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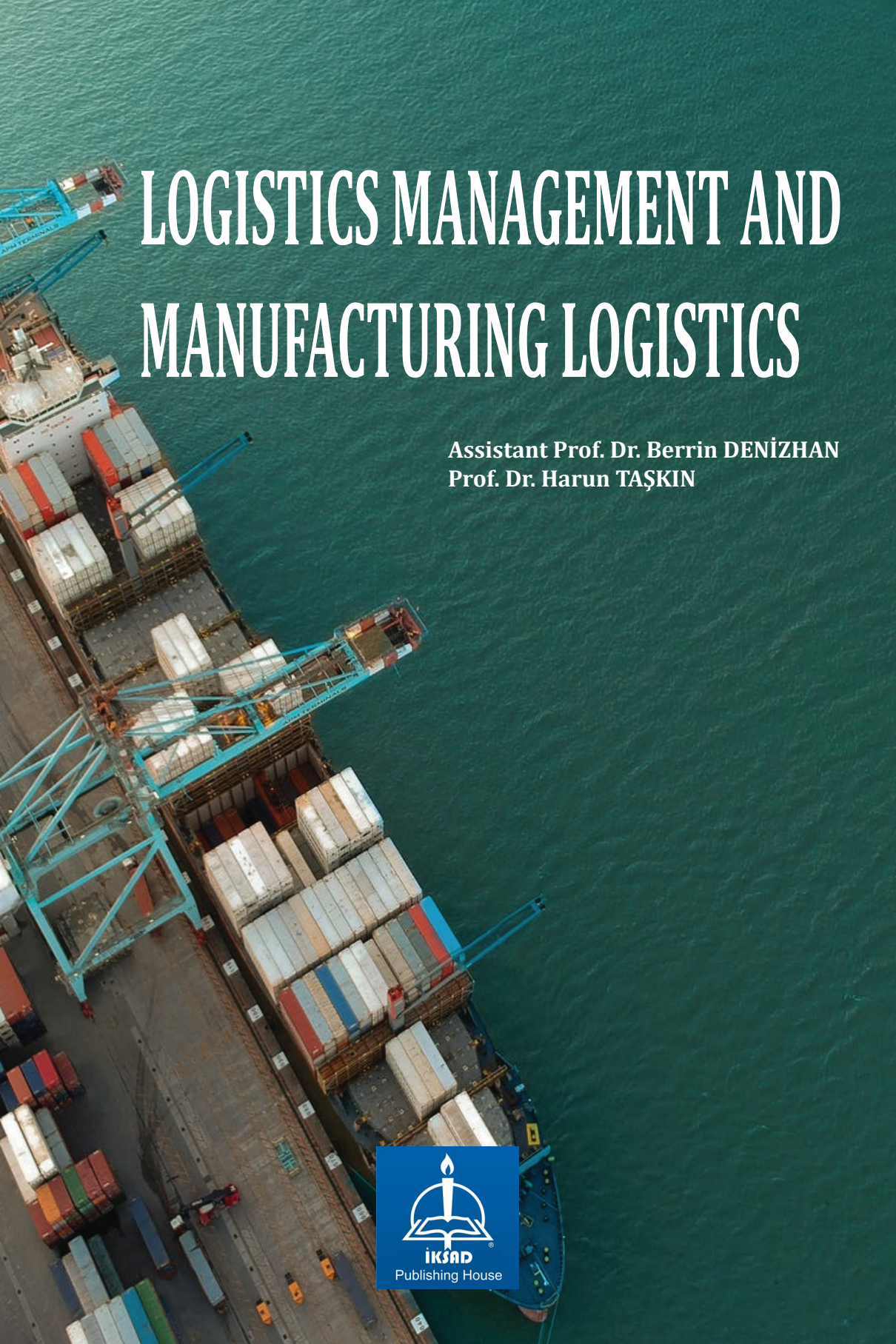

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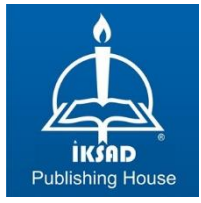

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PREFACE

In today's rapidly developing technology environment, it is necessary to keep up with this change and development. Hence, uncertain conditions such as the pandemic experienced in recent years increase logistics management's importance and keep it up to date. The human being, who always exists by producing something, has to catch this change first in himself and then in what he produces and in the places of production. The last point reached in manufacturing from the past to the present is speed, time, quality, and cost. “Logistics,” which collects these concepts in itself, is the main point of departure for today's businesses. Logistics cannot be thought of only as input and output logistics. For logistics to exist and ensure logistics success, the company's concept of manufacturing logistics should be accepted, and the success of the company's manufacturing logistics should be prioritized.

Small and medium-sized enterprises (SMEs) need the most significant support in logistics and manufacturing logistics today. This book aims to contribute to the industry and readers from a manufacturing logistics perspective divided into four parts. The first one is concerned with the logistics management concepts. The second part focused on SMEs growth in Turkey. The third part is about manufacturing logistics and logistics focused factory.

This book was produced from the doctoral thesis entitled “Manufacturing logistics simulation model and an application" dated 2006, prepared by Prof. Dr. Harun Taşkın Consulting.

İÇİNDEKİLER

INTRODUCTION

In order to survive and compete effectively in today's business environment, manufacturing SMEs must change their focus from the functional model of management and operation to a flexible/manufacturing logistics view. One of the main objectives of manufacturing logistics is to manage logistics functions to achieve planned manufacturing activities in a specific time and quality. Successful logistics processes have broad functionality such as reducing inventory for all kinds of investment, increasing demand response flexibility, and achieving the correct product delivery at the right time with the minimum cost. The main objective of manufacturing logistics is to manage logistics functions to achieve planned manufacturing activities in a specific time and quality. The proposed Manufacturing Logistics approach and Model (ManLog) aims to provide this functionality in each SMEs. The model allows coordinating the logistics planning with manufacturing and using production schedule and inventory information provided by critical suppliers. By using this information, the logistics unit provides a temporary production plan to the manufacturing. In addition, the logistics unit assumes the responsibility of shop floor control activities and guides the departments such as manufacturing and maintenance in which material and information flow occur. (Denizhan, 2006). SMEs manufacturing systems information in terms of logistic capabilities and management of manufacturing logistics are not appropriately utilized to determine the most effective production plans (Scholz-Reiter et al., 2010). Most of the problems in SMEs occur due to the

unbalanced integration of internal manufacturing and logistics activities. We consider manufacturing logistics/supply chain problems of significant managerial interest in Turkey's small-medium enterprises (SMEs).

Logistics management analyses not only logistical problems but also primary manufacturing problems in the manufacturing environment. The manufacturing logistics concept was used as a function for decision-making systems in 1990 and 1992. Its aim is the control of manufacturing flows (Fordyce,1992; Fordyce 1990). In addition, manufacturing logistics refers to all planning, coordination, and service functions required to carry out manufacturing activities. A narrow and more traditional view of manufacturing logistics includes planning, scheduling, and controlling all activities resulting in the acquisition, processing, movement, and storage of inventory. These activities include order acceptance, production planning, and scheduling, inventory control, inventory distribution, and the design of the corresponding decision processes and decision support systems. A more appropriate, broader view of manufacturing logistics considers the flow of material, information, and services across enterprise, industry, and national boundaries. Coordinating these complex activities may require integrating multiple facilities and firms, manufacturing and service functions including sales, marketing, and information technology, and integrating with traditional logistics functions such as transportation, warehousing, and distribution. While research topics falling into the narrower view of manufacturing

logistics have been studied intensively, many issues involved in the broader view are still not well understood (Wu, 1999). Figure.1 summarizes the main aspects of manufacturing logistics research in a three-dimensional space. The three main dimensions are systems, decision scopes, and business environments. Given the three main dimensions, we may categorize manufacturing logistics research using the nomenclature: System, Decision Scope, Business Environment.

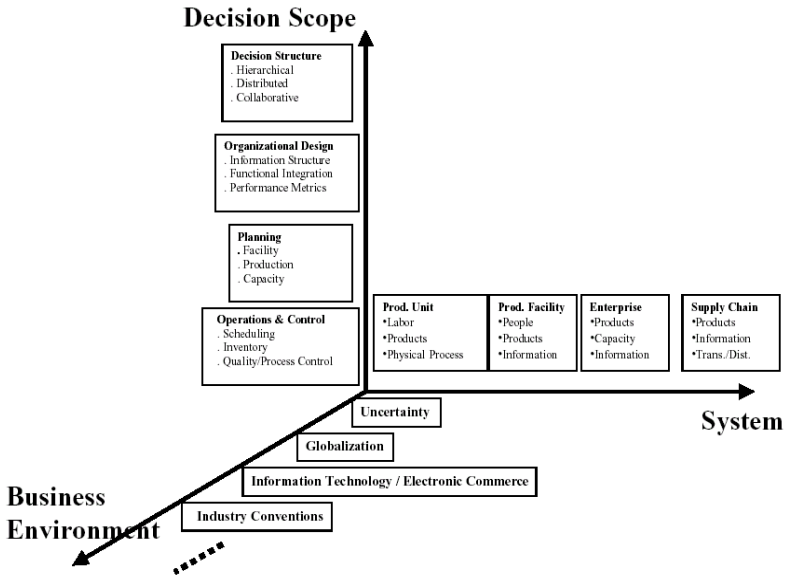

Figure 1. Dimensions of Manufacturing Logistics Research (Wu, 1999)

Competition has changed, and while the price is still important, it is no longer crucial. Price can be seen as an order enabler: the market needs a reasonable price but will not become the market leader because of its price. Leadership will be achieved through other competitive factors: Quality lead time and delivery reliability, product diversity, customization, direct deliverability. Choose the best mix of

competitive factors according to the type of industry and market will be one of the most critical choices in the future. Adapting the logistics to the new market will undoubtedly be one of the key strategic issues (Adreas, 1995). Manufacturing logistics constitution factors for any product are: presenting the aims, determining the changes, determining the inventory line, concurrent engineering, and logistics. (Denizhan, 2006). The future of logistics management will integrate manufacturing and meet enterprise needs (IMTR, 2000). Manufacturing lead times essentially are related to manufacturing logistics like processes times of products. Long or short process times are affected on product inventory, and inventory levels are an essential factor for material flows (Hitomi, 1996). Nowadays, many companies are giving up push-based production and logistics and prefer pull-based production and logistics because of using shorter processes times and response times. (Shang et al., 2005). The characteristics of the manufacturing processes and activities are a significant determinant of the logistics activities and logistics system design. Manufacturing processes and activities often create several constraints and opportunities for a logistics system (Dowlatshahi, 1999).

