Aalto University
School of Electrical
Engineering

Development of information systems

Information systems in industry ELEC-E8113

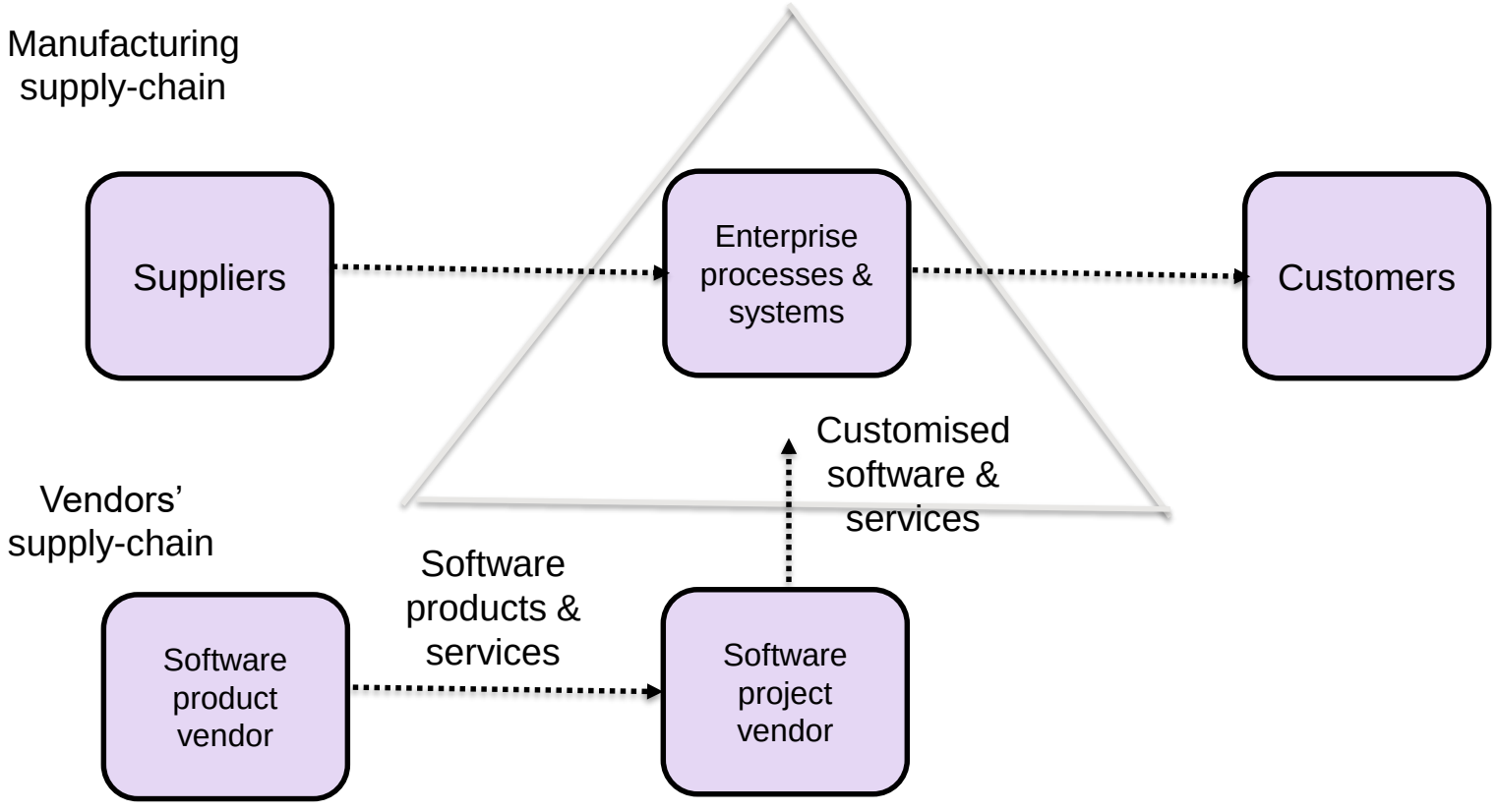
Start at 12.15!

