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V PLZNI

Product Lifecycle Management strategy and vision

Milan EDL

Проект „Развитие международного сотрудничества с украинскими ВУЗами в областях качества, энергетики и транспорта“

г. Харьков, 11/2018

Product

- The product is anything that can be offered on the market to meet the needs and wishes of the customer, this means that no products can not meet the needs of the customer.
- The marketing concept is not understood only as a product subject to its primary destination, but as a subject that contributes to satisfy customer needs.

Products can be

- material nature (e.g. engine, car, plane, ...)
- service (e.g. the hospitality, rental ...)
- thoughts (e.g. algorithm design, ...)
- person (e.g. a particular person ...)
- place (e.g. a particular place, ...)

Product lifecycle management

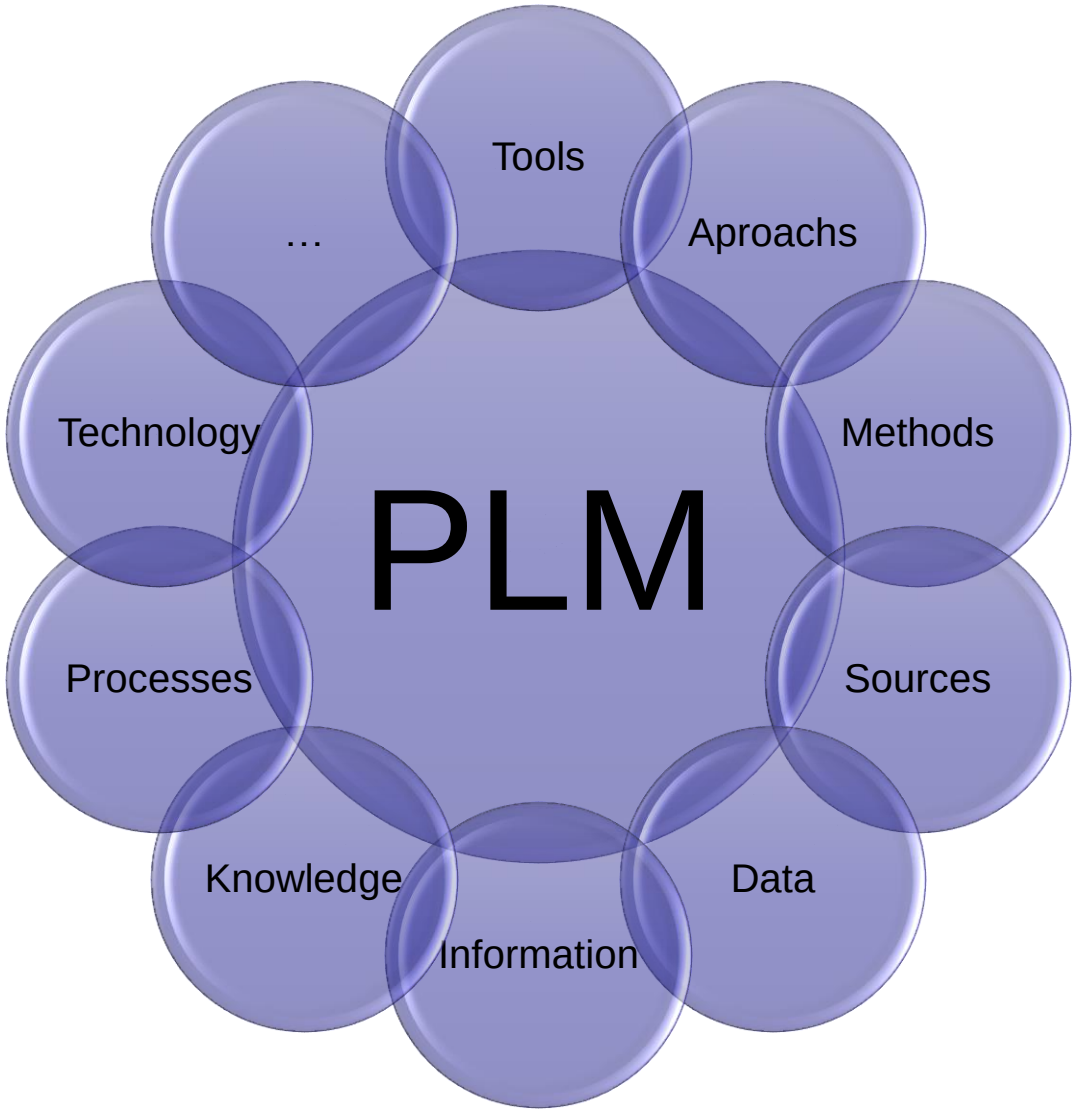
- very often the idea of creating a product is that product management for end "gates" of the company, ie. from idea, product development to manufacturing and shipping to the customer
- management product continues through service to dispose of the product

Product lifecycle management

- Product Lifecycle Management
- 產品 生命 週期 管理
- Управління життєвим циклом продукту
- 제품 수명 주기 관리
- Zarządzania cycle życia product
- 製品 ラ イ フ サ イ ク ル 管理
- Управления жизненным циклом изделия

Product lifecycle management

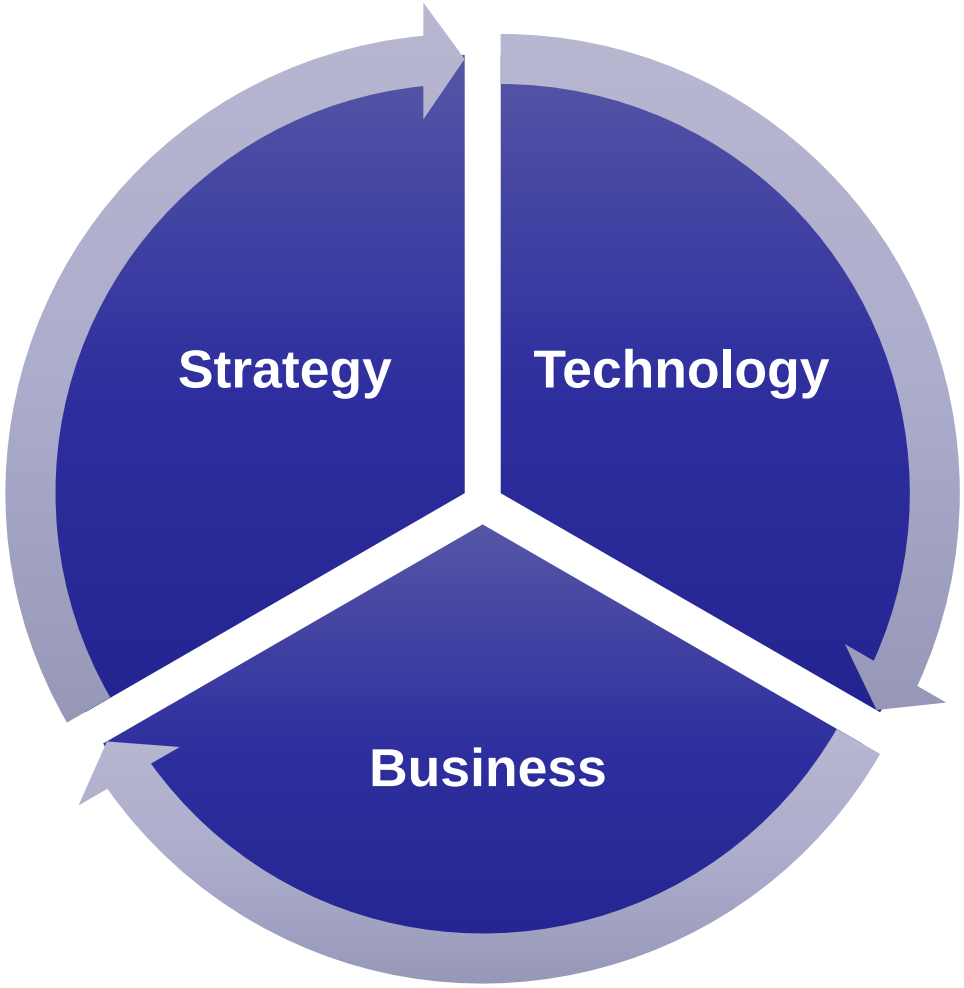
- PLM the management process of "life" of a product, from concept through production and service to disposal.
- PLM It is an information strategy.
- PLM the company's strategy.
- PLM integrates people, data, processes, systems management technology.
- PLM integrate systems, processes and tools for dealing with the implementation of new / innovative product.


PLM
Tools
Aproachs
Methods
Sources
Data
Information
Knowledge
Processes
Technology
…

Product lifecycle management

- A very important aspect of the entire PLM is the need for teamwork and integration of systems, tools and processes in the company and its surroundings, especially in **digital form**.
- As already described, product management throughout the lifecycle integration is very **heterogeneous processes,** which are implemented by a team of people at different levels of the company and the relatively long period of time.

Product lifecycle management



Views to PLM

- view in terms of marketing,
- view in terms of life of a product,
- view in terms of the place of realisation of individual products,
- view in terms of individual transformation processes,
- view in terms of the impact of the product on the environment,
- integrated view of the product life cycle.

View in terms of marketing

- development phase
- commissioning phase
- growth phase
- saturation phase
- phase decline

Phase developments

- initial idea
- product design
- high cost
- large influence future product
- zero sale

Phase introduction

- launch product sales
- first earnings
- the key is to create fees
- price may be higher soon

Phase growth

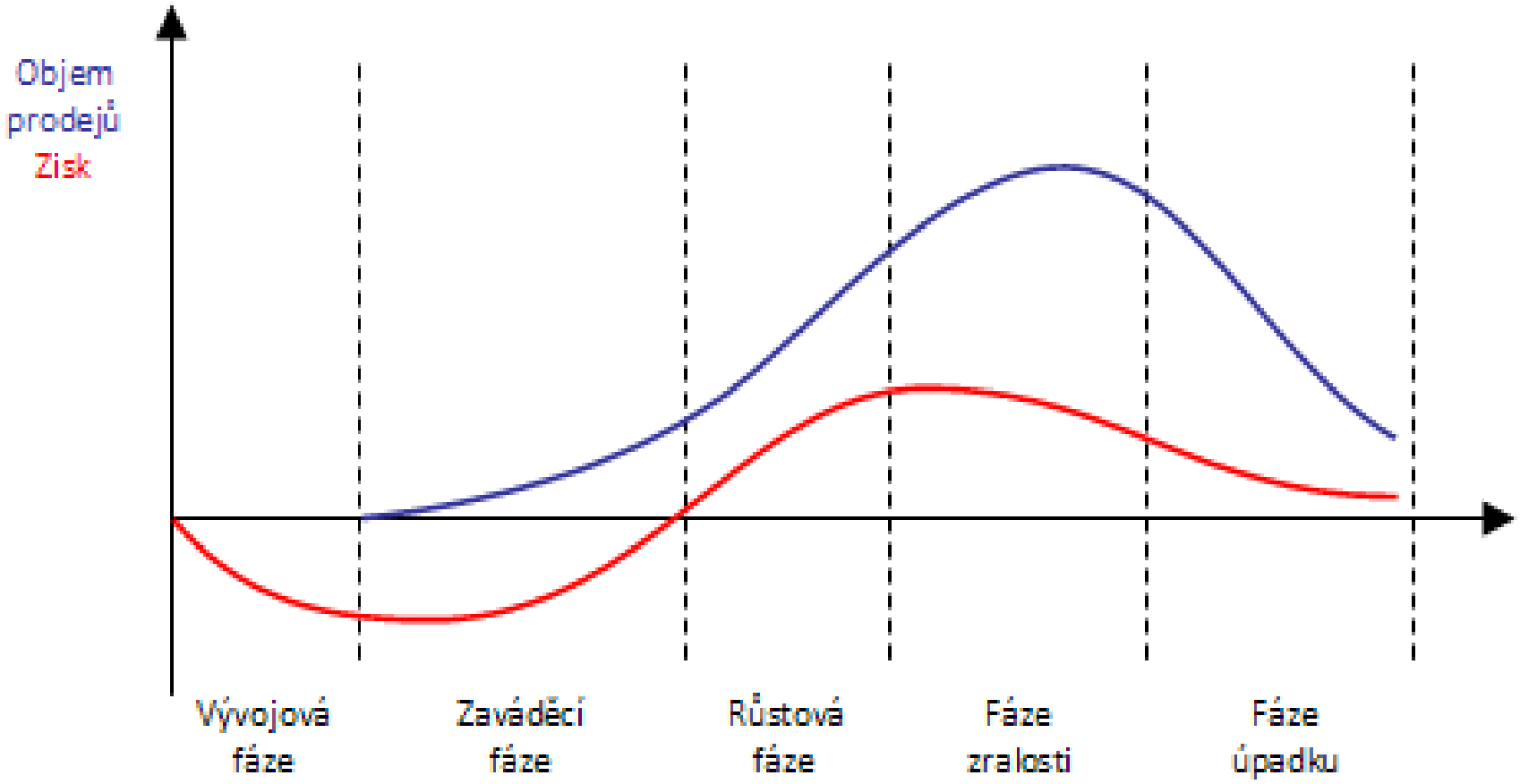
- incomes rise
- focus on increasing market share
- differentiation from competitors

Phase saturation

- market share at the highest level
- growth stops
- period of greatest gains
- gradually declining profit

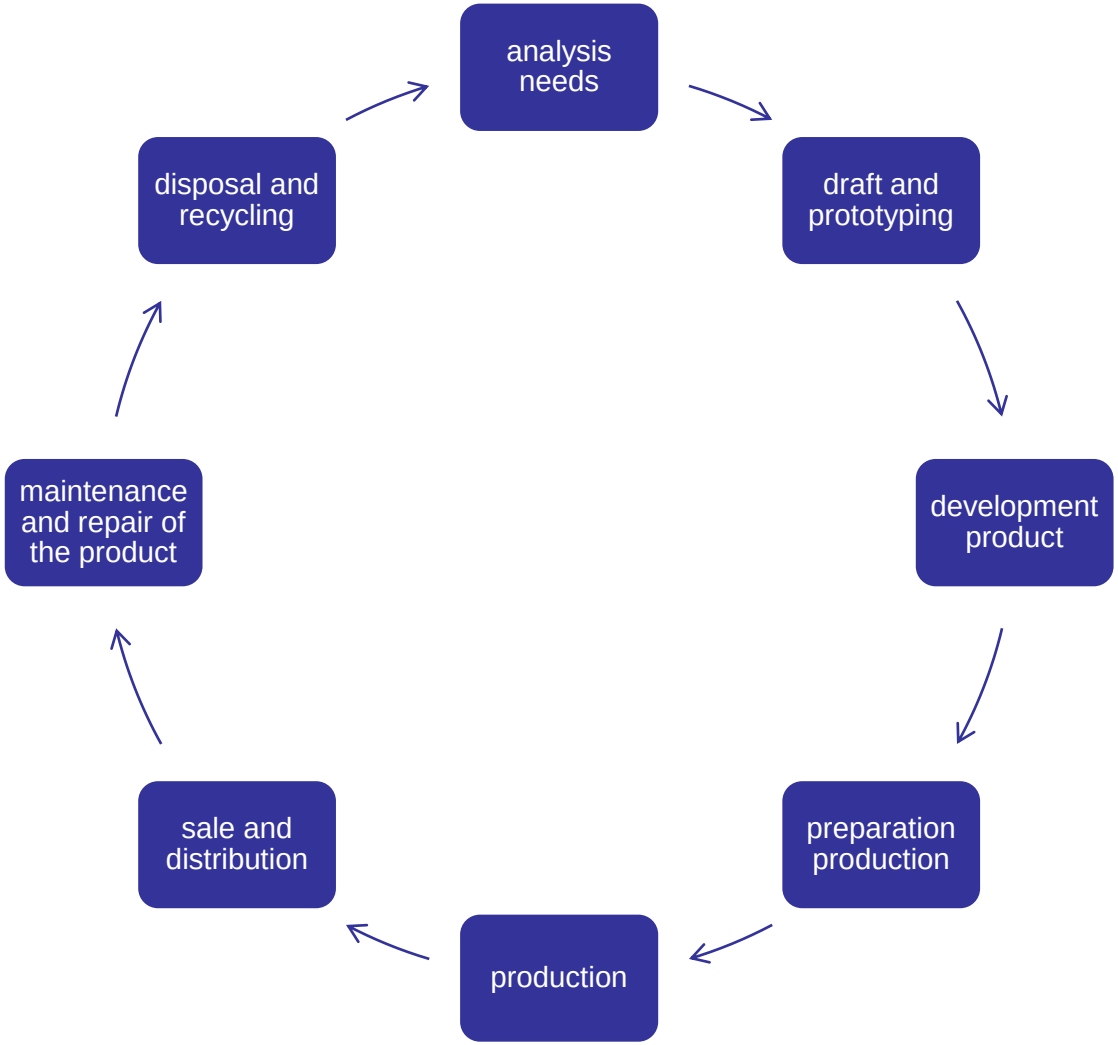
Phase decline

- decisions about product download
- must be tackled warranty products sold


Objem prodejů
Zisk
Vývojová fáze
Zaváděcí fáze
Růstová fáze
Fáze zralosti
Fáze úpadku

PLM terms of service life of a single product

- analysis needs,
- draft and prototyping.
- development product,
- preparation production,
- production.
- sale and distribution,
- maintenance and repair of the product,
- disposal and recycling.

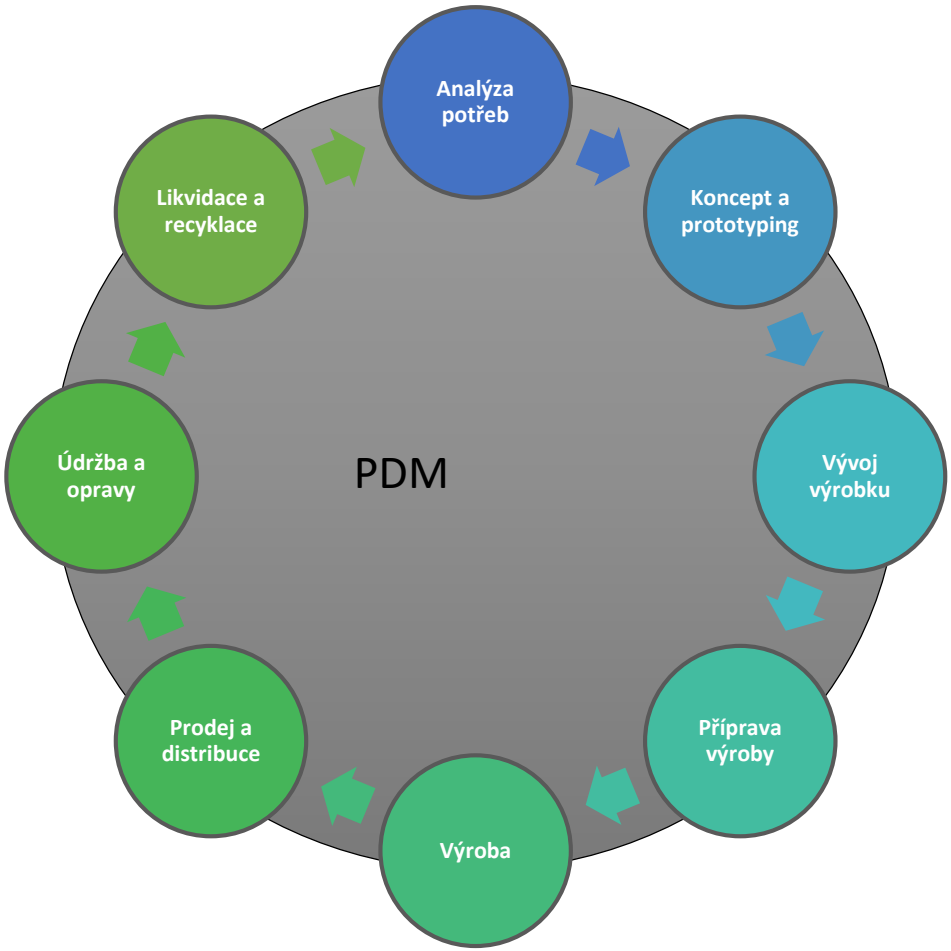

analysis needs
draft and prototyping
development product
preparation production
production
sale and distribution
maintenance and repair of the product
disposal and recycling

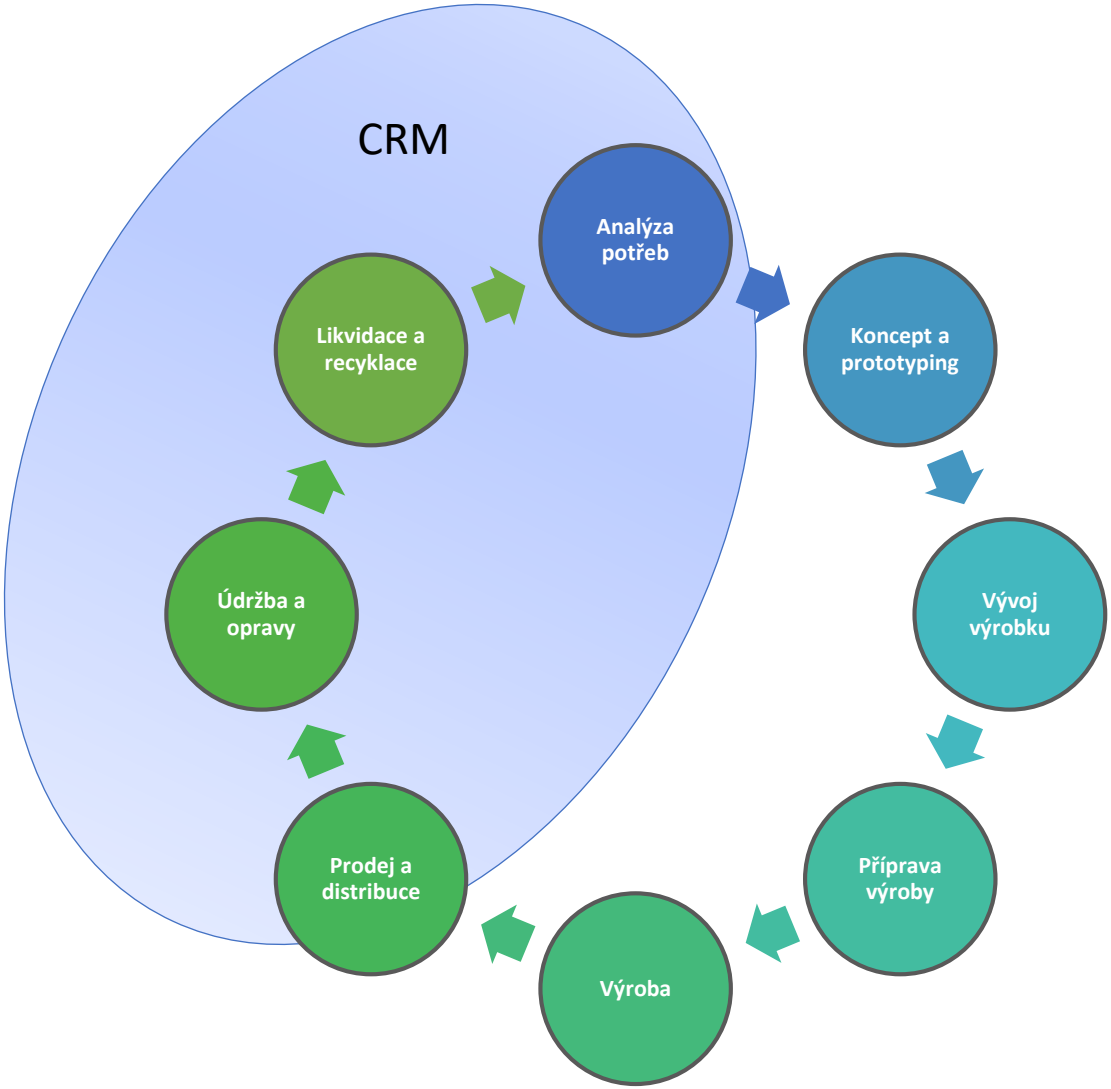
Integration with other systems

- **CAD (Computer Aided Design)** - it can be called a tool that allows you to create the concept, design, and product design, ie. Computer-aided designing new, but innovative product.
- **CAM (Computer Aided Manufacturing)** - can be characterized as tools for computer-aided manufacturing, ie. Tools to help prepare and validate various technological operations where the essential characteristic for PLM is taking over neprojektovaných drawings from CAD tools.
- **CAQ (Computer Aided Quality)** - can be determined as tools to promote quality management, ie. A tool that is used to support (data collection, data processing, data analysis), workplace inspections, it is also can be understood as a system enabling proper and timely circulation of documents in the company.

Integration with other systems

- **PDM (Product Data Management)** - it can be called a tool that lets you manage product data, ie. Allows you to manage, communicate, share, synchronize, archive and analyze data about products throughout their life cycle within the enterprise or business networks.
- **CRM (Customer Relationship Management)**- they can be called as a tool that is used to support communication and collaboration with customers, ie. A tool that focuses on the process of collecting, processing and evaluation of information about customers of the company, allowing to identify and, if necessary. reveal the needs and wishes of customers.
- **ERP (Enterprise Resource Planning)** - can be termed as enterprise resource planning, ie. An information system that works with corporate resources (financial, human, material and information) in order to effectively plan the activities in the company.


Analýza potřeb
Koncept a prototyping
Vývoj výrobku
Příprava výroby
Výroba
Prodej a distribuce
Údržba a opravy
Likvidace a recyklace
PDM


CRM
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Koncept a prototyping
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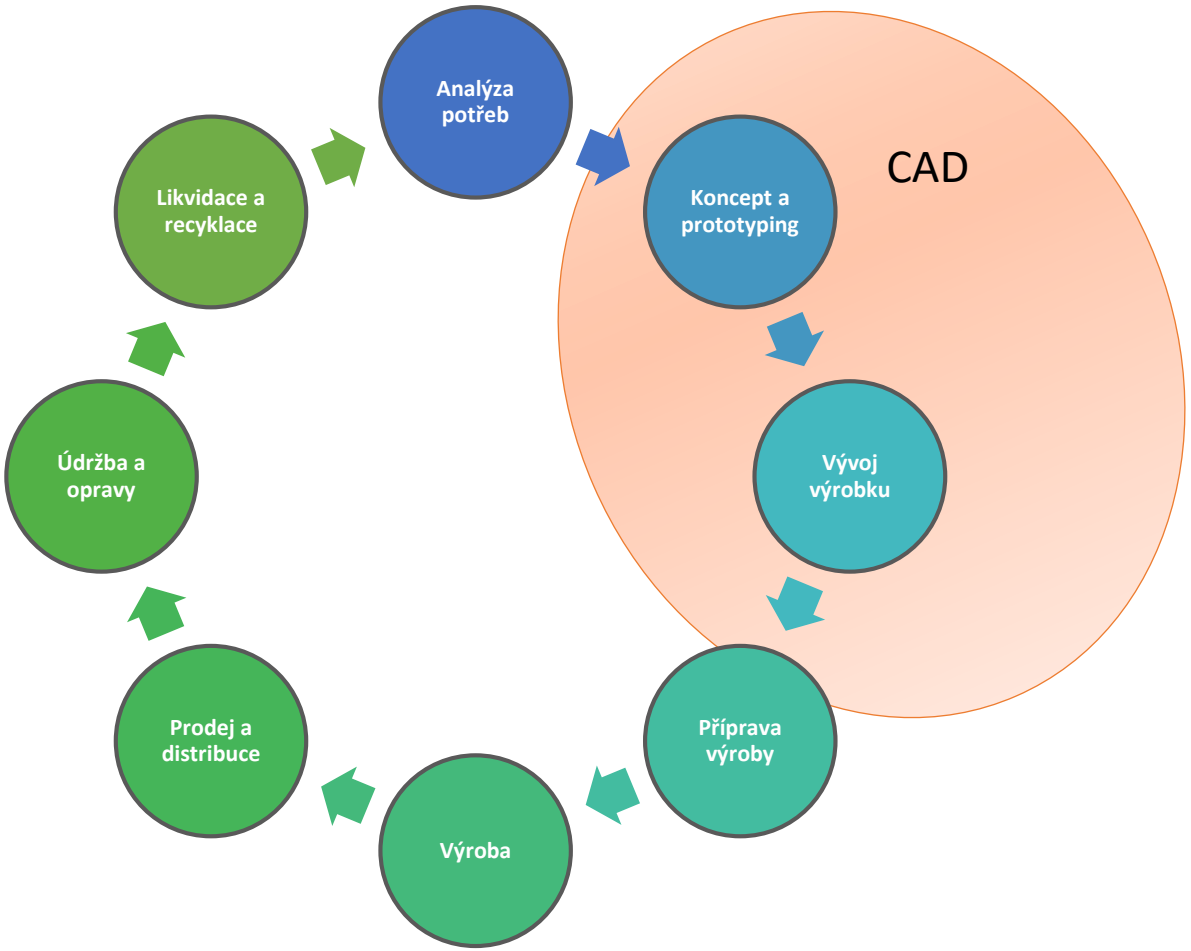
Příprava výroby
Výroba
Prodej a distribuce
Údržba a opravy
Likvidace a recyklace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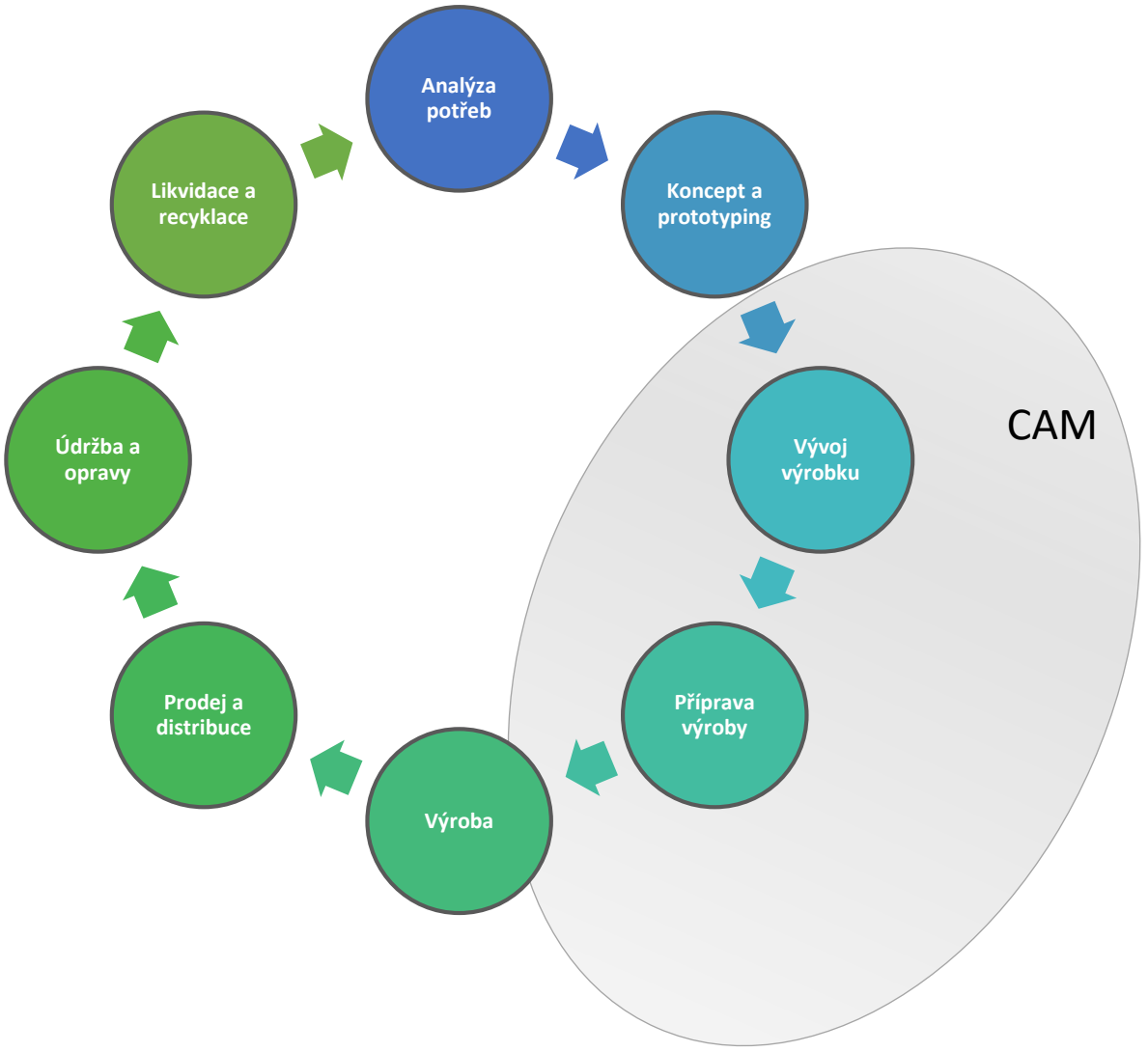
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Příprava výroby
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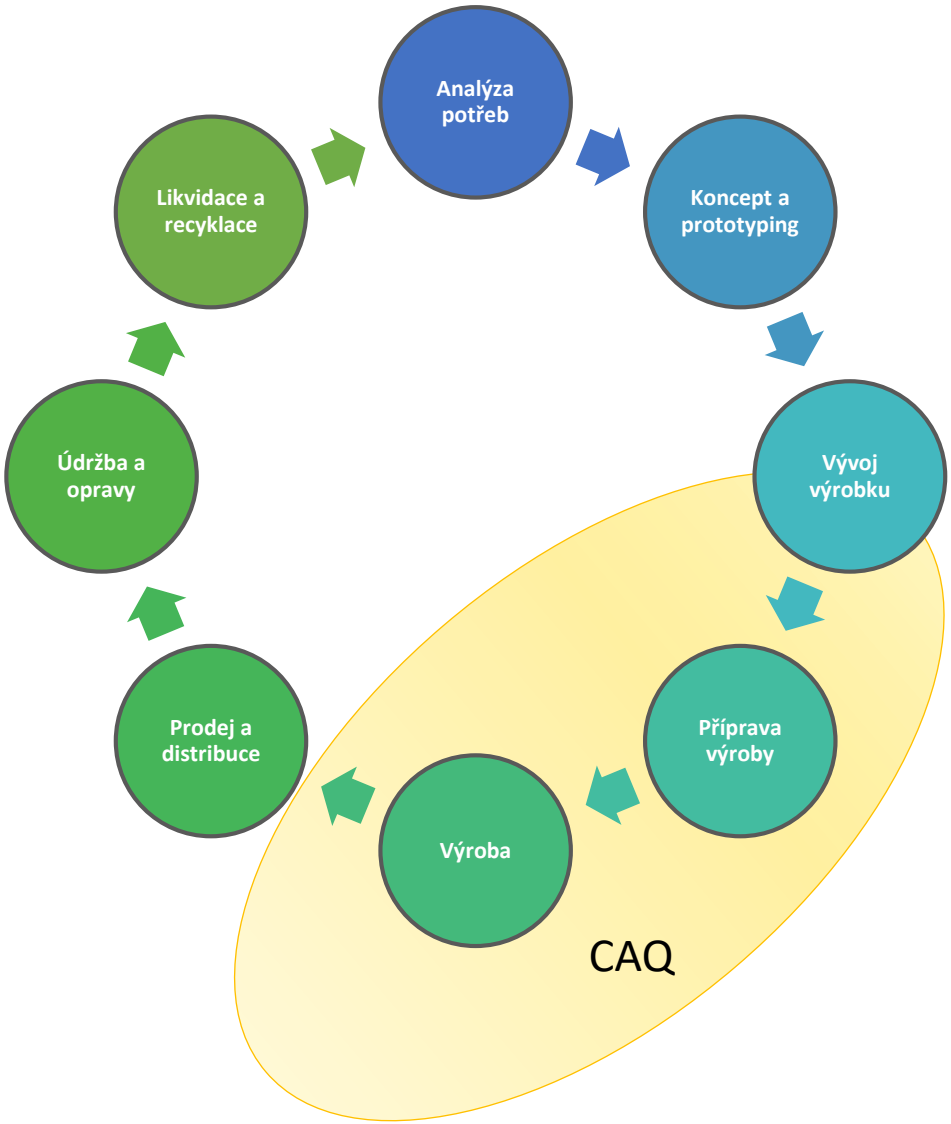
Prodej a distribuce
Údržba a opravy
Likvidace a recyklace
CAM


