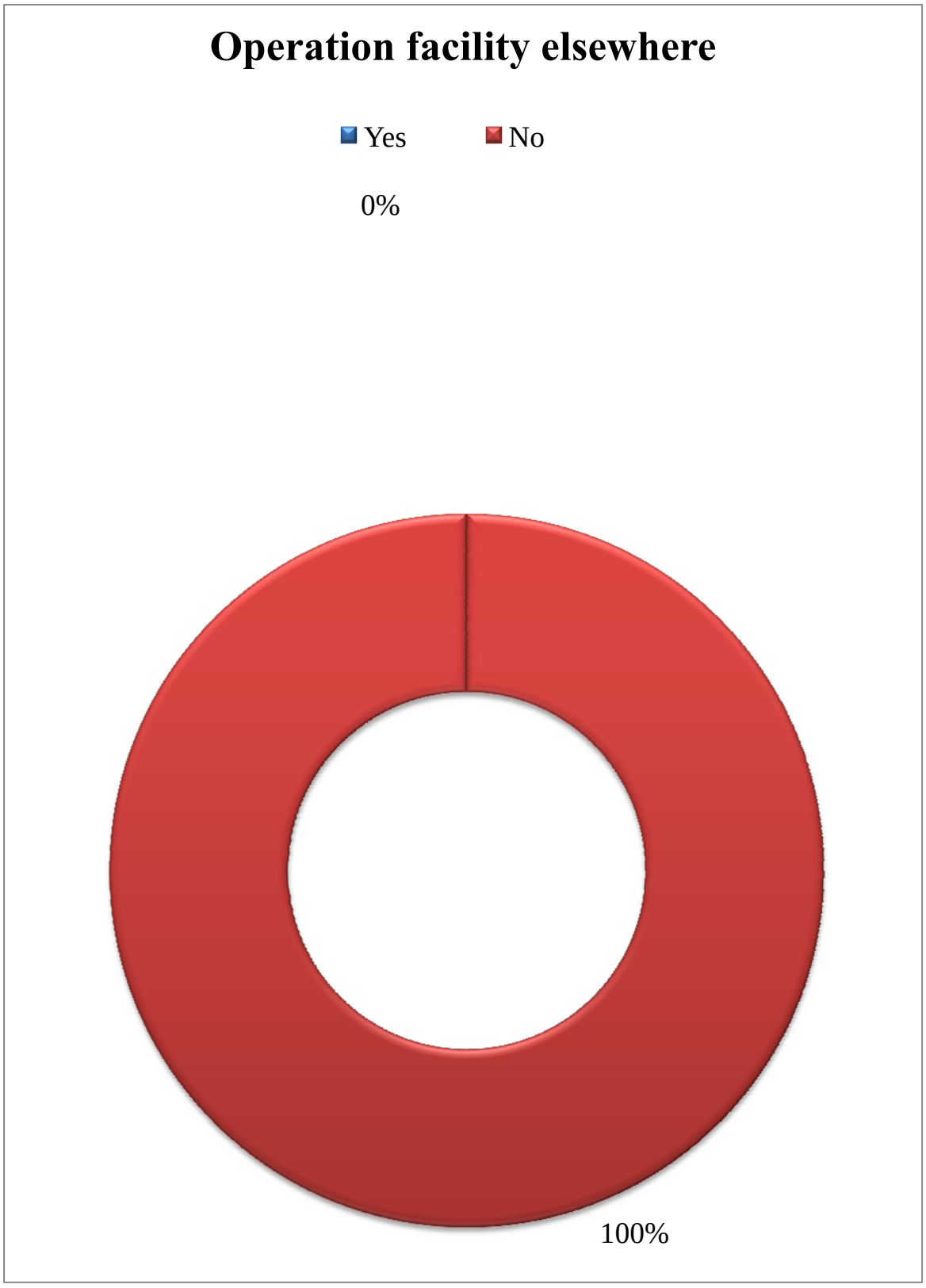
a) Do you have operations facility anywhere else?

To check the possibility of application of network design this question was asked by the researcher.

Sr. No.	Particulars	Frequency	Percentage
1.	Yes	00	00
2.	No	44	100
Total		44	100

Table 4.59

Among the small scale manufacturing units under study none of the units have operation facility anywhere else.



Graph 4.59

5.2.14 Supply chain strategy & performance measurement

A firm's supply chain strategy should ensure that its supply chain provides superior value to the end customer in an efficient manner. In almost all product categories, customers want more variety and quicker services at lower prices. Firms must recognize the nature of trade-offs between customer service and costs and arrive at an optimal decision on this front. If various processes and decisions within the chain are not aligned to suit a company's business strategy, it obviously cannot remain competitive in the long run.

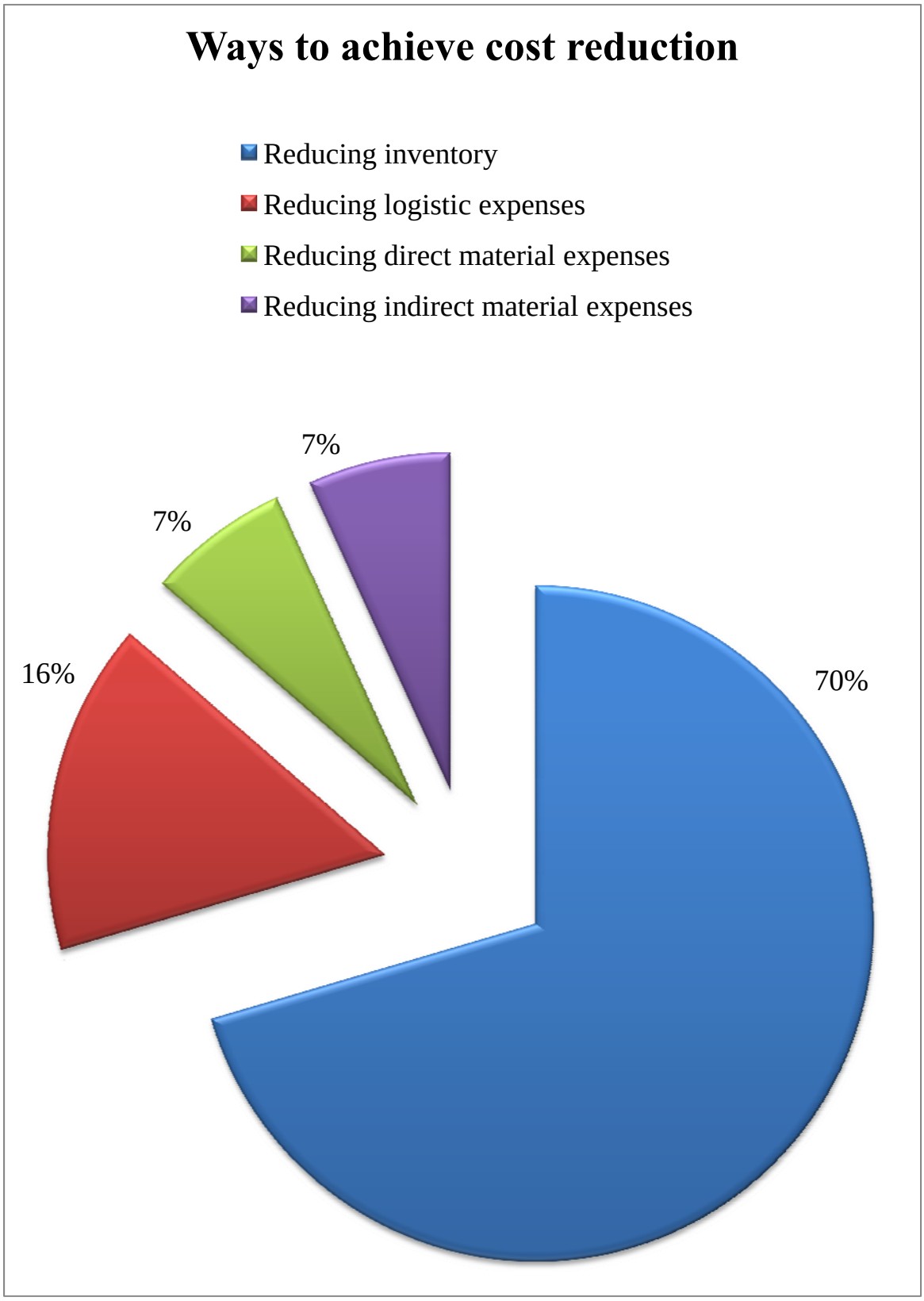
a) How cost reduction is achieved in your organisation?

To sustain in the today's competitive environment one must strive to reduce cost of overall process because increasing price cannot be the alternative for increasing profits.

Sr. No.	Particulars	Frequency	Percentage
1.	Reducing inventory	31	70
2.	Reducing logistic expenses	07	16
3.	Reducing direct material expenses	03	07
4.	Reducing indirect material expenses	03	07
Total		44	100

Table 4.60

Reducing inventory is the essence of reducing cost reduction which is followed by 70% of the small scale manufacturing units under study. It is also observed that 16% of the units achieve this by reducing logistic expenses, 7% achieves it by reducing direct material expenses and remaining 7% units achieves cost reducing indirect material expenses.


Ways to achieve cost reduction
Reducing inventory
Reducing logistic expenses
Reducing direct material expenses
Reducing indirect material expenses
7%
7%
16%
70%

Graph 4.60

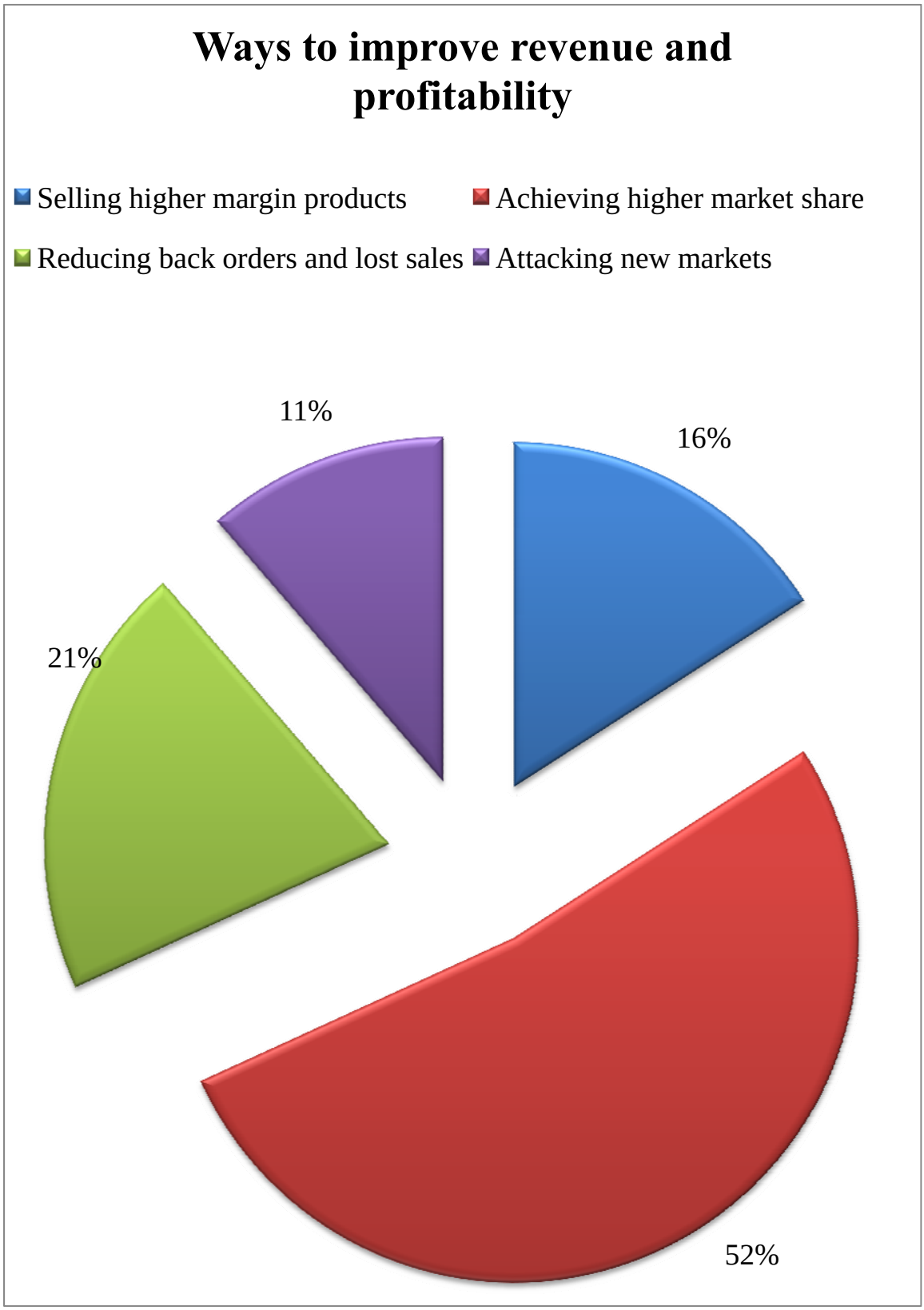
b) How revenue & profitability is improved?