Contents

- **Development of business processes**
- **Development of information systems**

Rationale of the lecture: Development of information systems in industry follows the general models of information systems development. It is part of business process development. Reuse of existing solutions in different ways is a good idea.

Situation


Manufacturing supply-chain
Suppliers
Enterprise processes & systems
Customers
Customised software & services
Vendors' supply-chain
Software products & services
Software product vendor
Software project vendor

Basic concepts (customer projects)

- You can develop both the business processes (what workers do) and the information systems (tools that workers use) of a manufacturing enterprise. These developments are strongly related.
- The objective of developments is business benefit. Business processes are the primary means and information systems secondary.
- You can create new business processes (radical change) or enhance existing ones (evolutionary change). Similarly with information systems.
- The requirements to information systems come from business processes
- Utilization of new information technologies may also motivate development of information systems
- Both development of business processes and information systems typically takes place within projects through particular steps. Essentially you are designing a path from a current situation (as is) to a target situation (to be)

Context of development (customer projects)

- Development of information systems often takes place as part of a business process development project
- It is desirable that development projects follow a development strategy
- Development projects may target existing production plants (brown field projects) or new ones (green field projects)
- Development project may involve one enterprise or a part of a supply-chain
- Development project usually creates most of the costs to the manufacturing enterprise whereas they get benefits later during operation
- Roles in development include users, and customer project vendor(s) and software product vendors
- Software product vendors have separate but related product development projects

Steps of development (customer projects)

- **One way to outline the phases of development (logical order):**
  1. Identifying needs
  2. Setting objectives
  3. Analyzing current situation
  4. Designing target situation
  5. Choosing a solution approach
  6. Developing applications and services
  7. Implementation, testing and deployment / commissioning
  8. Utilization, analysis, maintenance and redevelopment
- **Steps 1-3 are development of business processes, 5-7 development of information systems and 4 and 8 both**
- **Development is a change process during the lifecycle of the systems. Systems spend most of their time in the utilization phase.**

Identifying needs and setting objectives

- One can both proactively look for opportunities and react to observed shortcomings within the development strategy
- A development need can be a symptom of a problem, an observed opportunity or just a situation one has to react to
- A development need may concern business processes, information systems, manufacturing systems or organization or a combination of them of an enterprise or a supply chain
- After identifying a need one has to set measurable objectives and constraints for development, ususally in economic terms. KPIs are often utilized as objectives

Analyzing current situation

- The purpose is to create an understanding of the existing situation with required accuracy unless this is already known
- One needs to create an understanding between the reasons and symptoms of shortcomings, or properties of the enterprise and opportunities
- As a method one can utilize various types of modeling, e.g. BPM, to a required extent
- The target of modeling can be business processes, information systems and other properties of an enterprise and a supply chain
- The viewpoints of the EA may be useful

Designing target situation

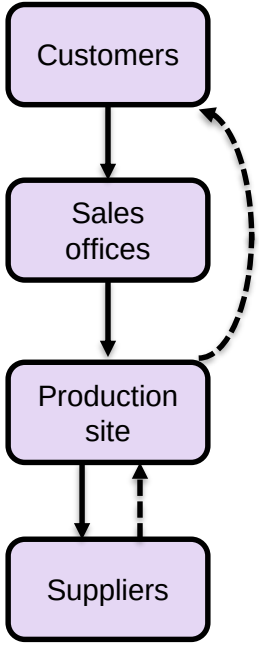
- The target situation is defined based on current situation, and objectives and constraints of development
- Create an understanding of a new situation with required accuracy and certainty
- Utilize modeling as needed. Modify models of current situation.
- Again, the target of modeling can be similar than in the analysis of current situation, i.e. business processes, information systems and other properties of an enterprise and supply chain
- Again, the viewpoints levels of the EA may be useful
- Requirements definition for the information systems based on this!

