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EUROPEAN UNION

Austria-Czech Republic

European Regional Development Fund



# LOGISTICS AND TRANSPORT

## Logistics of mechanical engineering



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



EUROPEAN UNION

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# I. LOGISTICS OF MECHANICAL ENGINEERING

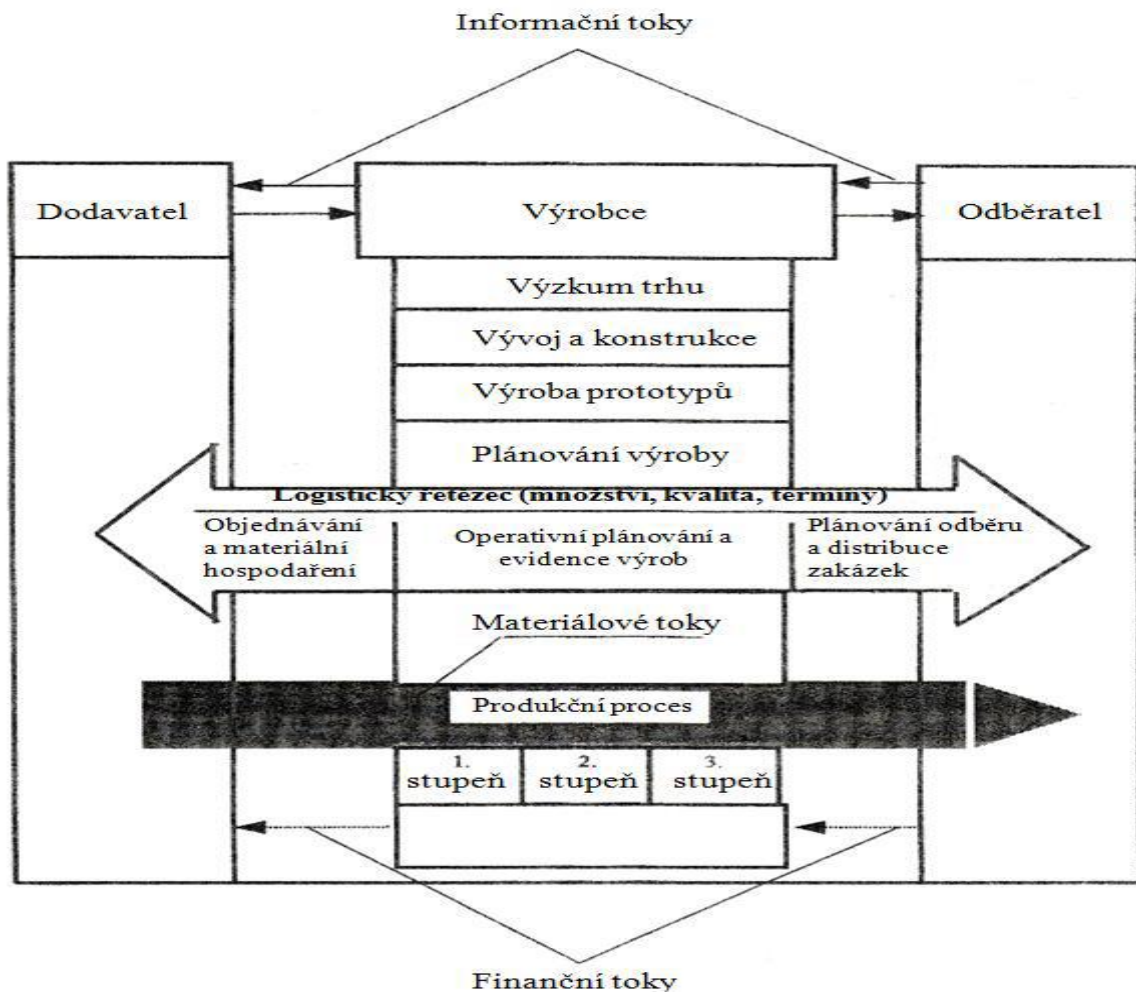
## I.1. Content and mission of logistics

- To identify, describe and manage logistics processes including supply and delivery of goods in the system of material, financial, organizational, information and realization flows
- The basic principle is prompt and quality delivery of goods or services at minimum costs with maximum efficiency
- It is a crosscutting integration discipline covering sub-disciplines, such as:
  - forwarding (transportation), planning, information technologies, economics, automatic processes management, inventory and storage strategies, handling, technological preparation, testing,

### The methods used:

- system analysis (ABC),
- mathematical methods of operational analysis,
- simulation,
- forecasting...

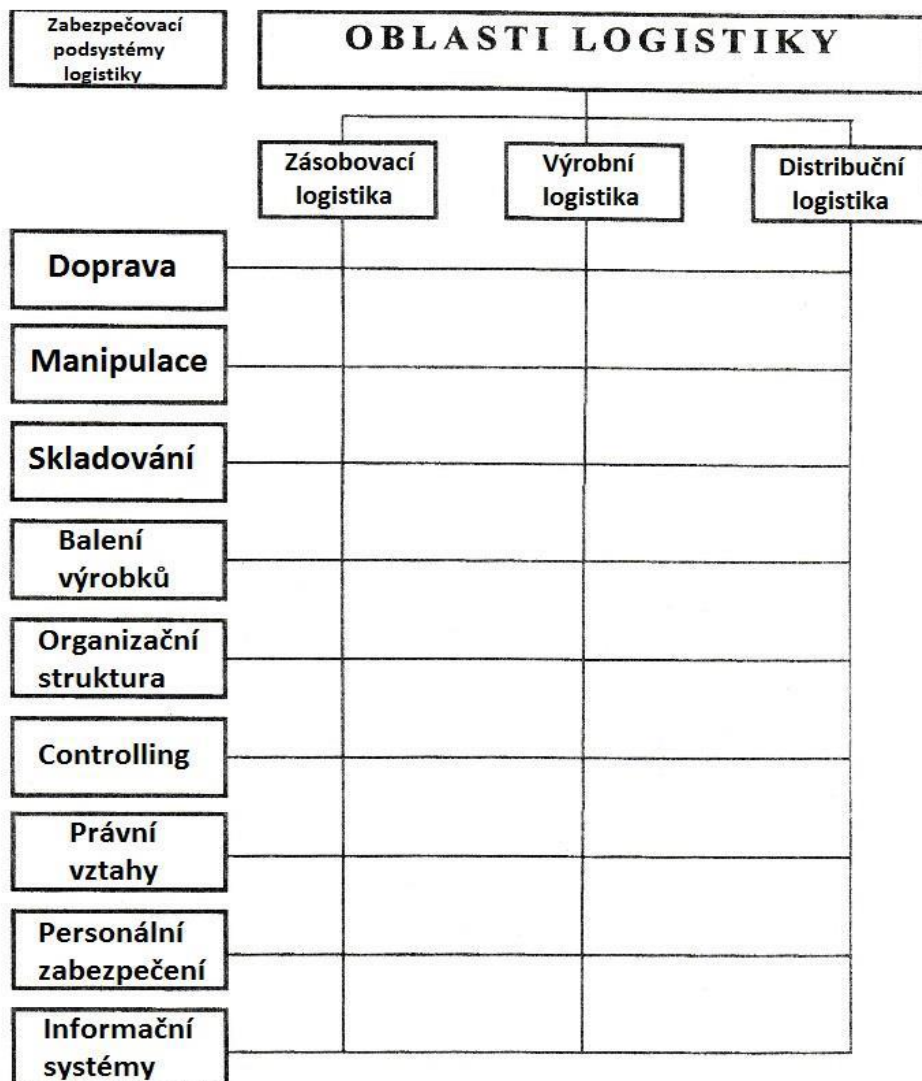
## I.2. Logistic system



Legend: informační toky – information flows, dodavatel – supplier, výrobce – manufacturer, odběratel – customer, výzkum trhu – market research, vývoj a konstrukce – development and construction, plánování výroby – production planning, logistický řetězec (množství, kvalita, termíny) – logistic chain (quantity, quality, dates), objednávání a materiální hospodaření – ordering and material management, operativní plánování a evidence výrob – operational planning and production records, plánování odběru a distribuce zakázek – procurement and distribution planning, materiálové toky – material flows, produkční proces – production process, stupeň – degree, finanční toky – financial flows