Analýza potřeb
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Vývoj výrobku
Příprava výroby
Výroba
Prodej a distribuce
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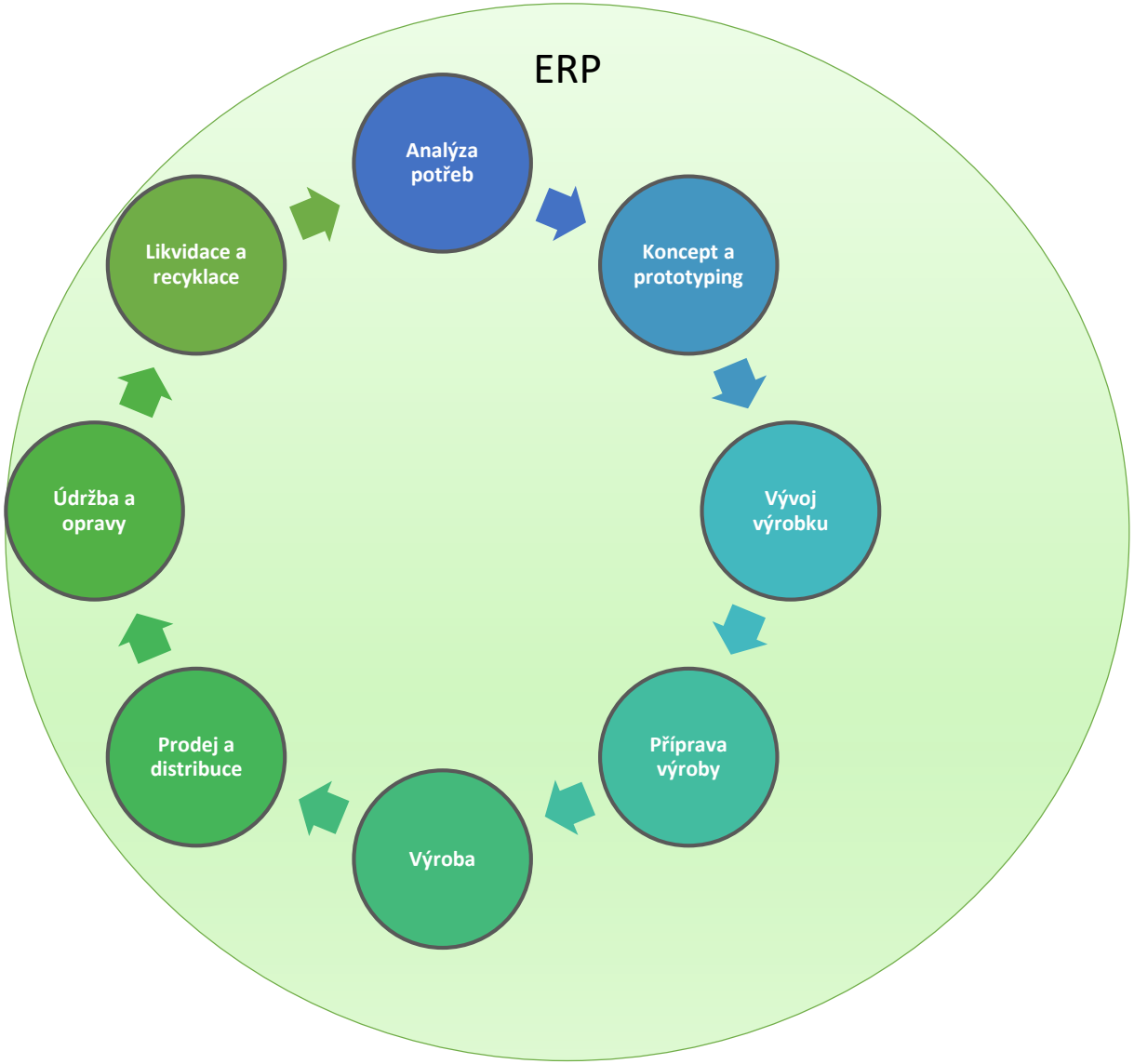
CAQ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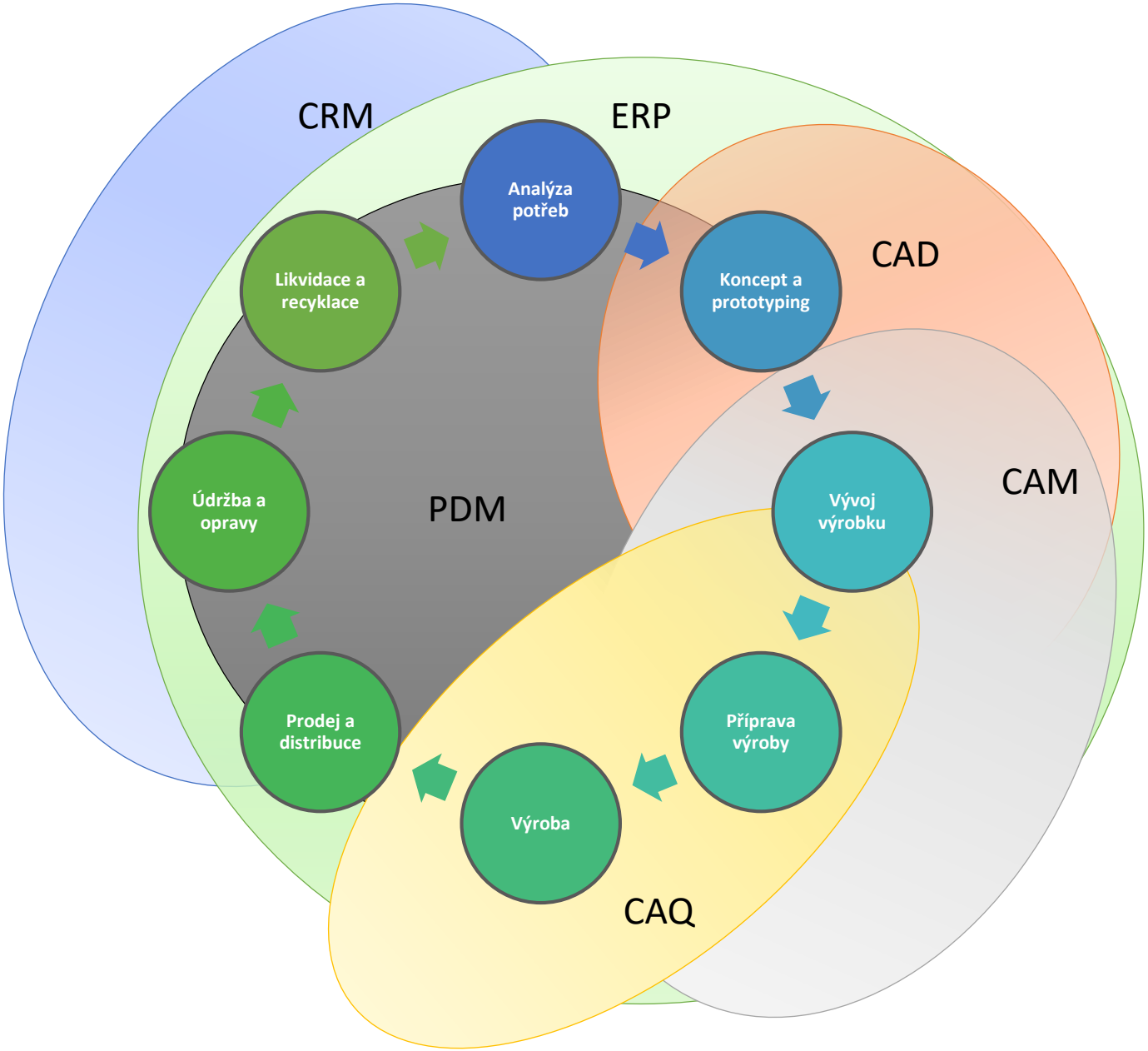
CRM
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Koncept a prototyping
Vývoj výrobku
Příprava výroby
Výroba
Prodej a distribuce
Údržba a opravy
Likvidace a recyklace

Integration with other systems

- **CAPP (Computer Aided Process Planning)** - Computer Support in processing technological documentation,
- **CAPPS (Computer Aided of Production Planning System)** - computer support systems planning and management,
- **CAMA (Computer Aided Maintenance)** - computer support maintenance of technical installations,
- **CAPE (Computer Aided Production Engineering)** - Computer Aided Manufacturing Engineering,
- **CATS (Computer Aided transport and Store)** - Computer Aided Management interoperable transport and storage,

Integration with other systems

- **CAT (Computer Aided Testing)** - computer aided testing, measurement and diagnostics,
- **CAA (Computer Aided Assembly)** - computer support assembly products
- **QFD (Quality Function Deployment)** - a tool to transform customer requirements into technical parameters of the product,
- **DBMS (Database Management System)** - a software package that controls the creation, maintenance and use of database
- **MES (Manufacturing Execution Systems)** - Manufacturing Information System
- **DFX (Design for X)** - a set of specific design guidelines.

Integration with other systems

- **MIS (Management Information System)** - Provides information management that are necessary for effective and efficient management of the organization based on user roles,
- **SCM (Supply Chain Management)** - supply chain management,
- **MRP (Material requirements planning)** - production scheduling and inventory management system based on the management of production processes,
- **APS (Advanced Planning System)** - a system of advanced planning environment with limited capacity, which allows you to simplify, improve and accelerate activities in the field of planning,
- **MRS (Marketing requirements Specification)** - a tool for gaining customer requirements.

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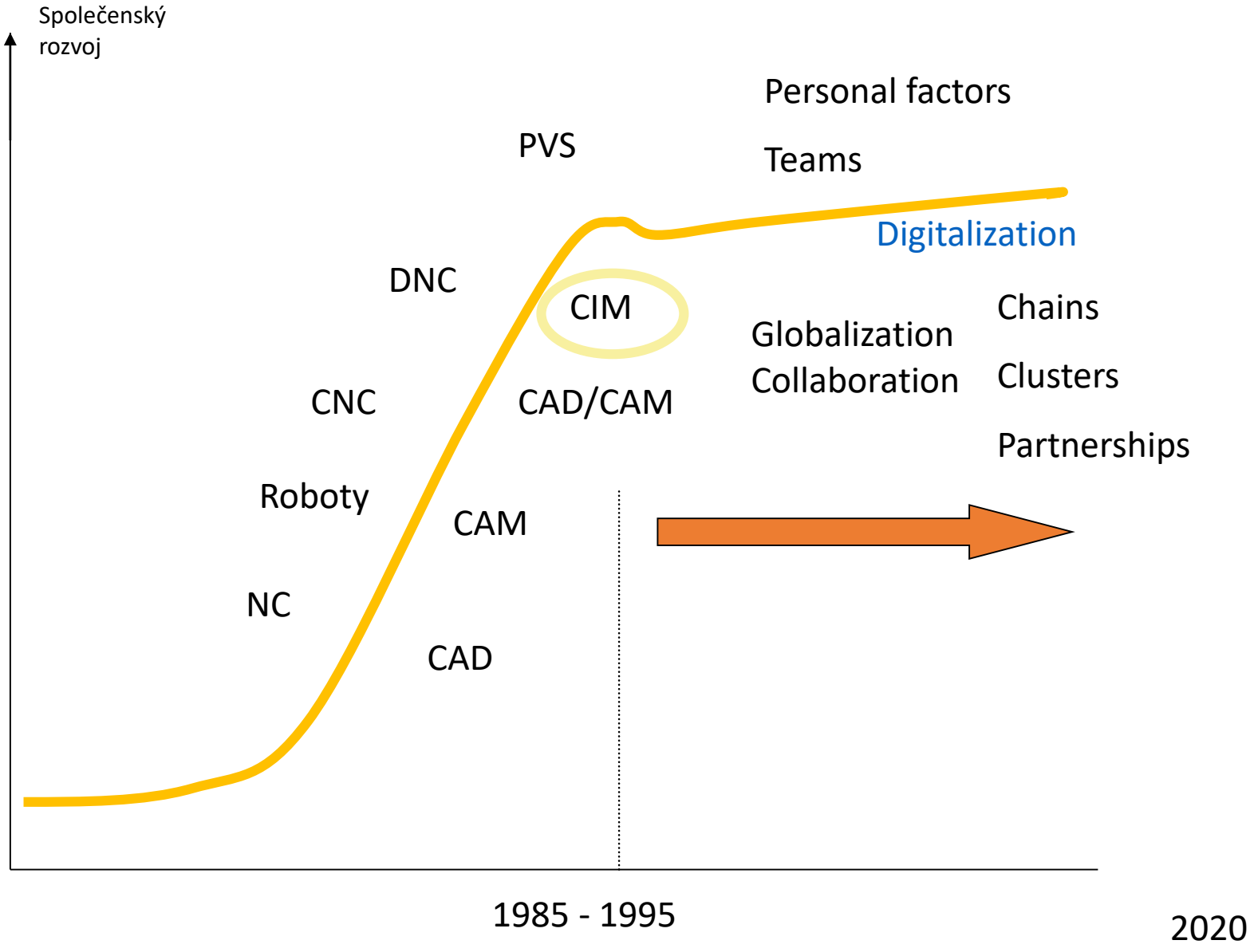
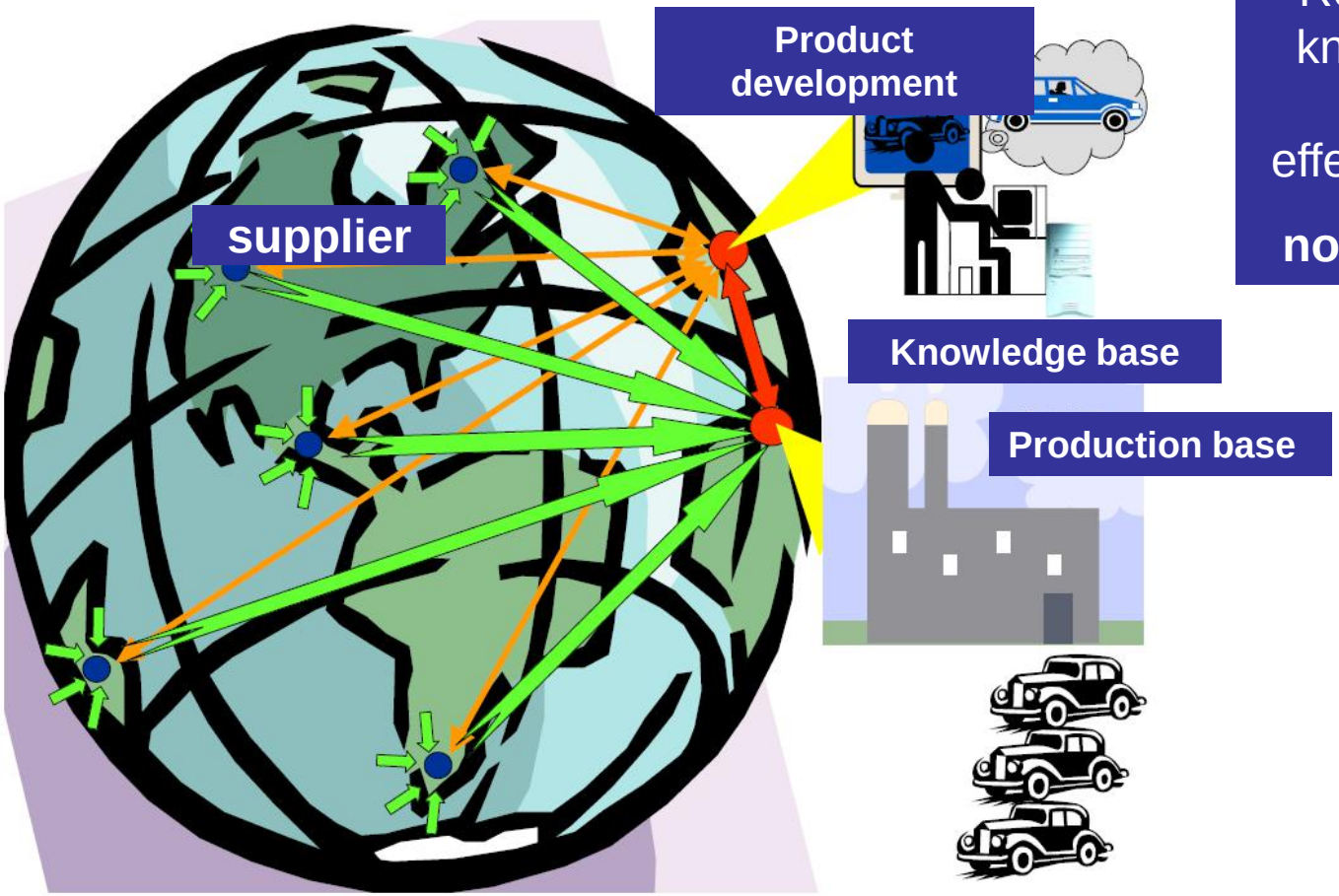
Digital Factory

Milan EDL


Společenský
rozvoj
Personal factors
PVS
Teams
Digitalization
DNC
CIM
Chains
Globalization
Collaboration
Clusters
CNC
CAD/CAM
Partnerships
Roboty
CAM
NC
CAD
1985 - 1995
2020

Globalization + digitalization = current trend



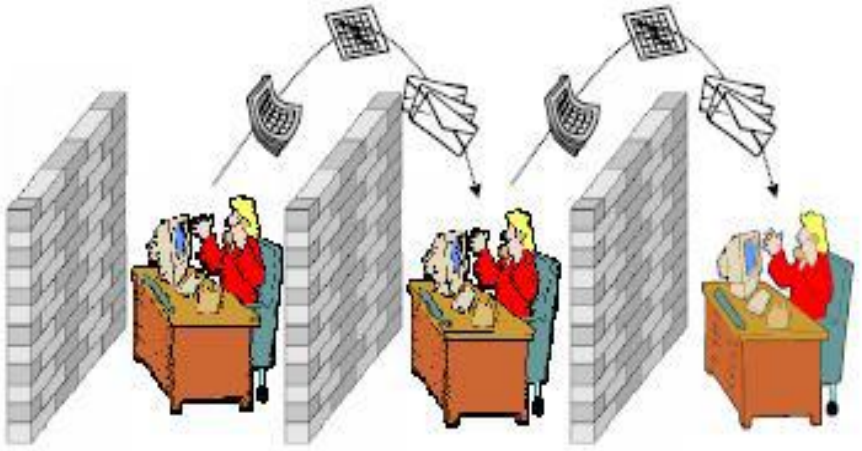
Roles play knowledge and effectiveness

no location

Zdroj: Horn - Siemens

Main aim of digital manufacturing methods are replace intermittent processes of sending project documentation from one office to next – after finishing previous work

Work in particular offices is necessary transform



for common parallel running work in team

Making workplace

3D laser scan

Simulation of material flow

3D visualization

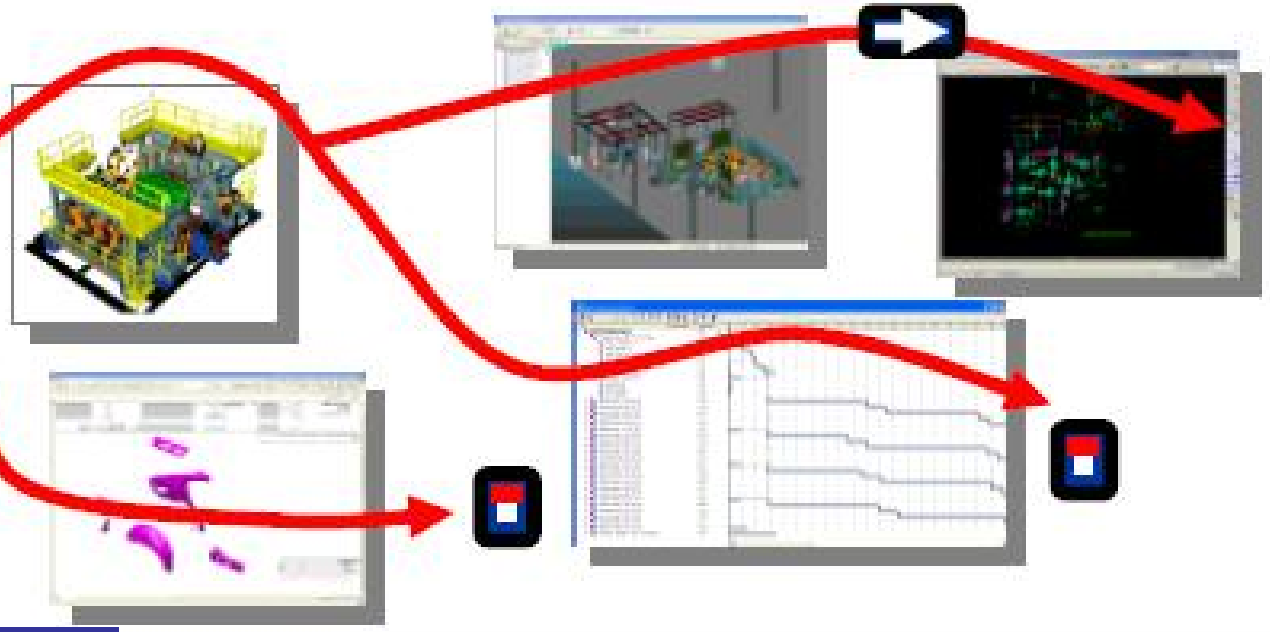
...

Ergonomics

Process are working with one share database – processing, control, editing, …

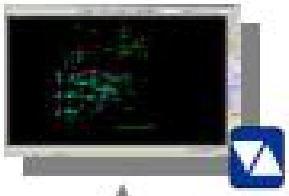
Parallel working

Current **sequence** process of creating production base



it must replaced

Parallel processes

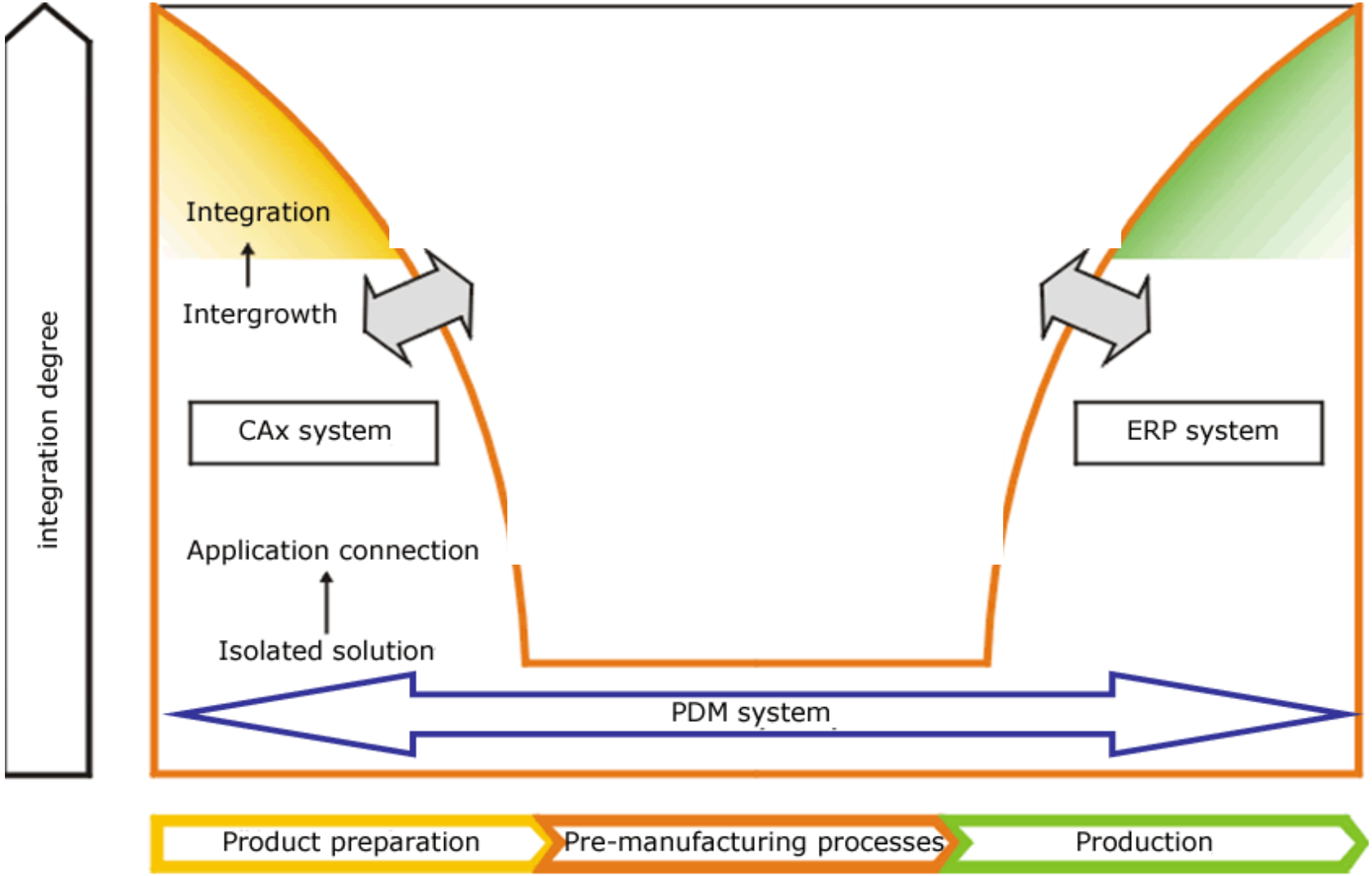


information

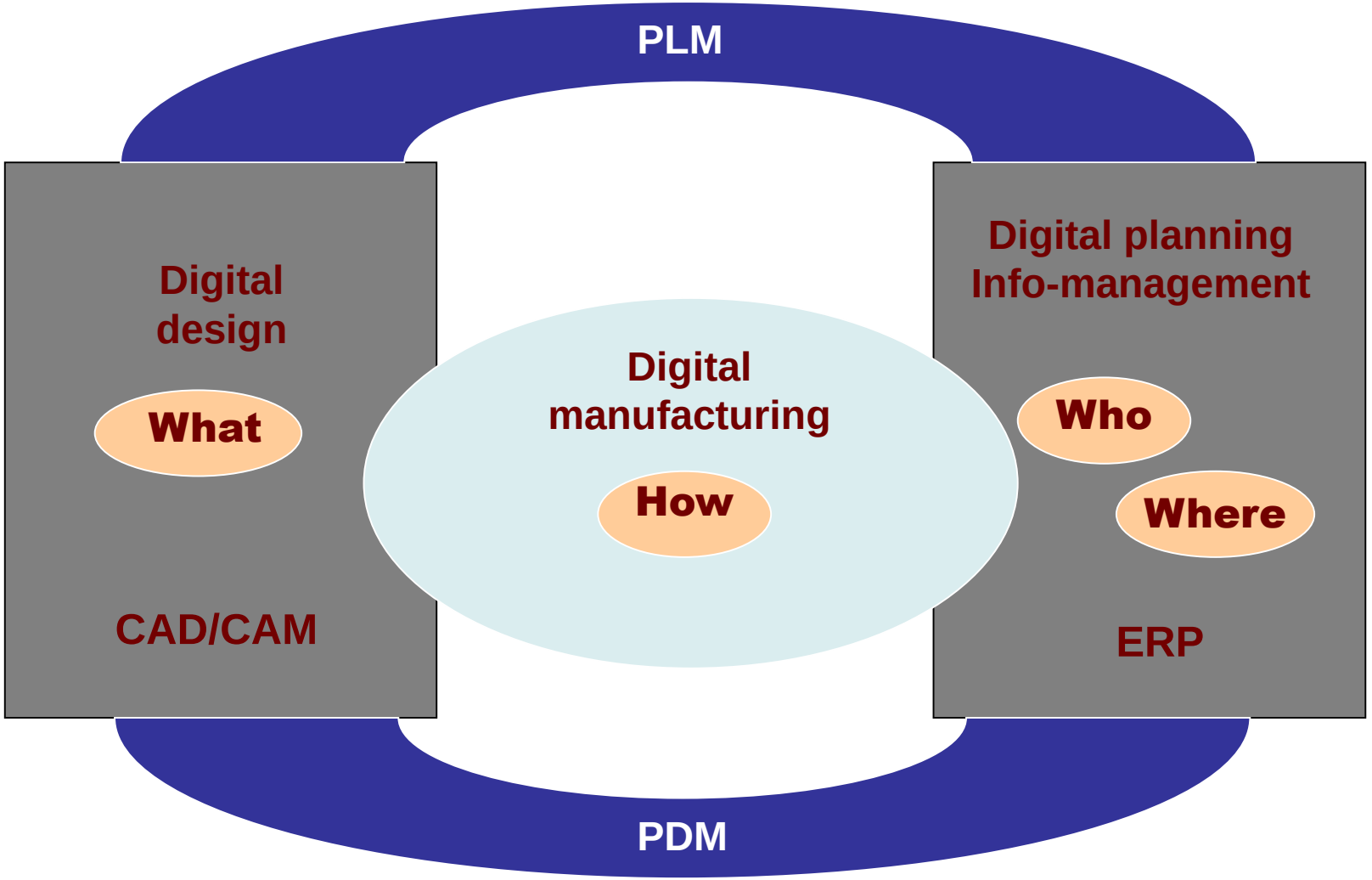
parallel process creation of production base

processes must execute with one shared database

Integration in DF



Basic Principles of digital manufacturing



Definition of term **Digital Manufacturing** is still in process. Many authors understand term only in relation to production and other authors more widely.

Digital manufacturing

Digital product — Orientation for geometry — Orientation for processes — **Real company**

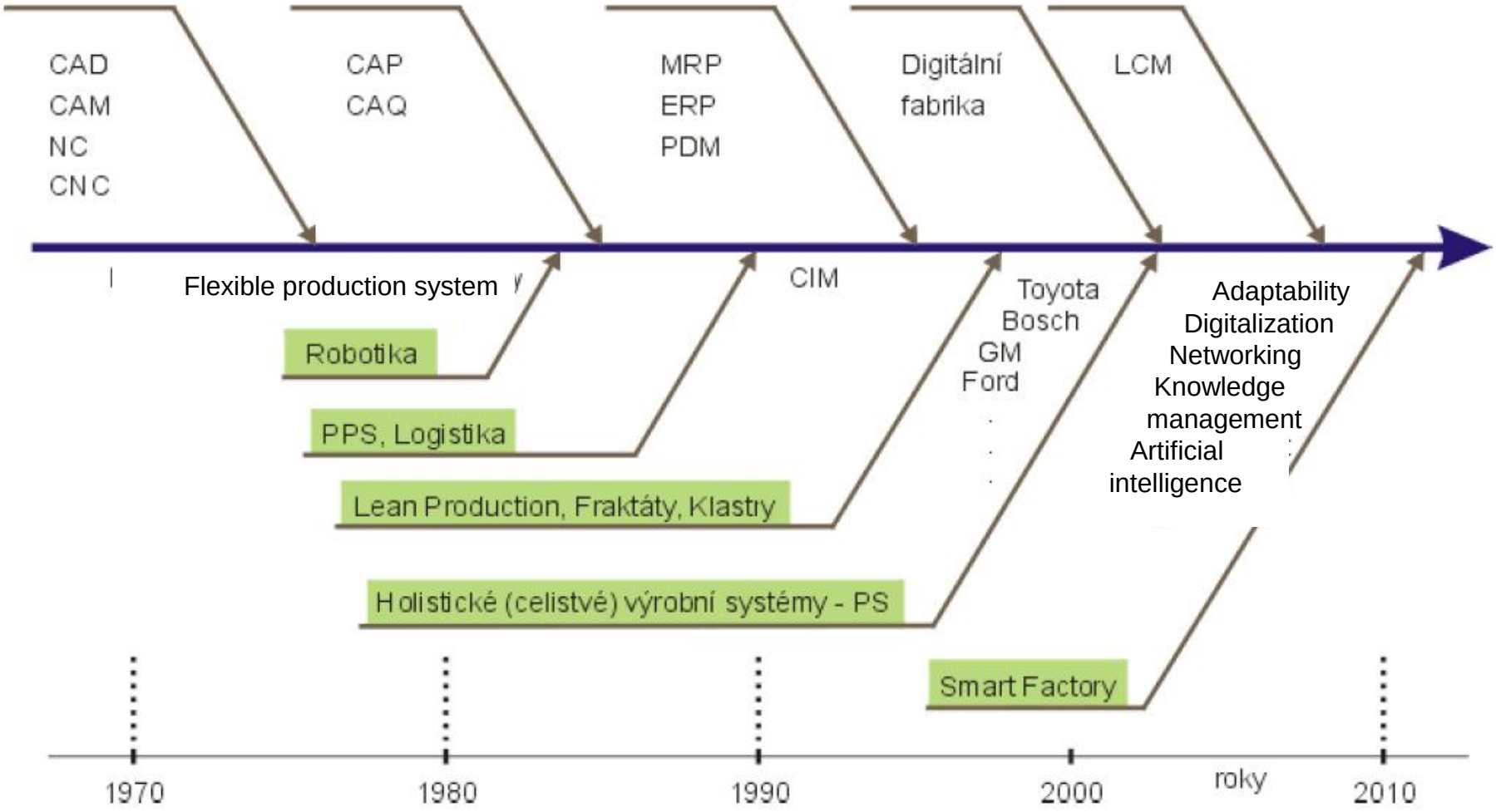
Product developing	**Planning**	**Projecting**	**Processes visualization**	**Real machines**
Design Construction Calculating Mock-up Presentation Documentation	Process dev. Technology Norms Production planning Material flow Layouts Simulation Verification Presentation Documentation	Process creation Structure Automation Scheduling Presentation Documentation	Material flow simulation Ergonomic simulation Kinematic simulation Validation Presentation Documentation	Machines installation Training Tests Running Production and assembly Maintenances Service

Virtual steps — **Reality**

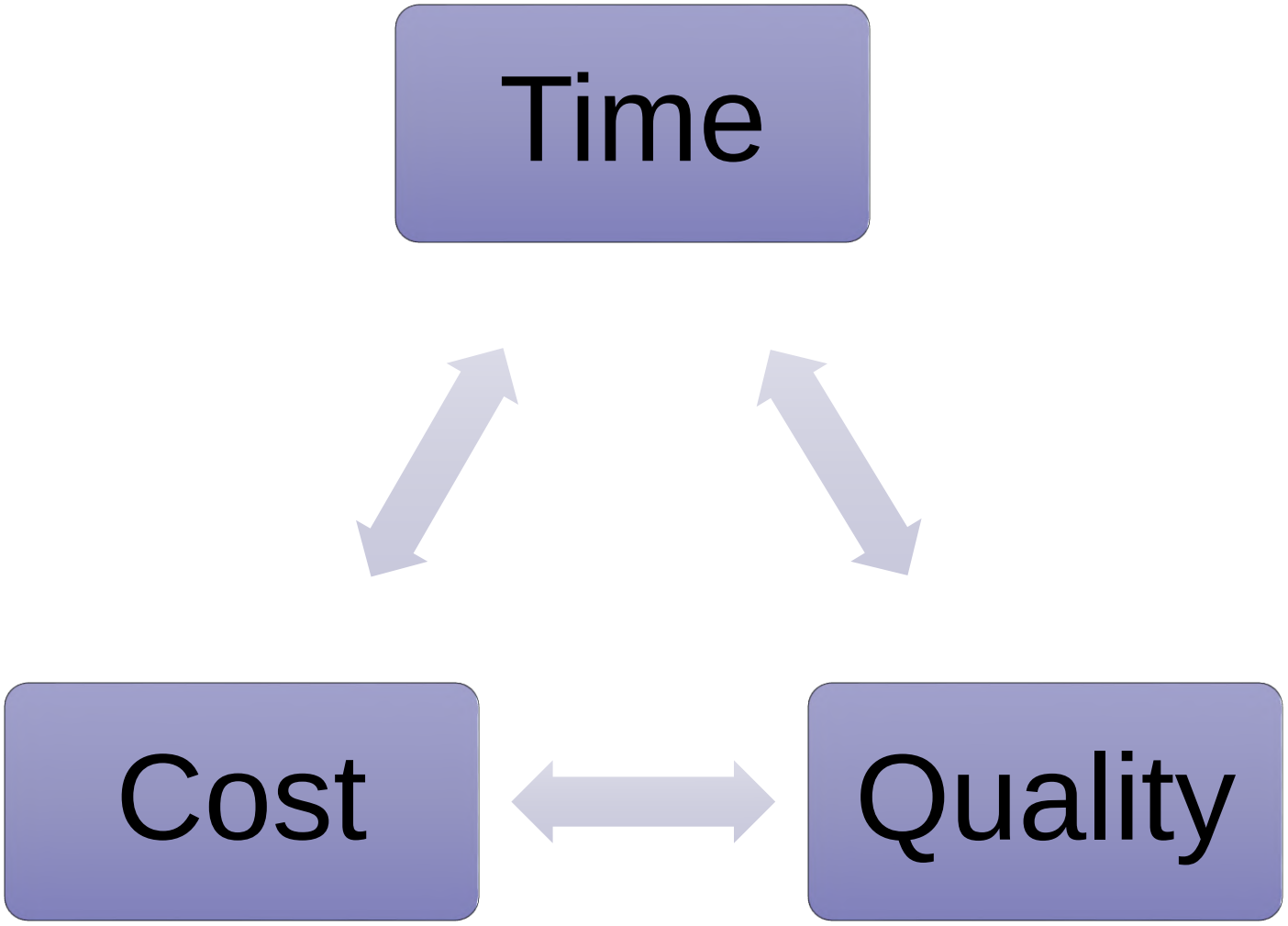
Digital manufacturing

- Digital Factory is an umbrella concept for a wide range of digital methods, models and tools, which are integrated in continuous data management
- The goal is to **digitally capture and form**, with the use of support software tools, the **whole product life cycle**
- Digital Factory gives a virtual image of real production, that is, it displays production processes in a virtual environment. It serves mainly for planning, simulation and optimization of serial manufacturing of difficult products

