CSM-Hotel Handbook

The Final Report of the Project:

CSM*-Hotel - a new manufacturing concept for small and medium sized enterprises

(* Competitive Sustainable Manufacturing)

TAMPERE UNIVERSITY OF TECHNOLOGY

Tekes

Concepts of Operations

About CSM-Hotel project

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Introduction

Competitive Sustainable Manufacturing Hotel (CSM-Hotel) is a clean manufacturing facility that collects under same factory roof several SMEs which can reach the new level of sustainability, manufacturing expertise and business credibility, visibility and clean manufacturing standard by using parts of the facilities dedicated to each stakeholder and by sharing common parts of the manufacturing and design infrastructure having also the possibility to share the resources, knowledge and capabilities of other stakeholders of the CSM-Hotel.

Within the CSM-Hotel exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance current and future potential to meet SMEs' needs to adapt to STEEP (Society, Technology, Economy, Environment, Politics) context requirements. The planned approach is built on best knowledge of clean and sustainable factory, clean manufacturing automation and open ICT in form of SOI (Service Oriented Infrastructure) and automation 2.0. Efficient use of FMS technology and robots with integrated design and logistics is made feasible by resource and knowledge sharing within distributed information integrated system

Table of contents

I THEORETICAL PART

1.0 Introduction

1.1 CSM paradigm

The well-known definition of sustainability is: "*The Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" [WCED]. This political statement is the root cause for today's key global challenges and related problems that call for a drastic change of paradigm from economic to sustainable development. Competitive Sustainable Manufacturing (CSM) is seen as a fundamental enabler of such change [Jovane]. Sustainable development has been recently increasingly emphasized around the world; in Europe (Factories of Future Strategic Roadmap and the Manufuture initiative), the USA (Lean and Mean), and Japan (Monozukuri and New JIT) [Tuokko]. The CSM paradigm widens the classical view of sustainability to interact with the Social, Technological, Economical, Environmental, and Political (STEEP) context [FoF PPP]. Sustainable manufacturing is a multi-level approach where product development, manufacturing systems and processes as well as enterprise and supply chain levels need to be considered, with metrics identified for each level [Jawahir et. al.][Sutherland et. al.].

1.2 CSM-Hotel - State Of the Art

The Japanese Ministry of Education, the Science and Technology Agency, and MITI jointly launched a full-scale R&D project on "inverse factory" designed to recycle consumed and discarded goods. The project is aimed at realizing a type of society capable of maintaining harmony with its environment. Hitachi developed the Life Cycle Assessment (LSA) and Disassembly Evaluation Method (DEM) for its electrical appliances products. Through the application of LCA and DEM, it replaced the conventional plastic tub of the washer with a corrosion-free stainless steel tub in 1984. And for example in 1990, Honda established the "Recycle Committee" and a Bumper Recycling Program and has been collecting used bumpers for remanufacturing. Many parts have since been produced from recycled materials.

MITI initiated an "Ecologically Conscious Factory" or "Ecofactory" project in 1992 with a 10-year R&D program budgeted at 15-20 billion Yen. It was done in conjunction with IMS-project together with EU and US. The research concentrated on developing production system and restoration system factories. The production system factory focuses on the product design and the materials processing, machining, and assembly stages of the product

life cycle. The restoration system factory is concerned with the recycling and disposal of materials at the end of their life. The formal IMS program began in 1995 following this two-year feasibility study (1992-94).The Japanese concept of the Ecofactory essentially consists of a production system factory and a restoration factory. The "Integrated System for Disposal of Home Appliances“ recycling factory pilot plant was built for demonstration 1998 within joint IMS project HIPARMS in which also TUT (Tampere University of Technology) participated. Toyota auto disassembly manufacturing started in October 1995 to establish recycle technology in body disassembly. Toyota CIM (Computer Integrated Manufacturing) developed in context was called MEchatronic NETwork (ME-NET). In Japanese CIM flexibility exists as a goal (among others). Japanese CIM was customer oriented, information arriving from customer via the planning system, and incorporated into the CIM activities. This point is crucial because it meant a fundamental change in all the economic logic that has dominated in more than a century. Economics systems was now pulling by demand and not pushing by supply. In an effort to understand the impact of the first 5 years of the IMS, a Mid-term review was initiated. It was reported that the Organisation successfully established a framework for global research, but could not evaluate project success at that time because only one project was completed.

1.2.1 Benchmarking Japanese Eco-Factory -projects 1990-2011

The manufacturing industry in Japan was 1990 facing serious structural problems brought about by their rapid development of overseas activities and manufacturing factories. The formal IMS program began in 1995 following a two-year feasibility study (1992-1994).

They established a support system project to developed manufacturing systems with operational environment transmission capability that should incorporate the following functions:

1) Multi-sensor Integrated Monitoring and Control System: The display of information to operators in remote sites requires many different sensory output devices. The performance of machines should also be measured, monitored, and adjusted remotely. A "watchdog" agent has neural computers providing on-line composition and reasoning.

2) Communications and Integration: The remote manufacturing system should encompass a multimedia information environment for information processing and transferring among geographically dispersed participants.

3) Data Abstraction: The transmission of compressed data may require a physical model of the manufacturing process. As a result, with only modifications of the

model parameters, information can be transmitted across the communication network.

4) Knowledge Acquisition and Learning: Intelligent tools are required for the acquisition and organization of the data in manufacturing processes to share with other manufacturing sites. In addition, the system should learn the behaviours of users from different sites.

5) Natural Language Translation: Tools are required for automated translation of texts between different languages. In the ideal case, the translation would be fully automated, highly accurate, stylistically perfect and applicable to many languages and many styles of text.

6) Tele-Maintenance and Collaborative Diagnostics: Multimedia- based Tools are required to support remote users for maintenance assistance. Interactive and collaborative tools will enable the technical personnel to perform diagnostics from a remote distance.

The committee for the "Promotion of Advanced Information and Communications Society" was been established in the cabinet to make active efforts to formulate policy for the promotion of the information society.

Also 1990 as important manufacturing related research activities, a Team working Environment for Advanced Manufacturing (TEAM) program was also been developed by the Mechanical Engineering Lab. of MITI to establish a collaborative design and manufacturing network system for the manufacturing industries.

Considering the deficiencies of the current control architectures and challenges presented above and the ineffective implementations of CIM, in the last decade, the research community introduced a number of new concepts for the design of manufacturing systems, such as bionic, fractal or holonic systems. The holonic system research in Europe was concentrated on Multi Agent System based controls and only lately Paolucci et. al. has been observed that “holons in a holarchy are quite similar to agents in MAS only if one disregards the fact that a holon can contain other holons”. The other difference comes from the modelling abilities of the constituent entities of the two types of systems. While agents are pure software entities, holons can include hardware, software and humans. The Japanese approach as autonomous systems has already led complete factory wide implementations.

1.2.2 Benchmarking Japanese Eco-Factories 1990-2011

1.2.2.1 Toyota – Implementing the Factory of the Future

Toyota is one of the original MITI initiated "Ecologically Conscious Factory" or "Ecofactory" project members and actually launched the Takaoka ecofactory project in 1992. 1990 Eiji Toyoda in conjunction with new ecofactory program set the task of new type of integrated R&D for creating the 21th century car (G21, The Prius project). This was also a follow up of integration of TPS –TDS-TMS that began 1984. At the same time (1992) Toyota introduced the Center System (Vice President Kimbara; the focus is not on function alone but developing better cars). For the first time the team leader came from R&D division (Uchiyamada) to develop a new integrated method for car development out of "uncertain departure". They started on the new approach merging soft and hard systems to develop first a concept-oriented approach based on simulations. Two key issues were "natural resources and environment". The factory to produce Prius was selected to be the Takaoka Plant that was to be the first ecofactory. Since then new Tsusumi plant was done to meet the growing demand of Prius and the new Prius factory in Mississippi is going to be similar.

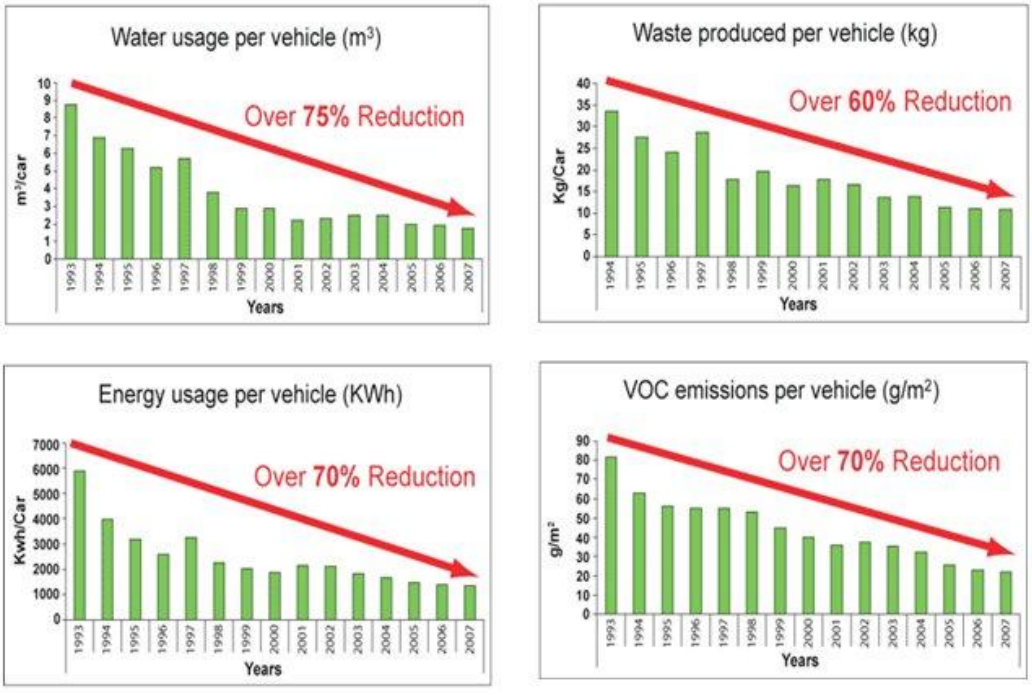

Figure 1: Toyota results

Toyota is known for its TPS (Toyota Production System) that has been evolving constantly. At 1992 it participated the big Japanese Ecofactory – project together with their main partner Denso and started the development of "NewLean" they call SSS (Simple Slim and Speedy) and development of current ecofactories. DENSO call their ecofactory as Perfect Energy Factory (PEF) and new approach CS3 (Compact Simple Slim and Speedy). They

started new holonic/bionic approach and the integration of TPS-TDS and TMS (Production-Product and Order). As the basis of the project was research that noted that more than 95% of the resources lifted from nature are wasted before the finished goods reach the market. And many industrial products - such as cars -demanded additional natural resources while being used. The definition of goal was similar to Europe INNOVA panel later did on eco-innovation: Ecofactory means the creation of novel and competitively priced goods, processes, systems, services, and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural resources (material including energy carriers, and surface area) per unit output, and a minimal release of toxic substances. The test factory was Tsutsumi plant which now is one of five Toyota global Eco-Factories worldwide that are designed to minimise the environmental impact and develop best practices for adoption elsewhere. Among its accolades, it has held the ISO14001 green standard for environmental management since 1996 thanks to innovations in energy saving, recycling and waste management. Tsutsumi meets half of its electricity requirements thanks to an array of solar panels, while the rest are met by an efficient gas co-generation system. To ensure only as much power is used as needed, energy saving lighting has been installed and patrols are carried out to monitor usage. Furthermore, the building even helps clean up the local environment as 22,000m of the assembly plant is covered in photocatalytic paint that reacts to sunlight and helps to break down harmful substances such as nitrogen oxides. The plant sends no waste to landfill and has reduced the amount incinerated by 82 per cent to 730 tonnes from 1999 to 2006. It aims to eventually cut this amount down to zero. Between 2003 and 2007, CO2 emissions have also been slashed by 36 per cent. Water usage fell by 14% during the same period, and a stringent recycling system has halved the amount discharged into local rivers; what's more, the water that is released from the plant is actually cleaner than the waterways it is from.

Implementing Radical Innovation or The Factory of the Future

As for *kakushin*, Toyota envisions its high-volume Takaoka, Japan, plant as the factory of the future: "*If processes are complex, it is difficult to identify the cause of problems. The processes at Takaoka are simple, keep the facility slim, and have people close by observe the process.*"

Figure 2: Toyota, Takaoka Plant, Japan

Toyota is aiming to set new standards at Takaoka for quality, productivity and flexibility and environmental performance. Takaoka has "Toyota's fastest production line that cut lead

times, logistics and the assembly time in half. And as Toyota has cut the length of Takaoka's assembly lines to half and reduced tree lines to two, it ditched the plant's huge, expensive machinery in favour of smaller, more nimble equipment. Using innovative approaches in virtually every step of the manufacturing process, from stamping and welding to painting and final assembly. And instead of a transfer bar, using partner robots. That allows the line to move 1.7 times faster than it used to. A new painting process allows us to apply three coats at the same time, without having to wait for each coat to dry. This shortens painting times by 40 percent. To build in quality, we will go beyond visual inspection and use high-precision instruments to measure several parameters. "The new manufacturing process at Takaoka completely change the way Toyota makes cars," and is called 'simple, slim and speedy' production system."But "simple" doesn't mean "simplistic." Indeed, the Takaoka plant is one of Toyota's most flexible plants capable of producing 16 models in two lines. The ramp up of new model is reduced to three months from one year and amount of change needed to 20%.

Watanabe said: "*We will have more flexibility than ever before: Each line at Takaoka will be able to produce eight different models, so the plant will produce 16 models on two lines compared with the four or five it used to produce on three lines."*

Takaoka previously built 660,000 cars a year on three lines. After the revamp, it will have the capacity to build 500,000 on two, shorter lines. While production volume will be lower, the plant will be much more efficient.

For Watanabe, being No. 1 means "being the best in the world in terms of quality." If Toyota's quality continues to improve, he says, volume and revenues will follow. If problems arise from over-stretching, he wants them made visible, because then his people will "rack their brains" to solve them — and if that means postponing growth, so be it.

As such, there are three keys to building a stronger foundation for Toyota's future, Watanabe said: "We must improve product quality, keep reducing costs, and, in order to attain those two objectives, develop human resources."

Indeed, the lean enterprise embraces a common language and culture based on customers and people. It's no longer enough to reduce costs and improve efficiency — companies must tap the only resources that make them unique: people and their ideas and abilities.

Key lessons learned from Toyota's energy efficiency successes include:

- Efficient support organisation and benchmarking: Focuses on the six internal activities from KPIs to target-setting. Maintains the three more outward-facing activities — creating visually-interesting reports for senior management, benchmarking performance against competitors and third party programs

- Work hard to make your Kaizens permanent: Temporary improvements are of limited value. Remove old methods, equipments, and processes after improved versions are developed.

- Look at new technologies and try to build them into the design and production process: Pilot projects can be helpful in demonstrating success and overcoming resistance from production staff and others more focused on product quality and volume.

- You can never report too much information: At the same time, it is important to recognize that different company officials will require different types of information. A deluge of data can be costly and cumbersome to sift through, especially for senior managers with limited amounts of time on their hands. Toyota goes to great lengths to gather and report vast amounts of data, but equally important is the effort the company puts into rolling this data up into more streamlined reports that senior management can easily digest and act upon.

- Awards and recognition—both internal and external—are important: These have the effect of motivating facility staff to go beyond strict compliance with environmental laws and regulations and instead reach for a higher level of energy efficiency and sustainability.

1.2.2.2 Hitachi - Super Eco-Factories & Offices

Hitachi was another important company in 1990 ecofactory project. Since then Hitachi has created Super Eco-Factory & Office certifications that are given to facilities that have achieved an industry-leading environmental load reduction. They certify those facilities as Eco-Factories & Offices that have both met their targets for the fiscal year under their GREEN 21 system for comprehensively evaluating environmental action and have performed above the given criteria in areas such as energy efficiency, improvements in resource recycling, and volatile organic compound (VOC) emissions reduction. Hitachi target was to bring up to 30 facilities, or 10 percent of the approximately 300 facilities eligible for certification, to the level of Super Eco-Factories & Offices by fiscal 2010, and the facilities themselves have worked hard to achieve a high level of load reduction in order to be

certified. As a result, three more facilities were named Super Eco-Factories & Offices in fiscal 2010, bringing the total to 35 (23 in Japan and 12 outside Japan).

To encourage environmental conservation, information on initiatives at these facilities is shared within the Group, along with energy-saving and water-processing technologies that are relevant to other Group companies. Facilities yielding outstanding results after introducing Hitachi Group energy-saving products conduct factory tours to demonstrate these products to people within Hitachi and to others.

As part of Hitachi's Third Environmental Action Plan, they will review Super Eco-Factory & Office certification criteria and mechanisms, launching a new designation: Eco Factory & Office Select. Certification criteria will be developed individually according to the characteristics of Hitachi manufacturing (factory) and non-manufacturing (office) divisions. For factories, standards will be raised for energy efficiency, renewable energy use, as well as water recycling and other Super Eco-Factory & Office certification criteria used to date. For offices, evaluation criteria will be established in areas such as energy saving for lighting, renewable energy use, and a building's overall environmental protection.

To maintain and raise the level of environmental activities in Eco Factories & Offices Select, certified facilities will be re-evaluated every year to check whether their performance for that fiscal year still meets the certification criteria. Hitachi goal is for every in-house company and Group company to have at least one facility certified by fiscal 2015.

Facilities already certified as Super Eco-Factories & Offices will be re-evaluated based on the new criteria.

1.2.2.3 Toshiba's Eco-Factory strategy

Toshiba has also been building its ecofactory strategy along with other first runners (Figure 3). The approach of Toshiba reflects closely the linkage of Life Cycle Assessment (LCA) for impact awareness and systems thinking utilizing Quality Function Deployment (QFD) for strategic adaptation of the system (Figure 4).

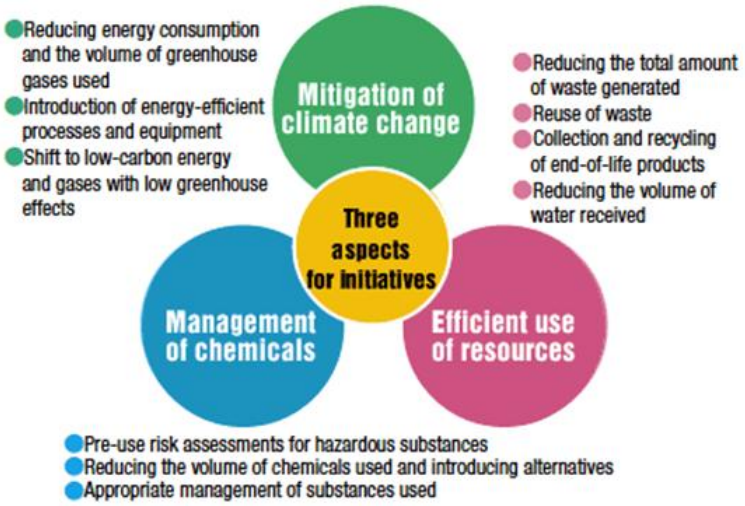

Figure 3: Toshiba's initiatives to reduce environmental impacts

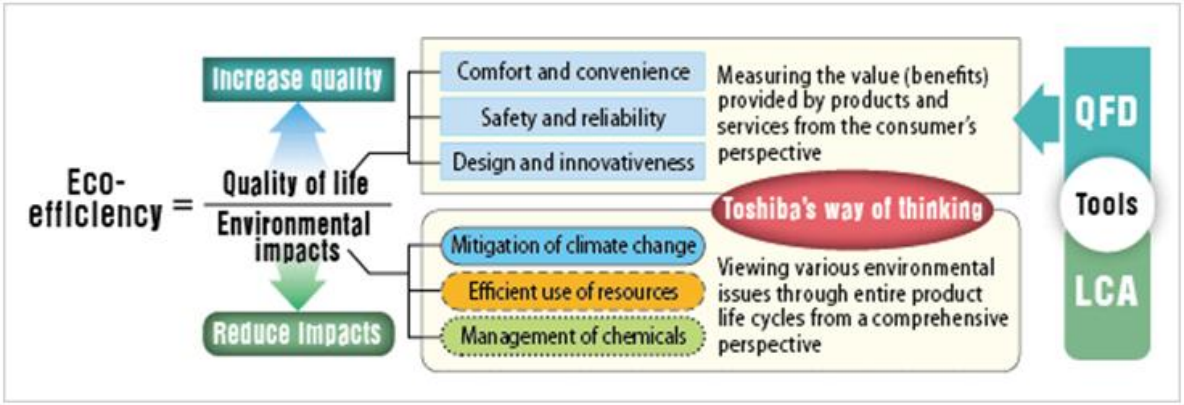

Figure 4: Toshiba's approach to reduce environmental aspects

1.2.2.4 Panasonic initiatives for eco-conscious factories

Panasonic was one of the 15 IMS companies and has developed consistently its approach towards GF (Green Factories.) The visual clarity of its key KPIs highlights their ecofactory approach. In addition to the existing indicators of "emissions reduction" and "reduction activities," "environmental performance strengthening," "risk reduction," and "HR development" have been added to promote GFs with a wider view (Figure 5). Noteworthy is the linkage of strategy and impacts.

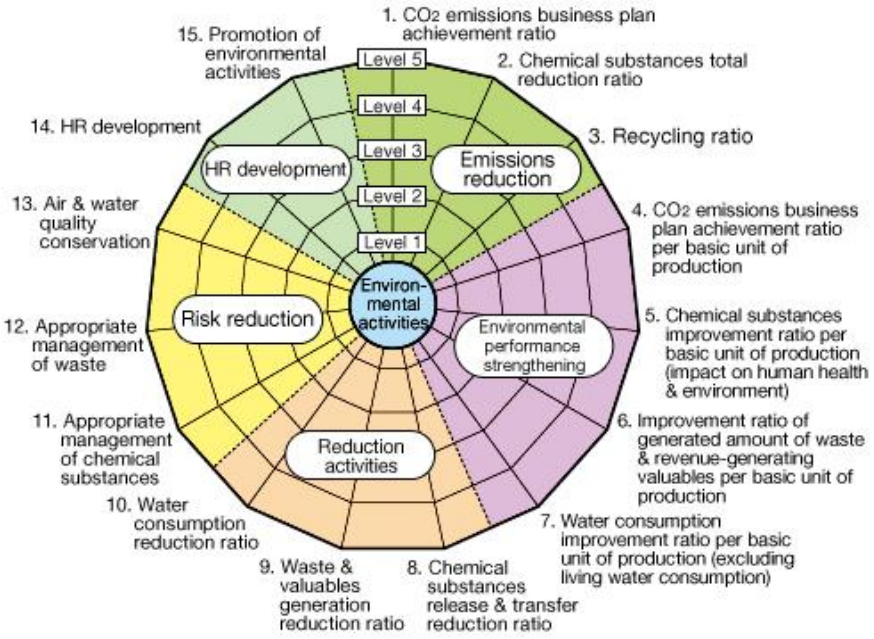

Figure 5: Panasonic - Indicators for GF assessment system

Green Factories aim to reduce environmental impact to as close to zero as possible. Reduce the environmental impacts in production activities focusing on factories' CO2 emissions, total waste generation, and chemical substance releases and transfers in midterm business plan and business goals, and implement those plans as well as progress control. Panasonics "Smart energy system" links and coordinates all systems to optimize the performance of saving, creating, storing and managing energy (Figure 6).