Beamon described supply chain models in four categories in 1998. These are Deterministic analytic models, stochastic analytic models, economic models, and simulation models. (Beamon, 1998). An analytical approach is among the modeling approaches in logistics; the properties are used to understand better the model's behavior and the effects of information sharing (Lee et al., 2000). The statements are

primarily used in complex supply chain problems; however, there is a need for a feasibility analysis to simplify the model and make assumptions. Also, if the model is capacity-limited and stochastic, performance assessment is quite tricky (Cachon et al. 2000, Lee et al., 2000, Chen, 1998). Applying such approaches in small and medium scale businesses becomes hard mainly due to a lack of data. The most used technique as an analytical approach is mixed-integer programming, which is also used to solve integrated planning problems, showing information sharing in the relationships among suppliers (Gaonkar et al. 2001). The difficulty of mathematical programming is that a model to define a real supply chain would be significant and time-consuming to run the model. Simulation is a general technique used in production and logistics for a long time (Kindler, 2000). One of the popular simulation approaches is the system dynamics, which was developed first by Forrester in 1961, who was working on the behavioral dynamics of the industry. A system dynamics model shows the feedbacks and delays. They developed this technique applying the supply chain functions (Towill, 1991, Sterman, 2000). Another simulation approach is called discrete event simulation, and similar activities can be run in the model (Beamon et al., 2001, Cenek, 2000).

Effective supply chain management is also defined as quick response manufacturing. The structure of the quick response systems resembles just in time production systems (Davis, 1993, Rabelo et al., 2004). It has a positive effect on the firm’s manufacturing performance that

supply chain and logistics management approach is applied strategically within the scope of the whole firm. The compliance of the logistics and manufacturing strategies' performances was examined in a study conducted, and it was found out that there was a performance increase (Gillyard, 2003). The effect of logistics and production functions on the performance of the whole business was found to be 34% (Sezen, 2003). It is also quite challenging to model the logistic systems as a whole and communicate among each of its functions appropriately to the actual system (Arbib et al. 2000, Nissen, 2001, Choi et al., 2002). In a study conducted in the chemical sector regarding manufacturing logistics, an integrated manufacturing logistics system was recommended to determine the amount of solvent to be added to two current production lines and maintain production without a hitch. It was ensured that the production capacity increased and truck capacities and routes were arranged based on the material need.

Most of the planning and optimization methods in manufacturing logistics have a central and hierarchical decision system. In a production coordination model developed for a business with multi-facilities, a model that minimizes the total inventory and preparation costs is used comparatively. By planning different facilities from a single-center, cooperative type planning is compared with the distributed type planning (Ertoğral et al., 2000). In the "Logistics Systems" model developed conceptually, the logistics system includes managing the material transporting and storing activities during the

delivery stage to the customers after manufacturing. It covers Material Flow Management systems and organization, including storing, transportation, and engineering services (Perminov et al., 2003). In two other studies conducted regarding modeling manufacturing logistics, the institution was modeled under the modeling architecture with a logistics approach. Its functionality was ensured with factors (Taşkin et al., 2004, Denizhan et al., 2006). ARIS, which is one of these approaches, designed the logistic system with an institutional architecture perspective. It covers the logistic system from demand estimation to marketing and sales stages (Eversheim et al., 1996, Scheer, 1998).

Small and medium-sized manufacturing enterprises must reassess their competitive positions and supply chains regularly and position themselves to respond rapidly to the changes. The supply chain in SMEs is a set of business activities, including purchase from open/spot market, manufacturing, or processing subcomponents/subassembly. The plant and delivery to large enterprises use hired transportation to enhance the value of the end product and ensure long-term regular purchase orders (Jitesh, 2007).

As emphasized in Valaan's study, the literature indicates that SMEs, in general, are not able to implement SCM to its full extent, mainly because they are managed at arm's length by larger customers and have to follow the norms stipulated by the buyer (Arend et al., 2005).

Quite comprehensive findings were obtained in another study regarding SCM in SMEs. A study also empirically tested a framework identifying the causal links among supply chain management (SCM) and information systems practices in manufacturing SMEs in Turkey. Tests of hypotheses indicate that both SCM and IS practices positively and significantly influence the operational performance of sample firms (Bayraktar et al., 2009). In recent years, it is seen that the focus is on automation for SMEs in manufacturing logistics (Seder et al., 2019). Supply chain performance measures perfect delivery, order fill rate, inventory turnover, response rate, customer service level, system downtime, order processing mistakes, delivery failures, system-wide cost, etc. However, mainly internal failures, inventory costs, customer service level, cost of wastages were found in SMEs as productivity. Considering the coordination mechanisms, while LEs are well developed at inter and intra organizational levels, SMEs suffer even from internal coordination problems.

As far as observed in the literature, several models have been examined in a narrow scope. The purpose of the model proposed in this study is to put forth a feasible, comprehensible, and practical general approach for SMEs. It is also aimed that the firm is led towards a logistics approach. This model was generated to support the competitive power of these businesses in Turkey, which have limited research and development budgets. It was demanded by the firm where the case study was conducted. SMEs adaptation to the rapid change process resulting from globalization and SCM is slower than

expected in Turkey as it is in the whole world. The proposed manufacturing logistics model was tested, providing a manufacturing SMEs managerial and operational intuition in Turkey. As the first step, a conceptual model was introduced. Moreover, secondly, the critical issues were addressed via a case study validated and applied within relevant contexts.

1. LOGISTICS MANAGEMENT

Logistics function can be handled in two ways as macro and micro dimensions. While considering the macro dimension, it is necessary to focus on logistics in company strategy and its role in creating added value. In the micro dimension, the interaction of manufacturing, marketing, and financial control functions with logistics in organizations is emphasized.

"Logistics in the modern sense; It is a logical function in itself in guiding the planning, distribution, audit, finance and human resources process directed at physical distribution, manufacturing support and procurement activities." Adequate managerial attention must be directed to the design and operation of the logistics system to achieve the enterprise's logistics purpose. Logistics management functions operate at three levels, strategic, tactical, and operational.

Each level is distinguished by the period in which decisions are made and the frequency of decisions made. Issues at the strategic level: Where to allocate production and what will be the best sourcing strategy. Issues at the tactical level: estimating, scheduling, ordering

materials with short lead times, and scheduling overtime to meet production needs. Topics at the operational level include inventory distribution, detailed scheduling, and determining what to do with an order when a machine breaks down.

As it is necessary to look at logistics from a managerial perspective, logistics has responsibilities related to management. The most important of these is in fulfilling the organization's strategic goals; it is to design and manage a system that will control the flow of materials, goods in the manufacturing process, and processed goods.

The purpose of the logistics function is to provide predetermined manufacturing-marketing support in minimizing total cost expenses. The logistics manager is responsible for planning and managing a system of activities that can achieve this goal. Responsibilities for the planning and management of the logistics system involve many complex tasks and details. The combination of the requirements for strategic goods movements and storage and their varying dimensions is the most critical indicator of the adequacy of the logistics system (Ratlif et al., 1996).

Especially in the ten years after the 1950s, four main developments have strengthened the institutionalization of the logistics function. The main developments in question can be listed as the comprehensive cost analysis, implementation of the system approach, emphasis on customer service, and review of the studies on marketing channels.

From the 1950s to the 1980s, the application area of the logistics management concept increased gradually. Although only purchasing and supply or storage systems were used at first, the concept of integrated logistics settled and found an application area due to developments, especially after 1980.

The first reason for the increasing importance of integrated logistics management is the need for a great deal of interdependence among all logistics areas that can benefit the business. The view of the total goods movements/warehousing system requires a higher order exchange and more collaboration or collaboration. Logistics system management is faced with a constant increase in labor costs at every point. Therefore, the logistics manager should develop methods that will provide capital for labor-intensive processes.

The second reason to support integrated logistics management; It creates approaches that bring people and departments with weakened relationships closer to each other or connect them. Concepts on this subject, to some extent, have diametrically opposite precedence; they relate to physical distribution, manufacturing support, and procurement. Controlling requirements for each similar activity is the third reason to support integration. Before designing the logistics system, it is necessary to determine the essential elements and concepts (Levi et al. 2002, Gillyard, 2003).

1.1. Essential Elements of Logistics System

Logistics-related process; It is a system between supply sources, customers, and the business. Within this system, information needs, orders, and market forecasts that are planned and classified within the scope of specific manufacturing and supply purposes flow from customers to sources of supply. Basically:

- Physical distribution,
- Manufacturing support,
- Supply support,

It is possible to talk about logistics elements in the process. Each function contains sub-functions. The sub-activities are packaging, transportation, storage, distribution center management, global logistics, production planning, stock control, quality control, and material management.

1.2. Physical Distribution

Physical distribution generally represents the level of customer service. The logistics function is responsible for the flow or movement of material from the producer to the consumer. All sub-functions from the end-production to the delivery to the consumer are part of the physical distribution. The warehouses, distribution centers, wholesalers, and retailers involved in this process are called distribution channels. The activities and responsibilities required by physical distribution can be classified as follows:

The activities required by physical distribution are:

- Accepting orders,
- Order processing,
- Placing stocks,
- Goods movements in storage and warehouse,
- It is the transportation from the distribution channel to the outside of the enterprise.

The responsibilities of physical distribution are:

- Pricing,
- Incentive support,
- Customer service,
- Delivery,
- It can be classified as the placement of returned goods.

Its task in areas such as maintaining the product life course is to coordinate marketing and planning.

While managing the physical distribution system aims to keep the customer service levels at the expected level and achieve this at the lowest cost. Physical distribution costs include many cost items such as transportation, facility, communication, stock, material handling, protective packaging, management costs. Therefore, the primary purpose of physical distribution is; strategically providing the desired customer service level at the lowest total cost level and contributing to revenue generation. Packaging, Transportation, Distribution Centers

Management, and Global Logistics can be included in physical distribution (Murphy et al., 2004).

1.3. Packaging

The primary role of the packaging function is to ensure that the products are delivered safely to the customer through distribution channels. In order to achieve this, three primary conditions must be met. These:

- Identification of the product
- Protection of the product
-Contributing to the effectiveness of the physical distribution function.

The information on the package identification in cases the shape of the package cannot be determined. Especially for consumer products, size and size differences complicate product identification.

Packaging is a function that must work in interaction with many administrative areas. The form, volume, and packaging directly affect the storage, material handling, transportation functions, and effectiveness. Package dimensions should be determined by carefully examining the storage and transportation capacities. The selected package type should protect the product from external factors in the warehouse environment and during transportation.

1.4. Transport

It is possible to define the transport function as physical activities connecting raw material suppliers, producers, warehouses, distribution channels, and customers, fixed points in the chain.

During logistics operations, there are the following transportations from production to consumption:

- Moving from the manufacturing area to the stock area
- Transportation of other elements in the existing area waiting to be transported by vehicle
- Loading into the transport vehicle
- Transport to a distribution center
- Unloading

Migration enables companies to consolidate their geographically dispersed operations. It provides a place and time added value to the company by ensuring that the products are available at the desired time and place. Increased transit times require higher levels of inventory. High inventories also cause storage costs. It becomes strategically important to make the transportation-related decisions explained in the supply chain decisions in this environment.

Regarding transportation, the options used by the organizations are road, air, rail, sea, and pipeline transportation. Regardless of the option, there are fundamental physical components that companies that provide transportation activities should have in common. These components are roads, terminals, and vehicles. Terminals are places

that carrier companies use to load and unload, determine routes, perform maintenance, and complete bureaucratic procedures.

Transport costs make up, on average, one-third of total distribution costs. Therefore, outsourcing in logistics, which is very important today. This relationship, defined as third-party logistics services, includes functions such as storage, payment, customs, and carrier selection. Third-party logistics companies provide manufacturers with their strategic knowledge and experience, advanced information systems, stock management, and warehouse controls (Stank et al., 1997). The aim is to help companies increase their revenues by reducing their logistics costs, thus focusing on their primary business, manufacturing (Bowersox, 1996). At the same time, management capabilities can be changed, and supply chain management and solutions can be offered with the fourth party logistics providers that have emerged recently.