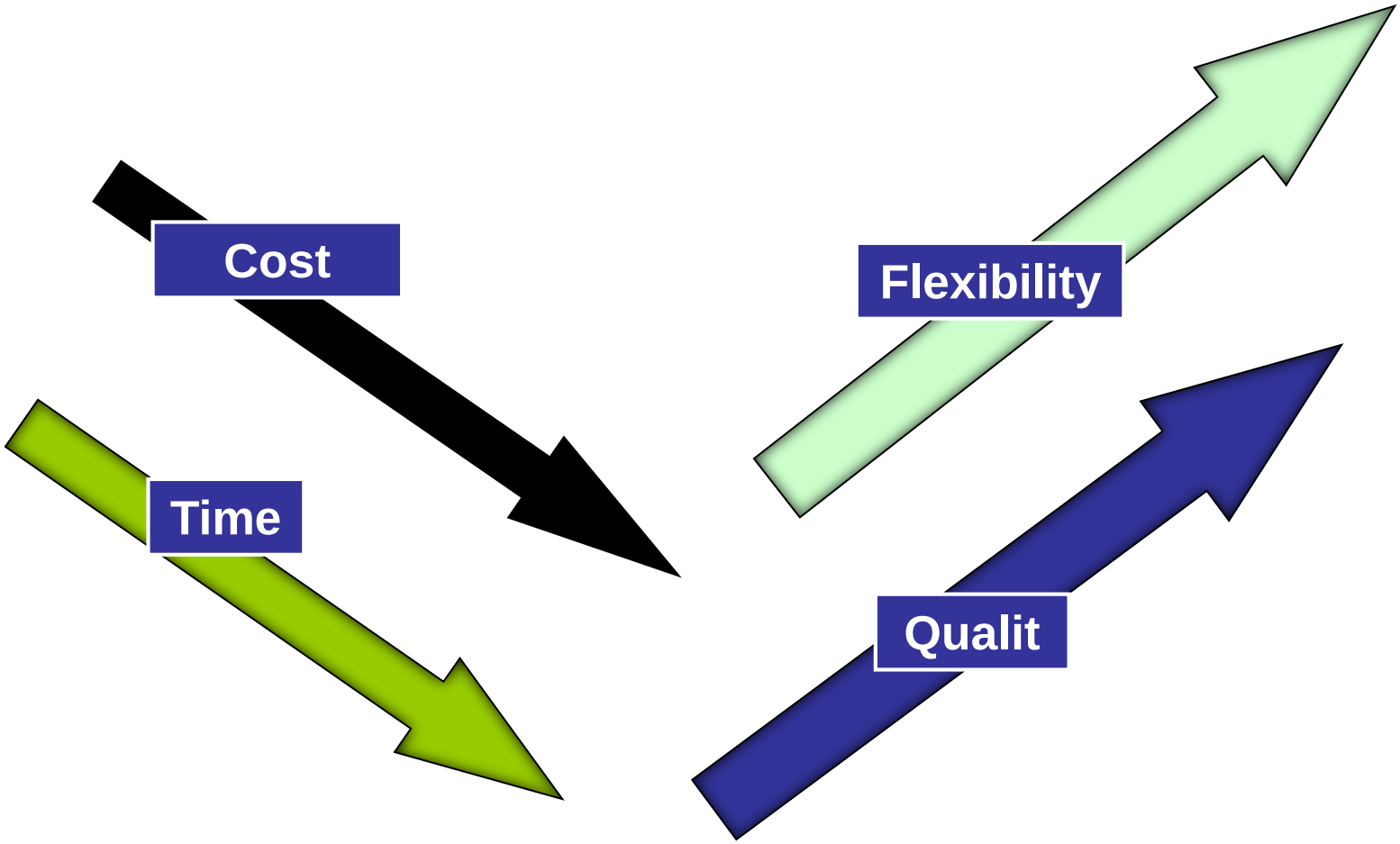
Particullal steps

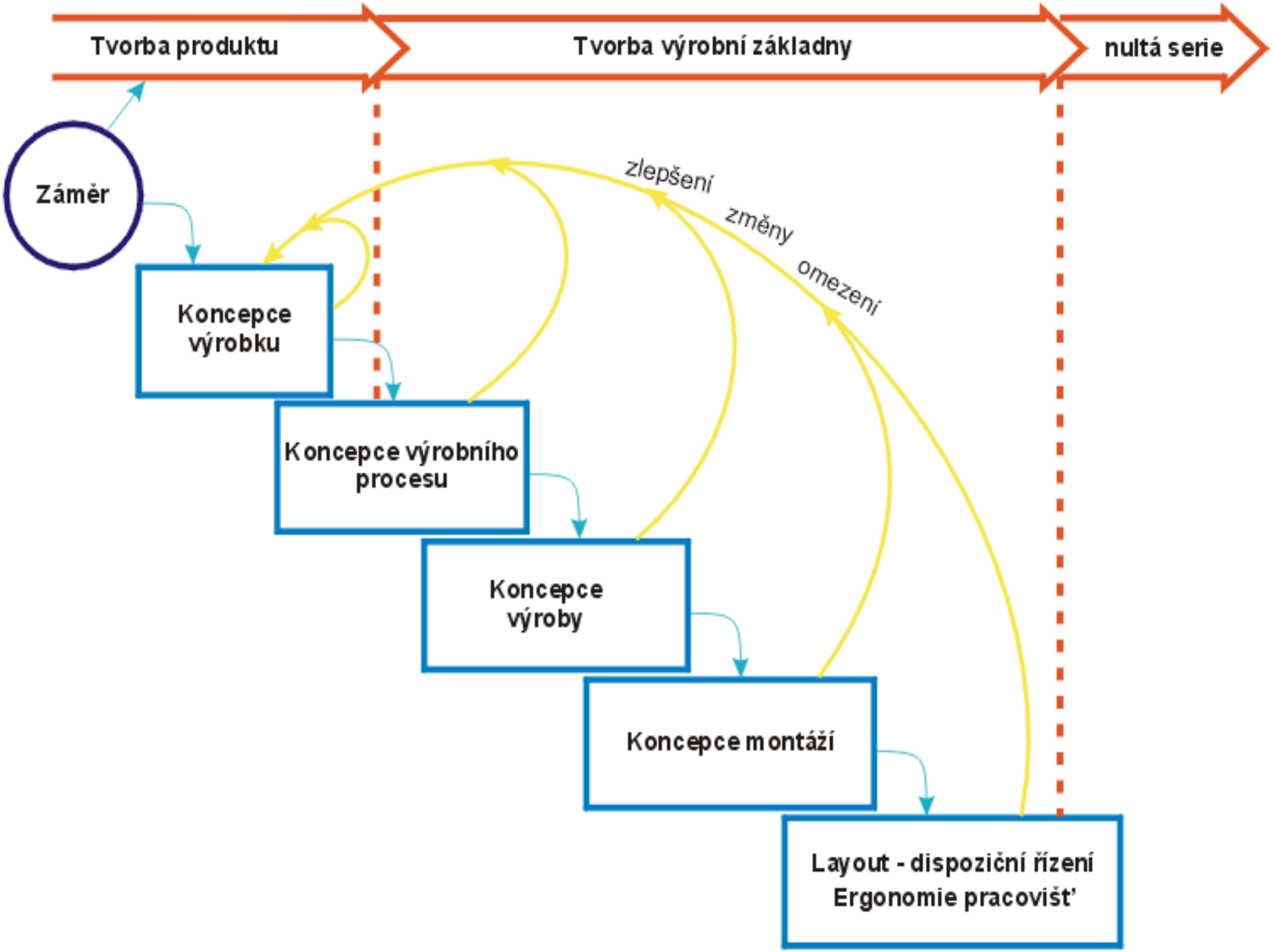


Profit



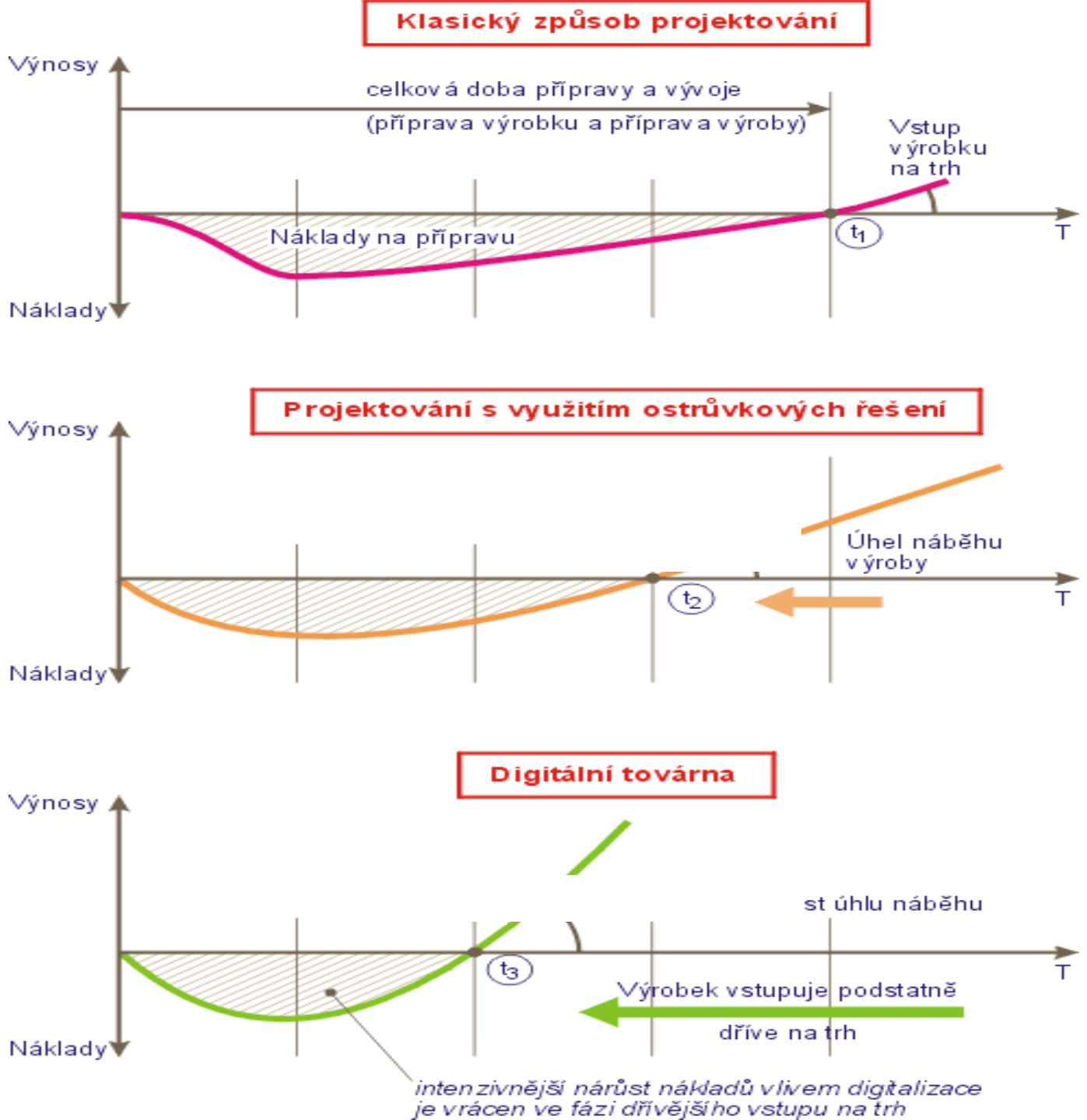
Profit




Tvorba produktu
Tvorba výrobní základny
nultá serie
Záměr
Koncepce výrobku
Koncepce výrobního procesu
Koncepce výroby
Koncepce montáží
Layout - dispoziční řízení
Ergonomie pracovišť
zlepšení
změny
omezení

Time

- Analyzes in the virtual world are faster than in the real world
- Lower demands for routine work
- Significant shortening of the start-up time
- DF facilitates communication during development and production
- DF improves communication with customers and suppliers


Klasický způsob projektování
Výnosy
celková doba přípravy a vývoje
(příprava výrobku a příprava výroby)
Vstup
výrobku
na trh
Náklady na přípravu
t1
T
Náklady
Projektování s využitím ostrůvkových řešení
Výnosy
Úhel náběhu
výroby
t2
T
Náklady
Digitální továrna
Výnosy
st úhlu náběhu
t3
T
Výrobek vstupuje podstatně
dříve na trh
Náklady
intenzivnější nárůst nákladů vlivem digitalizace
je vrácen ve fázi dřívějšího vstupu na trh

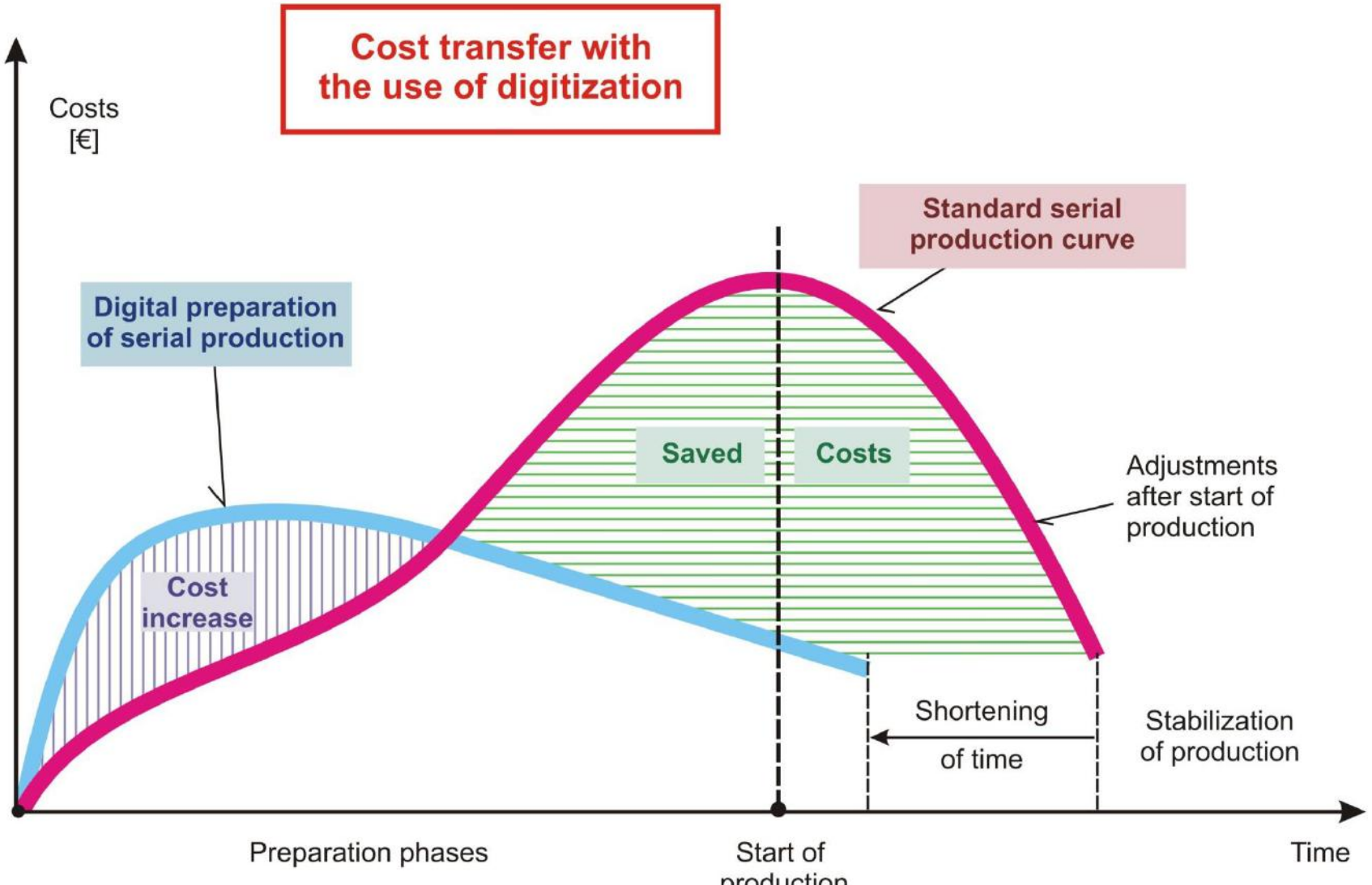
Quality

- Digitization ensures working with the right data
- Duplicates of data that is the source of errors are eliminated
- Improving change management, support processes, maintenance
- Logistics, flow of materials and tools to improve the economy
- Simulation helps to avoid defective goods and reduces error rates

Cost

- Product development optimization and production planning
- Reducing the amount of defective goods is a cost reduction
- Cost reduction by prototyping (using virtual models - mock-ups)
- By simulating in a virtual environment, it is possible to verify the efficiency of machines without having to buy them
- Revealing errors at the analysis stage, which means cost savings

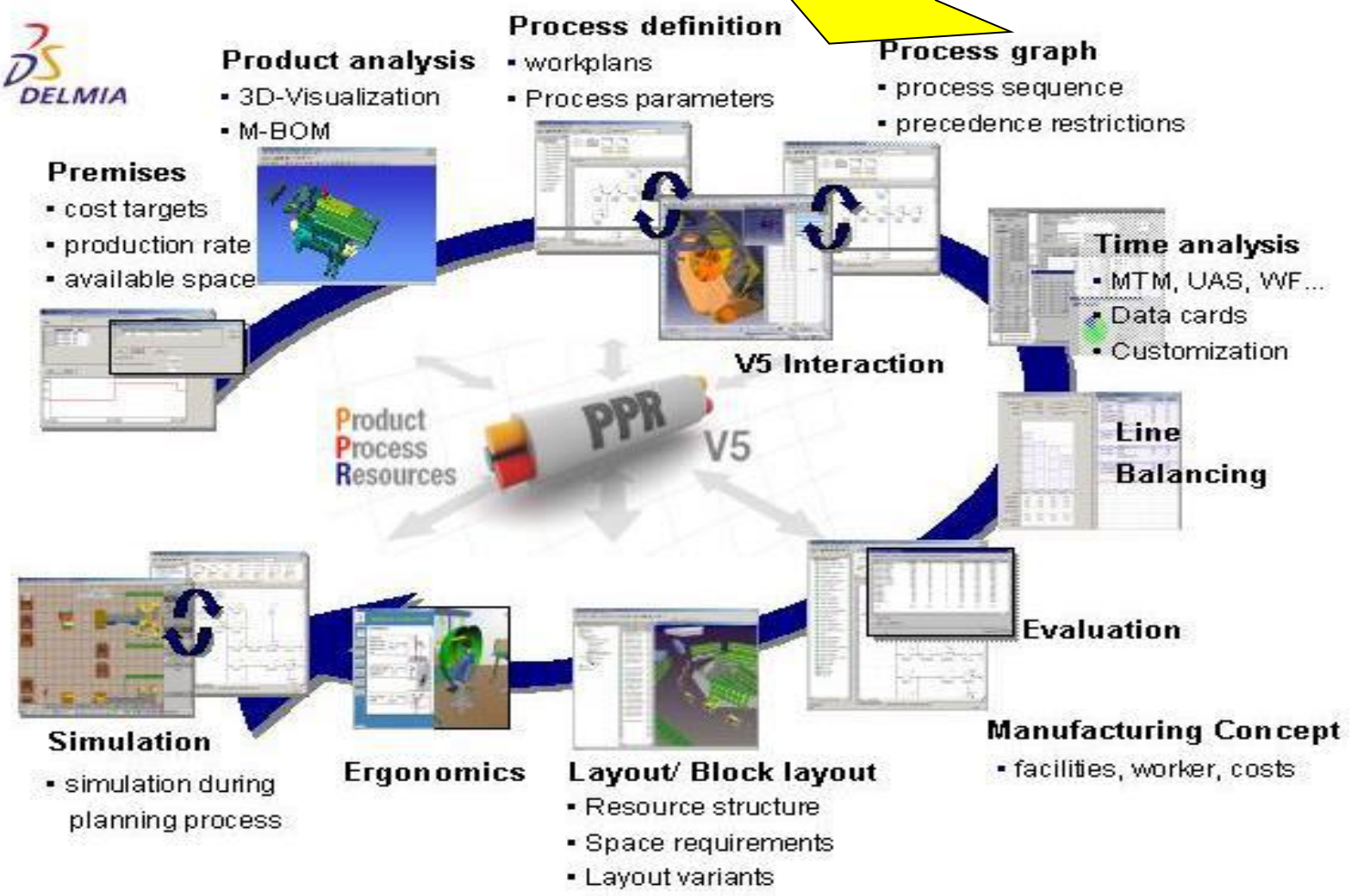
Basic scheme



Flexibility

- Rapid shortening of the preparatory phases
- Start production can begin earlier, because all the analyzes were performed in a virtual environment
- Faster achievement of expected production
- Digitization allows the preparatory phases:
  - Higher variability
  - Introduction of modularity principles
  - Higher versatility of production systems

PPR -


DELMIA
Product analysis
• 3D-Visualization
• M-BOM
Process definition
• workplans
• Process parameters
Process graph
• process sequence
• precedence restrictions
Premises
• cost targets
• production rate
• available space
V5 Interaction
Time analysis
• MTM, UAS, WF...
• Data cards
• Customization
Product
Process
Resources
PPR
V5
Line
Balancing
Evaluation
Manufacturing Concept
• facilities, worker, costs
Simulation
• simulation during planning process
Ergonomics
Layout/ Block layout
• Resource structure
• Space requirements
• Layout variants

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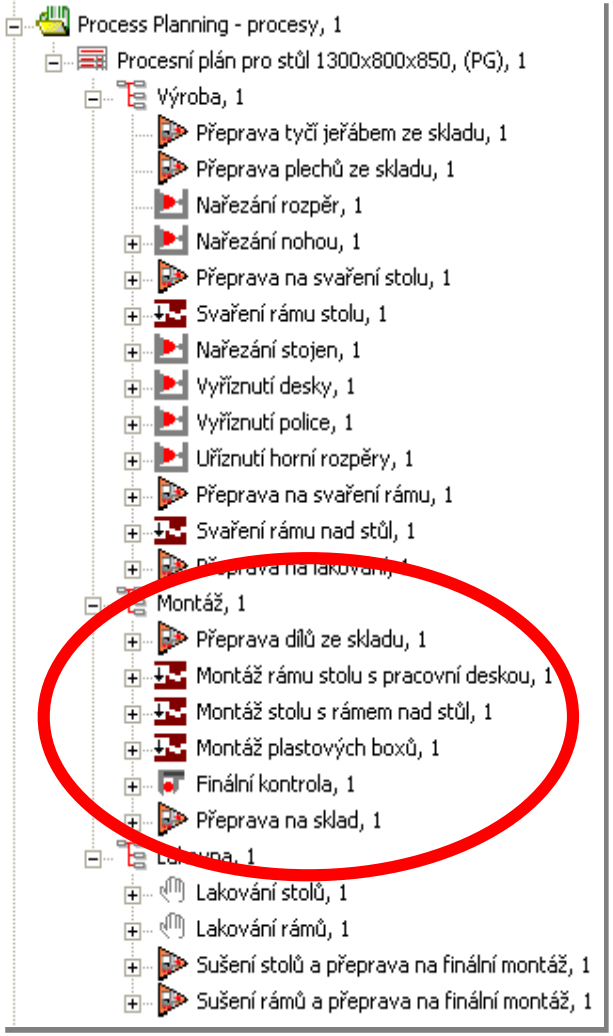
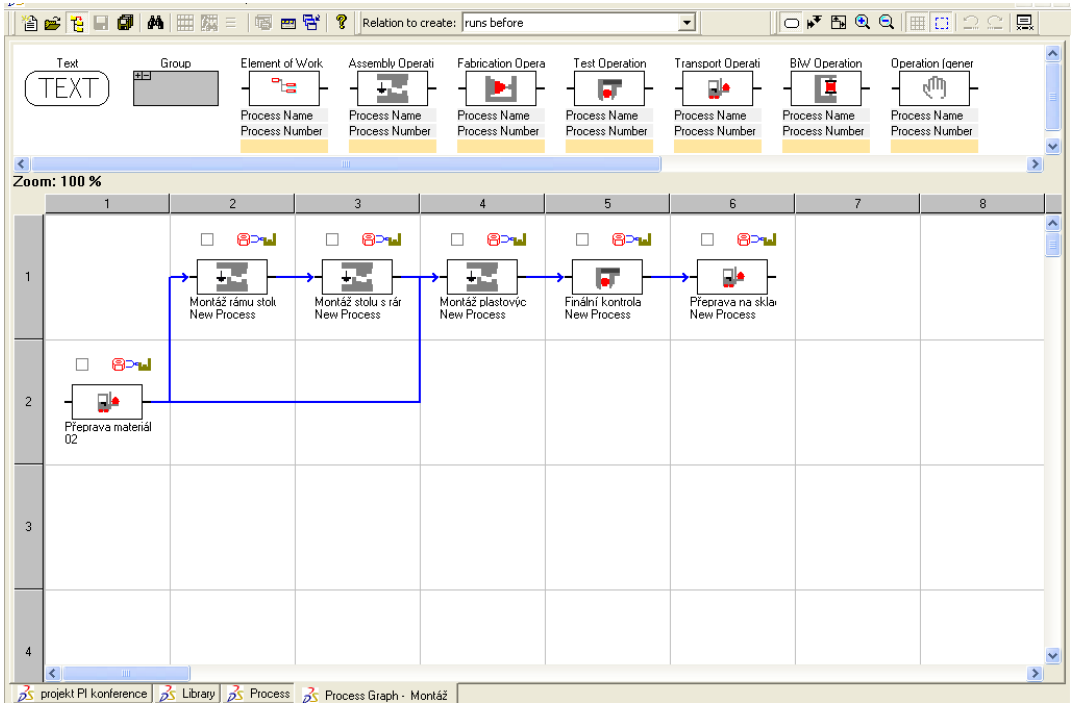
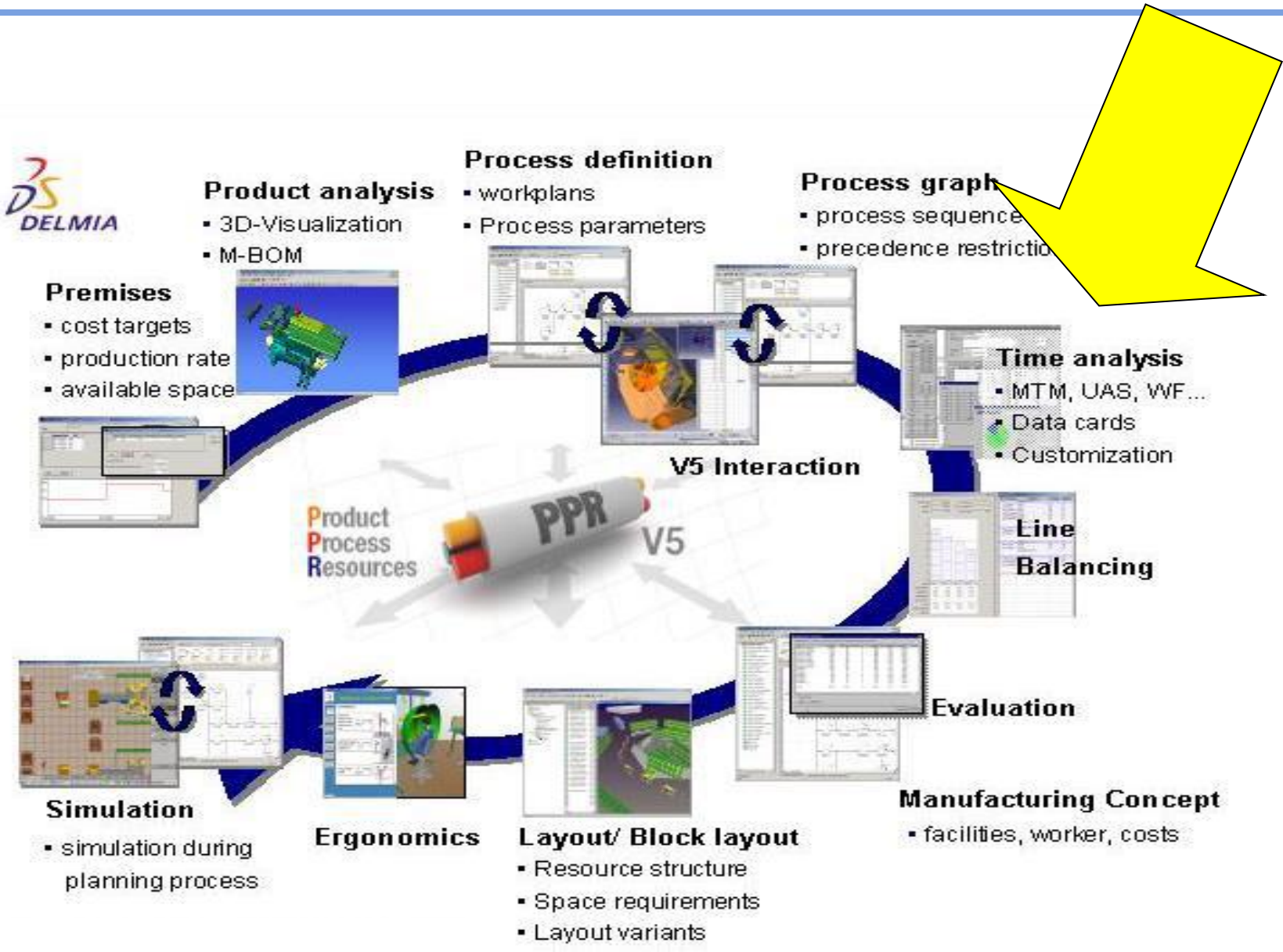
Processes





PPR - Hub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Time analysis - MTM

Datacard - MTM2

MTM-2

Get

Contact only	GA
Single grasping movement	GB
More than one grasping movement	GC
Weight allowance	GW-

Place

Approximately	PA
Loose	PB
Tight	PC
Weight allowance	PW-

Manual movement

Pressure	A
Regrasp	R
Eye travel	E
Rotate crank	C
Step	S-
Foot movement	F
Stoop, Arise	B
Process time	PTU / PTB

Method Level: MTM-2 | Time Type: T** | Description: operace 1 | Analyzed Times: tmu | Basic Times: tmu

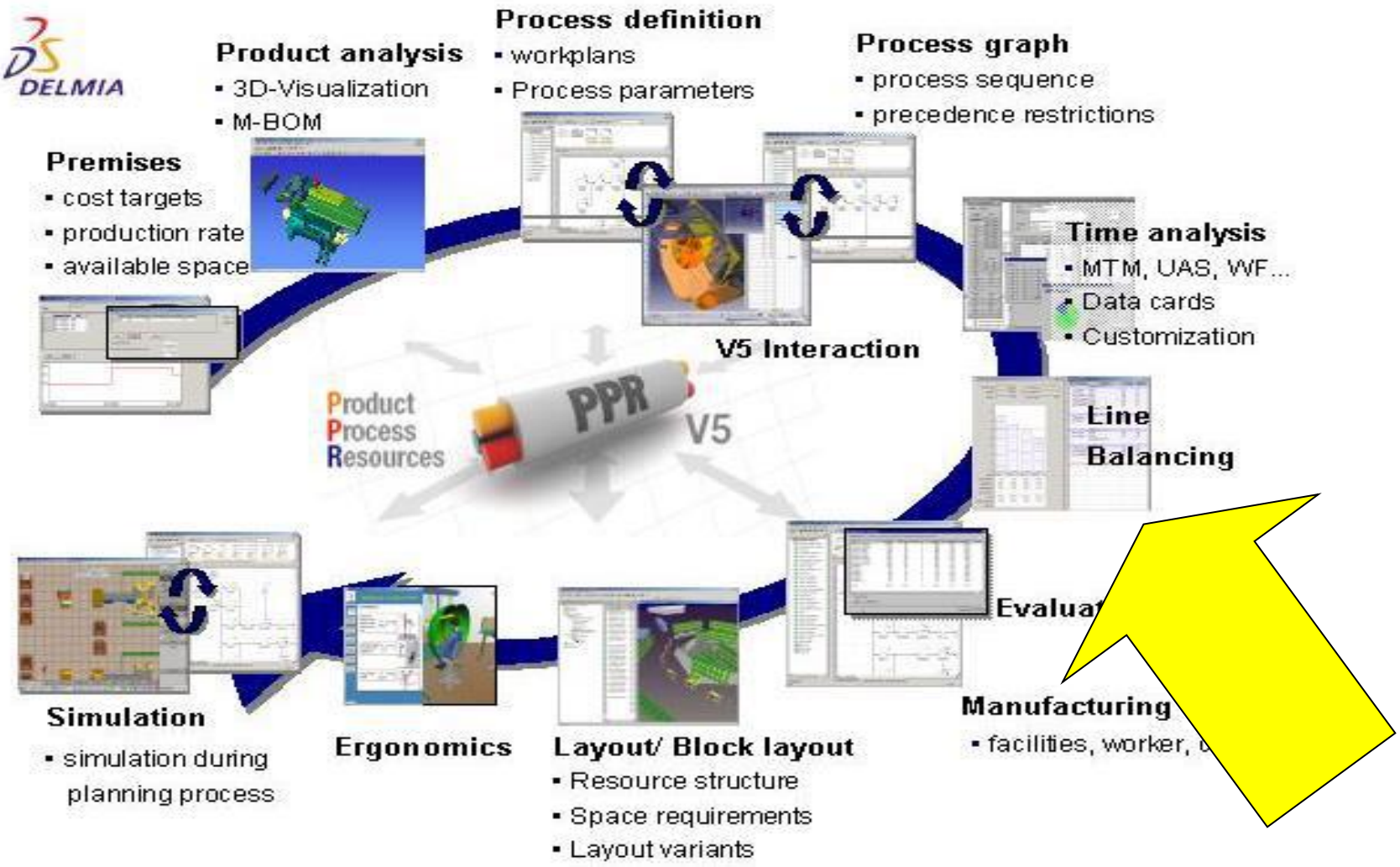
Number of Parts: 1 | Parts Simultaneously: 1 | Analyzed Time: 823,00 tmu

TTB 823,00 tmu | TTU 0,00 tmu | TW 0,00 tmu | TG 823,00 tmu | TRG 0,00 tmu

Analysis Lines | Basic Data | Long Text

	Description	Frequency	M	Code L.H.	Time (tmu)	Setup Time (tmu)	Code R.H.	M	Frequen	
23	Regrasp	1		R	6,00		R		1	
25					21,00		PC5		1	
27	Place	1		PA5	3,00					
29	Get	1		GB30	14,00					
31	Place	1		PC30	30,00					
33	Get	1		GC30	23,00					
35	Place	1		PA30	11,00					
37	Regrasp	1		R	6,00		R		1	Regrasp
39					21,00		PC5		1	Place
41	Place	1		PA5	3,00					
43	Get	1		GB30	14,00					
45	Place	1		PC30	30,00					
47	Get	1		GC30	23,00					
49	Place	1		PA30	11,00					
51	Regrasp	1		R	6,00		R		1	Regrasp
53					21,00		PC5		1	Place
55	Place	1		PA5	3,00					
57	Get	1		GB30	14,00					
59	Place	1		PC30	30,00					
61	Get	1		GC30	23,00					
63	Place	1		PA30	11,00					
65	Regrasp	1		R	6,00		R		1	Regrasp
67					21,00		PC5		1	Place
69	Place	1		PA5	3,00					
71	Get	1		GB30	14,00					
73	Place	1		PC30	30,00					
75	Get	1		GC30	23,00					
77	Place	1		PA30	11,00					
79	Regrasp	1		R	6,00		R		1	Regrasp
81					21,00		PC5		1	Place
83	Place	1		PA5	3,00					
85	Get	1		GB30	14,00					

PPR - Hub


DELMIA
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• cost targets
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Time analysis
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• facilities, worker,
Simulation
• simulation during
planning process
Ergonomics
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• Layout variants