Figure 6: Panasonics smart energy system

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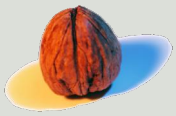
2.0 CSM-Hotel concept



IN NUTSHELL:

- *DiMS*
- *EDMS*

2.1 Background / Previous related research

In the background of the CSM-Hotel project there is the long time research work in the field of new production concepts. Enclosed the results of the previous projects have been briefly shown.

2.1.1 DiMS: Framework for Distributed Manufacturing Systems

The DiMS concept (Figure 7) aims to enable collaborative and autonomous manufacturing systems to respond more efficiently to challenges in dynamically changing global markets. The goal is to integrate the design and development activities of products, production systems, and business processes, supporting innovativeness from ideas and visions to efficient results. The DiMS concept is realized in the form of service-oriented and learning-based activities connecting requirements with existing capabilities and future possibilities. The information and knowledge of manufacturing systems is stored digitally, which makes it possible to have up-to-date information and knowledge that evolves with each manufacturing activity. This enables the accuracy of the information and knowledge to be used as the basis of future design and development activities.

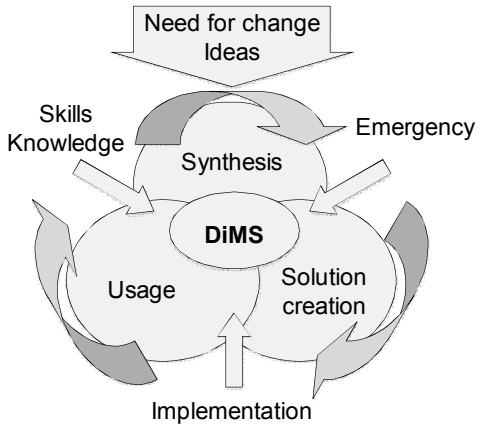


Figure 7: The framework of the DiMS-concept

The key characteristics of the DiMS approach are briefly explained as follow:

- Adaptive manufacturing, consisting of autonomous and co-operative manufacturing entities, capable of fulfilling their own tasks, and of operating together with other entities.
- Knowledge-based learning manufacturing entities, capable of developing and learning from the actions, constantly updating their skill and knowledge for future operations.
- Service-oriented activities, where the communication between the entities is seen as services. Only needed information is included in the services and the skills and knowledge are kept as the autonomy of the entities.

- Context-aware manufacturing entities, as a system is always part of a wider system. The entities are communicating with other entities, whether they are part of the same enterprise or existing in the manufacturing network.
- Formally presented manufacturing system ensuring that the information and knowledge exists only once in a formal and up-to-date form available to all related parties.
- Digital manufacturing system, as a domain where the information and knowledge of the entities as well as the manufacturing domains and activities is described as a digitally presented manufacturing system.

2.1.2 EDMS: Framework for Extended Digital Manufacturing Systems

Extended Digital Manufacturing Systems (EDMS) aim at an integrated environment for products, production systems, and business processes (Figure 8). The reference model of EDMS consists of manufacturing entities with different roles and their related domains and activities. A digitally presented manufacturing system contains the information and knowledge of manufacturing entities and activities that it is reasonable to represent in a digital form. This, at its best, makes possible efficient collaboration between all the manufacturing activities and related parties.

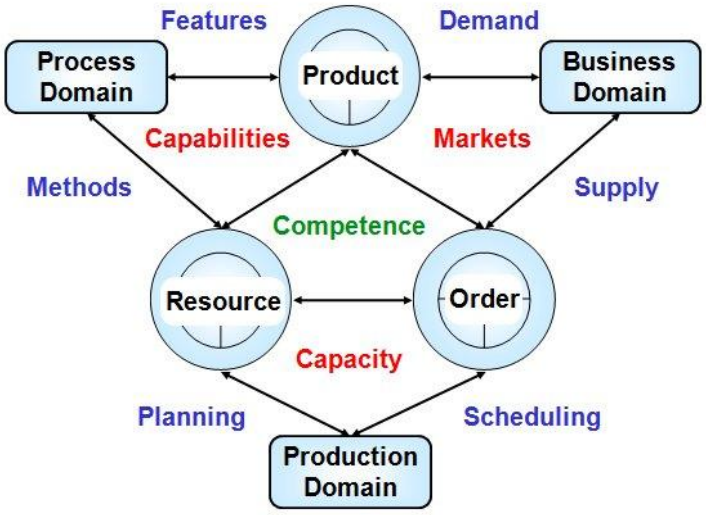


Figure 8: Framework for Extended Digital Manufacturing Systems

An EDMS can briefly be defined as follows:

- an integrated and collaborative environment for humans, machines, and information systems to act and interact;
- to enhance the research, development and management activities of products, production systems, and business processes,
- supporting knowledge-intensive decision-making in the entirety of their lifecycles.

The main areas of EDMS are modelling, simulation, analysis, and the management of changing information and knowledge. The enablers for these are the possibilities provided by ICT, together with human knowledge and skills. The key characteristics of the DiMS concept, which are mostly related to EDMS, can be explained as follows:

- An adaptive and knowledge-based manufacturing system consisting of autonomous and co-operative manufacturing entities.

- Service-oriented and context-aware manufacturing activities, where the communication between the entities is seen as services and the skills and knowledge are kept as the autonomy of the entities.
- Formally presented information and knowledge presented as a digital manufacturing system, a domain where the collaboration activities are happening between humans, machines, and information systems.

Modelling, Simulation, and Analysis

The roles of modelling, simulation, and analysis in the research and development of EDMS are:

- modelling aims to create a virtual replica of real-life manufacturing entities. It is used to understand a system and its behaviour. It can be used to repeat or refine an activity to achieve a specific result, as well as to extract a system in order to apply it to a different content or context [Dilts, 2005];
- simulation aims to understand the dynamic behaviour of the collaborating manufacturing entities, and
- analysis aims to verify and validate the results of simulations. The consequences of the solutions can be evaluated and the results of solution alternatives can be compared.

Change Management

Manufacturing systems operate in a constantly changing environment. The changes can be external or internal, direct or indirect, mandatory or voluntary. Change management intends to keep a manufacturing system operating efficiently and growing when it evolves over time. Changes in one area should be announced to the whole system. The earlier the changes and their impacts are known, the better the chance is of an efficient solution being implemented. For example, changes in product requirements, caused by a future product in the development phase, may require new capabilities and the planning for the new resources can be started. In a similar fashion, a new resource to be included into the existing system can offer new capabilities and these can be utilised in the development of the product even before the resource is actually implemented into the real system.

Change management can roughly be divided into managing the distributed information and knowledge that originates from different sources, as well as managing the communications between manufacturing entities of different levels of intelligence [Nylund et al, 2009c]. The evolution of the system entities can be seen from two different aspects of changeability [Nylund et al, 2008c]:

- changing by requirements – the ability to change to meet new requirements, where the structure of the system is changed, and
- changing by learning – the ability to improve the current capabilities by learning and updating the information and knowledge.

Typically, the entities must change during their existence both to meet the new requirements and to improve their activities [Nylund et al, 2009a].

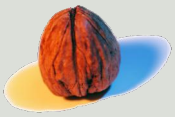
2.2 Introduction of the CSM-Hotel concept

The idea of the CSM-Hotel originates from industry. The main point is to collect several SMEs under the same factory roof offering partially shared hardware and software resources and solutions for collaboration. This enables the companies to focus on their core competences, and a new level of sustainability and competitiveness in their actions and interaction can be reached.

2.2.1 Main Characteristics

The characteristics of a CSM-Hotel can be described with the following terms; sustainable, competitive, adaptive, and optimised public-private model. Competitive refers to the ability to operate profitably and compete in global markets. For manufacturing companies, the ability to produce and provide products that meet the needs of customers in a profitable way plays a key role in achieving and realising competitiveness. In most cases, companies seek to respond to the challenges through collaboration rather than expanding their own operations [Wiendahl].

Sustainability, on the other hand, is defined as actions and development that meet the needs of the present without compromising the ability of future generations to meet their own needs [WCED]. Thus, competitive sustainable manufacturing requires manufacturing systems, processes, and outputs to be competitive and sustainable, i.e. profitable and viable now and in the future. An adaptive system must continuously adapt itself to the changing nature of its environment or it will become extinct. Similarly, a manufacturing system must change continuously to meet the changing requirements of the environment. An adaptive organisation would be able to survive in a business environment that is changing unfavourably.



IN NUTSHELL:

- *Working Under the Same Roof*
- *Collaboration*
- *Shared Resources*
- *Focus on Core Competence*
- *Public-private model*
- *Competitiveness*
- *Sustainability*

An optimised public-private model combines the best aspects of public and private viewpoints. The public part means joining the forces of several companies to cooperate under the same criteria and common overall control, and to agree on how transparent the companies are in their actions. The private part means that the companies still own their production entities, work as private companies, and have their own capabilities, as well as goals that are not contradictory to the common goals of the common environment.

2.2.2 General CSM-Hotel Structure

The basic idea of a CSM-Hotel structure can be explained with similarities to bus modularity. The companies all connect to a common integration platform via a bus or frame-type structure with standard interfaces [Pine]. Figure 9 shows examples of hardware and software options that can be connected to a common integration platform. The companies, as well as shared manufacturing and material handling resources, are connected to the platform both on the hardware and software levels, enabling integration to take place on both the physical and information system levels.

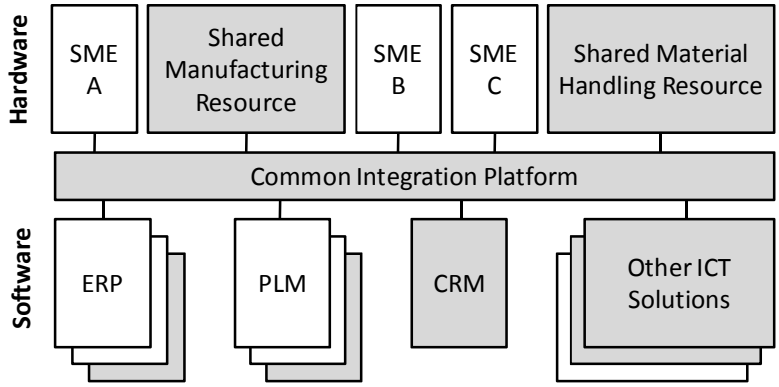


Figure 9: Principle of a CSM-Hotel software and hardware integration.

In addition to the integration of information systems, to ensure efficient and timely information flow and exchange, an important issue in the integration is the ICT configuration of a company that enters a CSM-Hotel. The CSM-Hotel concept favours cloud services and SaaS (Software as a Service) approach to ICT solutions, such as enterprise resource planning (ERP), product lifecycle management (PLM), customer relations management (CRM), and other ICT solutions. The support systems are required to be configured to match a common service interface, which companies can connect to. This lowers the configuration costs and allows several systems to be used simultaneously.

2.2.3 Operating in a Common Environment

A CSM-Hotel consists of individual and independent companies, as well as a common operating environment where the companies are interacting and utilising the same factory environment, including, for example:

- administrative services
- infrastructure of shared facilities and services
- decentralised production planning and control
- sharing knowledge, know-how, resources, and experience

Common administrative services include, for example, finance, human resource management, and purchasing and sales. Companies can use services acquired by the CSM-Hotel for operations such as hiring people, worker training, legal contracting, accounting and financial reporting, public relations, purchasing materials, and managing incoming orders.

This kind of environment includes common infrastructure for ventilation, heating and cooling, power, and lighting, as well as premises for offices and break rooms. The concept also enables common parts of the infrastructure to be shared, such as shared manufacturing and material handling resources, as well as maintenance, ICT support services, and training and education. Connecting the environment to its context includes mutual procurement and logistical solutions.

Production planning and control methods follow the guidelines of holonic production planning, e.g. [McFarlane]. The problems of centralised production planning systems that have been identified include a slow response to disruptions, uncertainty about the integrity of information, dependence on the reliability of the central node, and costs associated with reconfiguring the planning system [Ouelhadj] [Babiceanu].

Most of these issues can be avoided with a decentralised approach in which each company can have an independent control system. The challenge in the CSM-Hotel environment is to assure the coherence of planning in the parts where the companies collaborate in order to create efficient results over the whole system. At least a combination of the following two approaches can be used to increase control over the entire system.

1) Rule-based control methods. Companies can agree on a common set of basic control rules to assure the quality of the overall service level. These rules can also be changed over time.
2) Internal bidding system. In this system there is an internal dynamic market for the available services. The production units set the prices of services according to their internal states, which can be used for dynamic planning and control.

The participating companies also have the possibility to share their individual resources, knowledge, and capabilities with other companies. The companies can learn from each other to improve their own capabilities and develop the potential ability of the CSM-Hotel to be more successful and productive as a result of the synergies.

Despite interacting in a common environment, the companies have control over their own resources and intellectual property, and can act on the basis of their own visions and strategy, in harmony with the mutual environment and goals.

2.3 Different Roles of CSM-Hotel actors

2.3.1 Ownership of the CSM-Hotel

At least three different approaches to implementing a CSM-Hotel have been distinguished. The difference is in who is leading the hotel, i.e. a client company, a group of SMEs, or a hotel service provider.

A client-led hotel is probably the most likely alternative when a large company is aiming to harmonise the activities of some of its subcontractors. In this case, in addition to the SMEs in a hotel, it is also possible that the client company will relocate part of its own processes inside the same CSM-Hotel.

A more challenging alternative is a group of SMEs implementing a CSM-Hotel together. The aim of this alternative could be that the SMEs would seem a more interesting player to bigger companies when they offer their services together. As SMEs typically have limited resources and time aside from their core activities, they will most probably need external help to implement a CSM-Hotel. This alternative lacks a party that is running the operations of the CSM-Hotel and therefore it is necessary to decide who is in charge of maintaining the activities. At least in the longer run this will probably lead to a situation where an independent company will be formed to serve this need.

In the third alternative, a distinct player offers the CSM-Hotel as a service for possible client**s**. In this case the CSM-Hotel owner is merely offering the service and is aiming to develop and improve the concept to offer improved services in the future. In this case the actual CSM-Hotel structure will fall into either of the two first alternatives.

IN NUTSHELL:

Structure of Hotel:

- *a client-led hotel*
- *a group of SMEs*
- *Overall Service Provider*

Overall Service Provider is responsible to offer needed services and upkeep the infrastructure

An efficiently operating CSM-Hotel environment requires parties with different roles.

2.3.2 CSM-Hotel Overall Service Provider

CSM-Hotel overall service provider should be an independent actor, who's core competences are focused on acquiring services needed in hotel, development of general infrastructure and marketing the facility to external customers and interest groups. The main tasks of the overall service provider is to acquire desired services and upkeep the infrastructure, and charge the participants based on the volume of services that they use, see Figure 10.

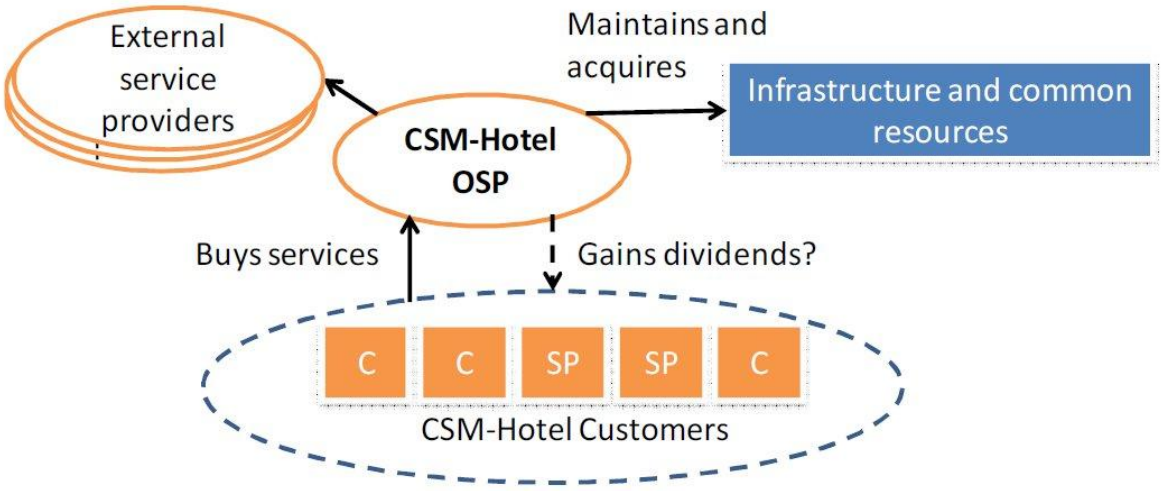


Figure 10: General Organization of the CSM-Hotel OSP

The CSM-Hotel OSP can be a cooperative or a limited company owned by the participating companies. Another option is to have a completely separate third party company to govern the CSM-Hotel. In either case, CSM-Hotel has the right to choose its customers. Direct competitors should not be included in the same hotel to avoid conflicts of interests and reduce risks of detrimental actions. CSM-Hotel customers can also include internal service providers who mainly focus on serving the manufacturing participants.

The profit generation logic of CSM-Hotel OSP is based on economies of scale and steady overall demand. As a big buyer it can gain discounts from purchases. The profitability of OSP is based almost solely on utilisation rate of acquired infrastructure and transaction costs, which means that flexible use (low setup costs) of shared resources is essential.

Combining the independent demand variations of the participants should level the variation of overall demand and thus allow higher utilisation rate with smaller penalties for lack of capacity. In case of a radical decline in demand of services, the CSM-Hotel OSP can look up for new clients to fill the gap in capacity. The environment should also work as an efficient after market for machinery, in which companies can sell capacity to each other or to the OSP.

2.3.3 Different Parties of the CSM-Hotel Environment

An efficiently operating CSM-Hotel requires parties with different roles, not just the companies performing their manufacturing activities within the hotel environment. At least the following roles can be recognised that can be useful for an efficiently operating CSM-Hotel environment:

- CSM-Hotel Service Provider
- Technology and Service Providers
- Technology End Users
- Universities and Research Institutes
- Science and Technology Parks
- CSM-Hotel Network

A CSM-Hotel service provider is responsible for the management of the whole hotel. In practice this role could be handled by an entity with another role, such as a main company or a technology park. It could also be a separate entity whose business is merely to provide the hotel service, not taking part in the manufacturing activities of the hotel or even being interested in what the hotel companies are offering. This kind of separate company could be formed or could emerge naturally.

Technology and Service Providers develop and offer common resources and solutions for a CSM-Hotel to the end users. These enable the end users to integrate into a CSM-Hotel environment both on the hardware and software levels. The resources and solutions are not limited to the integration; a certain service provider can offer its services to an individual CSM-Hotel company for its individual activities. In addition to these, the end users of a CSM-Hotel will integrate their own solutions and resources as a seamless part of the environment they are coming into.

Universities and Research Institutes offer basic and applied scientific research concepts and solution principles that usually focus more on the future. Science and Technology Parks offer facilities and support for testing future development ideas, as well as training and education for operating and interacting within a CSM-Hotel environment.

A group of CSM-Hotels may form a globally distributed network of hotels to complement each other, offering a wider range of services, as well as adding more capacity to offer globally local solutions. The latter reduces the need for long-distance logistics since the customers, as well as the material and human resources, exist in the same local ecosystem.

2.4 Different Business models

2.4.1 General Economic Framework

Before going into individual business cases or an individual company economic outlook, we should look at the CSM-Hotel as a whole entity. Figure 11 shows the basic components, which decide the overall economic sense of the concept.

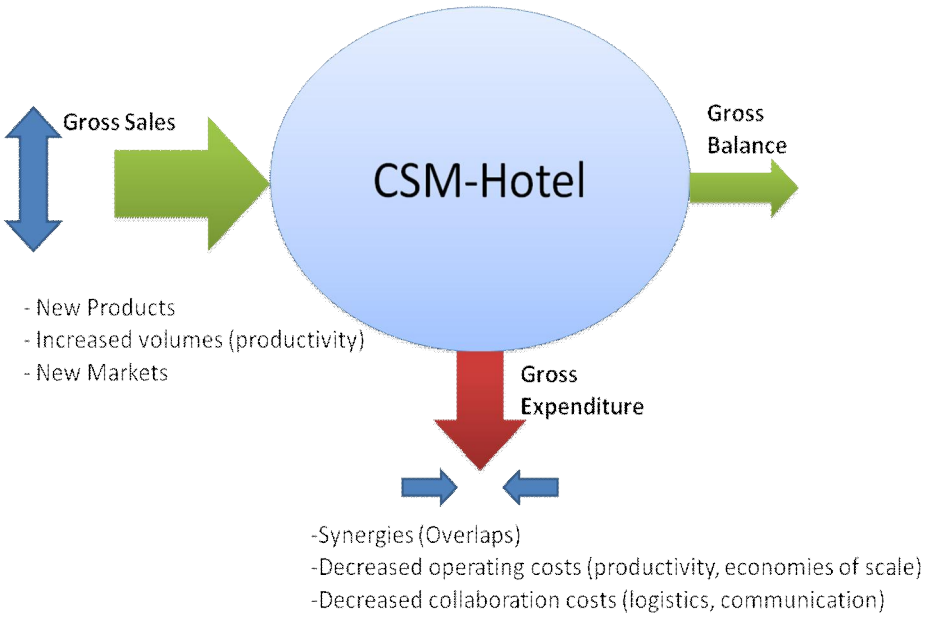


Figure 11: Overall profit generation scheme

Potential increase of overall revenues is connected to:

- New product innovations and larger service offerings due to increased collaboration and knowledge sharing, strengthened link between product design and manufacturing
- Increased overall output driven by increased productivity
- Improved possibilities for companies to enter new markets, because of connections and scale of the hotel

Potential decrease of overall costs is related to:

- Possibility to remove overlapping functions from different participants
- Decreased operating costs due to increased productivity
- Decreased purchasing costs due to economies of scale

IN NUTSHELL:

Combination of holistic view on profitability and fair negotiation power of parties is needed for long term success of the CSM-Hotel.