The transport function is one of the most studied areas of logistics. As can be seen in a study conducted in 1998, logistics only takes place as a transportation and distribution activity. Transportation is related to examining production planning and control activities and stock control as a sub-function of the supply chain (Beamon et al., 2001).

In recent studies, systems that require integration between companies at remote locations are being established. With the use of agent-based systems, which are autonomous software that can communicate with each other, transportation comes to the fore in these dispersed

systems; it can be designed and simulated in a robust, flexible, and natural way (Gerber et al., 2000).

1.5. Distribution centers management

Distribution centers are defined as individuals or institutions involved in delivering products or services from producer to consumer. The main function of distribution centers is to have the product in the amount and variety desired by the customer when the customer wants. The most well-known method used to fulfill this function is the Distribution Requirements Planning method. Distribution needs planning determines the stocks needed in the distribution centers for the next period. An appropriate point-of-order approach is used when planned orders in distribution centers turn into net requirements figures with Material requirement planning (MRP) logic and stock policies take the form of material flow. In multi-level distribution networks, this process continues in the distribution center at each level - regional, main center, or factory warehouse - and the identified needs constitute inputs to the master production plan. Distribution requirements planning tries to determine the highest product needs by using demand forecasts at the lowest level of the distribution network (14, 15).

1.6. Global logistics

An efficient logistics system is essential in local operations but a critical factor in global production and marketing. In addition to the obligation to meet the same criteria as a local logistics system, in global logistics; There is more uncertainty in the areas of distance,

demand, product variability, and documentation. Global logistics expertise needs to be incorporated into production and marketing to capture market growth.

Global operations pose two significant challenges in logistics: increased complexity and increased cost. Increasing complexity makes itself felt in two ways. Uncertainty in extended delivery times decreases market information and control ability with increased interfaces such as customs (Boversox et al., 2002).

With the potential suppliers, potential production facilities, and distribution centers in the modeling and design of global logistics systems, multiple possible configurations, and deterministic demands from customers, it is necessary to decide on the configuration of the production distribution system. At the same time, after determining the transportation prices, the goal is to maximize the company's profit after tax. Thus, a global logistics system that includes facility-production stock and distribution can be designed. However, to achieve rapid results, it should require technical expertise and be a standard model that can be applied to large areas (Goetschalk et al., 2002).

The main elements that should be included in a global logistics model due to its international and integrated structure can be classified as follows. These are:

- Electronic data exchange,
- Value-added network structure,

- Integrated service digital network,
- Information-based decision support system,
-Distributed decision-making systems are group decision-making or videoconferencing systems (Min, 1994).

Another element determined as the primary function area in logistics is Manufacturing Support.

1.6. Manufacturing Support

Manufacturing support is the process of planning, scheduling, and supporting manufacturing activities. All activities can be summarized under Production Planning and Control Activities. Activities required by manufacturing support:

- Planning the main production schedule,
- Supporting in-warehouse goods movements,
- Transportation in the manufacturing process,
- To put into practice the work in the process of dividing the parts into phases.

The manufacturing support process provides control of the material in the manufacturing process. The primary function of the manufacturing support process is to contribute to the development of the production plan and procure the materials necessary to ensure that the manufacturing processes continue according to the plan. Thus, the whole idea of manufacturing support focuses on time and amount rather than how production is done.

When manufacturing support, physical distribution, and supply functions are compared with each other, it is seen that there are essential differences between them. While the physical distribution and supply functions deal with uncertain market forces, the manufacturing support function is restricted to internal and apparent movements of goods under the complete control of the enterprise.
Uncertain market forces; can be expressed in incidental customer orders, unstable vendor practices, or critical material constraints that arise in isolation from the manufacturing support function. From an operational planning point of view, segregating manufacturing support due to internal and external movements of goods presents an opportunity for optimal coordination. The responsibilities of manufacturing support can be summarized as follows:

- Storage of stocks at the manufacturing site,
- To provide the highest flexibility for delays and geographic coordination between physical distribution and manufacturing.

Manufacturing support system; Inspects parts, semi-finished products, and finished goods after they are supplied or left at the first point of production. The aim is to control parts and semi-finished goods' storage and physical movements between and within the warehouses where the enterprise is injured, between the manufacturing stages and the finished stock (Daganzo, 1999).

1.6. Production planning and control

Although production planning and control are within the scope of manufacturing logistics, the production planning and control process includes coordinating product demand and product supply in a production area. It is the function responsible for the planning and control of the material flow throughout the production process. The system's starting point is the demand for the firm's product produced and sold. This demand is the only independent variable of the system and cannot be controlled by the manufacturer. The manufacturer estimates customer demand, and sales figures for each product that will likely occur in specific periods are determined. It is possible to meet the determined demand with the help of stocks and production to be made. Foreign demand generates domestic demand, and the production planning unit develops the production plan. The plan should answer what will be produced and when and what capacity will be used.

There are four types of inputs used in the implementation of the production planning and control process.

- Product definitions: It is necessary to define the product at any stage of production. Technical drawings and descriptions are often used. Another essential document is the product recipes. It identifies the parts that make up the product and includes assembly information at various stages of production.

- Production Features: The steps followed to reveal the final product should be defined. The production's sub-operations, the operations' order, the required equipment, and the standard times required for each operation are the basic information that constitutes the production features.

- Available resources: The production planning and control unit should determine how much of the production area, equipment and workforce is available in production.
- Required production quantities: It is obtained by using demand forecast and customer order information.

With the production planning system, how long the products will be produced, what is on hand, and which materials are needed are answered. Five different levels of planning and control functions take place. These are the work plan, the production plan, the master production plan, the material requirement plan, and the production activity control level.

- Business plan: It is a plan that covers the main objectives that the company wants to achieve in a 2-10 year period. It includes long-term forecasts. Information from finance, marketing, and production departments is used. It shows the direction the firm will go and includes targeted developments related to production lines, markets. Preparation of the business plan is the responsibility of the top management. It is usually revised every six months.

- Production plan: It is the plan that determines the product group quantities to be produced for each period, the desired stock levels, the necessary equipment, labor and material resources for each period, and the availability of these resources in line with the targets determined by the business plan. The level of detail is not very deep. Quantities are determined based on a product group. The planning period is between 6-18 months and is revised every three months.

- Master production plan: It is the plan to produce all product types belonging to product groups. The production plan is decomposed to determine the quantities of each product type to be produced during the production periods. The level of detail is more complex than in the production plan. The planning period is 3-18 months, but it also varies according to the purchasing and production lead times. The main production plan is revised on a weekly or monthly basis.

- Material requirement plan: The plan is prepared to produce or purchase the materials to produce the products specified in the master production plan. The level of detail is high. The planning period is as long as the purchase and production lead times, usually between 3-18 months, similar to the master production plan.

Production activity control represents the implementation and control phase of the production planning and control system. The flow of

work is planned and controlled throughout the entire enterprise. The planning period is relatively short, varying between days and months. All product components, workstations, and orders are covered by the planning and control process, deepening the level of detail (Bowersox et al., 1996).

Due to this integrated operation of the production planning and control system, MRP systems called production resource planning were developed for all companies' departments. Therefore, the effectiveness of logistics activities will be directly reflected in manufacturing and will affect the following logistics process. Logistics activities in the manufacturing phase are also significant and critical activities.

Research on logistics trends in Europe in 1999-2005 by the Logistics Research Institute in Edinburgh showed that; focus on production increased by 30% in 2005. Although the number of factories is the same, the focus on production has increased by increasing the factory features. Another important indicator is stock levels in logistics. With the increase in stock centers, the increase in stocks in Europe may reach 35%.

1.7. Inventory management

Inventories are critical cost factors in logistics, and reducing stock levels is one of the ways to reduce manufacturing costs. On the other hand, logistics-oriented stock analysis shows the interdependence of logistics and stock control and is an essential parameter in logistics performance analysis (Lutz et al., 2003).

Theoretically, a business can keep an equal amount of inventory at each facility of each goods item it acquires. However, few businesses follow such a luxury stocking program that does not consider the total cost. The main objective is to maintain the lowest possible inventory level in line with customer service and manufacturing objectives. Logistics programs should be started with the aim of leaving as little material in stock as possible. The answer to a healthy stock program can be found based on these five factors distributed according to the selective plan. These are :

- Qualifications of customers,
- The qualities of the products,
- Completion of the transport work,
- Activities related to manufacturing,
- Competitors' practices.

For every business, some customers are profitable, while some customers are not equally profitable. Profitability comes from providing the necessary support activities to purchase various types of products, providing large-scale steps, price, providing the necessary marketing services, and maintaining the usual relations. Businesses with high profitability constitute the primary market of the enterprise. When the business ranks its products in terms of profitability, the stock amounts of each product gain importance. In addition, the size of the goods, the transportation cost due to their size, and the stock policy to be applied accordingly are essential. In this case, it would be

wise to stock more, as the cost of transportation is vital for large volumes of goods.

Another point to be considered while determining the stock policy is competitors. Faster and more consistent delivery is always an advantage. Therefore, even if distribution-related activities increase the cost, it can keep its stocks in a specific warehouse to make the logistic effect usable. Inventory policies followed can gain an edge over competitors.

1.8. Material Management

The procurement function deals with the purchase and physical movement of finished goods or parts, materials from the source of supply to manufacturers or assembly plants, warehouses, or retail stores. From the manufacturer's point of view, the process of acquiring materials is called purchasing. The concept of material is used to identify the physical movements of goods within the business without considering the readiness for resale holdings. Thus, the material is used for the flow of goods within the business. Product is used to identify goods for customer loads outside the business. Logistics system in the life cycle of a system extends from planning, analysis and design, testing, production, distribution, and customer. Activities required by the procurement function:

- Quality reliability,
- Storage and placement in the warehouse,
- Quality control and acceptance,

- Transport within the business,
- Interviews,
- Finding a source of supply,
- Needs can be classified as planning.

Materials management is a coordination function that performs the planning and control of the flow of materials in the input logistics system. The purposes of this function can be summarized as follows.

- Optimum use of company resources,
- To achieve the targeted service level.

Increasing sales does not mean increased profits, because at the same time, labor, material, and operating costs rise. However, effective material management ensures that the suitable material is available at the right time and in the right place, making efficient use of business resources. The main functions to be examined in material management are:

- Purchase,
- Product Receiving and Quality Control,
- Warehouse Management,
- Production Planning and Control,
- Stock management,
- Can be classified as Material Handling

1.9. Purchasing

Effective purchasing of products and services brings significant competitive advantages to an organization. The process connects the suppliers, which can be called the local part of the supply chain, the suppliers' suppliers, and the chain members, including the leading organization. In a narrow sense, it is the process of obtaining a product or service for a company, and in a broader sense, it is the process of obtaining a product or service for a company. It is not just the conclusion of activity but the successful execution of a series of activities that cross organizational boundaries.

Purchasing has organizational activities that can be classified as financial, operational, and strategic.