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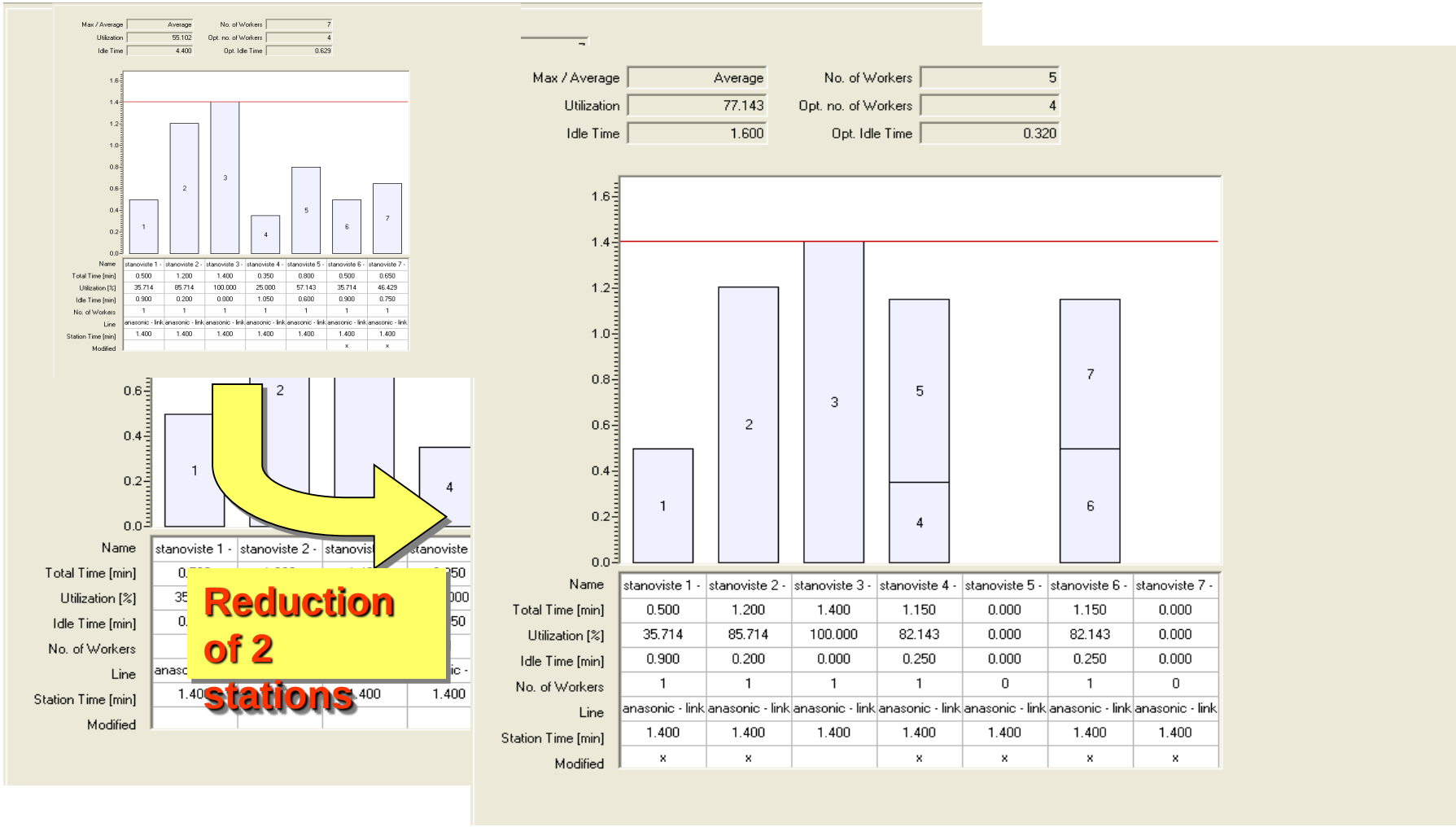
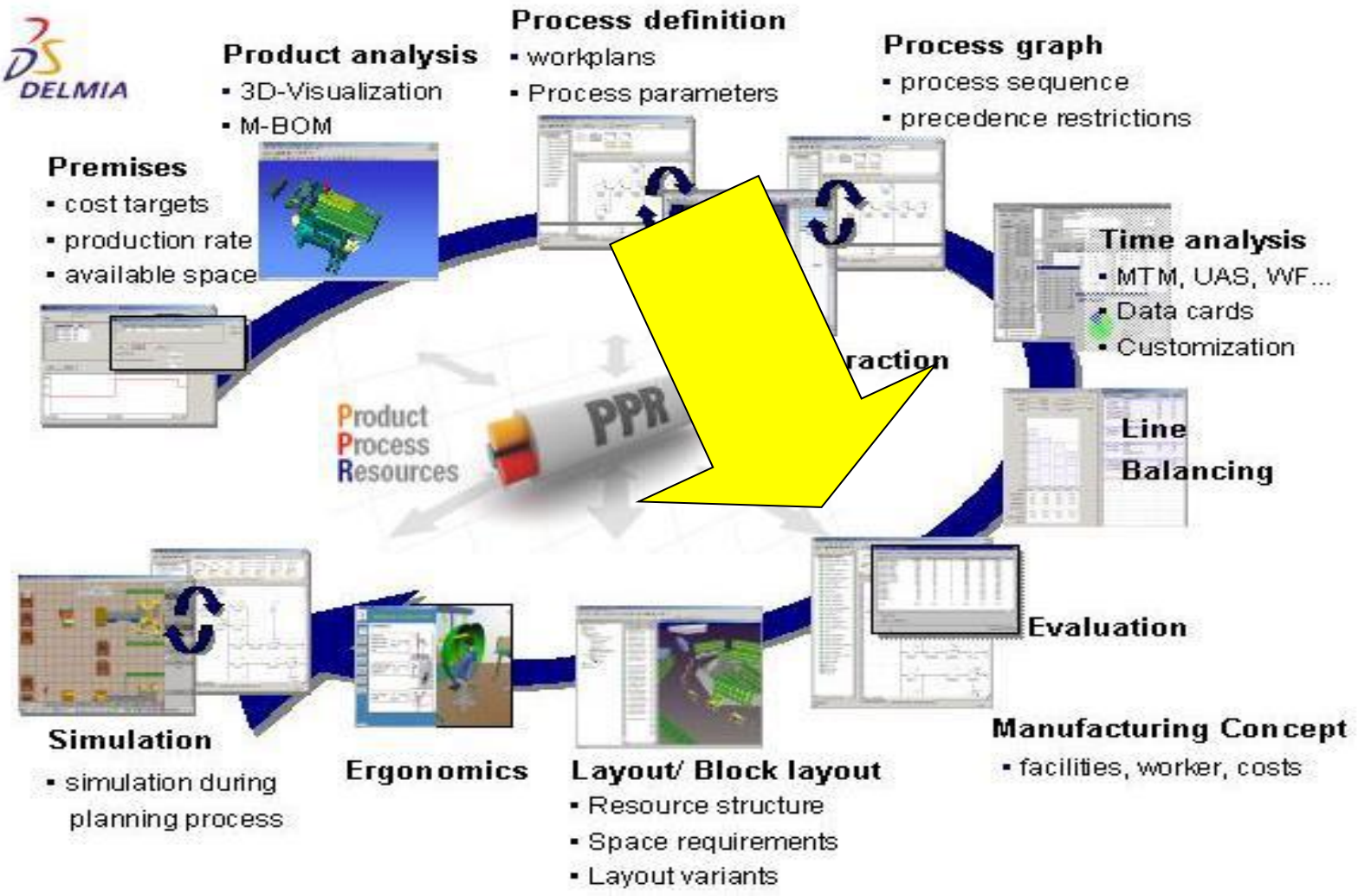
Line balancing



Max / Average	Average
Utilization	77.143
Idle Time	1.600
No. of Workers	5
Opt. no. of Workers	4
Opt. Idle Time	0.320

Name	stanoviste 1 -	stanoviste 2 -	stanoviste 3 -	stanoviste 4 -	stanoviste 5 -	stanoviste 6 -	stanoviste 7 -
Total Time [min]	0.500	1.200	1.400	1.150	0.000	1.150	0.000
Utilization [%]	35.714	85.714	100.000	82.143	0.000	82.143	0.000
Idle Time [min]	0.900	0.200	0.000	0.250	0.000	0.250	0.000
No. of Workers	1	1	1	1	0	1	0
Line	anasonic - link	anasonic - link	anasonic - link	anasonic - link	anasonic - link	anasonic - link	anasonic - link
Station Time [min]	1.400	1.400	1.400	1.400	1.400	1.400	1.400
Modified	x	x		x	x	x	x

PPR - Hub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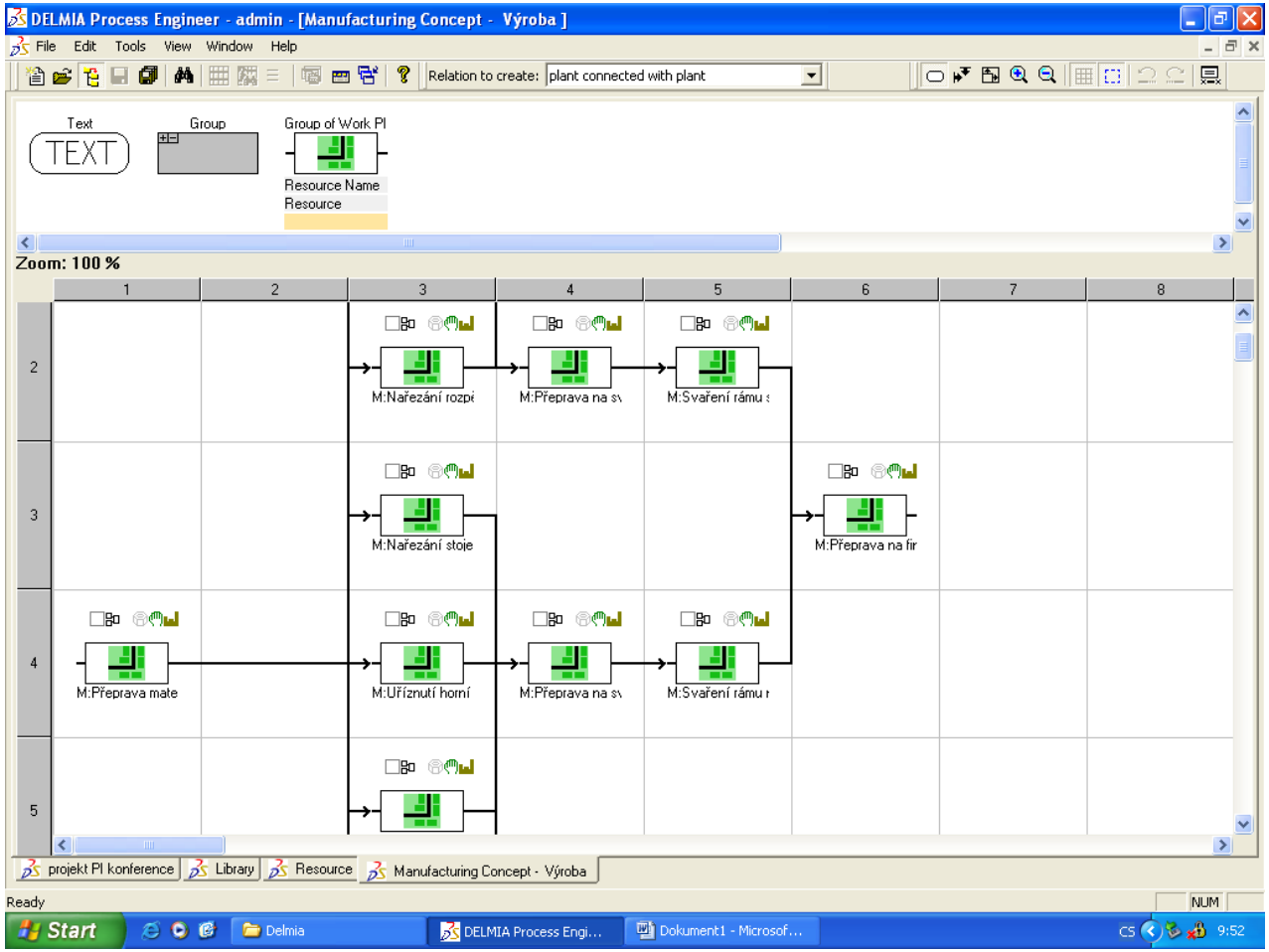
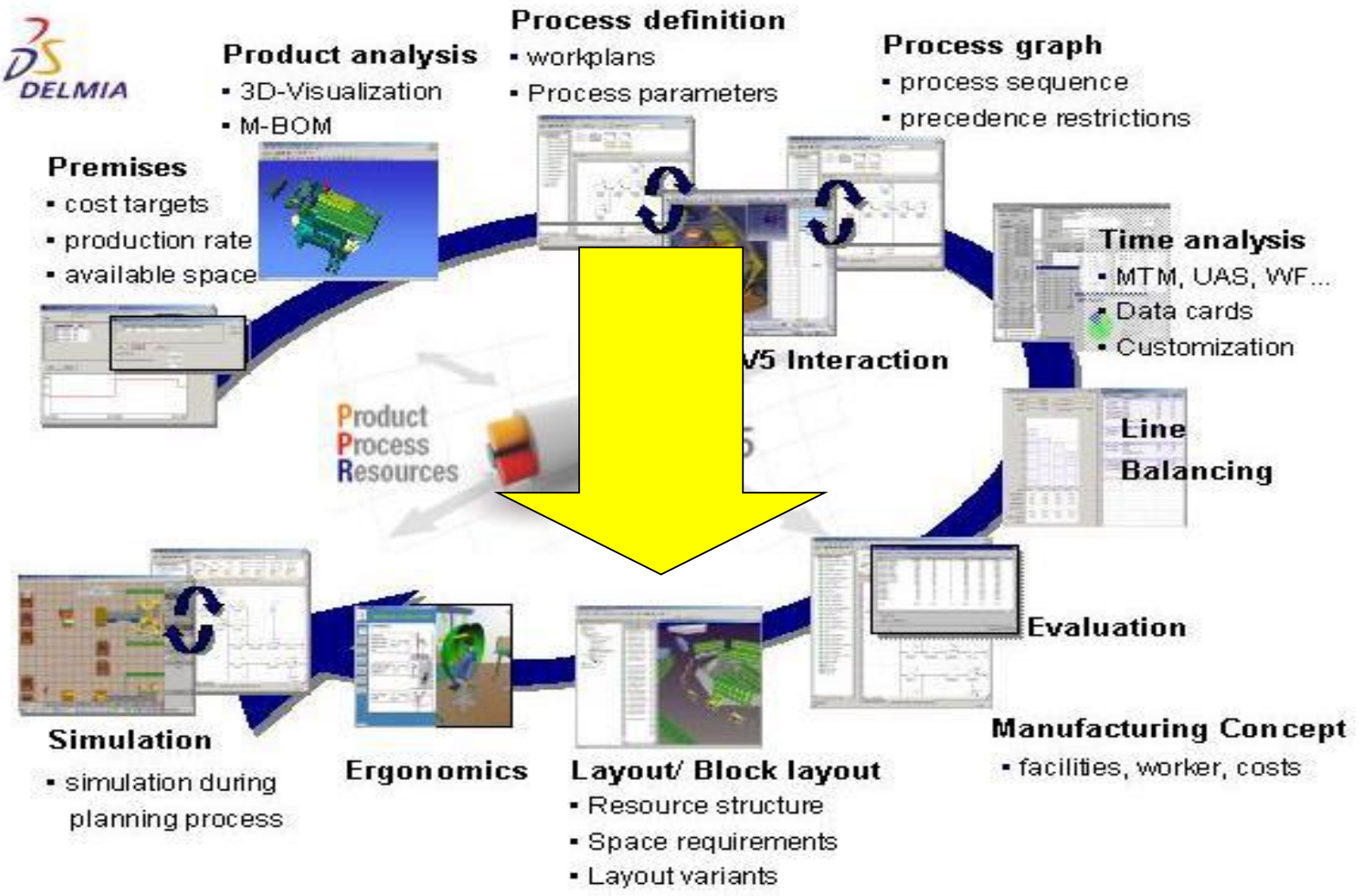
Manufacturing concept



PPR - Hub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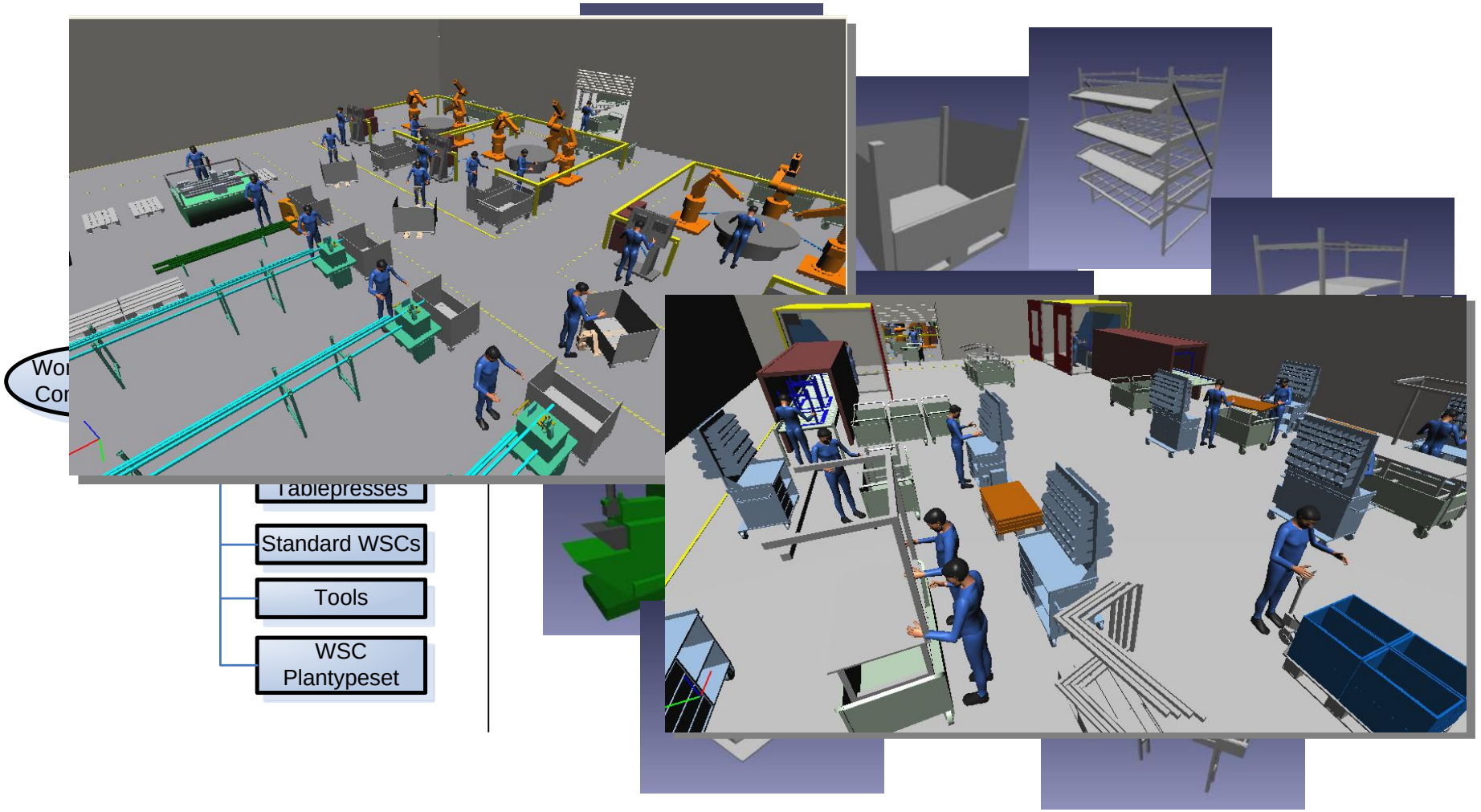
Resource library



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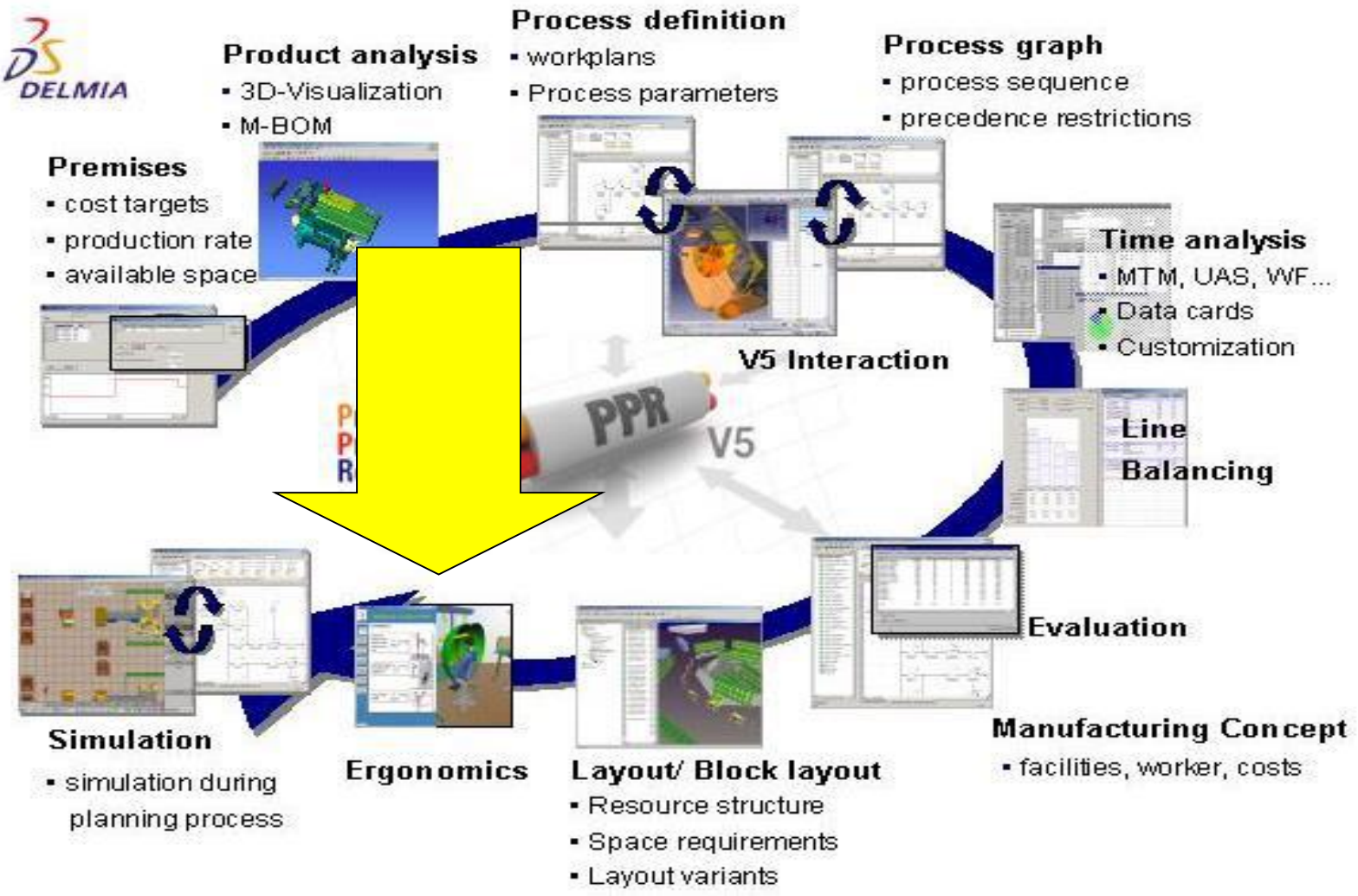
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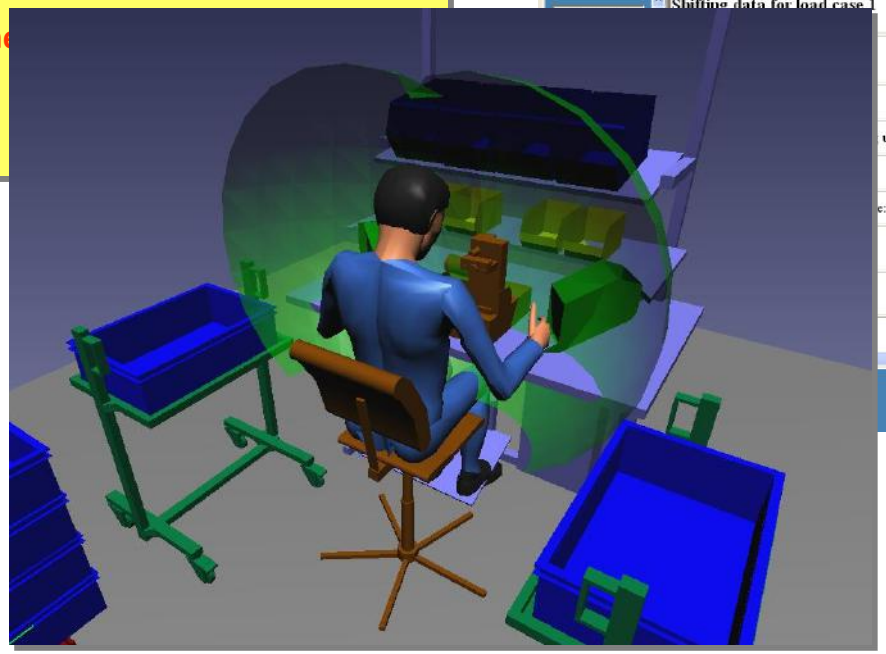
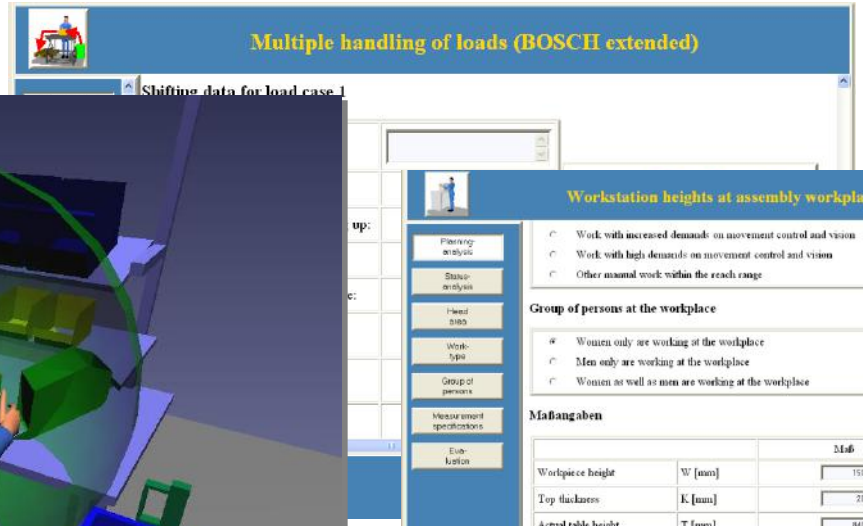
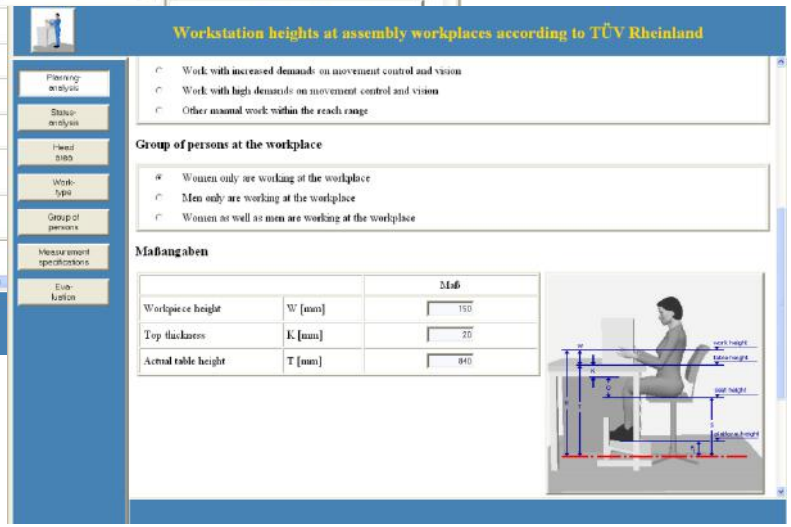
Ergonomics

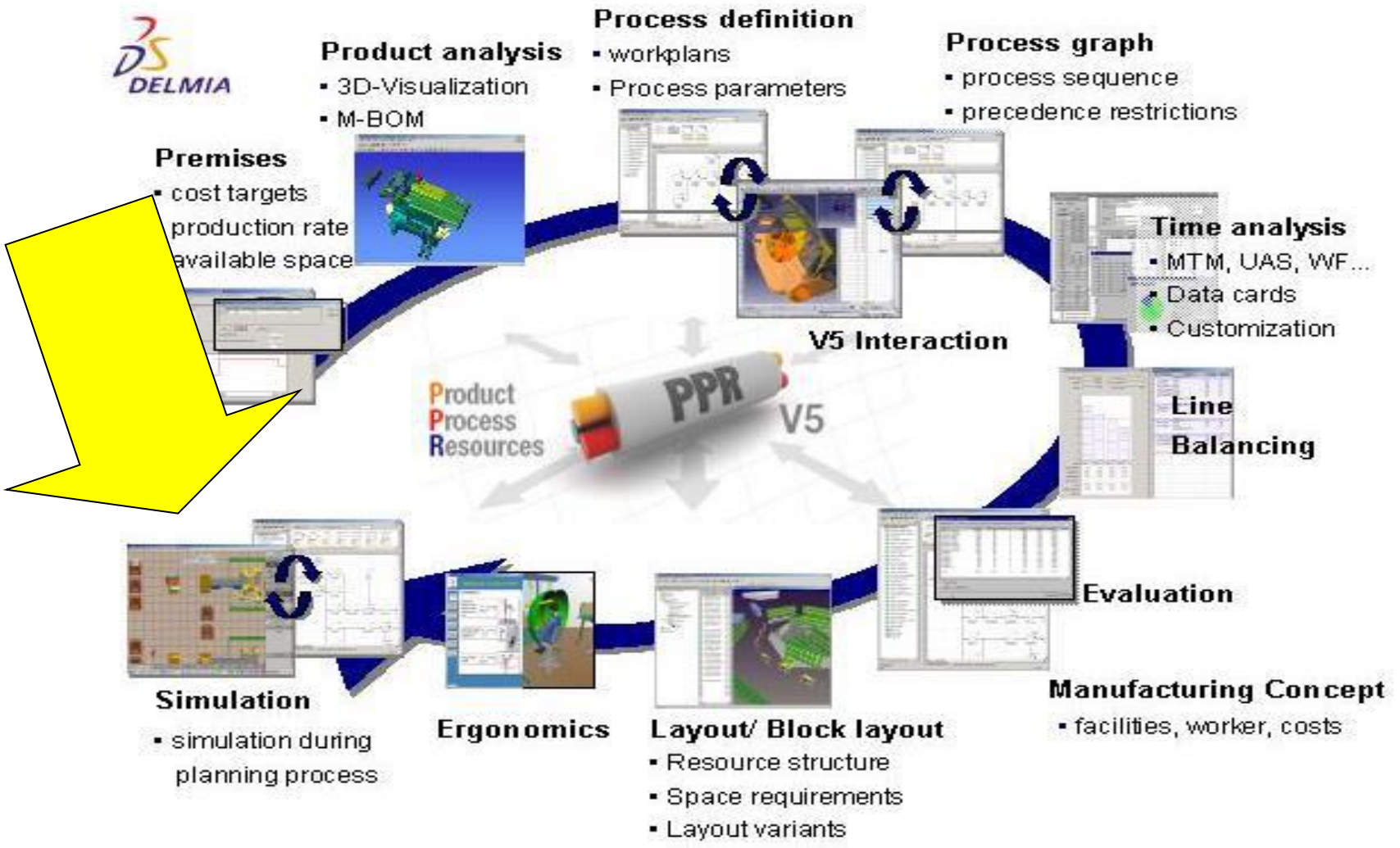
- **Calculation analyses**
  - Workstation dimensions
  - Handling of loads
  - Muscle loads
- **Che**







PPR - Hub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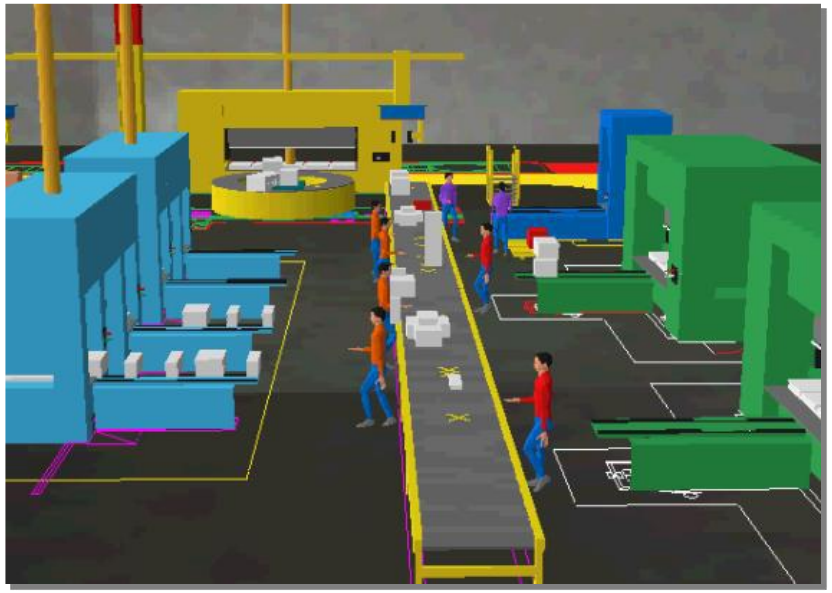
Simulation