Major objective of any firm is to improve the level of profitability by increasing revenue which indicates the efficient level of firm.

Sr. No.	Particulars	Frequency	Percentage
1.	Selling higher margin products	07	16
2.	Achieving higher market share	23	52
3.	Reducing back orders and lost sales	09	21
4.	Attacking new markets	05	11
Total		44	100

Table 4.61

To improve revenue and profitability respondent firms majorly tries to achieve higher market share. This is done by 52% of the firms where as 21% units improves by revenue and profitability reducing back orders and lost sales, 16% improves it by selling higher margin products and 11% improves by entering in new markets.


Ways to improve revenue and profitability
Selling higher margin products
Achieving higher market share
Reducing back orders and lost sales
Attacking new markets
11%
16%
21%
52%

Graph 4.61

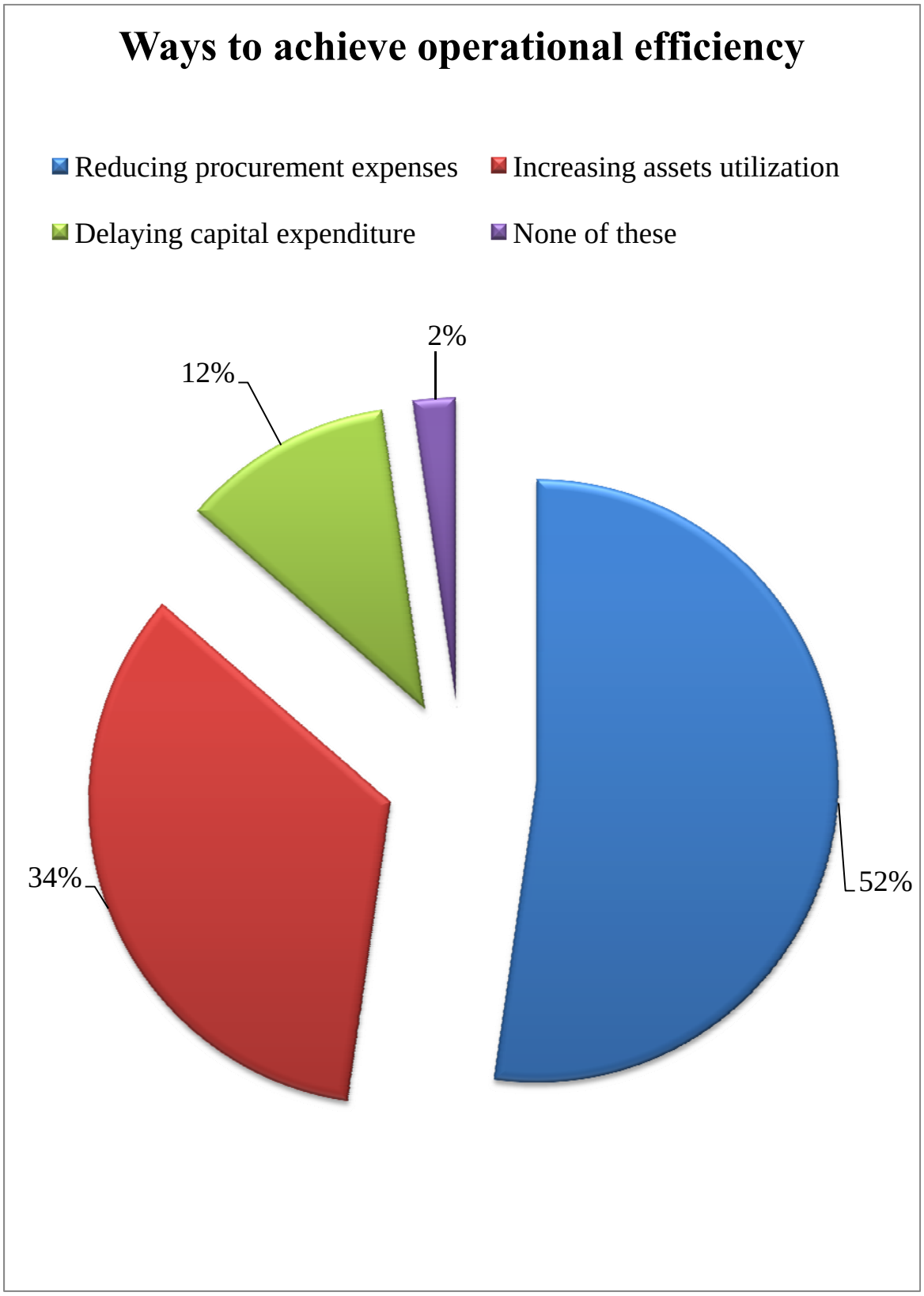
c) How you improve operational efficiency?

Operational efficiency means increasing productivity with better utilization of available resources. Researcher is interested in knowing the awareness of operational efficiency among small scale manufacturing units under study.

Sr. No.	Particulars	Frequency	Percentage
1.	Reducing procurement expenses	23	52
2.	Increasing assets utilization	15	34
3.	Delaying capital expenditure	05	12
4.	None of these	01	02
Total		44	100

Table 4.62

52% of the small scale manufacturing units improve operational efficiency by reducing procurement expenses, 34% units improves by increasing assets utilization, 12% improves by delaying capital expenditure and 2% does not use any of the mentioned methods. Even though they are using different ways of achieving the operational efficiency the ultimate result is the same as observed by researcher.


Ways to achieve operational efficiency
Reducing procurement expenses
Increasing assets utilization
Delaying capital expenditure
None of these
2%
12%
34%
52%

Graph 4.62

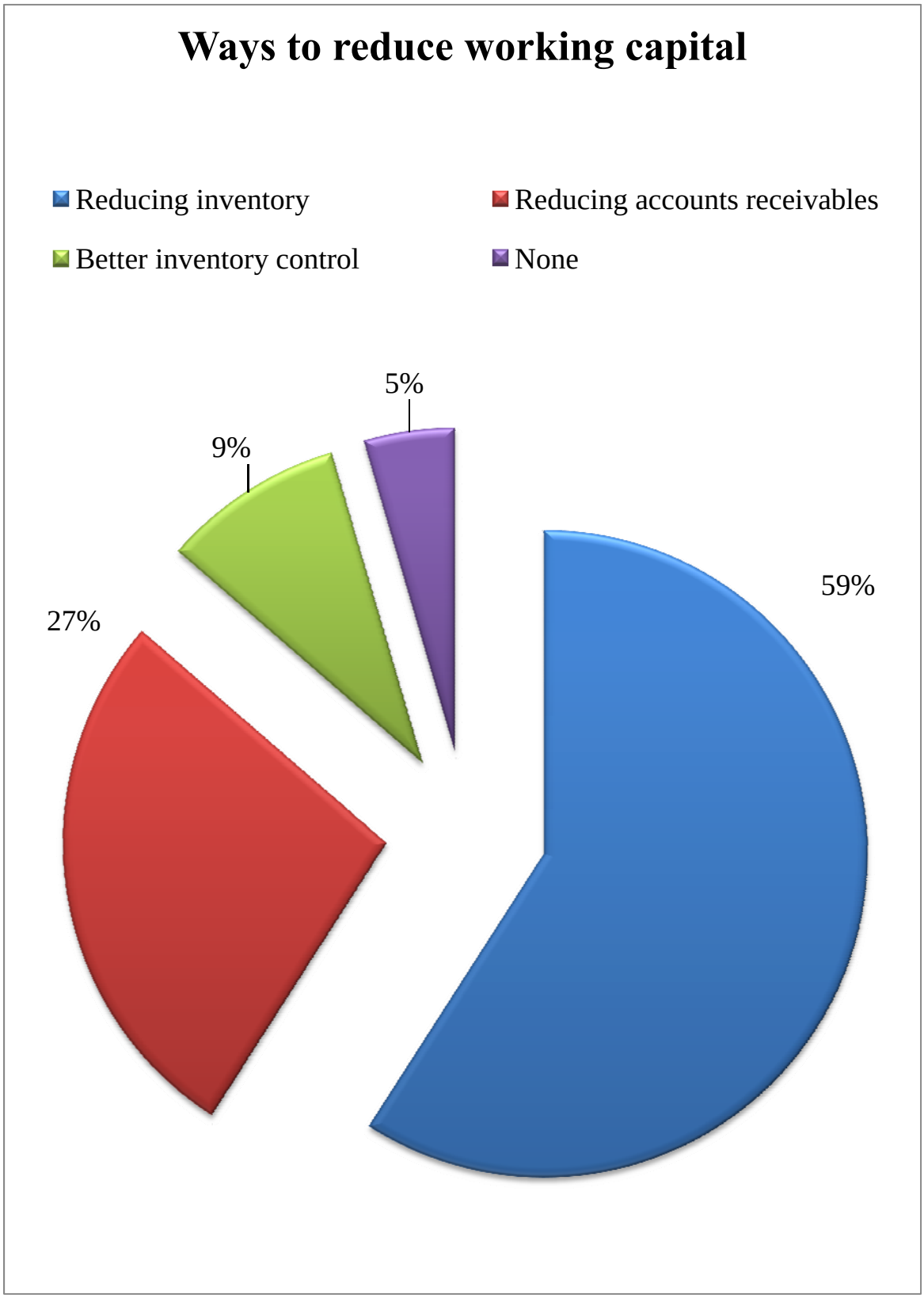
d) How you reduce working capital?

Working capital is called as blood for any firm. The firm's success depends upon how well these firms are able to reduce the use working capital.

Sr. No.	Particulars	Frequency	Percentage
1.	Reducing inventory	26	59
2.	Reducing accounts receivables	12	27
3.	Better inventory control	04	09
4.	None	02	05
Total		44	100

Table 4.63

To achieve the objective of reducing working capital 59% respondent units reduces the inventory, 27% reduces account receivables, 9% respondent units achieved it by better inventory control and rest 5% of the units doesn't apply any method.