## 1.3. Disciplines of logistics, logistic chain

- **Logistic system** - structure of processes
- **Logistic chain** – interconnection of related processes
- **Process** – elementary component of the chain
- **Internal and external logistics – basic distinction of processes:**
  - Management of material purchasing and sub-deliveries (quality, delivery terms)
    - transportation of material and sub-deliveries
    - Receipt of material and sub-deliveries
  - Storage, recording – entry into ACS
    - dispatching for processing
  - set of manufacturing operations including surface protection and assembly
    - final inspection and testing, documentation
  - packaging and storage, handling, waste disposal
    - dispatching on schedule, information to customers
    - transportation of products to customers (BtB or BtC distributors)
  - acceptance, sale
  - invoicing, direct debit, complaints



*Legend: zabezpečovací podsystémy logistiky – logistics security subsystems, zásobovací logistika – supply logistics, výrobní logistika – production logistics, distribuční logistika – distribution logistics, doprava - transportation, manipulace - handling, skladování - storage, balení výrobků – product packaging, organizační struktura – organizational structure, controlling, právní vztahy – legal relations , personální zabezpečení - staffing, informační systémy – information systems*

## 1.4. Basic types of flows in logistics

### Flow and dimensions

- Material, information, value (specific type of information), human resources flow

**Material, information and value flows create a 3D matrix together with the human resources flows**

### Inventory by type and purpose

- material, raw material, sub-deliveries, packaging (general, system)
- in motion or at rest
- insurance, storage, inter-operational, operational, scrap insulator, reference products

**Information flows** – intangible flows that organize and control the process and ensure traceability (including retroactive)

**Value flows** – VA, quality

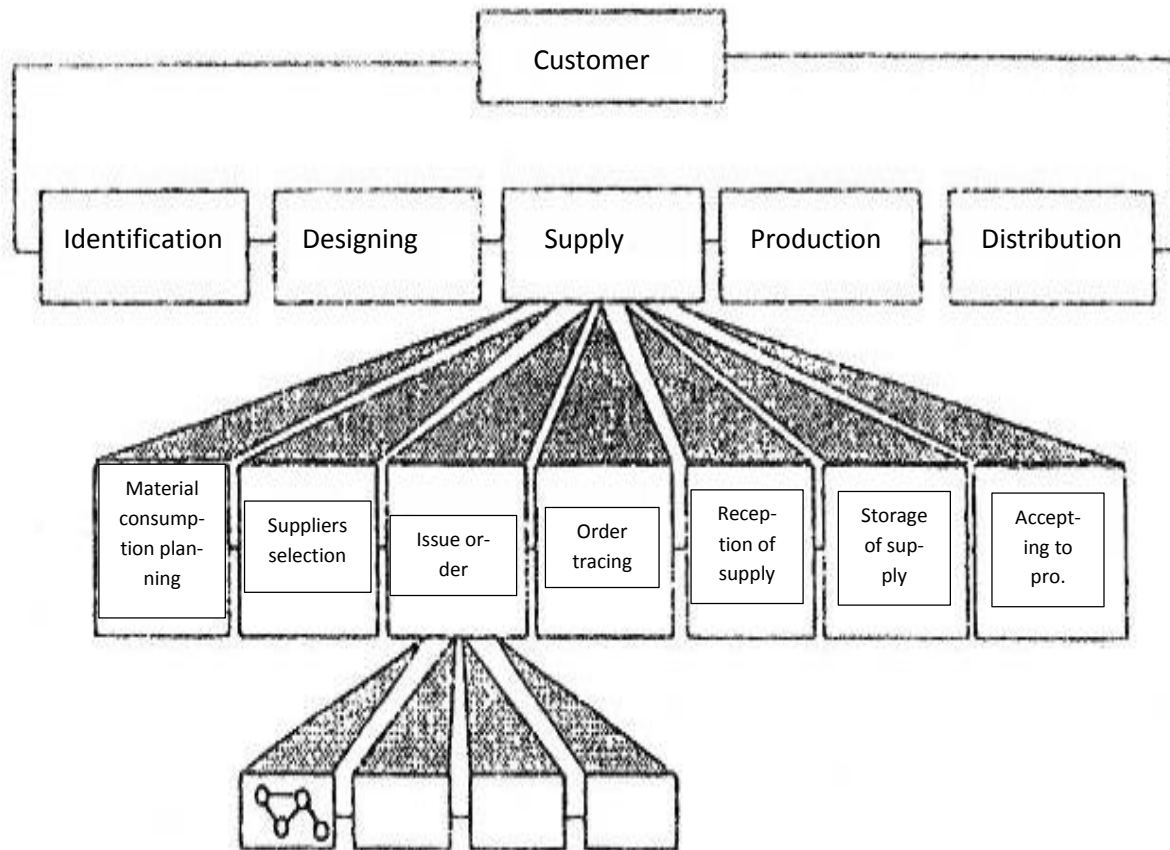
**HR flows** – organization of people's participation in the processes, measuring consumption and identification

## 1.5. Problems solved in logistics, objectives, performance, costs

- Disproportions – qualitative, quantitative, financial, space
- Objectives and tasks of logistics:

**To satisfy complex needs of customers in the shortest time possible, with the quality above standard, at minimum reasonable costs, in an eco-friendly manner**





*Principle of logistic system decomposition*

- **Logistic performance ( parameters)**
  - reactivity-speed of customer satisfaction
  - reliability and quality of supply (close to 100 %)
  - Flexibility ( individualization of supply)
  
- **Logistic costs**
  - Cost of organization ( planning and management)
  - Cost of realization of the flow (transport...transport)
  - Cost of poor quality and operation interruption

## 1.6. Problems and risks of logistic systems

- Flexibility x cost
- Risk of interruption of production process x inventory = costs and expiration
- Capacity balance – elimination of bottlenecks
- Reverse traceability of continuous and discontinuous processes
- Quality and frequency of control, process reliability, downtime due to failure
- Cost of inventory types
- Continuous production time
- repeatability (size of series), batch size (calculation)
- Complexity of logistic thinking
- IT support of logistic systems management, interconnection.

## 2. LOGISTIC MANAGEMENT AND SUPPLY LOGISTICS

### 2.1. Logistic management and Business management

**Logistic management** - focus on processes, organization and management

Material flow management from the development, through production and distribution to customer