Define a solution approach (customer projects)

- The purpose is to define a project how to migrate from the current situation to the target situation
- An important decision is to choose to which extent the project will be based on software products or services, or customized solutions (make or buy). This has a strong effect on costs
- The trend is going towards increasing use of software products, e.g. MES, ERP, and efficiently done customization
- It is reasonable to utilize (reuse) existing applications in the manfacturing enterprise, available technologies, knowledge and standards in order to increase efficiency and reduce the risks of the development
- A particular type or part of development is integration of existing applications when the required functions and data already are in the existing systems that just lack interoperability

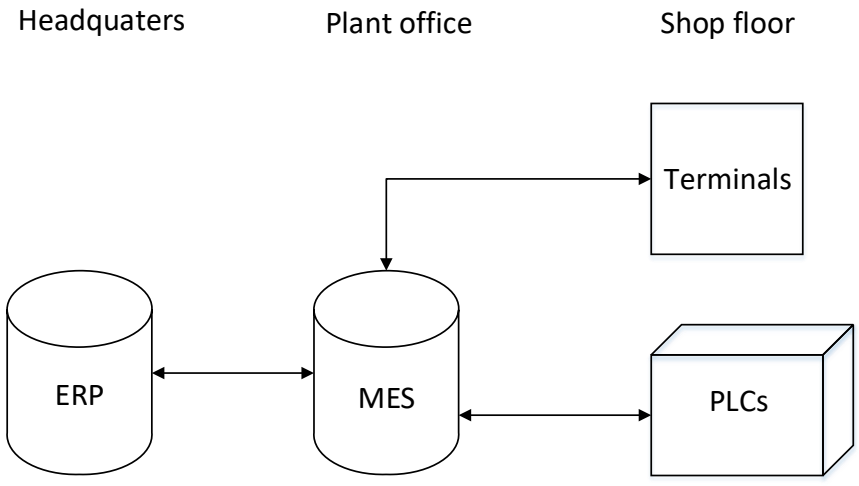
Example: Redesign of business processes in a supply-chain (2000's)

- **A company manufacturing expensive and customized consumer goods is loosing market share most likely due to their long delivery time**
- **BPM of the customer delivery process in the supply-chain identifying slack time in sales, purchases and manufacturing**
- **New sales and purchasing processes and early identification of issues in ordering and delays in manufacturing**
- **New agreements with partners, new sales configurator, enhancements in production monitoring**
- **Particularly integration of sales configurator and production monitoring with ERP**



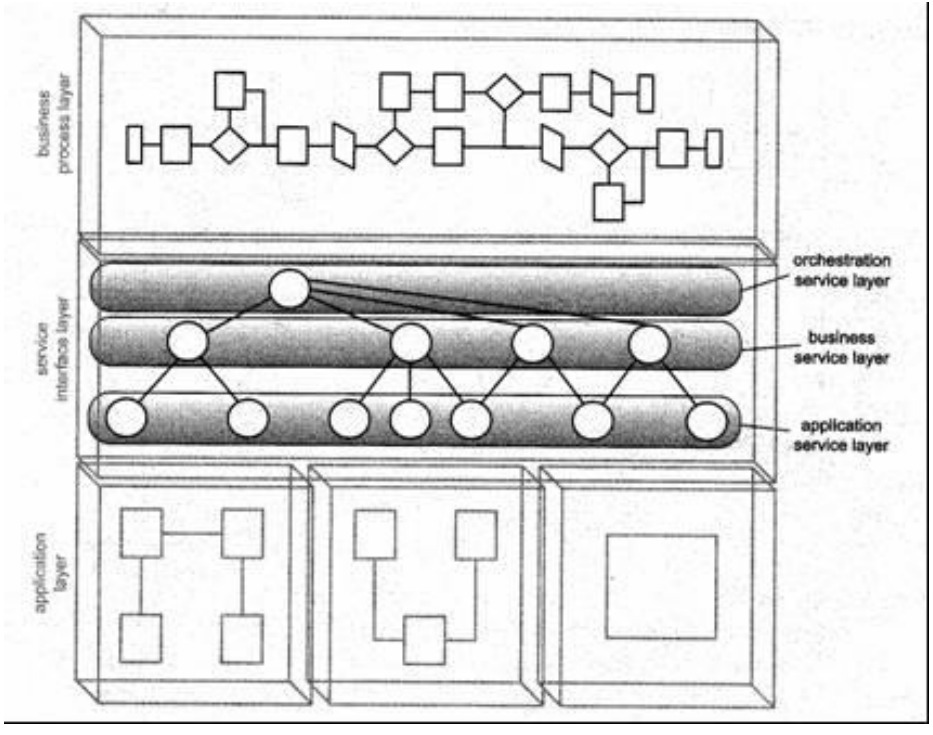
Example: Commissioning a new MES (2010's)