- Decreased transaction costs, because of better (quality, speed) dissemination of information
- Decreased logistic and material handling costs because of shorter distances, lesser need of storing, and combined in- and outbound deliveries

Productivity increase is thought to be gained via following drivers:

- Technological improvement
- Better responsiveness to changes (flexible capacity, robust control methods, virtual design & planning)
- Effective bottom-up process development

2.4.2 Leading Company and Suppliers

Main drivers: Synergies, Production reliability, Design for Manufacturing

Structure: Usually final assembly of the end product and various sub-assembly suppliers.

General Features: High demand correlation, variable integration

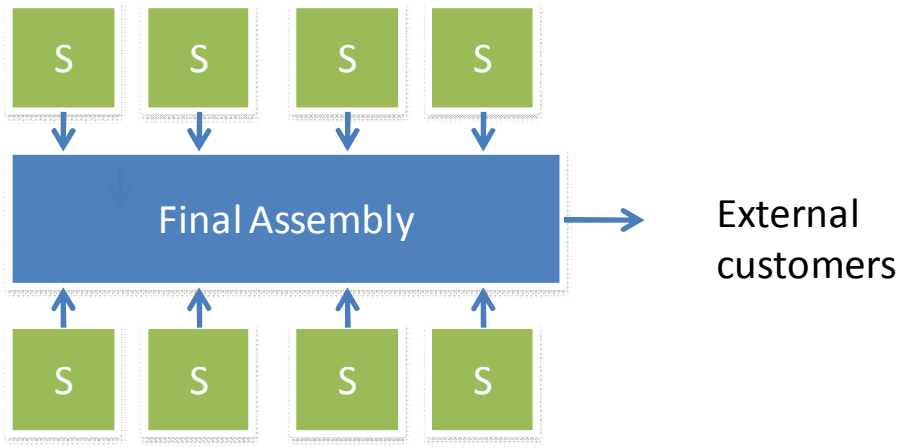


Figure 12: Main assembly lead structure of CSM-Hotel

In an environment of a single leading company, the operational benefits of short distances and integrated material handling are obvious. Similar setups have been beneficially employed in e.g. supplier parks. Moving to a CSM-Hotel environment enables better assessment of the entire production flow, reduces unnecessary storing and allows faster dissemination of production information.

How does the overall cake grow?

- Technological advancement of small suppliers that can reduce overall production costs

- DfMA benefits of integrated supply network
- Cost and time reductions in storing and material handling
- Cost reductions related to transaction management and capacity planning

2.4.3 Equal Partnership or Network

Main drivers: Synergies, Economies of scale, Combined markets

Structure: Several similar size actors, possibly from same cluster, no direct competitors

General Features: Variable demand correlation, Variable integration

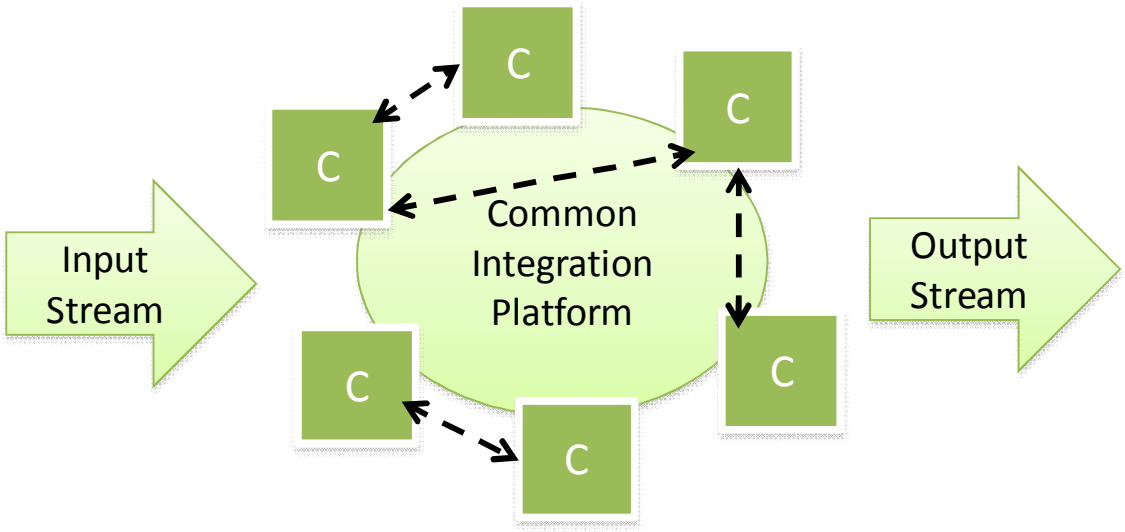


Figure 13: Integrated network of SMEs that share inbound and outbound logistic and information streams

Figure 13 shows the basic structure of a collaborative network that shares inbound and outbound logistic and information flows, and is partially integrated in everyday activities. In collaborative networks the benefits can be found in both market offerings and operational costs.

How does the overall cake grow?

- Ability to offer wider scale of services and attract bigger customers
- Marketing value of working in a high quality and sustainable environment
- Reduction of overlapping functions
- Economies of scale in supporting services, logistics and recycling
- Overall efficiency of information processing enhances

2.4.4 R&D Oriented Model Factory

Main drivers: Virtual Design, Ramp-up speed, Process quality, Consistent measurement

Structure: One or more deeply integrated actors, possibly engineering offices included

General Features: Fast product release cycle / new technology driven strategy

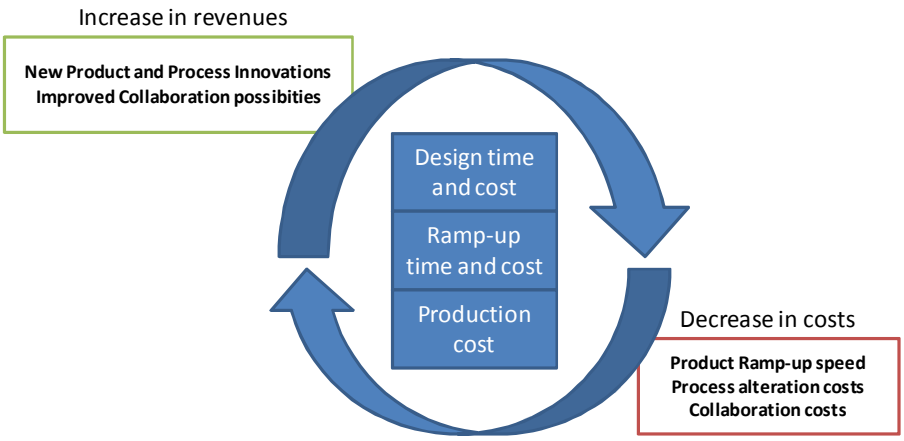


Figure 14: Design Cycle

Profitability of a new product release is mainly related to three factors; Design time, production ramp-up time, and cost structure of the product. CSM-Hotel can be configured as a test bench and initial ramp-up location of new products. In these cases the target is to get rid of initial launch problems and find efficient production configuration that can be replicated in other locations.

In this kind of environment, the focus is in management of change. Both product designs and the manufacturing environment can have a relatively short lifespan.

How does the overall cake grow?

- Faster and better quality design (more desirable products)
- Quicker ramp-up speed
- Marketing value of working in a high quality and sustainable environment

R&D Benefits

- *Virtual manufacturing, better design inputs*
- *Close collaboration with universities and research facilities*
- *Easily reconfigurable manufacturing environment*

2.4.5 Service Oriented Customizing Shop Counter

Main drivers: Process quality, rapid customization of new services, consistent measurement

Structure: One leading company / several deeply integrated actors

General Features: Knowledge intensive products, varying customer needs

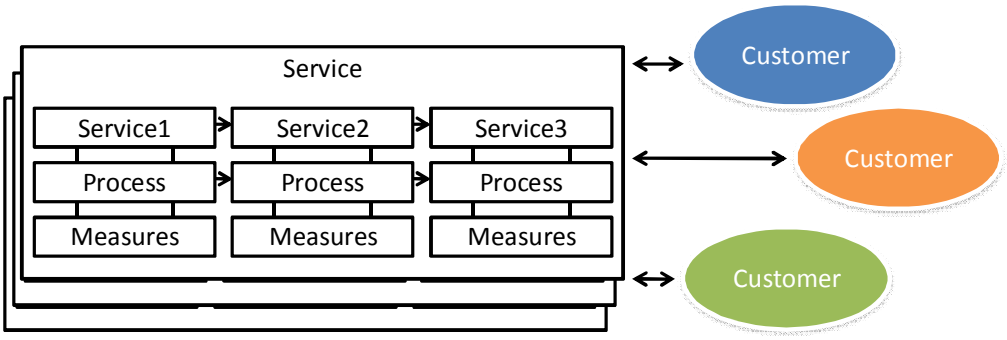


Figure 15: Link between services, processes and measurement

Companies are using increasing amount of effort to processing and producing knowledge. While mass customization practices are widely applied in manufacturing activities, knowledge intensive practises are formalised to a much lesser extent, leading to unnecessary rework, unexpected outcomes, and more problems in control and management.

CSM-Hotel can offer a built-in structure that allows more accurate measurement, control and management of knowledge intensive processes. Fast customization is done by combining services of existing processes into new offerings. Measurement is done at process level and the desired indicators (e.g. money, time, energy consumption) are advanced onto services, thus creating a consistent activity based measurement system, see Section CSM-Hotel Management.

The basic idea is to maintain consistency of processes to allow rapid configuration of new service offerings. This approach should bring significant benefits in typically project oriented manufacturing environments.

How does the overall cake grow?

- Improved service range and growth in sales
- Accurate pricing information to allow better management

Table 1: Collected presentation of most important areas of collaboration

Structure	Strategy	Major dependencies	CIP Core
Client-led hotel	**Supply Chain efficiency**	**Product**	Facilities, Storage, Deliveries, Planning information, Order management, Material handling, Quality control
Client-led hotel / Equal partnership	**Effective capacity allocation**	**Resources**	Facilities, Storage, Capacity booking, Service accounting, Logistics
Model (ramp-up) Factory	**Inter-organizational innovation**	**Research and development**	Information exchange, Research facilities, Performance benchmark
Equal partnership	**Sales channel collaboration**	**Sales + delivery**	Customer relations management, Aftersales, Marketing, Distribution network
Model (ramp-up) Factory	**Fast time-to-market**	**Product design-Production**	Process organisation, PDM, Change management
Customizing Shop Counter	**Mass customisation**	**Process and knowledge management**	Product data management, Change management, Production data, Service oriented production

Table 1 shows a collected presentation of how CSM-Hotel structure, pursued benefits and most important integrated solutions link together. Structures that pursue operational efficiency benefit from combined storages and material handling. The target is to decrease the amount of logistic work per unit while maintaining a good service level and on-time deliveries. Integrated storage also allows a visible price tag to be attached to inventories. This can work as an additional motivation to increase inventory turns.

Efficient use of new and existing capacity requires either shared investments or a marketplace where companies provide services to each other with low transaction costs. This requires special focus on work queue control, setup costs and automated transaction processing.

Sales channel collaboration integrates logistics and possibly parts of customer related information management. Also operations such as maintenance and reverse logistics may be subject to integration. Shared facilities can enhance information exchange in research and development related activities. Otherwise the integration mostly related to information sharing and knowledge management.

Production ramp-up and mass customization efforts relate to integration of practices and product related information. In both cases it is important to align organisational structures to support the targets. Virtual enterprises and process organisations are often used in these purposes.

The realisation of Common Integration Platform is dependent on strategic benefits that companies are pursuing. Also the different parties can seek benefits in varying dimensions, so that integration on some aspect only concerns part of the companies. Depending of the situation the focus can be in physical solutions, information management or organisational structures and practices. Close proximity of different parties supports collaboration in all these domains and helps to build trust required in such an environment. It should also be understood that CSM-Hotel does not have to provide ready-made solutions in all the aspects from the beginning. The system is evolutionary in the sense that collaboration can grow tighter or weaker in time and also change nature as companies evolve.

2.5 Implementation Plan of the CSM-Hotel

We are proposing an overall service provider, CSM-Hotel OSP, as a party who is responsible for building, upkeep and development of main infrastructure. The natural tasks of OSP can also include acquiring external service providers. The OSP is necessary for having a holistic view of the system performance and strategic planning. At the same time individual companies, i.e. CSM-Hotel customers can focus on their core business while just giving inputs for planning.

The actual ownership of the OSP in this consideration is of secondary importance. Funding of the investment can come from private equity investor, a major client of the CSM-Hotel, or from the manufacturing companies. The funding structure can also change in time and different parties can have a variable share of OSP ownership. A limited company separated from the capacity users allows flexible funding possibilities.

IN NUTSHELL:

Targets of the organisational structure:

- Clear causality between investment risk and expected profit requirement
- Coherence of the local optimisation targets of the individual parties
- Long-term development of a viable infrastructure for successful businesses

Drivers and constraints of decision makers:

- Initial investments are derived from customer needs
    - OSP can't add new costs to customers without an acceptance
    - OSP won't carry an investment risk without a secured customer base
- The target of OSP is to maximise utilisation of the existing infrastructure
    - A driver for economically efficient use of resources
    - A driver for keeping the established customers happy
- The target of both OSP and its customers is profitable growth
    - A driver for meeting both internal and external customer demands at all times

Customer's business model (what does the customer want)

- The target of a customer is to only pay from acquired services
    - A driver for local cost-optimisation
    - A driver for development of operational performance
- The target of a customer is to reduce investment risk associated with new technology
    - A driver for faster technology introduction on individual business level

Pricing

An important part of creating trust and reducing disarray is the visibility of the service pricing structure. Here we propose a general pricing model that contains both a fixed (e.g. monthly) and a flexible (based on use) pricing component. A fixed portion reduces the investment risk of the OSP, and therefore also lowers the expected profit requirement to justify the investment in the first place. The flexible part is essential for the whole reasoning of being a customer in CSM-Hotel; being able to adjust operative cost structure based on current demand. The relative share of fixed and flexible components can and should vary depending on the nature of the investment.

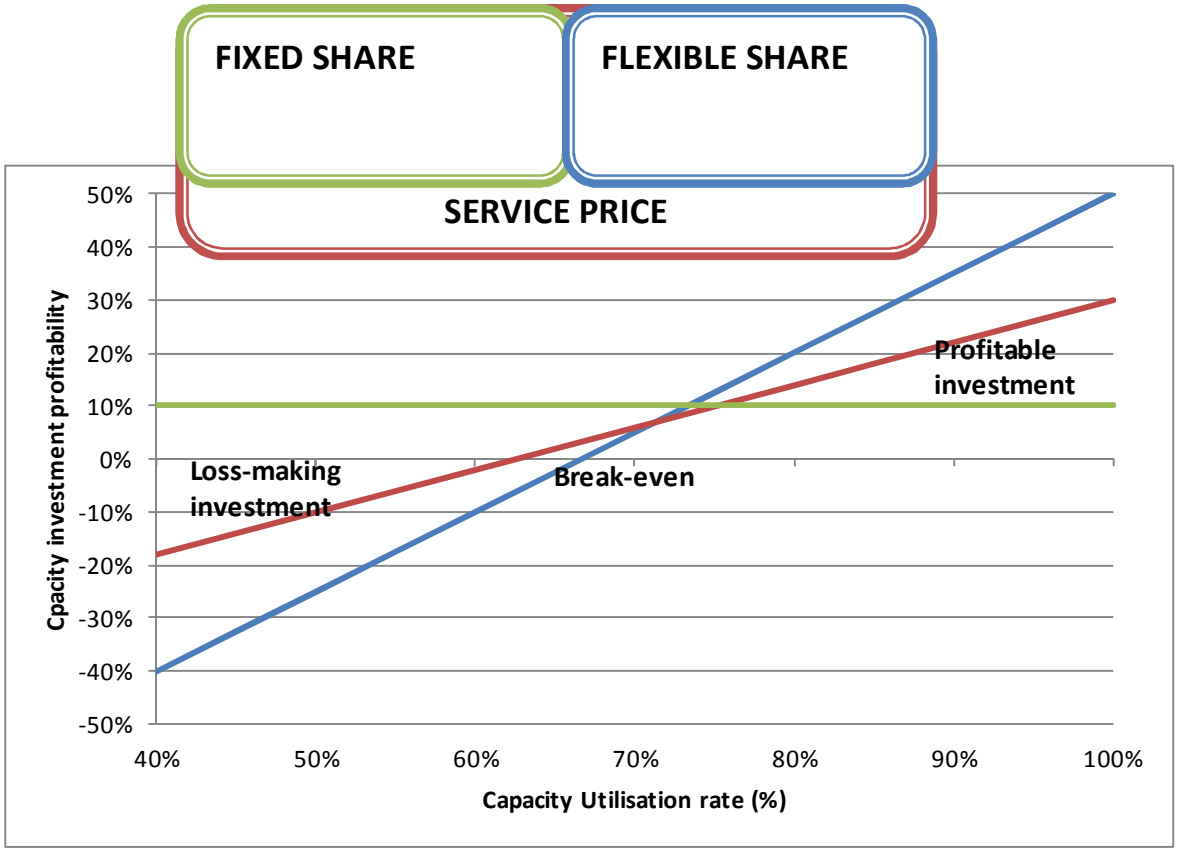


Figure 16: Example of investment profitability from service provider's point of view with fixed, flexible and mixed pricing policy

Internal market

Different companies who are operating in CSM-Hotel can also sell manufacturing capacity or services to other parties in the same environment. The rules of internal marketplace are much more liberal than those related to the OSP because an internal transaction does not require a long term commitment. Therefore any agreement and pricing satisfying both seller and customer is feasible. It is also possible for individual companies to buy some of the common infrastructure from the OSP or vice versa.

Decision making and development

The main purpose of having a separate controlling entity of the common facilities is to provide a coherent strategic view for infrastructure development and allow individual customers to focus on their core business. Several formal and informal methods can be used for gathering customer inputs for development. These will not be discussed in detail here.

The decision making power in CSM-Hotel is related to the negotiation power of individual parties. This correlates with the ownership of common infrastructure and the significance as a customer to other parties. It is also possible that the companies located in CSM-Hotel own the OSP or a part of it. This can also be an agreed long-term target from the moment the infrastructure is being built.

Bottlenecks and harmful decisions

A special interest in both design and operating phase of CSM-Hotel should be focused on possibly constraining solutions. A big risk for any CSM-Hotel customer is to have service level of the environment limiting own growth potential. Typically such limitations are connected to solutions that cannot be scaled up in small portions of capacity, such as operational or storage space, material handling solutions, or critical bottleneck resources like paint shop.

There are two possible alternatives for approaching this problem;

1. **designing adaptive (scalable) structures, and**
2. **designing distributed structures.**

Both of these approaches are applicable and coexistent in CSM-Hotel concept. Scalable structures are suitable when integration brings operational benefits and capacity requirement is based on desired service level and investment costs. Examples of scalable structures include production and storage facilities, automation solutions and some special processes such as heat treatment.

Distributed structures allow both capacity and feature increments in a flexible manner. Distributed structures are more difficult to coordinate than integrated solutions. Benefits include scalability through replication, robustness of solutions, and quick adaptation to changing requirements.

2.5.1 Main Economic and Operational Risks

Limits of growth: CSM-Hotel implementation plans should provide realistic expansion paths for both Hotel infrastructure and individual participants. Pre-emptive analyses are also needed to insure that growth of an individual party is not blocked by some critical resource that cannot be acquired with reasonable costs.

Integration problems: Technical and information system integrations may cause unexpected problems and costs. Integration processes should be continuously improved and developed. In a poor scenario high costs of integration could annul the cost savings accounted from working in shared environment.

IPR Protection / Information ownership: Highly integrated collaboration and innovation processes can blur the ownership of valuable information. Contracts and collaboration principles need to be well defined to insure legal rights of each participant.

Partnership reliability: Functioning partnerships require a great deal of trust between participants. CSM-Hotel should select its customers in a way that this is possible.

Cost of OSP services: The cost structure of OSP and service pricing principles should be visible to clients, so that clients know what they pay for. There should be a mutual understanding of what is reasonable service price and in what limits it can develop in future.

Possibility and cost of changing location: There shouldn't be a situation where CSM-Hotel OSP can hold companies for ransom, because of the costs of leaving CSM-Hotel. Company exit-plans should be included in implementation phase, just as integration plans.

Cultural differences: The working cultures of different companies can collide in areas of collaboration or use of shared resources. Some coherence can be secured in hotel customer selection process, but otherwise CSM-Hotel trusts on written down principles and agreements.

2.6 CSM-Hotel Common Integration Platform Management

CSM-Hotel control is introduced from point of view Overall Service Provider (OSP) which is the key enabler for a co-operation between hotel customers and common integration platform (CIP) processes. Level of the co-operation deepness defines the uses of processes and management principles.

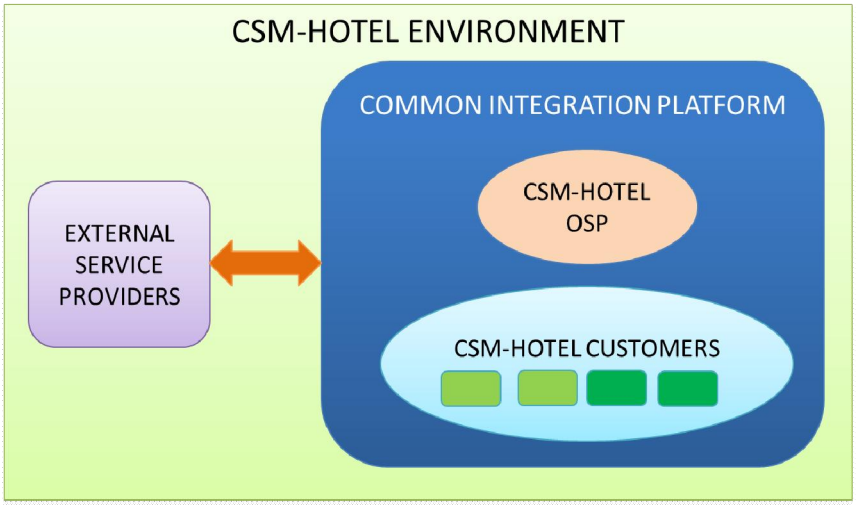


Figure 17: Organisation of the CSM-Hotel environment.

Figure 17 introduces extended logic of the CSM-Hotel environment. CSM-Hotel common integration platform is concerned to the processes and functions between OSP and customers. Overall Service Provider offers services and processes in common integration platform. OSP can offer example integrated and shared facilities, resources, logistics, storage, process inputs and outputs, information collection and management. Shared processes between OSP and actors are centralised whereas actors own processes are controlled by themselves. OSP controls centralized processes and actors their own decentralised processes. External service provider's offers services which CSM-Hotel tends to acquire from third party operator.