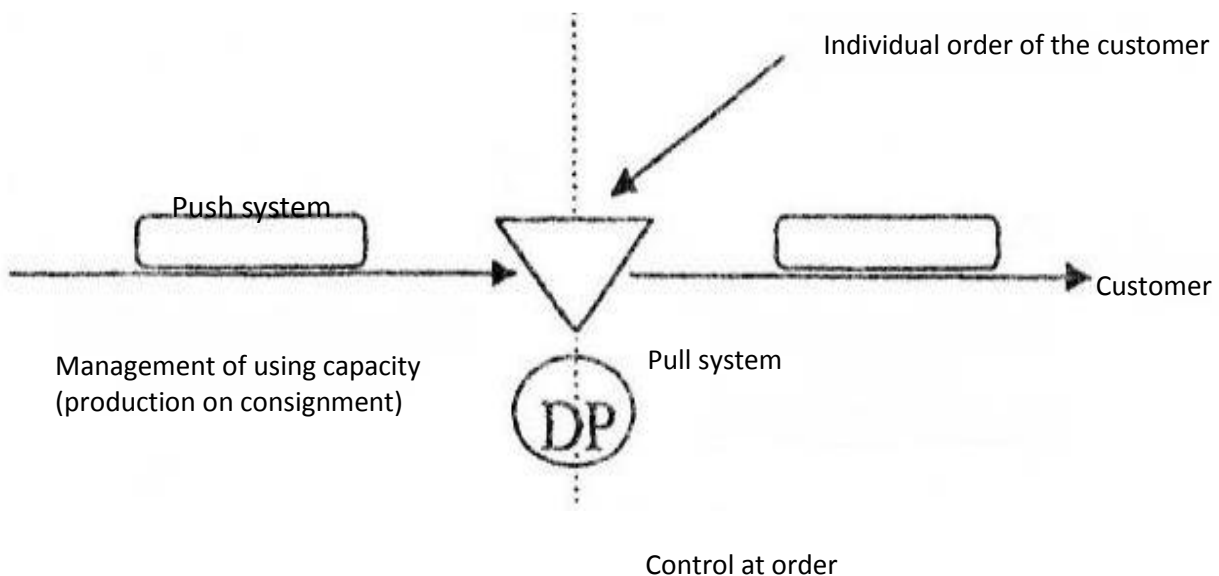
- organizational part (design and structuring of system)
- management part in the system

**Logistically managed company**

- focus on processes, not on functions,
- directing and optimization of orders flow course
- balancing capacities at cost-effectiveness

**Postponement principle** – processing of order up to product usable by the customer

- postponement of individualization after order
- (DP ( Decoupling Point) – warehouse or interim storage)



### **Decoupling is possible:**

- in a distribution warehouse
- in a warehouse of finished products
- in a warehouse of assembly systems
- in a warehouse of raw materials and semi-finished products
- in a warehouse of supplier

### **Decoupling point divides managing activities in a chain into:**

- Inventory management at decoupling point
- Management of continuous period of production (production planning and management, distribution management)

**MRP1** – Material Requirements Planning, **MRP II** Manufacturing Resource Planning,

**DRP** – Distribution Requirements Planning, **SIC** Statistical Inventory Control

## **2.2. Supply logistics**

### **Inventory management**

- quality and flexibility for good price, stability.

### **Purchasing management**

- market research, selection of supplier, negotiation of terms, contractual relations, assessment of supplier, orders, liquidation of invoices

### **Supply logistics**

- transportation, acceptance, handling, storage, complaints

### **Development of supplying**

- Supply at all costs, price-oriented purchasing, material warehouses management, supply logistics, purchasing marketing, advanced logistics

### **Purchasing management**

- market research, working with suppliers (evaluation), contractual terms for repeated purchase or terms of single individual purchase

## Selection of supplier

- quality, price, delivery conditions (packaging, frequency of supplies, invoice maturity, reactivity, guarantees, cure, reliability – stability).
- It is possible to use value criteria analysis.

## Supply logistics – types of material and semi-finished products supply systems

- **Just-in-time** – delivery on time, synchronized with the production (cheap x risky)
  - **XYZ analysis**
  - X – components with constant consumption – high reliability of prediction
  - Y- components with fluctuating consumption – medium reliability of prediction
  - Z – components with irregular consumption – low prediction ability, high risk
  - **ABC analysis**
  - Classification of materials by annual consumptions, by items (quantity x price).
  - Percentage of individual materials is calculated by the consumption and a graph is created (Pareto analysis). Empirical research has shown that 20 % of the items bind 80 % of the stock capital
- **Consignment** – inventory is at the supplier´s expense (replenishment)
- **Warehouse** – customer´s warehouse is close to his headquarters, inventory is at the supplier´s expense. Information on the warehouse movements is shared
- **Production fractalization** – the supplier´s registered office is close to customer

## Receipt of supplies (on consignment)

- Qualitative and quantitative compliance verification, customs or other ecological or hygiene formalities.
- receipt to warehouse (transfer into cell, entering information into system, handing over delivery documentation to liquidation). Subsequently, delivery note is checked, then order and invoice.
- in the case of quantitative or qualitative discrepancies, it is decided on possible refusal of delivery or conditional acceptance with a complaint. Complaints can be also made later in the case of complex qualitative delivery taking. Cure (náhradní plnění).

# 3.PRODUCTION LOGISTICS

## 3.1. Production logistics

- Design of production system and selection of its character (according to the type of production)
- production planning and management (from the beginning to the warehouse of finished products)

**Design** (it is based on market marketing information)

- Areas, layout, load-bearing capacity of floors and manipulation equipment, material flow, production sequence, information flow (networks), ecology (waste, air conditioning), energy, human resources (social background), transport routes

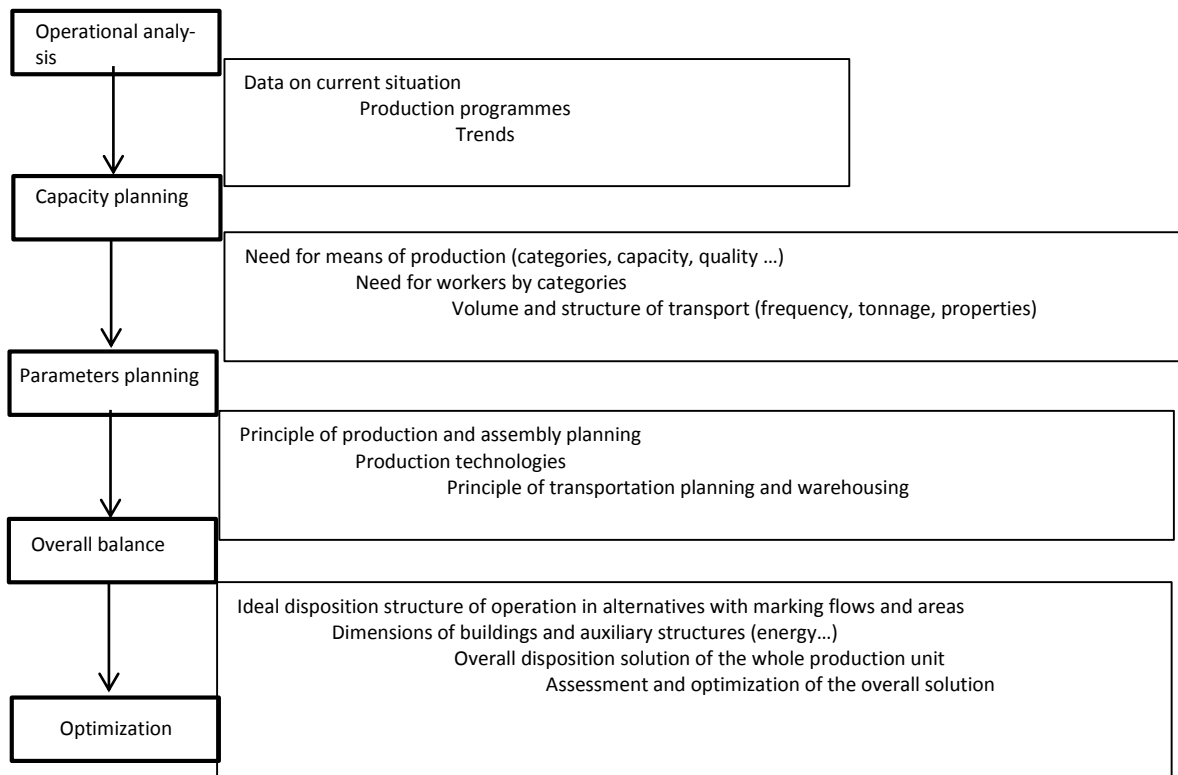
**Design procedure:**

type and quantity of products / r

qualitative features of products

capacity / production cadence (maximal, efficient, minimal)

## 3.2. General scheme of production system design



## 3.3. Capacity calculations of need for means of production and resources

### Need for machinery

**$K_t = F/k$**  Maximum planned production capacity ( theoretical )

**$K_t$  (pieces / m)** capacity of production per time unit (month )

**$F$  (h/m)** working time banking per time unit (month)

**$k$  (pieces / h)** cadence of production – reciprocal value **of cycle time  $C = 1/k$**

**Example:** Calculate the capacity of production using a machine, if  $C = 20$  s, and efficient working time banking  $F_e = 180$  h/m.