Simulation module



Our virtual company

Process simulation

Robotics and simulation

Assembly

MTM analysis

Ergonomics study

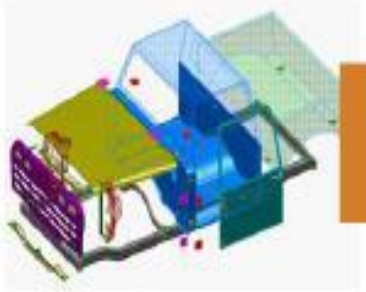
Costs

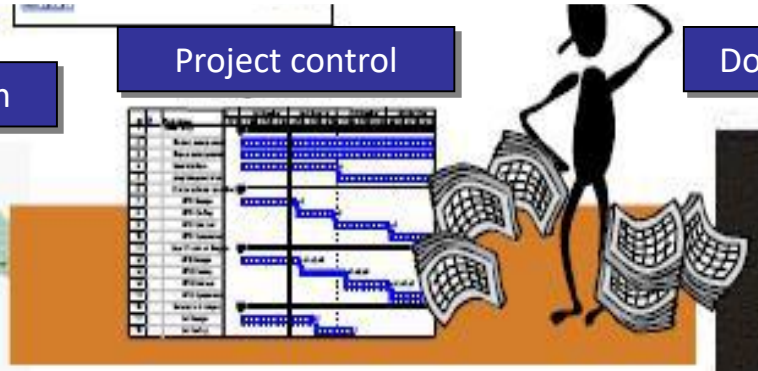
Logistics

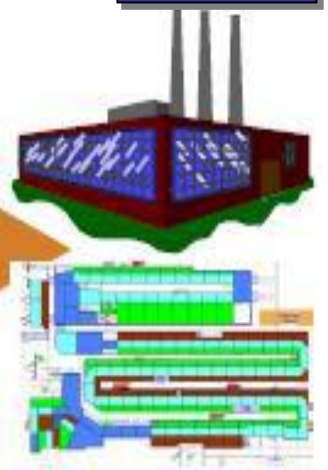
Products information

Project control

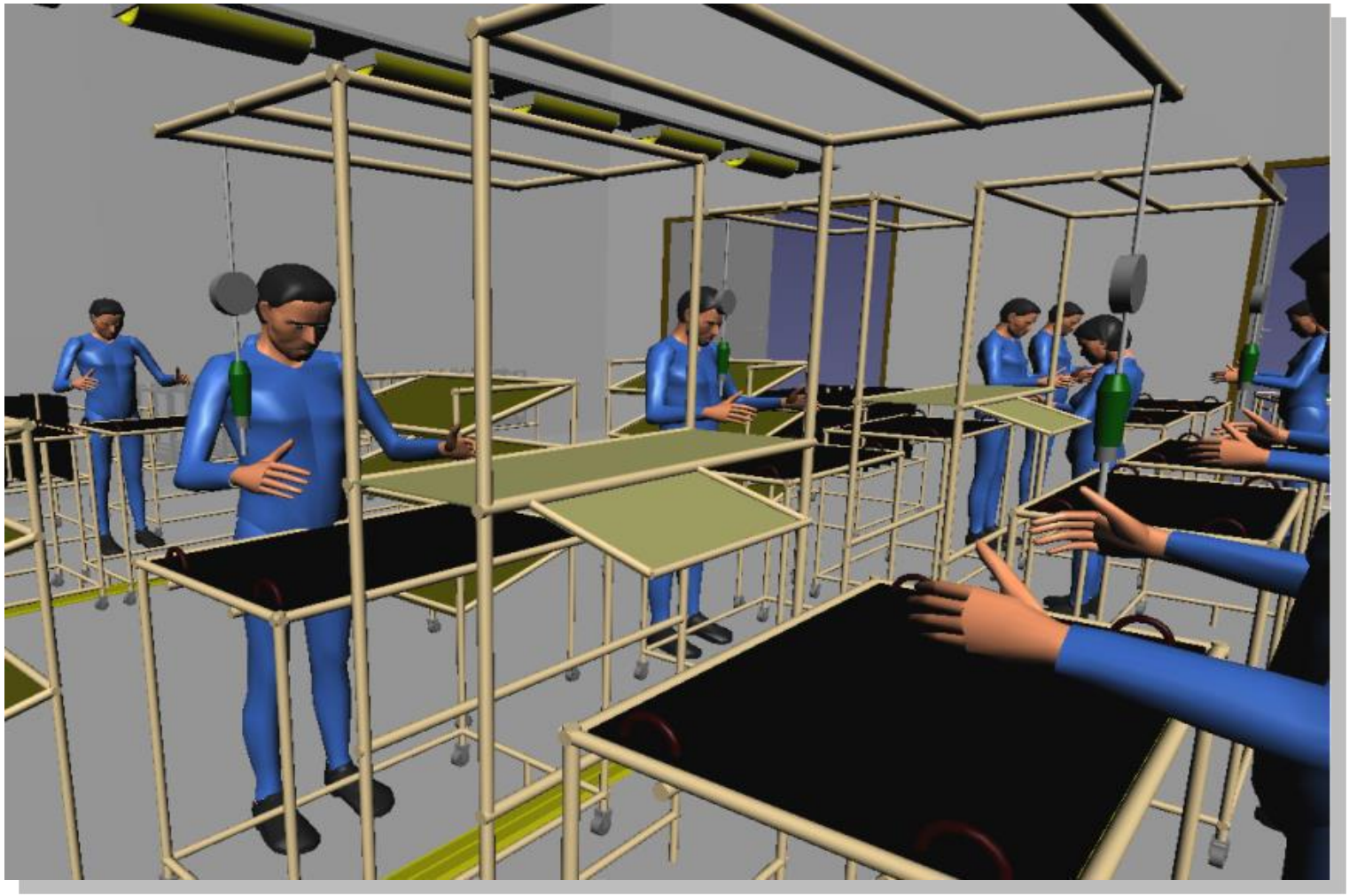
Documentation



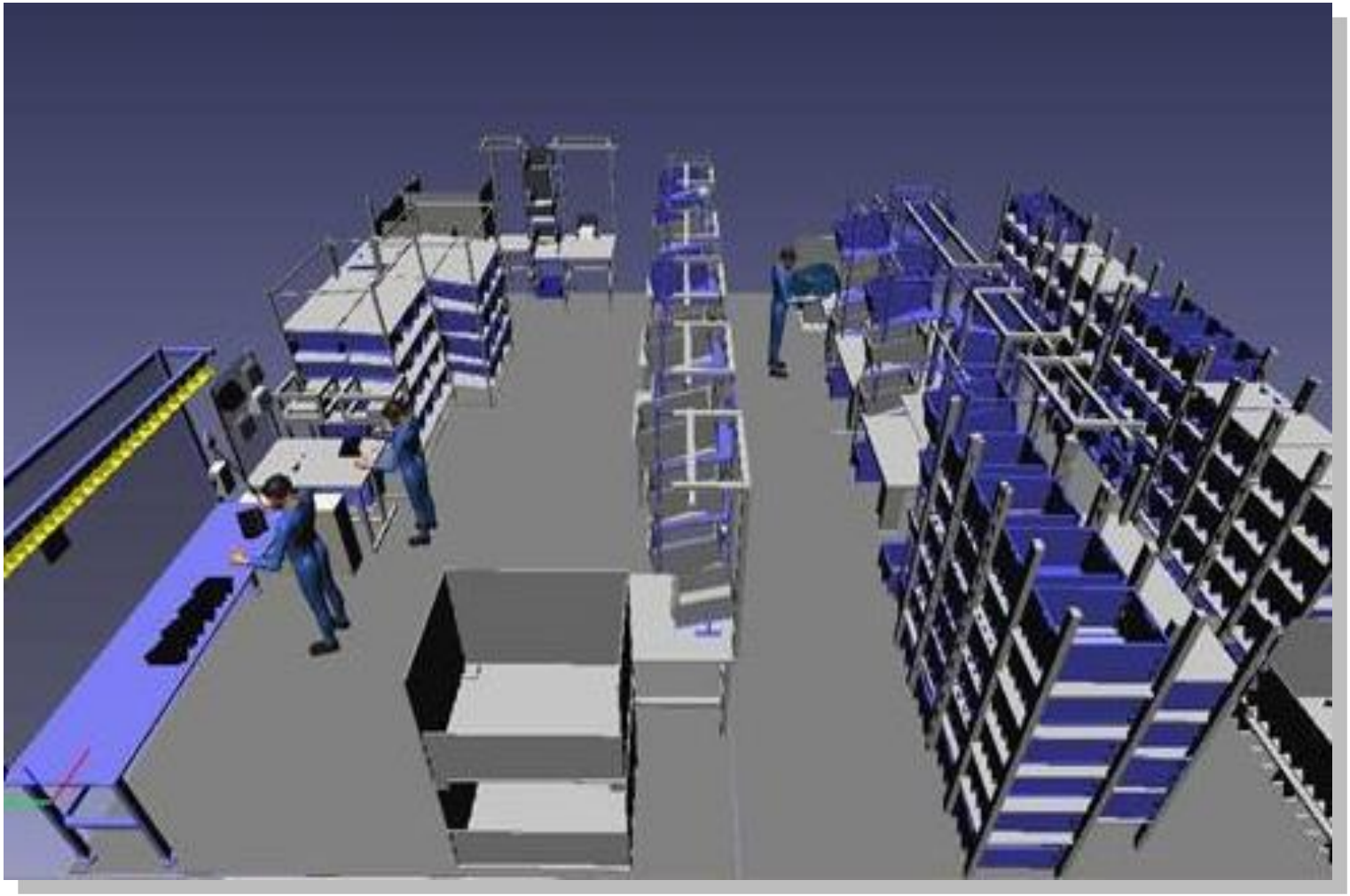




Layout



Layout



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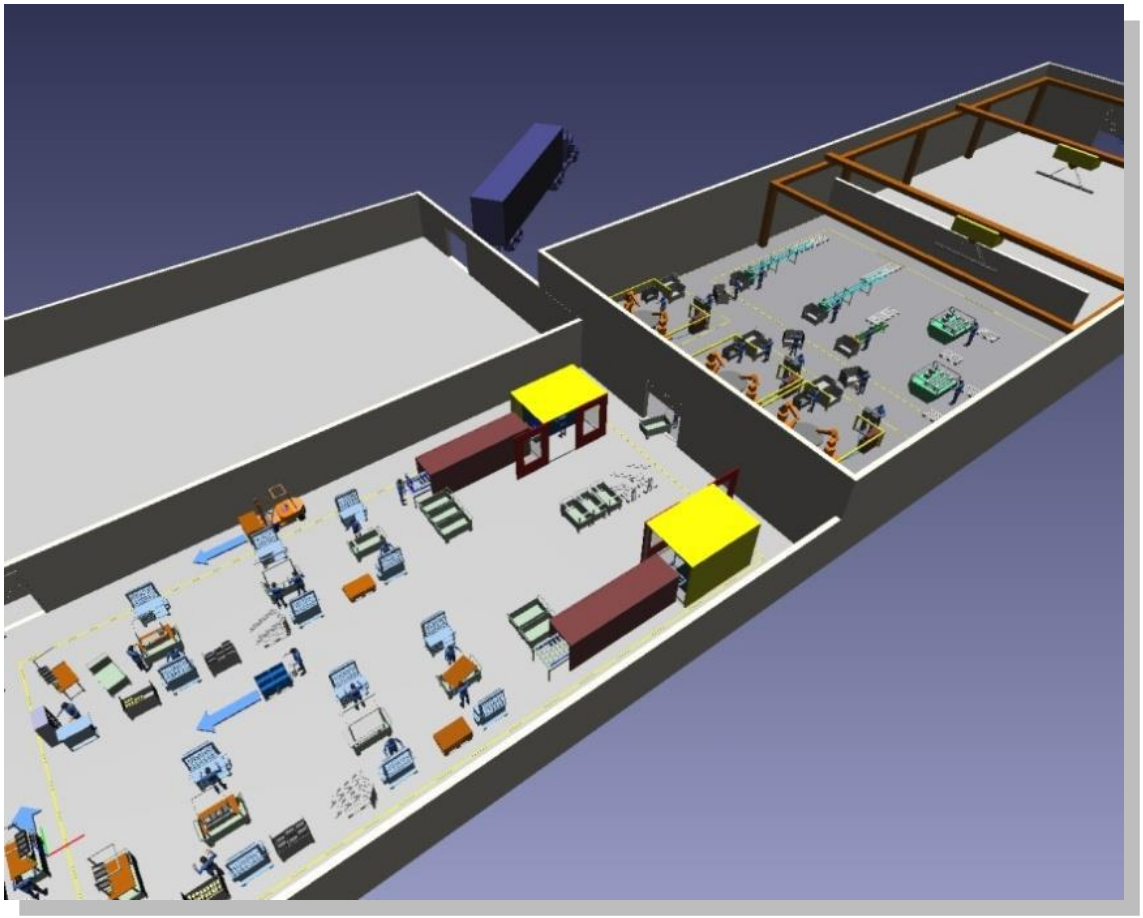

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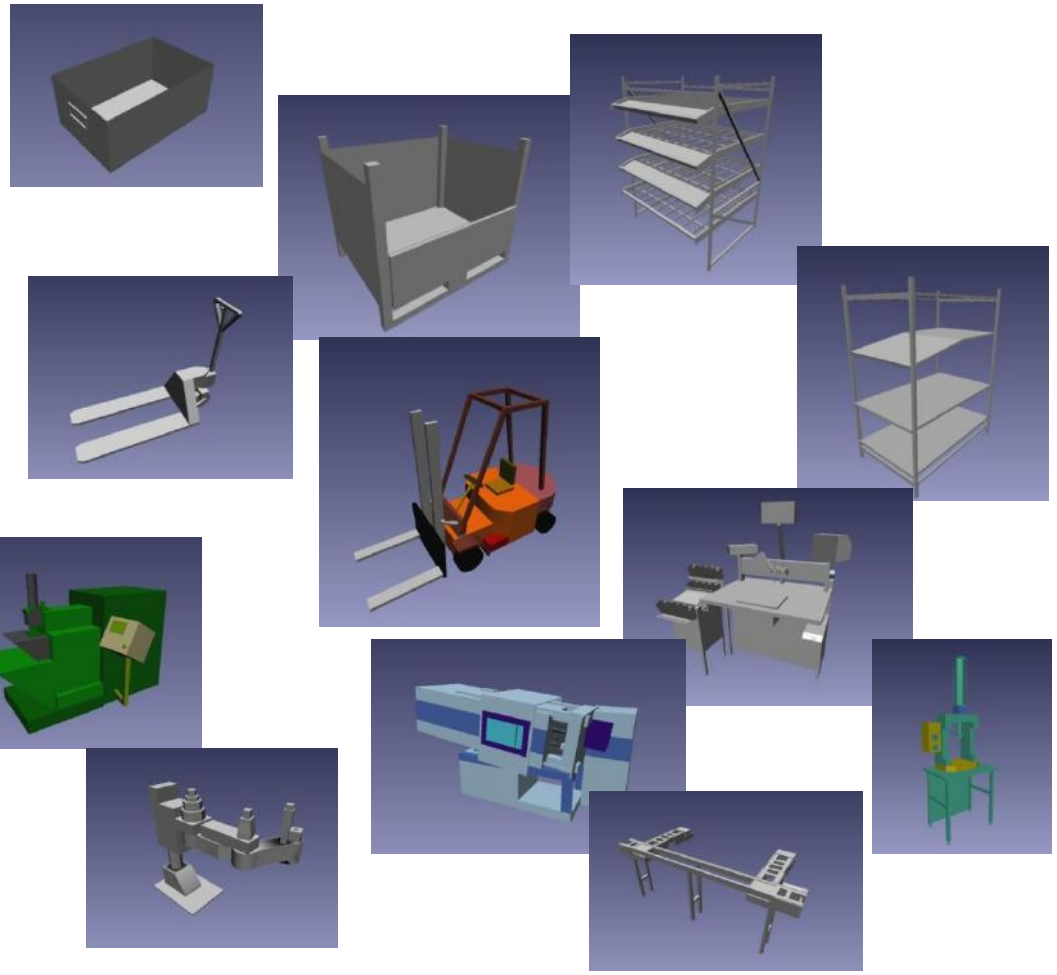
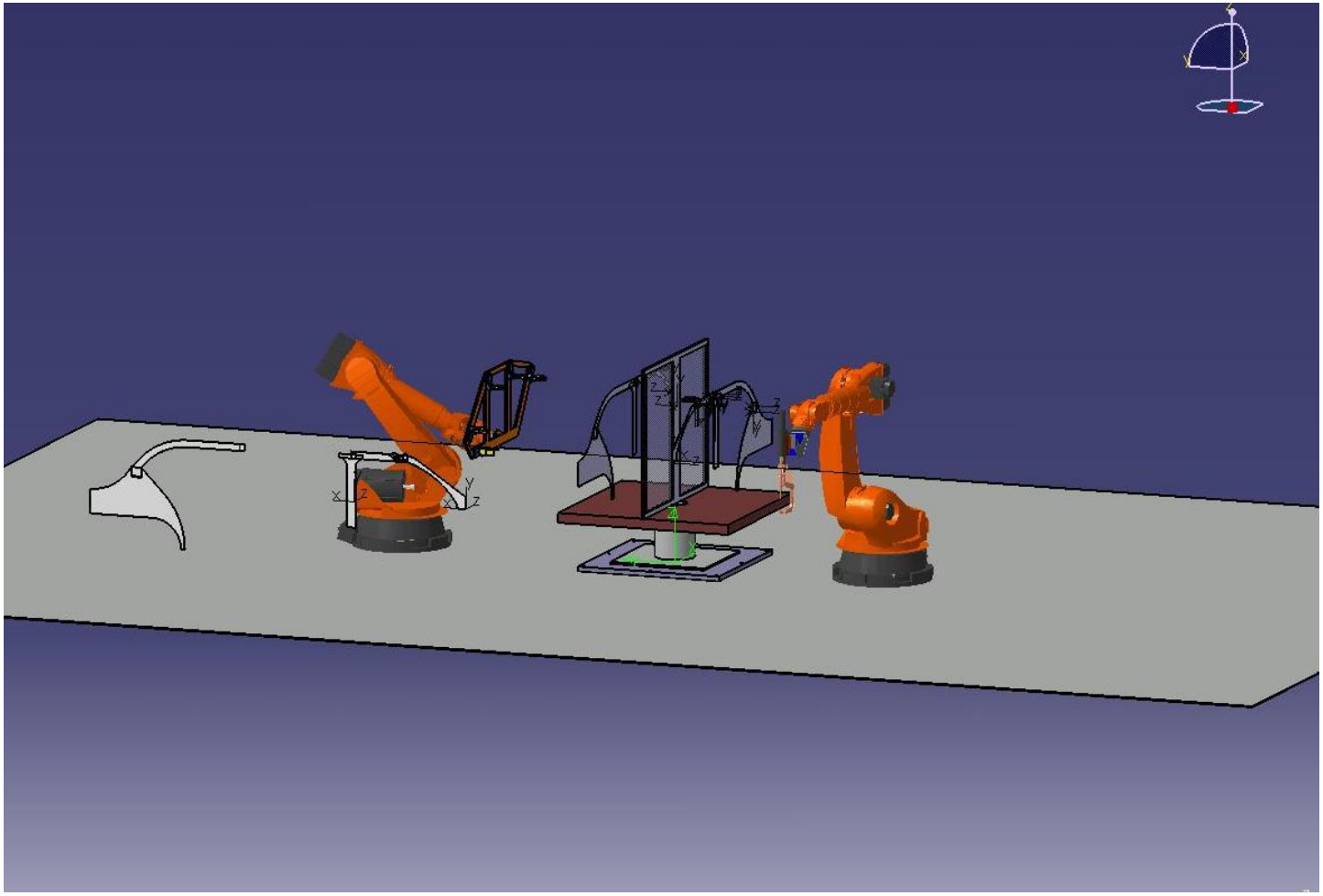
Library of graphical components

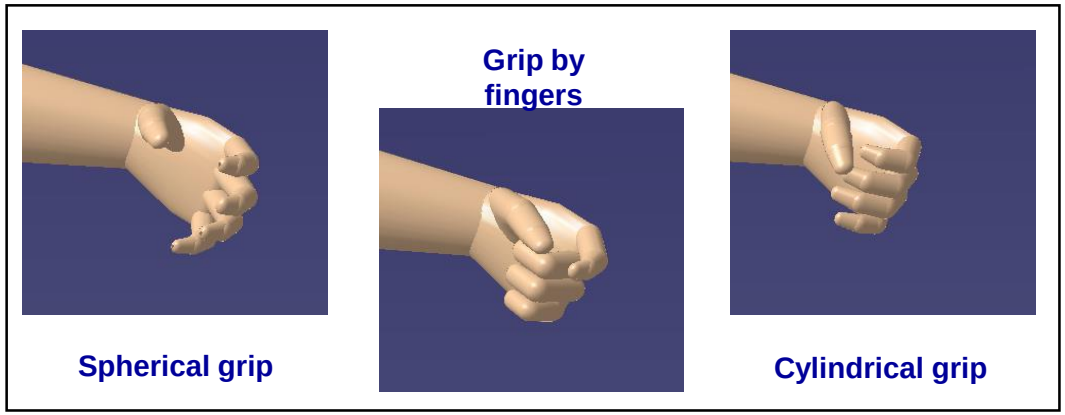
- Work System Components
  - Electrical Installation Components
  - Fixtures
  - MBC Profiles
  - Machines
  - Partsbins
  - Pivot Chairs
  - Pneumatic Tablepresses
  - Standard WSCs
  - Tools
  - WSC Plantypeset



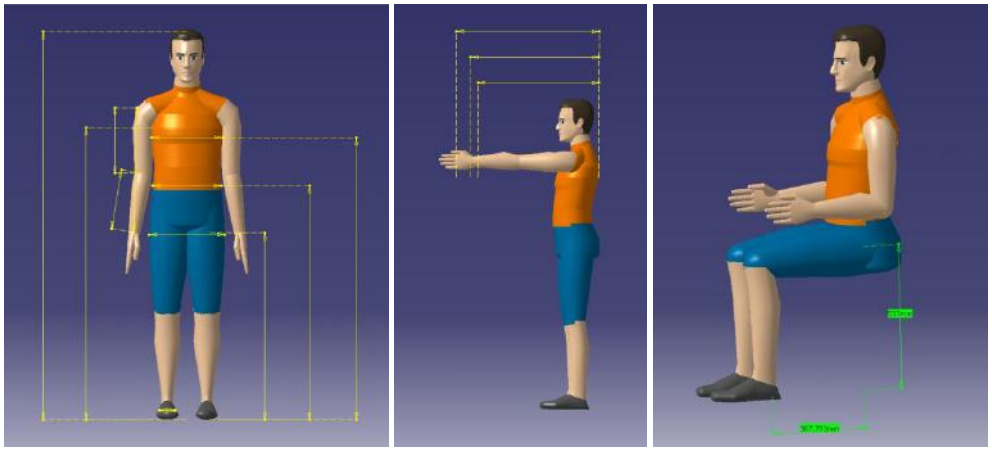
Robotics



Ergonomics

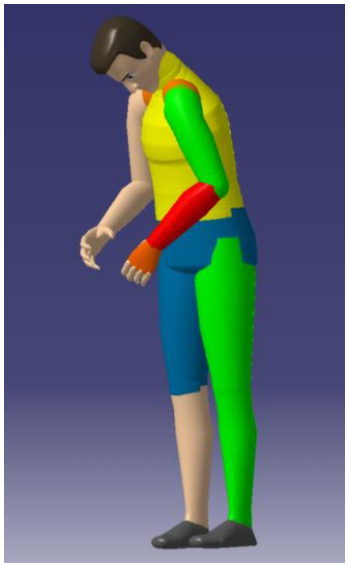


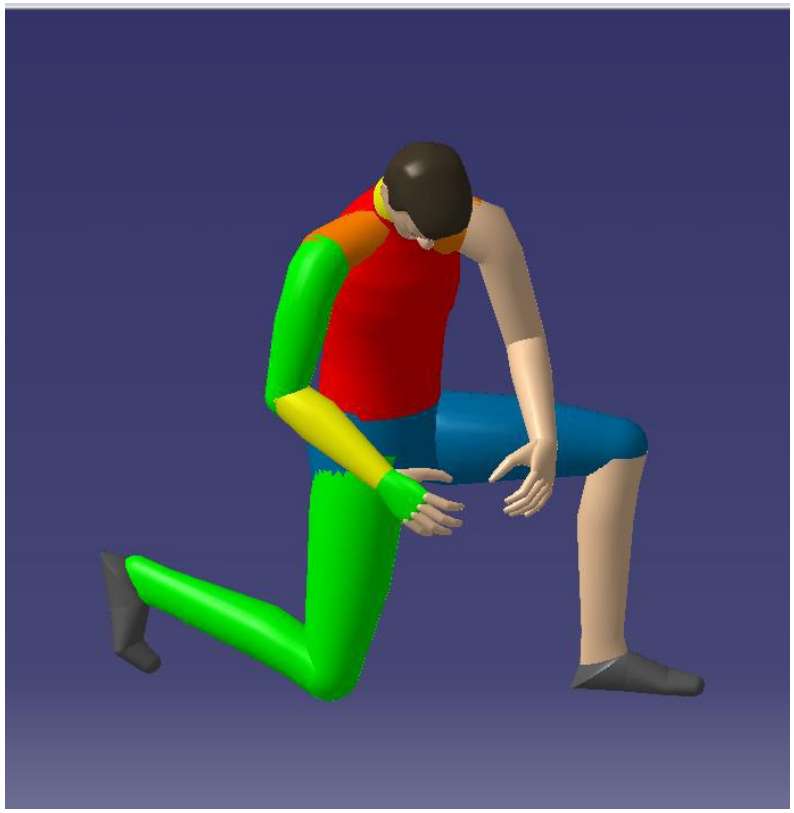
Digital model of people has many anthropometric dimension



Ergonomics

Color identification overloaded area of body in various position





Simulation

Examples of DF

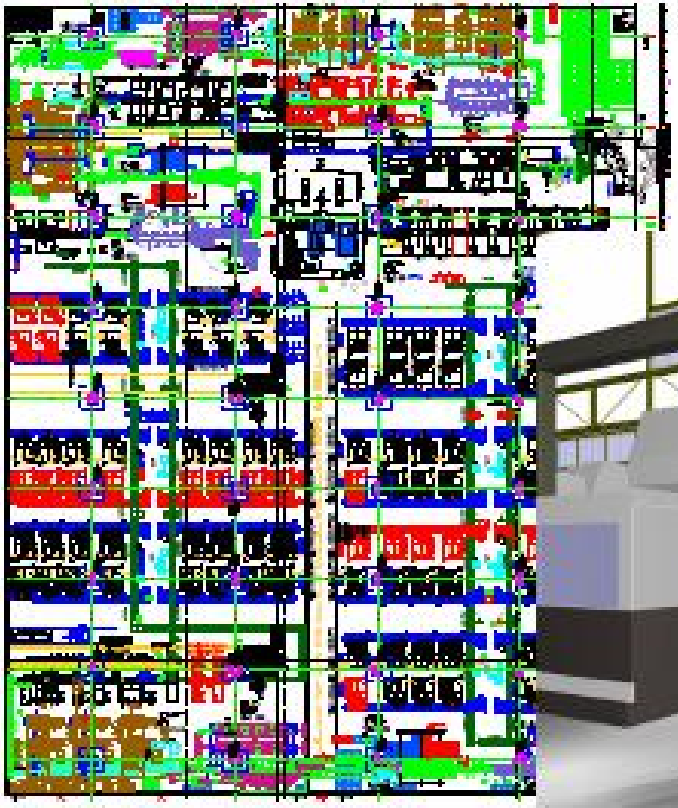
Examples of using programming tools – it has chosen from real projects

Processing and digitalization concern to all levels production process from outer logistic flow through production and assembly and workshop up to particular workplace and their ergonomic solution.

Simulation verify various variants and choose “optimal” solution.

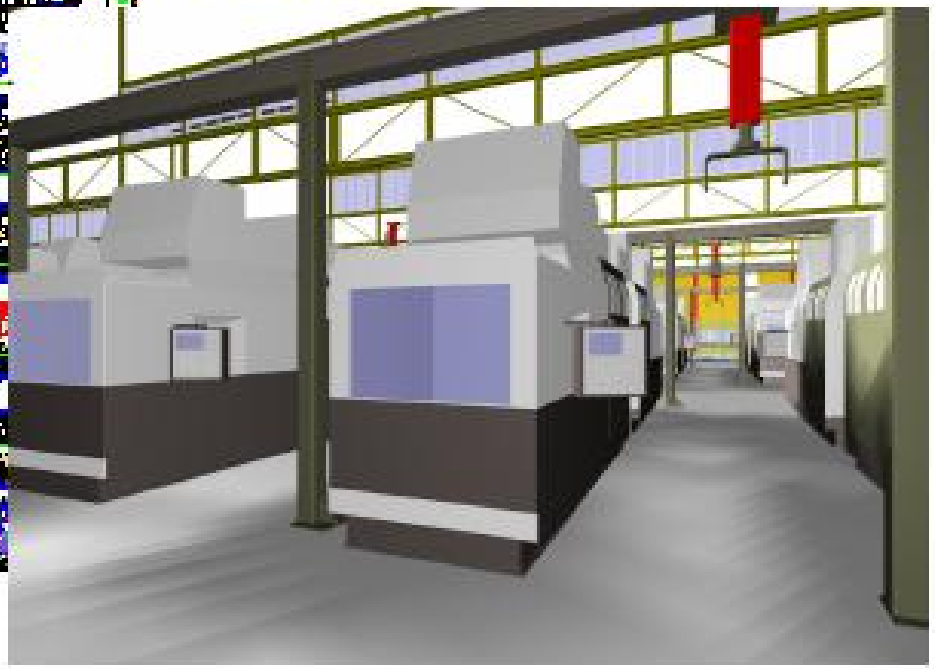
3D or 2D projecting

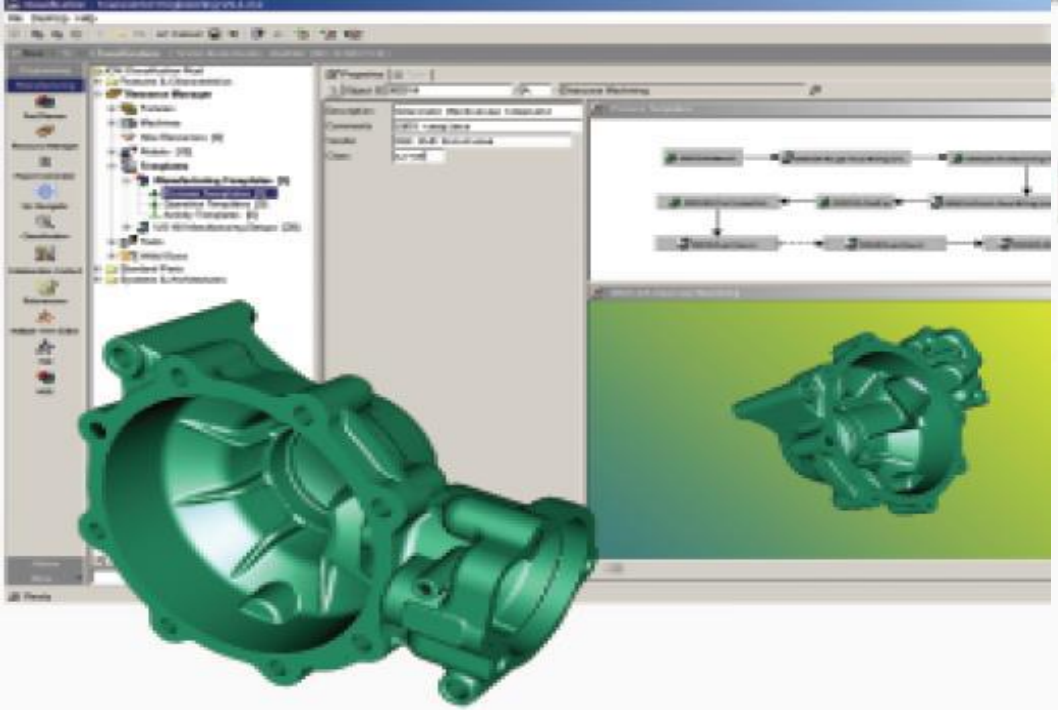
Basis: 2D-Layoutplanung

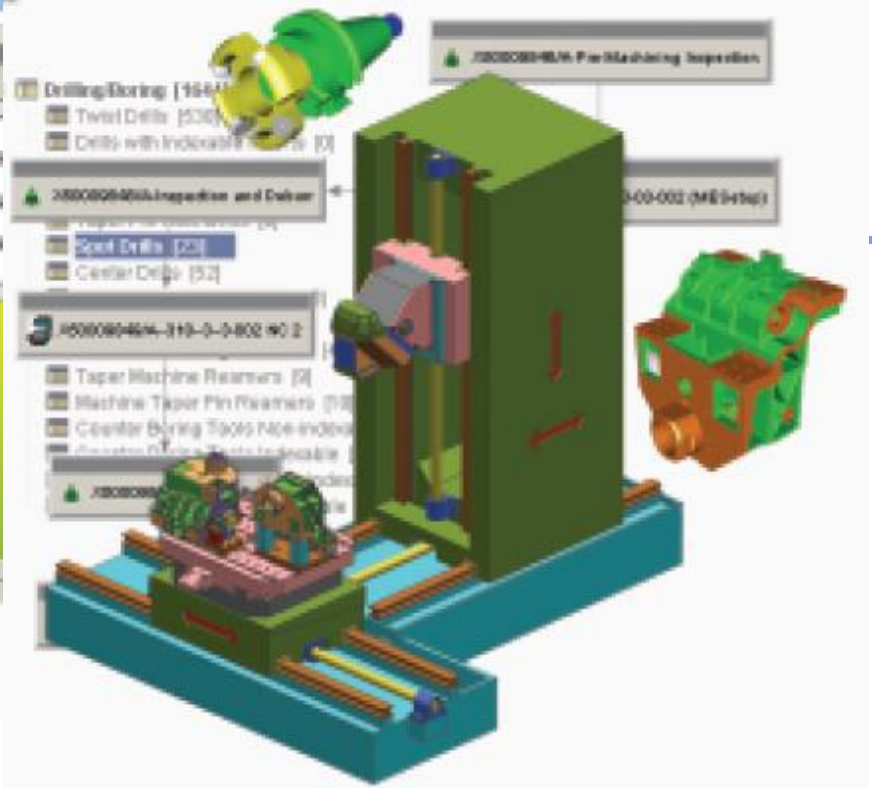


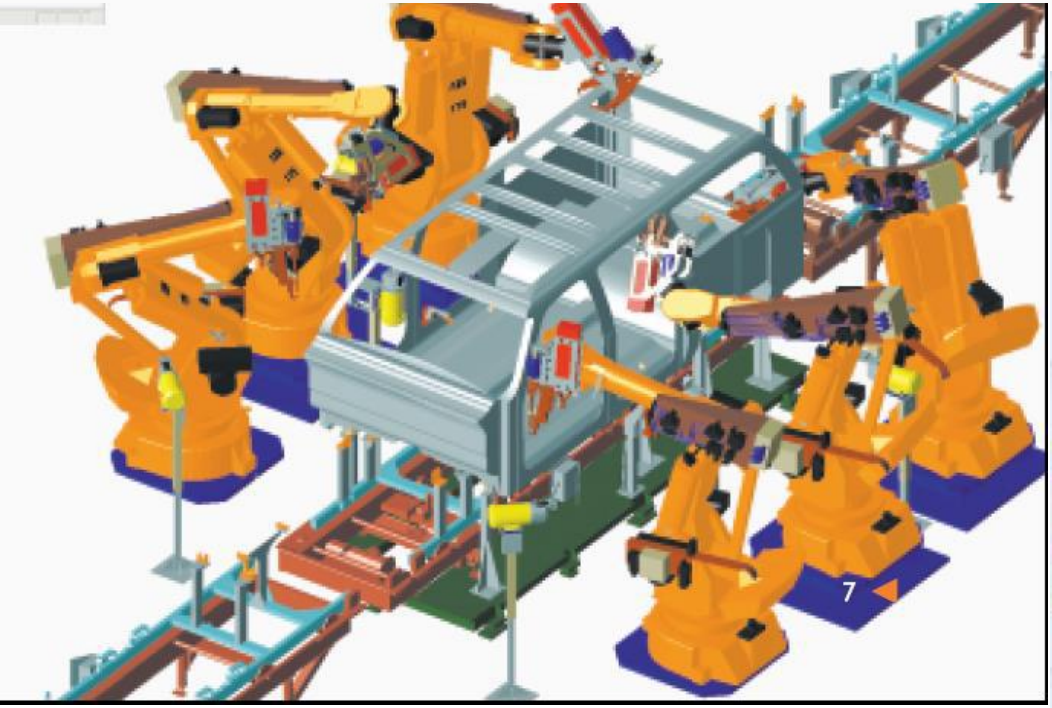
Kosten-/Nutzenverhältnis 3D-Layoutplanung ist mittels Aufwandsreduzierung und Entwicklung übergreifender Standards weiter zu verbessern!

Option: 3D-Layoutplanung






Drilling/Boring
Twist Drills
Spot Drills
Center Drills
Taper Machine Reamers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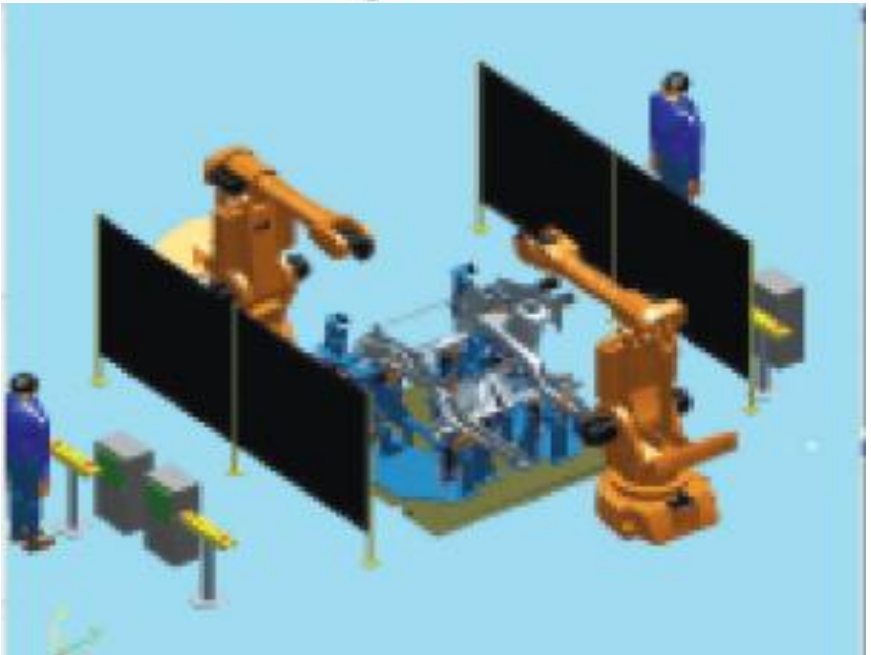

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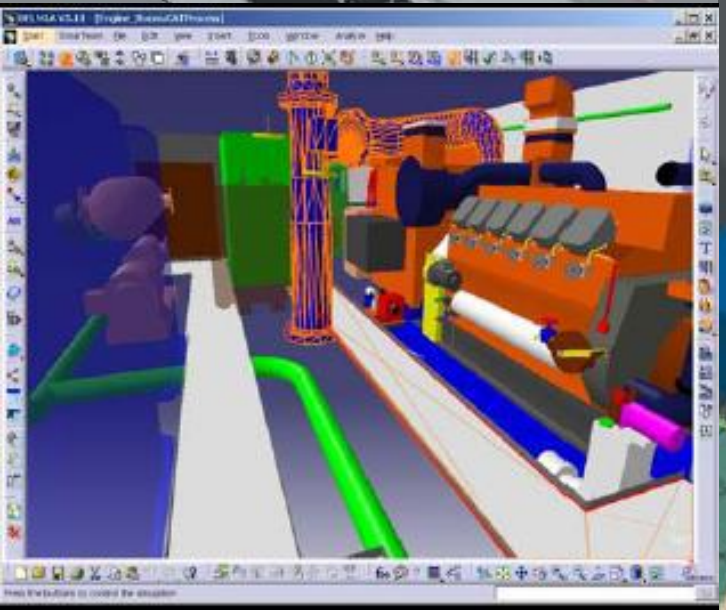
Logistic scheme