Ways to reduce working capital
Reducing inventory
Reducing accounts receivables
Better inventory control
None
5%
9%
59%
27%

Graph 4.63

5.3 STATISTICAL ANALYSIS

Following the research methodology researcher has collected data through questionnaire and following three supply chain performance measures were calculated with the help of formula given.

5.3.1 Calculating length of various stages of the chain

The following formulae are used to calculate the length of the various stages in the supply chain:

DRM = RM x 356 / CRM

DWIP = SFG x 365 / CP

DFG = FG x 365 / CS

Total length of chain in days = DRM + DWIP + DFG

Where, CS = Cost of sales,

CP = Cost of production,

CRM = Cost of raw material,

RM = Raw materials inventory,

SFG = Semi-finished goods inventory,

FG = Finished goods inventory,

DRM = Days of raw material,

DWIP = Days of work in process,

DFG = Days of finished goods

The duration of time taken by the material flow is observed by this measure.

Sr. No.	Company Name	*Days of raw material*	*Days of work in process*	*Days of finished goods*	Length of SC
Engineering units					
1.	Ahmednagar Steels Pvt. Ltd.	0.050	0000	0.500	0.55
2.	Sachin Pattern & Engineering Works	0.025	0.02	0.008	0.053
3.	Shriram Udyog	0.013	0000	0.005	0.018
4.	Super-Tech Heavy Equipments	0.025	0.10	0.330	0.390
5.	Varun Industries	0.010	0000	0.167	0.177
6.	Sahayadri Engineering Works	0.019	0000	0.200	0.219
7.	Ashok Projects	0.020	0.250	0.500	0.770
8.	Mauli Industries	0.020	0.167	0.100	0.287
9.	Kaushik Enterprises	0.025	0.100	0.330	0.450
10.	Rajput Engineering Works	0.016	2.000	0.500	2.516
11.	Mahesh Engineering Works	0.003	0.025	0.200	0.228
Manufacturing units (others)					
1.	Kirti Galicha Tiles	0.063	0000	1.200	1.267
2.	S.B. Precision Springs	0.012	0000	0.083	0.095
3.	M/S Swami Tiles	0.008	0000	0.500	0.508
4.	Thacker Rubber & Allied Industries Pvt. Ltd.	0.019	0000	0.500	0.520
5.	Aayush Kitchen Trolleys	0.008	0000	0.200	0.208
6.	D.P. con Engineering	0.017	0.056	0.330	0.406
7.	Shree Rajlaxmi Industries	0.006	0000	0000	0.006
Chemical units					
1.	Sunil Industrial Corporation	0.021	0.107	0000	0.128
2.	Estelle Chemicals Pvt. Ltd.	0.014	0000	0.100	0.114
3.	Krishna Chemicals	0.066	0000	0.063	0.129
4.	M/S Mahesh Marketing	0.008	0.200	0.083	0.290
Casting/Fabrication units					
1.	Super-Tech Engineers	0.025	0.100	0.333	0.458
2.	Chetak Industries	0.008	0.017	3.030	3.055
3.	Apra Casting	0.056	0.013	0.813	0.882
4.	Supreme Industries	0.080	0.040	3.333	3.453
5.	Star Casting (Pvt.) Ltd.	0.050	0.067	0.050	0.167
6.	Sheetal Foundry	0.100	0000	0.200	0.300
7.	Forcas Impex Pvt. Ltd.	0.100	0000	0.200	0.320
8.	Utkarsha Industries	0.020	0.110	0.333	0.463
9.	Shreenivas Fab Innovative Pvt. Ltd.	0.030	0.667	1.493	2.190
10.	Saee Engineering & Fabricators	0.025	0.045	1.250	1.320
11.	Guru Engineering works	0.025	0.005	0.100	0.130
12.	Manakos Engineers & fabricators	0.020	0.188	0.167	0.374

Maintenance/Packaging units					
1.	Abhiruchi Enterprises	0.013	0.025	0.090	0.127
2.	Cargo Pack Industries	0.046	0000	0.001	0.047
3.	Shree Balaji Powder Coating & Anodizing	0.001	0.630	7.600	8.231
4.	Durga Polytherm Pvt. Ltd.	0.001	0.063	0.114	0.178
5.	S.S. Suppliers	0.014	0.087	0000	0.101
6.	Trimurty Foundry	0.100	0000	0.042	1.420
Agri product units					
1.	Chaitanya Poultry Feeds & Hatcheries	0.114	0000	0.500	0.614
2.	J.K. Engineering & Industries	0.025	0000	0.253	0.278
3.	Shubham Agro Implement	0.030	0.667	1.493	2.100
4.	Mahesh Fabrication	0.010	0.034	7.090	7.140

Table 4.64- Length of various stages of the supply chain

It is observed that 7 out of 11 engineering units (64%) have more length of supply chain due to a larger value of DFG as compared to values of DRM & DWIP. To reduce the length of supply chain, DFG should be reduced. The corresponding percentages for the remaining units are 86%, 50%, 83%, 67% & 100% respectively.

5.3.2 Evaluating the efficiency of Supply Chain Management

The internal supply chain inefficiency ratio is measure of the efficiency of internal supply chain management. To calculate this ratio, researcher considered total inventory carrying costs and the distribution costs to the components of the internal supply chain management costs. Researcher calculates the internal supply chain inefficiency ratio as follows:

$$SCC = DC + INV \times ICC$$

$$SCI = SCC / NS$$

Where *DC = distribution cost,*

INV = inventory (inclusive of raw materials, semi-finished goods and finished goods),

SCC = the supply chain management costs,

NS = net sales,

ICC = the inventory carrying cost,

SCI = the supply chain inefficiency ratio.

The inventory carrying cost for most firms is estimated to be in the range of 0.15 – 0.25. In the absence of any data, one can work with an inventory carrying cost of 0.2. *Firms with efficient supply chain systems will have relatively lower scores on this performance measure.*

Sr. No.	**Company Name**	***supply chain management costs (SCC) In lakhs***	***Net Sales (NS) In lakhs***	**SC Inefficiency**
Engineering units				
1.	Ahmednagar Steels Pvt. Ltd.	4.12	1000	0.004
2.	Sachin Pattern & Engineering Works	84.25	84	1.003
3.	Shriram Udyog	23.42	120	0.195
4.	Super-Tech Heavy Equipments	670.79	1800	0.400
5.	Varun Industries	184.93	60	3.080
6.	Sahayadri Engineering Works	3.27	10.2	0.321
7.	Ashok Projects	50.18	120	0.418
8.	Mauli Industries	80.89	7.2	11.234
9.	Kaushik Enterprises	670.79	1800	0.320
10.	Rajput Engineering Works	33.91	120	0.286
11.	Mahesh Engineering Works	5.55	90	0.062
Manufacturing units (others)				
1.	Kirti Galicha Tiles	69.59	144	0.483
2.	S.B. Precision Springs	3.29	36	0.091
3.	M/S Swami Tiles	91.24	132	0.690
4.	Thacker Rubber & Allied Industries Pvt. Ltd.	72.83	48	1.517
5.	Aayush Kitchen Trolleys	4.08	24	0.170
6.	D.P. con Engineering	9.79	50	0.196
7.	Shree Rajlaxmi Industries	0.04	12	0.003
Chemical units				
1.	Sunil Industrial Corporation	6.88	18	0.382
2.	Estelle Chemicals Pvt. Ltd.	429.48	500	0.859
3.	Krishna Chemicals	8.64	18	0.480
4.	M/S Mahesh Marketing	227.27	60	3.790
Casting/Fabrication units				
1.	Super-Tech Engineers	670.79	1800	0.370

2.	Chetak Industries	77.07	120	0.642
3.	Apra Casting	79.00	108	0.648
4.	Supreme Industries	208.03	360	0.579
5.	Star Casting (Pvt.) Ltd.	97.03	1000	0.097
6.	Sheetal Foundry	10.21	60	0.170
7.	Forcas Impex Pvt. Ltd.	10.21	63.8	0.160
8.	Utkarsha Industries	5.93	11	0.540
9.	Shreenivas Fab Innovative Pvt. Ltd.	54.45	27.6	1.970
10.	Saee Engineering & Fabricators	184.20	36	5.117
11.	Guru Engineering works	47.30	36	1.314
12.	Manakos Engineers & fabricators	75.19	30	2.506
Maintenance/Packaging units				
1.	Abhiruchi Enterprises	14.42	40	0.360
2.	Cargo Pack Industries	349.00	35	9.970
3.	Shree Balaji Powder Coating & Anodizing	520.13	24	21.67
4.	Durga Polytherm Pvt. Ltd.	100.88	20	5.044
5.	S.S. Suppliers	161.79	180	0.900
6.	Trimurty Foundry	22.14	120	0.185
Agri product units				
1.	Chaitanya Poultry Feeds & Hatcheries	7.67	14.4	0.532
2.	J.K. Engineering & Industries	28.17	72.0	0.391
3.	Shubham Agro Implement	54.45	27.6	1.940
4.	Mahesh Fabrication	1370.55	100	13.70

Table 4.65- Figures of elements of efficiency of supply chain

It can be observed from the table and formulas used that the inefficiency ratio can be reduced by either increasing sales value or reducing inventory. Increasing sales may be difficult than reducing inventory by applying selective inventory control methods.

5.3.3 Supply chain working capital productivity

The supply chain working capital productivity is calculated using the following formula:

$$SWC = INV + AR – AP$$

$$SWCP = NS / SWC$$

Where AR = Account receivables (excluding loans & advances),

AP = Account payables,

INV = Inventories (inclusive of raw materials, semi-finished goods and finished goods)

SWC = the supply chain working capital,

NS = net sales,

SWCP = the supply chain working capital productivity.

