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# AN OUTLOOK: INFORMATION LOGISTICS SYSTEMS USING INTELLIGENT TRANSPORTATION SYSTEMS

**ANA LAZAROVSKA**
Post- Doctorate in science with a major in aeronautical science management,
Atlantic International University,
Pioneer Plaza, 900 Fort Street Mall #905, Honolulu, HI 96813, United States

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## ABSTRACT

The future of information logistics systems leveraging intelligent transportation systems (ITS) is highly promising and big data analytics that enable real-time data sharing, optimized routing, and enhanced safety, thereby reducing congestion and promoting sustainability. As global adoption of smart infrastructure accelerates, integrating these systems into a unified framework aligned with the global logistics concept is crucial, emphasizing precise identification of information needs, clear operational requirements, and strategic planning. This integration aims to create scalable, adaptable, and resilient logistics networks that meet evolving industry demands, ensuring efficient, reliable, and environmentally friendly transportation solutions for the future.

**Keywords:** Concept of a logistics information system, development and design of a logistics and information system, LIKS interoperability in traffic and transport.

## 1.0 INTRODUCTION

Developing effective logistics information systems requires integrating intelligent transport systems into a unified framework aligned with the global logistics concept, which emphasizes precise identification of information needs for each object involved. These systems must accurately define requirements, specify necessary measures and obligations for current operations, and facilitate planning and management to ensure seamless service delivery. Ultimately, the mission of such a system is to support scalable, future-proof development by aligning with the company's evolving requirements and strategic plans, ensuring compatibility and efficiency across the entire logistics network.

### 1.1 Definition of basic terms

> *"Logistics is a combination of science and art. It uses quantitative methods of engineering and analysis to incorporate logistical considerations into product design, development, production, and operation, but it is an art because it integrates human experience, intuition, and creative thinking."*
>
> Langeford, 1995[1]

[1] http://web.efzg.hr/dok/trg/predavanja%20pl%20bj%2011-12.pdf

  

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According to the definition of the Council of Logistics Management from 1991, *"Logistics is part of the supply chain process and represents the process of planning, implementing and controlling the flow and storage of goods, materials, services and information from the place of their production to the point of their consumption, in order to most effectively and efficiently meet the needs of users."*[2]

*"Information is the result of processing, manipulating, and organizing data in a way that adds knowledge to the recipient. In other words, it is the context in which the data is taken."*[3]

*"Communication is the process of sending information to oneself or to any other entity, through language or through a contractual character."*[4]

*"Integration represents renewal, complementation of what is important, transition from a broken state of being to a conditioned state."*[5]

*The term Intelligent Transport Systems (ITS) is based on three keywords: information, communication and integration.*

*"An information system is a formal part of the communication system of a particular business unit and consists of a group of people and machines that process information and are in communication relationship to realize business goals."*[6]

*"A logistics information system (LIS) is a system of interconnected subsystems and elements that, using human, material and technical components, intangible components, portable components and organizational components, enable the collection, processing and storage of data and information and the provision of data and information to logistics entities such as product manufacturers."*[7]

### 1.2 Setting the foundation and goals

This paper highlights the vital importance of modernized logistics information systems in boosting competitiveness and operational efficiency within transportation sectors by leveraging real-time data for better decision-making. Emphasizing the role of technological modernization, the paper demonstrates how seamless coordination and robust information support can accelerate goal achievement and foster a more efficient, responsive logistics system.

[2] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[3] http://hr.wikipedia.org/wiki/Informacija
[4] http://staznaci.com/komunikacija
[5] http://staznaci.com/integracija
[6] http://hr.wikipedia.org/wiki/Informacijski_sustavi
[7] http://bs.wikipedia.org/wiki/Informacioni_sistemi

  

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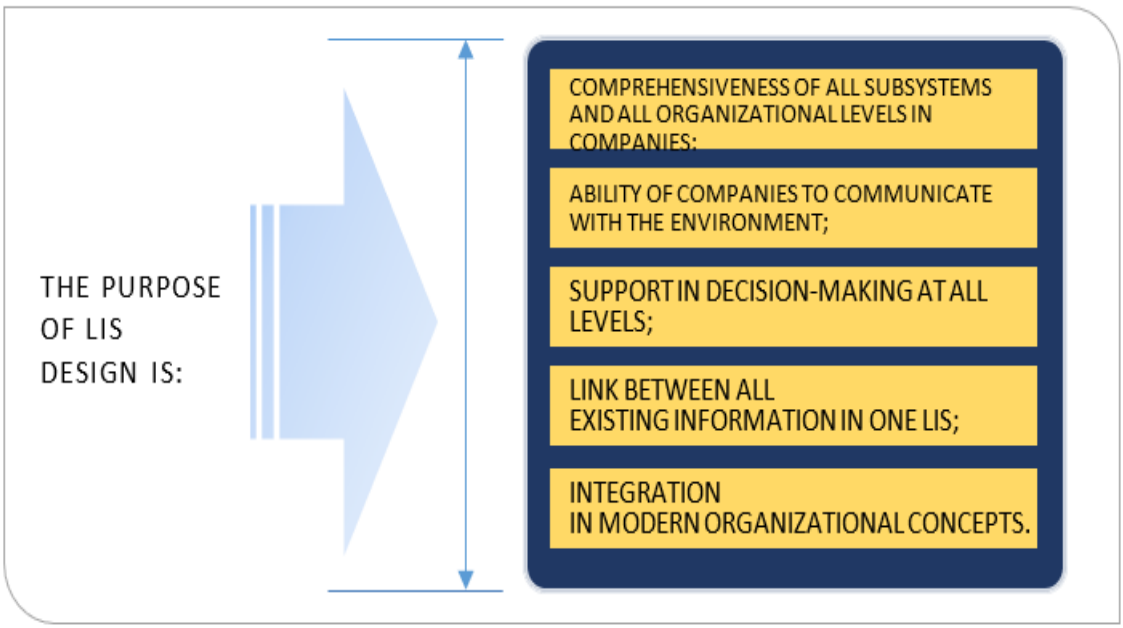


**Figure 1, Objectives of LIS design**[8]

An information logistics system enhances organizational efficiency by integrating information and functions digitally, emphasizing targeted group-specific data delivery, which enables timely detection of relevant changes and supports optimal decision-making.

### 1.3 Structure of the paper

Following the methodology for the development of scientific and professional papers, this paper will be presented in five chapters.

- Introductory part.
- Concept of a logistics information system.
- Development and design of a logistics and information system.
- LIKS interoperability in traffic and transport.
- Final thoughts.

The paper effectively outlines its thematic structure, starting with foundational concepts and advancing through theoretical frameworks and development methodologies for logistics information systems, culminating in a focused analysis of current problem-solving systems aligned with modern needs, and finishing with a synthesis that underscores the critical role of these systems in overcoming contemporary logistical challenges.

## 2.0 CONCEPT OF THE LOGISTICS INFORMATION SYSTEM

Regardless of the type and form of logistics products, information is an important ingredient for every logistics product. Data transfer models are an integral part of the information system.

[8] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  

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**Figure 2, Components and functions of the logistics information system[9]**

Every logistics information system has 4 basic functions:

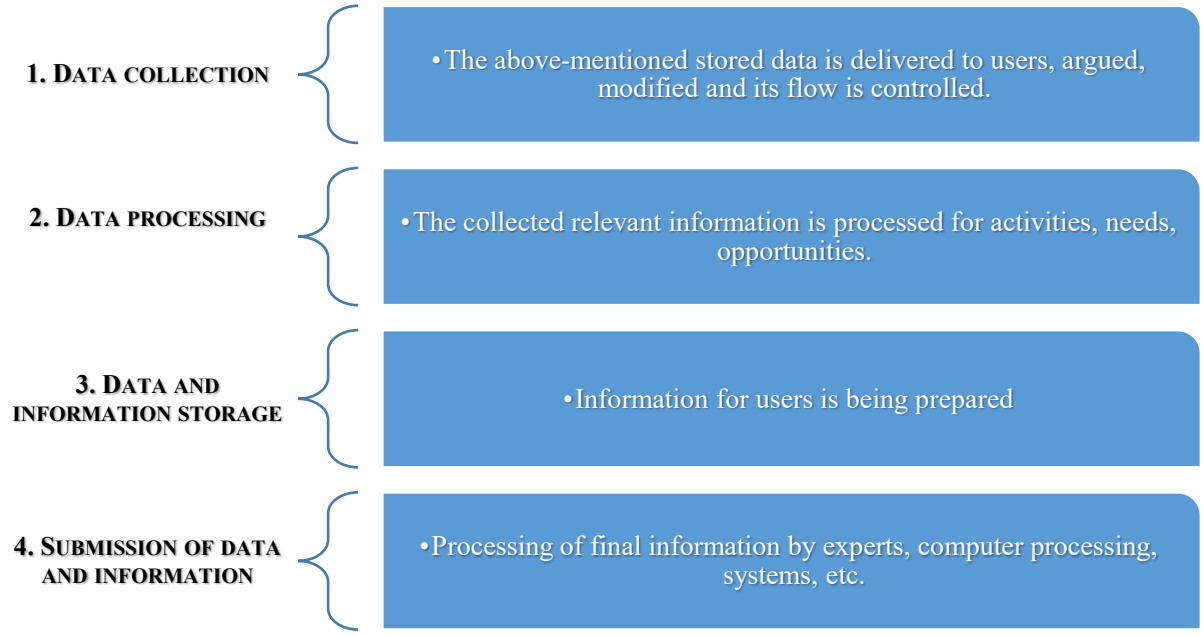


**Figure 3, Basic functions of the logistics information system[10]**

[9] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[10] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  

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In order for all logistics entities to achieve their basic functions, their system must consist of five interconnected components:

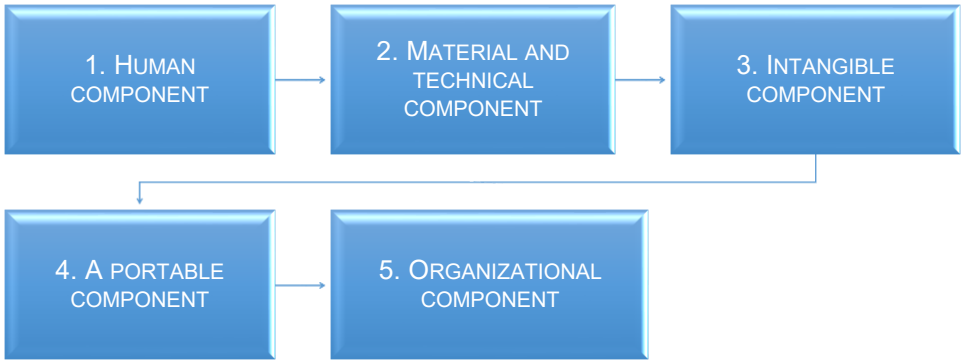


**Figure 4, Connecting logistics components**[11]

Every information system must contain these five components.