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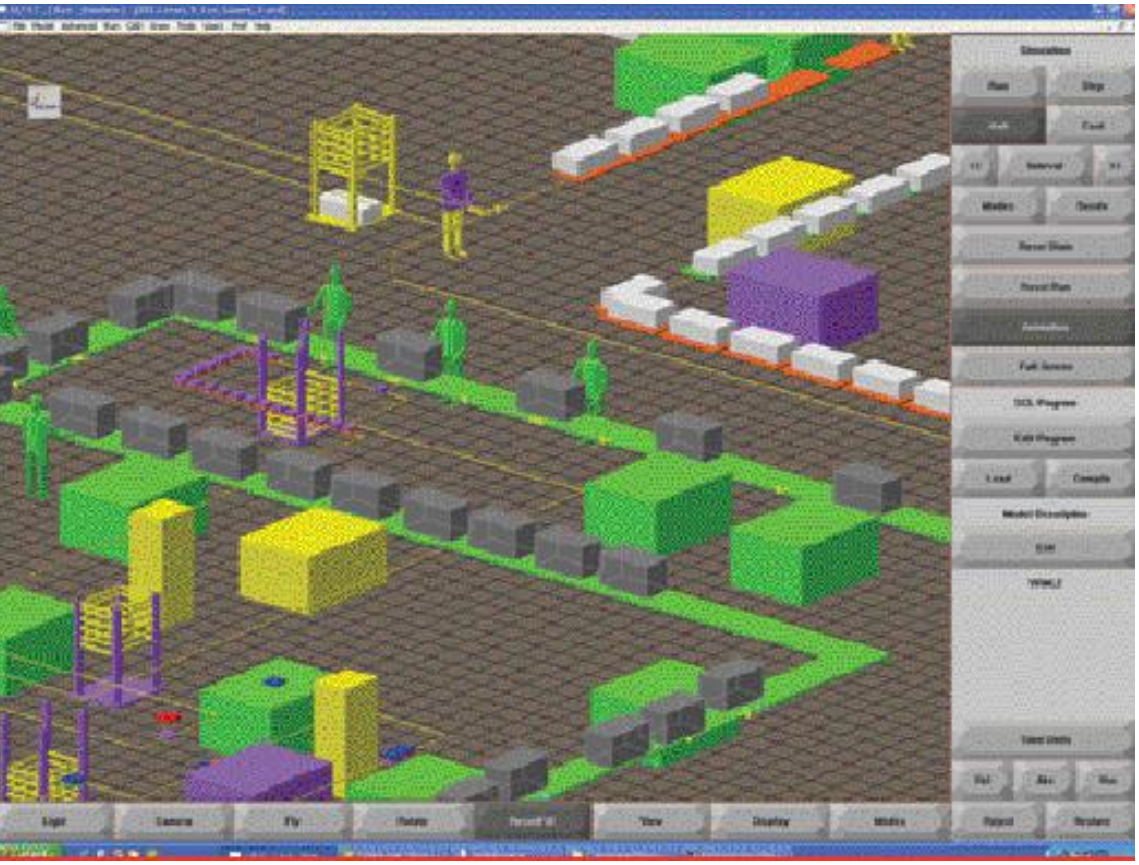
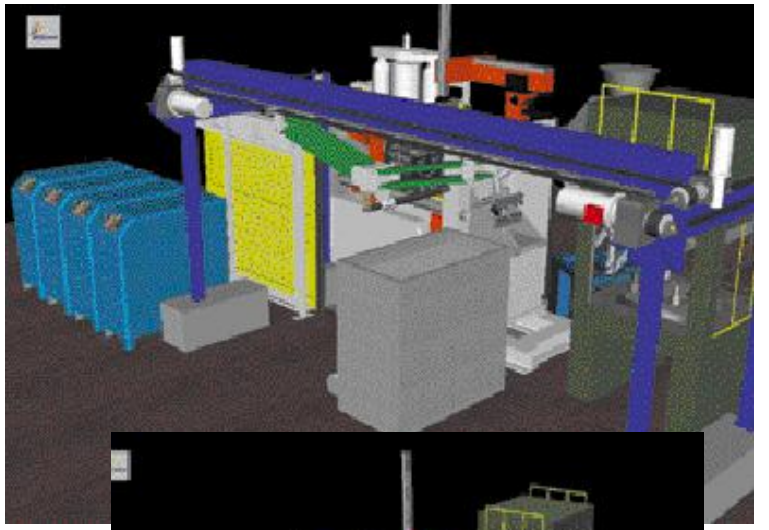
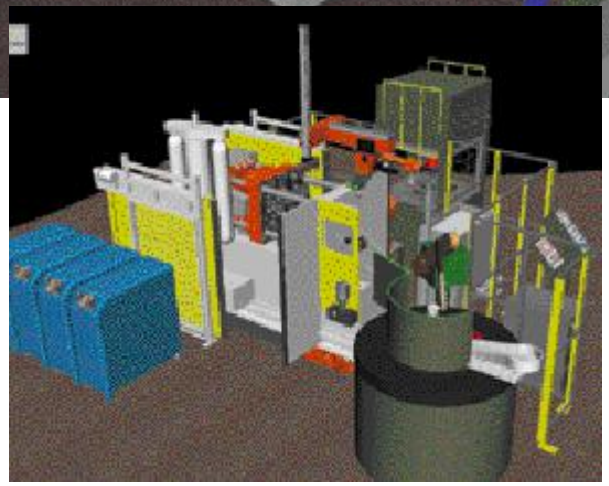
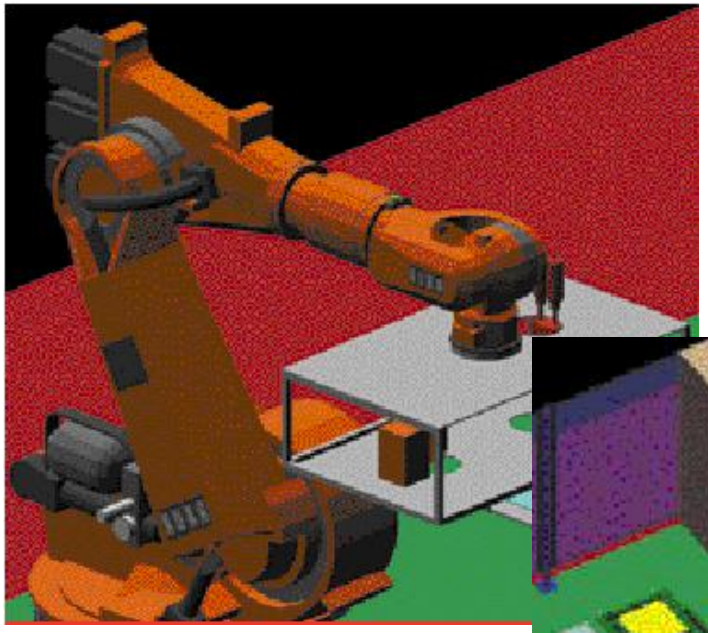
DF consists of various type of production and services







Robotic workplace



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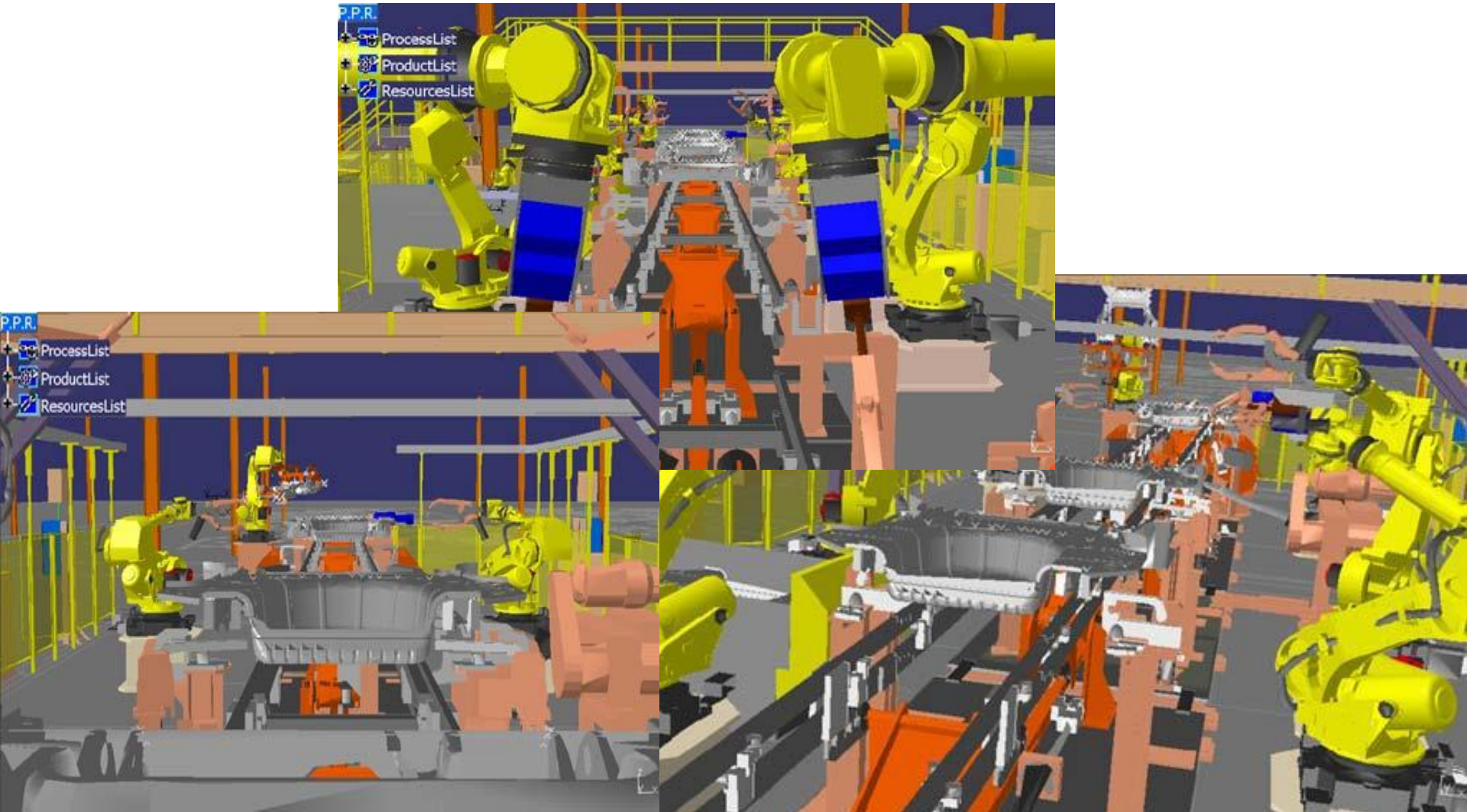
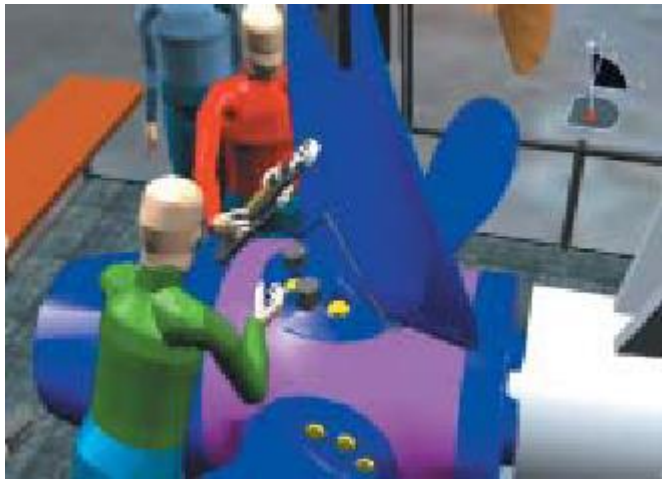
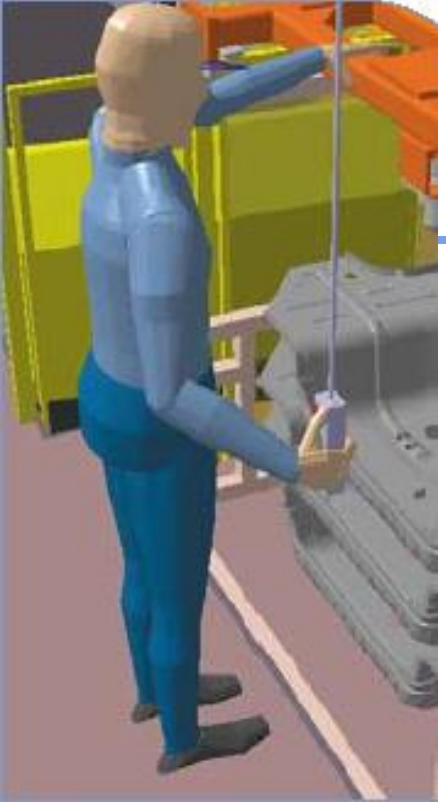
Welding link



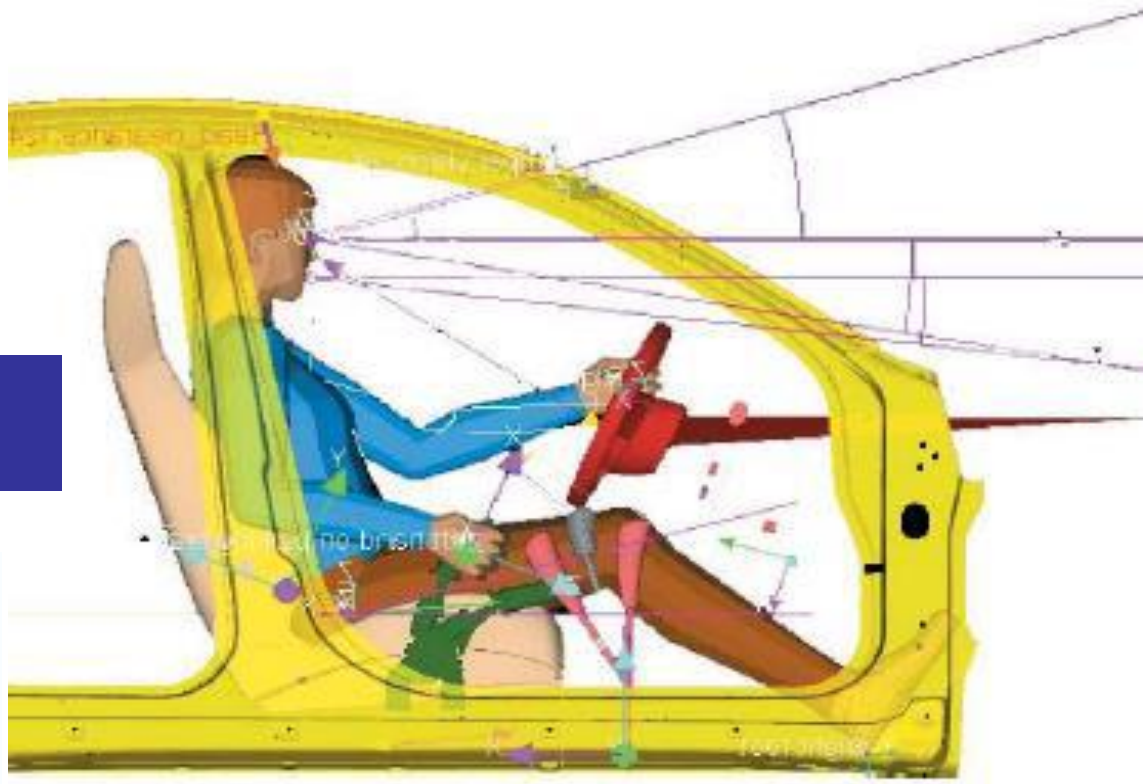
Ergonomic modules



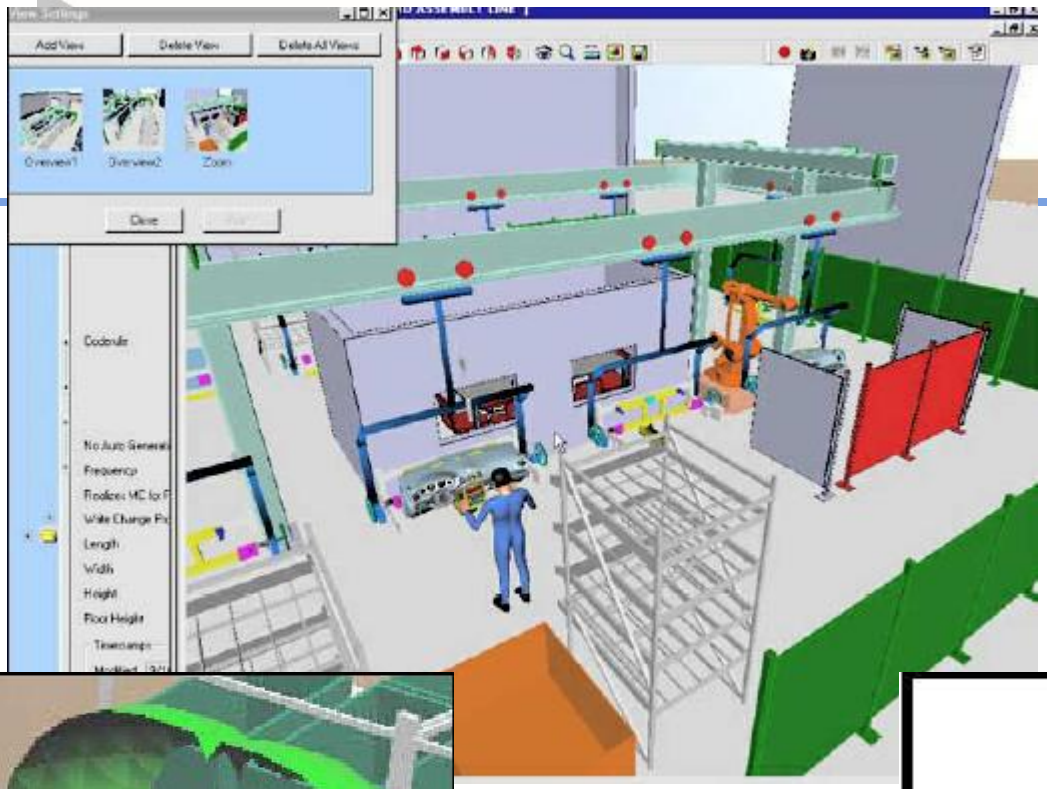


Ergonomic studies examine not only heights or distances but also force set-up in workplace

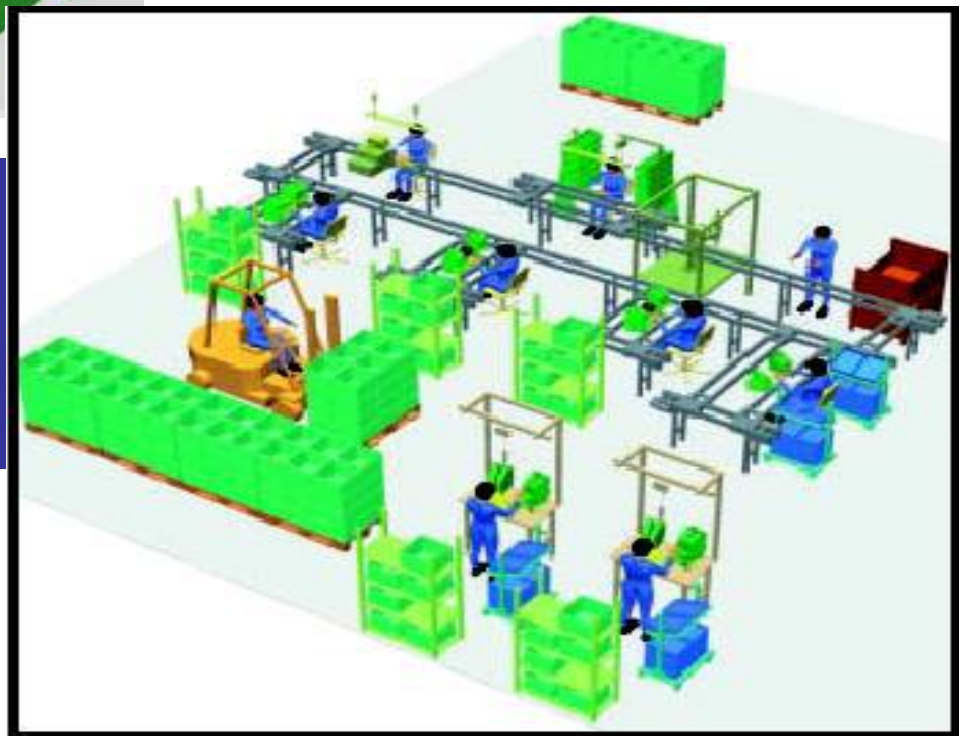
Ergonomic studies of control item are normal

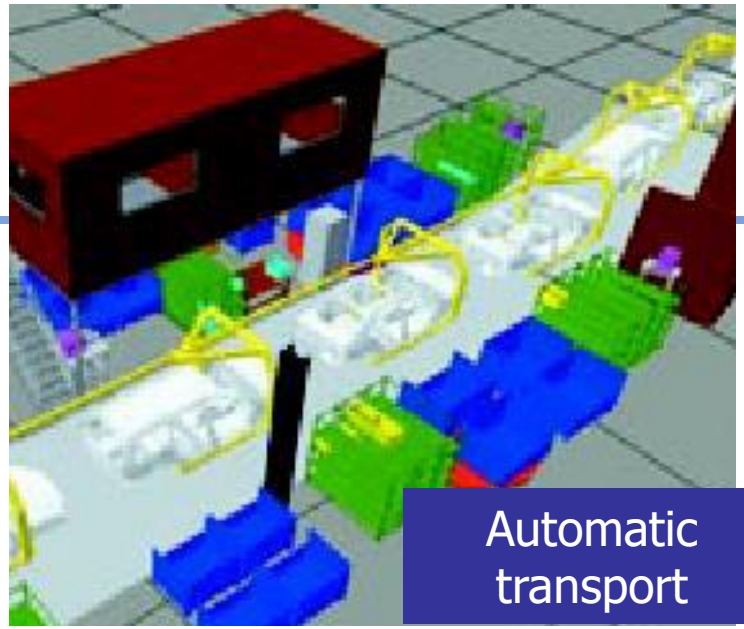


Examination of details



In practices are solved not only real situation but also fictive situation





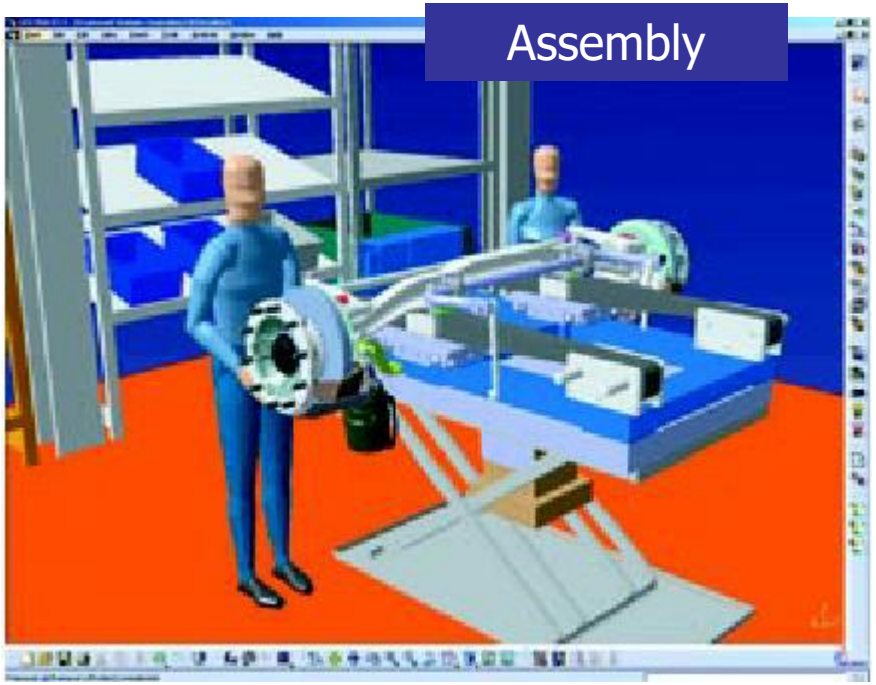
Automatic transport

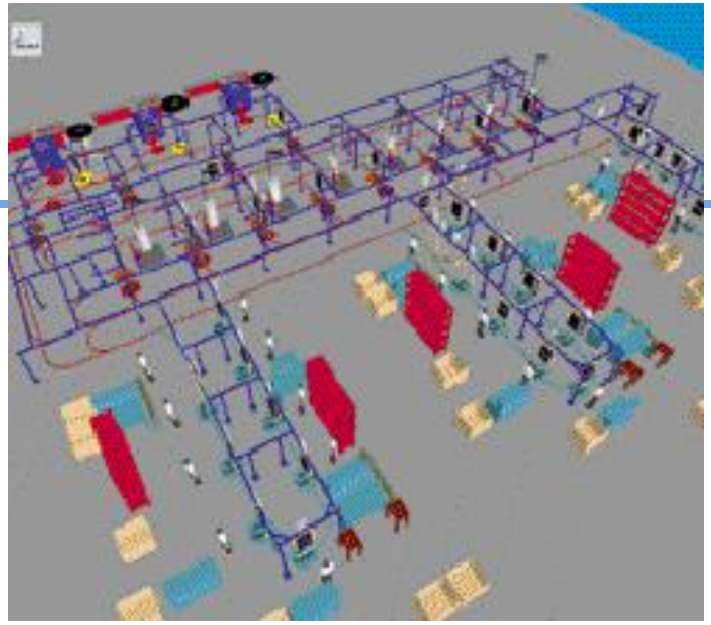
Cable

Examples of studies

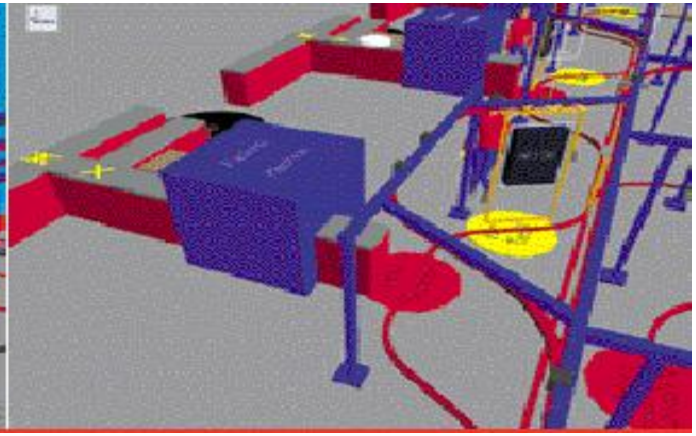
Link in press

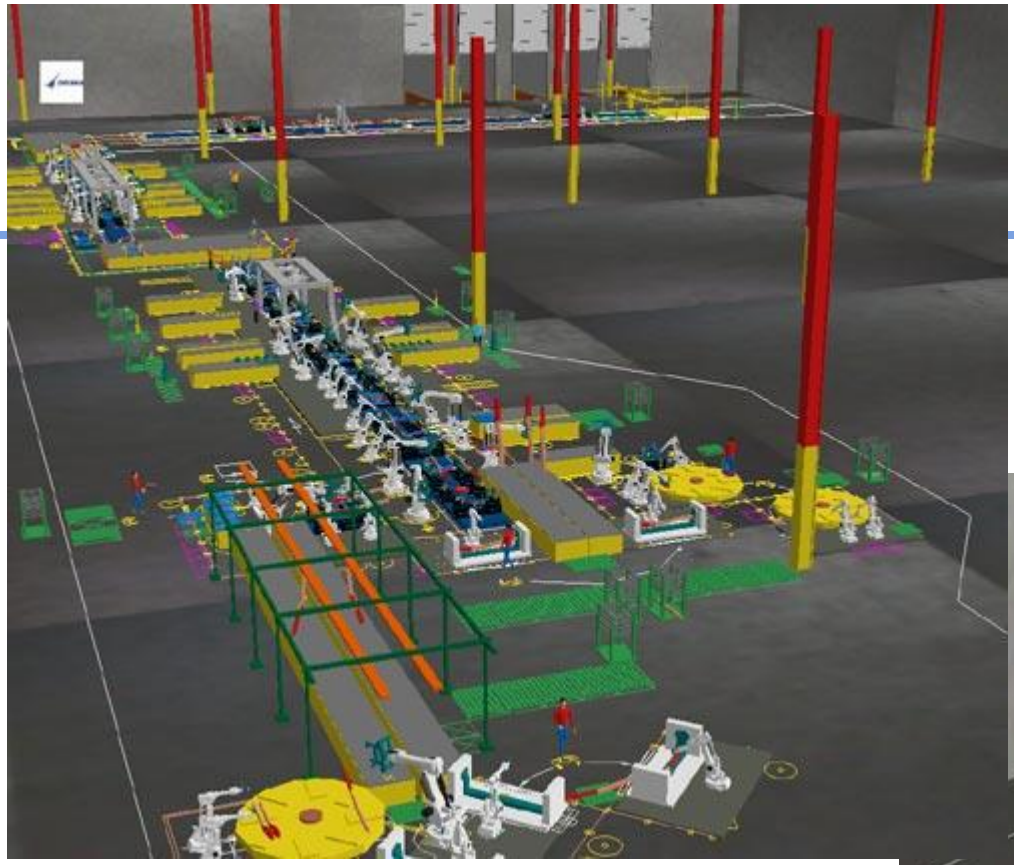
Assembly



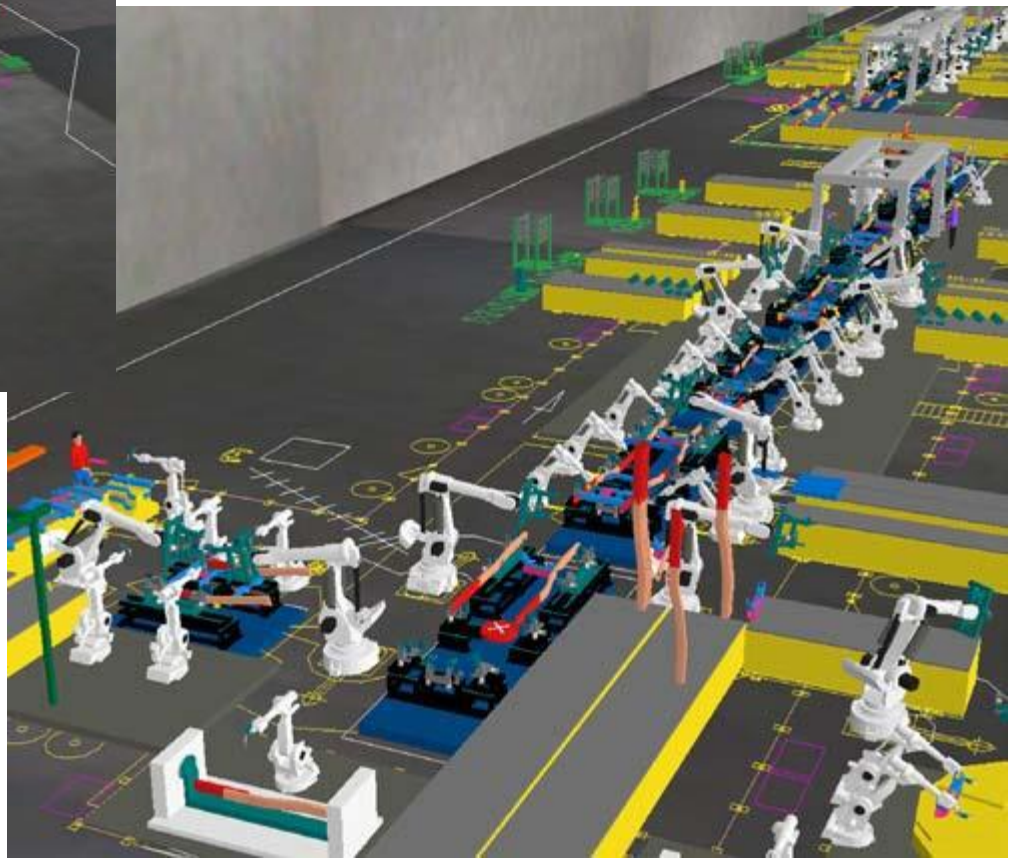


All systems are possible simulate and examine with help “what – if” analysis



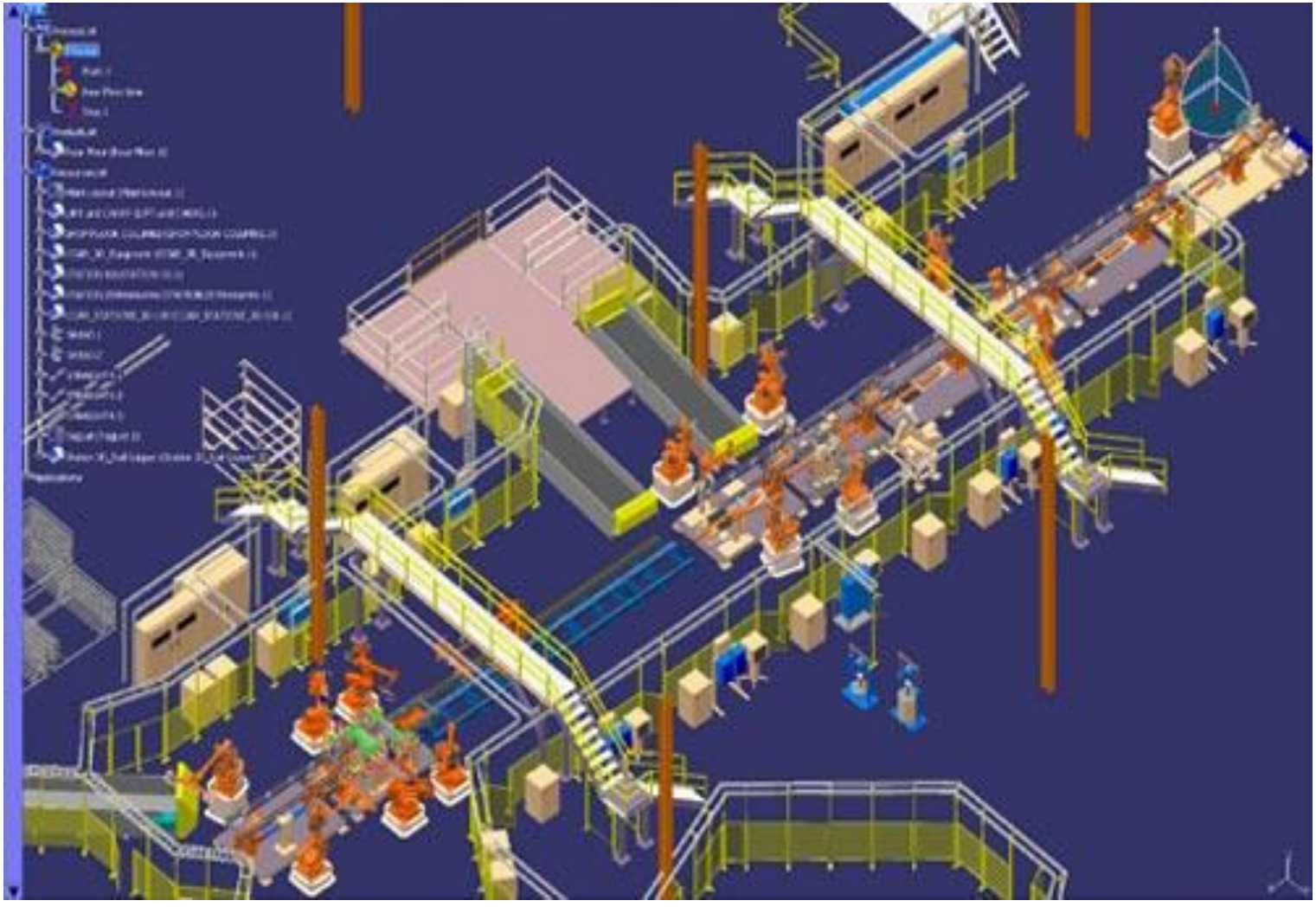


Disposition must consists of all necessary data from logistic operation – we can use simulation

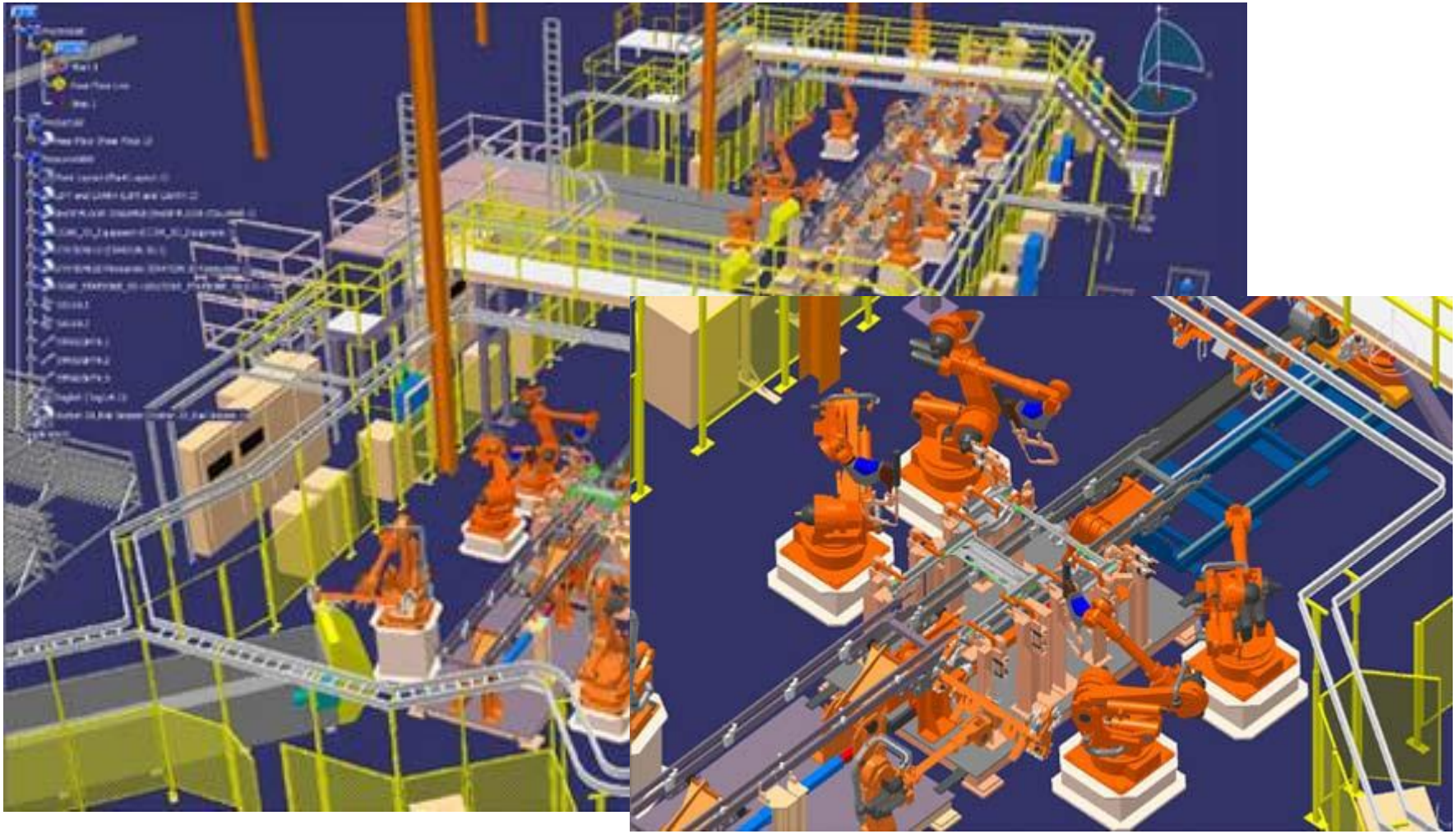


It prepares for simulation

Total disposition

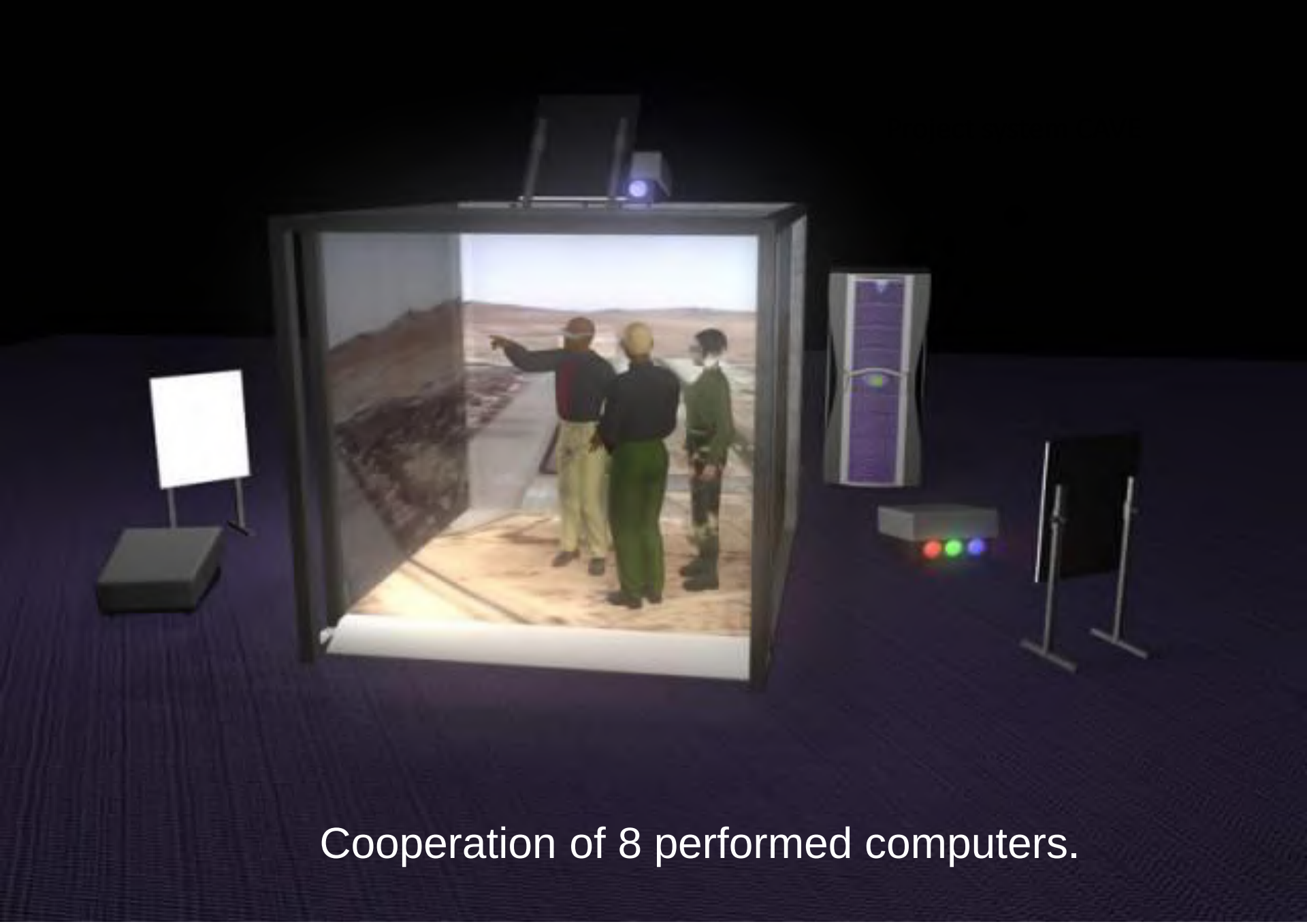


Detail view



Virtual reality

Special computer devices – CAVE



Cooperation of 8 performed computers.