Financial Impacts: About 55% of expenses in a typical manufacturing company are purchasing expenses. Purchased product costs in the retail sector constitute the most considerable item among all expenses. The effect on profits of a 1% reduction in purchasing costs in companies would correspond to the effect if sales increased by 10%. For many companies, it is easier to reduce their purchasing costs by 1% than to increase their sales by 10%. For an effective purchase, the cost factor is more important than the price. Products that are not needed or do not meet the needs should not be purchased simply because they are cheap.

Operational Impacts: Material unavailability can cause a production line to stop. Even worse, a product can fall apart in the customer's

hands due to poor quality materials. Purchasing should ensure that suitable quality material is available in the company at the right time. In addition, raw material costs can be reduced by using materials close to the standard by taking the opinion of the purchasing units at the design stage. The cash management efforts of the finance department are positively supported by the plans to facilitate the payments to be made with the suppliers.

Strategic Effects: Many company strategies, such as technical lead in the market, reducing the time to market for new products, increasing market share, improving customer service quality, and improving cash flow, can be realized with the help of effective purchasing planning and management. Michael Porter defined purchasing as one of the support activities in the value chain. It was stated that activities such as identifying new suppliers, searching for different inputs, and monitoring supplier performance were strategically important.

A business plan should be dev eloped to ensure that the purchasing function is integrated with the business strategy. In all lines of business, these items usually make up the purchasing strategy, but the importance given to each can be variable. The main business objectives in the business plan can be determined as follows, they are

- Providing products and services in the desired quantity and quality,
- Providing the product and service at the lowest cost,

- Ensuring that the supplier provides the best service and delivers smoothly,
- Minimizing stock investments,
- Developing good relations with existing suppliers and researching potential suppliers. (Levi et al., 2002, Bowersox et al, 2002).

1.9. Product receiving and quality control

Product received is the activity of physically receiving the purchased material from the carrier company. It checks whether the correct number and quality of the product are delivered by comparing the authorized purchase order that receives the product with the documents sent by the supplier company. In case of any deficiency or inconsistency, the purchasing, production, and accounting departments are informed.

With the quality control function, all the features of the received product (size, design features, brand, chemical and physical properties, industry-standard, etc.) are examined, and their compliance with the demand is checked. The materials used in production directly affect the quality of the finished product, thus sales and after-sales service. The quality control function is critical in shaping the customer service function and determining service levels, impacting product quality.

1.10. Warehouse management

Storage is the process of physically holding raw materials, semi-products, and finished products in a specific area. Many factors such as the physical environment required for the storage of raw materials, semi-finished and finished products, the average value of the stocks, the perishability of the products create differences. For raw materials, for example, only on-floor storage in a closed environment may be possible, while a complex racking system is designed for finished products. Since the value of raw materials is less than the finished product, the measures taken to protect against physical damage require less cost.

According to where they are established, warehouses can be named factory warehouses, regional warehouses, and local warehouses. There are two different types of warehouses in terms of the services they provide. In general warehouses, products are kept for long periods, and the primary purpose is to prevent damage to the product. There is minimal movement and product handling. In distribution warehouses, products are received in large numbers, stored in batches, and made into small orders in line with market demands. The movement and transportation of products are carried out intensively.

The main purpose of warehouse management is to work cost-effectively and to increase the level of customer service. Fixed costs include expenses for warehouse space and equipment. The majority of operating expenses are labor expenses, and labor expenses vary depending on the product handling equipment used, the location and

availability of stocks, the warehouse layout, and the applied order-taking system. Studies show that storage costs in sales vary between 6-9% in the west. In the same respect, Turkey's share of this rate was around 16% (Ölçer et al., 2001). With an effective warehouse management system, the following issues are targeted:

- To use warehouse space cost-effectively,
- Providing quick and easy access to stored products with appropriate tracking and marking methods,
- Receiving and placing materials efficiently,
- Minimizing the transportation activities to and from the warehouse,
- Having the flexibility to store products in different numbers and sizes,
- Establishing effective communication points with the departments or customers that will demand the products.

In warehouse management, the products received are grouped in quantity and quality based on stock keeping units and stored in designated places. In line with the incoming requests, the products are taken to the order preparation area, and they are prepared for loading in line with the information transmitted. Every physical activity is recorded in the computer environment. The products are made ready for the packaging stage.

Cubic utilization and stock placement are factors that have significant effects on the efficient use of warehouses. Benefit can be increased by

mainly using the following methods as stock placement or warehouse organization systems.

- Grouping and placing products that are functionally close to each other: By placing products with similar or identical usage purposes close to each other, it is ensured that warehouse personnel can move while preparing orders.
- Placing fast-moving products close to each other: The products that frequently move in the warehouse environment are kept close to the receiving and packaging areas, thus providing economy of movement.
- Keeping physically similar products in close places: Economical use of similar stock space and warehouse resources is ensured.
- Keeping semi-product and material stocks in separate places: While semi-products are kept close to the packaging areas, the materials that will feed the product lines are placed close to the production area .

Responsibilities of warehouse management:

- Determining the limits of the supply source, collecting it, and making it permanent,
- To conduct guiding researches for new supply sources,
- To ensure coordination with supply sources.

The direction, type, and related units of the information flow become important in the realization of these activities, which we know not

only as logistics activities but also as general production activities in terms of logistics.

1.11. Information Flow for Logistics Requirements

The information flow for the needs is related to determining what kind of goods stocks are needed in which settlements of the logistics system. The primary purpose of fulfilling the information need is to establish a plan for the combined logistics activities. This kind of coordination enables to achieve continuity in activities and to make this situation structured. In logistics activities, it depends on the size of the order, the availability of stocks, and the speed of the movement. The main purpose of information flow needs is to harmonize these different goods movements.

It includes information flow, coordination, and planning of logistics activities according to needs. Within this scope, there are four areas of managerial thought.
These are:

- Product Market forecast,
- Order processing,
- Main production programming,
- Planning areas according to needs.

Forecasts about future sales are made with “product-market forecasts.” Estimated sales to specific markets or customers are the first step in logistics planning. Based on the estimates, incoming orders are evaluated, and at the same time, the physical distribution

process, which provides the logistics power, is started. The combination of stock statuses and planned stock needs and product-market forecasting and order processing is made into a distribution needs schedule for a given planning period. The distribution needs a schedule combined with manufacturing capability and capacity to coordinate logistical activity. This synthesis is also shown as the main production program. The master production schedule determines how the enterprise will deploy its manufacturing capacity according to the planned time period.

Another consideration is the flow of information is the planning of needs. If the finished product is being purchased for resale, the best thing to do is establish a sales limit for each purchaser. In contrast, coordination between manufacturing and material procurement is a typically multifaceted process requiring more complex timing than retail or wholesale purchasing. The term "Material Requirements Planning" is used to discuss this aspect of logistics. In manufacturing businesses, valuation and planning capacity are also required to ensure the master production schedule is accomplished. This is called capacity needs planning (Cachon et al., 2000). These functions and the logistics tasks of the enterprises that will perform the logistics information flow are formed. Seeing this as a starting point will provide long and short-term advantages to the business.

1.12. Logistics Duties of Businesses

The logistics task of the enterprise is to develop a system that will meet the needs at the lowest possible expenditure level. However, to achieve this, logistics strategies, organization, and performance measures must be established and supported by senior management and other functional managers (Min et al., 1994). The logistics system primarily deals with supporting manufacturing and marketing activities. The most critical question at the policy level in achieving the desired level of success and centralizing the costs of logistics activities. For this purpose, logistics planning has determined two different criteria, these are;

- Logistics service success level
- Total logistics costs.

Efforts in this regard aim to balance the level of success and costs that will enable the enterprise to achieve its logistics goals. Logistics success; is measured by availability, adequacy, and quality. Availability affects the system's capacity to satisfy material and product needs continually. With this situation, the availability is related to the stock level. As a general rule, the lower the planned stock levels, the more significant the investment in average stocks.

The adequacy of the logistics success level indicates the time from order receipt to stock delivery. Success competence consists of speed and consistency of delivery.

The quality of success determines the damaged or correct goods and how well logistical tasks resolve unexpected problems. The prompt delivery of a damaged product will have no purpose.

The logistics system should be viewed as a cost center. Total cost level has a direct relationship with customer service policy. Achieving high availability, proficiency, and quality at the same time is expensive. The higher the availability, competence, and quality, the higher the cost of achieving the overall success level. Often the planning problem arises from the fact that there is an inconsistent relationship between logistics cost and increased level of success.

2. MANUFACTURING LOGISTICS

Manufacturing logistics is an integrative function of an enterprise's logistics activities and supply chain management. The scope of manufacturing logistics and its basics in terms of planning and control will be introduced. Its role and importance in business logistics will be explained in this section.

2.1. Business Logistics and Manufacturing Logistics in Business

Logistics activities are activities that concern the whole of an enterprise. All of the basic logistics activities in every part of the business are defined as business logistics. Material management covers the production process and all raw material and semi-finished product flow in the production process. Almost all of the function, called the concept of input logistics, includes material management activities. On the other hand, the concept of distribution covers all

flows and movements that start from the last production point and ensure that the products reach the final consumer through distribution centers. All post-production distribution and customer service activities form the function called output logistics.

Logistics cannot be thought of only as input and output logistics. In order to be able to talk about the existence of logistics and to ensure logistics success, the concept of manufacturing logistics must be accepted by the company. Therefore the success of manufacturing logistics should be prioritized. It is possible to collect logistics in three groups: business logistics, input logistics, output logistics, and manufacturing logistics. However, although logistics activities are generally grouped into these three subgroups, they are not strictly separated from each other.

Any function of input logistics may concern manufacturing logistics, and any function of manufacturing logistics may concern output logistics. For example, it is the marketing unit that directs demand forecasts in factories. Manufacturing information and evaluations can be considered as outputs for purchasing. Therefore, there are points where all three intersect. The sum of all these activities is business logistics. As can be seen, each of the production activities we know so far is a logistics activity when viewed from a logistics point of view. Alternatively, today, the logistics aspect of these business functions that we know comes to the fore and creates value for companies.

For the institutional development of business logistics, it is also necessary to coordinate supply chain activities with effective information flow methods (Stock et al., 2000).

Effective Supply Chain Management and Logistics Systems are generally tried to be provided by integrating input and output logistics, which are two basic logistics systems. As a result of not ensuring the coordination of these two flows, stock problems often occur throughout the chain, or customer service is adversely affected. At this stage, it is the manufacturing logistics that provide the coordination.

In research on manufacturing logistics, manufacturing logistics was examined in three dimensions. These are Systems, Decision making, and Business environment. Technological innovations, business combinations, and global competition are highly influential on manufacturing logistics. Accordingly, the main research topics in manufacturing logistics are uncertainty and variability, human behavior, globalization, limits of existing information systems, redundant information or insufficient information, product increase (diversification), and shortened life cycle, wrong decisions, and performance measurements. There are incomplete, incorrect, unnecessary information, ambiguous or incomplete definitions, and uncertainties arising from human behavior (Stank et al., 1998).

The success and awareness of logistics activities and manufacturing logistics within the enterprise is the essential move that will bring the importance of the supply chain to the company. Implementing these

activities with all companies in the chain is a precautionary activity formed and taken as a result of stock, insecurity, and uncertainty in enterprises. It is stated in the “Status of Logistics 2001” reports that; manufacturers have given their suppliers greater control over the supply of materials. However, it is unclear who will own the surplus stock. Recently, despite all their benefits, software programs still tend to be costly and incapable of adapting to change (Bowersox et al., 2002).