1. Lifeware, human component consisting of a team of experts, analysts or programmers and all personnel who, in every function and with any activity, participate in the operation of the system when using the results of data processing or information.
2. Hardware, material basis - electronic computer, intended for communication and transmission, and other computer equipment intended exclusively or predominantly for processing data, information, input-output devices.
3. Software stored on memory media is mainly magnetic i.e. electronic records. Software consists of intangible elements, programs (algorithms), training and methods relating to the organization, management, processing and use of the results of processing, the total human knowledge embedded in machines, equipment and other devices.
4. Netware, material-technical and immaterial component, communicating within the network. It represents a network basis for communication of the elements and parts of the system as a whole. It consists of various communication hardware and software devices, and consists of means and connections for remote data transmission, telecommunication devices and connections.
5. Orgware, organizational procedures, methods and ways to connect and harmonize all components.

In companies, decision-making can be categorized into three levels: strategic, tactical, and operational. Strategic decisions are made by top management to set long-term goals and overall direction, often involving significant resource allocation and policy formulation. Tactical decisions are handled by middle management and focus on implementing the strategies by developing specific plans and allocating resources effectively. Operational decisions are made at the ground level by frontline managers and employees, addressing day-to-day activities and ensuring the smooth running of business operations. Datawarehouses play a crucial role across all these levels by organizing and providing accessible, high-quality data to support informed decision-making.

[11] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  


**Figure 5, Levels of decision-making**[12]

- The operational level includes leaders from the lowest levels who control and coordinate the work of the executors.
- Middle management is a relatively larger group, which includes functional managers and others.
- Senior management is a smaller group that leads the entire organization, defines the main goals, strategies, and provides resources.

### 2.1 Types of information systems and their role in the logistics system

Depending on the level of decision-making, there are different information systems:

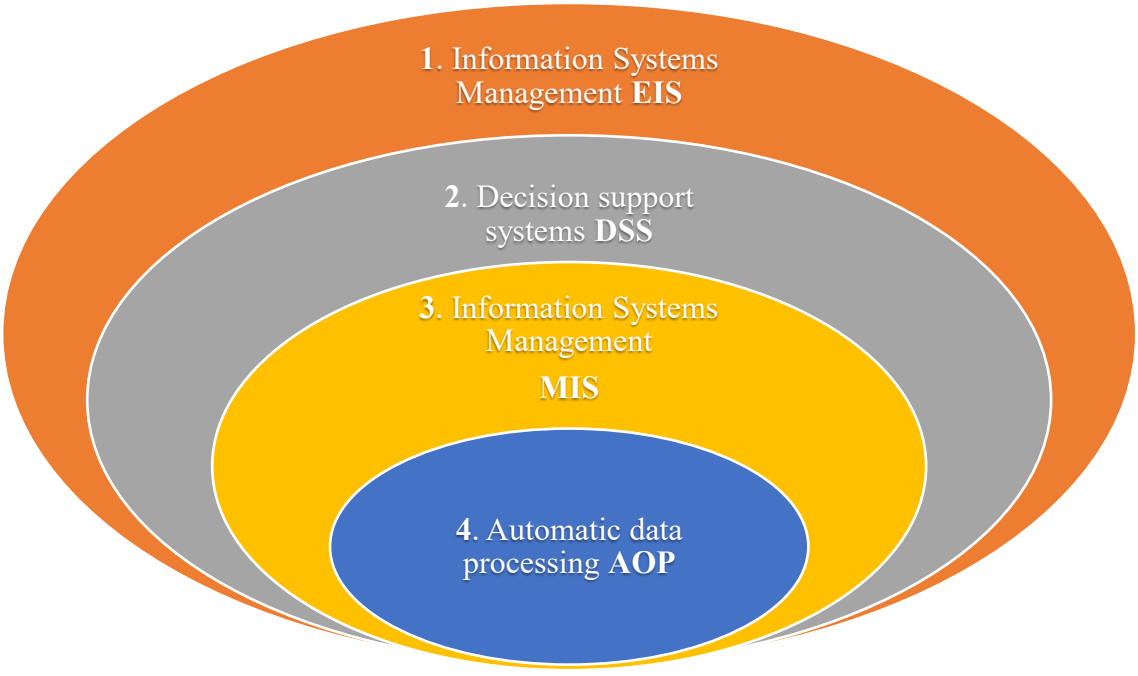


**Figure 6, The connection between information systems**[13]

The Virtual Command Center (VCC) is integral to service-oriented engineering, serving as a centralized control hub that manages cooperative procedures, offers real-time data, and ensures visibility and supervision across diverse logistics processes, regardless of operating systems or

[12] http://hr.wikipedia.org/wiki/Informacijski_sustavi

[13] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  

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programming languages. By integrating system support and facilitating communication through e-services, the VCC enables vertical and horizontal integration of information systems, thereby enhancing coordination, responsiveness, and efficiency in complex operational environments.

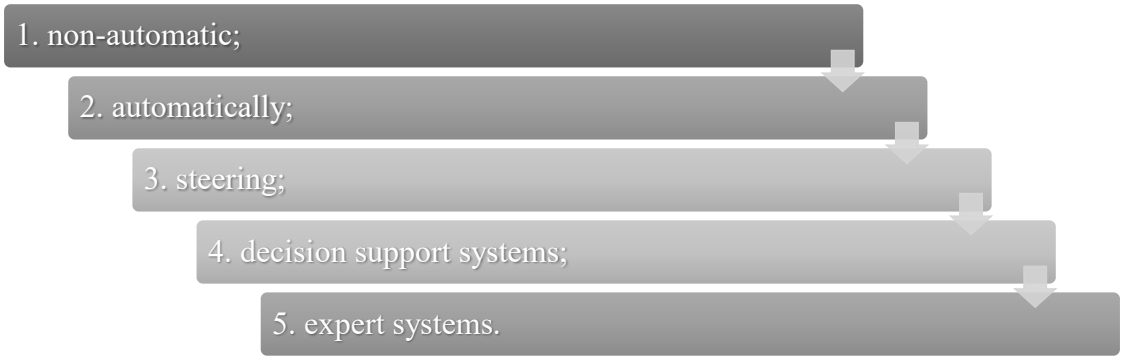
- The vertical integration of information systems in E-logistics implies that the flow of information exists between several different decision-making levels.
- Horizontal integration of information systems is a system that involves the flow of information at the same level of decision-making.

The primary interest is the company's ability to review and update information from the business domain with its partners.

The main goal is to use a combination of integrated software solutions that will support all operational processes related to complex inter-logistics, through the system:

- Enterprise ResourcePlanning, (ERP);
- Customer Relationship Customer (CRM);
- Supplier Relationship Management (SRM);
- Partner Relationship Management (PRM);
- Employee Relationship Management (ERM).[14]

Automatic Data Processing (ADP) is a key provider of business outsourcing and data processing services, offering systems that generate various reports to support operational needs, while managing diverse services including automotive and heavy equipment computer systems, though its credit rating was downgraded from AAA to AA in 2014. Management Information Systems (MIS) are computerized systems designed to manage, analyze, and disseminate information crucial for operational and strategic decision-making, facilitating improved organizational efficiency through tools like decision support systems, expert systems, and executive information systems. MIS encompasses the study of how individuals and organizations evaluate, design, and utilize systems such as Just-in-Time, Kanban, Electronic Data Interchange (EDI), and Electronic Funds Transfer (EFT) to enhance decision-making and operational effectiveness. Information transport systems in information logistics systems are divided into 5 groups:




[14] http://books.google.ba/books?id=wnQ1uGWPKmkC&printsec=frontcover#v=onepage&q&f=false

**Figure 7, Transport and Logistics Systems Information Group[15]**

### 2.1.1 Non-Automated systems and their role in the logistics system

Non-automated information systems rely on manual or mechanical data processing, with data stored as documents in a repository, leading to unstructured, inconsistent, and duplicate data handling. These systems are characterized by slow, non-unified processes, prone to errors, and often produce reports based on verbal or experiential information rather than standardized, formatted data. Consequently, decision-making can be unreliable due to the lack of rigor and consistency, highlighting the limitations of these systems in effectively managing and utilizing organizational information.