Using of haptic devices, e.g. glove

In projects is possible to use combination virtual and real situation.

Example UWB

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Product data management

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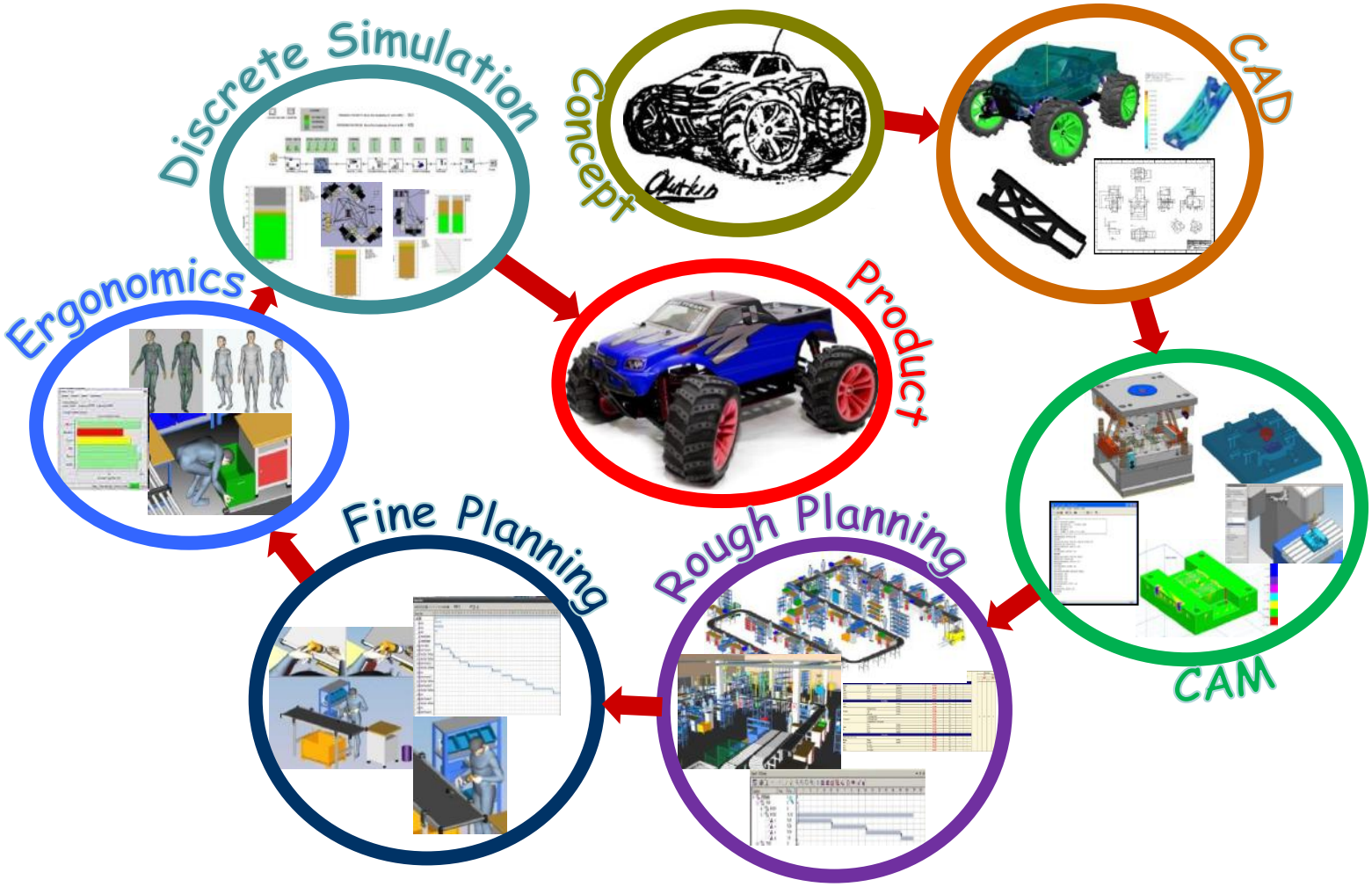
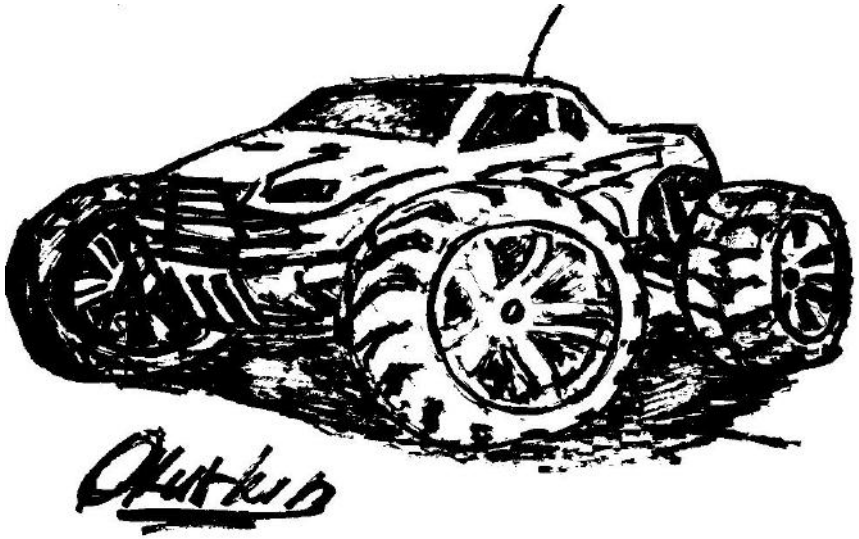
DF Concept at UWB

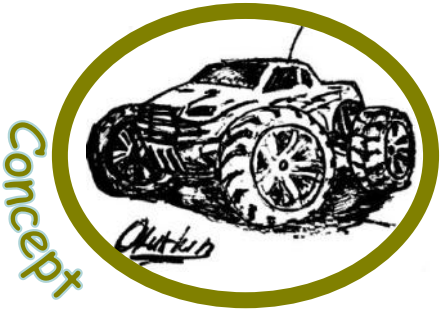


Design Concept

Designers‘ vision of the product according customers‘ needs.

Idea of appearance.





CAD

CAD systems helps to designer engineer to create drawings and materials for technological engineer.

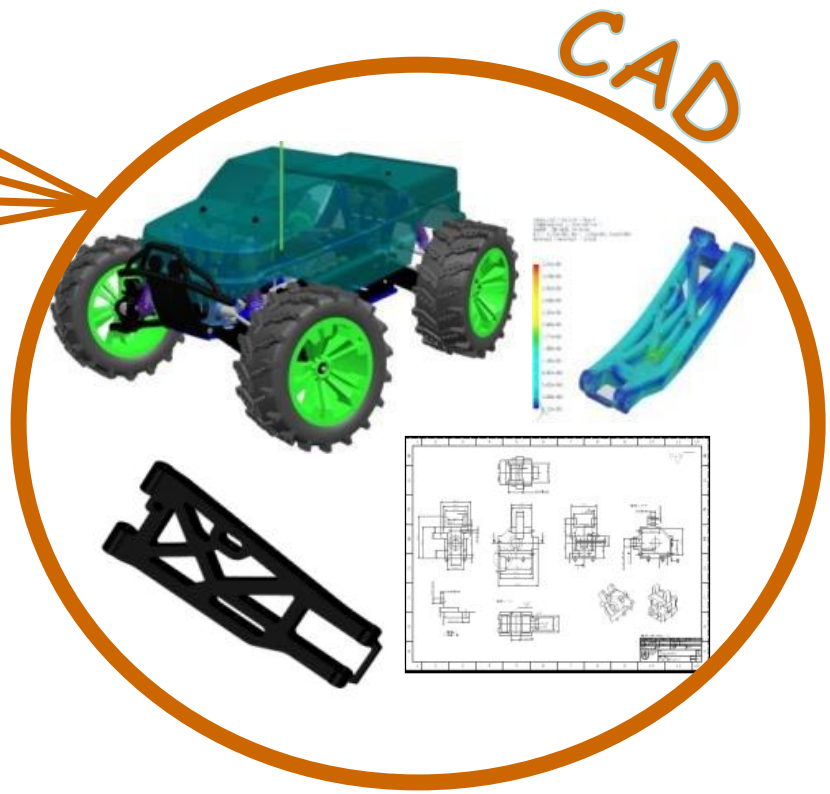
Part of the DF(Dassault sytemes – CATIA, Siemens NX)

Styling

Design

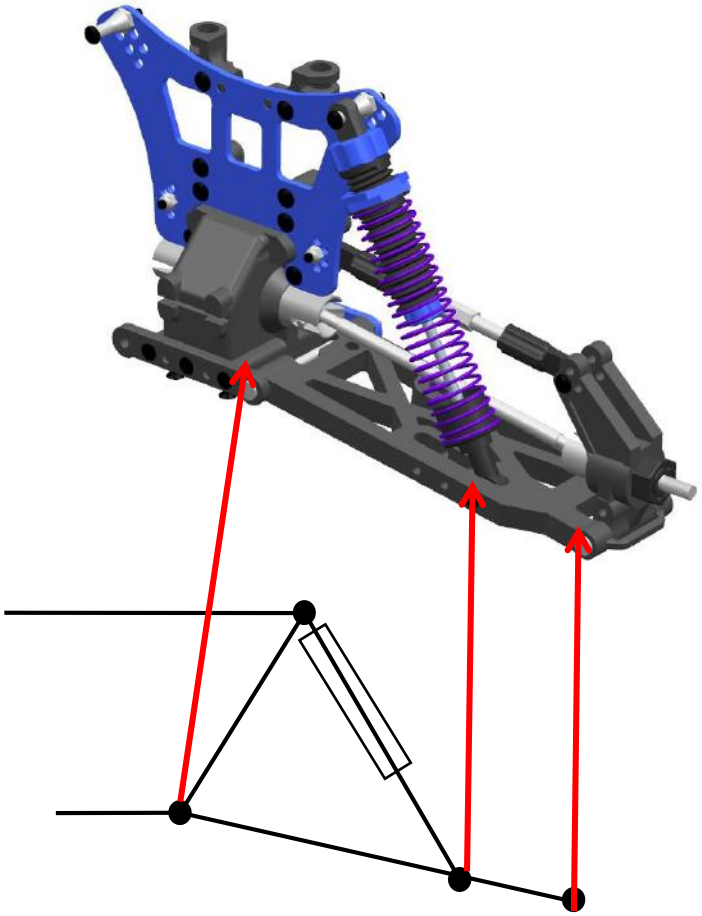
Simulation/FEM analysis

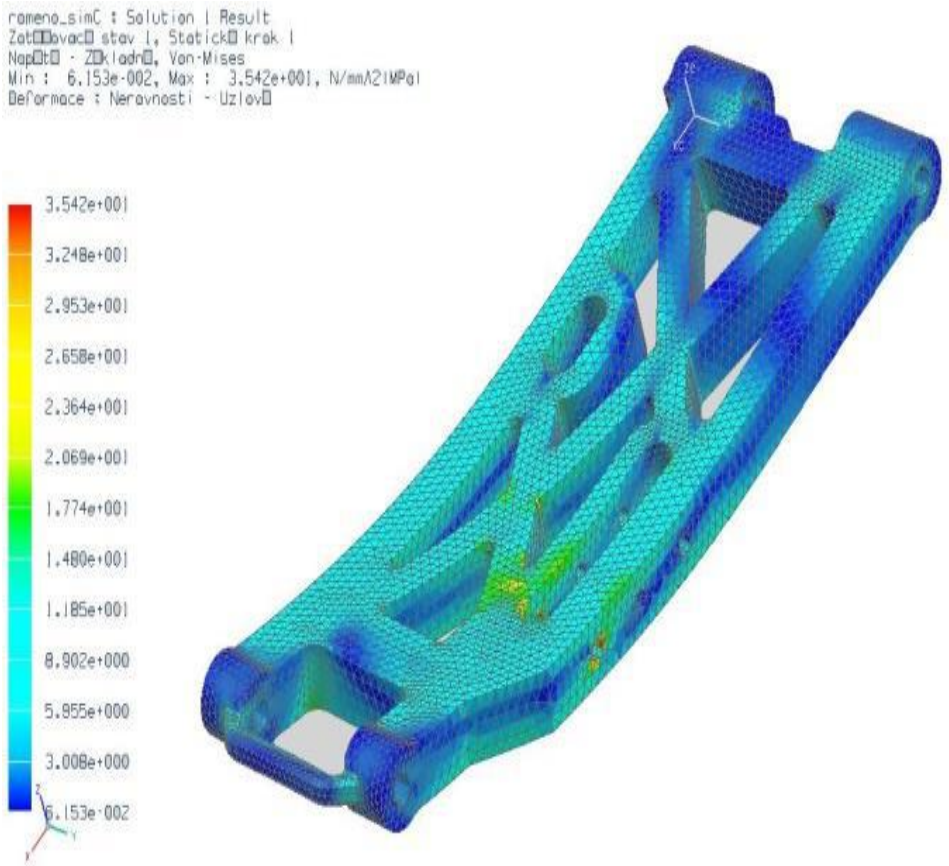
Drawings for Technology



CAD - Simulation

Suspension arm of RC model





Stress analysis at NX

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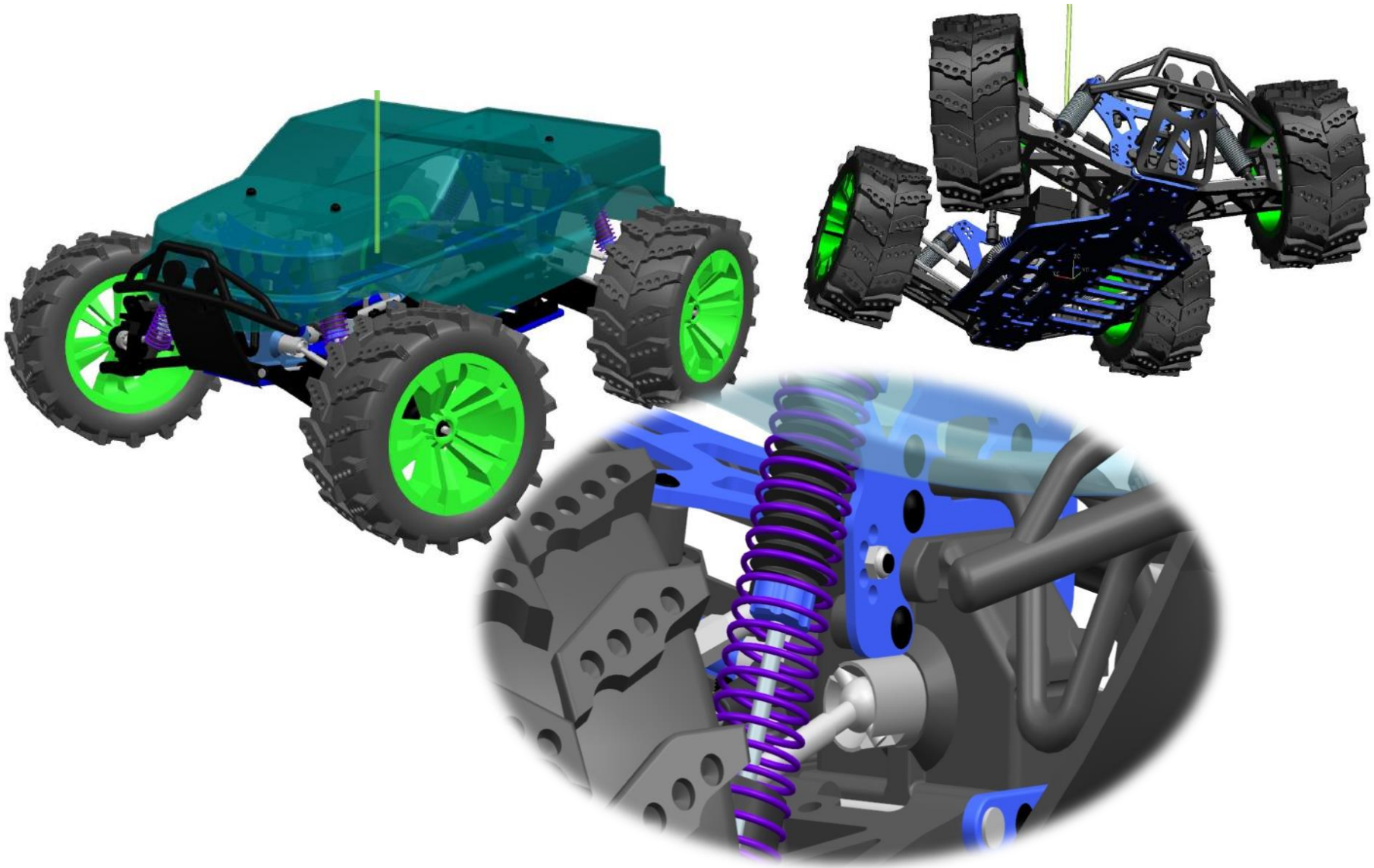
CAD - Design



CAM

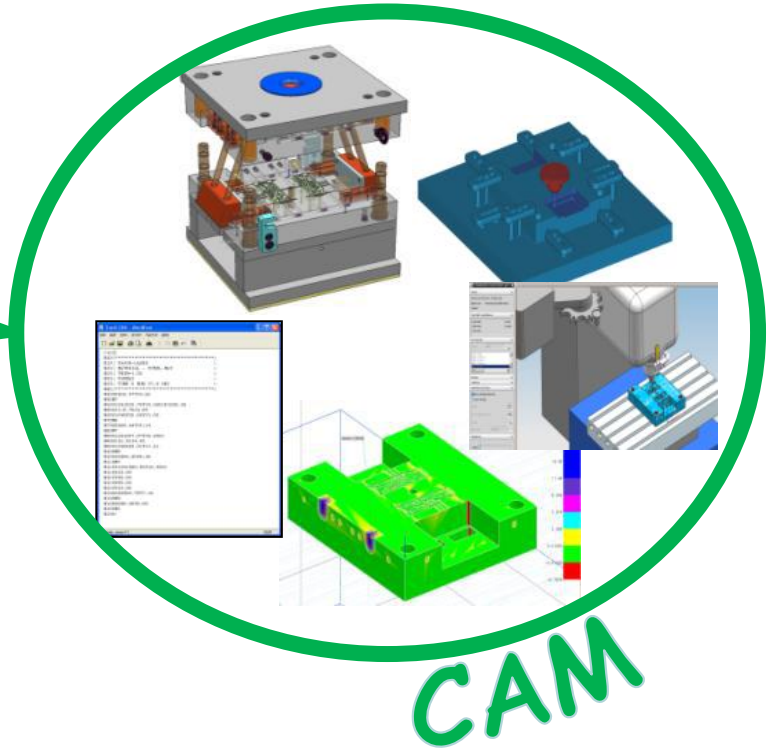
CAM modules helps to technology engineer to set optimal cutting environment

Part of the DF(Dassault sytemes – CATIA, Siemens NX)

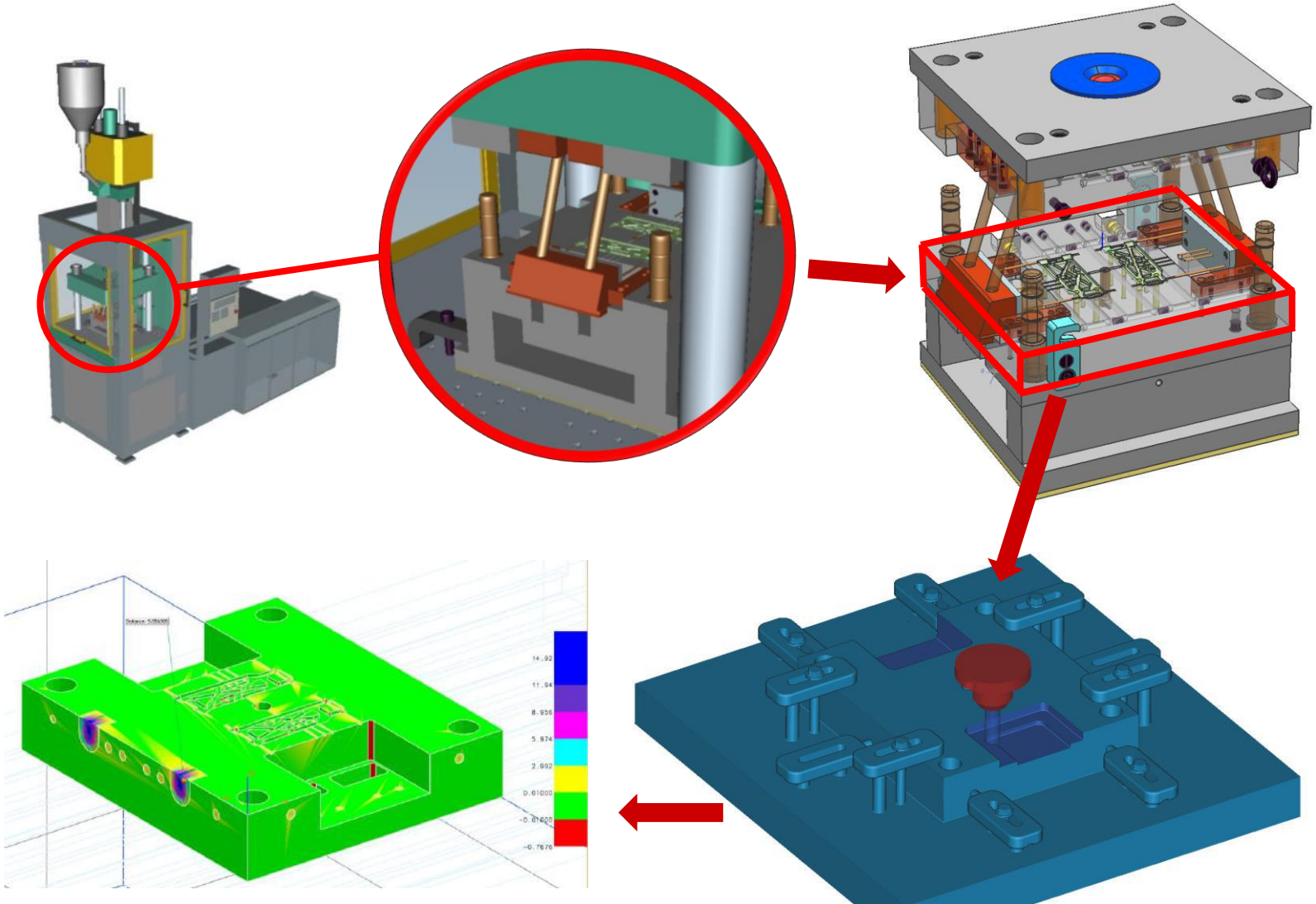
Tooling

Machining

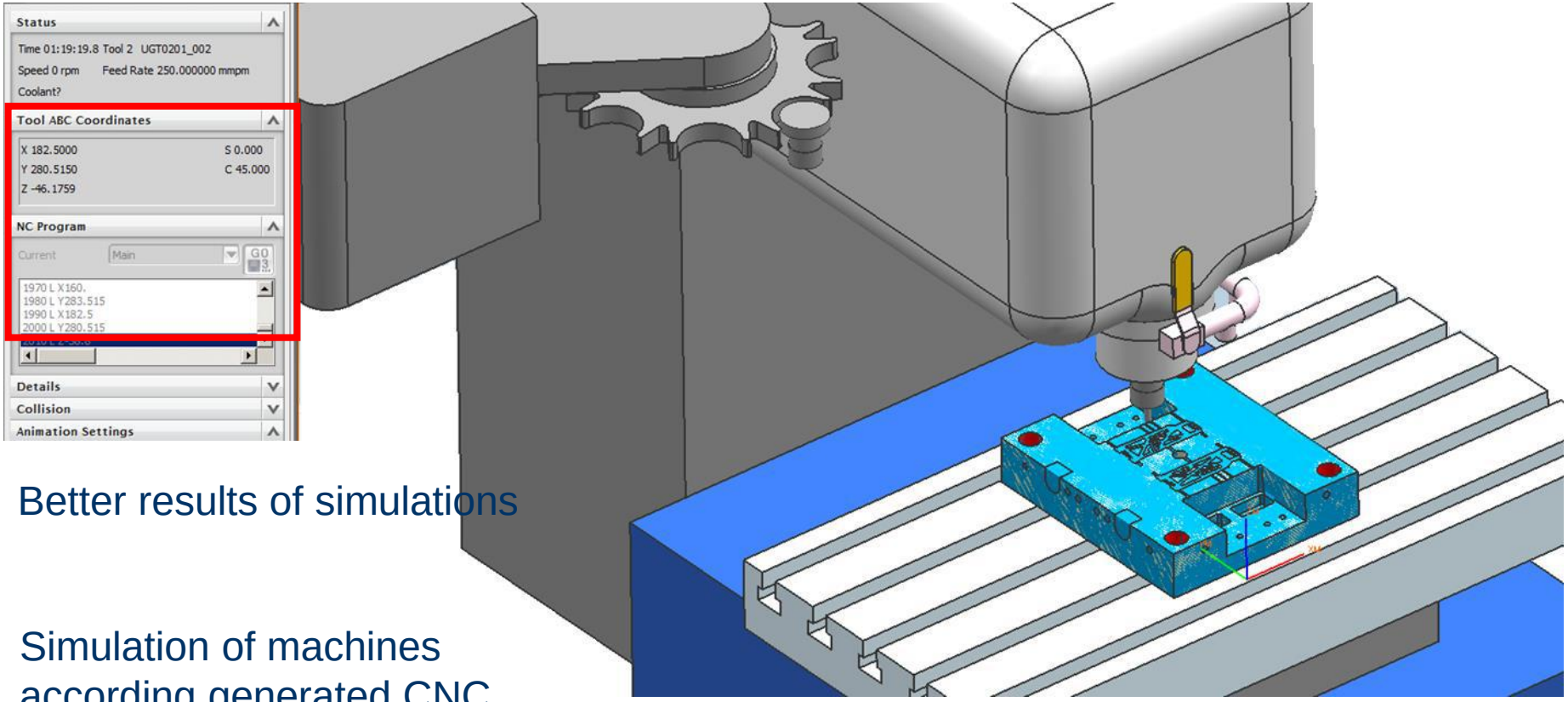
Generating NC programme



CAM - Tooling



CAM - Machining



Better results of simulations

Simulation of machines according generated CNC programe

Database of driving systemes (Sinumering, Heidenhai…)

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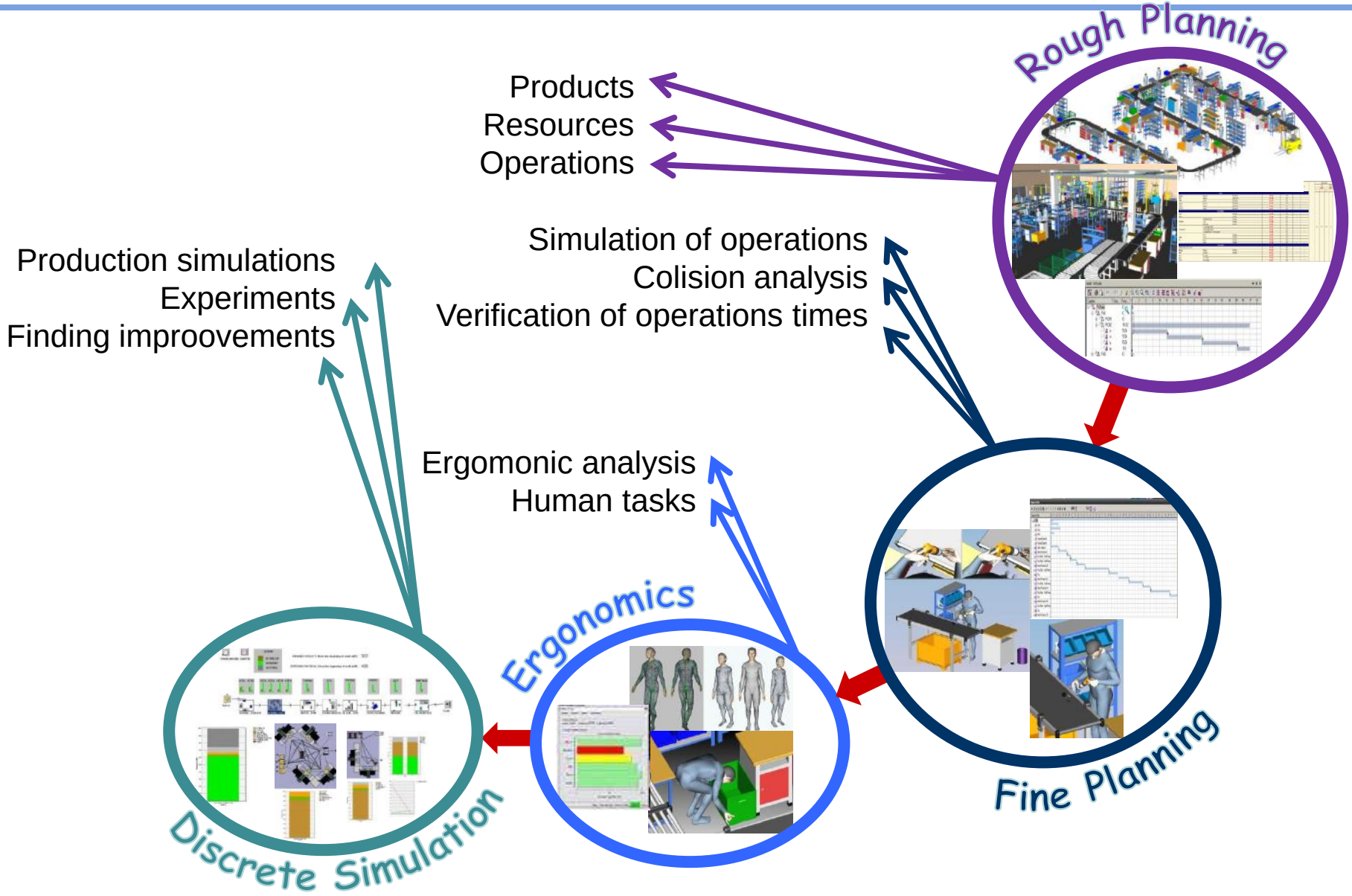
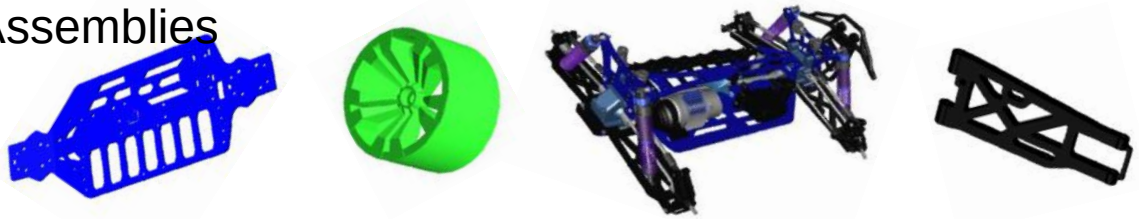
Digital Manufactruring