$C = 1/k$ , where  $k = 1.60 / 0,3 = 180$  pieces / h,

$K = 180 \cdot 180 = 3\,240$  pieces / month.

## The actual capacity is lower due to scrap and downtime – the Japanese defined OEE

$$\text{OEE} = \text{Kt} \cdot \text{C} \cdot \text{Ksz} \cdot \text{Kc}$$

**OEE** overall economic efficiency of the system (1)

**Kt .C** theoretical capacity of production in economic terms / unit of time (CZK/m)

**C** price of 1 piece in CZK (CZK/piece)

**Ksz** coefficient giving the ratio of quality products / the total number of pieces produced

**Kc** coefficient giving the ratio between the actual production cycle and theoretical cycle

### Need for workers

- direct production workers (from the time consumption standards)
- indirect production workers ( VR) based on experience or standards
- technical – based on experience or standards in the field
- managers – based on experience in the field

### Need for space (areas)

- production (based on the machinery, manipulation area, interim warehouses, control, ...)
- Service – machine, tools, control (calculated based on production capacity)
- warehouse (calculated based on production capacity)
- social and administrative areas (calculated based on the number of workers)

### Manipulation (internal transport)

- by the quantity and mass of the material transported



## 3.4. Material and information flows

Sum of input material in kg must always be equal (per a given period of time) to the sum of material in stock (kg), production (kg) and finished products warehouse (kg) and scrap (kg)

$$M_{vm} = M_{sm} + M_{nv} + M_{shv} + M_{zm}$$

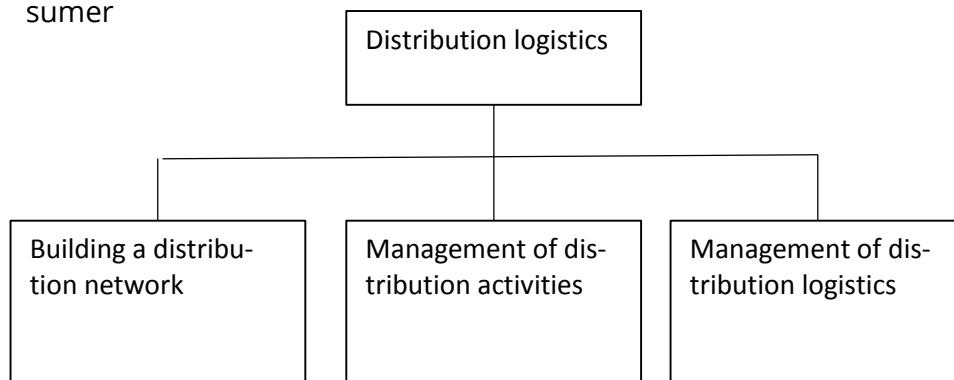
### Basic types of production and its management

- one-off production, small batch production, volume production, mass production
- Production management balances three parameters – time, sources, quantity in quality
- Flexible production systems- allow to change the product range rapidly
- Inflexible production system – any change causes necessary interventions and adjustment

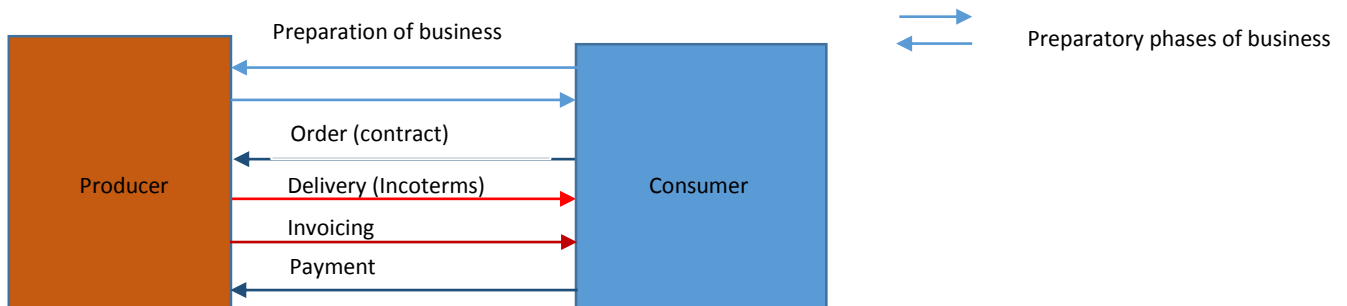
# 4. DISTRIBUTION LOGISTICS AND TRANSPORT AND TRANSPORTATION OF PRODUCTS

## 4.1. Distribution logistics

- spatial, material, time and information interconnection of a producer and a consumer



- Market system : supply – demand, tool of demand research is marketing
- Distribution logistics strategy : distribution channels, interfaces (intermediaries), conditions, legal framework ( Incoterms )
- Operative: physical movement of goods, information and financial flows, services, ...
- Kotler ´s concept: market research, sales promotion, obtaining contacts, transformation, negotiation (contracts), distribution, financing, risk (preparatory or realization)
- Distribution channels (flow from producer to consumer, including intermediaries) - minimal!
  - BtB ( business to business )
  - BtC ( business to client )
  - Direct – producer – consumer without any intermediary (in terms commerce and physically)
  - Indirect – producer - intermediary (physical, commercial) – consumer
  - Material, information and financial flow between producer and consumer



- Distribution channel can cover the following: producer, retail network, warehouses, agencies, banks, insurance companies, carriers, shops, internet sellers...

## 4.2. Transport and transportation of products - Incoterms

**Incoterms** (abbreviation of *International Commercial Terms*) is a set of international rules for the interpretation of the most commonly used trade clauses in foreign [trade](#).

Incoterms were established in [1936](#) in [Paris](#) by the [International Chamber of Commerce](#) in order to eliminate the problems related to the differences of commercial code in different countries. As international trade underwent big changes, in [1953](#), [1967](#), [1976](#), [1980](#), [1990](#), [2000](#) and [2010](#), it was gradually adjusted. On [1 January 2011](#), the tenth issue came into force - Incoterms 2010<sup>[1][2]</sup>. The changes concern all five conditions listed in Group D, which were outdated and therefore were supplemented by the following two conditions: **DAT**(Delivered at Terminal) and **DAP** (Delivered at Place).

They deal with the relations resulting from [purchase contracts](#), obligations related to customs clearance, packaging of goods or delivery taking. Although Incoterms have always been intended for international trade, sometimes they are used also in contracts concluded within domestic commercial transactions. The basic myth often encountered with in business practice is the idea of direct linking of the INCOTERMS clause to transport contract. The mistake consists in the fact, that the incorporation of such provision (i. e. the INCOTERMS clause) is usually a part of the purchase contract, and the obligations resulting from it are binding for both the seller and the buyer. The role of INCOTERMS used in a concrete purchase contract can therefore be characterised as a guide for the party responsible for providing transport services.

## Incoterms Clauses

- [Group E](#)
- [Group F](#)
- [Group C](#)
- [Group D](#)
- [Terms](#)
- [References](#)
- [External links](#)

### **Incoterms clauses**

Since [2000](#) , Incoterms contain 13 clauses divided into four categories, determining is the first letter of English abbreviation. Since 1 January 2011, the version in force contains only 11 items and 2 categories (terms applicable to all types of transport and terms applicable only for sea transport). However, in practice, the clauses from 2000 have still been used.