“The new logistics concept is based on superior customer service, rather than a simple support system for always-on availability.” The logistics system should be able to react quickly, form quickly according to needs, and be creative enough to adapt to variability. In a research conducted on manufacturing systems for 2015, the future point of logistics management was defined as "it will be a system integrated with manufacturing and thus able to meet the entire organization's needs"(IMTR, 2000). Therefore, the logistics success of an enterprise can be realized primarily with the success of manufacturing logistics. It is challenging to define and differentiate the manufacturing logistics precisely.

2.2. Manufacturing Logistics

The concept of Manufacturing Logistics was first used as a function in decision support systems in 1990 and 1992 under the name of the Manufacturing-Logistics Management system. The main focus is on the monitoring and control of the manufacturing flow (Fordyce et al., 1990, 1992). Manufacturing logistics covers the performance of in-

house raw materials, auxiliary materials, operating materials, purchased parts, semi-finished and finished products from the entrance to the warehouse, the transformation effects between material and information flow, manufacturing structure activities (information and parts transformation effects). Product structure, etc.). The formation of the manufacturing logistics of any product includes the following factors;

1- Setting the goals,
2- Determining the changes,
3- Determination of the stock line,
4- Simultaneous engineering and logistics.

1- To optimize the short product cycle and customer-oriented products, the product life cycle should be reduced, and customer-oriented products should be increased. For this, product diversity is used. Due to the increase in product diversity, the complexity of the products increases, and the necessity of creating a fixed logistics chain arises. For this, it is necessary to reduce the variability of semi-finished products and raw materials. The use of group technology will also facilitate these processes.

2- To identify changes and reduce logistics costs, variability should be reduced at all product levels. The factors affecting the determination of this variability should also be revealed. It is imperative to define design changes and new product manufacturing processes and to define customer requests.

3- Determination of the stock line: The long flow time of raw materials, semi-finished products, and products and uncertain processes are the main reasons for increasing the number of manufactured product stocks. The reasons for this increase are: the market demand for the product is not predicted flexibly, the demand forecasting strategy is insufficient, the number of suppliers is high, stock costs are not reduced, customer flexibility is not provided, and the desired innovations in the product are not determined.

4-Product complexity or diversity is initially due to insufficient R&D activities. It arises from the production flow stages, the lack of coordination. Concurrent engineering is achieved by carrying out similar R&D activities and determining the logistics processes required for them, determining the flow of production and auxiliary materials, determining their timing, reducing time-related costs, and increasing product and production quality. The starting point in concurrent engineering is reducing product changes, making the innovation chain consistent from start to finish, reducing initial stocks, combining similar processes, ensuring expected flows. Simultaneous engineering reduces process times, creates joint projects, and ensures capacity balance (Schönsleben, 2004). If we consider a manufacturing system according to the basic material flow, the logistic factor at every production stage will emerge.

After defining the manufacturing logistics in this context, it is necessary to look at what kind of activities are related to which business areas in more detail.

The research area of manufacturing logistics can be examined in three dimensions. These three main dimensions.

- System,
- To decide,
- Defined as the Business Environment.
- System: The different levels at which physical resources are located in a manufacturing environment are of this size. The four levels of Manufacturing Logistics systems are manufacturing unit, manufacturing facility, institution, and supply chain.

Production Unit: A basic production unit consists of a production line, workshop, flexible production cell, or other operational units, which are related to the primary production resources of the production system. Major logistics publications at this level include the workforce, the product, and the physical process of the product. These are the most emphasized points in the studies. It is possible to make different classifications.

Manufacturing Facility: A manufacturing facility is an area made up of different manufacturing units. By definition, the emphasis is on the integration of different units in the facility. Studies, from the point of view of manufacturing logistics, have also focused on these inter-unit problems. These problems are related to people, products, and information.

Institution:

An institution consists of multiple production areas with design, engineering, marketing, and sales activities. At the enterprise level, manufacturing logistics is about products, capacity, and information in the domestic field. Hence, ERP systems cover a crucial part of logistics problems at this level.

Supply Chain: From the perspective of Manufacturing Logistics, a supply chain is a dynamic whole in which manufacturing, service, and distribution institutions are organized in different industries. The supply chain can focus on productive issues related to the product, information, transportation, and distribution.

- Decision Area or Decision Making:

Decision-making is one of the critical areas in manufacturing logistics research. We can define the decision-making domain at four levels.

Operations and Control: Decisions from short to long term have a direct impact on manufacturing operations. The main decisions at this level are scheduling stock, quality, and process control decisions.

Planning: In this statement, mid-to-long-term decisions are influential in the design of operations. Critical decisions at this level are related to facility planning, production planning, and capacity management.

Organizational Design: Demonstrates integration, evaluation, and knowledge sharing across different organizational resources. Critical

decisions at this level are knowledge structure, functional integration, and performance measures.

Decision Structure: What is meant here is the guiding decisions and business processes. Another frequently used definition is hierarchical decision structure, non-monocentric, dispersed, and collaborative decision structure research and topics.

- Business Environment: The business or business environment is an area that defines the boundaries of manufacturing logistics (51).

The factor that most concerns manufacturing logistics is manufacturing times. Short or long production times directly affect the amount of the stock. Hence, inventory policies play a crucial role in a material flow. These are interrelated between supply and production subsystems, production and sales subsystems (50). Today, many companies prefer to abandon the push-based production and logistics type and switch to a pull-based production and logistics system that responds to the demand.

Because working decisions are made with shorter production times, production lines are made more flexible to use time and other resources efficiently (Shang et al., 2005).

Since the logistics manager is responsible for the in-house movement and storage of the materials that feed the production lines, he has an essential interaction in logistics and supply. Since the absence of any

material will cause the production lines to stop, the logistics unit should keep the raw materials and safety stocks at a certain level, ready to meet the needs of the production programs. In order for the production and logistics activities, which should be at the production planning stage, to be realized with minimum error, in some companies, planning was taken from the production department, and the responsibility was transferred to the logistics unit.

Manufacturing support is also about managing intermediate stocks between stages of manufacturing. The primary logistical responsibility in manufacturing is to participate in the master production scheduling and ensure that materials, component parts, and in-process stocks are available on time. Thus, all production support is about how the product will occur and what, where, and when the product will be made. Manufacturing support is quite different from market distribution. Market distribution is reaching more customers and responding to uncertain demand and consumption. Manufacturing support covers the movement of needs under the control of the manufacturing organization. Random customer orders and variables The uncertainties created by laps are not commonplace in manufacturing operations. From the planning stage, expanding manufacturing support to domestic procurement activities in foreign market distribution allows privatization and efficiency (Bowersox et al., 1996). In order to discuss manufacturing logistics, the system must first be planned.

3. SMEs IN TURKEY

SMEs play a critical role in the Turkish economy because of their number and the large workforce involved. In geographical terms, the distribution of SMEs reflects that of the population as a whole. They are concentrated in the coastal regions along the Marmara and Aegean Seas, with 38% and 17% of the enterprises, respectively, and Central Anatolia, 16%. The Mediterranean coastal region (11%), the Black Sea region (9%), south-eastern Anatolia (6%), and eastern Anatolia have far less organized formal economic activity. As mentioned in the OECD 2004 report, their average profile is different from that of SMEs in the European Union or most other OECD countries. Their average workforce and turnover are much smaller. They also lag well behind in terms of know-how, skill levels, capital investment to support their activities, and access and ability to take advantage of modern technologies, especially in the information and communications fields. SMEs need help with technology, information, and training. (OECD, 2004).

Only a tiny share of SMEs are in the manufacturing sector. According to SIS data, on 1 January 2001, there were around 210 000 SMEs (1-250 workers) in the sector (99.6% of the total number of manufacturing firms). SMEs (64.3% of the manufacturing total) employed just over 1 million people, accounting for 34.5% of the sector's value-added. Manufacturing sector SMEs are handicapped across industries: metallic goods: 26.1%, textiles, clothing, and leather goods: 25.6%, wood, and furniture: 24.3%, food, and drink: 12.7%,

paper: 3.9%, other sectors: 7.4%. Furthermore, these enterprises are generally tiny.

Some of the fundamental weaknesses of the sector are:

- Insufficient know-how and low level of technology
- The university-based intellectual potential is high. However, university-industry interactions are weak because there is inadequate funding for cooperative projects at the universities, and research laboratories and equipment are limited in some faculties.
- Even if more Turkish SMEs wished to improve their technological capacity and modernize their plant and equipment, they would find it difficult to obtain financing and access to credit and equity.

In January 2003, the Turkish Small and Medium Industry Development Organisation (KOSGEB) started a re-organization process based on a principle of continuous change for developing its services.

TÜSİAD (Turkish Industry and Business Association) - Sabancı University Competition Forum (REF) published a report on innovation in Turkey's manufacturing industry in 2007. 62% of the participants in the study were composed of SMEs, and significant results were obtained in SMEs supply chain and manufacturing competencies in Turkey. Firms were asked what the three most essential elements that determine competitive power in their industries

are. The most considered elements are product quality/performance and production cost, respectively. The third and fourth elements were timely delivery/short delivery periods and being adopted as a trademark. Management of planning, operation, and control functions in a decentralized manner is one of the most used organizational approaches. It is asked which firm's top management uses performance indicators. Production field management for internal control purposes, the performance indicators used more than 90 % of the firms are customer satisfaction/complaints, the quality ratio (the ratio of defective products), and cash flow. The production field management controls the manufacturing preliminary and preparation periods in about 68 % of the firms. Delivery reliability is the 6^{th,} while inventory kept daily is the 13th out of 14 criteria in total. The ERP software, mainly used in the chemical sector, is the least used in the metal sector.

Interestingly, firms often share production planning data reciprocally with the other firms within the scope of the supply chain. The most widely used sector is the machine industry (72%), and half of these firms declared that they were using it at a high level. 22% of the firms considered this sharing feasible for their firms. For the benefit of all firms in the supply chain, this practice, which decreases the supply costs by ensuring that the suppliers make better production planning and the suppliers, and the leading producers make better supply planning, becomes more common (Yegenoglu et al., 2007).

To increase SMEs' effectiveness in the supply chain based on the present conditions and our experience, we identified the main elements in Figure 2. Accordingly, the primary goal of a manufacturing SME should be extending the logistics-focused factory and manufacturing logistics approach to the business. Information systems and information sharing increase the partnership power of the firm while also help adjust the manufacturing flow. Logistics performance analysis in the firm supports that the firm obtains awareness in terms of logistics. Also, the cooperation between universities and industry or other government subsidies are accelerators and help adopt this process in continuity.