Rough Planning

1. Parts/Assemblies

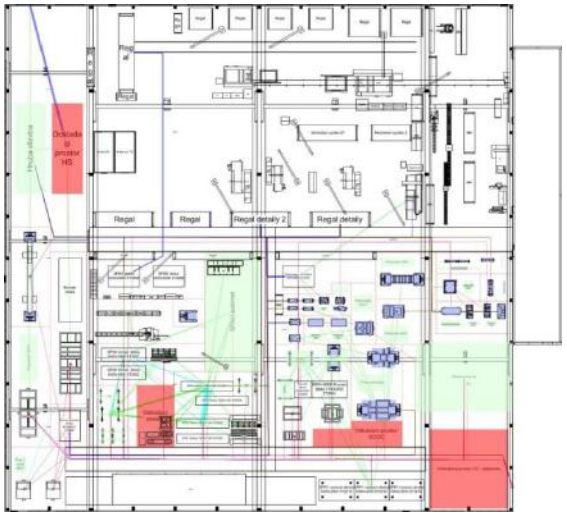


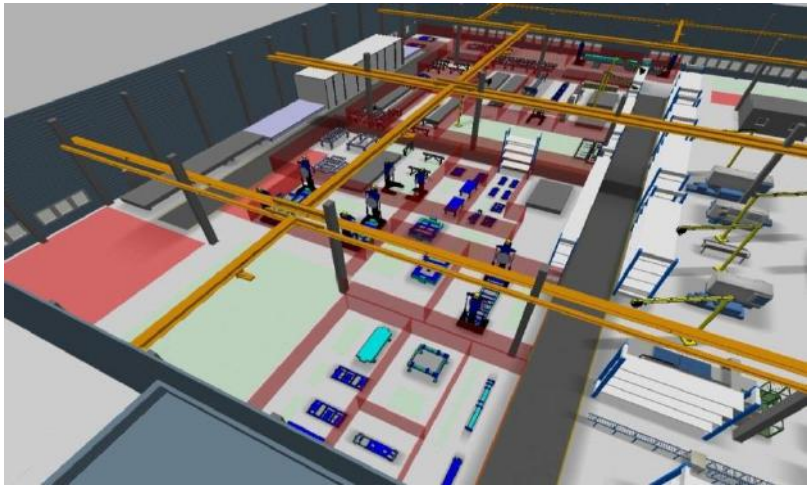
2. Operations

3. Resources

Rough Planning - resources

Rough Planning - resources





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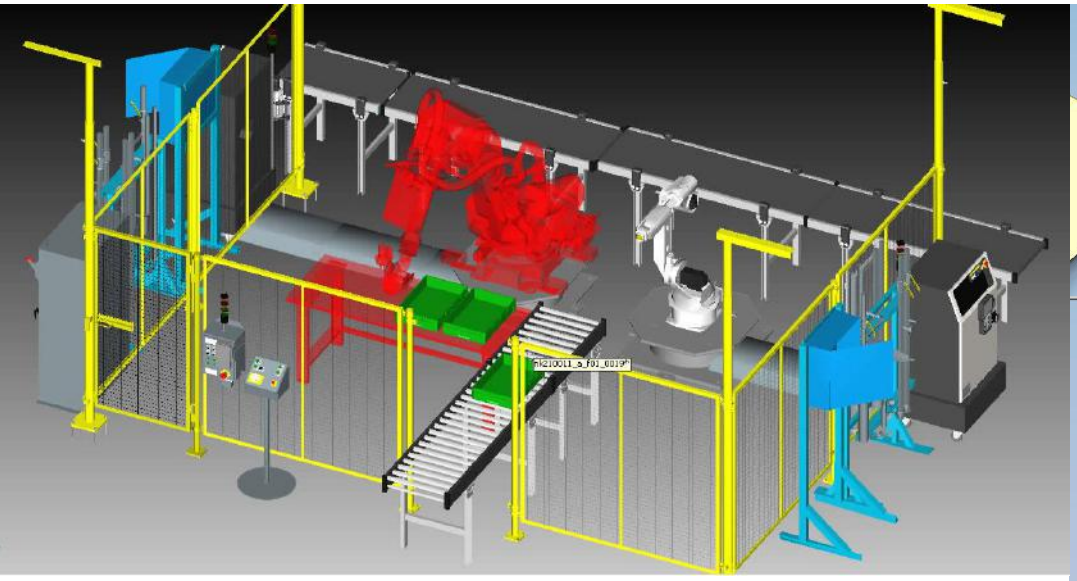
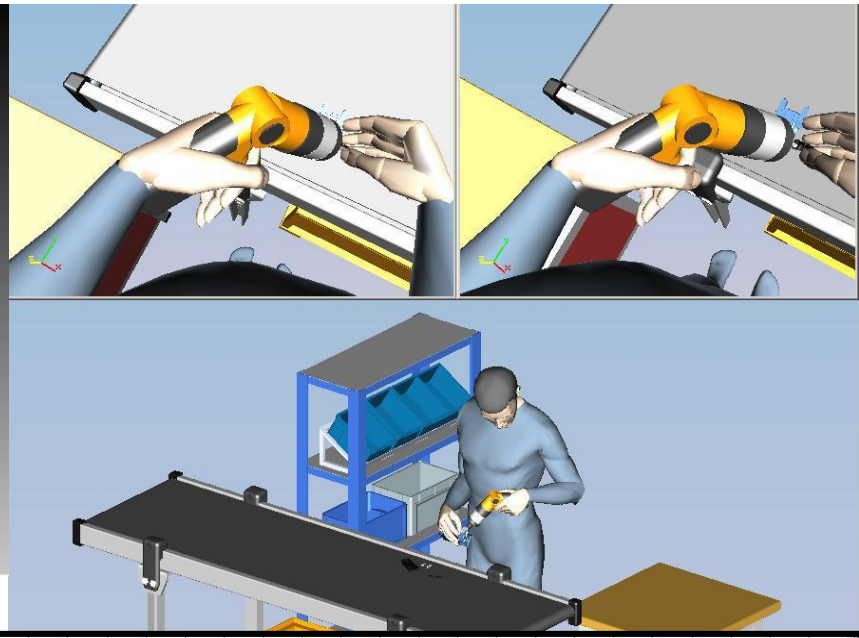
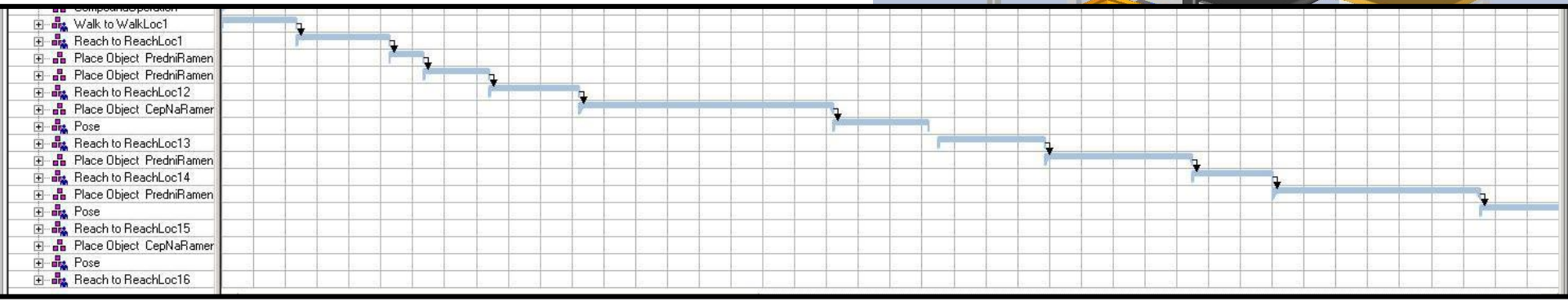
Fine Planning







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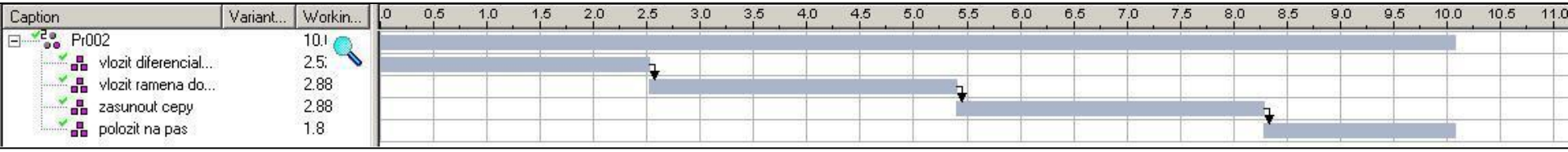
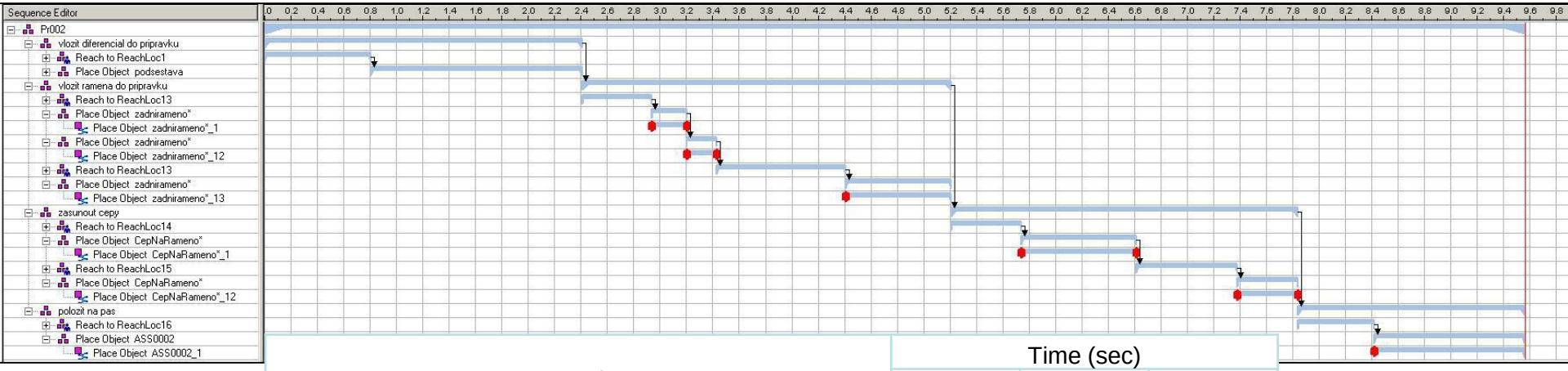
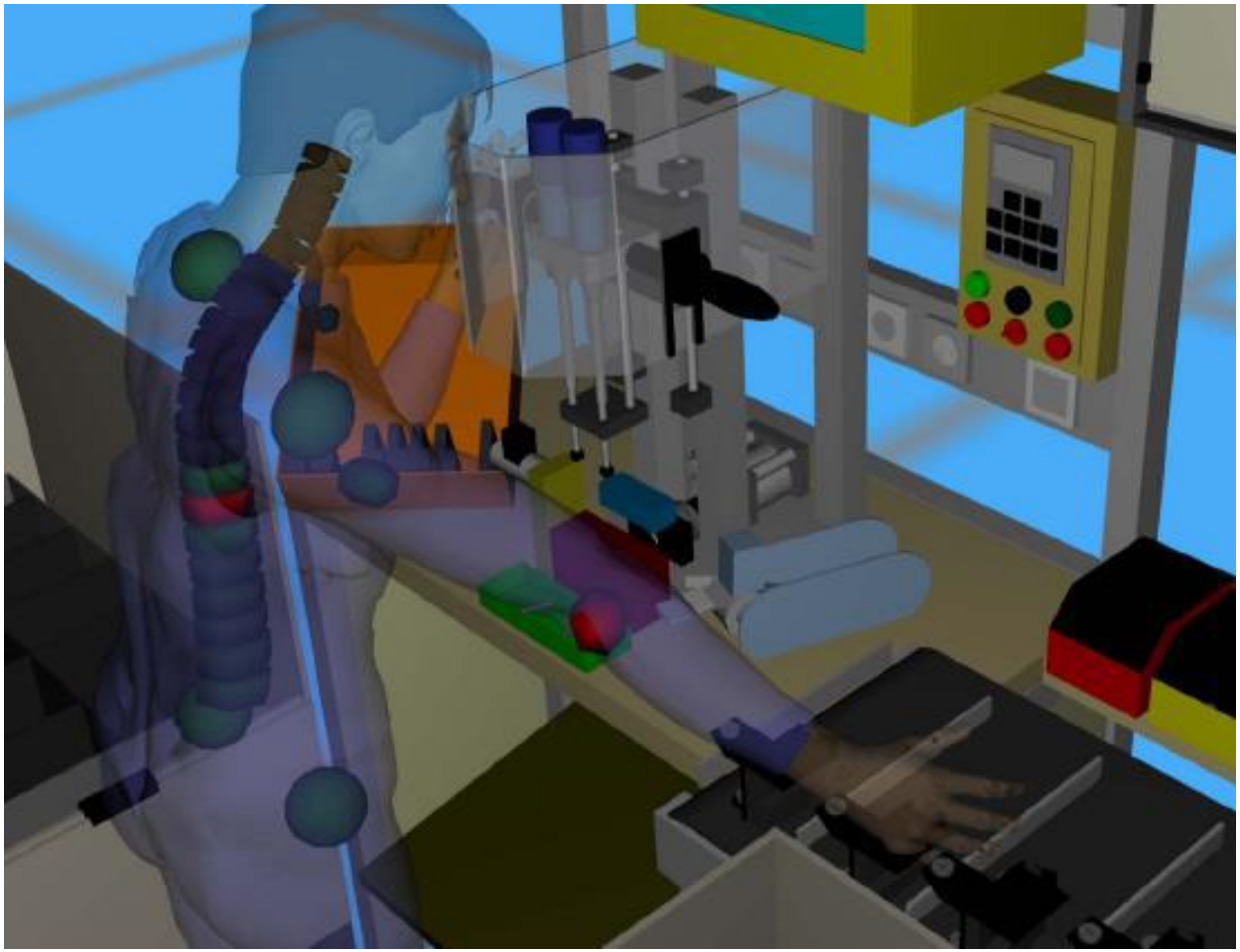
Fine Planning





Operation	Time (sec)		
	Rough	Fine	Real exp.
Reach and Place Part001 to mounting device	2,52	2,41	2,07
Reach and Place Part0001 to mounting device	1,44	1,42	1,25
Reach and Place Part0002 to mounting device	1,44	1,39	1,32
Reach and Place pin 01	1,44	1,32	1,41
Reach and Place pin 01	1,44	1,28	1,43
Put assembled part away from mounting device	1,8	1,71	1,61
total time	10,08	9,57	9,49

Ergonomics



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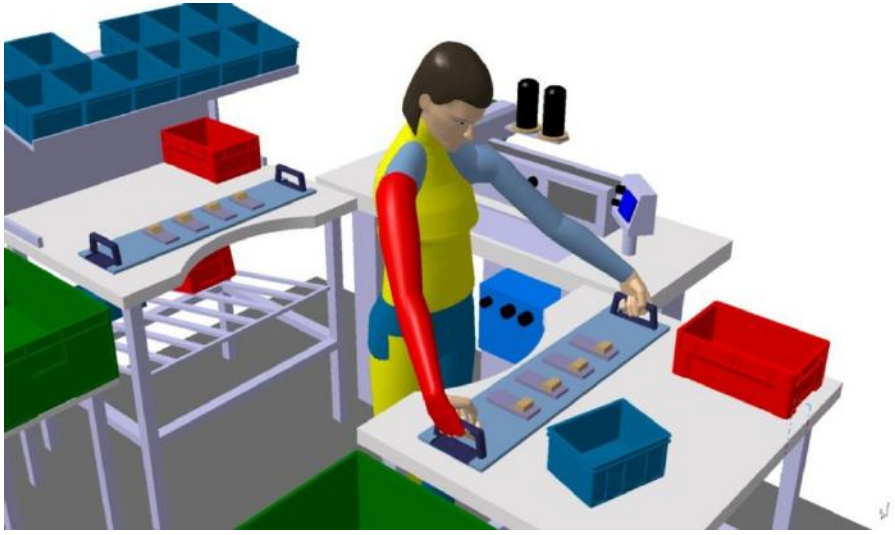
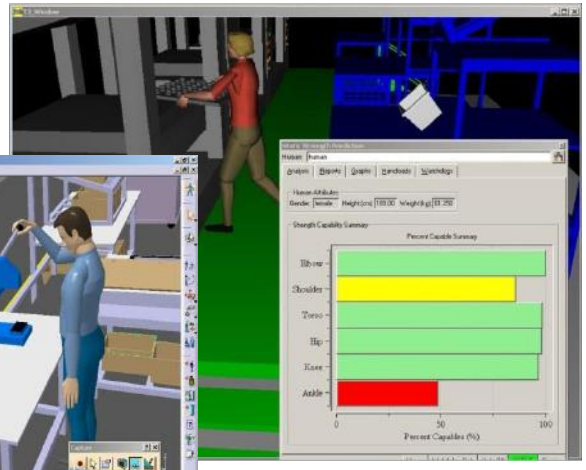
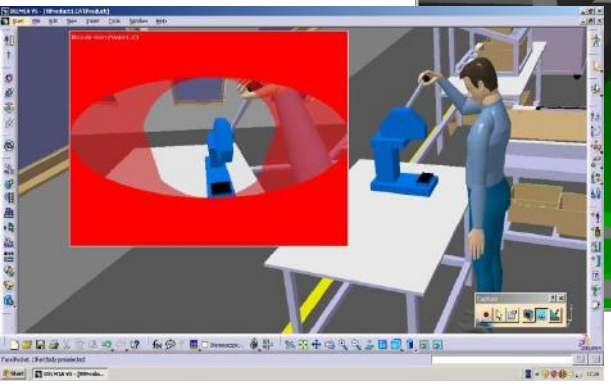
Ergonomics







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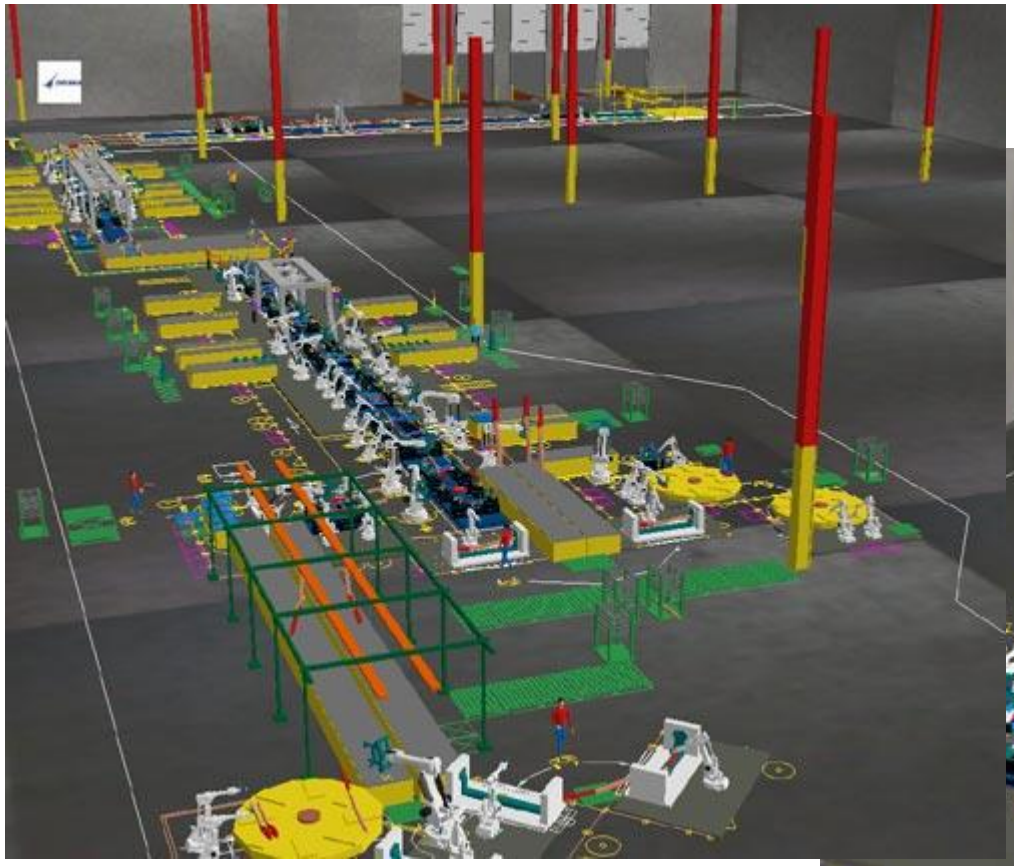
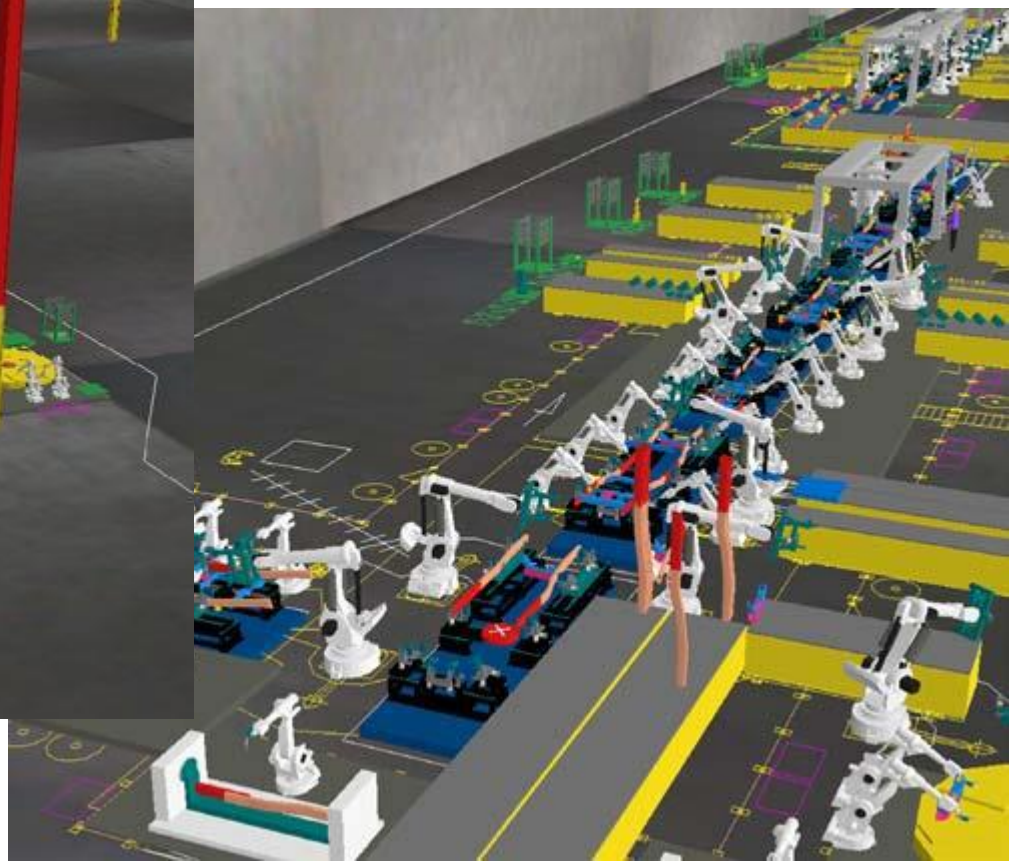
Modelling and simulation





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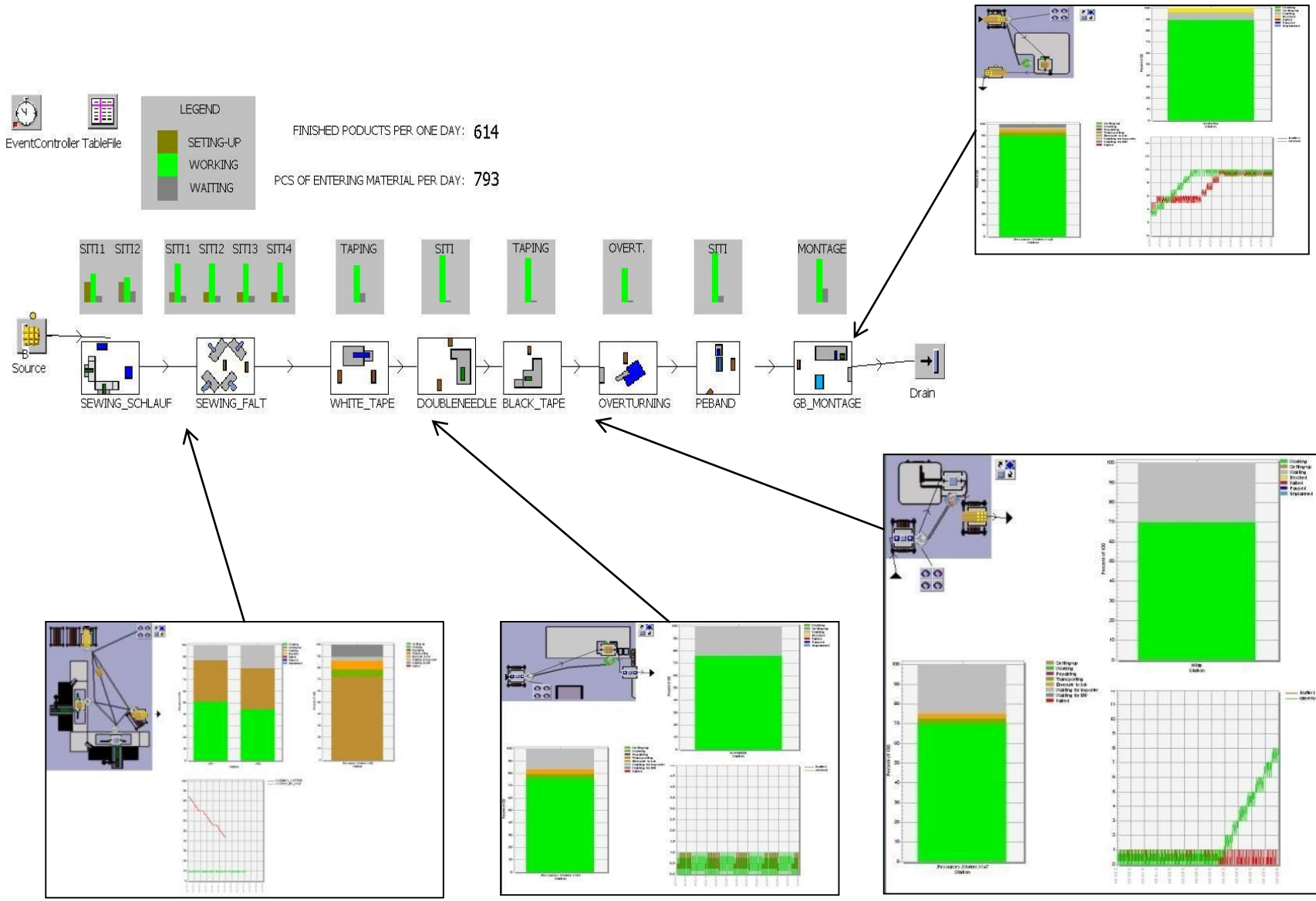
Discrete Event Simulation



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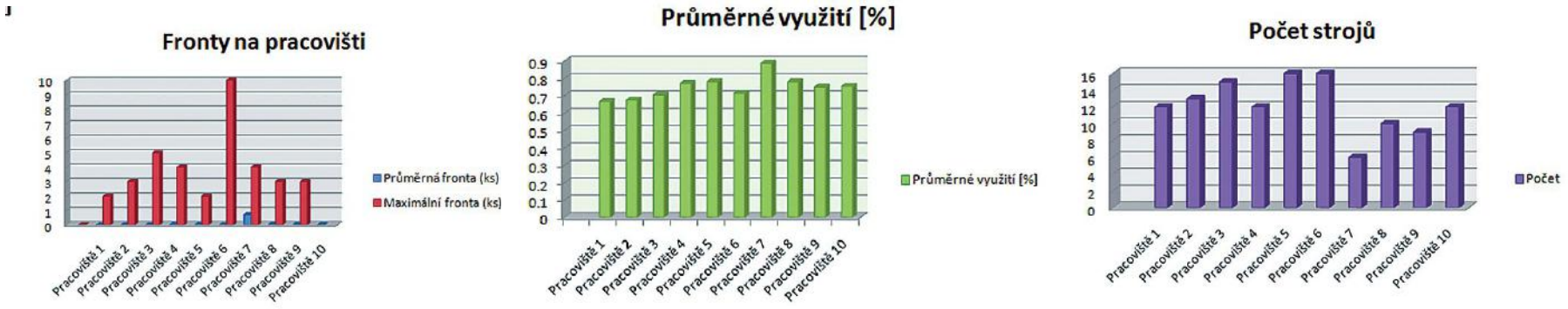
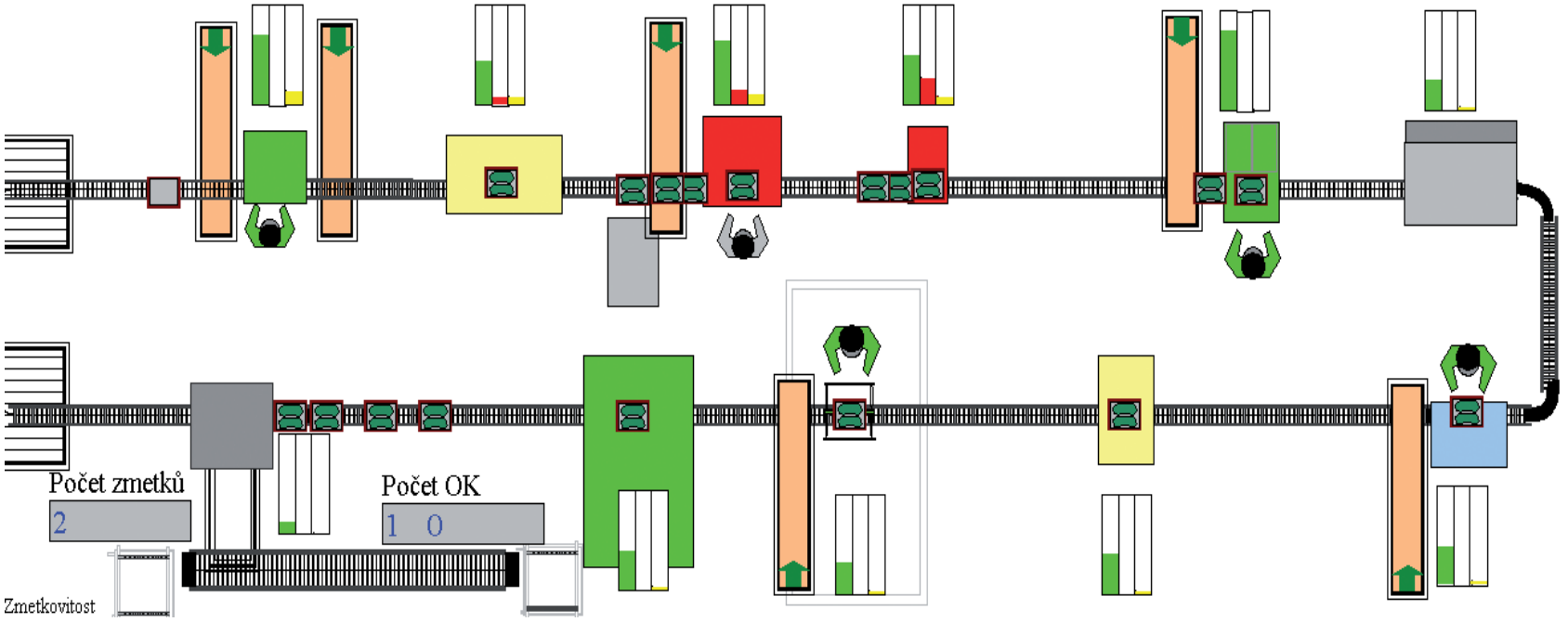
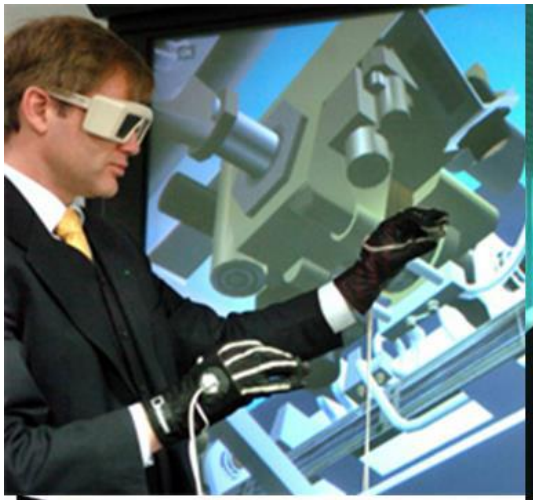
Modelling and simulation

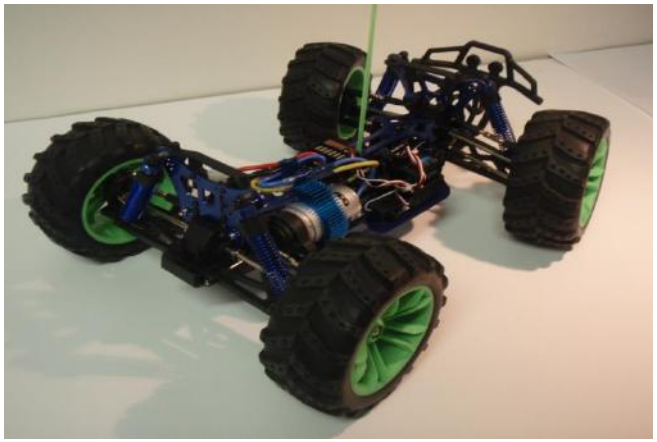


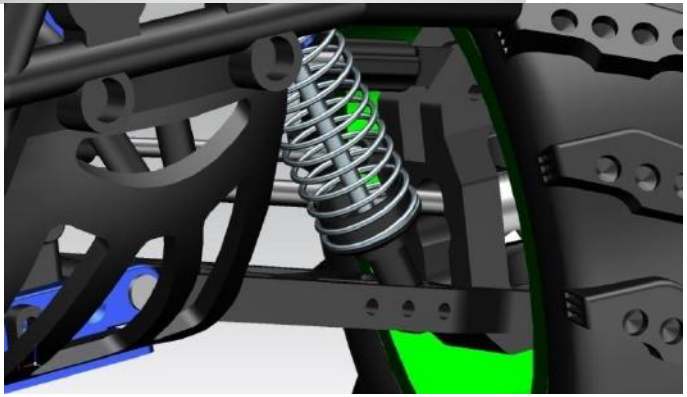


Virtual reality



Production





Video

- TeamCenter - http://www.youtube.com/watch?v=mIPfMnsCTm4
- Introduction to PDM - http://www.youtube.com/watch?v=6zNeunC-SX0
- Portfolio Management for Product Development - http://www.youtube.com/watch?v=67sLBThpAI8

Video

- NX 8 numerical control simulation - http://www.youtube.com/watch?v=6ZUpjWVwbSw
- CNC Simulation, verification and NC post-processing - http://www.youtube.com/watch?v=dJgcd0iBybo
- CNC simulation milling - http://www.youtube.com/watch?v=CL-I-RvMeAU

Video

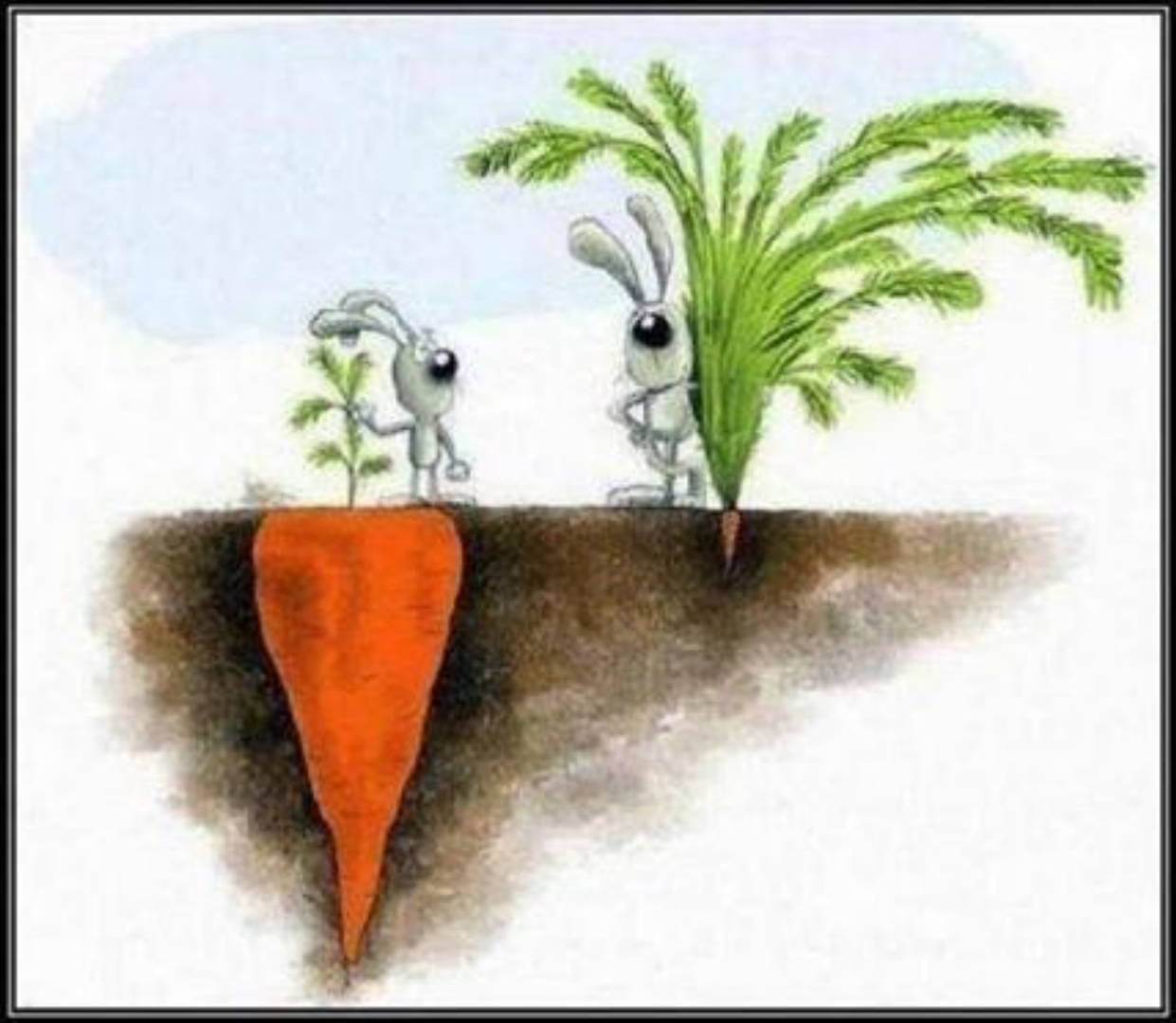
- Robotics Simulation at Volvo Cars with Tecnomatix - http://www.youtube.com/watch?v=Xx0PRMhev3A
- Tecnomatix 10 - Efficient Planning - http://www.youtube.com/watch?v=g-HFnjHXKGE
- Tecnomatix 10 - PLM for Manufacturing - http://www.youtube.com/watch?v=gvzL0ReckuA
- Tecnomatix 10.1 Process Simulate Human -- Real-time fatigue tool - http://www.youtube.com/watch?v=HBHtNKaNTk8

Video

- Tecnomatix Jack - Kinect Plug in - http://www.youtube.com/watch?v=4FoeydgNjRU
- Tecnomatix Jack - Kinect Plug - http://www.youtube.com/watch?v=vuY4vVPX4hs
- Augmented reality in industrial engineering - http://www.youtube.com/watch?v=_eX08z33vnc
- Augmented reality in industrial engineering - http://www.youtube.com/watch?v=vuY4vVPX4hs

Video

- Virtual CAVE on University of Žilina - http://www.youtube.com/watch?v=qJS5rqL2ahc
- Jack Tips & Tricks: Scaling Jack and Jill – Tecnomatix - http://www.youtube.com/watch?v=dXBKGrUuJ_A&list=PLB862277A1217D6A9
- Jack Human Simulation with MS Kinect - http://www.youtube.com/watch?v=_JIkoWV4yFo
- Human Simulation to perform Ergonomics Analysis in a PLM - http://www.youtube.com/watch?v=UZs-cCsMqaI



SUCCESS

it's not always what you see

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