- A company in machine-building industry wants to achieve decreased tardiness of their deliveries
- An important problem is inefficient detailed scheduling with Excel
- More optimal detailed scheduling, work order monitoring and capability to better forecast potential lateness
- Production planning oriented MES with integration to ERP and shop-floor (some customization)
- Particularly modeling resources and products for the MES application and the integration tasks



Development according to SOA (both projects)

- Development of information systems is typically done according to a defined information system architecture of the enterprise
- If the architecture conforms to SOA the development can be made in terms of new or modified business processes, services and applications
- Entity-centric services before task centric ones
- There are also other relevant software architectures and different variations of SOA (e.g. cloud computing architectures)

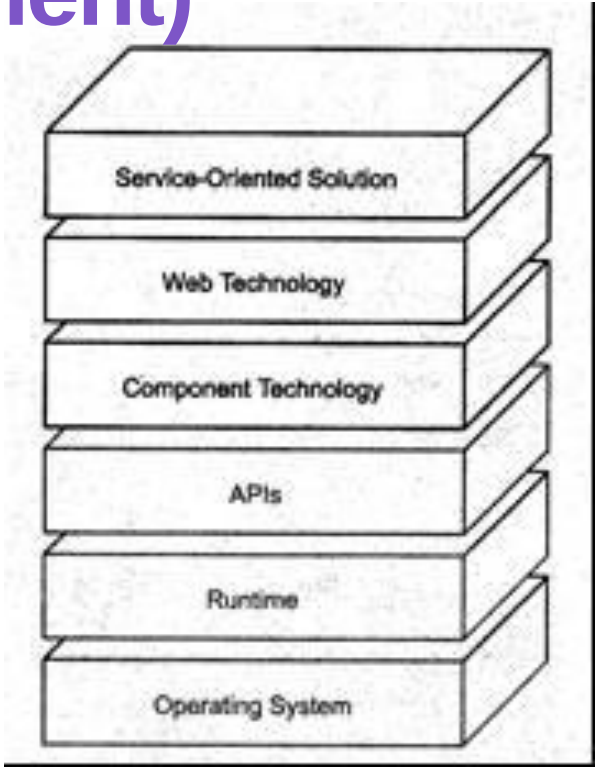


Utilizing existing software resources (both projects)

- Software products or services provided by vendors are likely to be a part of the new solution. Software products have some capability for customization and integration with other applications to be used in implementation, e.g. modularity, workflows
- It is often necessary or useful to utilize existing applications, e.g. ERP, when developing new ones. Existing applications maybe utilized through their interfaces.
- The new applications typically need to be integrated with the existing ones
- Various software resources (e.g. source code, libraries, components, applications, services) may be utilized using their required infrastructure (e.g. containers) and utilizing their architecture (e.g. frameworks)
- Knowledge about various existing resources is needed!

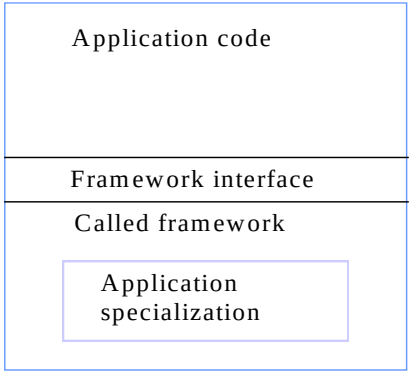
Utilizing technologies: Technology stacks (product development)