### 2.1.2 Automatic data processing systems, transaction systems

Automatic Data Processing Systems or Transaction Processing Systems revolutionized data collection, storage, and processing by leveraging computers to enhance efficiency and data quality, particularly in business functions like accounting and finance, initially through batch processing on low-capacity computers. These systems introduced standardized nomenclature and elevated computer literacy, but their implementation often overlooked comprehensive system integration, decision-making automation, and the interconnectedness of data, leading to isolated information silos, insufficient IT expertise, and a focus on mere automation rather than optimizing overall efficiency.[16]

### 2.1.3 MIS -Management Information System

Management Information Systems (MIS) have evolved from simple automatic data processing and control functions to complex, integrated systems that support decision-making and business management by providing fast, high-quality, user-friendly information tailored to organizational needs. These systems consist of interconnected subsystems functioning as a cohesive whole, enabling quick access, detection, and utilization of data, thereby reducing uncertainty and empowering top management to make informed, timely decisions. By emphasizing real-time data processing, improved reporting, and user-centric information delivery, MIS significantly enhances overall business system efficiency, control, and strategic planning.

The effective processing of transactions and the strategic use of information are fundamental to shaping a company's operational framework, with top management playing a crucial role in guiding these processes. Their involvement ensures that business systems are designed and managed to enhance reporting accuracy and managerial decision-making, ultimately leading to improved organizational performance and better strategic outcomes.[17]

### 2.1.4 DSS -Decision Support Systems

[15] http://en.wikipedia.org/wiki/Management_information_system
[16] www.itrevizija.ba
[17] Извор : www.itrevizija.ba

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A Decision Support System (DSS) is software designed to monitor databases and decision models, aiding in complex, unstructured, and routine decision-making processes by providing support through structured approaches and pre-defined algorithms, though it does not automate decision-making entirely; instead, it facilitates interactive work where problems are often not fully formalized or similar to previous cases, making it a valuable tool for higher-level decision-making that benefits from structured analysis without replacing human judgment.

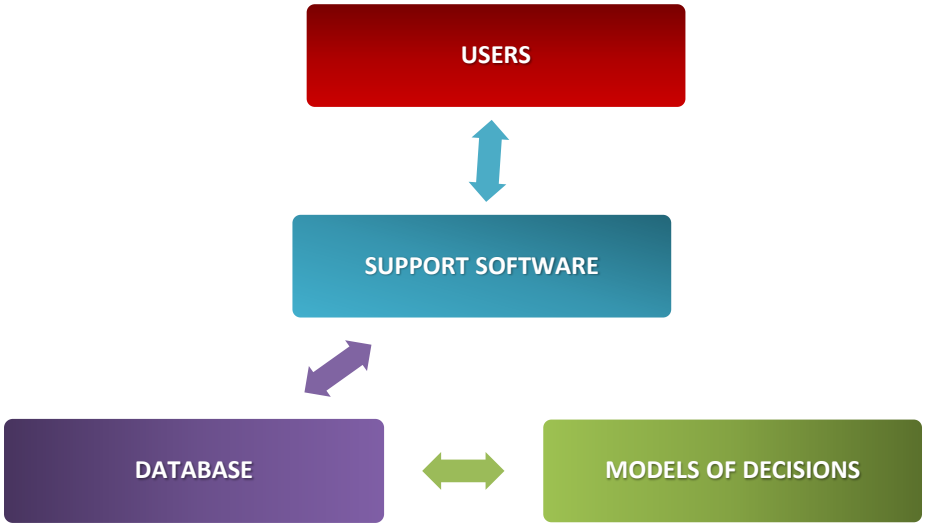


**Figure 8, Structure DSS**[18]

### 2.1.4.1 Geographic Information Systems GIS

Geographic Information Systems (GIS) are a specialized type of Decision Support System (DSS) designed for spatial data analysis, integrating geographic, land registry, demographic, and traffic information to facilitate planning and decision-making. By visually representing data on maps, GIS provides a comprehensive geographic overview of market structures, customer distributions, and other relevant spatial patterns, enabling organizations to make informed decisions based on spatial relationships and trends.[19]

### 2.1.5 Specialized information systems

Specialized information systems are designed to enhance decision-making in complex conditions by integrating advanced data processing, analytics, and real-time information management, enabling users to analyze multifaceted data sets, identify patterns, and generate informed insights, thereby improving the accuracy, efficiency, and effectiveness of decisions in dynamic and unpredictable environments across various sectors such as healthcare, finance, military, and emergency management.

### 2.1.5.1 Information systems in the transport of goods

[18] извор: http://www.scribd.com/doc/6815524/6-logisticki-informacioni-sistemi
[19] Извор : www.itrevizija.ba

  

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Intensive communication between participants and the exchange of a large amount of information is necessary for the development of ITS and the application of ILS for the rationalization of goods traffic. Thanks to the automation of information transfer in IT activities, there are huge savings that increase the productivity and efficiency of traffic.

Communication with the transfer of information from the sender to the recipient is carried out in order to achieve the unity of goods traffic and, thanks to this process, the participants have the same or similar idea of an event. Some means that have experienced computerization of a unique number of products such as: EAN6, UPC7, EFTPOS8, EOS9, EIHR10, EDI11, etc.

### 2.1.5.2 Unique product labeling systems

Advancements in computer technology and data collection methods have revolutionized business operations by enabling real-time, accurate, and cost-effective access to vital information such as supplier data, sales figures, organizational performance, and customer demand. This evolution led to the development of standardized, machine-readable symbols and systems like OCR codes, magnetic codes, barcodes, European Article Numbering (EAN), Universal Product Code (UPC), electronic funds transfer, Entry Order Systems, electronic home retailing, and electronic data interchange (EDI), all of which facilitate seamless data capture, processing, and communication across various business functions, enhancing efficiency and decision-making.[20]

### 2.1.6 Information systems that support the business of modern companies

Modern digitalization aims to enhance business efficiency through precise billing, streamlined procurement, real-time inventory monitoring, and automated customer service using just-in-time systems. Integrating these digital processes into marketing strategies bolsters support for critical subsystems like ordering, warehousing, sales, finance management, and communication with business partners, resulting in improved operational coordination, reduced errors, and increased responsiveness to market demands.[21]

### 2.1.6.1 Supply chain and commodity management information systems

Computerized information systems streamline procurement, inventory, and order processing by maintaining accurate records of products, prices, suppliers, and transactions, thereby enhancing efficiency and accuracy. Entry Order Systems (EOS) facilitate seamless communication between enterprises and customer databases, supporting order preparation, procurement, and transport planning. Implementing such complex systems requires organized databases, communication protocols, ordering software, and technical infrastructure. Barcode scanning automates receipt and dispatch processes, while inventory management systems track stock levels, order histories, service records, and financial data, ensuring comprehensive oversight and efficient operations across the supply chain.

### 2.1.6.2 Sales management information systems

[20] извор : www.itrevizija.ba

[21] извор : www.itrevizija.ba

  

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POS (Point of Sale) and EIHR (Electronic In Home Retailing) systems, along with coding standards like the European Article Numbering Association and UPC, play a crucial role in modern retail operations by enabling real-time data collection and communication between sales terminals and regional centers. These systems facilitate just-in-time inventory management, reducing costs and optimizing stock levels, while providing tangible benefits such as improved planning, reporting, and inventory control. By integrating POS systems with computer equipment and communication networks, managers can effectively monitor trends, respond swiftly to market demands, and enhance the efficiency of physical distribution, leading to a more responsive and data-driven retail environment.[22]

### 2.1.6.3 EDI Electronic Data Interchange

EDI (Electronic Data Interchange) streamlines business communication by enabling fast, secure, and automated exchange of documents, leading to cost savings, improved data security, and operational efficiency. Its adaptable platform supports compliance with evolving standards and strengthens partnerships, making it essential for businesses seeking reliable, scalable, and efficient interactions across global markets.

**Table 1. Strategic and operational decisions in individual subsystems of the logistics system[23]**

| SUBSYSTEM | STRATEGIC DECISIONS | OPERATIONAL DECISIONS |
|---|---|---|
| *PRODUCTION* | LONG-TERM PRODUCTION PLANNING | PRODUCTION PLANNING IN ACCORDANCE WITH PROJECTS OF INDICATORS OF THE LAW |
| *TRANSPORT* | CHOICE OF TRANSPORT MODES CONSUMER CHOICE | VEHICLE DISTRIBUTION PERFORMANCE EQUIPMENT PLANNING |
| *STORAGE* | PUBLIC REGARDING OWN STORAGE, DETERMINATION OF THE NUMBER AND LOCATION OF WAREHOUSES | STORAGE, CHOICE OF MECHANIZATION, INDICATORS FOR WORKING STORAGE |
| *CONSEQUENCES PROCESSING* | CHOICE OF WAYS TO MANAGE ORDERS | ORDER TRACKING, ORDER VALIDATION, ORDER RECONCILIATION |
| *STOCK* | CHANGE SYSTEM | FORECASTING, STOCK MONITORING, STOCK TURNOVER |