2.6.1 Common Integration Platform

Common integration platform (CIP) consist core processes and supporting processes. CIP core processes are business management, information management and resource management. With Business management OSP maintain CSM-hotel services, processes and functions. Resource management process enables OSP to create, control and active supporting services, processes and functions for actors. User configuration is needed in activation of supporting processes. Information management is essential for controlling, displaying, distributing information and enabling measurement and commutation.

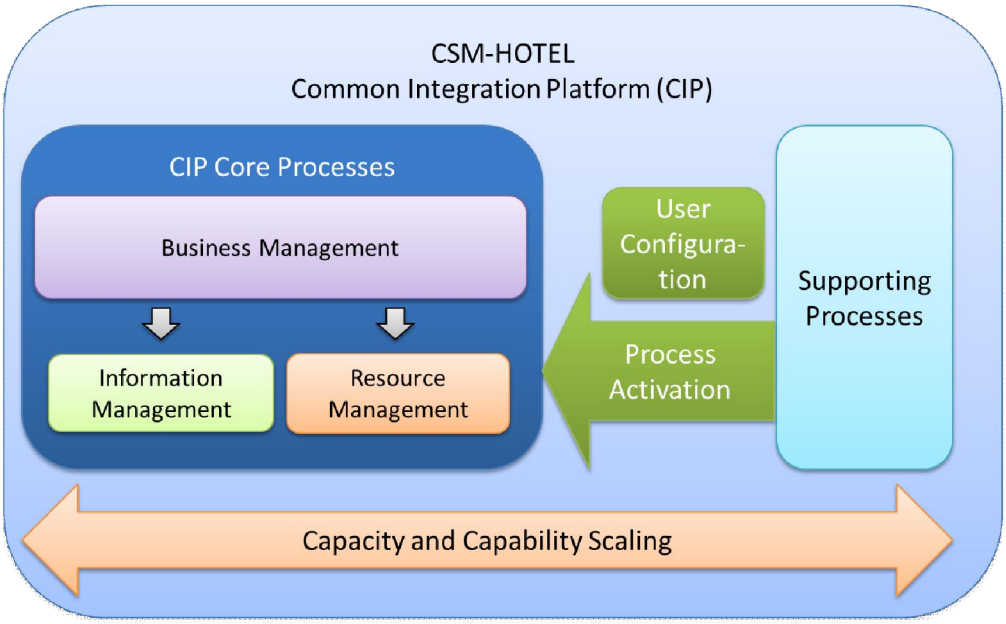


Figure 18: Common Integration Platform processes and functions.

In Figure 18 are presented essential processes and functions for managing CSM-Hotel daily operations. User configuration and capacity/capability scaling are introduced more closely on the later section. Level of the co-operation deepness defines requisite of supporting processes and capacity/capability scaling level.

Figure 19 introduce essential processes for the CIP core in more precisely. Business management, information management and resource management are processes which OSP use to control and enable services and functions for the CSM-Hotel customers.

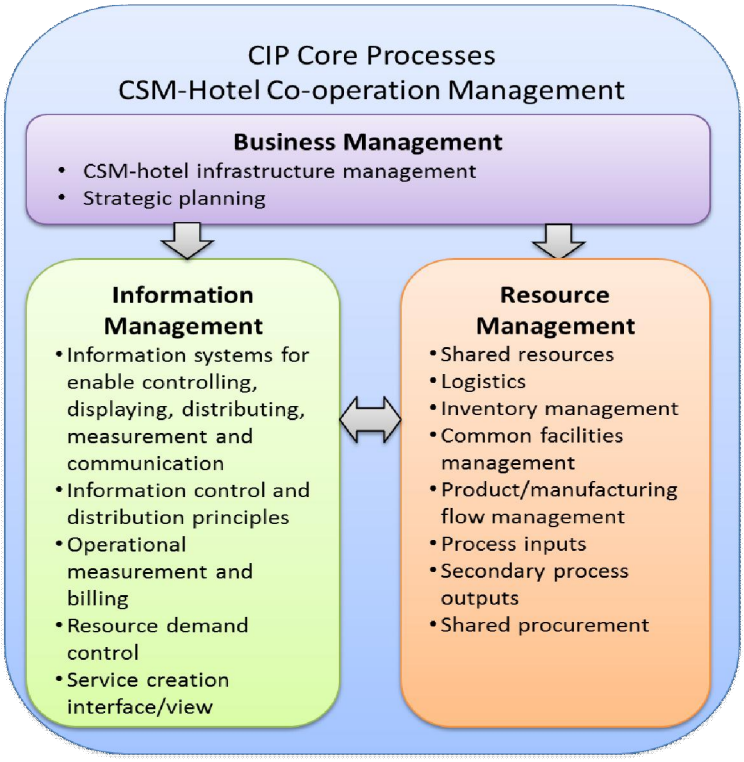


Figure 19: Core processes in CSM-Hotel common integration platform when.

2.6.2 Business Management

The CSM-Hotel strategic planning is charge of OSP which decides the main strategic lines and business models. In thus, tactical planning is done by co-operation between shared resources, but every actor take over by their own businesses tactical and operational planning.

More precisely the business management planning is shared in three parts. First part is a strategic planning that is needed for CSM-Hotel management of defining OSP strategy, direction, and making decisions on allocating its shared resources to pursue this strategy. CSM-Hotel actors have their own strategic planning for undivided operations. Tactical planning is the specific actions which CSM-Hotel actors take in implementing their strategy. In tactical planning you also need to understand and decipher the strategic goals of the CSM-Hotel, in order to manage co-operation. An Operational planning OSP control shared resources and co-operation and actors execute own operations with own planning system. An efficient operational planning requires proactive thinking to fit strategy within the operational layer of the business.

2.6.3 Resource Management

Resource management is used to control and activate or create the CSM-Hotel shared resources and processes. Shared resources are controlled centrally by OSP whereas actors own processes are controlled decentralised by actors themselves. Resource management is the integration of processes and functions within CSM-Hotel to maintain and develop the agreed services which support and improve the effectiveness of its primary activities.

Table 2: Resource management processes.

Process	Description
Shared resources	OSP manage shared resources with co-operation by actors. Examples of shared resources are dispatch or receiving department.
Logistics	Shared logistics are controlled by OSP. Actors can have their own decentralised logistics for undivided operations. Examples of shared logistics are combined transports or CSM-hotel internal FMS.
Inventory management	In shared inventory every actor has their own specified inventory spot in a combined region which is controlled by OSP. Actors could also have their own decentralised

	inventories.
Common facilities management	Common facilities include everything necessary for OSP to operate that are not part of the products and services being produced. Thus common facilities include property, buildings, utility equipment, interior fit outs, office furniture, communication devices, etc. Common facilities management includes multiple activities to ensure functionality of the built environment by integrating process, people, place, capability and capacity.
Product or Manufacturing flow management	Manufacturing flow means organised and planned management in order to respond to CMS-Hotel actors' demand in shared manufacturing operations. Shared products flow is also organised by OSP.
Process inputs	OSP offers example water and energy for CSM-Hotel clients. OSP also take concern of billing from process inputs.
Secondary process outputs	OSP take care of CSM-Hotel waste management
Shared procurement	Shared procurement is designed to use at shared material purchase and management

2.6.4 Supporting Processes

Supporting processes are auxiliary activities which actors can activate for extending businesses. OSP offers supporting processes and user configuration services in CSM-Hotel. Level of the co-operation defines integration deepness between CMS-Hotel actors. Figure 20 shows examples of the supporting processes.

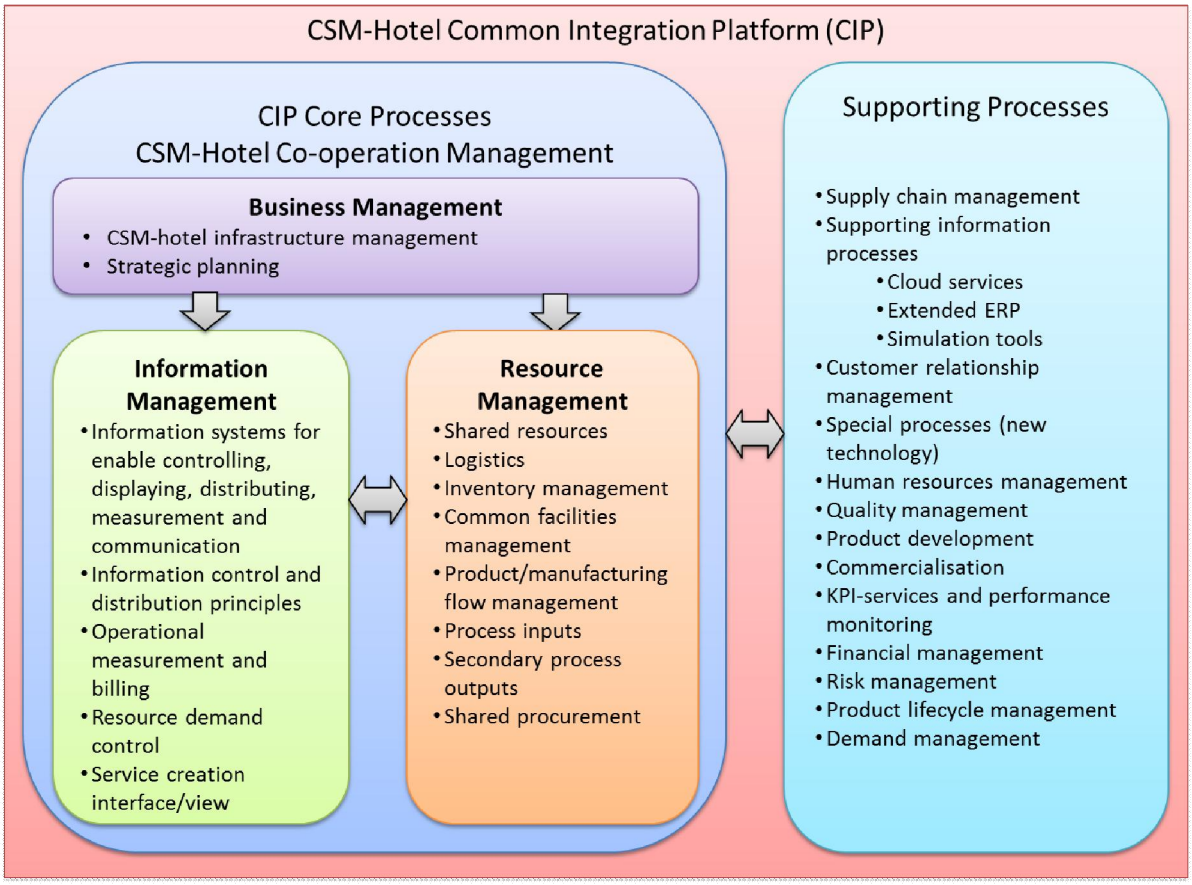


Figure 20: CSM-Hotel Common Integration platform processes.

Table 3 demonstrates and describes supporting processes.

Table 3: CSM-Hotel supporting processes.

Supporting process	Description
Supply chain management, SCM	Supply chain management is the oversight of information, materials, and finances as they move in CSM-Hotel from OSP and actors to consumer. SCM involves coordinating and integrating material and information flows both within and among actors.
Supporting information processes	Supporting information processes are extended services which enables an efficient operations monitoring and performance. Examples of the supporting information processes are cloud services, extended ERP and simulation tools.
Customer relationship management, CRM	CRM operations are for managing both CSM-Hotel customers and OSP/actors relationships. CRM enables CSM-Hotel clients to control their marketing, sales and customer service processes and analyse customer behaviour.
Human resource	HRM is the function within CSM-Hotel that controls recruitment

management, HRM	and management for the people who work in the CSM-Hotel. Human Resource Management is performed by OSP.
Quality management, QM	QM is a customer focused approach that enables the customer satisfying. Quality management provides best quality product at lowest possible price. OSP can offer a shared quality manager for the CSM-Hotel actors.
Product development	Product development means the producing of products or services with different or new characteristics that offers new or additional benefits to the customer or manufacturer.
Commercialisation	Commercialisation is the last phase of the new product development process in which the decision is made to put the new product into full-scale production in CSM-Hotel.
KPI-services and performance monitoring	KPI services are tools for measure operations with specified indicators. With KPI tools CSM-Hotel is able to evaluate performance in processes and functions.
Financial management	Financial management is that managerial activity which is concerned with the planning and controlling of the CSM-Hotel actors and OSP financial resources. OSP takes care of controlling, planning, directing, monitoring, and measuring of the financial resources of CSM-Hotel.
Risk management	Risk management enables management to effectively deal with uncertainty and associated risk and opportunity, enhancing the capacity to build value for CSM-Hotel.
Product lifecycle management, PLM	Product life cycle management is the process of controlling product design, production and maintenance information. PLM is designed to use in a shared products and production related to shared products.
Demand management	Demand management is the process of managing shared resources and materials. OSP controls demand management in collaboration with the actors.

Supporting processes have been limited only a significant operations and functions. OSP can also activate and create of another kind of processes depending on actors' requirements.

2.7. Information management in CSM-Hotel

Information management supports efficient control of capacity and production processes in the CSM-Hotel network. Structured flow of communications is enabler of controlling complex systems. Information is produced and stored locally in CSM-Hotel actors own processes to reduce the complexity of information processing. Shared information can be aggregated and stored centrally by an ICT service provider.

Information systems in the CSM-Hotel environment should provide users access to relevant information, but also ensure that private business information is secured. The environment is challenging, because collaborators might use several different information systems with deep integration.

To fully utilize collaboration opportunities between SMEs, integration is necessary in the software, hardware and management dimensions. Software and hardware integration are needed for enabling individual production entities to work efficiently in CSM-Hotel environment. Management integration includes common quality standards, measurement practices and ground rules for the areas of collaboration. The level of integration between the participants should be seen as a strategic decision. In a loosely integrated environment the companies might merely use a common order handling and material handling processes to achieve some benefits of scale. In other cases collaboration can include research and development of new products, which naturally requires a deeper integration between the participants in various aspects. From production planning and control points of view, common control principles are part of the integration platform. The strategic decision about the level of integration between the participants defines how tightly they should be connected in planning, control and information sharing aspects. [Toivonen et al]

IN NUTSHELL:

- *Information management has an important role as an enabler of controlling complex systems*
- *Integration is necessary in the software, hardware and management dimensions*
- *The level of integration is a strategic decision*

2.7.1. Variety of Information Systems

Businesses use a variety of different information systems in order to measure and control their activities, display and distribute information, and communicate with each other. Examples of typical information systems are given in Table 4.

Table 4: Examples of Information systems

Information system	Description
Enterprise Resource Planning, ERP	ERP is management software that allows businesses to use a system of integrated applications to manage their operations. ERP software integrates functions, including manufacturing, development, sales and marketing.
Decision Support Systems, DSS	Decision-support systems are specifically designed to help making decisions in situations where there is uncertainty about the possible outcomes. DSS comprise tools and techniques to help gather relevant information and analyse the options and alternatives. DSS often involves use of complex spread sheet and databases to create "what-if" models.
Executive Support System, ESS	Executive Support System is designed to help in making strategic decisions. It gathers analyses and summarises the key internal and external information used in the business.
Management Information Systems, MIS	A management information system is mainly concerned with shared sources of information. MIS usually takes data from the transaction processing systems and summarises it into a series of management reports.
Knowledge Management Systems, KMS	The objective of KMS is to support creation, transfer/storage, and utilization of knowledge in organisations and supply chain. Knowledge Management Systems are designed to help businesses create and share information. These are can be used in a business where several CSM-Hotel actors provide knowledge and expertise from different areas to encourage new innovations.
Transaction Processing Systems, TPS	Transaction Processing Systems are designed to process routine transactions efficiently and accurately. Examples of transaction processing systems: • Inventory control • Resource demand control • Billing

The borderlines of different systems are often not clear, as software vendors tend to integrate an ever increasing number of functions in their tools. Also the reduction of separate systems decreases maintenance and integration effort on the systems.

2.7.2. Information control and distribution principles

Information has a critical role in the flow of communications and is the enabler of controlling complex systems; there is a necessity for and concern about the integrity of information [Clifford]. Information is produced and stored locally to reduce the complexity of information processing.

Information technology has an important role when integrating a supply chain [Gunasekarana]. Information systems in CSM-Hotel environment should provide information access and dissemination to users, but also ensure that private business information is secured. The environment is challenging, because collaborators might use several different information systems with deep integration. A common integration platform can be thought of as an interface and communication channel into which different information systems are integrated.

The ability to trust operational information is essential. The main challenges in this environment are related to interoperability between different information systems, aggregating meaningful and accurate information for high level decision-making and separating private business information from areas of collaboration.

Information System Integration

The link between information use, systems and infrastructure is shown in Figure 21. The Figure demonstrates requirement levels for the use of information systems and management. [Schlögl]

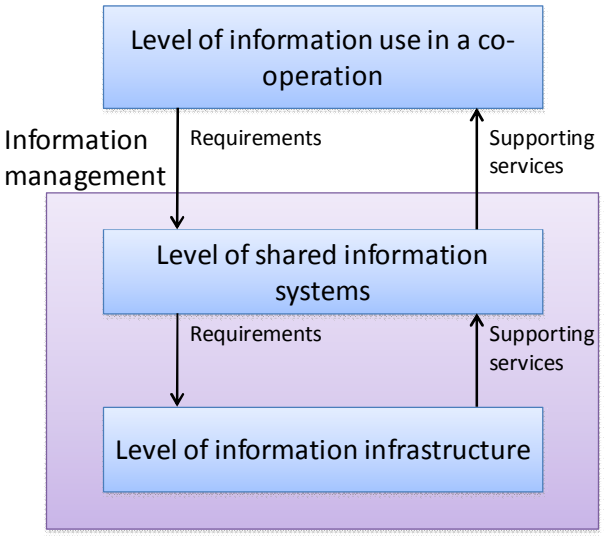


Figure 21: Information infrastructure design (modified from Schlögl et. al.)

The nature of the information used in co-operation sets demands to the control of the information. Similarly requirements for ICT infrastructure can be derived from information system design. An example of increasing integration need is given in Figure 22.

The deeper the collaboration of the clients of the CSM-Hotel is the more the integration of information processing systems and support processes are needed. This sets special demands to the integration of information processing systems, to the configuration process and integrity of the information. Furthermore, CSM-Hotel platform interface has to be adequately simple and well-defined so that the different

information processing systems and infrastructures can be connected among themselves. [Schlögl]

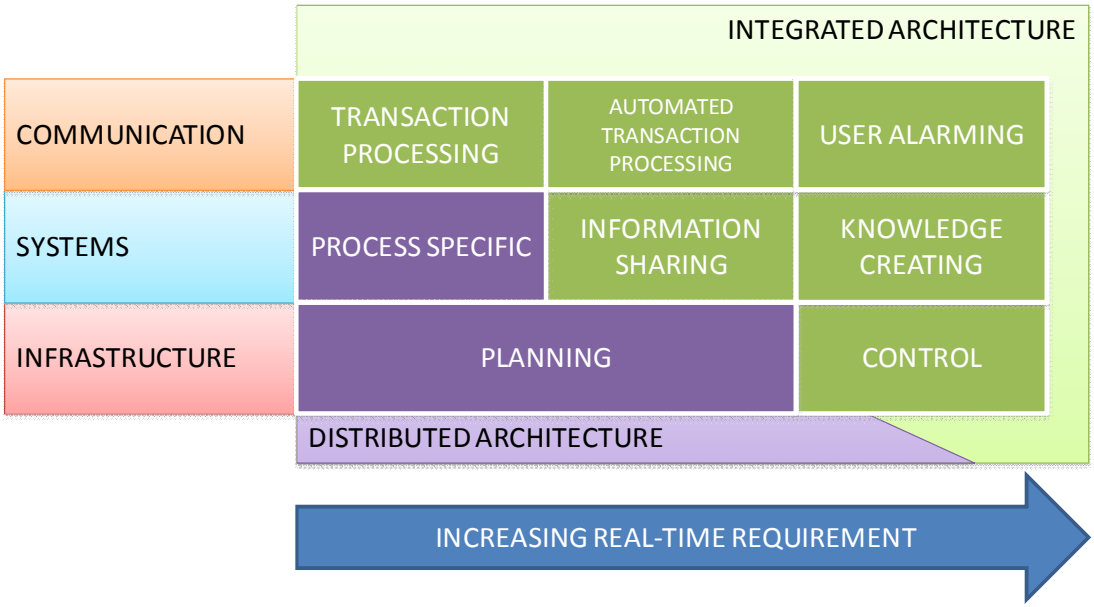


Figure 22: Requirement of integration for different use cases

Communication level integration is always present when humans or systems interact with each other. Automated processes require system level interaction, so that different systems can interpret received messages independently. Common data formats or software interfaces are also required for information sharing between separate systems. For time critical applications integration of software interfaces is not enough, but ICT infrastructure should be integrated as well. The same goes for knowledge creating processes that need access to various sources of unstructured information.

Information management solutions in the CSM-Hotel can also be offered as cloud services. From a users point-of-view this hides the need for consideration of ICT infrastructure. The cloud services offers possibility to move in the next stage in the evolution of the net-based technologies. Cloud services are delivered to the CSM-Hotel clients as a service wherever and whenever they need it. Cloud services are typically scalable, internet-based and shared, offering the CSM-Hotel actors cost-effective solutions to their business demands. With cloud services clients can react fast to changes in their operating environment by, for example, activating or terminating processes and functions as needed or dynamically updating their infrastructure elements. OSP offers services which

IN NUTSHELL:

- *Need of infrastructure integration is affected by response time requirement*
- *Cloud services hide the infrastructure from users*

allow clients to pay only for what they use and tie up less capital in own hardware. Typical cloud service attributes are [Tieto Corp]:

- Delivered as a service, where clients buy a ready-to-use designed services
- Flexible, which means services scalability up or down dynamically as the clients demands
- Multi-tenant by shared infrastructure, software or platforms which allows utilisation and efficiency improvements
- Self-service availability
- Standard connectivity with known and widely available connectivity technologies
- Consumption based pricing

Collaboration intensives

Table 5 describes what kind of information should be shared in different forms of co-operation and which information systems typically handle that data. The needs are derived from strategy and the area of co-operation that supports it. In some instances individual items of information are replaced with a process, e.g. change management covers all information essentially produced by the aforementioned process.

Table 5: Shared information in collaboration environments

Focus	Dependency	Information systems	Shared information
Capacity allocation	Resource	ERP, booking and bidding systems, TPS	Work queues Service offerings and availability Inventory levels
Production process	Product, order	ERP, MES, BPM, SCM	Production status Order management Performance metrics Inventory levels
Production planning	Product, capacity	ERP	Demand forecast Order backlog Capacity availability Product assortment
Product customization	Product, customer	CRM, order management, production control	Sales process Change management Service descriptions Performance metrics
Ramp-Up, R&D	Product and production system	Planning tools, PLM/PDM, QS	Layout and process data Change management Quality control

Capacity allocation: In order to support efficient capacity allocation, the information systems should lower transaction costs between capacity owners and users. The term transaction cost here is used in a broad sense, including any work effort, time and money associated with a transaction that does not bring direct benefits to anybody. Important elements in lowering these costs are availability of information, automated transaction processing, scheduling of work queues, and a joint marketplace for available resources.