Sr. No.	Company Name	*Net Sales (NS) In lakhs*	*Inventory (INV) In lakhs*	*A/c receivables (AR) In lakhs*	*A/c payables (AP) In lakhs*	SC Working Capital Productivity
Engineering units						
1.	Ahmednagar Steels Pvt. Ltd.	1000	1.16	100	75	38.23
2.	Sachin Pattern & Engineering Works	84	418.23	10	2	0.200
3.	Shriram Udyog	120	116.80	20	18	1.010
4.	Super-Tech Heavy Equipments	1800	3244.46	900	800	0.480
5.	Varun Industries	60	730.00	10	6	0.082
6.	Sahayadri Engineering Works	10.2	13.63	1.5	0.5	0.722
7.	Ashok Projects	120	249.42	10	8	0.466
8.	Mauli Industries	7.2	401.50	4	1	0.178
9.	Kaushik Enterprises	1800	3244.46	800	700	0.500
10.	Rajput Engineering Works	120	169.46	4	0.75	0.695
11.	Mahesh Engineering Works	90	27.38	.65	0.50	3.270
Manufacturing units (others)						
1.	Kirti Galicha Tiles	144	165.47	4	2	0.860
2.	S.B. Precision Springs	36	14.26	6	3	2.090
3.	M/S Swami Tiles	132	455.84	0.8	0.6	0.289
4.	Thacker Rubber & Allied Industries Pvt. Ltd.	48	356.87	5	3	0.134
5.	Aayush Kitchen Trolleys	24	0.92	2	1.5	16.94
6.	D.P. con Engineering	978777	48.36	20	10	0.857
7.	Shree Rajlaxmi Industries	3600	0.18	1	0.5	17.65
Chemical units						
1.	Sunil Industrial Corporation	18	34.07	3	1	0.499
2.	Estelle Chemicals Pvt. Ltd.	500	2129.17	100	40	0.220
3.	Krishna Chemicals	18	38.32	1.5	1	0.465
4.	M/S Mahesh Marketing	60	1099.84	8	0	0.054

Casting/Fabrication units						
1.	Super-Tech Engineers	1800	3244.46	900	800	0.530
2.	Chetak Industries	120	384.62	10	6	0.309
3.	Apra Casting	108	313.49	15	5	0.333
4.	Supreme Industries	360	1034.17	15	13	0.350
5.	Star Casting (Pvt.) Ltd.	1000	1020.13	100	90	0.970
6.	Sheetal Foundry	60	41.06	2.5	1.5	1.426
7.	Forcas Impex Pvt. Ltd.	63.8	41.46	2.5	1.5	1.420
8.	Utkarsha Industries	11	29.57	2	1	0.360
9.	Shreenivas Fab Innovative Pvt. Ltd.	27.6	272.27	30	30	0.101
10.	Saee Engineering & Fabricators	36	914.93	90	85	0.393
11.	Guru Engineering works	36	235.99	15	10	0.149
12.	Manakos Engineers & fabricators	30	365.00	0.5	0.5	0.082
Maintenance/Packaging units						
1.	Abhiruchi Enterprises	40	71.63	6	4	0.543
2.	Cargo Pack Industries	35	347.80	14	10	0.099
3.	Shree Balaji Powder Coating & Anodizing	24	7.13	0.5	0.27	3.260
4.	Durga Polytherm Pvt. Ltd.	20	504.16	30	10	0.038
5.	S.S. Suppliers	180	802.96	15	12	1.090
6.	Trimurty Foundry	120	49.88	15	10	2.186
Agri product units						
1.	Chaitanya Poultry Feeds & Hatcheries	14.4	33.46	4	2	0.406
2.	J.K. Engineering & Industries	72.0	140.87	20	14	0.490
3.	Shubham Agro Implement	27.6	272.27	30	30	0.100
4.	Mahesh Fabrication	100	1368.75	12	4	0.072

Table 4.66- Figures to calculate SWCP

After analyzing the table it is observed that inventory figures are high.

Further all the performances of supply chain management are collected in a single table by the researcher for further analysis.

Sr. No.	Company Name	Length of SC	SC Inefficiency	SC Working Capital Productivity
Engineering units				
1.	Ahmednagar Steels Pvt. Ltd.	0.55	0.004	38.23
2.	Sachin Pattern & Engineering Works	0.053	1.003	0.200
3.	Shriram Udyog	0.018	0.195	1.010
4.	Super-Tech Heavy Equipments	0.390	0.400	0.480
5.	Varun Industries	0.177	3.080	0.082
6.	Sahayadri Engineering Works	0.219	0.321	0.722
7.	Ashok Projects	0.770	0.418	0.466
8.	Mauli Industries	0.287	11.234	0.178
9.	Kaushik Enterprises	0.450	0.320	0.500
10.	Rajput Engineering Works	2.516	0.286	0.695
11.	Mahesh Engineering Works	0.228	0.062	3.270
Manufacturing units (others)				
1.	Kirti Galicha Tiles	1.267	0.483	0.860
2.	S.B. Precision Springs	0.095	0.091	2.090
3.	M/S Swami Tiles	0.508	0.690	0.289
4.	Thacker Rubber & Allied Industries Pvt. Ltd.	0.520	1.517	0.134
5.	Aayush Kitchen Trolleys	0.208	0.170	16.94
6.	D.P. con Engineering	0.406	0.196	0.857
7.	Shree Rajlaxmi Industries	0.006	0.003	17.65
Chemical units				
1.	Sunil Industrial Corporation	0.128	0.382	0.499
2.	Estelle Chemicals Pvt. Ltd.	0.114	0.859	0.220
3.	Krishna Chemicals	0.129	0.480	0.465
4.	M/S Mahesh Marketing	0.290	3.790	0.054
Casting/Fabrication units				
1.	Super-Tech Engineers	0.458	0.370	0.530
2.	Chetak Industries	3.055	0.642	0.309
3.	Apra Casting	0.882	0.648	0.333
4.	Supreme Industries	3.453	0.579	0.350
5.	Star Casting (Pvt.) Ltd.	0.167	0.097	0.970
6.	Sheetal Foundry	0.300	0.170	1.426
7.	Forcas Impex Pvt. Ltd.	0.320	0.160	1.420
8.	Utkarsha Industries	0.463	0.540	0.360
9.	Shreenivas Fab Innovative Pvt. Ltd.	2.190	1.970	0.101
10.	Saee Engineering & Fabricators	1.320	5.117	0.393
11.	Guru Engineering works	0.130	1.314	0.149
12.	Manakos Engineers & fabricators	0.374	2.506	0.082

Maintenance/Packaging units				
1.	Abhiruchi Enterprises	0.127	0.360	0.543
2.	Cargo Pack Industries	0.047	9.970	0.099
3.	Shree Balaji Powder Coating & Anodizing	8.231	21.67	3.260
4.	Durga Polytherm Pvt. Ltd.	0.178	5.044	0.038
5.	S.S. Suppliers	0.101	0.900	1.090
6.	Trimurty Foundry	1.420	0.185	2.186
Agri product units				
1.	Chaitanya Poultry Feeds & Hatcheries	0.614	0.532	0.406
2.	J.K. Engineering & Industries	0.278	0.391	0.490
3.	Shubham Agro Implement	2.100	1.940	0.100
4.	Mahesh Fabrication	7.140	13.70	0.072

Table 4.67- Performance of SSMU's

Standard statistical tools like measure of central tendency and measure of dispersion were used by the researcher for the analysis of the performances of supply chain management of small scale manufacturing units under study and are presented in the tables below separately.

Sr. No.	Types of Units	Average	Standard Deviation	Coefficient of Variation (in %)
1.	Engineering units	0.5144	0.6991	135.9059
2.	Manufacturing units (others)	0.4300	0.4196	97.5814
3.	Chemical units	0.1653	0.0834	50.4537
4.	Casting/Fabrication units	1.0927	1.1696	107.0406
5.	Maintenance/Packaging Units	1.6840	3.2499	192.9869
6.	Agri Product units	2.5330	3.1717	125.2152

Table 4.68 - Statistics related to length of supply chain

From the above statistics, researcher interpreted that the chemical units are performing good since their average length of the supply chain is minimum amongst all along with the smallest value of coefficient of variation (CV), manufacturing unit follow them in performance.

Sr. No.	Types of Units	Average	Standard Deviation	Coefficient of Variation (in %)
1.	Engineering units	1.5748	3.3178	210.6807
2.	Manufacturing units (others)	0.4500	0.5274	117.2000
3.	Chemical units	0.4800	1.6213	337.7708
4.	Casting/Fabrication units	1.1761	1.4502	123.3058
5.	Maintenance/Packaging Units	6.3548	8.4036	132.2402
6.	Agri Product units	4.1408	6.4111	154.8276

Table 4.69- Statistics related to supply chain inefficiency

From the above results, it is interpreted by the researcher that the manufacturing units have smallest inefficiency value (i.e. maximum efficiency) with the lowest coefficient of variation. The chemical units follow them in performance but with a bigger value of coefficient of variation.

Sr. No.	Types of Units	Average	Standard Deviation	Coefficient of Variation (in %)
1.	Engineering units	4.1666	11.3316	271.9633
2.	Manufacturing units (others)	5.5457	8.0534	145.2188
3.	Chemical units	0.3095	0.2109	68.1280
4.	Casting/Fabrication units	0.5353	0.4754	88.8056
5.	Maintenance/Packaging Units	1.2027	1.2824	106.6216
6.	Agri Product units	0.2670	0.2121	79.4396

Table 4.70- Statistics related to supply chain working capital productivity

In this case, the manufacturing units seem to perform best with the maximum average supply chain working capital productivity, but with a little higher coefficient of variation. The engineering units follow manufacturing units in performance. In both the cases coefficient of variation is high.

Researcher also calculated chi-square test for the independence of two attributes at 5% level of significance to test the independence the type of unit with length of supply chain, supply chain inefficiency and supply chain working capital productivity. The corresponding Chi-Square values are 12.8314, 19.1701 and 7.2051 respectively as against tabulated value of $X^2_{10,\ 0.05} = 18.307$. The hypothesis of independence is accepted in case of length of supply chain & supply chain working capital productivity. But it's rejected in case of supply chain inefficiency. It shows that the supply chain inefficiency depends on the type of units.

To test the hypothesis that "*Logistics management has significance with reference to efficiency of small scale manufacturing units*." the researcher found it difficult to quantify the data for calculations. After discussion with the guide and statistician it was decided to give marks to the choices of the questions related to the logistics and take a total of marks obtained in all the questions and then present it as percentage. The same is shown in the table given below. It was also decided to take 70% marks as optimum score for small scale manufacturing units.

Sr. No.	Company Name	Logistics marks	Percentage Marks
Engineering units			
1.	Ahmednagar Steels Pvt. Ltd.	84	70
2.	Sachin Pattern & Engineering Works	90	75
3.	Shriram Udyog	89	74
4.	Super-Tech Heavy Equipments	80	67
5.	Varun Industries	82	68
6.	Sahayadri Engineering Works	86	72
7.	Ashok Projects	86	72
8.	Mauli Industries	82	68
9.	Kaushik Enterprises	80	67
10.	Rajput Engineering Works	83	69
11.	Mahesh Engineering Works	82	68
Manufacturing units (others)			
1.	Kirti Galicha Tiles	87	73
2.	S.B. Precision Springs	81	68
3.	M/S Swami Tiles	85	71
4.	Thacker Rubber & Allied Industries Pvt. Ltd.	90	75
5.	Aayush Kitchen Trolleys	83	69
6.	D.P. con Engineering	77	64
7.	Shree Rajlaxmi Industries	93	78
Chemical units			
1.	Sunil Industrial Corporation	84	70
2.	Estelle Chemicals Pvt. Ltd.	75	63
3.	Krishna Chemicals	85	71
4.	M/S Mahesh Marketing	83	69
Casting/Fabrication units			
1.	Super-Tech Engineers	80	67
2.	Chetak Industries	74	62
3.	Apra Casting	80	67
4.	Supreme Industries	85	71
5.	Star Casting (Pvt.) Ltd.	78	65

6.	Sheetal Foundry	84	70
7.	Forcas Impex Pvt. Ltd.	84	70
8.	Utkarsha Industries	87	73
9.	Shreenivas Fab Innovative Pvt. Ltd.	85	71
10.	Saee Engineering & Fabricators	90	75
11.	Guru Engineering works	86	72
12.	Manakos Engineers & fabricators	88	73
Maintenance/Packaging units			
1.	Abhiruchi Enterprises	85	71
2.	Cargo Pack Industries	79	66
3.	Shree Balaji Powder Coating & Anodizing	84	70
4.	Durga Polytherm Pvt. Ltd.	87	73
5.	S.S. Suppliers	76	63
6.	Trimurty Foundry	84	70
Agri product units			
1.	Chaitanya Poultry Feeds & Hatcheries	86	72
2.	J.K. Engineering & Industries	87	73
3.	Shubham Agro Implement	85	71
4.	Mahesh Fabrication	83	69

Table 4.71- Logistic performance of SSMU's

To test the hypothesis researcher used t-test to judge the performance of the different type of units by using their percentage marks. The null hypothesis

H_0: Average of the percentage marks is 70% for logistics of individual units, is tested against alternative hypothesis

H_1: Average of the percentage marks is greater than 70%.