## 2.2 Methodological framework for system development

[22] Извор : www.itrevizija.ba

[23] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  

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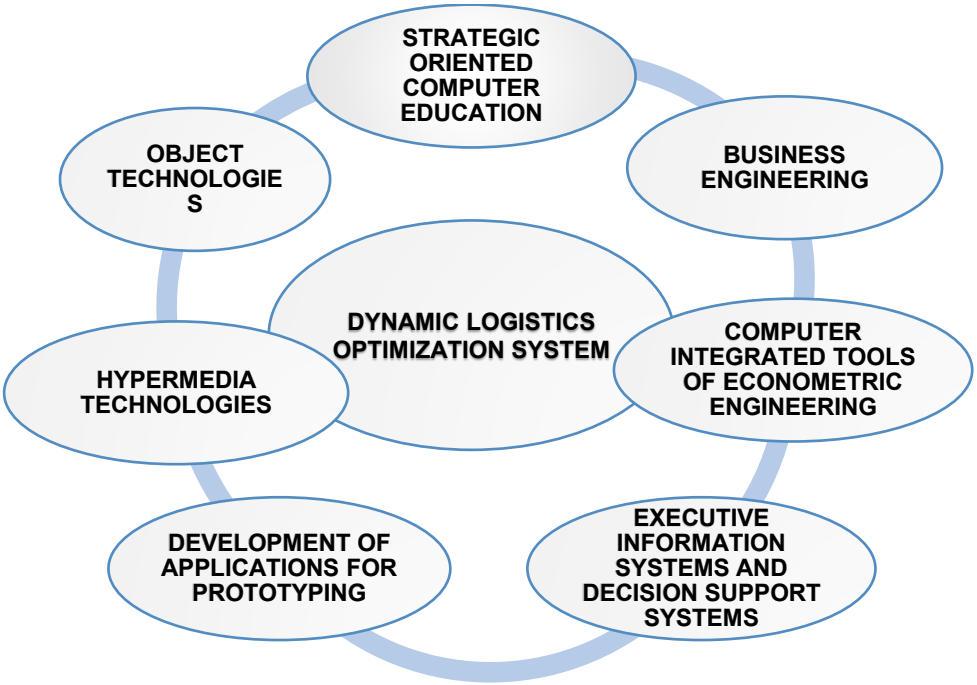


**Figure 9, Methodological framework for the development of information technologies in micro-logistics systems[24]**

When is micro-logistics systems harmonized and how important is the methodological framework for the development of information technologies. After all segments, the generation of all data is followed by the dynamic optimization model of the micro-logistics system.

The efficient implementation of information technology requires a clear distinction between the forms and functions of the two most important types of information technologies:

**TRANSACTIONAL INFORMATION TECHNOLOGY**

- collection, processing of data, reporting necessary to quickly identify problems and ways to quickly solve them.

**ANALYTICAL INFORMATION TECHNOLOGIES**

- of the final results already obtained, establishing an objective diagnosis and finding appropriate solutions. In the implementation, two models are used:
- DESCRIPTIVE MODELS
- forecasting and management models
- NORMATIVE MODELS
- Optimized models for planning in certain logistics chains.

[24] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  

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**Figure 10, The most important types of information technologies[25]**

Logistics formation systems from the perspective of micro-logistics systems can be defined by their subsystems as:

a) production logistics subsystem;
b) trade logistics subsystem;
c) transport and traffic logistics subsystem;
d) distribution logistics subsystem
e) forwarding logistics subsystem;
f) subsystem for environmental logistics
g) financial logistics subsystem and etc.

Communication between entities within ILS can be:

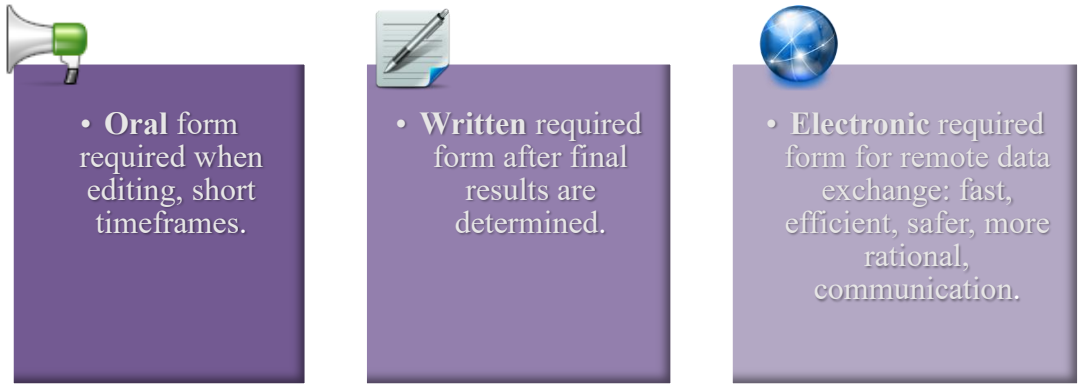


**Figure 11, Communication modes[26]**

**Forms of communication within ILS**


[25] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[26] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  

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**Фигуре 12, Electronic communication forms**[27]

### 2.3 Mission of logistics information

Logistics decisions according to the degree of complexity hierarchy can be:


**Figure 13, Complexity of logistics decisions**[28]

The decision-making process comprises problem identification and solution selection, with strategic decisions focusing on critical processes relevant to key decision-makers, extending beyond initial adoption to final realization. Tactical decisions serve as operationalized strategies aimed at enhancing organizational efficiency by implementing strategic plans, while operational decisions support the execution of higher-level commitments through routine, day-to-day choices.[29]

Logistic decisions based on time can be:

[27] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[28] file:: Skripta za I parcijalni za Logističkesisteme 1
[29] http://hr.wikipedia.org/wiki/Poslovno_odlu%C4%8Divanje


**Figure 14, Logistics decisions according to time periods[30]**

According to the stages of the logistics product production process, logistics decisions can be:

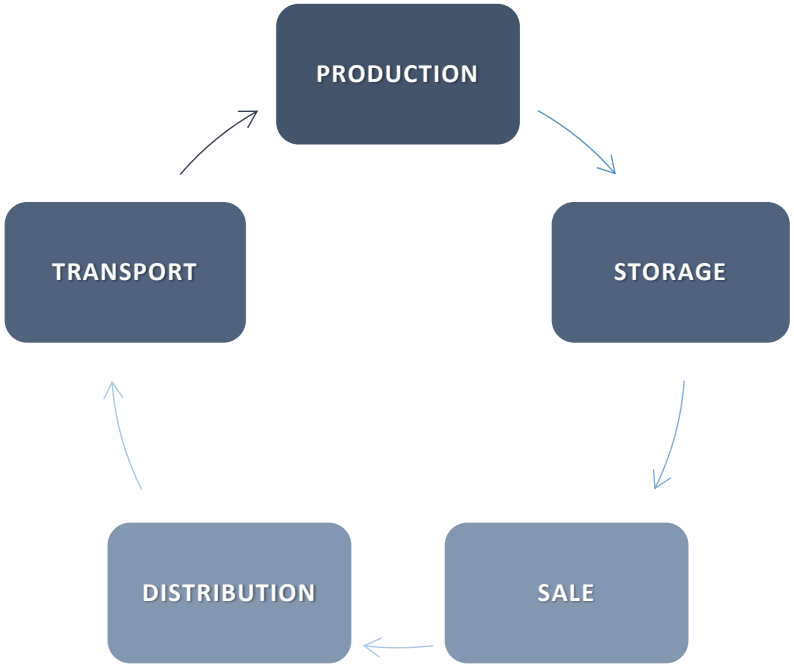



**Figure 15, Logistics decisions according to the stages of the logistics product production process[31]**

## 3.0 DESIGN AND DEVELOPMENT OF A LOGISTICS INFORMATION SYSTEM

LIS (Lattice Information Systems) should indeed be closely integrated with functions that define its foundational structure and facilitate efficiency assessments via mathematical algorithms, as this alignment ensures accurate modeling, optimal performance, and reliable validation of the system's capabilities.

[30] http://hr.wikipedia.org/wiki/Odlu%C4%8Divanje
[31] file:: Skripta za I parcijalni za Logističke sisteme 1


**Figure 16, Efficiency algorithm LIS[32]**

### 3.1 Information system design

The 1970s and 1980s experienced a software crisis in the LIS development process, particularly characterized by an Ad Hoc approach, which involved improvised, non-generalizable solutions often created for specific tasks such as organizational or committee initiatives. These ad hoc solutions lacked adaptability and proper planning, leading to inefficiencies and ineffective implementations within Library and Information Science (LIS), as overstepping boundaries and errors resulted in a fragmented development process that struggled to meet evolving needs effectively.

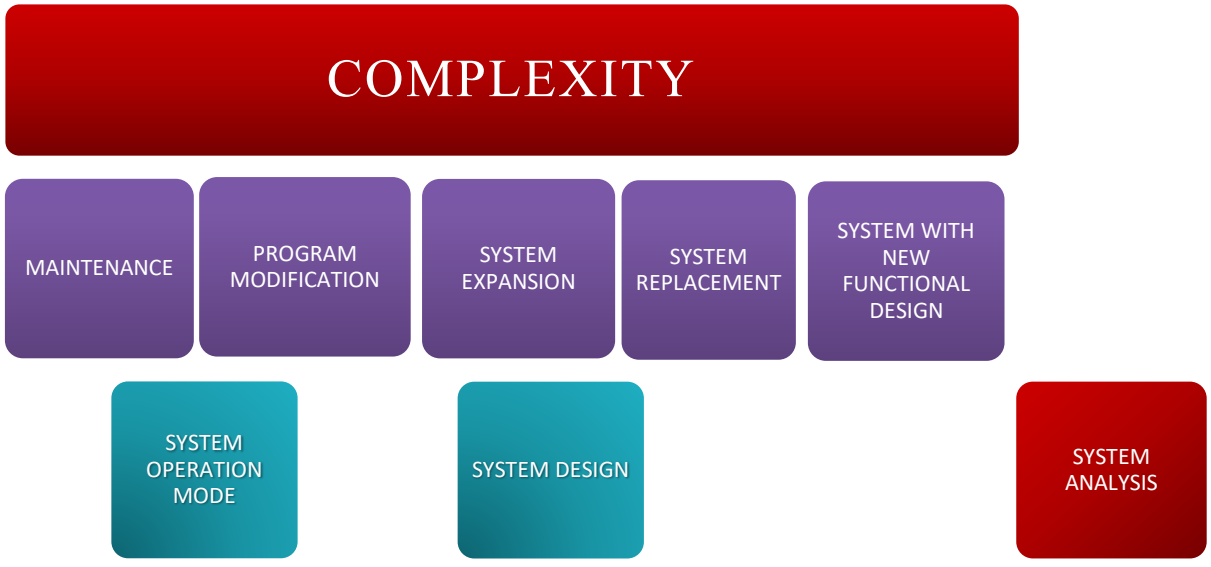
The software crisis should be solved through:

1. Established system design methodology and technique,

    1.1. Computer Aided Software Engineering CASE helped software engineering in the domain of software tools used to design and implement applications. The goals of CASA are:
    1.2. Improving designer productivity
    1.3. Reducing the time required for software development
    1.4. Increasing software quality

2. Increasing system performance

3. 4th generation languages




[32] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

**Figure 17, Procedures in designing a logistics information system[33]**

### 3.2 Information Systems Design Methodology

Software engineering, revitalized around 70 years ago with the advent of CAD, CAM, CIM, and CASE technologies, is the disciplined application of engineering, scientific, and mathematical principles to develop high-quality software efficiently and cost-effectively. This approach emphasizes systematic processes, methodologies, and tools to manage complexity, ensure reliability, and facilitate maintenance, thereby transforming software development from an ad hoc craft into a structured engineering discipline.

Software engineering by definition of software includes:

- programs;
- data; and
- documentation.

The approaches to design and development depend on the LIS: the size of the system, the time available, the training of the staff and the environment.

LIS projection can be carried out in two ways:

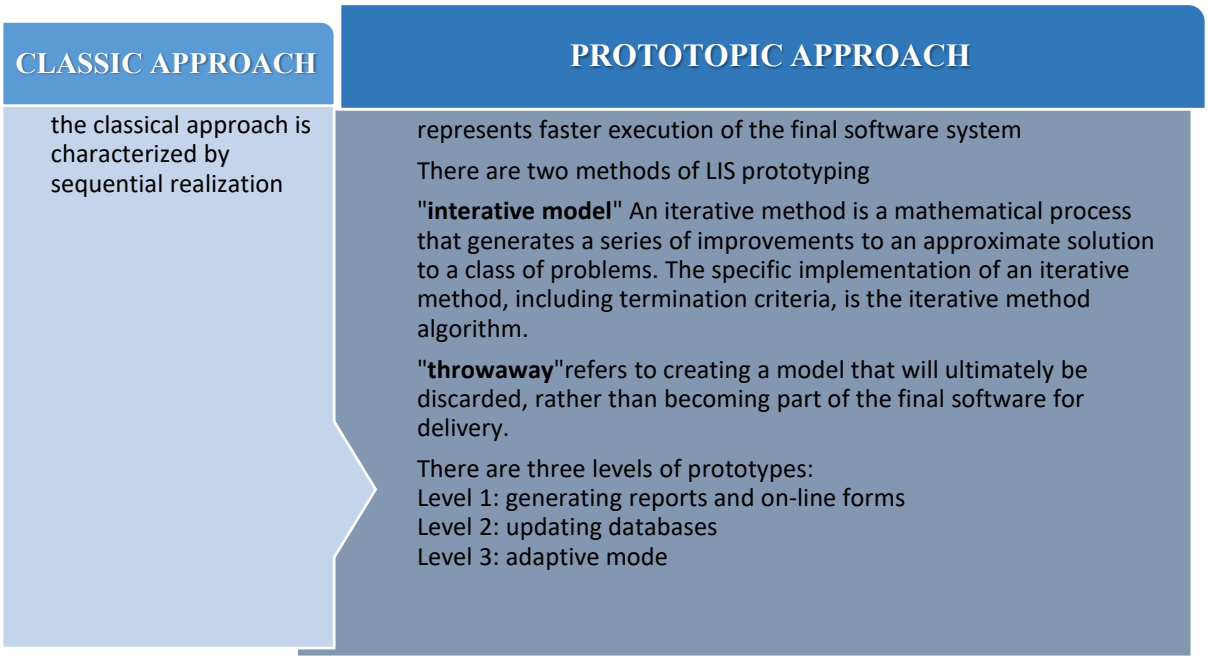



**Figure 18, Prototype approach[34] [35]**

[33] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[34] http://en.wikipedia.org/wiki/Iterative_method
[35] http://en.wikipedia.org/wiki/Software_prototyping

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Software engineering is based on the development life cycle methodology divided into the following phases:


**Figure 19, LIS development phase[36]**

### 3.2.1 Phase 1, LIS Development Strategy

Phase 1 of the LIS Development Strategy involves establishing the work type, introducing necessary work processes, and setting the software design, with a focus on selecting an approach—either classical or prototype—and planning all activities in detail, including resource allocation, timelines, and quality control measures. A multidisciplinary team of company professionals and software engineers is formed at the outset to ensure comprehensive understanding of system processes, and a precise work plan is developed to guide the project from initial conception to final implementation, considering material, personnel, and financial resources to ensure successful project realization.

### 3.2.2 Phase 2, Recording and Analysis of the Real System

Phase where the basic information is defined in real parameters. In this phase it is defined:

1. Structural model of the system: Identification of subsystems with their subsystems until it is decomposed into the basic system functions in the real system and until the organizational levels and structures (functional, organizational and spatial scheme of the system) are defined).

2. Process model: The described approach emphasizes a comprehensive process-oriented view where functions are translated into processes, with their interrelations mapped as process

[36] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005

  

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relationships, forming a structural model that spans all organizational levels via flow diagrams. When modeling database schemas, this methodology extends to defining entities—representing future tables—and the relationships between these entities, which correspond to linkages or associations between tables. This integrated perspective ensures that processes and data structures are coherently aligned, facilitating clarity, consistency, and an effective foundation for database design and organizational process optimization.

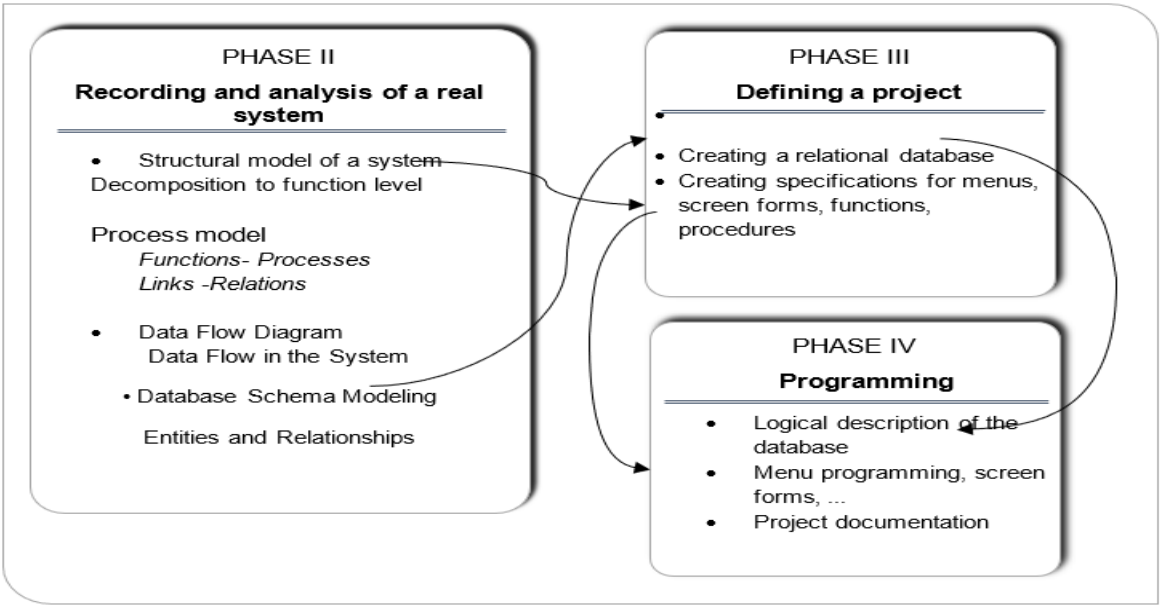
### 3.2.3 Phase 3, Defining LIS Projects

Defining Library and Information Science (LIS) projects entails developing a comprehensive database grounded in a rational model, which involves establishing detailed database specifications that encompass all relational database components, such as the menu system, data display formats, report templates, and a database update questionnaire, ensuring the system is well-structured, user-friendly, and capable of supporting efficient information management and retrieval.

The process model guides the development of screen forms and database update forms by outlining the necessary workflows, ensuring that user interactions and data management are effectively captured, while the structural model provides the framework for designing the menu and submenu hierarchy, facilitating intuitive navigation and organization within the system.[37]

### 3.2.4 Phase 4, LIS Programming and Implementation

Programming is the systematic process of transforming logistical and problem-related challenges into executable solutions through analysis, understanding, and algorithm development, followed by verification of correctness and resource efficiency, culminating in the implementation of the algorithm as source code written in one or more programming languages.