Production process: Integrated supply chain coordination requires information of current production status and inventory levels. Order management can be integrated in order to perform automatic production calls. Performance metrics are used for productivity assessment and development purposes.

Production planning: Capacity planning requires information of future demand and benefits from shared forecasts and order backlogs. Production planning needs to react to production disruptions and planned maintenance breaks.

Product customisation: Integration of order management allows timely deliveries of customer tailored modules in supply network. Customisation process can be based on option lists and modularity. Service orientation can increase reuse of previously planned work processes in project oriented production. Systematic data collection helps in cost estimation of projected oriented work.

Production ramp-up: A new product ramp-up requires integration of product and process design, change management and quality control. The task is challenging because of multiple simultaneous fields of change. Just as in case of a product customisation, a rapid production ramp-up requires full utilisation of existing knowledge and tested practices.

Information systems framework

Figure 23 introduces information management framework for CSM-Hotel environment. The demonstrated requirements consider a genuinely collaborative CSM-Hotel, in which actors have various shared processes and functions. The requirements have been divided to the four main categories and processes. The main categories are management, control, integration and tools whereas process categories are divided to the business, cooperation, controlling and development processes.

Within a process the information sharing needs are real-time or repetitive, so system integration is necessary. Information exchange between processes is periodic and less time critical. Usually this kind of information sharing does not require integrated information tools. In practise this means that information systems supplier can provide separate sets of integrated tools to support different processes.

IN NUTSHELL:

Separate integrated solutions can be offered to support:

- *Business process*
- *Co-operation*
- *System upkeep*
- *Development*

Required features of the CSM-Hotel ICT:

Key requirements for information management in the CSM-Hotel

	Management	Control	Integration	Tools
Business processes	Business management	Supply chain & production control	New product / business process introduction	BI, DSS, CRM, ERP
Co-operation processes	Collaboration management	Capability mapping and control	Shared service, new order introduction	ERP, MES, TPS
Controlling processes	Process/system integration management	Supplier-customer definitions	Platform integration, self-configuration	CIP maintenance, configuration tools
Development processes	CSM-Hotel infrastructure management	Development coordination	Synthesis formation	Analysis tools, planning & design tools

Figure 23: ***Key requirements for information management in the CSM-Hotel***

Business processes: A business process is a set of activities that will accomplish the targets set to the information management in the CSM-Hotel environment. Integrated business process supports supply chain management, production control and the processes in new products introduction. Examples of operations included in a business process are human resource management, customer relations management, financial services, order management or distribution.

Co-operation processes: Co-operation in the CSM-Hotel include processes that involve several users sharing goals and that depend on information transfer between these users, and the ability of the users to synchronize their shared resources and processes. Efficient co-operation can be enabled with mapping capabilities of shared resources and processes. As an example shared production process requires common work queue control, capacity allocation, production planning and decisions for adequate inventory levels.

Controlling processes: Controlling processes are the key tools to reduce costs and mitigate risks in CIP maintenance and integration process. Controlling processes are also needed for supplier or customer definition, configuration operations and maintenance of shared operations, functions and processes between the CSM-Hotel clients.

Development processes: Development processes are needed to increase the CSM-Hotel efficiency and transparency. In the development process it is important to identify and measure the performance of currently running CIP processes. Development and coordination activities can then be focused on bottlenecks and recognised new requirements.

2.7.3. User Integration in a Collaborative Environment

Previous chapter focused on information systems integration. This chapter provides some insight about bringing new entries to CSM-Hotel environment. Typical integration cases are introduction of a new company, service or a product.

In CSM-Hotel some of the key operations are information dissemination and integration management. Also information integrity assurance is important for securing efficient collaboration between the CSM-Hotel actors. Connection management between the CSM-Hotel platform provided systems and clients own information systems is supported by the platform, but executed by the clients. This sets demands for the platform provided systems which have to provide interfaces for integrating different kinds of information systems. This integration platform enables communication in the CSM-Hotel between different actors.

IN NUTSHELL:

- *Common Integration Platform can automate parts of user integration process*
- *Capacity scalability is a key requirement for any process included in CIP*

Production planning over supply network

Close collaboration in supply chains gives opportunities of extending planning activities over the whole supply chain instead of individual companies. There are some fundamental reasons that make this difficult in practise:

1) The size of a planning problem increases exponentially as more activities are included
2) The prior leads to aggregation of planning model, decreasing level of detail and increasing time delay (weaker responsiveness)
3) Different actors have different objectives, which can be very difficult to be described simultaneously in a single target function
4) Rescheduling of long activity chains causes a lot of instability in the system (i.e. system nervousness), especially when the schedules are tight
5) Updating a large scale model takes a lot of work effort and can still be unreliable

A common approach is to keep separate planning activities, but increase information visibility over the supply chain. In this case the key is to identify useful information from each decision maker's point of view. Such information can include for example order backlog, demand forecasts and inventory levels. Besides making information available, also action signals are important. A monitoring system should indicate when rescheduling is required in a specific location. Here a trade-off exists between system stability and planning performance. High barrier of rescheduling improves system predictability, but more frequent alterations may allow the system to operate with lower inventory levels.

If relative volumes a great enough, a better approach is to integrate the production process and shift focus from production planning to production control. Production control operates on reliable information, short planning horizon and much fewer decision making variables than scheduling problems. In practise this means separating distinct product lines in different companies that serve a specific supply chain. One example from production process integration is to examine optimal locations of inventories. Often excessive inventories are held in companies that have the least negotiation power in the supply chain. In these cases the size of companies defines the network structure instead of placing inventories regarding operational performance or costs. A simple holistic assessment can improve overall performance on this aspect.

Common Integration Platform

CSM-Hotel common integration platform is provided by Overall Service Provider as the main tool that integrates centralised solutions and their users. Table 6 introduces the key features of the CSM-Hotel platform.

Table 6: Features of the integration platform

Features of the platform	Description
Stable and maintainable	Platform should be a stable structure, because changes in interfaces can cause a broad need of reconfiguration. In addition platform has to be an easily maintainable.
Scalable	Stable does not mean stagnant, platform can scale up or down with demands of users. On software side this means flexibility regarding number of users and features.
Clear	Clarity is an important element of user interface design. Indeed, the whole purpose of user interface design is to enable clients to interact with OSP system in a meaning and functional fashion.
Responsive and efficient	Platform user interface has to be fast and available to response at clients' actions. In addition platform user interface has to be efficient for improving clients' daily operations.

Platform should enable efficient operations and the ability to react to changes in the CSM-Hotel environment. Self-configuration is promoted in order to handle complexity of various systems and use cases. Maintenance means assuring that centrally offered processes (Figure 3) are operational and efficient for users at all times. Scalability is required to guarantee that platform continues to satisfy customer needs in changing situations. Clarity simplifies maintenance process and increases usability of platform user interface. Most of all, the platform should provide solutions that fulfil the needs of the users.

IN NUTSHELL:

CIP should be designed as the backbone of CSM-Hotel

Common Integration Platform can be thought of as a backbone of the CSM-Hotel. The solutions selected to it are important to most of the actors in the system and provide a significant performance or cost benefit when delivered in an integrated fashion. Therefore it is clear that the centralised structures have to be designed to offer long term solutions through performance and adaptability.

Principles of user configuration

Platform configuration can be a simple, well thought and tested process, which saves time and effort. Table 7 shows what kind of integration support a platform can give.

Table 7: User responsibilities and platform provided support in configuration process

User	Platform
Collects and provides production information	Offers integrated solutions for different purposes
Defines own processes	Offers coherent modelling tools
Performs data conversions	Provides interoperable data formats
Sets available services or capacity	Shows available service listing
Manages private data	Manages public data (and shared data in integrated systems)
Accounts bought/delivered services	Accounts bought/delivered services
Configures measurement system	Sets required and preferred metrics
Maintains manufacturing items	Provides purchase items for common purchases

Platform consists of preferred software tools and defined interfaces. It can provide assisting tools and methods for configuration process, but adaptation is always done on the user side. Users are left with the choice on how deeply they want to integrate to the environment, i.e. which common processes they are using and how much information they are sharing. At simplest the configuration process requires interfaces for transaction processing and not much else.

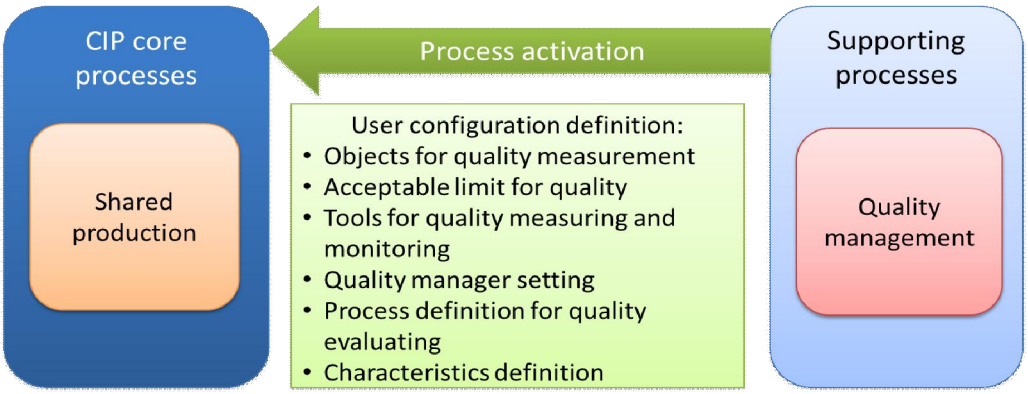


Figure 24: An example of CIP scaling.

Figure 24 shows user configuration process for quality management process activation in shared production process. Shared CSM-Hotel services and supporting processes are introduced in a common integration platform which is managed by OSP. For shared operations and functions OSP have measurement system which enables billing from used services and common resources. Centralised operations or functions enable reduced costs

because of greater volumes of procured material or services. Unified operation measuring also allows holistic performance monitoring.

Capacity and capability scaling in CSM-Hotel

Process scaling is an important function in the CSM-Hotel environment. OSP has to prepare plans for scaling operations in order to ensure the business development possibilities for CSM-Hotel clients. At the same time OSP has to take notice in changes of demand that could result a need for capacity downgrading. Scaling operations concerns mainly centralised resources and processes from common integration platform. Examples for significant scalable processes are:

- Facilities
- Shared resources
- Logistics, especially CSM-Hotel internal logistics
- Inventories
- Manufacturing flow management

Solutions for scaling are based on modular structures and specific plans for extending/reducing capacity or capability of processes. Scalability is a very important for the development of the integrated operations. Centralised structures can otherwise become general bottlenecks that degrade performance of all their users. Decentralised structures are scalable often through replication and usually do not become large scale bottlenecks.

Limits of the flexibility can be defined by estimating or measuring platform processes capabilities. Capabilities signal the ability to stay competitive (Quality, Cost, Delivery) in changing market environment [Fujimoto]. It is also important to define profitable area of flexibility limits so that the profitability of operations can be evaluated.

The marginal utility of an integrated structure is lowering as capacity increases. Therefore at some point the flexibility benefits of a decentralised structure become more and more intriguing. In such a situation the structure should be divided inside the CSM-Hotel. In large scale this also means that CSM-Hotels should rather spread out as a network than trying to expand as a single large unit.

2.7.4. Activity Based Process Data Management

The processes and functions in the CSM-hotel are measured with specified indicators and data is collected to information systems. Data is processed into information that can be utilized in the planning work. For example manufacturing processes can produce useful data for planning process. Various processes can be measured in terms of manufacturing time, energy and material consumption and the ability to produce quality.

The monitoring of the CSM-Hotel requires description of processes and determination of influencing factors. Also capabilities for producing services and products should be determined. In this context identifying capabilities means ability to create services and products competitively with current resources, capacity and skills. To achieve an understanding of efficiency of operations it is important to collect and analyse process information.

IN NUTSHELL:

- *Division of work into controllable size fractions*
- *Entrepreneurs within the enterprise*
- *Bottom-up development*

Table 8: Term definitions

Production entity	Production resource or a group of resources that form an autonomous unit and have a common control, e.g. machine tool, manufacturing cell, assembly line, etc...
Process	A defined set of actions required to produce a wanted outcome
Activity	Individual actions that together form a process. A process is in some cases referred as an activity in order to maintain consistency with the term activity based costing from Cooper and Kaplan.
Service	A description of a process outcome
Service instance	A single service event
Product	A finished or in-process item
Order	Digital information of the requested product, manufacturing signal

The structure and ideas presented here are derived from few basic principles:

- Division of work into controllable size fractions – Pursuit of efficiency through specialisation
- Entrepreneurs within the enterprise – Emphasis on customer in internal relations as well
- Bottom-up development – Basis for a large scale continuous development of organisation

Data collection and aggregation

A typical way to collect data from a manufacturing environment is to control input/output ratio of production entities. Production entities have their own control measures, such as utilisation rate, produced quality, processing time, price of machine hour etc. On the other hand we have measured output that together carries the total costs associated with the production entity.

In activity based measurement the indicators are primarily connected to processes that the production entity performs. The aim is to directly measure the inputs that are needed for producing a specific unit as shown in Figure 25.

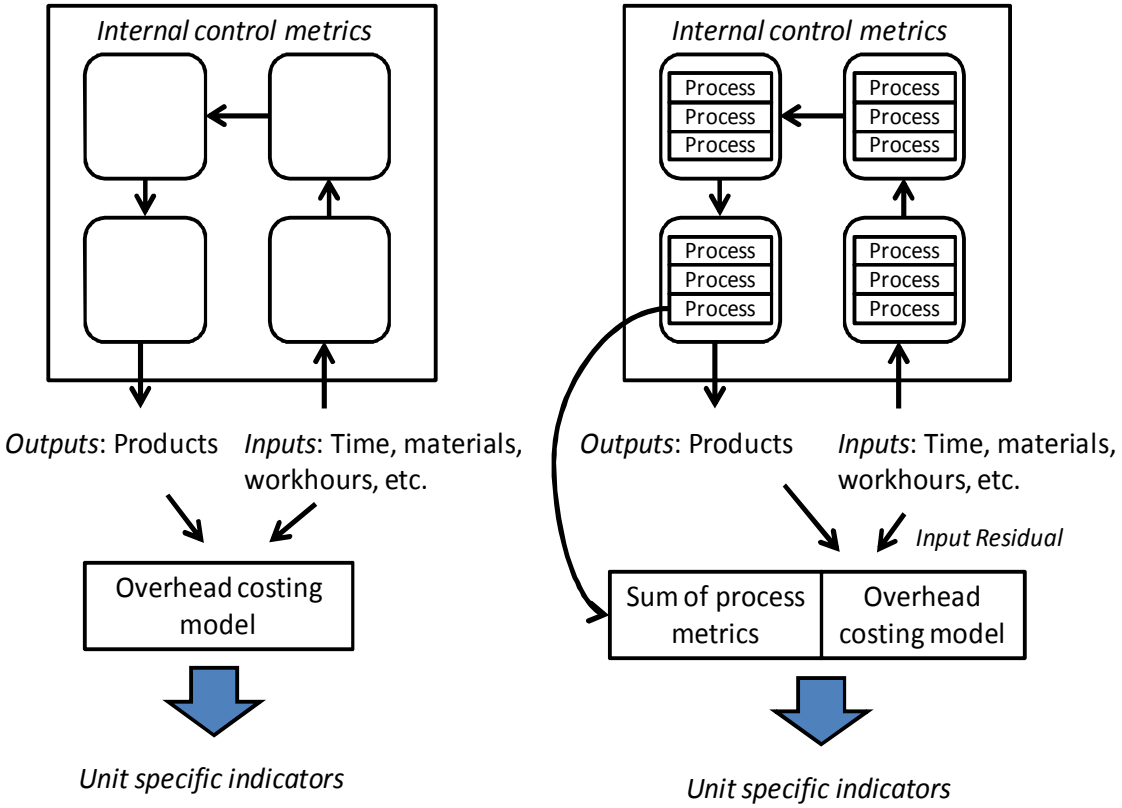


Figure 25: Comparison of traditional and activity based measurement process

Usually the actual measurement process does not require large scale changes, because the process specific indicators are already in place for internal control purposes. The problem is rather that this information is not being utilized in reporting to upper management levels. The following problems arise from depending too much on models in information aggregation:

- Large volume products carry also the non-volume correlated share of low volume production costs
- Improvements and development in production processes are not automatically updated planning tools

- Internal performance metrics of different entities are not visible for comparison purposes
- Management set metrics are not integrated to processes, and have a weak guiding link on organisation

To counter these problems we are presenting a basic structure of stored factory floor data item. This item should be general enough to allow flexibility in sensor selection and control practices, but specific enough to provide a consistent structure for information handling.

Table 9: Example data sheet of a service instance

Service Bill	Parameter	Value
Classification	Service name	Turning, small
	Producer (entity ID)	DMG123
	Customer ID (internal)	CellA2
	Customer ID (external)	-
	Process ID	PR0053
	Product ID	PID123456
	Product type	SA3
Targets	Delivery target	12:05:13
Control measurement	Start time	12:01:13
	End time	12:04:03
	Energy consumption	1870 Wh
	Quality	Visual, OK
Structure	Sub-service	[Clamping]
	Sub-service	[Machining]
	Sub-service	[Unclamping]
	Sub-service	[Dispatching]
History for backtracking and development	Measurement data	[File location]
	Work instructions	[File location]

The example data sheet contains *Classification*, *Target*, *Measurement*, *Structure* and *History* fields. Classification information is used for aggregating different views from base data. Target setting is meant to provide performance information for service owner. Targets can be the values used in planning tools, or management set objectives. Control measures contain the actual measured data. Structure describes from which sub-services the main service consists. Square brackets ([ ]) refer to an embedded/linked document, thus implying that the document is hierarchical. History fields are meant for production backtracking. These fields can contain measured data that is not meaningful business information, such as machining forces.

The basic data element described here serves multiple users and use cases. Typically Manufacturing Execution Systems (MES) are focused on describing resources and material flow but leave out organisational structures. Management oriented Business Intelligence (BI) systems and Decisions Support Systems (DSS) are more focused on business processes and organisational structures. The modelling difference of the system usually means that the input data for the tools is aggregated from separate sources. We are suggesting that factory floor data could be directly used for both control and management purposes if it was classified properly. This should simplify system integration, increase the speed of data processing, and enhance information integrity.

Service oriented production control

The service oriented approach applied here means that all provided service instances have a defined internal or external customer. In pull-control systems this customer is usually the succeeding production entity, while in push-control systems the customer is the product that requests manufacturing services. These internal supplier-customer interfaces have an important role in clarifying system structure and responsibilities, performance benchmarking and targeting development practices. Figure 26 shows the customer-supplier interfaces in pull- and push-control systems.

IN NUTSHELL:

Service-oriented control does not set limits regarding the organisation of production

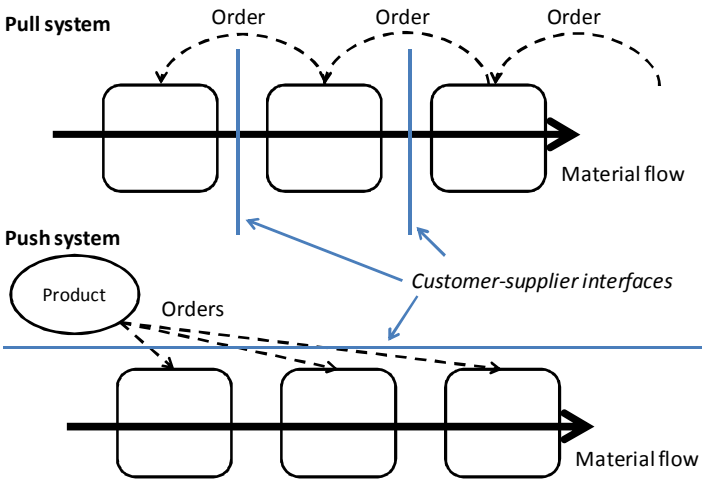


Figure 26: Pull and push systems

In a pull system it is possible to treat production entities as suppliers and evaluate them by their service level, i.e. delivery time and delivery reliability. In push systems entities are service providers and production control is based on resource availability and price. At the same time we can have internal performance metrics, such as inventory turns or production lead time, as shown Figure 27.

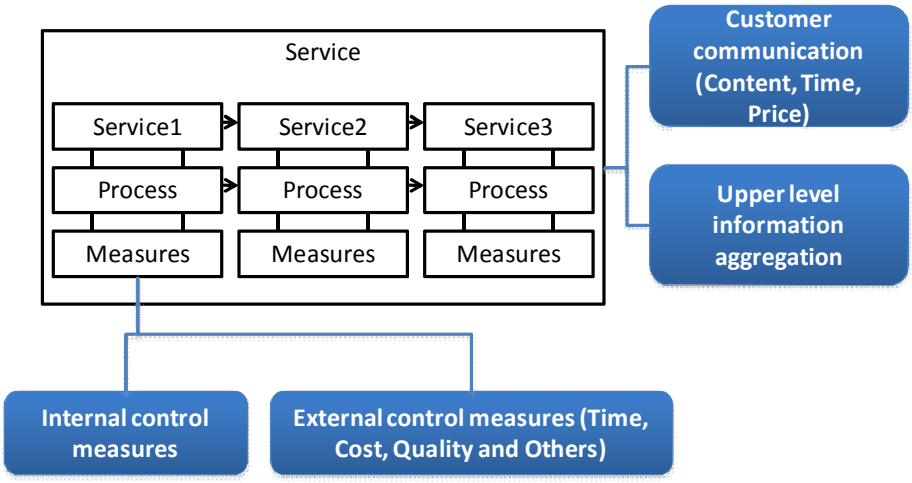


Figure 27: Internal structure, metrics, and external communication of a service

Service oriented systems make little difference between internal and external suppliers or service providers. More stable system can is created by limiting the options of the "buyer", an extreme case being a production line where only one possible supplier exists. Service orientation in production control does not refer to a chaotic system, but rather implies that production entities are given some degree of freedom to plan their own execution.