#### **Group E**

- *The goods is transported by the buyer directly from the seller´s plant, the buyer takes all responsibility for the goods.*
- [EXW](#) (Ex Works) – from a plant (place agreed)

#### **Group F**

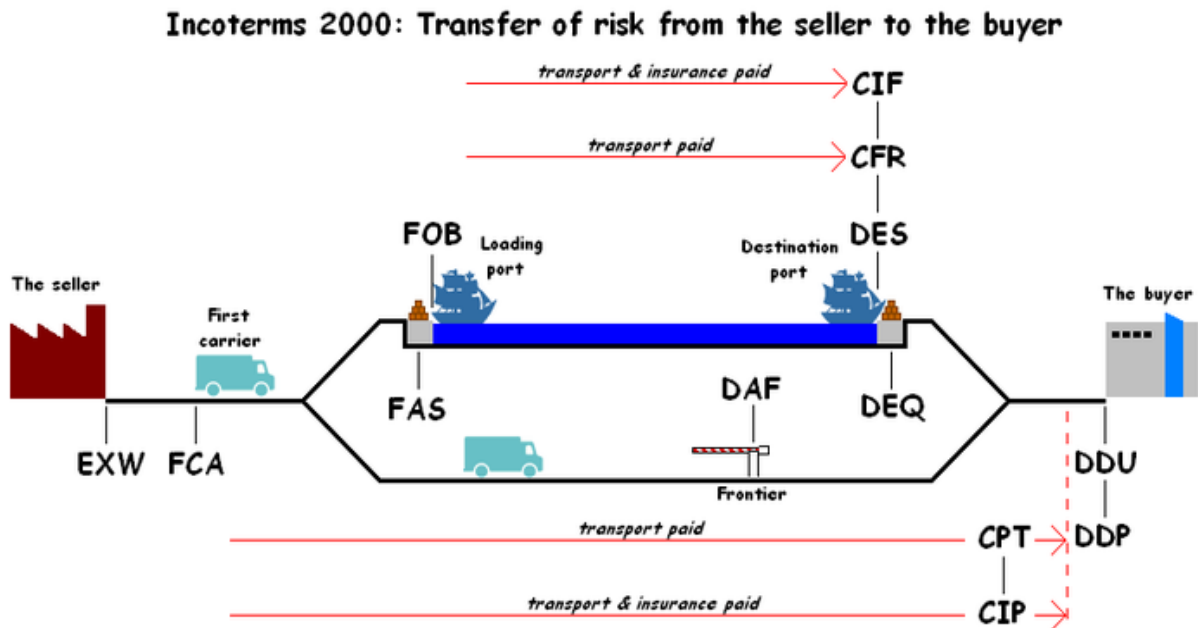
- *The seller is invited to deliver the goods to the carrier designated by the buyer.*
- [FCA](#) (Free Carrier) (place agreed)
- [FAS](#) (Free Alongside Ship)(agreed port of embarkation)
- [FOB](#) (Free On Board) (agreed port of embarkation)

#### **Group C**

- *The seller must ensure the transport contract without taking over the risk of losing or damage of goods.*
- [CFR](#) (Cost and Freight) – agreed port of destination
- [CIF](#) (Cost, Insurance and Freight) – agreed port of destination
- [CPT](#) (Carriage Paid To) – agreed place of destination
- [CIP](#) (Carriage and Insurance Paid to) –agreed place of destination

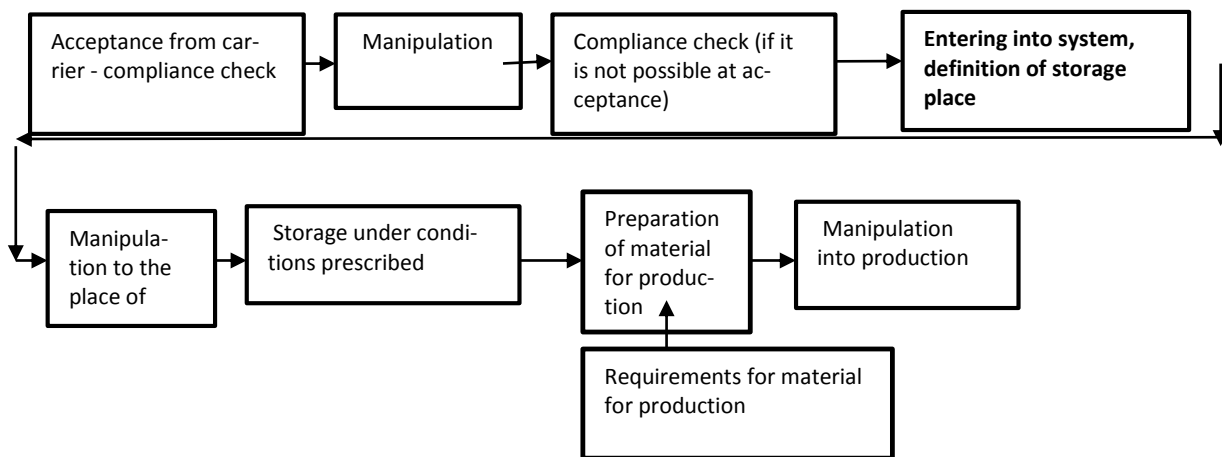
## Group D

- The seller must bear all costs and risks related to the entire route of transportation of goods.
- [DAF](#) (Delivered At Frontier) – agreed place. This term was abolished as of 1 January 2011.
- [DES](#) (Delivered Ex Ship) – agreed port of destination. This term was abolished as of 1 January 2011.
- [DEQ](#) (Delivered Ex Quay) – agreed port of destination. This term was abolished as of 1 January 2011.
- [DDU](#) (Delivered Duty Unpaid) – agreed place of destination. This term was abolished as of 1 January 2011.
- [DDP](#) (Delivered Duty Paid) – agreed place of destination
- [DAT](#) (Delivered At Terminal) – this term was introduced as of 1 January 2011.
- [DAP](#) (Delivered At Place) – this term was introduced as of 1 January 2011.



# 5. STORAGE OF MATERIALS AND SEMI-FINISHED PRODUCTS AND PACKAGING OF GOODS

## 5.1. Storage of material and semi-finished products



### Warehouse requirements:

- space, physical and transportation conditions
- storage method, record-keeping of material (manual, semi-automatic, automatic, codes)
- manipulation method
- Strategy ( LIFO, FIFO ), inventory, goods checking, re-pricing

### Purpose and functions of warehousing

- disconnection of the chain in order to balance the production cycles and material supply
- technological reasons
- strategic reasons (to overcome supply crisis)
- speculative price function

## Classification of warehouses by their relation to production

- input warehouse ( material and semi-finished products)
- interim (buffer) - unfinished products
- output – finished products
- detached warehouses

## Warehouses by type of goods and premises ownership

- manufacturer´s own warehouses
- consignment warehouse of supplier (rented or not rented premises)
- warehouse

## Classification of a warehouse by operation

- storage area, equipment
- manipulation device (trolleys, stackers, manual auxiliary devices, cranes)
- ventilation and heating
- support facilities (maintenance, chargers, offices, IT)
- packaging, unpacking
- “isolation” warehouse of non-conforming products / supplies
- warehouse of auxiliary materials, special waste or chemicals warehouse

## Warehouse design principles

- functionality, that is, maximum utilization of the space
- manipulation and automation – often warehouse cells in shelf systems
- observing the conditions of storage (temperatures lower than in production premises, pressurized suction)
- safety of work (load-bearing capacity of floors and shelves, marking, compliance check)
- automation of storage, documentation, IT involvement
- marking of goods (bar codes, QP, RFID, ...)
- manipulation devices, tools including system pallets
- warehouse layout transversely to receipt / dispatching, accessibility
- centralized receipt or assortment receipt
- organization of unloading (loading), administration of the data processing system