[37] http://www.scribd.com/doc/6815524/6-logisticki-informacioni-sistemi

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**Figure 20, Connecting the phases in the design of LIS[38]**

### 3.2.5 Phase 5, Commissioning

This phase can be accomplished in two ways:

1. Started using the entire LIS system
2. Phased introduction of LIS

When following a sequential approach, the most common phase of introducing IS for use means that certain subsystems are implemented according to the dynamics of their finalization and in any case, in accordance with the time dynamics of Phase I.[39]

### 3.2.6 Phase 6, Operation and Maintenance

This phase, often referred to as the maintenance and evolution phase, encompasses the ongoing use, upkeep, and modification of existing systems, databases, and applications to ensure they remain aligned with evolving user needs and environmental changes. Its primary functions include maintaining databases and applications across all levels (such as AOP, MIS, DSS), implementing necessary modifications based on system changes, and generating new requirements for future applications. This continuous process ensures the system's relevance, efficiency, and adaptability over time.[40]

## 4.0 LIKS INTEROPERABILITY IN TRAFFIC AND TRANSPORT

In traffic and transport, there are immanent logistic processes for the interoperability of the process in space and time. Interoperability is the most important characteristic of logistics for the functioning of the system, for its regulation, control and improvement.

LIKS (Logical Information - Communication System) was developed in order to manage flows in complex supply networks. This capability of LIKS in traffic and transport provides access to key information, so that individual and collective participants become more efficient and dynamically effective. Interoperability is achieved by creating an electronic E-infrastructure that connects participants through electronic messages and services. The main goal of this structure is to enable the service to customers to be made more efficient. The quality of interactive action in interoperability is assessed by displaying a gradation. This point represents a conceptual design model for operational management, planning, implementation and control of logistic flows.

### 4.1 Interoperability – definition

[38] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[39] http://www.scribd.com/doc/6815524/6-logisticki-informacioni-sistemi
[40] http://www.scribd.com/doc/6815524/6-logisticki-informacioni-sistemi

  

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*"Interoperability is the ability of a system or product, whose interfaces are fully known, to communicate and function with other products and systems, without any restrictions on access and implementation."*[41]

The term interoperability is often used in the sense of engineering systems, or alternatively in a broader sense, taking into account the social, political and organizational factors that affect a system's operation.

When we argue for software interoperability, we mean the ability of different programs to be executable, readable and writable (through the use of compatible file formats and the use of the same protocols).

There are two types of interoperability:


**Figure 21, Interoperability division**[42]

Both types of interoperability are essential for joint interaction in contribution and development, especially in SCM (SupplyChain Management) and SC (SupplyChain) where all elements are connected together (explanation later in the text).

### 4.2 LIKS- Logistics information communication systems

[41] http://autopoiesis.foi.hr/wiki.php?name=KM+-+Tim+12&parent=NULL&page=interoperabilnost
[42] http://autopoiesis.foi.hr/wiki.php?name=KM+-+Tim+12&parent= NULL&page =interoperabilnost

  

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E - Logistics is defined as "a mechanism for automating logistics processes and providing integrated, end-to-end execution and supply chain management services in logistics processes."".[43]

E - Logistics is based on seven basic components in the system:

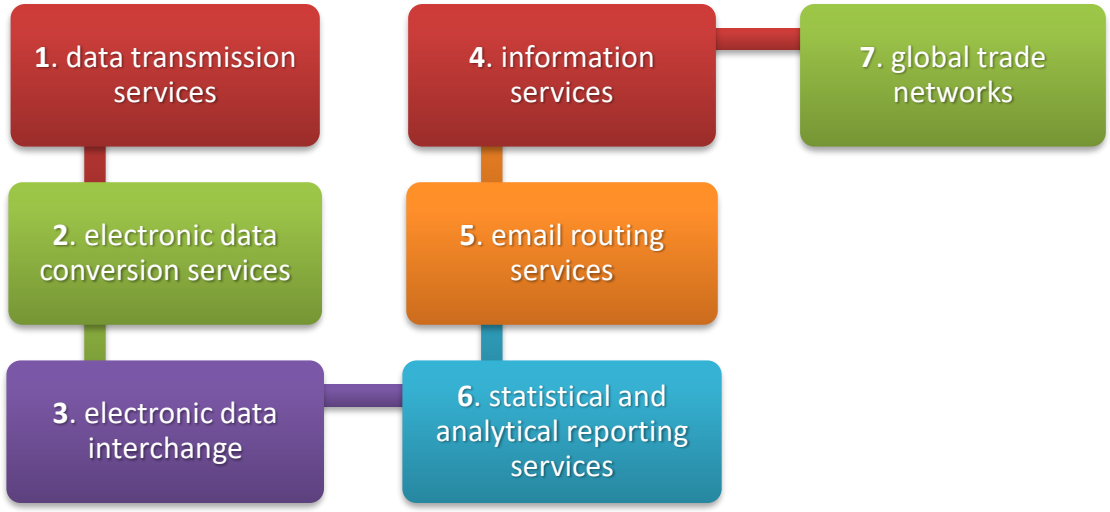


**Figure 22, Main components of E-logistics[44]**

The scope of e-logistics activities includes at least nine basic units:

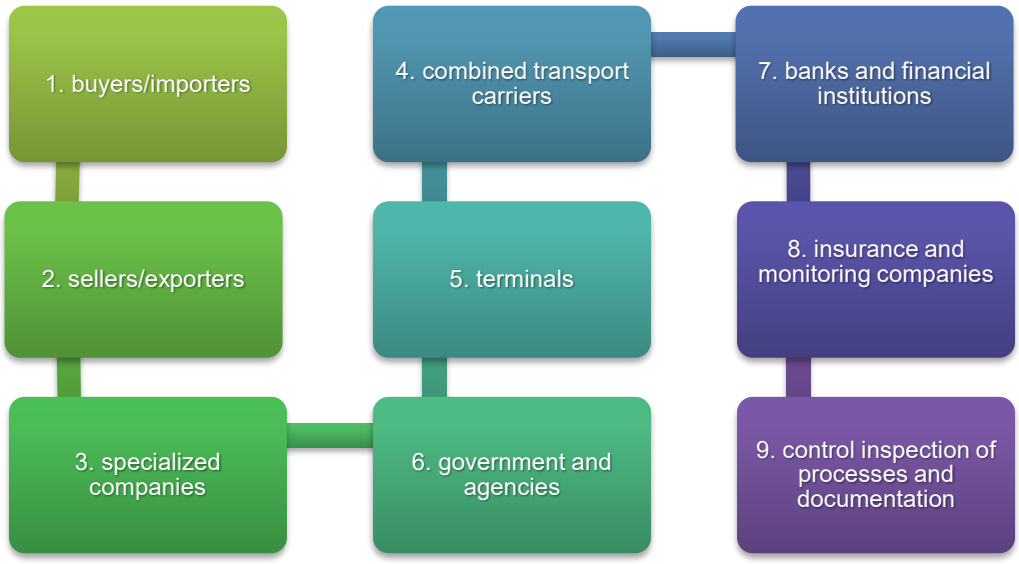


**Figure 23, Area of e-logistics activities[45]**

[43] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[44] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.
[45] R Zelenika, "Logistički sustavi", Ekonomski fakultet Sveučilišta u Rijeci, Rijeka2005.

  

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ICT, or Information and Communication Technologies, encompasses a broader scope than traditional IT by emphasizing unified communications and integrated systems, including telephone, wireless, computer, middleware, storage, and audiovisual components that enable users to access, transmit, and manipulate information. It signifies the convergence of audio-visual, telephone, and computer networks into a single, streamlined infrastructure, often utilizing unified cabling systems, which offers significant economic benefits by reducing costs associated with multiple separate networks and simplifying signal distribution and management.[46]

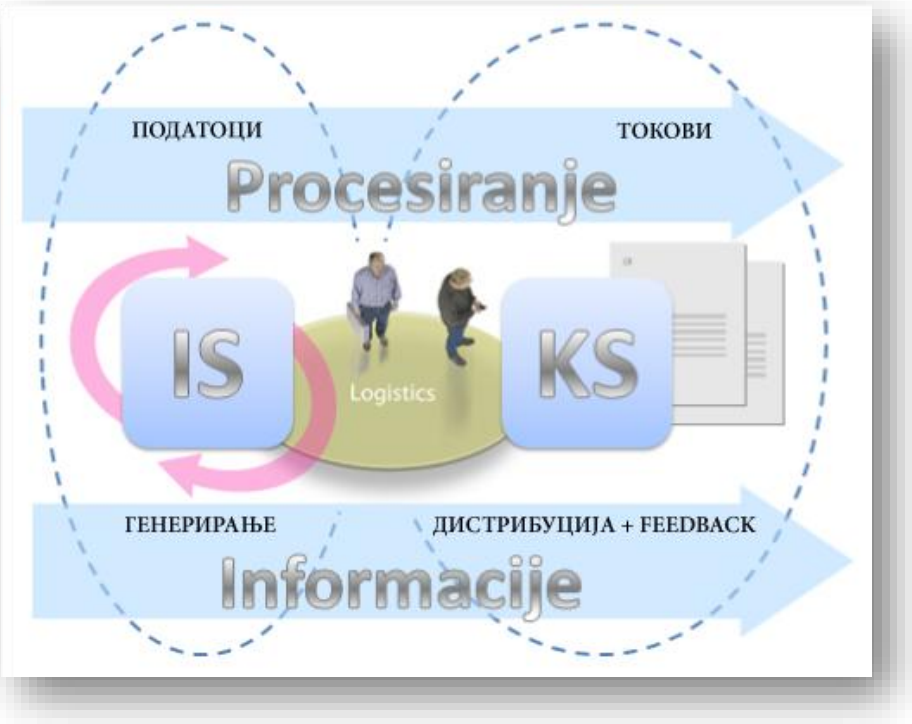


**Figure 24, Terminological distinction between the information and communication parts in LIKS[47]**

"Therefore, the basic function of an information communication system is to store and transmit factual data from the system and the environment and process them into information required by the user."[48]

### 4.3 Structural setup for interoperability in traffic and transport

**Table 2, Interoperability continuity [49]**

[46] http://en.wikipedia.org/wiki/Information_and_communications_technology
[47] http://en.wikipedia.org/wiki/Information_and_communications_technology
[48] http://en.wikipedia.org/wiki/Information_and_communications_technology
[49] Marko Subotić, Milorad K. Banjanin, Branko Miletić, INTEROPERABILNOST LIKS-a U SAOBRAĆAJU I TRANSPORTU, 2009.