Management views and decision making

Product line performance

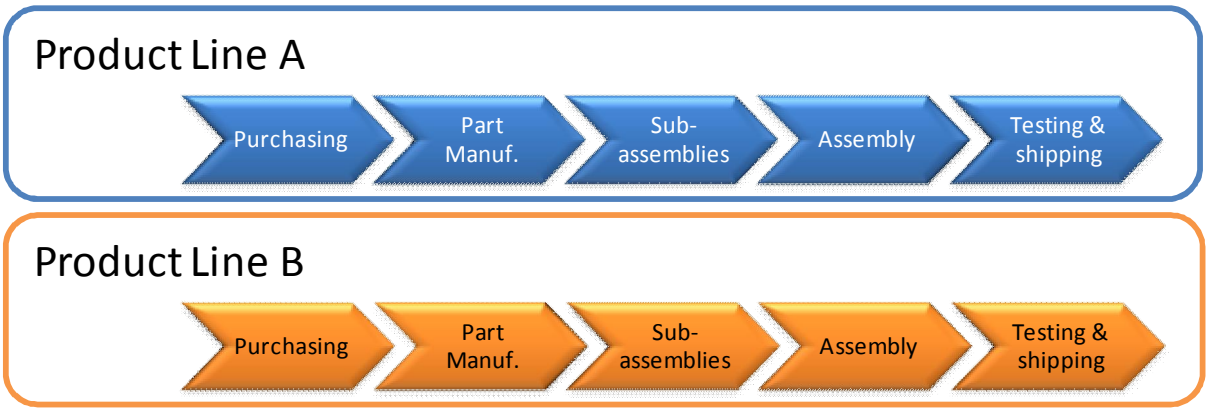
Activity based measurement allows management to rely on more accurate information than in overhead costing. Cost- and environmental impact of a product line can be counted as a cumulative sum of individual services. This information can also be utilised in introduction of new products, as the target is usually to configure new offering largely from the existing services.

Operational performance (such as lead time or inventory turns) metrics are easily accounted in traditional measurement system as well. The main impact of the measurement change is the possibility to benchmark different operations against each other.

IN NUTSHELL:

Management systems should show the performance of:

- *Products*
- *Activities*
- *Customers*
- *Suppliers*

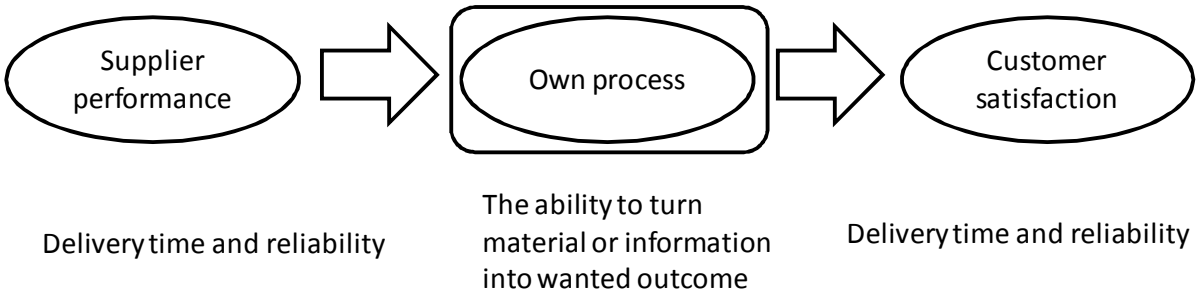


		Purch.	Part Mfg.	Sub assy	Assembly	T&S	Total
Cost	**Cumulative**	Direct + residual	Direct + residual	Direct + residual	Direct + residual	Direct + residual	**Sum**
Environ-mental	**Cumulative**	Direct + residual	Direct + residual	Direct + residual	Direct + residual	Direct + residual	**Sum**
Operative	**Comparative**	Direct	Direct	Direct	Direct	Direct	**Direct**

Activity performance

"A comprehensive approach such as the Fractal Factory avoids emphasis on the product as the prime factor, since this would preclude a whole range of solutions at the outset. Factories whose prime resource resides in the skills of their workforce will do well to base their external and internal structures on this aspect." [Warnecke]

The statement implies that while product focus describes the present, it gives little tools for planning the future. Activity orientation requires the description of processes and organisational structures that perform these. There are three main domains that need to be considered while evaluating activity performance; supplier performance, process effectiveness and customer satisfaction.



Supplier performance affects directly on needed safety stock (in material or time) and therefore the performance of a specific activity. Operative performance metrics of a certain process or processes of an entity should describe the ability to turn material or information into desired outcome. Good operative metrics, such as inventory turns, consider both lead time and inventories. Customer consideration is essential to ensure correct offering, quality, time and place.

It should be noted that required process inputs, such as workforce, energy and money, are already included in the cost and environmental impact analysis of service instances. Resource usage, for example, is not a good activity performance indicator because it leads to excessive build up of intermediate storages.

Customer performance

Customer specific accounting tries to capture cost of office processes and customer specific product modifications. This information is useful for differentiating service level or pricing based on customer profitability.

In CSM-Hotel, or in any other supply chain, some customers can be very profitable for one actor but account negative value for another. Proving this with a coherent reliable accounting practice may give an option to alter profit sharing in the supply chain into more economically sustainable direction. Other possibilities are changing the service level or finding another supplier.

Supplier performance

Supplier performance considers cost, quality, delivery time and reliability. These metrics can be applied in internal supplier-customer interfaces as well. Supplier performance information can be used to target development practices, to conduct make or buy decisions, and for selecting preferable service providers to supply chains.

Execution and control

All presented management views can be flexibly generated from the data assigned to service instances. The direct link between control and performance indicators can be utilised to the opposite direction as well. Management targets should be split to lower level objectives and brought visible on execution level, as shown in Figure 28.

Visible factory floor level control indicators work best when they are directive rather than restrictive. The aim should not be to decide how people should perform their tasks, but rather give feedback on the results of their actions. Good control indicators are derived from corporate targets, are sensitive to

IN NUTSHELL:

Performance indicators should be carefully selected to direct organisational behaviour

actions and restricted to impact zone of the user, and are easy to understand. Visual indicators are essential in bottom-up development, captivating the idea that small improvements in large scope result a large impact.

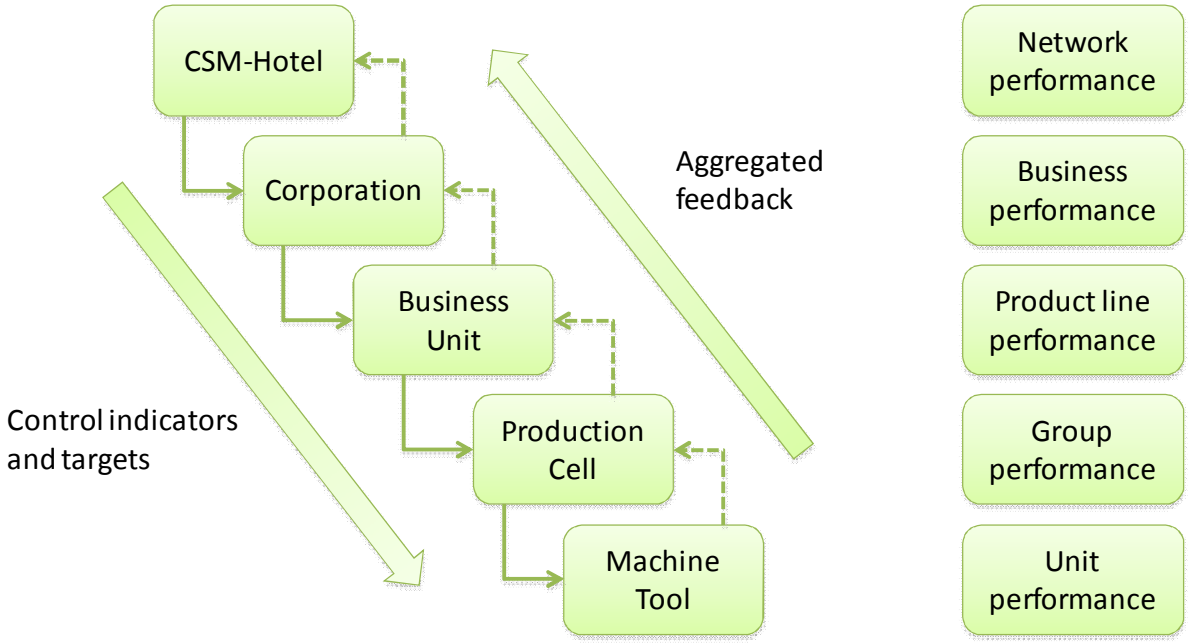


Figure 28: Target setting for fractal hierarchies

Corporate or even supply network performance indicators should be rolled to the level where they can still be attached to the processes. That means a direct impact on the corporate metric can still be described.

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3.0 Social Aspects of the Concept

When introducing ESET-context, which is also base of the STEEP-framework, Jovane et al. [Jovane] states that socially sustainable development can be achieved, as people feel that they can have a fair share of wealth, safety and influence. These factors can be traced back to universal human needs that are common in several different need theories. These are needs like basic need for food and shelter, safety and security, social support and love, feeling of being respected and pride in activities, mastery, and self-direction and autonomy [Tay]. According to Jovane et al. [Jovane] because of its social dimension, sustainable development aims at enlarging the vision from present needs towards the future generations' expectations. This way social aspect is tightly linked to all aspects of sustainability. When dealing social sustainability in manufacturing company level Koho et al. [Koho] lists aspects that must be taken in consideration. These are means like employee safety and well being, employment, human rights, and engagement (Figure 29).

IN NUTSHELL:

- *Concept promotes interaction and collaboration across the firms creating tighter social community*
- *Hotel-level actor and society can promote companies to operate socially responsibly*
- *Challenge is how to get enterprises invest in social sustainability even if it could mean some economical sacrifices in short term*

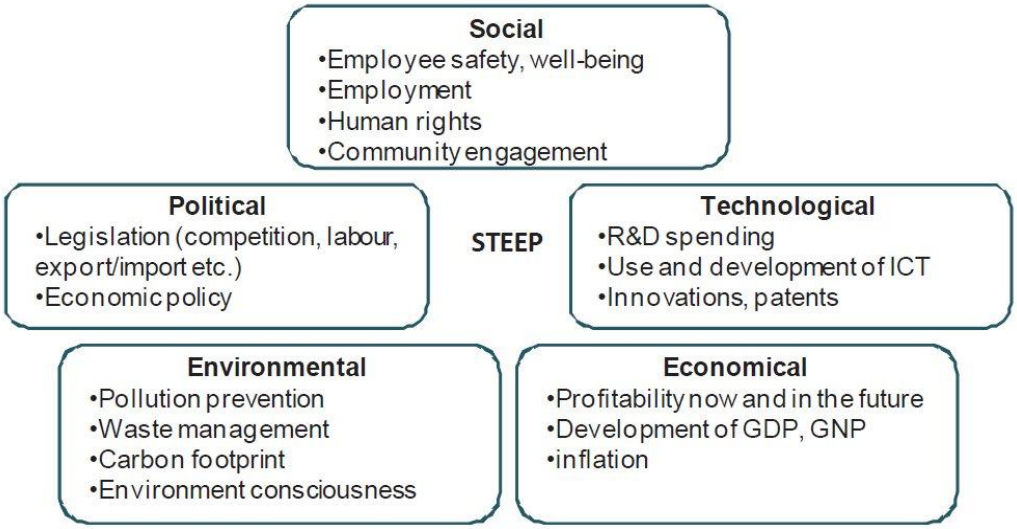


Figure 29: STEEP-framework [Koho]

3.1.1 Social Sustainability in CSM-Hotel

CSM-hotel concept should give answers on how to contribute on social sustainability at company level, hotel level, and society level. Because CSM-Hotel concept gives room for many different kinds of CSM-Hotel realizations, hotels impacts on social sustainability can differ radically depending on particular hotels participants, location, management and its surroundings. Still some general remarks can be made on how CSM-Hotel type implementation can answer on challenges of social sustainability.

3.1.2 Benefits

Distinctive features in CSM-hotel are common physical facilities and at least in some extent common operative practices that enable seamless cooperation in CSM-hotel and synergy between companies. When companies have common social facilities it increases social intercourse between employees on different companies and tasks. Interaction can be enhanced by organizing social events like parties, sporting events and past time activities for all the participants in hotel. Also when companies work in collaboration employee supporting actions like health care or day care for children would be easier arrange. This enables emerging of tighter social community in which employs feel being part of. Closer interaction between companies and employees gives also wider perspective on operations on how ones work affect operations on different places and what is the purpose of each work stage. Studies suggest that if organization can foster a sense of purpose and belonging among its members, it can have direct positive effect on work motivation [Moynihan].

When companies are working closely together and physically in same facilities, it is easier to organise in collaboration education and training for employees. This encourages employees

for continues learning, which benefits both companies and employees and also gives motivation for workers when they see that companies invests on them. Organizing education in collaboration with other partners on hotel also increases learning best practices from other participants. Employees with highly routine jobs are especially likely to have lower work motivation [Moynihan]. Investing in training and education promotes their possibilities to advance in ones career over time and also gives more job opportunities and security if company faces tough financial times. When interacting with people in different companies people are networking which also gives better opportunities in job markets. One idea of CSM-Hotel is that companies can use flexibly other companies' recourses, including workforce, so that employees can also flexible work for different companies in a hotel without changing employer if one company faces slower period in their business. This increases job security and can give variety in workers job description.

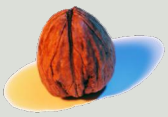
Fair share of wealth, human rights and worker safety are issues that depend strongly on current implementation and surroundings of CSM-hotel. These factors can still generally be taken better in consideration when there are hotel level operator that can issue general standards, norms and conditions that each company must fulfil in order to be part of the hotel. When workers are well networked and skilled, it also promotes companies to take good care of it employees for that they don't change their workplace. When social sustainability is promoted well in company- and hotel level it is competitive edge in job markets attracting skilled and motivated workers. In society level CSM-Hotel concept gives easy platform for to start up firms with lower capital. This promotes entrepreneurship and employment in wider perspective.

3.1.3 Challenges

Because CSM-hotel constructs' from individual companies and personnel's, it cannot be ensured that work community and social relations are always good as possible. Les formal relations can be also risk making conflicts between personnel's in different companies more possible. This can make cooperation between companies difficult and hurt the working environment. There should be a method for handling conflicts between companies and personnel's in businesslike manner. On the other hand too close work community can also be risk if it leads to groupthink. There members value group membership to the point that they exclude any evidence that is damaging to group members or contrary group norms [Janis]. Behaviour that damages performance, like corruption and incompetence can become tolerated [Moynihan].

In CSM-Hotel type community trust between actors becomes essential. Environment where workers work flexibly for different companies and are well networked can create tough competition for both employees and jobs. This potentially creates tension in work community, distrust between companies, and uncertainty on ones position. In this kind of

environment confidentiality of companies private information can also become compromised. On a hotel level the challenge is how to measure and ensure that individual company's behaviour is socially responsible considering issues like e.g. work safety and human rights. Control must be sufficient enough that these issues don't get neglected, but it does not become distracting for the enterprises. With too much control it is danger that companies feel lost of independence and sense of suspicion and mistrust is generated. Social sustainability cannot be achieved just by controlling and monitoring but also attitude of towards importance of social sustainability must change and recognize its importance. Challenge is how to get enterprises invest in social sustainability even if it means some economical sacrifices in short term. This needs promotion and support to act socially responsibly by both CSM-Hotel and society. Society could support companies' e.g. with tax incentives if they operate socially sustainably. Possibility to this depends on surroundings and political climate on witch hotel operates.



IN NUTSHELL:

- *Companies can focus on their core business*
- *Shared resources bring benefits*
- *OSP and other hotel companies offer services*

3.1 Technical Aspects of the Concept

The CSM-Hotel concept does not define minimum technical state of the companies which work there, but the new environment can add some requirements for the companies. The CSM-Hotel concept gives its customers possibilities to work at higher technical level than working by their own. The main enabler for that is that companies can focus on their core business and direct their investment for that. All other services are subcontracted from other hotel companies or co-operated with hotel companies and OSP.

Figure 30 explains why companies are possible to work with better devices in CSM Hotel than by own. CSM Hotel is possible to use more suitable devices, which are effective, environmental friendly and special machine for that environment. The enabler for that is that these devices have several users. These enable higher utilisation degree, lower variation in demand and lower investment risk. The CSM-Hotel companies work in close relationship together and they know other companies capabilities'. By sharing expensive resources companies can get its' capacity load higher and reduce usage variation. This lead shorter pay-off period and make possible to invest more expensive and effective devices. There are some resources that should be shared in CSM-Hotel. Using shared resources is one main target to get benefits in working in it. Production facilities including places, air-condition, water, electricity and pressured air are recourses that should be shared. Shared storage is also example of the recourse which benefits can be calculated easily. There are a couple of possibilities to handle special company needs:

1. The CSM-Hotel OSP can offer the service or acquire it from outside the community

2. One of the hotel companies offer the service

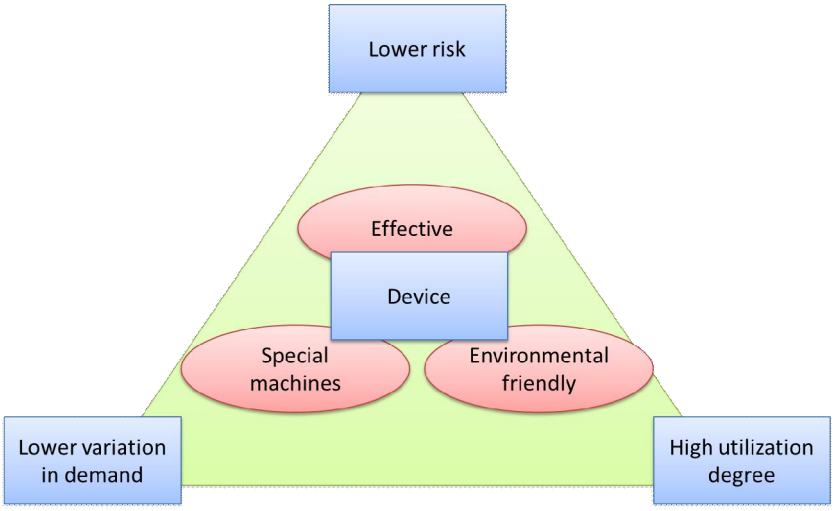


Figure 30: In CSM Hotel it is possible to use more suitable devices than companies is possible by own

If the CSM Hotel OSP offers service, all the hotel companies can get service, but they do not need to take full risk of the service. The CSM Hotel companies can use it by agreed price even if demand varies. If the hotel company buy that machine, it can get order from other companies to that machine and these order lower demand variation to that machine. The CSM Hotel OSP can offer services which are available to the hotel companies by annual or usage based fee. These services could be for example software services (e.g. CAD- or ERP-software), property, or value adding services (e.g. machines). Hotel companies can use these services by their needs, take these modules what they need and pay usage as agreed.

3.2 Economical Aspects of the Concept

3.2.1 Introduction

Sustainable economics incorporates an underlying assumption that long term viability of a business holds a value of its own (as opposed to profit maximization at any chosen time interval). Gollier [Gollier] suggests that theory of real option value can be used as an economic tool to model sustainability. Thus the basic question is: how much current welfare should we invest in order to get rewards in the future? The Brundtland Commission gave a partial answer to this question with their definition of sustainable development:

> "The Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." [WCED]

IN NUTSHELL:

"In an uncertain world, flexibility is crucial. Irreversible decisions have a hidden cost coming from the subsequent inability to use information that will emerge in the future." [Gollier]

Real option value tries to bring dynamic elements to static cost-benefit analysis. The key is to entail several decision making points after the initial investment decision. The possibility of making corrective actions after unfavourable development is not included in static models. The approach requires a definition and consideration of three main variables: Value, time value (i.e. effective discount rate), and uncertainty (i.e. risk).

Value

Value is generally described as a monetary unit, euros, dollars and pounds. It constitutes from different assets listed in a company's balance sheet. In investment calculations value is reduced to current and future cash flows. Because these cash flows are supposed to be generated with a specific asset, a transition process is needed. It might be possible to incorporate environmental and societal values through transition process, by introducing negative cash flows on environmental impact and positive cash flows for increased worker productivity. This is difficult in practise because of the unreliability of the estimates. Also, it is not clear how well a direct process model describes causalities of a complex socioeconomic system.

Time value

Time value is used to quantify how valuable future cash flows are in present situation. The effective discount rate can be quite freely decided to reflect expected return on investment

(target ROI), risk free interest rate or some other preferred discount rate. The important thing is to understand what the discount rate reflects.

Uncertainty

Traditional risk management estimates the risk impact (probability x influence). Traditional investment calculations estimate risk as variation of expected return. Neither of these methods is at best capturing the low probability but big influence risks. The problem arises from commonly used normally distributed risk estimate that effectively ignores events happening once in fifty or a hundred years on average. However, it doesn't take 50 years of history to find many disruptive occurrences that have drastically changed life on business, national and global levels. In the global market economy, the probability of these disruptions affecting one's customers, suppliers, or operations is increasingly high. In the aftermath of Fukushima accident professor Fujimoto stressed that actions which deteriorate national competitiveness are not feasible risk management practises. The statement implies that in order to be sustainable one also needs to be (short-term) competitive.

3.2.2 What kind of a value should be placed on continuity (sustainability)?

The question presented in the heading is essentially the same as the one Gollier is asking. The difference is that it is easier to reply from a society's than individual owner's point of view. One could argue that zero value should be merited on basis of sustainability, as actively reallocating capital to most effective targets should maximise welfare. However, without a contradiction, it can also be stated that an investment with a lower level of risk and a similar expected value is preferable over a higher level of risk. From economic point of view it is easier to approach sustainability by pricing risk instead of predicting value.

IN NUTSHELL:

- *One needs to be competitive in order to be sustainable*
- *Low cost strategy does not equal low risk strategy*

In the light of theory of real option value and the definition of sustainable development, it could be concluded that good risk management practices leave company with the ability to change course until the generation of decisions will be made. For example strict payback period limitation as an investment criterion is an effective tool for short term cash flow management. Problems may arise when payback period is used as a long term investment guideline. The reasoning behind payback time criteria is to minimize the uncertainty of predicting the future cash flows. This argument does not hold for investments associated with long term risk management. Even investments with expected value of zero can still be economically sensible if they prevent disruptive risks.

3.2.3 Allocation of capital and capacity in CSM-Hotel

CSM-Hotel lowers transaction costs between participants. This is due to close physical proximity, established cooperation relations, improved information visibility and shared ownership in various instances. The lowering transaction costs should evoke an internal marketplace that allows efficient allocation of resources at all times.

Just as capacity, CSM-Hotel also supports efficient reallocation of capital. Shared infrastructure and service consumption based pricing create an environment where companies can quite freely adjust the ratio between fixed investment costs and need of working capital. Existing customer base and integration to the manufacturing environment should decrease the investment risk in general. Another possible outgrowth could be internal financing operations of CSM-Hotel. Other companies or a third party (e.g. OSP) could provide liquidity on better terms than external financial market, if they have a higher valuation of securities.