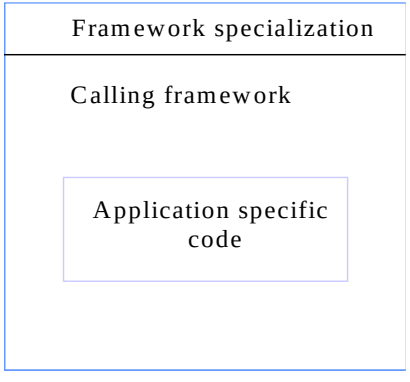
- Learning, choosing and utilizing existing software stacks is an important part of developing software products or customized applications
- A developed service-oriented application is depended on several layers of a technology stack
- Web technology can be based on e.g. SOAP, REST or OPC UA
- Applications may be developed with object-oriented programming, software components, scripting languages or visual programming languages



Utilizing technologies: Software frameworks (product development)

- Software platforms often conform to software frameworks
- The framework provides general purpose functionality which can be turned to applications through application specific code
- Understanding the framework is necessary for developing meaningful applications
- A called framework provide APIs that can be called from an application
- A calling framework will call the application through defined interfaces



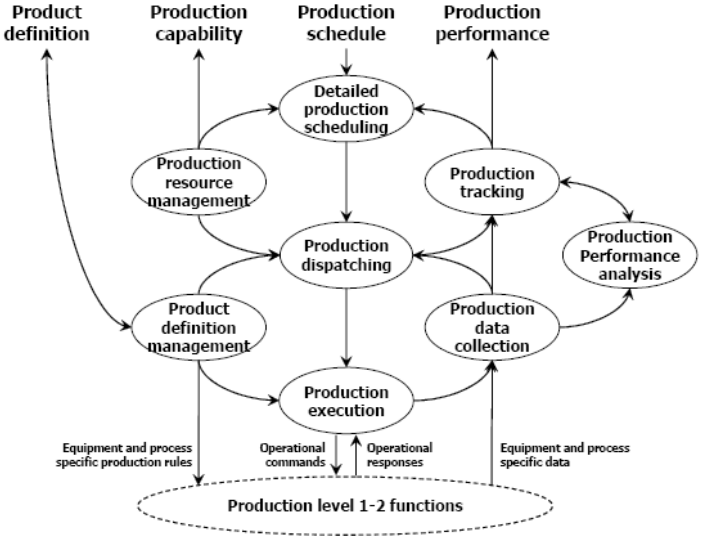


Utilizing design knowledge (both projects)

- **There are various types of knowledge that may be utilized in design and development in general. The types of knowledge may be categorized with following attributes.**
  - Owner: personal, organizational and public knowledge
  - Topic: requirements, designs, implementations, testing, deployment, maintenance
  - Type: tacit, explicit, documented, managed, implemented
  - Scope: specific (to an organization, about a design or a tool) or general
- **Design patterns are public, tested and documented design knowledge, which can be utilized if applicable**
- **Design patterns present designs of tested solutions to common design problems and their applicability and implications (e.g. OOP, SOA, EAI)**

Utilizing standards (both projects)

- Standards can bring unity to your information system when that is needed
- Technical standards, e.g. WS-* are useful parts of an information system architecture
- Application domain specific standards, e.g. ISA-95 and OPC UA, can be used as tools at different phases of development for analysis, design and implementation
- Standards are particularly applicable in multi-enterprise or multi-vendor projects and systems integration (e.g. OPC UA)



Implementation, testing, deployment, maintenance and redevelopment

- Vendor's viewpoint, user's involvement too
- Implementation, testing and deployment may include adoption of various new things, e.g. business processes, organizational structures, and information and manufacturing systems
- Implementation can take place as configuration or cutomisation of a software product
- Various activities will be needed during deployment, e.g. training of workers and coordination with partners in the supply chain
- The result of the development will be maintained and possibly redeveloped over a long period of time, which could create income to the vendor
- Applications can be maintained as cloud services

Commissioning, utilization, administration and analysis

- **User's viewpoint, vendor's involvement too**
- **Various activities will be needed during commissioning, e.g. workers and partners need to learn and adopt new business processes and information systems. Commissioning should not disturb on-going business**
- **The outcome of the development will be utilized and administrated over a long period of time, which should create assessable benefits and costs**
- **The benefits and costs are analyzed and compared to original objectives and constraints. Analysis should verify if the development project succeeded and the development strategy works**
- **If the business objectives of the development were stated in terms of KPIs their new values have to be monitored**