  

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| INTEROPERABILITY LEVEL | PREREQUISITES FOR ACHIEVING INTEROPERABILITY | CURRENT STATUS |
|---|---|---|
| Institutional | Interoperability readiness | Mainly different and silent |
| Models on information | Data formalization and decryptors | Early stages of development |
| Data schema | Adoption of database standards | A lot depends on the traffic and transport sector. |
| Data exchange | Useful standards | Availability in expansion |
| Networks | Standard network protocols | Broadband reception |

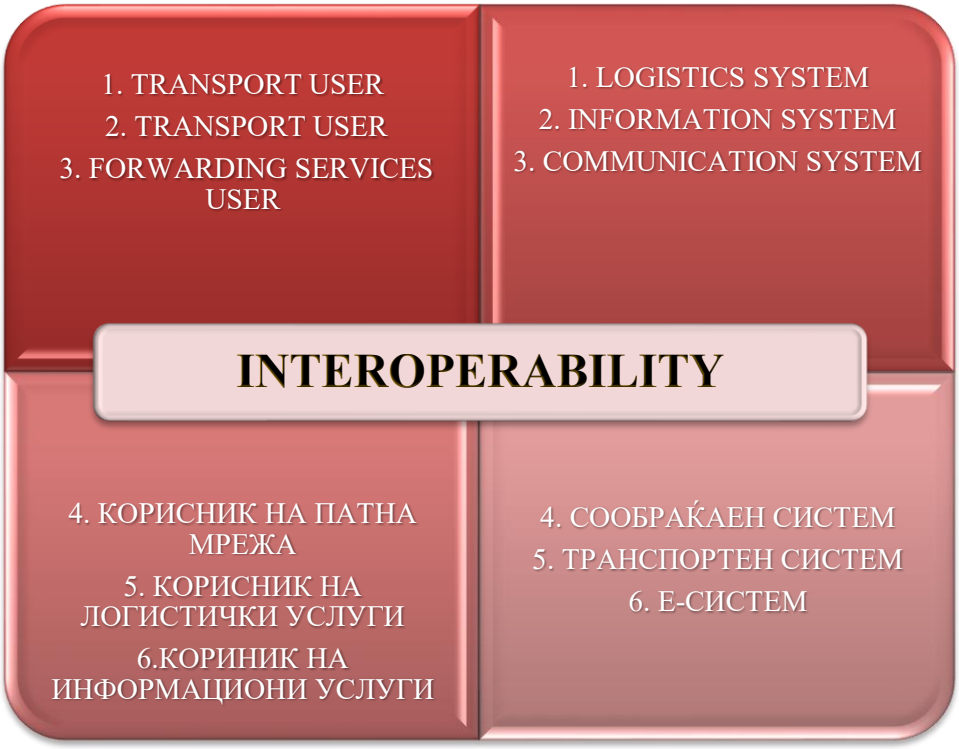


**Figure 25, Interoperability architecture[50]**

The logical conclusion of attempts to standardize the basis of the interoperability architecture will not result in this by itself. Interoperability requires consistency based on technical, semantic and institutional parameters.

### 4.4 LIKS Design and Interoperability

[50] Marko Subotić, Milorad K. Banjanin, Branko Miletić, INTEROPERABILNOST LIKS-a U SAOBRAĆAJU I TRANSPORTU, 2009.

  

LIKS can be viewed from two aspects.

| FUNCTIONS | STRUCTURE |
| --- | --- |
| •the system is observed as a technologically implemented medium with the intention of recording, storing, expressing, and inferring. за. | •a collection of professional personnel, processes, data, models, technologies, and some formalized languages, forming a cohesive structure for organizational and functional use.<br>•**Structural system analizsis,** Structural Systems Analysis (SSA) is a methodology for the specification of information and communication systems. |

**Figure 26, Aspects of LIKS[51]**

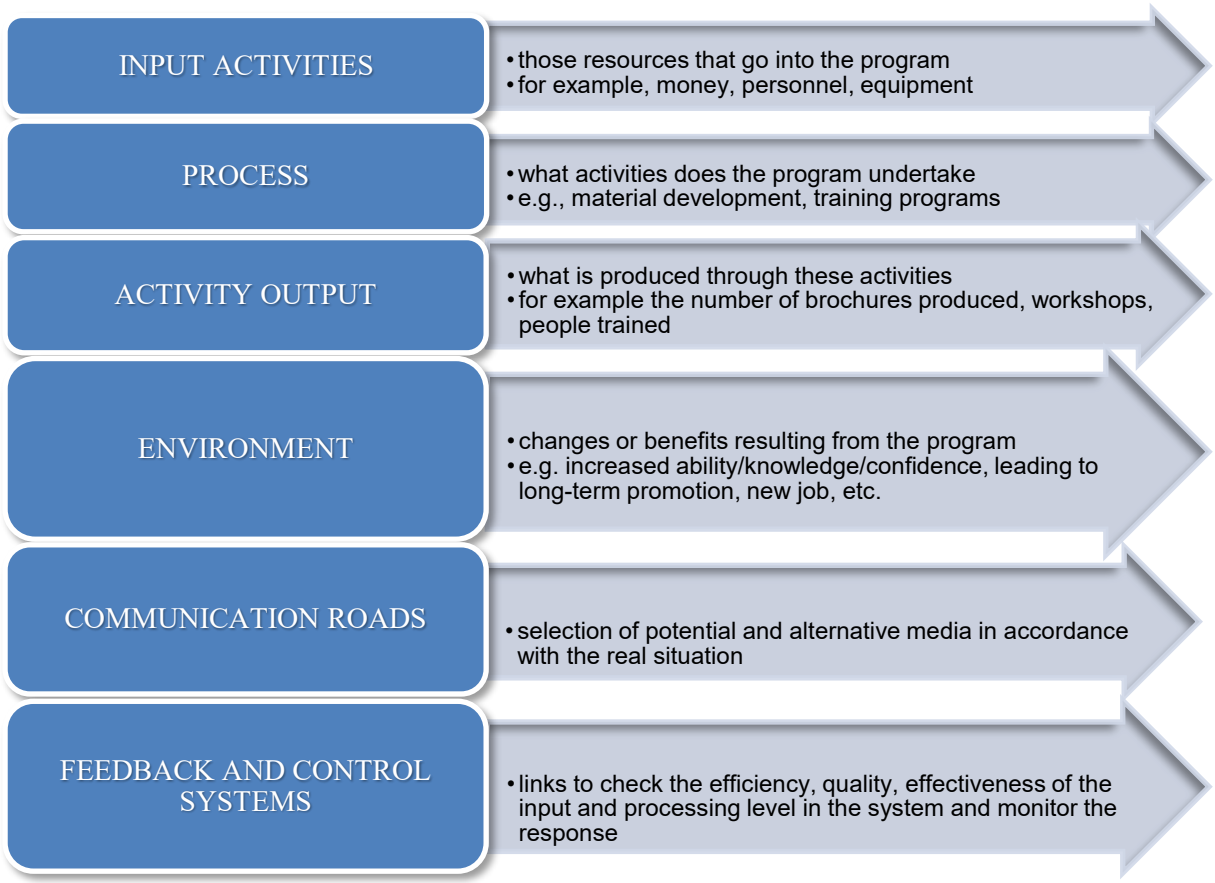


**Figure 27, Model LIKS[52]**

[51] Marko Subotić, Milorad K. Banjanin, Branko Miletić, INTEROPERABILNOST LIKS-a U SAOBRAĆAJU I TRANSPORTU, 2009

[52] http://en.wikipedia.org/wiki/Logic_model

  

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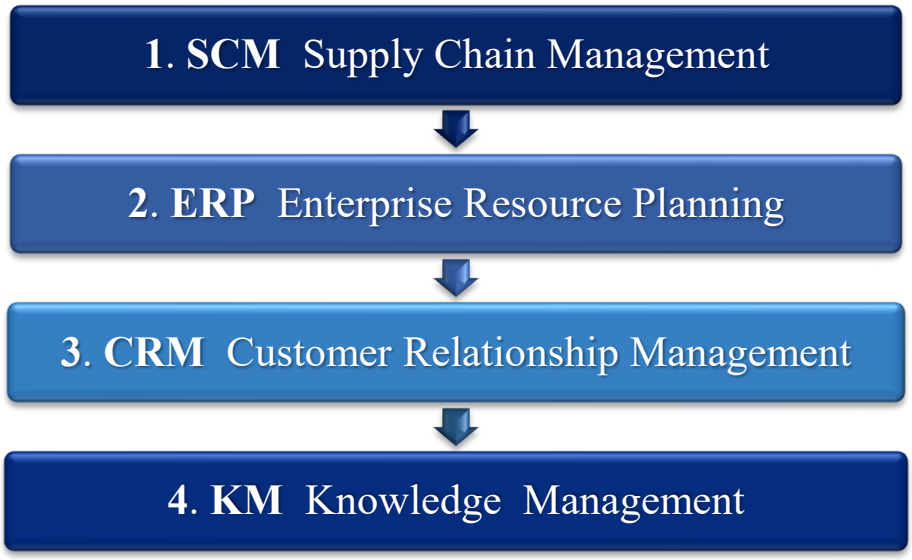
### 4.5 Integrated systems in LIKS

An integrated system is an extension of a hybrid processing system that puts technologies in the hands of users and allows them to process their transactions. and represents a way of doing business at significant savings; customers save time and organizations can reduce human resource costs.[53]

Logistics information communication systems include the use of:




**Слика 28, Интегрирани LIKS системи [54]**

### 4.5.1 SCM SupplyChain Management

The course offers participants foundational knowledge of supply chain management (SCM), emphasizing its role in enhancing productivity and competitiveness by managing the flow of information, materials, and services from raw suppliers to end customers. It covers core concepts, techniques, and analytical methods used by supply chain managers to address common challenges, supporting strategic development within manufacturing and service industries. By understanding these elements, participants will be equipped to make informed decisions that optimize supply chain operations and contribute to their organization's overall success.[55]

[53] http://en.wikipedia.org/wiki/Customer_integrated_system

[54] Marko Subotić, Milorad K. Banjanin, Branko Miletić, INTEROPERABILNOST LIKS-a U SAOBRAĆAJU I TRANSPORTU, 2009.