Sr. No.	Types of Units	t calculated	t table value	Degree of freedom
1.	Engineering units	0	1.80	10
2.	Manufacturing units (others)	0.5994	1.94	6
3.	Chemical units	-0.8434	2.35	3
4.	Casting/Fabrication units	-0.2948	1.80	11
5.	Maintenance/Packaging Units	-0.7135	2.02	5
6.	Agri Product units	1.2677	2.35	3

Table 4.72- t- values of various categories of units for logistic performance

In case of all types of units the null hypothesis is accepted at 5% level of significance, which means that none of the units show a good performance.

Researcher further used t-test for all the 44 units in combination and the value thus found is -0.2150, where as $t_{43,0.05} = 1.65$. In this case the null hypothesis is accepted at 5% level of significance, which means that none of the units show a good performance.

By applying z-test to test the same null hypothesis against the corresponding alternative hypothesis based on all 44 units. The P-value of this z-test is calculated to be 0.5860 which is greater than 0.05 researcher interpreted that the null hypothesis should be accepted, which means, all 44 units taken together are not showing a good performance.

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CHAPTER-6
CONCLUSIONS AND FINDINGS

6.1 INTRODUCTION

In the foregoing chapters, an attempt has been made to analyse the management of supply chain in small scale manufacturing units in Ahmednagar MIDC using the data collected by the researcher. This detailed analysis has led to the interpretations, which are offered on the strength of statistical projection of the data, As a result, an understanding of management of supply chain in small scale manufacturing units in Ahmednagar MIDC has been made possible.

In this chapter the researcher proposes to arrive at certain conclusions on the basis of factor like demand forecasting, material resource planning, make or buy decision, purchasing process, transportation of raw material, material handling, inventory management, production planning and control, IT in supply chain, Transportation of finished goods, customer relation management, network design, supply chain strategy and performance measurement of the small scale manufacturing units in the area mentioned. These conclusions are presented with reference to the interpretations made in earlier chapter. Thus following the research methodology adopted the researcher has been able to present his conclusions individually with reference to each factor, which further, would be helpful to frame possible recommendations.

6.2 GENERAL CONCLUSIONS

Organisation profile

Gathering basic information like initial investment, turnover, number of workers working, number of working shift, level of management participation and product categories researcher has come to the following conclusions.

Initial investment is required to start the business and to purchase plant and machinery. 52% of the units have invested more than 30 lakhs, where as 48% units understudy has invested less than 30 lakhs. It is concluded that more than 71% of

the units have manpower less than 20 indicating majority of the units require less manpower and complexity is less as compared to the bigger firm present the same area.

It is also concluded that most of the units are engaged in job work with annual turnover more than 30 lakhs and falls in the category of intermittent production process and runs only first shift. Percentage of such units is 65.

If we look in the industry mix it is concluded that casting/fabrication units constitutes 27%, engineering units constitutes 25%, manufacturing 16%, maintenance/packaging units 14%, agri products and chemical units 9% each with the major business objective of profit maximization and other minor objective of increase returns on investment, turnover and maximization of customer satisfaction. Level of participation by the management in all the business activities is observed by the researcher at the time of personal interviews with the owners/managers. Participative decision making reduces engagement whereby profitability and productivity grows.

Demand forecasting

Forecasting is the pre condition of good planning. Lack of forecasting may create a problem in planning process though, 61% of the units under study are using demand forecasting for the business planning purpose, still 39% lack in its implementation. Planning never gives guarantee of success but still it definitely reduces the uncertainties. To reduce uncertainties time horizon plays key role in today’s competitive business environment short time horizon based forecasting using market research is in practice by 22 units out of 27 under study.

Researcher concludes that market research as a favorite method for forecasting is being utilized by majority of small scale manufacturing units but scientific approach should be developed by the units under study.

Material Resource Planning

Units under study are managing their material resource planning, 75% of the firms apply MRP and 25% looses advantage of the same out of total 44 units under study. 61% of the units are interested in controlling the inventory cost by implementing MRP where as 24% takes the advantage in procurement of raw material and 15% for the purpose of scheduling and product structuring. To be more specific researcher concludes that 73% of units apply MRP for direct and indirect material where as 24% for direct and 3% for indirect material.

Make or Buy decision

To reduce cost and concentrate on the core competencies of the business units, which is missing in small scale manufacturing units under study, researcher found that only 10 units (22%) under study out of 44 units outsource some of their activities. Out of these 10 units, 6 units (60%) outsource for strategic and investment reasons, remaining 4 units (40%) outsource for internal in capabilities and foe reducing cost of production.

Researcher concludes that 78% units understudy is far away from outsourcing and they should understand the importance of outsourcing in today's changing business environment for their growth and development.

Purchasing process

Purchasing involves funds which have alternative uses and should be given utmost importance. Researcher concludes that small orders dominate other methods of purchasing like blanket and stockless in small scale manufacturing units where the above concept is completely missing. 52% of the units understudy purchases in small orders where as 37% units prefer blanket and 11% prefer stockless and other methods of purchasing.

It is also concluded by the researcher that in the world of information technology very few small scale manufacturing units are making use of internet facility to search for the sources of supplies i.e. only 7% units, where as methods like referring trade directories are still popular in 77% units and 16% units refers catalogs which are time consuming methods.

Implementation of scientific procurement has helped 61% units to gain cost reduction over competitive price, wastage control and capital release. Researcher also concludes that only 43% units refer historical data while making purchases indicating good record keeping procedure whereas other units are not at the advantage of historical data as it is not in use.

Transportation of raw material

Transportation is an important supply chain driver because all the material is brought from different locations. Movement of material is important component of supply chain being non value adding process adds unnecessary cost to the product. 38 units under study purchase their major raw material from within the state reducing the complexity of transportation where as only 41units purchase other material from state reducing the lead time of procurement and ultimately reducing the length of supply chain.

To own the transport facility firms needs capital investment and many times it remains idle for days together leading to inefficiency of capital productivity. 91% of the firms own the facility and rest uses shared transport facility. Moreover 98% of the units under study use roadways which is decided by lot size in 66% units, speed of delivery in 21% units and cost and safety in 13% of units.

Nearly 66% of the units receive their raw material without packaging because of huge size and weight above 100 kgs of the raw materials. 71% of the units have weight of raw material above 100 kgs for a single unit.

Warehouses are owned by the respective firms and the raw material is stored into it.

Material handling

Cost of product increases to the extent of 15 to 25% and even more because of material handling in organizations. To reduce the unwanted cost the handling should be reduced to minimum. The study reveals that units under study knows the importance of location of stores and for this reason 86% units have their stores either near to entrance gate or near to the consuming department but the housekeeping part is lagging and needs utmost attention.

Researcher found that equally important factor of location of finished goods stores, 91% units have this facility near to main entrance or middle of the production plant. It is also concluded during physical visits to units that 80% of units use floor operated material handling equipments and posses less interest towards use of allied material handling equipments. Proper selection of material handling equipment reduces the cost to a measurable extent, researcher could not find allied material handling equipments with the units under study at the time of personal visits.

55% units under study believe in material handling affects the productivity as well as production.

Various criteria can be listed while selecting material handling equipment. Researcher concludes that 57% units give importance to safety, 18% are of the opinion that flexibility of equipment is important and 16% gives stress on efficient service and rest 9% to cost factor.

Inventory management

Success of SCM in any business units is dependent on inventory management. Inventory management is major issue in small scale manufacturing units under

study. Researcher concludes on the basis of detailed analysis of inventory management of small scale manufacturing units that 66% units maintain safety stock. Inventory replishment process in the units under study implement push strategy rather than pull strategy. 64% units are applying push strategy which indicates poor inventory management. Almost 77% units apply ABC as most popular selective inventory control technique.

Researcher concludes that 34% of the units have failed to manage inventory and these units must improve their inventory management techniques.

Production Planning and Control

Planning in all aspect of business is must because it is the essence of business management. Planning and control should go hand in hand otherwise it will create a problem while managing business activities. Production planning and control helps the units to achieve their set production objectives as to delivery, quality and quantity.

Plant layout refers to arrangement of machinery equipments, workers and other facilities inside plant. Plant layout is dependent on the production process. 52% units under study use process layout, 25% use product layout, 14% use mixed type of layout and 9% are not bothered about the plant layout.

Production type varies accordingly, 30 units are in job work, 12 units are in batch production, 2 units are in flow type production and none of the units have any other type of production.

35 units i.e. 80% are using flow chart to control the production process.

Researcher concludes from above analysis that majority of the small scale manufacturing units give the importance to production planning and control activities in their production activities.

IT Supply Chain Management

Supply chain is considered either too expensive or too sophisticated for the present level of business operations of small scale manufacturing units. Small scale manufacturing units suffer from being highly labour intensive, having less-educated employees, and consequently being weak in technology acceptance and adoption. This deters small scale manufacturing units from proactively embracing information and communications technologies. Researcher concludes that 59% of the units use IT for material accounting purposes only, other areas like demand management, computer aided process planning, process control and optimization, maintenance data management, warehouse management, transportation scheduling, sales and distribution where IT application is possible but researcher could not find its application may be because of financial constraints being small scale manufacturing units.

Transportation of finished goods

Small scale manufacturing units face natural disadvantage when dealing with the overall management of the supply chain that concerns them because of small size and high fragmentations. Small scale manufacturing units generally do not have a clear view of the entire supply chain beyond their immediate operations and contacts. Therefore, units under study can only manage the supply chain within their close proximity. It is concluded by the researcher that 40 out of 44 units under study sells goods within the state in their owned transport facility by road only and no other mode of transportation is used as transportation of finished goods is within the Maharashtra.

Researcher also concludes that 71% units under study prefer lot size over speed of delivery, transportation of cost and safety in selecting mode of transport.

Researcher also concludes that 48% unit’s product weight is more than 100 kgs and has huge size which makes packaging difficult. Packaging material used in other

units are corrugated sheets and plastic containers. All these packed goods are stored in their own warehouses.

Customer Relation Management

Best practice in SCM dictates the necessity to share and coordinate information with all suppliers and customers linked to them. Fear of survival leads to non sharing of data and information among small scale manufacturing units and their customers. It is concluded by the researcher that 95% of the units collects required CRM information through telephone and no statistical tools are applied to the data thus collected. While conducting the personal interview with the owner/manager researcher observed that the customers of the units under study are satisfied with their performance because of their expertise in the field, quality of products and good pricing.

Network design

Network designs have a significant impact on performance because they determine the supply chain configuration and set constraints with which the other supply chain drivers can be used either to decrease supply chain cost or to increase responsiveness. Researcher concludes that network design concept is absent in small scale manufacturing units and also they are completely unaware of this.

Supply chain strategy & performance measurement

A firm’s supply chain strategy should ensure that its supply chain provides superior value to the end customer in an efficient manner. In almost all product categories, customers want more variety and quicker services at lower prices. After analysis of collected data on the basis of cost reduction, improvement in revenue and profitability, operational efficiency and efforts to reduce the working capital it is concluded by the researcher that 70% of small scale manufacturing units under study follow inventory reduction as a method of cost reduction, 52% units tries to

achieve greater market share for uplifting of revenue & profitability, 52% units reduces procurement expenses for improving operational efficiency and 59% units reduce inventory to reduce the use of working capital.