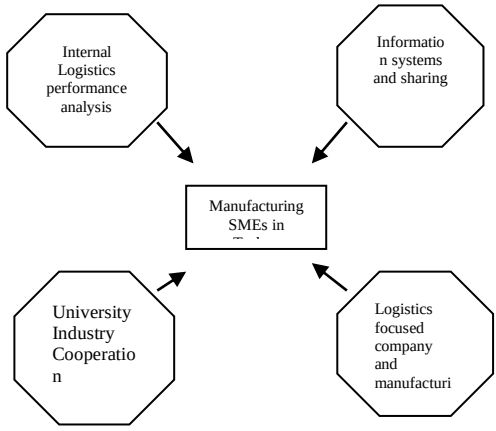

Figure 2. Manufacturing SMEs proposed relation

4. CONFIGURATION OF THE LOGISTIC- FOCUSED FACTORY

It is pretty costly to create a logistic value in businesses. Additionally, it is not easy to measure it. In this case, in order for the logistics to

realize customer satisfaction with minimum cost, primarily the factory needs to be administered in a logistic-focused integrated structure. It is necessary that critical information should be obtained, which is required for logistics and followed continuously. The formation of information logistics, which is a part of the competitive business logistic, involves all the functions and control of the business and ensures organizational information flow, which is the management's job (Klein, 1993). From our perspective, the most critical role in information logistics is the formation of manufacturing logistics because the whole purpose is primarily to ensure value increase in manufacturing, which is the main activity of the business and hence to yield a benefit for the business. The purposes of information logistics are:

- increasing the firm performance,
- increasing customer service as a result of better distribution planning,
- monitoring the activities in a better way and providing control,
- reducing the gaps in the intercorporate relationships,
- increasing cooperation among firms (Klein, 1993).

In order to reach these purposes, eight significant priorities are making up a logistic-focused factory that will ensure continuity. These are;

- Logistics outsourcing
- Partnership
- Customer approach

- Value creation
- Quality
- Innovation
- Process approach
- Time\Speed (Schönsleben, 2004)

Modulation (also called grouping) will help accommodate the logistic priorities in the business with process-oriented auditing and teamwork. A manufacturing logistic model to be developed with such a perspective will increase the awareness and efficiency in the firms' supply chain.

5. GENERAL FRAMEWORK OF THE MANUFACTURING LOGISTICS MODEL

5.1. Planning of Manufacturing Logistics Systems and Performance Indicators

Before modeling manufacturing logistics systems, all major points related to the model should be selected and planned. The planning process for this modeling must include certain essential functions required by the systems departments. These include determining logistics measure points, material flow techniques, and the logistics information system. Logistics has six scarce resources: surface, volume, availability, staff, work equipment, supporter equipment, and organization equipment. These six resources are used to execute the aims of the logistics. These aims are to achieve logistics performance (Eversheim,1996).

Moreover, in supply chain systems, factors and significant decisions of manufacturing logistics can be classified as in table 1. The structural considerations in manufacturing are the stage, scope, location, mix, and size of the manufacturing facilities and the type and scope of distribution centers or public or contract to the warehouse. Resource allocation factors involve education and learning costs—exposing management and employees to the best practices in the industry. Management policies involve supply management, the justification and acquisition of technologies, and performance indicators for the WIP inventory. Cost drivers and performance indicators at the same time come under the management policy of the company. Management policies involve analyzing the modeling process, improving or redesigning it to meet competitive market and cost objectives, and identifying performance indicators to monitor the business, its success, and investment requirements.

Table 1. Key factors and decisions in terms of manufacturing in supply chain systems. (Adopted from Gopal et al, 1992).

MANUFACTURING				
Resource Allocation	**Management policies**	**Cost Drivers/Performance indicator**	**Automation and Information technology**	**Structural**
- Education and learning - Plant - Equipment - Preventative maintenance - Systems automation - WIP inventory - Direct labor - Indirect labor	- Staffing level (direct/indirect) - Coordination of activities - Policies and procedures - WIP inventory levels - Delivery performance - Capabilities - Technologies - Product lines per plant - Manufacturing mission - Quality	- Quality Processes variability Yield Scrap Rework - Process cycle time - Direct labor cost - İndirect labor and overhead support staff - Delivery performance - WIP inventory levels	- CAD/CAM/CAE - FMS/FM cells - Robotics - Group technology - Integration of business systems - Intelligent information systems - Manufacturing planning and control systems - Plans/schedules - Process control - Process cycle times - WIP tracking - Quality information	- Plant location - Concentrated vs. dispersed manufacture (plans per production line) - Single plant or plants at diffrent stages of manufacture - Level of Technologies - Capacities - Manufacturing flexibility - Local regulations and tax implications - Local market implications - Local labor and material costs - Local economy - Political

In performance assessments made within the scope of a supply chain, criteria such as resource utilization, flexibility, trust, and innovation may be used in addition to the commonly employed criteria: cost and quality (Chan et al., 2003, Cohen et al.,1997). The logistics performance of businesses can certainly be assessed with different indicators. In a 2004 study conducted in 1200 Taiwanese manufacturing firms, these firms' logistic performances and capabilities are evaluated based on their use of information technologies and information sharing, benchmarking, and flexibility in

responding to their customers (Shang et al., 2005). Furthermore, there are several key performance indicators in assessing the factory's internal and external logistics performance, and it is possible to classify these as short-term and long-term indicators. The key performance indicators in these two groups can be divided into five groups: effectiveness, efficiency, satisfaction, and information technology and innovation. These performance indicators can be assessed through a survey process that poses various management, employees, customers, and operators (Krauth et al., 2005).

How can we design these performance indicators and cost drivers for manufacturing according to the data flow within the system and organization? In order to realize this, a performance point should be constituted to measure the effectiveness of manufacturing logistics in a more detailed manner, and the activities here and at the critical points should be determined. Selecting the criteria is critical in assessing and designing any system (Beamon, 1999). As shown in Figure 3. the activities that must be primarily present in the performance center can be collected in the departments concerned with logistics management, logistics planning, and manufacturing logistics units. Furthermore, research, marketing, and logistics service providers can be combined within a logistic service department.

Logistics Management	Logistics Planning	Manufacturing Logistics Management
• Purchasing • Order definition and management • Material requirement planning • ERP • Delivery lead time planning • Tracing of demand • Warehouse and stock control	• Quality planning • Creating order lists • Order planning • Design of material movement • İnvestment planning • Method and process planning • Product development	• Material preparation • warehousing • Quality assurance and control • scheduling • initiation of the manufacturing process

Logistics service center
• Research, • Process development • Marketing • Logistics service providers
•

Figure 3. Logistics performance centers and activities (Schönsleben, 2004)

5.2. Manufacturing Logistics Model

Traditional logistics practices and technologies that integrate productive activities within the factory are necessary but not sufficient for competitive success. New logistics practices and technologies must also link all enterprise activities. Additionally, most organizations have traditionally been structured along functional lines, with logistics functions fragmented and relegated to lower organization levels. For instance, warehouse managers, traffic coordinators, purchasing managers, and material managers would operate independently" over the wall" fashion. To satisfy the requirement of our new, more integrated logistics model, we propose a model of manufacturing logistics with the following aims and characteristics:

The integrated architecture of the production units at the three levels are:

- Support of operating strategy.
- Coordination of material and information flow.
- Meeting throughput, accuracy, and reliability goals.
- Incorporation of well-defined interfaces.
- Support of timely communication with customers/suppliers.
- Meeting schedule and financial objectives.
- Meeting strategic objectives.
- Support or information systems throughout the enterprise

The main issue is decentralizing responsibilities in the traditional manufacturing environment, including central planning, visibility, and control. The trend in many companies is the centralization of planning activities instead of local planning. Figure 4 shows how the model increases centralization with the other functions in the manufacturing process. Increasing the control of inventory is one of the crucial issues. ManLog is composed of Management, Planning, and Control Levels, as shown in Figure 4. Logistical control is the primary managerial department of manufacturing systems at every stage. The database system is more beneficial for the Control and Management function. These database systems must integrate with Enterprise Resource Planning (ERP) systems. Planning level to guide related functions with Demand Forecasting that is supplied for required materials.

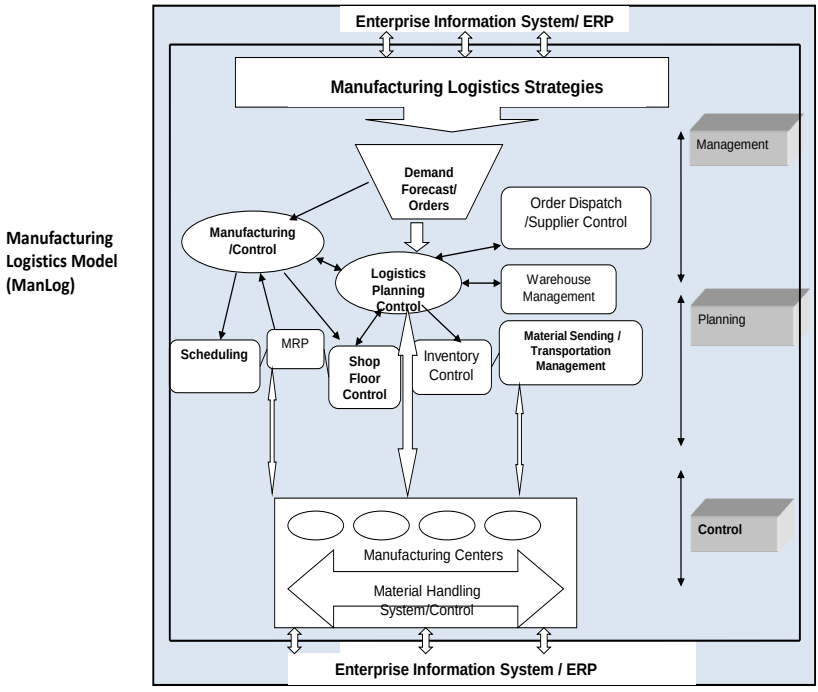

Figure 4. Manufacturing Logistics Model (Man-Log) (Denizhan, 2006).

These related functions are Manufacturing Control and Logistics Control. Manufacturing control functions control the inventory levels and decide needs according to specific demand. However, at the same process, forecasting knowledge comes to Logistics Control Functions. The Logistics department makes a Preproduction Plan, controls Stocks, the material dispatch time, buffer level, stock level, and place in the manufacturing plant. Stock control is checked out alternatively by the Logistics Control and Manufacturing Control departments. The main objectives of the model are to reduce WIP, prevent due date

delays, synchronize the manufacturing and logistics functions and thus increase meet throughput time.

6. ANALYSIS OF LOGISTICS/MANUFACTURING SYSTEMS

This part may guide to analyze any companies logistics analyses. Assuming that company has a make-to-order policy. Due to high product variety and indefinite demand conditions, the stock is produced only as of the occasion demands. The redundancy of many product components requires the implementation of an adequate stock program. First, the company's current logistics systems may be analyzed with data gained from 41 questions organized within three categories: inbound logistics, outbound logistics, and manufacturing logistics. As a result of our analysis, we have suggested the new logistics and manufacturing logistics strategies shown in Table 2. Through our interviews and observations, we have determined the fundamental problems areas to be the following:

- There were several breakdowns in the manufacturing plant caused by **supplier delays**.
- Inbound and outbound materials are uncontrolled, which leads to **incorrect warehouse information.**
- Despite adopting a barcode system, some materials were lost or unnecessarily long to be located and retrieved.
- Workers take parts from the warehouse without proper inventory control protocols and share these parts with other workers, again without inventory control.

- VIP levels are not controlled, and the manufacturing plant lacks a sufficient number of stock areas.
- Logistics decisions are only made after specific manufacturing planning activities, and this procedure can lead to breakdowns in the synchronization of material flows.