## 5.2. Packaging of goods

### Packaging requirements

- funkční ( přepravní, ochranné, manipulační, hygienické, evidenční a informační )
- aesthetic and ecological (packaging disposal / returnable packing material)
- economic and legislative

### Design and production of packaging

- **one-off type** (usually consumer goods - disposal)
- **returnable** (system packaging of higher values and special properties. This includes pallets, special pallets, containers, ...). It is necessary to keep records of them and depreciate. So-called pallet account.
- **packaging labels** – record keeping, checking, certificate of origin, expiration, certification, information on goods, instructions, safety conditions



# 6.ECONOMICS AND CONTROLLING IN LOGISTICS

- Logistics, as any other activity, has a material and economic dimension
- Planning-control-evaluation of cost-efficiency (confrontation of plan and result)
- Most parameters are monitored by means of economic indicators
- As any other activity, logistics is also related to costs (consumption) and performance (assets)
- Costs arise in each of the logistics phases - performance, profit in realization of sales (purchasing material, transportation, storage, production, ... transportation, sale)
- the costs are basically fixed (sometimes administrative costs) and variable (depending on the volume of goods)
- Each phase of the logistic chain has a different specific structure (classification, analytics) of the costs

## 6.1. Basic types of costs and their importance:

- Material costs – cost of transportation services
- Personnel costs – wage costs, social and health insurance
- Costs incurred to sold goods
- Costs of energy
- Services costs
- Taxes and charges
- Depreciation of tangible and intangible assets (tax, financial)
- Interest payable

## 6.2. Basic types of performance and their importance

- Sales (from own products and services)
- Sales from the goods sold
- profit margin (difference between the costs and selling price)
- Value added (difference between sales and costs of material and services)
- revenues from sales
- Interest expense
- Operational economic result (without financial revenues)
- Profit before tax
- Profit

Controlling monitors and analyses the conformity / discrepancies between the situation and plan. A part of the plan is also a budget as an economic parametrization of the process .

Indicators represent an instrument for controlling (extensive, intensive, synthetic) in the form of measurable variables.

Analysing (comparing) the indicators “plan/situation” or with competition enables to identify the weak points .

The analysis tool is an IS, which gathers, sorts out, retains and process data according to the algorithms.

## 6.3. Selection of suitable indicators

- **Stock level (CZK)**
- **Turnover of stock** = purchase (sale) of stock per a given period (CZK) / overall stock (CZK)
- **Stock rotation** – number of days for which the stock is exchanged (turnover x 360)

- **Due date** (number of days from invoice issue to payment - days)
- **Turnover of receivables** – the actual average period from invoicing to payment (days)
- **Turnover of liabilities** – the actual average period from invoicing to payment (days)
- **Logistic costs ratio** = ratio of logistic costs to sales (CZK/CZK)
- **Reliability of delivery = S1 . S2**
  - **qualitative**S1 = Number of quality deliveries / the total number of deliveries
  - **terms reliability** S2 = Number of deliveries delivered in a time limit / total number of deliveries
- **Use of warehouse(s)** – average percentage of warehouse occupancy to its capacity
- **Continuous production time**
- **System of overall analytic indicators**
- **ROS, ROE, profitability...)**

# 7. LOGISTICS MANAGEMENT WITH USING IS

## 7.1. Information system (IS)

**IS** – it is used for designing, optimization, operative management and monitoring of operations and course of processes

**There is a great advance in rationalization due to the IS (planning, monitoring, financial flow, ...)**

- IS for support and optimization of logistics chain parts (projection)
- IS for optimization of planning all stages in the chain
- IS for automation of management in all aspects (material flow, efficiency, finance...)

### **Supply logistics in terms of IS**

planning material and energy consumption (consumption curve), auxiliary material, selection of suppliers (continuous assessment), concluding contracts, pallet account management (returnable packaging), expiration monitoring, preparing material based on the strategy adopted (FIFO, LIFO), acquiring receipt and issue documentation and keeping accounts .

Exit documentation for planning, controlling, accounting. **Regular stocktaking.**

### **Production logistics in terms of IS**

A tool to create and optimize production plants over time, using technology, needs of specific components, determination of batches, production schedule, assembly and testing, need for machinery and workers, plans of cooperation and stock movement.

Everything on the basis of specifications.

The outputs are planning documentation, operational production plan including the preparation of materials and operations schedule, keeping records on actual situation (times, material consumption, documentation for economics).

### **Distribution logistics in terms of IS**

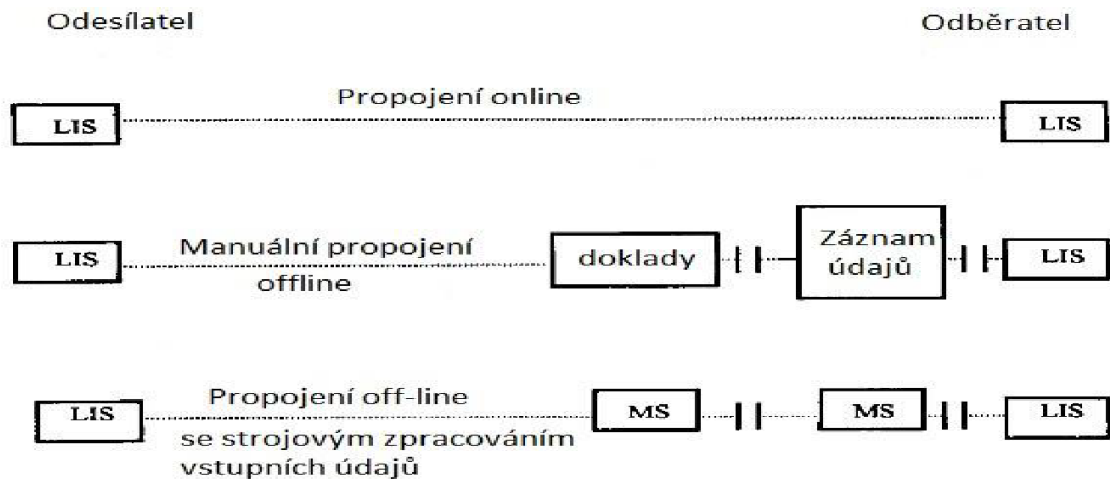
Inputs (information) from marketing surveys, benchmarking, product sets, data from customer organizations, contracts concluded, price lists, sales plans for finished products stock, customer satisfaction.

Creating sales plans, processing orders, keeping records of orders and their realization, invoicing, pallet account, documentation for stocktaking, competitive comparisons, efficiency assessment.

## 7.2. Placing order in IS and its processing

### Complex information on product and customer

- confirmation of order, making internal order for the implementation
- orders may have a form of individual order, call-off or contract
- internal order is an instruction to ensure timely production in accordance with the standards (before confirmation of the order to the customer, if there is no capacity blocking, capacity throughput must be checked on a company model)
- the order may be in the form of an individual order, call-off or contract
- Internal order is an instruction to ensure production in time according to standards
- (before the order confirmation to the customer, if there is no capacity blocking, capacity throughput must be checked in the company model)
- calculation (if it is not repeated, contractual)
- creation of implementation plan (execution) of the order and a possibility of its continuous monitoring
- ensuring traceability of products



LIS - logistický informační systém  
 MS - místo mezistyku, např. optické snímání dokladů,  
 magnetická páska, kazeta, disketa

*Legend: odesílatel - sender, odběratel - customer, propojení online - online connection, manuální propojení offline - manual offline connection, doklady - documentation, záznam údajů - data recording, propojení off-line se strojovým zpracováním vstupních údajů - offline connection with machine-processed input data*

*LIS - logistic information system*

*MS - place of interim contact, e.g. scanning, tape, cassette, computer disc*

## 7.3. Identification of goods, materials, unfinished production, finished products

Basic factor for production automation, quality of data and outputs in real time.