6.2 STATISTICAL CONCLUSIONS

Statistical tools were used by the researcher to analyse the calculated data and following conclusions were given.

Length of supply chain

Length of supply chain depends on days of raw material, days of work in progress and days of finished goods. It is concluded by the researcher that 7 out of 11 engineering units (64%) have more length of supply chain due to a larger value of days of finished goods as compared to values of days of raw material & days of work in progress. To reduce the length of supply chain efforts have to be given to reduce the days of finished goods i.e. inventory of finished goods should be low as possible. The corresponding percentages for the remaining units are 86%, 50%, 83%, 67% & 100% respectively.

Efficiency of Supply Chain Management

The internal supply chain inefficiency ratio is measure of the efficiency of internal supply chain management. Firms with efficient supply chain systems will have relatively lower scores on this performance measure.

Researcher concluded that efficiency ratio can be reduced by either increasing sales value or reducing inventory figure. Increasing sales volume is difficult for these small scales manufacturing units thus these units must strive to reduce inventory by applying selective inventory control methods.

Supply chain working capital productivity

After detailed analysis of the table for supply chain working capital productivity it is concluded by the researcher that inventory figures are more for the units under consideration and should be reduced to improve the supply chain working capital productivity.

Further all the performances of supply chain management are collected in a single table by the researcher for further analysis.

Sr. No.	Company Name	Length of SC	SC Inefficiency	SC Working Capital Productivity
Engineering units				
1.	Ahmednagar Steels Pvt. Ltd.	0.55	0.004	38.23
2.	Sachin Pattern & Engineering Works	0.053	1.003	0.200
3.	Shriram Udyog	0.018	0.195	1.010
4.	Super-Tech Heavy Equipments	0.390	0.400	0.480
5.	Varun Industries	0.177	3.080	0.082
6.	Sahayadri Engineering Works	0.219	0.321	0.722
7.	Ashok Projects	0.770	0.418	0.466
8.	Mauli Industries	0.287	11.234	0.178
9.	Kaushik Enterprises	0.450	0.320	0.500
10.	Rajput Engineering Works	2.516	0.286	0.695
11.	Mahesh Engineering Works	0.228	0.062	3.270
Manufacturing units (others)				
1.	Kirti Galicha Tiles	1.267	0.483	0.860
2.	S.B. Precision Springs	0.095	0.091	2.090
3.	M/S Swami Tiles	0.508	0.690	0.289
4.	Thacker Rubber & Allied Industries Pvt. Ltd.	0.520	1.517	0.134
5.	Aayush Kitchen Trolleys	0.208	0.170	16.94
6.	D.P. con Engineering	0.406	0.196	0.857
7.	Shree Rajlaxmi Industries	0.006	0.003	17.65
Chemical units				
1.	Sunil Industrial Corporation	0.128	0.382	0.499
2.	Estelle Chemicals Pvt. Ltd.	0.114	0.859	0.220
3.	Krishna Chemicals	0.129	0.480	0.465
4.	M/S Mahesh Marketing	0.290	3.790	0.054

Casting/Fabrication units				
1.	Super-Tech Engineers	0.458	0.370	0.530
2.	Chetak Industries	3.055	0.642	0.309
3.	Apra Casting	0.882	0.648	0.333
4.	Supreme Industries	3.453	0.579	0.350
5.	Star Casting (Pvt.) Ltd.	0.167	0.097	0.970
6.	Sheetal Foundry	0.300	0.170	1.426
7.	Forcas Impex Pvt. Ltd.	0.320	0.160	1.420
8.	Utkarsha Industries	0.463	0.540	0.360
9.	Shreenivas Fab Innovative Pvt. Ltd.	2.190	1.970	0.101
10.	Saee Engineering & Fabricators	1.320	5.117	0.393
11.	Guru Engineering works	0.130	1.314	0.149
12.	Manakos Engineers & fabricators	0.374	2.506	0.082
Maintenance/Packaging units				
1.	Abhiruchi Enterprises	0.127	0.360	0.543
2.	Cargo Pack Industries	0.047	9.970	0.099
3.	Shree Balaji Powder Coating & Anodizing	8.231	21.67	3.260
4.	Durga Polytherm Pvt. Ltd.	0.178	5.044	0.038
5.	S.S. Suppliers	0.101	0.900	1.090
6.	Trimurty Foundry	1.420	0.185	2.186
Agri product units				
1.	Chaitanya Poultry Feeds & Hatcheries	0.614	0.532	0.406
2.	J.K. Engineering & Industries	0.278	0.391	0.490
3.	Shubham Agro Implement	2.100	1.940	0.100
4.	Mahesh Fabrication	7.140	13.70	0.072

Performance of SSMU's

Standard statistical tools like measure of central tendency and measure of dispersion were used by the researcher for the analysis of the performances of supply chain management of small scale manufacturing units under study and are presented in the tables below separately.

Sr. No.	Types of Units	Average	Standard Deviation	Coefficient of Variation (in %)
1.	Engineering units	0.5144	0.6991	135.9059
2.	Manufacturing units (others)	0.4300	0.4196	97.5814
3.	Chemical units	0.1653	0.0834	50.4537
4.	Casting/Fabrication units	1.0927	1.1696	107.0406
5.	Maintenance/Packaging Units	1.6840	3.2499	192.9869
6.	Agri Product units	2.5330	3.1717	125.2152

Statistics related to length of supply chain

From the above statistics researcher concludes that the chemical units under study are performing good since their average length of the supply chain is minimum amongst all along with the smallest value of coefficient of variation (CV), manufacturing units follow chemical units in performance. The remaining units need much improvement in their performance.

Sr. No.	Types of Units	Average	Standard Deviation	Coefficient of Variation (in %)
1.	Engineering units	1.5748	3.3178	210.6807
2.	Manufacturing units (others)	0.4500	0.5274	117.2000
3.	Chemical units	0.4800	1.6213	337.7708
4.	Casting/Fabrication units	1.1761	1.4502	123.3058
5.	Maintenance/Packaging Units	6.3548	8.4036	132.2402
6.	Agri Product units	4.1408	6.4111	154.8276

Statistics related to supply chain inefficiency

From the above results, it is concluded that the manufacturing units have smallest inefficiency value (i.e. maximum efficiency) with the lowest coefficient of variation. The chemical units follow them in performance but with a higher value of coefficient of variation. The other units need improvement in their performance.

Sr. No.	Types of Units	Average	Standard Deviation	Coefficient of Variation (in %)
1.	Engineering units	4.1666	11.3316	271.9633
2.	Manufacturing units (others)	5.5457	8.0534	145.2188
3.	Chemical units	0.3095	0.2109	68.1280
4.	Casting/Fabrication units	0.5353	0.4754	88.8056
5.	Maintenance/Packaging Units	1.2027	1.2824	106.6216
6.	Agri Product units	0.2670	0.2121	79.4396

Statistics related to supply chain working capital productivity

In this case, the manufacturing units seem to perform best with the maximum average supply chain working capital productivity, but with a little higher coefficient of variation. The engineering units follow manufacturing units in performance. In both the cases coefficient of variation's are high. So action is required to reduce the variations in the SWCP of these units.

Researcher also calculated chi-square test for the independence of two attributes at 5% level of significance to test the independence the type of unit with length of supply chain, supply chain inefficiency and supply chain working capital productivity. The corresponding Chi-Square values are 12.8314, 19.1701 and 7.2051 respectively as against tabulated value of $X^2_{10,\ 0.05} = 18.307$. The hypothesis of independence is accepted in case of length of supply chain & supply chain working capital productivity. But it's rejected in case of supply chain inefficiency. It is concluded that the supply chain inefficiency depends on the type of units.

Logistic performance of small scale manufacturing units

After testing the Logistic performance of SSMU's by the hypothesis,

H_0: Average of the percentage marks is 70% for logistics of individual firms against alternative hypothesis,

H_1: Average of the percentage marks is greater than 70%

with t-test to judge the performance of the different type of units by using their percentage marks researcher concludes that for all types of units the null hypothesis

is accepted at 5% level of significance, which means that none of the units show a good performance.

Sr. No.	Types of Units	t calculated	t table value	Degree of freedom
1.	Engineering units	0	1.80	10
2.	Manufacturing units (others)	0.5994	1.94	6
3.	Chemical units	-0.8434	2.35	3
4.	Casting/Fabrication units	-0.2948	1.80	11
5.	Maintenance/Packaging Units	-0.7135	2.02	5
6.	Agri Product units	1.2677	2.35	3

t- values of various categories of units for logistic performance

Using t-test for all the 44 units in combination the calculated t-value is found to be -0.2150. After compairing this value with tabulated value ($t_{43,\ 0.05} = 1.65$) researcher concluded that the null hypothesis is accepted at 5% level of significance indicating none of the units show a good performance.

Further to conclude through z-test, the same null hypothesis was used as in t-test above against the corresponding alternative hypothesis based on all 44 units. The P-value calculated (0.5860) was compared with probability value 0.05. Researcher concludes that the null hypothesis is accepted indicating that all the 44 units taken together are not showing good performance.

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CHAPTER-7
RECOMMENDATIONS

The collected data was analysed and interpreted using methods as described in the topic research methodology of this thesis. On the basis of analysis and interpretation, conclusions regarding the subject are drawn. Conclusions are verified and checked with the help of statistical techniques such as chi square test, t-test and z-test.

These tests are conducted in order to verify the hypothesis in order to bring out a clear picture of management of supply chain in small scale manufacturing units of Ahmednagar MIDC. The researcher proposes to arrive at certain recommendations on the basis of factor listed below, of the small scale manufacturing units in the area mentioned.

Demand forecasting

Material resource planning

Make or buy decision

Purchasing process

Transportation of raw material

Material handling

Inventory management

Production Planning and Control

IT in supply chain

Transportation of finished good

Customer Relation Management

Network design

Supply chain strategy and performance measurement

The researcher's recommendations, with reference to above mentioned factors, naturally follow the conclusions arrived at regarding these in the previous chapters. These recommendations are presented for all the factors as below.

- Forecasting being the precondition for planning any activity in the business, 39% units under study is not using demand forecasting for planning purpose. These units may be planning informally but a formal structured planning need to be developed by these small scale manufacturing units.

  Majority of the small scale manufacturing units are using a method of market research for demand forecasting, researcher would like to suggest small scale manufacturing units should also use other scientific demand forecasting methods.

  By applying other scientific methods of demand forecasting procurement can be more effective as to the existing status of the small scale manufacturing units.

- Material resource planning is the essence of inventory control. Material resource planning though it is practiced by small scale manufacturing units understudy researcher feels that the majority of these units need to improve their material resource planning for effective, efficient and improved productivity.

- Outsourcing has become a part of business today but the importance is yet not clear to the small scale manufacturing units under study, Therefore researcher would like to suggest that small scale manufacturing units should start outsourcing activities other than core business activities to the maximum extent. Researcher knows that implementation of outsourcing business activities may or may not be possible to great extent but wherever it is possible small scale manufacturing units should redefine the activities and outsource it.

- Capital of small scale manufacturing units is blocked in inventory, to control the inventory economic ordering method in purchasing should be adopted by these units.

  Small scale manufacturing units should develop the alternative sources of supply. Researcher recommends that these units should attend trade shows/fairs as well as must use modern internet techniques for searching new suppliers.