After examining the previously determined performance criteria and the literature's supply chain and logistic performance assessment studies, we formulated our analysis questions. As shown in Table 5.2, there were a total of 41 questions organized into three groups: (1) logistics management and planning (input logistics), (2) manufacturing logistics (manufacturing support), and (3) logistic services (output logistics). Questions about quality, storage, and purchasing are within the scope of input logistics, while stock control and the support of product movement within the warehouse come under the heading of manufacturing logistics. The manufacturing process covers transportation, workforce flexibility, operation duration, and the effectiveness of work centers. Finally, the physical distribution of finished products includes marketing, recycling, logistics, and transportation questions. Assessments regarding each question were rated from bad to sound on a one to five scales. Individual interviews with the employees and on-site observations were done within the scope of the assessments.

Table 2. The staff, tasks, and responsibilities of the logistic system (Denizhan, 2006)

The Logistic System	Activities	Responsibilities	Purpose
Logistics management and planning	• Quality, Reliability • Storing and placement at warehouses • Monitoring and acceptance • Transportation within the firm. Locating the orders • Interviews • Finding supply sources Planning necessities Purchasing	• Determining the limits of the supply source, gathering together, and ensuring sustainability • Conducting leading research for new supply sources • Coordination with suppliers • Selection of the supply source • Timing of purchasing • amount of purchasing, Performance analysis of suppliers	• Supporting manufacturing or resale organizations by providing the appropriate purchasing with the minimum total cost
Manufacturing Logistics	• Planning the main manufacturing program • Supporting the movement of goods within the warehouse • Transportation within the manufacturing process • Implementing studies for the division into stages of project parts • Leading R&D	• Storage of stock at the manufacturing location • Delays occurring between physical distribution and manufacturing. Providing the highest flexibility for geographical coordination	• Supplying manufactured goods and materials in order to contribute to the development of the production plan and to ensure that manufacturing operations are proceeding properly

	studies		
Logistics services	• Accepting orders • Processing orders • Locating stock • Storage and moving merchandise at the warehouse • Transportation of goods outside the business within the distribution channels • Transportation	• Pricing • Incentive support • Customer service • Delivery • Placing returned goods • Maintaining marketing planning and coordination in the field: e.g., maintaining product life cycles • Selecting the type of transportation service • Load balancing • Carrier routing • Vehicle scheduling • Equipment selection • Processing demands • Packaging	• It is contributing to income generation by providing the desired level of customer service at the least total cost.

The following data are used in the analysis:

- System load/ongoing data (orders loaded in the system, product data).
- Technical data, structural data of the factory, manufacturing flow data, disruptive data.

  - Organization data (working time organization, resource adjusting data, activity organization).

Input examination is a significant factor that relates directly to the manufacturing process and the effectiveness of the logistics system; wrong and faulty products will increase process duration and add to cost. However, our analysis determined that quality control must include considerations beyond those concerned with controlling input quality. Quality assessment points at the manufacturing stage have also been considered. Input controls are made regularly, yet the most critical problem experienced is that although the raw materials may have been inspected, inspection at the input stage does not necessarily reveal all the defects. For example, a copper roll that has been controlled at the input phase may contain undetected defects that will cause problems during the manufacturing process leading to decreases in the manufacturing rate. The ratio of conformity to the deadline at the factory was found to be 85%. The reason for the 15% non-conformity is stated as the While considering the customer.

The ratio of conformity to the term set for the factory was determined to be 85 %. The reasons for the 15% non-conformity are the disruptions in the manufacturing process resulting from poor delivery conditions. Moreover, defective products from suppliers are another factor that slows manufacturing. While quality still can be realized, the process is drawn out by the slowness of communication with suppliers, which causes manufacturing periods to be extended. Relationships with the suppliers appear as regular visits, and supplier assessment is made with the criteria and forms that the firm has developed because of its own experience. However, the most critical

problem here is the absence of a flexible supplier structure. The inadequacy of the communication tools and the fact that a communication function as significant as the internet is not used contributes to communication difficulties and delays. Also, the forms continue to be filled out on traditional paper and ink media and not saved digitally on a hard disk. This way makes updated follow-ups of the assessment forms inefficient and creates additional space to store the paperwork. There is a wide range of materials necessary for product sub-components, and there are many suppliers. Since there is no digital information transmission over the internet, there are delays in finding alternative suppliers when necessary. Communications with suppliers occur via telephone and surface mail correspondence, which wastes both time and paper and leads to misunderstandings and time lost playing phone tag. There is no grouping on the table related to the suppliers.

Other delays during manufacturing are caused by problems in material flow, breakdowns in the warehouse, defects in materials, and the absence of required materials. The number of orders that can fulfill is unknown, and there are cases where orders cannot be met. However, the causes have not been adequately identified.

In the analysis concerning storage, the following issues are relevant:

- Determination of area
- Stock location and platform design
- Warehouse configuration

- Stock location procedures are in place.

Problems that may be faced in this phase are listed below.

- Disruptions occur in production due to delays caused by suppliers.
- As a result of the mistakes caused by errors in material input from the warehouse to production, misleading warehouse information is formed in the stores.
- When a barcode system is used, if it is managed in the warehouse apart from production, materials may remain in the warehouses longer than they should.
- Despite an inventory management program, frequent and informal exchanges of material between production and warehouse workers may lead to a random distribution of material.
- The inability to execute buffer stock controls daily may hobble production and lead to area problems. Specific stock places and material shelves belonging to each machine group may also be misused. Some materials may be forgotten, misplaced, or lost on the shelves.
- Since production can inform the logistics department after identifying planning and requirements, a delay in the logistics process may cause long delays in the whole system, creating disorder in the logistics unit.

- At the end of each day, production reports are filled out, and salvage and stopping information are recorded. These data are entered into the computer the following day, and stock information is updated. However, salvage and stock information are not being assessed continuously in their entirety. This information is not currently followed.
- Safety stock is held separately according to parts. The raw material is held in stock in an amount sufficient to last for the number of days it would take to resupply it. A study intended to minimize stock and inventory does not exist. Increasing the stock on hand and using stock that is counted frequently may lead to higher production costs and increase area requirements. However, low preparation periods, the identification of small party sizes, and the increase in buffer stock areas may decrease stock amounts and, at the same time, increase the stock circulation speed. On the other hand, an increase in stock mobility will cause warehouse mobility to improve. Thus production logistics effectively can be increased by reducing the whole product circulation time.

In the context of production logistics, the following issues are of concern:

Concerning stock control:

- Raw material and finished product storage politics.
- Product mixes at the warehouse points.

- Number, size, and placing of warehouse points.

Concerning information flow and order processing:

- Sell order – inventory interface procedures.
- Order information transfer methods.
- Order placement rules have been established.

Concerning material handling:

- Equipment selection.
- Equipment renewal politics.
- Receiving orders procedures.

Our findings gathered at the plant may be summarized as follows:

- Identified stock politics do not exist.
- Stock levels of raw materials, semi-finished products, and finished products are not known.
- Safety and minimum stock amounts exist for very few materials.
- Studies intended to reduce stocks are not being done.
- A follow-up for the product in every phase by planning cannot be done. There may be times that stock amounts do not reflect correct information because units lend and borrow materials to and from each other. Such materials are not taken directly from stock.
- Salvage values are not currently known.

- The number of tasks that a worker can perform has been identified, and their capacities are known. This gives information about which work may be transferred to a specific work unit in all given situations.
- Theoretical line balancing is not being done. Balancing is executed in real-time by the workers and management.
- Work unit capacity usage rates are being calculated.
- Overall planning is done annually, and detailed planning is at monthly, weekly, and daily intervals (based on bench use).
- Bench use capacities are measured and assessed.
- The rate of planned orders to realized orders is not known.
- The frequency of bench/vehicle deterioration is being followed.
- Capacity use rates of material handling vehicles have not been identified. Their routing and planning are not being done.

Compliance with the 2005 year term projections regarding factory production has been determined to be 85%. The factory has identified the following reasons for the incompatibility value of 15%, and these reasons are listed respectively:

1. Delays caused by late payments.
2. Problems caused by suppliers.
3. They are halting production while R&D changes are put into use during the manufacturing phase.
4. Problems faced in transportation, chiefly because the transportation firm does not arrive as scheduled.

5. Non-compliance with the term is experienced due to delays resulting from the premature return of materials needed in the manufacturing process.

The problems faced are primarily determined by product variety. Professional logistics firms are of little value because material requirements are formulated in small amounts at rates determined by particular production and product types. Problems experienced with suppliers may cause disruptions in production and delays in the term date. The material flow plan and production plan should be reconciled, and shop floor control should be adequate. This kind of analysis permits us to expose the current structure, which brings us to the first step of our model: the strategy identification phase.

6.1. Identification of Logistics Strategy

A logistics is an independent unit responsible for warehouse and material receiving; logistics employs procedures that do not occur during the production, planning, and procurement processes. By ascertaining the rate of realized orders based on product groups, the stock is held for 15 days. Inventory valuation is performed monthly and compared to the levels of previous months. However, dynamic stock control has not been implemented about the production phases; consequently, changes and disruptions occurring in manufacturing cause significantly longer logistics delays.

As a result of our analyses, we have determined that the logistics system in the organization performs only procurement and distribution functions. The only function of manufacturing logistics is to dispatch materials to manufacture. However, logistics is a department faced with continuing responsibility, and its job is that much more difficult in the actual conditions of the manufacturing process. Consequently, the firm should establish its "logistics-oriented management" and "manufacturing logistics" approaches at the outset of each production run as the first step of its management approach.

The firm's strategy should be identified by considering its economic, technological, competition, and market conditions. After identifying this overall firm strategy, the individual logistics strategies of each unit should be identified, and the manufacturing logistics strategy should be formulated through a combination of logistics and manufacturing system strategies. With this aim, assuming that the firm's general strategy has been identified, only the logistics and manufacturing strategies have been formulated.

The most crucial function in the business, which manufactures products to order and stock, provides a value-adding inventory flow. This flow must have a minimum cost structure to keep buffer stock levels at their minimum value, and it must respond to customer requests. However, these aims necessitate integrating procurement, manufacturing, and distribution into a coherent and efficient structure. Moreover, logistics is not simply a function that is contained within a single firm. It also extends between firms, and our approach allows for

an integration of logistics resources among manufacturers and their suppliers to create maximum synergy among all parties involved. For this reason, the logistics strategy of the firm should be the "Integrated Logistics Strategy" shown in figure.5.

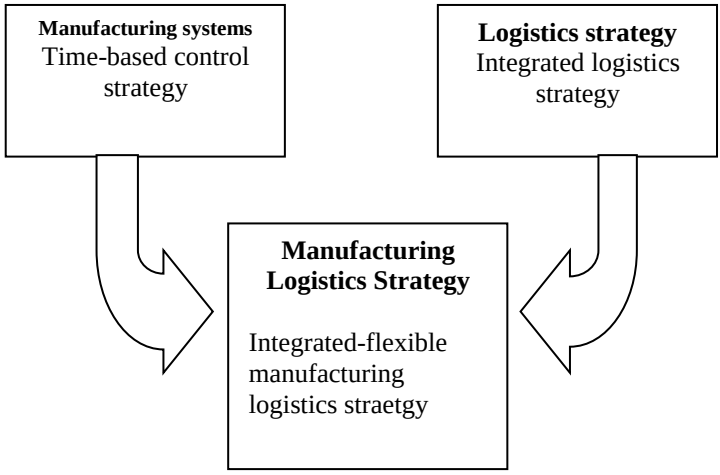

Figure. 5. Proposed manufacturing logistics strategy approach for the company (Denizhan, 2006)

The realization of an integrated logistics strategy requires internet support and information-sharing platform infrastructure. The firm works with many suppliers and needs a rapid flow of correct information to and from these suppliers. The most important deficiency in the current system is its lack of internet use. The firm policy for procurement and other departments precludes internet use, and this lack of internet facilities leads to considerable inefficiencies and miscommunications. This lack of up-to-date communications facilities leads to problems, especially in relationships with suppliers

and searching for new suppliers. It also increases both times and the cost of contacting suppliers.