**An integral part of monitoring the consumption, and material and product flow is the consumption (need) for labour and machinery-use time.**

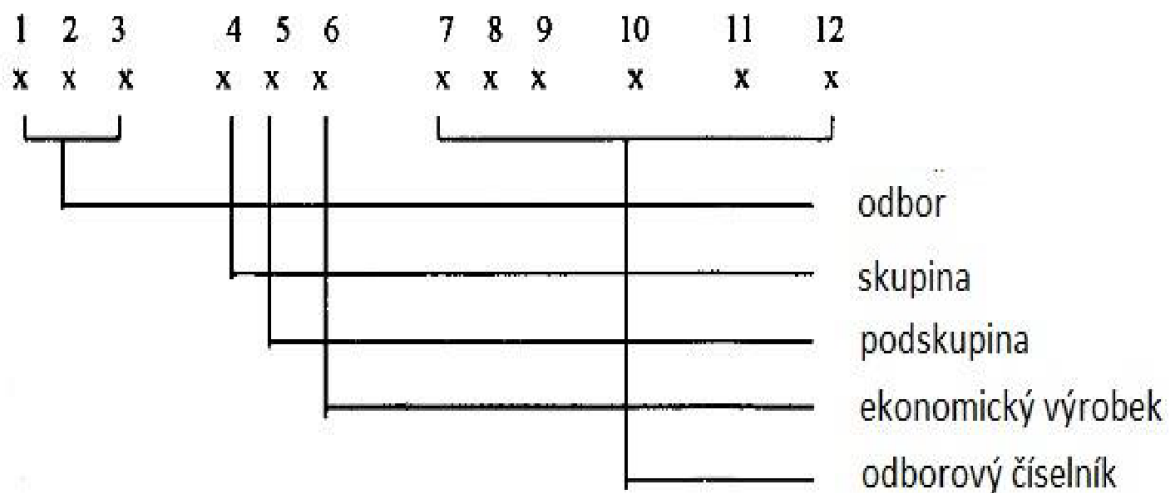
- Manually processed pallet tags
- Bar code (near reading, capacity of information, damage)
- QR code
- RFID (a chip), printed label - numeric, far-read code with a possibility of changes recording

## Identification of worker, operation, time, quality

- terminal
- car
- attendance
- beginning of operation, end of operation, evaluation of operation (automatic, semi-automatic, manual)
- feedback in the form of on-line current performance in comparison with the plan

## Uniform classification of industrial products (CR)

In the international environment, the EAN systems are used - necessary for the custom and tax purposes. There is also a marking for the country of origin.



*Legend: odbor - department, skupina - class, podskupina - subclass, ekonomický výrobek - economic product, odborový číselník - industry code*

# 8.MANIPULATION DEVICES

Manipulation systems are classified as:

- Mechanised
- Semi-automated and automated
- Computer-controlled

## 8.1. Classification:

- **lifting devices**
  - cranes
  - lifting mechanisms
  - elevators
- **transportation devices**- transportation systems for transportation of loose material
  - for transporting lump material
  - cableways
  - technical service and transportation means in agriculture
  - devices for pneumatic transport
  - mining transportation devices
- **devices for operational and inter-operational manipulation**
  - industrial robots and manipulators
- **devices for loading operations**
  - devices for loading operations
  - wheel excavators and stackers
  - shovel and bucket excavators
  - machinery and devices for earthmoving, construction and road work
- **Transportation devices**
  - metallic and made of combined materials, devices for palletization and containerization
  - packaging, containers, means of transport for palletising, made of plastics
  - wooden packaging, swap bodies
  - metal packaging



- **storage devices**
  - devices for storage of piece goods
  - devices for loading operations
  
- **Device for material treatment for manipulation**
  - scales (excluding laboratory scales and household scales)
  - filling and wrapping machines, machines for packaging adjusting
  
- **Means of transport**
  - transport trolleys
  - trucks and their modifications
  - trailers and semi-trailers
  - rolling stock for freight transport
  - sea-going vessels and vessels of combined navigation
  - airplanes

## 8.2. Choosing manipulation system

- manipulation equipment must be as standardized as possible,
- a system shall be designed so that it ensures continuous material flow,
- capital shall be concentrated rather in active means and devices, less in buildings, structures, etc. ,
- when choosing mobile devices, it is necessary to minimize the ratio of weight and payload,
- devices shall be used as much as possible,
- gravity shall be used as much as possible

## 8.3. Conditions influencing the selection of manipulation systems

- **technical**
  - material,
  - operational,
  - construction
- **economic**
- **social**

# 9. MATERIALS MARKING

## 9.1. Automatic identification

- facilitates tracing of orders,
- has a positive impact on the logistic performance system,
- helps to reduce stock,
- improves the reliability and accuracy of logistic system functioning,
- reduces the volume of manipulations and results in reduction of time necessary,
- it is used for transmission of information on passive elements of a logistic chain,
- it becomes one of the prerequisites for improving the customer services level

## 9.2. Most frequently used AI technologies

### Bar codes

- the most frequently used, the most important and the cheapest technology
- the most widely-known bar codes are EAN (European Article Numbering) - international standard
- 2 basic types: EAN 8 and EAN 13.

### RFID (Radio Frequency Identification)

- technology is used mainly in dirty environment and at locations with poor visibility.
- data carrier is so-called tag
- used in transportation, storage, production, control of people movement in closed spaces, objects protection.
- this technology is more costly than bar codes

### Biometric technologies

- based on human physiological features (fingerprints, signature, voice, hand geometry, iris, retina, DNA...)
- the main principle e. g. in the case of voice identification is to compare the actual voice with a set of voices stored in the computer database
- used in places where there is necessary to ensure high security and safety, and where the price of such a technology does not play a decisive role - mainly in banking

## Numeric structure of EAN 13

- prefix (a three-digit number – country of origin – 859 Czech Republic)
- 4 digits for identification of a producer
- 5 digits for identification of a product
- control digit.

The structure of dark and light lines includes:

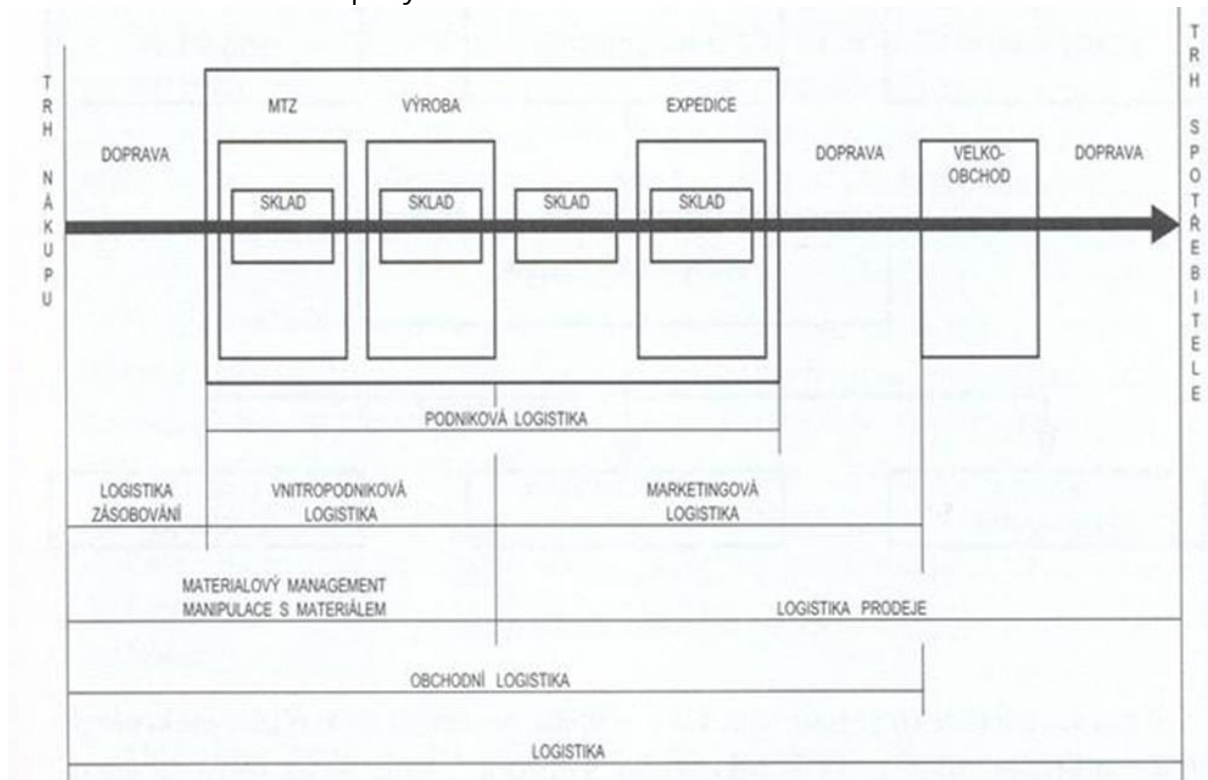
- start, stop character, separation character
- light field in front of and behind the code (necessary for correct reading of the code by scanner)