- Though the transportation is non-value adding process still it is very essential to increase form utility. Use of 3PL is strongly recommended for small scale manufacturing units to gain the expertise experience of these service providers in the field of logistics. The same concept of outsourcing logistics activities must be applied to warehousing also.

  Moreover “Working together Works” is the slogan of success. In today’s vibrant economy small scale manufacturing units cannot afford to compete in isolation or in localized market since the arena for competition has expanded. Small scale manufacturing units can come together and form work group for developing SCM practices which will lead to sustainable economic growth and business improvement.

- Use of scientific material handling is the road to success and this mantra should be accepted by small scale manufacturing units. These units differ in their business activities and accordingly they need to concentrate on internal material handling systems whereby cost reduction can be achieved.

  Material handling equipment should be properly selected to reduce the cost of material handling, in addition to that researcher would like to recommend for improving material handling efficiency all possible efforts should be under taken by small scale manufacturing units.

23% of the small scale manufacturing units under study are not having proper locations of finished goods stores. It is suggested that these units should relocate finished goods stores by which material handling cost can be reduced.

- 64% units understudy shows poor management of inventory which means these units should implement selective inventory control techniques like ABC, VED, SDE, HML etc. for improved productivity and efficiency of the respective units.

- Planning, replanning and control of production activities should be adopted on daily basis and new innovative production processes with automation must replace the older methods of production to increase the productivity and decrease the length of supply chain.

  Charts showing minute to minute development of product must be displaced on the shop floor at respective places to make aware the concerned personnel about the progress and improvement needed in the product.

- Automation is not possible without adopting information technology measures. Researcher recommends the training to the less educated employees about use of technology and up gradation in working style of these workers. Researcher do understand the expenses involved in these changes to be made but also knows that if sophistication is not adopted it will deter small scale manufacturing units in coming days and will left them nowhere.

  Researcher recommends that information technology should not be used only for material accounting purposes but also be used for demand management, manufacturing execution system, computer aided process planning, process control and optimization, engineering data management, maintenance data management, warehouse management, transportation scheduling, sales and

distribution, ERP/MRP II, drawings/CAD for organizational growth and sustainability.

- Small scale manufacturing units purchase and distribute their finished good majorly in Maharashtra thus full load utilization of transport must be adopted wherever possible while returning which will fetch them maximum utilization of available facility and cost reduction as well.

  It is also recommended that these small scale manufacturing units should utilize transport facility in common and cost thus incurred must be divided among them as per unit load cost.

- Though the small scale manufacturing units are in constant contact with their supplier as well as customers it is recommended that a formal way of collecting the information should be adopted and analysis should be carried to implement the outcome which will improve the relation between them and mutual goals of businesses can also be achieved.

  It is also recommended to these small scale manufacturing units that price of product must be analysed at regular intervals because price is the deciding factor for gaining customers loyalty with other factors.

  Small scale manufacturing units should share the data and information without the fear of survival for the better customer relation management.

- “United We Stand”, knowing this fact researcher recommends a development of network design within the same product category units to improve the overall performances of these units.

- If small scale manufacturing units has to serve the customer with product variety and quicker service at lower prices, these units should strive to increase their sales and should gain the advantages of mass production.

- The Small scale manufacturing units have not recognised the value of SCM as a tool for business excellence and a roadmap for growth in a competitive marketplace, therefore there is a need to work on following grounds

  a. Seek external advice and help from recognized experts.
  b. Formulate the Associations (informal or formal groups).
  c. Develop the network for collaboration on SCM practices.
  d. Conducts a benchmarking of performance management in supply chains.
  e. Should be in constant contact with Chambers of commerce or industry associations to bridge the gap of small scale manufacturing and SCM practices.

- Researcher strongly recommends that the large scale manufacturing units should actively promote the awareness of SCM through sponsored training and development programs. Right sets of people and skills should be developed which will provide the technical expertise and management know-how necessary to conduct good SCM practices to achieve operational excellence.

  Over and above large scale manufacturing units should financially support to streamline the respective areas small scale manufacturing units with regard to SCM implementation.

- Researcher strongly recommends that the human resources and financial constraints in small scale manufacturing units are to be analysed and a benchmark has to make in this regard which will help to decide the strategies

for stronger synergistic supply chain network for these small scale manufacturing units.

- Researcher feels the need of Government support is necessary in establishing the basic SCM infrastructure required for the efficient movement and distribution of goods and services were especially poignant. However, it was recognized during research that the infrastructure development must go in tandem with skills and incentives. Governments and relevant public and Industrial agencies like MCCIA must set clear policies in helping small scale manufacturing units to move with the SCM wave by facilitating the creation of logistics facilities for the survival, sustenance, growth.

To conclude, the researcher strongly recommends the following

a. Control of finished goods inventory which will help to reduce the length of supply chain.

b. Electronic links to firms and customers has to be improved to gain better CRM.

c. Continuous flow of products and information has to be maintained between these units and small scale manufacturers.

d. Proper material resource planning needed to avoid uncertainty.

e. Scientific purchasing procedure should be followed by small scale manufacturing units.

f. Supplier's warehouse should be used as far as possible.

g. Transport facility should be shared by these small scale manufacturing units, which will help to reduce the non value adding transportation cost.

h. Firms should work on plant layout, mixed layout is recommended to take advantage of both types of layouts.

i. Allied material handling equipment should be used which will give dual benefits of flexibility in material handling and reduced capital investment.

Researcher would like to draw the attention of small scale manufacturing units towards distribution operations which in the future will need to support mobile commerce, such as consumers ordering and paying for products with their smart phones. In fact, units that want to succeed in the long term may have no choice but to go mobile. Small scale manufacturing units must be fully prepared to go when and where our customers and consumers are. In addition to smart phones, consumers are increasingly using the internet and even television to place orders. To meet the demand for frequent, small orders that these technologies promote and enable companies will have to engage in rapid replenishment to ensure availability of their products.

Moreover small scale manufacturing units must also consider reverse logistics because it is a complicated process that requires the capture of numerous data such as the frequency, volumes, and types of returns. In order to properly understand and manage the process, each product should be traced from the point of return through final disposition. Warranties and service agreements must also be monitored, and credits must be applied where needed. The goal is always to minimize the number of returns as well as the cost of handling them and do it without alienating customers.

Thus it can be concluded that supply chain management has an impact on the performance of small scale manufacturing units situated in the Ahmednagar MIDC. Looking forward, the small scale manufacturing units displays tremendous potential in generating employment and boosting economy in the state. The newly

defined rules are *work in group*, *concentrate on core competency* and *share the infrastructure* that holds the key to success in the small scale manufacturing units.

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CHAPTER-8
APPENDIX

THE QUESTIONNAIRE

I] Organisation profile:-

a) Name of the organization:

b) Owners name:

c) Address:

d) Phone nos.:

e) Initial investment: ☐ 0-10 lakhs ☐ 10-30 lakhs ☐ 30 lakhs & above

f) Number of employees: ☐ 0-20 ☐ 20-40 ☐ 40 & above

g) Number of working shifts: ☐ Ist shift ☐ Ist & IInd shift ☐ Ist, IInd & IIIrd shift

h) Annual Turnover: ☐ 0-10 lakhs ☐ 10-30 lakhs ☐ 30 lakhs & above

i) Product catagory: ☐ Engineering ☐ Manufacturing ☐ Maintenance/Packaging
☐ Agri Products ☐ Casting/Fabrication ☐ Chemical

j) Business objectives: ☐ Maximise customer satisfaction ☐ Maximise profit
☐ Increase return on investment ☐ Increase turnover (sales)

k) Participation by management level:

☐ a. Director ☐ General Manager

☐ b. Senior Manager ☐ Manager

Note: Please give your preference numbers in the boxes given against each option wherever necessary.

II] Demand forecasting:-

a) Whether you use forecasting of demand for production planning?

☐ Yes ☐ No

(i) What period generally you consider for forecasting?

☐ Short term ☐ Medium term ☐ Long term ☐ Very large term

(ii) Which method you use for demand forecasting?

☐ Delphi approach ☐ Market research ☐ Life cycle analogy ☐ Informed judgement

(iii) Does demand forecasting methods affects efficiency of forecasting?

☐ Yes ☐ No

b) Whether demand forecasting has helped your organization in improving procurement procedure?

☐ Yes ☐ No

III] Material resource planning:

a) Do you use material resource planning while planning for purchasing?

☐ Yes ☐ No

b) Why you use material resource planning?

☐ Inventory control ☐ Scheduling ☐ Product structure ☐ Procurement of raw material

c) Which technique you use for material planning?

☐ Material planning for direct material ☐ Material planning for indirect material

☐ Both ☐ none

IV] Make or buy decision:

a) Which activities you outsource?

	Yes	No
Order processing	☐	☐
Inventory management	☐	☐
Customer service	☐	☐
Procurement	☐	☐
Import/Export management	☐	☐
Information system	☐	☐
Manufacturing	☐	☐
Warehousing	☐	☐
Transportation	☐	☐

b) What are the major reasons for outsourcing of above activities?

☐ Strategic reasons ☐ Investment reasons

☐ Lower cost ☐ Lack of internal capability

V] Purchasing process:-

a) Which buying method you use to procure material?

☐ Blanket orders ☐ Small orders ☐ Stock less orders ☐ Any other

b) How you select sources of supply?

☐ Trade directories ☐ Catalogs ☐ Internet ☐ Trade shows

c) Which scientific procurement method you use to purchase material?

☐ EOQ ☐ ABC ☐ POQ ☐ Any other

d) Which purchasing principle you find beneficial for application?

☐ Right supplier ☐ Right quality ☐ Right price ☐ Right Quantity

e) How your organisation have benefited from scientific procurement method?

☐ Competitive price ☐ Capital release ☐ Cost reduction ☐ Wastage control

f) What all records you use for purchasing?

☐ Records of basic information ☐ Records showing what is available

☐ Historical ☐ none of above

VI] Transportation of raw material:-

a) From where you purchase major raw material?

☐ Locally ☐ Within Maharashtra ☐ Outside Maharashtra ☐ Foreign market

b) From where you purchase other raw materials?

☐ Locally ☐ Within Maharashtra ☐ Outside Maharashtra ☐ Foreign market

c) How the raw material is transported to the factory?

☐ Separate facility ☐ Shared facility ☐ Through courier ☐ Directly to the vendor

d) How you decide mode of transportation?

☐ Speed of delivery ☐ Transportation cost ☐ Lot size ☐ Safety

e) Which mode of transportation you use to transport raw material?

☐ Railways ☐ Road ☐ Water ☐ Air

f) What is the approximate weight of raw material (per unit)?

☐ Below 10 Kgs ☐ Below 50 Kgs ☐ Below 100 Kgs ☐ Above 100 Kgs

g) What type of packaging material is used to pack raw material?

☐ Plastic containers ☐ Corrugated containers ☐ Metallic containers ☐ Without packing

h) Do you store raw material in warehouse? If yes choose option,

☐ Owned ☐ Shared ☐ Rented ☐ Suppliers warehouse

VII] Material handling:-

a) Where is your raw material stores situated?

☐ Near main entrance ☐ Far from entrance gate

☐ Middle of production plant ☐ In isolation

b) Where are your finished goods stores situated?

☐ Near main entrance ☐ Far from entrance gate

☐ Middle of production plant ☐ In isolation

c) Which principle you use to select material handling equipment?

☐ Planning principle ☐ Operating principle

☐ Equipment principle ☐ Costing principle

d) Which group of material handling equipment you use?