[55] http://en.wikipedia.org/wiki/Supply_chain_management

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**Figure 29, SupplyChain Management SCM[56]**

A sophisticated supply chain integrates various organizations, people, activities, information, and resources to efficiently transform raw materials into finished products and deliver them to consumers, emphasizing seamless coordination and value realization. It also incorporates reverse logistics, enabling used products to re-enter the supply chain at multiple points, allowing residual value to be recycled, thereby promoting sustainability and cost efficiency.[57]

### 4.5.2 ERP Enterprise ResoursePlanning

A business management software typically consists of integrated applications designed to help a company efficiently collect, store, manage, and interpret data across various business activities such as product planning, costing, production or service delivery, marketing and sales, shipping, and payment, thereby streamlining operations and supporting decision-making processes.

[56] http://www.aitvn.asia/en/short-term/100/11565_logictics-and-supply-chain-management.html
[57] http://en.wikipedia.org/wiki/Supply_chain

  

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**Figure 30, Enterprice resourse system**[58]

ERP systems are comprehensive, integrated software solutions that provide real-time data sharing across various business functions such as production, purchasing, sales, and accounting, enabling efficient resource management and external relationship management. They rely on shared databases and adaptable hardware and network configurations, supporting both large and small organizations, and are a significant investment industry that enhances organizational coordination and reduces errors. Unlike traditional development systems, ERP implementation involves complex integration processes tailored to diverse hardware and network environments, making them vital tools for streamlining operations and facilitating seamless transactions across enterprise functions.

### 4.5.3 CRM Customer Relationship Management

Customer Relationship Management (CRM) is a technology-driven approach focused on building and maintaining strong relationships with current and potential customers by organizing, automating, and coordinating sales, marketing, and support activities. It emphasizes a customer-centric philosophy, providing personalized solutions, direct

[58] http://www.govirtualoffice.com/solutions/erp-accounting/

  

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communication, and efficient customer service to address individual needs, enhance satisfaction, and foster long-term loyalty.

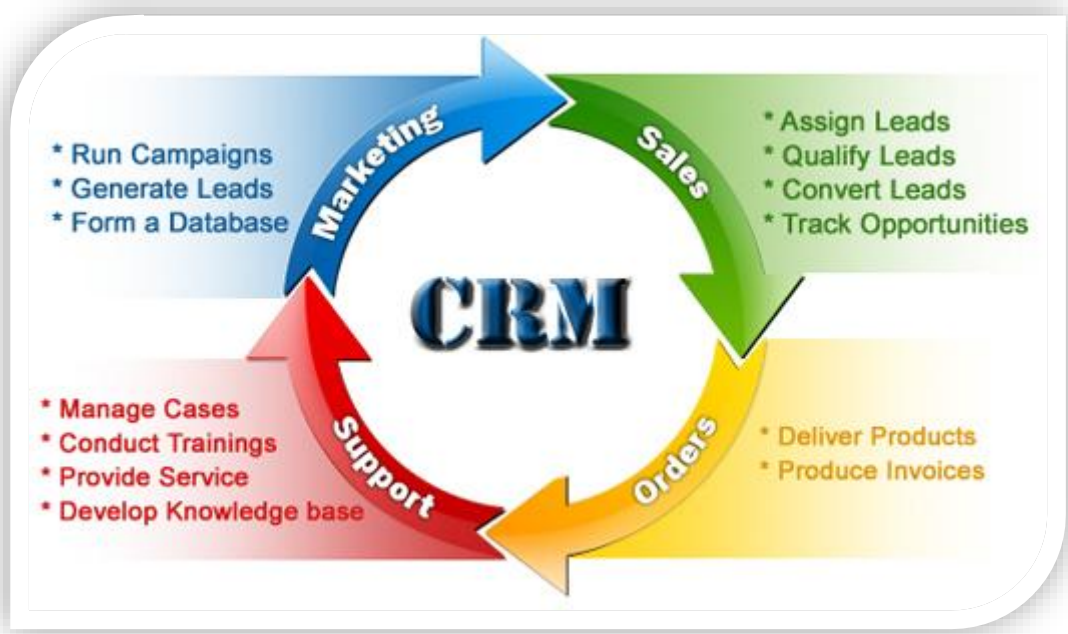


**Figure 31, Customer Relationship Management[59]**

The described features—Sales Automation, Use Technology, and Manageability—collectively enhance an organization's sales efficiency and strategic planning by streamlining customer interactions, leveraging advanced data warehousing and CRM integration for real-time insights, and providing robust forecasting tools to manage growth and demand unpredictability. These capabilities enable businesses to optimize sales promotion analysis, ensure seamless coordination across sales channels, deliver valuable KPIs, and adapt to market changes, ultimately fostering more informed decision-making and sustained growth.

### 4.5.4 KM Knowledge Management

Knowledge management (KM) is a strategic, multidisciplinary process that involves capturing, developing, sharing, and utilizing organizational knowledge to enhance efficiency, innovation, and decision-making, ultimately supporting the achievement of organizational goals through the optimal use of information and expertise.

[59] http://www.enmain.com/category/it-management/crm/

  

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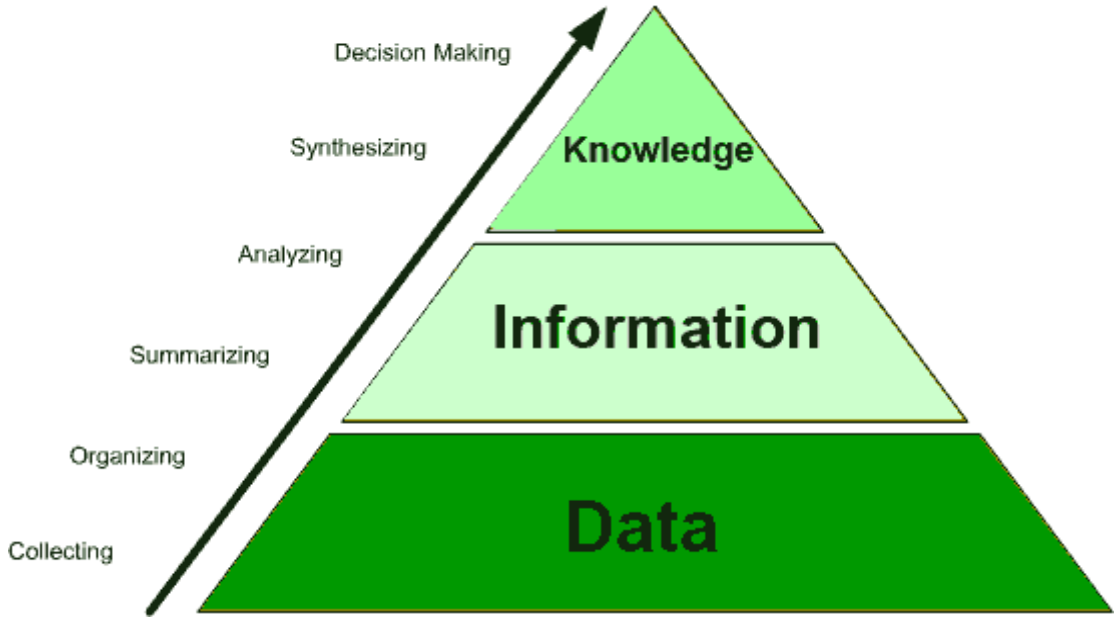


**Figure 32, Knowledge Management**[60]

Knowledge Management (KM), established in 1991, is an interdisciplinary field encompassing business administration, information systems, management, libraries, and information science, with recent research expanding into areas like media, IT, public health, and policy. It is widely adopted by corporations, public institutions, and non-profits, often integrated into strategic, IT, or HR departments, and supported by consulting firms. The primary aim of KM is to enhance organizational performance, competitiveness, innovation, and knowledge sharing, aligning closely with organizational learning but distinguished by its strategic focus on fostering knowledge sharing to drive continuous improvement and organizational growth.

## 5.0 CONCLUSION

The research underscores the critical role of embedded information systems in logistics, highlighting their function as the backbone of decision-making and management within supply chains. These systems enable real-time collection, processing, and dissemination of high-quality information, which is essential for efficient planning, control, and operational accuracy. Modern technological advancements in computer and information technologies have become indispensable for managing space and time effectively, ensuring speed, precision, and completeness in logistics activities. The ongoing evolution of logistics systems, driven by technological progress, promises enhanced service quality, capacity, and alignment with future logistics goals and objectives, making their use irreplaceable in contemporary and future logistics management.

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