At the same time, an integrated strategy also aims to facilitate (1) contact with suppliers, (2) increase compliance with predetermined priorities, (3) the supply of critical parts, and (4) information sharing. This procedure allows for decreases in unnecessary storage and reductions of both delays in the manufacturing process and order processing time. On the other hand, manufacturing logistics should share planning, control, scheduling, and stock control activities, done with the traditional logistics-oriented approach of nearly all firms with logistics departments. A manufacturing logistics strategy that can synchronize procurement, manufacturing, and distribution should rely on time-based control techniques. Production assembly according to order, and its goal should be to achieve minimum stock levels while reducing circuit time. We call this an Integrated-Flexible manufacturing logistics strategy and offer it as an approach that may permit reductions in stock amounts through increased stock circulation speed by enabling an unproblematic material and information flow between storage and manufacturing to reduce schedule deviations to a minimum. Material mobility in storage with high material variety will also increase. The next step after determining the strategies is determining the decision level at which the model will be implemented.

6.2. Anchoring the Decision Level

Decisions are made in the phase of model control and are implemented at the mid-level decision area of the organization structure. Unit managers and control engineers are responsible for this phase. In this context, necessary conditions for implementing the model are:

- Determination of logistics strategy and integration with the manufacturing system.
- Ability to integrate the operation into an ERP system.
- Functionality.

6.3. Construction of Information Sharing Points of Manufacturing Logistics Information Model

The information model and sharing points are disclosed to be understood by employees and managers in this phase. The other aim of this stage of the process is to provide a systematic explanation and demonstration of how additions can be made to the logistics software adapted for this purpose or a current ERP program software.

Manufacturing logistics activities are distributed among five modules. These are stock control, shop floor control, material dispatch/transportation management, logistics planning, and storage planning, and all units are in the usage area of the logistics department. The most important approach to increasing manufacturing logistics effectiveness is found in the shop floor control module. Essential points in the shop floor control are identified as buffer stock-

flow and machine and assembly line flow. Logistics calculates buffer stock-flow because logistics performs dispatch to manufacturing. Depending on the production program, the shop floor control module will maintain the capacity of manufacturing to understand and manage the manufacturing process flow. Its job is to optimize material flow by determining how the necessary materials will be sent to which assembly line, by whom, and if necessary, in which vehicle. The continuous operation of this system depends on a determination of buffer stock zones and capacities according to the assembly line or machine requirements and conditions. It will be possible to undertake evaluation, maintenance, and all necessary transaction with the flow of buffer stock calculated by evaluating daily salvage reports.

Through the assembly line menu, it will be possible to see delivery dates of finished product amounts currently available on all lines and the realized delivery date if completed. Through the functions available under this menu item, it will be possible to do line-based guidance on related units regarding finished products and any delays and defects.

Buffer stock zones should message when capacity approaches its maximum value, and the logistics unit should implement the necessary transportation plan. A warning is generated when ¾ of capacity has been surpassed. Thus, this provision allows preparation time to become available. The information flow shown in Table 4 should increase material mobility, decrease manufacturing accumulation, and

facilitate all materials dispatched from storage. The system should also be able to send warnings and messages about emergencies.

Material transportation and dispatch management are critical parts of the model. Workload forms are only required as part of the follow-up of the manufacturing department in the current system. Control of the detailed production program by logistics, both in the planning and control phases, will hasten material flow and contribute to the achievement of simultaneity with manufacturing. This approach supports the notion that the planning function cannot be separated from logistics planning. Independent, unintegrated work units make coordination much more complex and also slow down business.

Table 4. Information flow between manufacturing control and warehouse management (Denizhan, 2006)

Manufacturing Control		Warehouse Management
○ Order received –Code ○ Amount ○ Delivery date ○ Transportation and loading information ○ Production Program ▪ Year ▪ Week ▪ Number of Weeks ▪ Code ▪ Name ○ Critical levels Critical Material List ○ Code ○ Amount in the warehouse ○ Amount Needed ○ Tem time	⟵ ⟶	• Code • Stock name • Address • Amount • Shelf Life • Material characteristics • Unit • Volume- Place need • Maximum amount that can be stored • Warehouse responsible • Order number (shows as a counter how many times that material has been ordered that year until that time or how many deliveries have been done)

Following the production programs of the suppliers of critical products does more than prevent delays in the procurement process; this procedure also minimizes warehouse and stock costs. The firm has built partnerships based on trust with some suppliers over the years. Likewise, medium-sized, growing firms must build such trust through standard information sharing with the thought that the process will allow all parties to enjoy tremendous success. Although managers and firms see trust problems and risk-sharing in this topic as primary concerns, this structure should be beneficial. Before the operation, all parties have established mutually agreeable borders and rules. In this model, stock amounts are shared with suppliers to participate in three-month production programs.

6.4. Determination of Performance indicators

Logistics performance indicators show the effect of logistics on firm goals, especially in the four areas mentioned previously. These four areas are quality, cost, delivery performance, and flexibility. Can choose the dominant performance indicator as shown in table 5. In order to carry out an enhancement regime and enable control sustainability dependent upon the results of the analyses done, decisions about measuring these criteria must be made with managers.

Table 5. Dominant performance indicators of the business

Performance Areas	Measurement Points	Criteria
Quality	Warehouse, manufacturing centers	Critical warehouse levels, bench productivities
Cost	Stock Control, Warehouse	Determination of stock levels and reducing WIP.
Delivery performance	Manufacturing centers, Logistics	Reducing circulation time

No changes have been undertaken in facility settlement. Only a simulation model has been implemented to observe the effects of additional buffer stock zones and the construction of a material transportation system beforehand. In the model we constructed with simulation model, a capacity limit was established by increasing buffer stock zones. The locations for these zones have been identified with the input of worker experience and insight and by taking facility order, assembly line structure, and transportation distances into consideration. Logistics unit employees realize shop floor control and dispatch of material to manufacturing areas. This way, the effectiveness of the logistics control over manufacturing and the initiation of shop floor control activities have been realized. Previously, the material flow plan of each assembly line was identified by logistics which also determined which workers were responsible and from which stock zones they should obtain their materials and components. The simulation model assumes that manufacturing occurs according to continuous demand. Both scheduling and line balancing is done according to the shifting

contingencies and exigencies of the production process. Table 6 shows that the manufacturing logistics model includes Logistics Control and Planning unit among functions that previously had been assigned only to manufacturing. Logistics planning can envision demand forecasts and the MRP program before the first plan is formulated and can formulate its own temporary logistics plan. This temporary plan provides an opportunity to contact related suppliers beforehand by realizing warehouse, stock, and material controls before implementation; and it also offers an opportunity to formulate a material distribution plan in the manufacturing phase as a step

Table 6. Manufacturing logistics processes definitions

Process	Related Units	Input	Activities	Output
Manufacturing Planning	Logistics-Planning and Control, Manufacturing	Part definition Part classification Product tree information Order amount Forecast information	Machine information and the formation of a general process plan according to schedule as well as an Alternative Process plan	Manufacturing Process and manufacturing times
Scheduling	Logistics-Planning and Control, Manufacturing	Parts ordered Delivery dates Compliance of material transportation system with schedule	According to The Earliest Delivery Date, Scheduling is done with an algorithm of the resources to be used, stocks and schedule. Material dispatch transactions	Production Schedule

			are done according to this scheduling and buffer stock zone capacities and manufacturing needs.	
Inventory – Stock Management	Logistics-Planning and Control, Manufacturing	Parts and Materials Net Need of Order Procurement times Order cost Stock cost	Measuring stock according to information in stock database, economic order quantity algorithm, and safety stock policy. Determining economic order amount Forecasting order dates Raw material stock bought material stock and finished product stock information Follow-up of material in assembly	Stock and manufacturing information
Shop floor Control	Logistics-Planning and Control, Manufacturing	Stock Control Machine Control Assembly Control	Follow-up of materials waiting and buffer stocks, Machine defects and delays, material transportation system	Control – Synchronizing

			control Finished material control and control in periods determined in the schedule.	

7. DISCUSSION

The findings suggest that balancing assembly lines and determining party sizes are essential steps concerning decreasing circulation time. A rapid, dynamic system can be achieved by reducing party size and synchronizing buffer stock zones and material flow.

The manufacturing logistics approach has been evaluated as positive by the business's logistics, procurement, and manufacturing units. It is a step toward a structure in which, as we suggested, the logistics department between the manufacturing department. The first phase of this process is to begin realizing the dispatch of materials by logistics to manufacturing. The fact that shop floor control activities are within logistics instead of manufacturing, or are shared, enables material control and warehouse mobility to occur on time and correctly. However, a total integration will require a restructuring and evaluation process, which will take a considerable amount of time. On the other hand, the model has been assessed as highly intuitive and requires very little understanding. The firm assessed it as a total package that could be realized within a newly established business for which it would be especially advantageous.

Differences in management approaches cause this. They must follow all demand, costs, and stock situations in all phases of decision-making. Central control capable of enabling this must include integrating group or individual decisions to optimize the entire system. Central control is usually the pushing system because decision-makers decide to push the stock to the phases needed more. In the centralized control model, decisions are made independently in phases separated from each other. Supplier agreements should be reached by central grouping control with suppliers, and during the manufacturing decision phase, supplier information should be made available within the system. The logistics and procurement departments have also accepted this structure to be assessed in future studies.

Logistics Strategy should be described at the beginning. The logistics strategy aims to decrease costs (variable costs), use less capital (investments, fixed costs), increase service quality, increase manufacturing support, and increase delivery performance. These decisions should be made within the top management of the firm and shared with all units. This application assumes that manufacturing cannot act independently of logistics in any phase, and it also assumes the necessity of a manufacturing logistics perspective.

Inventory policies (pushing, pulling, location of stocks) are essential due to the requirements of assembly-line production, production-oriented to order, and material variety. However, with this model, the current follow-up of buffer stocks is being done. The model we have

suggested requires an investment also because of cost and the inefficiency of infrastructure.

Transportation strategy (types, dispatching sizes, rotation, scheduling) should be determined. A professional transportation firm should be hired. Likewise, outsourced facilities such as warehouses should be negotiated with suppliers until the order level and throughout the next delivery phase. Logistics should be effective in the dispatching of material and, additionally, informing manufacturing programs and shop floor control. With this combination of capabilities, Logistics will formulate a preplan towards manufacturing and a temporary need plan. As a result, the transmission of order information between manufacturing will be faster and more efficient, and material shortages will be prevented. Logistics should, on its own first determine its needs by receiving demand orders simultaneously with manufacturing

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