☐ Floor operated group ☐ Vertical handling group

☐ Overhead handling group ☐ Allied equipments

e) What in your opinion are the factors affecting material handling system?

☐ Production system ☐ Product to be handled

☐ Cost of material handling device ☐ Type of building in which material is to be handled

f) What criteria you think is important while selecting material handling equipment?

☐ Reduced cost of transportation ☐ Efficient services

☐ Safety ☐ Flexibility

g) Which is the problem area with respect to material handling, in your organisation?

☐ In receipts & stores ☐ In production areas

☐ In dispatch department ☐ No problem

VIII] Inventory management:-

a) What type of inventory is carried by your organization?

☐ Safety ☐ Seasonal ☐ Pipeline ☐ Dead stock

a) Which inventory replishment process you use?

☐ Pull ☐ Push

b) Which method you use to check inventory?

☐ Snap check ☐ Daily check ☐ Half yearly check ☐ Yearly check

c) Which scientific inventory control technique you use for your organization?

☐ ABC, ☐ VED, ☐ FSN, ☐ SDE.

d) In your opinion what must be the reason for inventory pileup?

☐ Uncertainty ☐ Forecasting errors ☐ Incorrect lead time ☐ Wrong safety stock

IX] Production planning and control:-

a) Which type of production layout is used in your organisation?

☐ Product layout ☐ Process layout

☐ Both in combination ☐ any other

b) Which production type do you use to produce product?

☐ Job ☐ Batch ☐ Flow ☐ Any other

c) How you control production progress?

☐ Gantt chart ☐ Flow chart ☐ Line balance ☐ Mile stone chart

d) Give preference about important core area in production planning?

☐ Manufacturing planning ☐ Factory planning

☐ Production planning ☐ Financial planning

X] IT in supply chain management:-

a) What is the usage pattern of IT applications?	Yes	No
Demand management	☐	☐
Manufacturing execution system	☐	☐
Computer aided process planning	☐	☐
Process control and optimization	☐	☐
Engineering data management	☐	☐
Maintenance data management	☐	☐
Warehouse management	☐	☐
Transportation scheduling	☐	☐
Sales and distribution	☐	☐
ERP/MRP II	☐	☐
Materials accounting	☐	☐
Drawings/CAD	☐	☐

XI] Transportation of Finished goods:-

a) In which market you sell your product?

☐ Locally ☐ Within Maharashtra ☐ Outside Maharashtra ☐ Foreign market

b) How the finished goods are transported to the whole seller/warehouse?

☐ Separate facility ☐ Shared facility ☐ Through courier ☐ Directly to the customer

c) Which mode of transportation you use to transport finished goods?

☐ Railways ☐ Road ☐ Water ☐ Air

d) What is the approximate weight of finished goods (per unit)?

☐ Below 10 Kgs ☐ Below 50 Kgs ☐ Below 100 Kgs ☐ Above 100 Kgs

e) What type of packaging material is used to pack finished goods?

☐ Plastic containers ☐ Corrugated containers ☐ Metallic containers ☐ Without packing

f) Do you store finished goods in warehouse? If yes choose option,

☐ Owned ☐ Shared ☐ Rented ☐ Whole seller warehouse

g) How you decide mode of transportation?

☐ Speed of delivery ☐ Transportation cost ☐ Lot size ☐ Safety

XII] Customer relation management:-

a) How you collect customers feed back?

☐ Through wholeseller ☐ Telephone ☐ Questionnaire ☐ No feedback

b) Do you use statistical methods to analyse collected data?

☐ Chi square test ☐ ANOVA test ☐ Students T test ☐ none

c) Do you think your customers are satisfied with your product?

☐ Yes ☐ No

d) What made your current customers decides to do business with you?

☐ Product/service ☐ Price ☐ Quality ☐ expertise

XIII] Network design:-

b) Do you have operations facility anywhere else?

☐ Yes ☐ No

c) If yes, whether you use any network planning & for what purpose?

☐ Cost minimization ☐ Profit maximization ☐ Work planning ☐ Timely delivery

d) Which of the four dimensions of customer service you stretched upon?

☐ Order delivery lead time ☐ Responsiveness ☐ Delivery reliability ☐ Product variety

XIV] Supply chain strategy & performance measurement:-

a) How cost reduction is achieved in your organisation?

☐ Reducing inventory ☐ Reducing logistic expenses

☐ Reducing direct material expenses ☐ Reducing indirect material expenses

b) How revenue & profitability is improved?

☐ Selling higher margin products ☐ Achieving higher market share

☐ Reducing back orders and lost sales ☐ Attacking new markets

c) How you improve operational efficiency?

☐ Reducing procurement expenses ☐ Increasing assets utilization

☐ Delaying capital expenditure ☐ none of these

d) How you reduce working capital?

☐ Reducing inventory ☐ Reducing accounts receivables

☐ Better inventory control ☐ none

e) Please give approximate figures:

Sr. no.	Particulars	Abbreviations	Figures
01.	Days of raw material	DRM	
02.	Days of work in progress	DWIP	
03.	Days of finished goods	DFG	
04.	Raw material inventory	RM	
05.	Cost of raw material	CRM	
06.	Semi finished goods inventory	SFG	
07.	Cost of production	CP	
08.	Finished goods inventory	FG	
09.	Cost of sales	CS	
10.	Distribution cost	DC	
11.	Inventories(RM,WIP,FG)	INV	
12.	Inventory carrying cost	ICC	
13.	Net sales	NS	
14.	Account receivables(excluding loans& adv)	AR	
15.	Account payables	AP	

Date:- **Name of organisation:**

Signature & seal:

8.2 SCOPE FOR FURTHER RESEARCH

Students and scholars who are interested in taking a research in the field of supply chain management for small scale manufacturing units have many good topics available. Few of them are mentioned herewith

1. Distribution operations in the Future

Distribution operations in the future will need to support mobile commerce, such as consumers ordering and paying for products with their smart phones. In fact, companies that want to succeed in the long term may have no choice but to go mobile. One must be fully prepared to go when and where our customers and consumers are.

In addition to smart phones, consumers are increasingly using the internet and even television to place orders. To meet the demand for frequent, small orders that these technologies promote and enable companies will have to engage in rapid replenishment to ensure availability of their products.

Supply chains in the future will also have to serve consumers in a sustainable manner. The product will have to flow smoothly through the supply chain with minimal inventory. To reach that objective, companies are likely to collaborate on warehousing and transportation. In addition, they may share third-party logistics service providers (3PLs) that will handle direct-to-store delivery for multiple companies or coordinate shared warehousing among different parties. Companies may also collaborate on city and suburban or rural deliveries.

The rapid exchange of point-of-sale data will be necessary to signal changes in consumer demand so that manufacturers can produce the products that retailers require. In this case, the companies need to share and synchronize master data, a base of common information about product types and inventory.

2. Reverse supply chain management

A reverse supply chain deals with the reverse flow of material, where the product moves back from the end customer (point of use) to the manufacturer. It can deal with either the entire product or a part of product (e.g., packaging material like the bottles in which Coke is sold). A firm has to manage this process during different phases of the product life cycle. The most common instances of reverse supply chain are as follows:

- ***New product return***: In developed markets, firms have been offering liberal return the product for any reason within a few months of purchase. Approximately six percent of retail purchase in the United States is returned by customers. In India, product returns of this kind are offered by catalogue companies and e-retailers. This category of products is usually re-packaged or re-branded for existing or new markets after minor repair operations.

- ***End-of-life product return***: Because of tough environmental regulations, firms in developed markets have to take responsibility for their products at the end of the product life and must provide for collection and product re-manufacturing or proper disposal. Many progressive firms have been promoting the idea of a green supply chain by ensuring that they re-use most of the components of the returned product and, consequently, achieve their goal of sustainable development. BMW has been working on the idea of a 'totally reclaimable' automobile.

There can also arise situations of product return at an intermediate stage of the product life cycle, as observed in the recent case of Mattel, where the company recalls its product because of unforeseen problems related to safety. (In 2007, the global toy manufacturer and marketer Mattel, Inc. recalled almost 800,000 Chinese-made toys.)

Reverse chains are more difficult to manage because of uncertainties in quantity and timing. Further, one may not have the necessary economies of scale in collection and transportation. Most firms have not been able to integrate their forward and return supply chains. In India, reverse supply chain is still in a nascent stage. However, as observed in developed markets, reverse supply chain will become an important issue for most firms in the coming decade.

Savings in Reserve Logistics: Reserve Logistics has become inevitable part of Supply Chain Management and it can be a significant source of costs and therefore of potential saving, in many organizations, it still receives much less attention than it deserves.

Reverse logistics is a complicated process that requires the capture of numerous data such as the frequency, volumes, and types of returns. In order to properly understand and manage the process, each product should be traced from the point of return through final disposition. Warranties and service agreements must also be monitored, and credits must be applied where needed. The goal is always to minimize the number of returns as well as the cost of handling them and do it without alienating customers.

Few points on how to accomplish that goal

Develop the right policies: The efficiency and cost of reverse logistics processes are greatly influenced by a company's returns policy. A stingy policy will keep costs low but may hurt customer relations, whereas an overly generous one, while attracting customers, will increase costs. Any policy should be benchmarked against industry standards. The usual standard in retail is a 30-day return, but policies are harder to benchmark for business-to-business companies and will require research.

Return product acquisition is fairly straight-forward for retailers-the customer simply brings products back to the store. Sellers of larger items, such as

furniture, often contract with their delivery providers for return services. Business-to-Business companies must decide who is responsible for unsold products and compare the costs and benefits of picking up inventory themselves, having distributors pick it up and deliver it to the disposition site, or outsourcing the process to a third party logistics company.

One economical strategy is to pick up unsold merchandise during the delivery of new inventory, creating backhauls for a private or outsourced fleet. Some companies have found that collaborating with customers to streamline the return process, including at times offering financial incentives to minimize returns; can greatly reduce the need for backhauls of unsold goods.

Whatever approach a company adopts, the key to successful product acquisition is full visibility from the moment the product is returned, so that responsibility and payment for the return can be clearly assigned. Consolidation and optimization of shipments can greatly reduce transportation and handling costs.

Regarding disposal, the trick is always to balance the costs of transportation, sorting, and disposal against any potential recoverable value. High value items such as electronics and automotive parts may be inspected, remanufactured, and resold. Unsold consumer goods, by contrast, may be shifted to areas where sales are stronger. Items with a short shelf-life, such as fashion apparel, are often sold to third parties that then resell them through discount outlets or to developing countries. Should final disposal be necessary, one option is to find a recycler that is willing to pay to reuse any recoverable material?

A symptom of inefficiency

Smart companies and their suppliers recognize that returns are often a symptom of inefficiencies elsewhere in the supply chain. To find out why products are being returned, appropriate data should be captured, analyzed, and shared with management throughout the organization. This information should also be fed

back to the product design team, as understanding the reasons for returns and failures can lead to better product design and eventually fewer costly returns.

The theoretical goal of reverse logistics is to have zero returns, eliminating the need for the process in the first place. Researcher may use the topic of reverse logistics of various companies for effective cost reduction. By working on this topic, researcher can uncover significant sources of cost savings, gain an edge in customer and supplier relations, and collect invaluable information for improving other areas of business.

Interested researcher have a vide scope to study on collaboration between trading partners to integrate the supply chain which will help to improve real-time visibility, reduce waste and lead times, support sustainability, and enhance service levels.

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