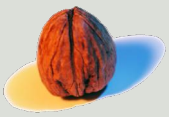
CSM-Hotel provides an environment for increasing investment value through improved utilisation rate and mitigating risk through financial flexibility. Both of these impacts have a positive effect on value of any investment. In good circumstances this could spring a faster growth rate of the companies and the system as a whole.

3.3 Environmental Aspects of the Concept

Environmental sustainability is the process of making sure current processes of interaction with the environment are pursued with the idea of keeping the environment as pristine as naturally possible based on ideal-seeking behaviour. [Malik]

An "unsustainable situation" occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. [Barbier]

Theoretically, the long term result of environmental degradation would be local environments that are no longer able to sustain human populations to any degree. Such degradation on a global scale could imply extinction for humanity. [WorldCSD]



IN NUTSHELL:

- Efficient Processes and the Latest Environmental Technology!
- Closed-Loop Material Flow – The 6R Approach
- Thrifty use of Raw materials, Reduction of Emissions and Energy Consumption

The state of sustainability in an environment can be shown as in the Table 10.

Table 10: General evaluation measurement of sustainable development recognition [Makki]

Consumption of renewable resources	State of environment	Sustainability
More than nature's ability to replenish	Environmental degradation	Not sustainable
Equal to nature's ability to replenish	Environmental equilibrium	Steady state economy
Less than nature's ability to replenish	Environmental renewal	Environmentally sustainable

3.3.1 Environmental sustainability in CSM-Hotel

With the help of efficient processes and the latest environmental technology, CSM-Hotel will minimize the emissions from operations and CSM-Hotel will have as little impact on the environment as possible. Examples of this are the common internal and external logistics and a joint procurement, which will significantly reduce both costs and the carbon footprint of activities and the environmental load.

In CSM-Hotel there will be paid attention to the thrifty use of raw materials, recycling, and reduction of emissions and energy consumption. This is prerequisite for companies to meet emerging and ever-tightening requirements now and also in the future. In particular

attention is also paid to energy efficiency of the devices and processes. The latest technology and the different technical solutions, such as energy saving states of devices, will have a significant impact to the total energy consumption of operations.

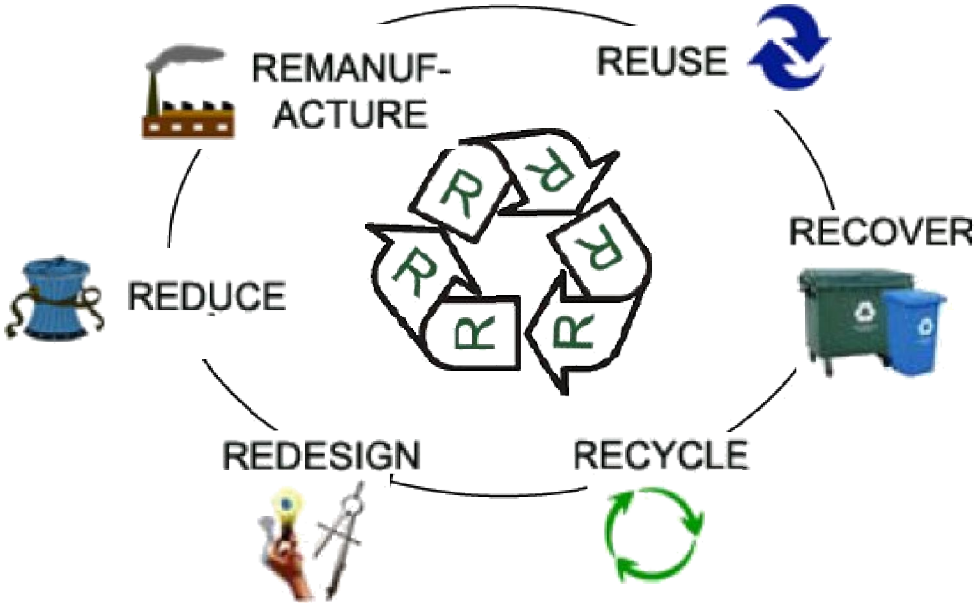


Figure 31: Closed-loop Material Flow – The 6R Approach [Modified from Jawahir]

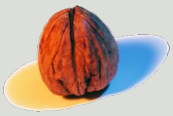
All processes in CSM-Hotel should be designed so that material flow forms closed loop (Figure 31). According to the 6R approach [Jawahir] one should always rethink and redesign processes and products in order to be more sustainable. It also essential to organize comprehensive recover and recycle processes so that products could be remanufactured and valuable raw materials could be reused. With the reuse of renewable and recycled material it is possible to minimize quantities of waste that is transformed to landfills.

Environmental sustainability requires that human activities settles to the limits nature in such a way that the biodiversity and ecosystem functioning is not compromised. Energy constitutes a key challenge of eco-development because 90 % of our planet's energy comes from fossil energy sources. Eco-efficient production is based on renewable and non-renewable resources-saving and emission reduction. The most essential in environmental sustainability is to implement more environmentally friendly production and consumption practices. [UEF]

3.4 Political Aspects of the Concept

Sustainable development is strongly affected by political decision-making. Laws and regulations can be used to guide the industry to sustainable development. However, the political decisions can also obstruct sustainable development in some situations. In this context, political instruments are laws, regulations, and various kinds of restrictions, as well as, subsidies and reliefs (e.g. tax reliefs).

Political situation and political decision-making generates both risks and opportunities for the business. The political risk is, for example, an unfavourable change of the political situation or legislation in the country in which the company operates. The political opportunity describes, for instance, the situation in which the company has invested in a certain eco-efficient technology, which provides a competitive edge when the regulations tighten.



IN NUTSHELL:

- *Political risks and opportunities*
- *Companies can respond to the laws and regulations more effectively; shared costs, more knowledge and resources*
- *Companies have better possibilities to impact, and get their voice heard*

In the CSM-hotel the companies can respond to the laws and regulations (e.g. emission limits) more effectively, since the costs can be shared among the companies and there is more knowledge and resources than in individual company. Opportunities to gain funding and financial support are better when the operation is fundamentally sustainable and more resources and expertise are available for the application process.

CSM-hotel has better possibilities to impact, and get the companies' voice heard in, both municipal and national level. That is, because the CSM-hotel is a larger and more interesting actor than individual SMEs, and furthermore, the CSM-hotel brand may be better known and respected among decision-makers. If it is possible, for instance, to affect the land use planning, a better infrastructure for CSM-hotel can be achieved. In conclusion, the sensitivity to explore the political climate and to find the ways to impact, wherever the CSM-hotel is located, are better in CSM-hotel because of better availability of resources and expertise.

3.5 CSM-Hotel's Effects on Sustainable Future

Based on the STEEP-review of the CSM-Hotel, the challenges of the Finnish and the global manufacturing industry have been analyzed (Figure 33). The main challenges have been identified natural resources, labor, information processing, predicting the future and the issues related to new technologies. Next, the previous mentioned challenges are described in more detail.

3.6.1 Major sustainable future related problems

Natural resources aren't sufficient for all. As a result of over-consumption, the natural resources are reduced and mountains of waste are growing. Resource and material consumption has also a direct impact on greenhouse gas emissions. The survival of earth and the mankind requires a radical reduction in the use of natural resources. German Wuppertal Institute's so-called "Factor 10"-concept states that humanity must reduce energy and material flows in one tenth over the current 30-50 years or one generation. [Formin 1]

During the last century, for example, water use has increased six times, which is more than twice the population growth over the same period [Formin 2]. A shortage of clean water may in future lead to situation, where the water may cost more than oil. Frugal use of water resources is the only real solution to water scarcity [Formin 3].

Globally speaking, the processes pollute and consume energy too much. Overmuch waste is also generated and material recycling and reuse has improved hopelessly slow. In addition, the goods are produced all over the world in a different location than the market, which increase the amount of cargo.

Information doesn't flow. We live in information society, where information is everywhere. Certain things cause challenges for the information flow, which are the same also in production environment. Form, location and timing of the information are crucial for the successful operations. It can be that production isn't optimal, because of the lack of communication. The information flow can also slow down because of the long supply chains. One has to also know what information is reliable and who uses the information. The biggest issues are still related to information systems. In many cases the information systems and formats are incompatible.

Not available skilled labour. Population ageing is unprecedented (Figure 32), without parallel in human history—and the twenty-first century will witness even more rapid ageing than did the century just past [4]. Aging together with the early retirement causes, that in future there will be lack of skilled labour available.

There are also some other major challenges that effects for the availability of skilled labour:

- People aren't necessary willing to move to small places or over long distances in search of work.
- Education doesn't meet the needs of industry

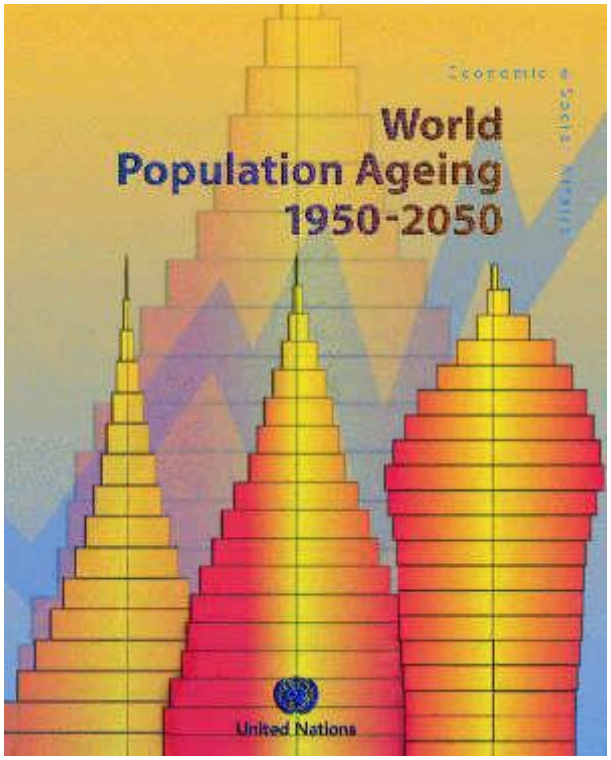


Figure 32: Frontpage of the UN publication "World Population Ageing 1950-2050" [4]

Uncertainty of the long-term competivity. Future is hard to predict. That is one reason why companies might be uncertain about the future. It is hard to see what are the next big things and sometimes even thought the new trends are identified, the organization itself isn't adaptable enough to take the advantage of it. Other challenges are related to innovations and continuous development. New innovations must be done and process must be developed in order to be competitive. Companies must also have ability to manage the disruptive risks.

New technologies aren't used. Common reason for that is money. Companies might be willing to implement new technologies, but new things can be so expensive that they don't have ability to invest. It can also be that due the lack of expertise or unawareness of new developments, companies' implementations become slow. The root cause for that could be lack of basic research or resources in R&D.

3.6.2 Solution – CSM-Hotel

All the problems presented earlier can be overcome. The CSM-Hotel concept gives one solution for the future challenges. In this kind of flexible collaborative manufacturing environment, the main targets are competivity, sustainability, continuous development and healthy workforce – the four cornerstones of the sustainable future and also CSM-Hotel.

CSM-Hotel is design so that it has the ability to plan, design and react. Hotel will also have efficient operations and resources to adapt for changes. Next, the previous mentioned key elements of the CSM-Hotel are described in more detail.

Ability to plan and design

- Due to the shared and combined forecasts, the production planning is more accurate and efficient
- Both product design and manufacturing chain will be next to each other, which gives better premises to design new
- The flexible and collaborative structure of the CSM-Hotel constitutes an innovative manufacturing environment

Ability to react

- Service Oriented Production architecture enables rapid introduction of new products or service offerings
- Distributed Solutions are robust and speedy in recovery
- Real Time Monitoring gives for the whole environment precise information about the status of the production.

Resources for change

- Flexible capital structure allows companies to adjust investment / working capital ratio
- Benchmarking raises awareness of the best available practices
- CSM-Hotel is committed to use of the newest possible technology, which gives a great advantage to its companies

Operational Efficiency

- Due to the collaboration it is possible to efficiently allocate resources, which will have a major impact to productivity and competivity of CSM-Hotel companies
- Hotel companies are located close to each other and their transportations are combined, which minimize all logistics costs

- When companies are doing business together, they will also get benefits from the economics of scale, scope and specialization

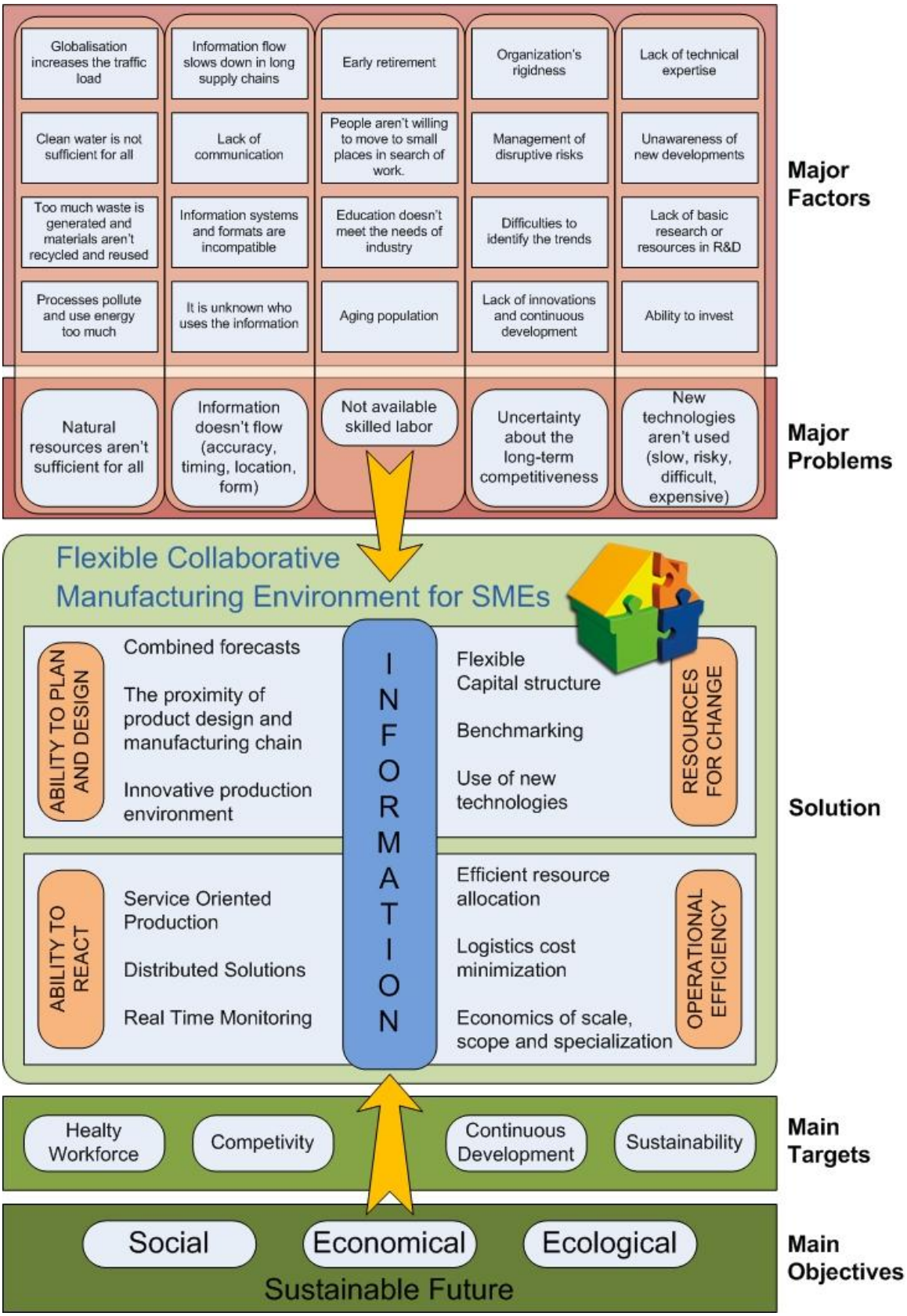


Figure 33: Major problems and objectives where the CSM-Hotel concept effects

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II PRACTICAL PART

4 How the CSM-Hotel Works?

4.0 Everyday Operations

The basis of functional CSM-hotel and successful co-operation are shared ambitions, rules and commitments. Rules should include how the hotel is managed, financed and what principles are utilised in order to facilitate collaboration. Companies in the Hotel work as independents companies and a great deal of co-operation can be based on private agreements instead of shared policies.

Information is shared electronically when possible. This enhances traceability, allows automation of office processes, unifies data structures and improves overall control. All companies have their expertise and manufacturing is organised to fully utilise the expertise of each participant. Companies do not have to master everything alone. Communication between hotel companies occurs in different levels. Information systems and workers from different companies communicate with each other on regular basis.

Electronic communication and transactions: Use of common interfaces allows automated transaction processing. Electronic communication increases efficiency in a large share of office processes, such as measurement, billing, planning and control, product tracing, and purchasing. In a collaborative environment it is important that different actions and transactions leave a trace that can be verified by multiple parties.

Collaboration: The main core of CSM-Hotel concept lies in collaboration of the companies. The assets, skills, connections and knowledge of different companies can create additional value when brought together. Companies can focus on their core businesses and allocate work to where there are best capabilities for achieving targets. Businesses can also learn from each other and map their performance against reference companies. Informal communication is seen to have an important role in bringing up new ideas and innovations. This is enhanced by shared public premises such as cafeterias and recreation rooms.

Focus on value adding operations: Objective of the CSM-Hotel is to allow companies to focus on their primary operations. Outsourced support services reduce the amount of individual office work. Close proximity of the companies allows one to take small portions of the value chain without increasing logistic work too much. This increases benefits of specialisation and allows manufacturing processes to be performed with the best competence.

Investments: CSM-Hotel does not limit the investments individual companies are planning to make. Rather it enhances growth by lowering transaction costs and supporting higher utilisation of assets. The investments made to infrastructure by the OSP should be demand

based. In practise this means that either businesses' have a possibility to decline from offered services, or there is a mutual agreement on investment policies and price levels. Companies can also share investments that benefit multiple users.

Holistic System Development: Decision making structure of CSM-Hotel depends on ownership structure and the nature of collaboration and strategic targets that are set for the environment. The most important function in order to guarantee service level of the businesses in CSM-Hotel is capacity planning. Capacity planning should be based on aggregated forecasts to level variation, reduce effects of forecasting errors and allow a holistic view on the system. Strategic planning is needed in order to identify the partners that can bring the most value to the system.

Use of Support Services: The level of quality in supporting services can be a great asset from an individual company's point-of-view. Services like waste management, energy management, quality control and e.g. ability to perform EDI transactions increase the credibility of small businesses. The set of supporting services can be tailored to meet the needs of companies so that they pay only from the services they need.

Improving Core Services: Core services are directly related to businesses and CSM-Hotel infrastructure. This means that companies are tied to one service provider and it is usually not cost efficient to consider other alternatives. The core services include facilities, storage and material handling solutions, integrated information services and factory automation solutions. Integrating these services allows cost savings because of economies of scale, higher resource utilisation, increased level of automation, and powerful machinery that increases productivity. Collaborative decision making is preferred for investment decisions in core services.

4.1 "All kind of integration"

Common Integration Platform (CIP) is meant for all practices, technologies, flows, and solutions that are integrated in CSM-Hotel environment. CIP describes the content of an integrated flow and the interface how one can connect to it. CIP is meant to be a stable structure, while adding features i.e. new flows is easy. Centralised nature of CIP reduces the need to do complex and difficult cross-configurations, as shown in Figure 34.

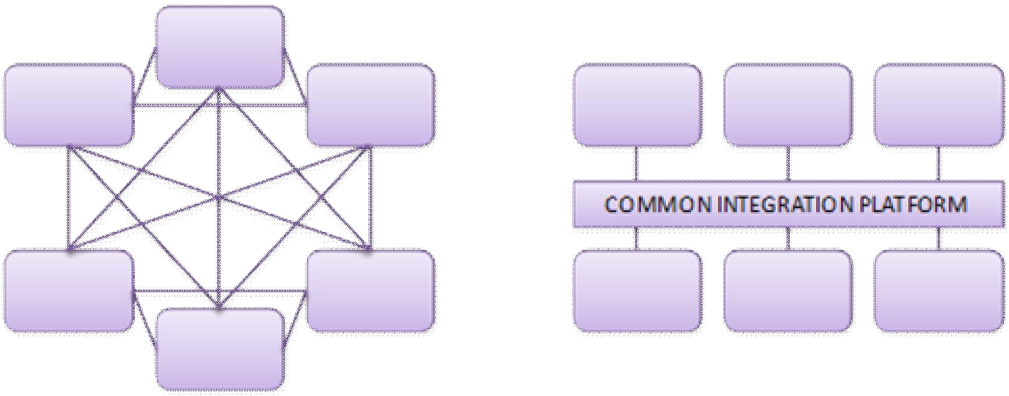


Figure 34: Reduction in number of connections between a full cross-configuration (15 links) and a platform configuration (6 links)

Any new entrant needs to configure itself to connect to CIP on wanted aspects. The established link allows it to cooperate with any other system entity. Centralised structure also helps in data collection and measuring. A change in CIP interface causes a reconfiguration need for all participants who are connected to it. Therefore it is favourable that centralised solutions are scalable regarding capacity and features. Some examples of integrated solutions are given below:

Facilities

A ground rule for integrating facilities is to separate productive space (private) from shared supporting facilities such as storage space, meeting rooms, etc. Supporting facilities are often with a volatile use, so integrating them can save in investment costs. This also means central capacity planning for supporting facilities and private capacity planning for production areas.

Storage

Storage space could be easily implemented as a distributed structure. However, integration of main storage provides clear benefits:

- Efficient material handling at the dock
- Decrease of necessary overall storage space
- Customer focus on own storage -> motivation to pay attention to inventory levels
- Division of production and storing facilities

These benefits should overcome the additional configuration and control effort required by a centralised structure.

Material Flow

The targets for material flow design are simple control, small amount of logistic work, traceability and speedy deliveries. In practice these are usually obtained when the number of material handling spots is limited, directions of flows are constant, and transport containers are standardised.

Capacity and production processes

Irregular need, high investment cost and volume correlated efficiency can drive companies to acquire some production processes for common use. Examples of such investments could include deburring, paint shop, heat treatment, etc. The integrated control of several material flows requires combined work queues, capacity planning, order/booking system and agreed priority rules.

Secondary Process Outputs

The scale of CSM-Hotel allows efficient handling of secondary process outputs. Useful outputs, such as heat or material waste, could be directed to a closed loop for beneficial reuse. Other harmful emissions and waste neutralised or recycled to a greater degree than from dispersed small units.

Process Inputs

Typical process inputs include energy in different forms, water, compressed air, and other resources manufacturing processes consume. Most of these are produced in a centralised manner. The configuration here means simply connections to supply and meters for tracking consumption. Some benefits can be also pursued by installing a shared cutting fluid circulation.