# 10. TRANSPORTATION

## 10.1. The types of transportation

- The external transportation of company – it is provided from a supplier to a company and from the company to a client
- The internal transportation of company – it provides the transportation of materials inside the company



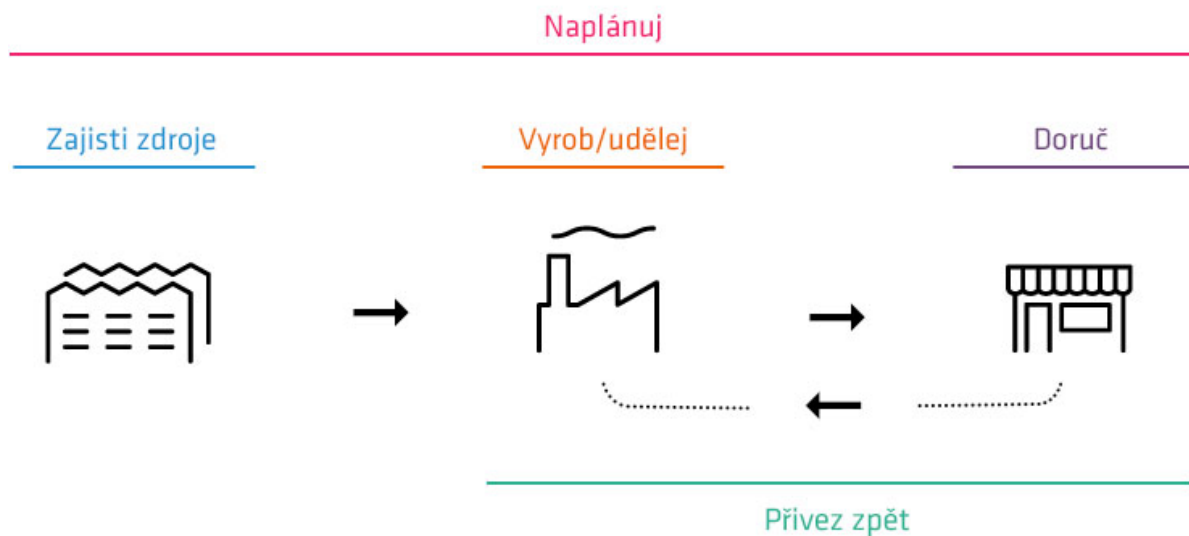
*Legend: trh nákupu – market of purchase, doprava – transport, logistika zásobování – supply logistics, sklad – warehouse, výroba – production, expedice – dispatch, velkoobchod – wholesale, trh spotřebitelů – market of consumer, vnitropodniková logistika – internal company logistics, materiálový management – material management, manipulace s materiálem – manipulation with material, podniková logistika – company logistics, marketingová logistika – marketing logistics, logistika prodeje – sale logistics, obchodní logistika – trade logistics, logistika – logistics.*

### The types of external transportation

- Road
- Railway
- Water
- Airway
- Pipeline

## 10.2. The functions of transportation facilities

- The reception and composition of transported materials
- The protection of transported goods
- Manipulability with the means of transport
- Shelf life
- The bearers of information



Legend: *Naplánuj* – Make a plan, *Zajisti zdroje* – Secure the resources, *Vyrob/udělej* – Make/produce, *Doruč* – Deliver, *Přivez zpět* – Move back

## 10.3. The standard of transportation – basic indicators

- **THE DENSITY OF TRANSPORTATION NETWORK** (mainly roads and railways)(km over 100 km<sup>2</sup> of the area of country or over the inhabitants)
- **THE INTENSITY OF TRANSPORTATION** (volume and performance)VOLUME OF TRANSPORTATION (tons, persons)
- **THE PERFORMANCE OF TRANSPORTATION** (number of tonokilometres - tkm, passenger-kilometres - oskm) – it is a multiple of transportation distance and transportation volume
- **THE SPEED OF TRANSPORTATION**
- **THE RELIABILITY OF TRANSPORTATION**

## 10.4. The planning of routes

- **PROBLEM** – the setting of route which the means of transport have to cover
- **CONDITIONS** (criteria)
  - the network of roads
  - the capacity of the means of transport
  - speed limit
  - the date of delivery
  - the availability of customers
  - delivery and collection at the same time
  - the working hours of drivers, etc.

## 10.5. Combined traffic

### RoLa

Originally from German – *Rollende Lan-strasse* – marks a system of accompanying transportation of road – railway.

### COFC / TOFC (Container of Flat Car / Trailer of Flat Car)

It is an unaccompanied combined transportation, which involves a transportation of large containers, swap bodies and road semitrailers. The most frequent is the transportation of large containers. The aim is to secure traffic between the dispatcher and the receiver, i.e. door to door service, by the means of rational use of railway, road, water or eventually airway transportation, respectively the combination of them.

## 10.6. The logistics of dangerous substances

The transportation of substances and objects the qualities of which can have a negative influence on the health and lives of people and the environment can take place on conditions, which are defined in international prescriptions for the transportation of dangerous substances:

- **European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)**  
*European Agreement Concerning the International Carriage of Dangerous Goods by Road*
- **Réglement concernant le transport (RID)**  
*Réglement concernant le transport  
Internationale ferroviaire des marchandises Dangereuses*

- **International Maritime Dangerous Goods Code (IMDG CODE )**
- **International Civil Aviation Organization – Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO TI )**
- **International Air Transport Association Dangerous Goods Regulations (IATA DGR)**

The condition for a transport of dangerous substances is their correct classification according to the criteria in the international procedures.

#### **The state supervision:**

- ADR control – the transportation sections of Regional Administrations
- RID control - Railway Inspection
- Mobile units (police, specialists, customs office)

#### **The exemption from the ADR regulations is applied to the following cases:**

- the transport of dangerous substances by private persons for their own use
- the transport of dangerous substances in case of first aid and environmental protection
- the transport of dangerous substances by special forces

#### **The subject passing the dangerous substances for transport (further referred to as ,dispatcher’) is obliged according to the ADR to secure mainly the following procedures:**

- to classify, wrap and mark the dangerous substances
- to comply with the ban on combined loading if it is performed
- to retain dangerous substances the transport of which is not permitted
- to pass the written instructions for drivers over to the carrier
- to give correct and entire data in the waybill, including declarations
- to hand over the copy of the permission according to the special legal procedures to the driver
- to inspect the original documents and to carry out a visual control of the vehicle and its equipment, whether they comply with the prescribed regulations, prior the loading
- to mark the containers
- to provide a training for the further persons participating in the transport
- to appoint a security advisor for the transportation of dangerous substances