Policies and practices

CSM-Hotel should include some ground rules that all participants agree to follow. These control shared capacity booking, information privacy, common conditions and development practices. In case CSM-Hotel makes a statement of following a standard as a whole, then all participants have to adapt to agreed policies or reporting methods to some degree. This does not necessarily require alteration of working methods, but consistency in reporting of actions. Platform can provide a reporting infrastructure that greatly reduces individual office work required for achieving a specific standard.

4.2 CSM-Hotel Services for an SME

Table 11: Core services and offering

CORE SERVICES	OFFERING FOR AN SME
PLANNING AND DEVELOPMENT	PRODUCTION AND OFFICE FACILITIES
CONSTRUCTION SERVICES	STORING , COLLECTING AND MATERIAL HANDLING SERVICES
PROPERTY MAINTENANCE	SHORT INTERVAL SMALL BATCH DELIVERIES
INTEGRATION SERVICES	SMALL START-UP COSTS
INFORMATION SYSTEMS	SUPPORTING NETWORK OF VARIOUS EXPERTISE
LOGISTIC SERVICES	EXTENDED AVAILABILITY OF MANUFACTURING PROCESSES
SHARED MACHINERY AND AUTOMATION	

Table 12: Additional services

Common spaces	**Human Resources**	**Maintenance**
Break rooms	Recruiting, Education	Condition monitoring
Negotiation rooms	Work welfare, Work safety	Service & Maintenance
Canteen	Staff pool, Temporary posts	Inspections & Corrections
Nursery	Recreational services,	Spare parts
Administration department	Culture activity, Sports	Real estate management
Secretary services	**Purchasing department**	**ICT**
Translation services	**Sales department**	Cloud services
Legal services	**Marketing department**	IT-support
Patent maters	**Research & Development**	CAD/CAM
IPR	**Environmental services**	ERP
Financial management	Waste management	**Quality Department**
Billing	Recycling	Quality system services
Accounting	Education & Advising	Auditing
Payroll computation	Information services	Quality certificates
Reporting	(e.g. statistics)	**Security services**
Filing		Guarding

IV Appendices

Appendix 1: Case Studies

During the project there were several CSM-Hotel cases under development, but the building of the real company case proved to be too challenging and unfortunately it wasn't possible to define any case so that it would have been possible to analyze it.

Still we were able to build four different kinds of CSM-Hotel cases which examine the concept from the different point of view. In Figure 35 the cases and the perspective of them are presented.

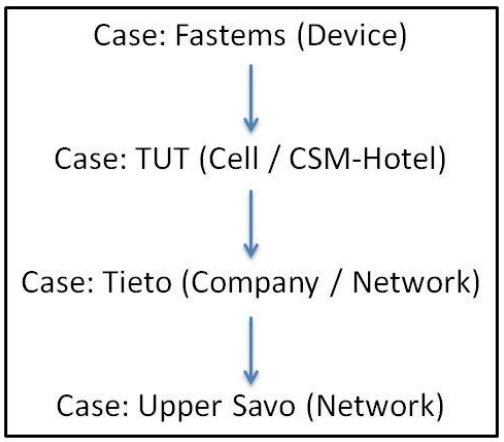


Figure 35: Structure of the CSM-Hotel cases

Case: Fastems Oy Ab

Fastems Oy Ab has two products, which usage in CSM-Hotel environment is researched during this project. Flexible Manufacturing System (FMS) is very logical solution to arrange CSM-Hotel inner logistic. Fadector OEE is a tool for following production efficiency.

FMS - Manufacturing management System 5 (MMS 5)

CSM-Hotel adds some special requirements for FMS. Working in CSM-Hotel is service based and decentralized. FMS tasks should be possible to present as services which are visible in a hotel as is defined. Fastems' new FMS control generation MMS 5 is an open decentralized service based system.

IN NUTSHELL:

- *Open, service based and decentralized FMS*
- *Adaptive and easy to extend*
- *Overall Equipment Efficiency (OEE)*

The System communicates base on normal Ethernet network and user interfaces are a browser based. MMS-5 consists of MMS kernel, which is the complete FMS control system with advanced features, and additional software modules which can be selected by user needs. A Special feature of the Fastems MMS 5 is that it is not dependent on any machine tool make and it is possible to fit large number of different makes and models of machine tools.

MMS 5 is not connected to any specific ERP manufacturer. CSM-Hotel companies are not fixed and in longer run it is mandatory that new companies must be possible to connect in Hotel FMS system software and hardware level with their existent devices.

The main advantages of the Fastems MMS 5 -system in CSM-Hotel environment are:

- Open software
  - Not limited to any machine tool make
  - Not limited to any ERP manufacturer
- Service based
- Modular structure

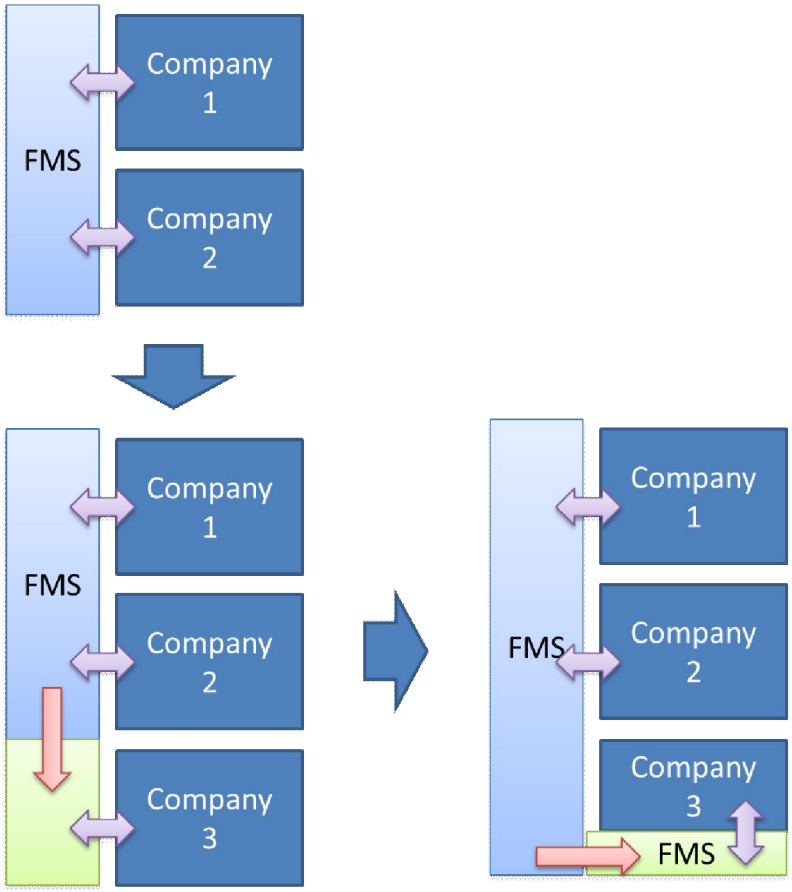


Figure 36: The CSM Hotel need the flexibility of FMS

To gain maximum possible agility CSM Hotels' inner logistic solution must be adaptive (Figure 36). If the logistic is solved by FMS, it must be possible to increase and decrease its' capacity. Companies' of inner logistic can also be solved by FMS and these must be possible to connect to the hotel FMS. The control systems of multiple FMS must communicate to each other. That is possible to solve by using SOA architecture.

Fadector OEE

Fadector OEE is system for monitoring CNC machine tools and to provide graphical and numerical statistics on their operation. Fadector OEE consists of server application, data collection devices, and a user interface web applications. In CSM-Hotel laboratory demonstration (Figure 37) we find Fadector OEE very good as a user interface of the manufacturing cell for job queues and also for user to input production information through it. Fadector OEE is very flexible and can be used as manual work phases as CNC machines. However, it still does not work very fell in fully automatic environment. In CSM Hotel environment CSM Hotel service provider can offer Fadector OEE server and all hotel customers to connect that server. In one CSM Hotel it is possible that every company has its own Fadector OEE database but it is also possible that in one or more companies' use Fadector OEE database serviced by the hotel OSP.

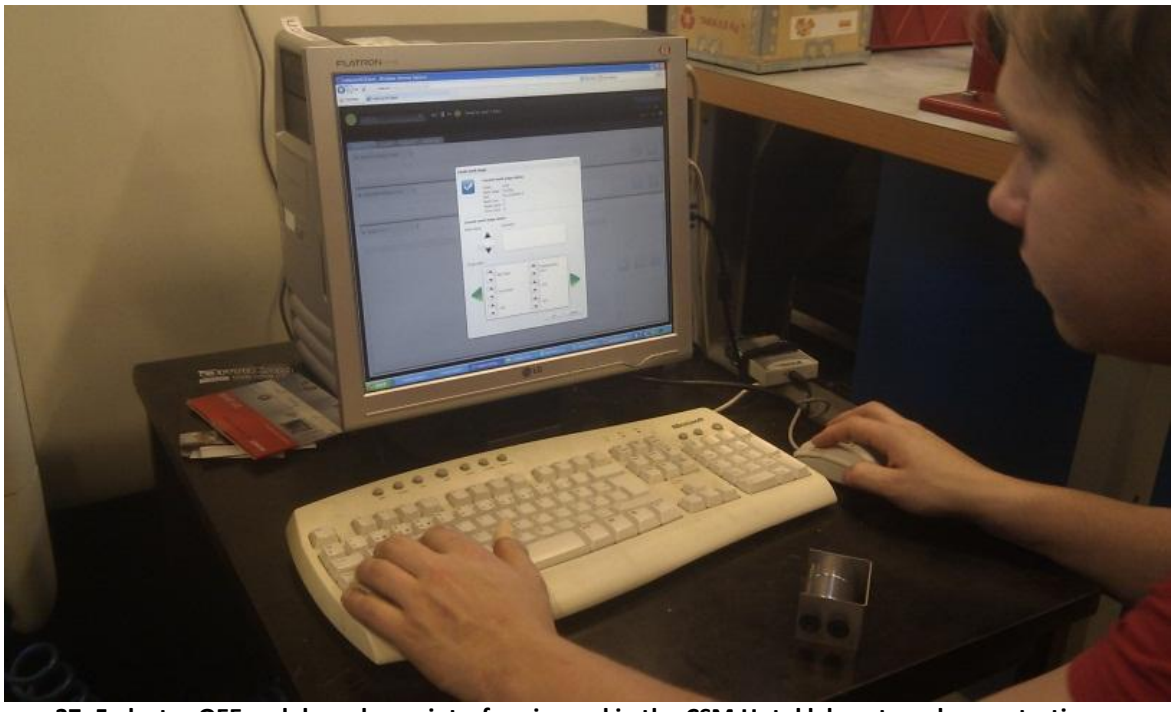


Figure 37: Fadector OEE web based user interface is used in the CSM Hotel laboratory demonstration

It is easy to wide Fadector monitoring targets e.g. green manufacturing or quality monitoring. Energy consumption or disposal monitoring is easy to implement in Fadector OEE.

Case: TUT - Laboratory Demonstration

IN NUTSHELL:

The CSM-Hotel concept was examined in an academic research environment that consists of several physical manufacturing resources and work pieces, their corresponding computer models and simulations, and local databases and a common knowledge base. The resources of the environment offer turning, drilling, milling, punching, and material handling capabilities. The resources and work pieces of the academic research environment are presented in Figure 38.

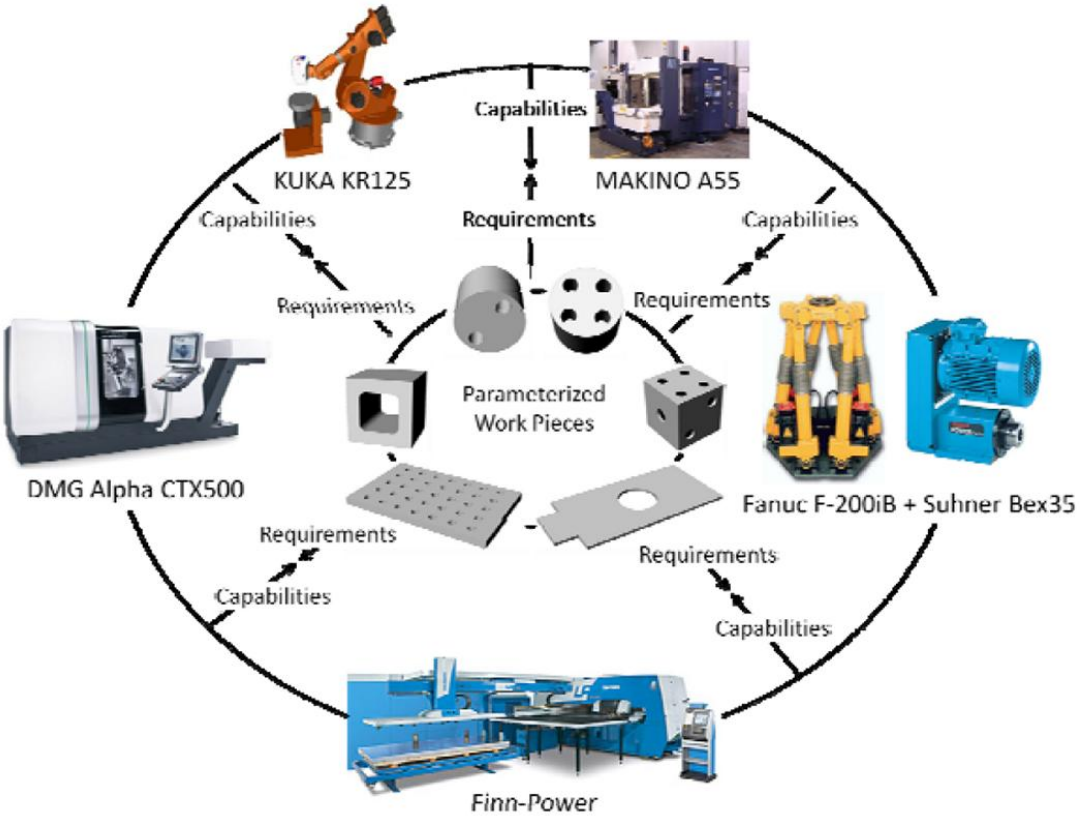


Figure 38: TUT - Academic research environment

The work pieces are cubical and cylindrical parts, as well as plates that are flat in shape, with different parameters that can vary within certain limits. Examples of the varying parameters are the dimensions of the parts (width, length, and depth), the number of holes, internal corner radiuses, sheet thickness, and the number of required fixings of a part in a certain resource. Other parameters affecting the resource capabilities are the material and tolerance requirements of the work pieces, as well as the selection of tools and devices available for the resources. The parameters were selected in such a way that the product requirements could be fulfilled by selecting from alternatives.

The manufacturing cells of the environment represent the individual SMEs participating in a CSM-Hotel environment (Figure 39). The manufacturing resources and work pieces as well as the activities of the research environment are fairly simple because the intention is not to demonstrate the manufacturing processes but to investigate how they can be integrated into the environment both on the software and hardware levels.

Figure 39: The manufacturing cells of the environment represent the individual SMEs participating in a CSM-Hotel environment

Partially, the capabilities of the different resources are the same or similar, which makes it possible to demonstrate the selection of the most feasible service provider. Changing the parameters of the work pieces affects the capabilities, i.e. when a certain parameter reaches a certain value, it will rule out some capability and therefore render the utilisation of some resource impracticable, while some other resource will still have the required capability. The selection of the most suitable capability and its corresponding resource can be performed in terms of the capability and availability of a resource during a moment in time or a longer period of time in correspondence between the goals and objectives. The objectives can be such as the fastest, greenest, or cheapest service provider.

In addition to the physical entities, corresponding virtual computer simulation models have been be constructed. Both the real and virtual parts of the entities are connected to the knowledge base, the digital part of the research environment (Figure 40). The complexity of the environment also facilitates interaction between different simulation models on the levels of the CSM-Hotel, hotel companies, and their individual processes, as well as their connection to the physical resources and to the digital part of the research environment.

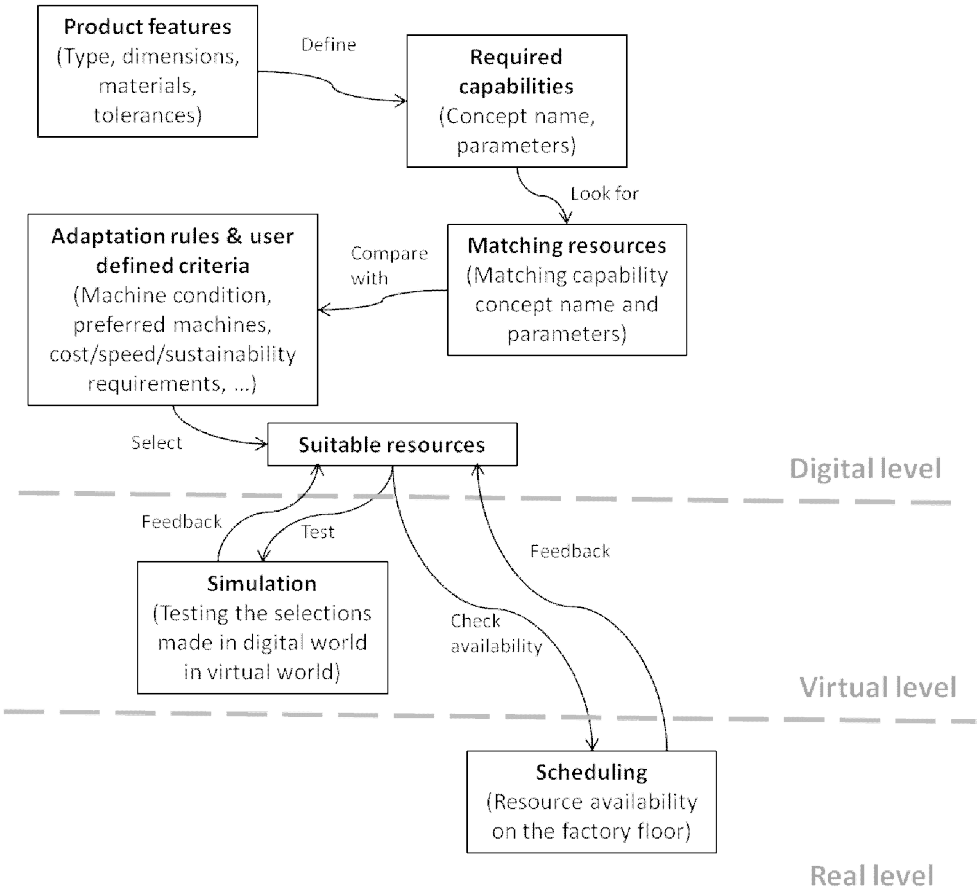


Figure 40: Different levels used in the environment

Case: Tieto Corporation

Tieto Corporation has a role in CSM-Hotel as an information service provider and a system integrator. For information management related topics, see Section 2.7 Information management in CSM-Hotel (p. 45->).

Case: Upper Savo

1. Introduction

In case Upper-Savo the co-operation in network of manufacturing companies were studied. Network consists of two larger companies and group of subcontractors that constructs from six small and medium enterprises (SME's). Geographically companies are situated mainly in same area so that four subcontractor companies and one main contractor are located within couple of hundred meters from each other. One main contractor and subcontractor are located about 30 km from this company group and one subcontractor is located about 200 km from there. Most of the subcontractors business relies, at least indirectly, heavily to either one or both of the main contractor's orders. Simultaneously with this study the network had ongoing larger project that aims to improve overall performance in the network and eco efficiency through collaboration and more efficient operations. The main objective of CSM-Hotel case project was to research how the CSM-Hotel concept can be applied to network in question and how the ideas from the concept can improve collaboration within the network.

IN NUTSHELL:

- *Co-operation in different areas is expected to bring cost savings, generate knowledge, improve capabilities, enable growth, and enable building up new business*
- *Currently companies are hesitant on creating CSM-Hotel type implementation because of they have recently invested to their own facilities*
- *Co-operation areas in CSM-Hotel concept that can be implemented without common facilities were focused on*
- *In current situation collaboration in Upper-Savo would resemble more traditional SME collaboration models*

2. Companies' view to cooperation

Current state

Within the network collaboration and co-operation development work has been done earlier concentrating especially supplier – customer relationships, and this work is ongoing. One of the main contractors has an agreement with its partner companies that development work will be organised such way, that the main contractor focuses its own development work and partner companies to their own. For development work a common interface should be constructed so that improvements, ideas and know-how done in one

place will transfer for whole subcontractor network. Subcontractor network is seeking ways to more independent development work and possibilities to collaborate with other companies in the area. One point made by representative from one of the main contractor was that actual network exists in the area mainly from the point of view of the main contractor. If this actor is removed it is hard to see collaborative network. One point of co-operation development is to increase subcontractor's networks independent collaboration so that network exists independently even without considering main contractors.

Seen Benefits

Many companies list the growth and search for more business opportunities as the future objectives. Dependence of one or two main contractors creates a risk if they cannot assure steady flow of orders. If subcontractors have wider clientele it would also benefit main contractors' risk management so that seasonal fluctuations of one or two main contractors would not affect subcontractors operations too strongly.

The collaboration with other companies in the area was considered the opportunity to generate new business by developing new products and finding new contacts. By combining resources and capabilities of the companies there are better opportunities to offer larger ensembles and to answer larger tenders. Collaborative company group would be seen more credible business partner for new customers than moderate size single company. There is also pressure to reduce production costs thorough out the network. With collaboration it is possible to streamline operations in the network thorough better communication and learning from others. Also when designing new product knowledge from whole network helps to make product designs that support efficient production. So far the co-operation development has focused supplier - customer relationships, but there could be also a lot of opportunities to co-operate horizontally in the network.

Challenges

When creating collaboration between large number of companies challenge is to find clear common goals and same commitment level of the companies. Development of closer collaboration takes work and recourses and if there is no immediate benefit it can easily be forgotten and be buried under more pressing issues. Challenge is also how to act if some companies can be considered in some extent competitors to others and have overlapping recourses. Some companies are located far away from the others which can be a challenge when building closer collaboration.

3. Survey of potential areas of co-operation

One of the objectives of the Upper-Savo case study was survey the most potential areas of co-operation or potential common facilities and services in the group of SME's. The list of common facilities and services gathered in the second CSM-Hotel workshop were used as a basis for the survey. The common facilities and services were collected under 17 topics:

- Administration
- Common facilities
- Procurement
- Production control
- Quality department
- Maintenance
- Building Services
- Environmental services
- Open books (transparency of costs)
- Human Resources
- Product development/design
- Financial administration
- Logistics
- ICT
- Research
- Marketing
- Sales

Most of the above mentioned topics had some examples of the possible common facilities and services. The complete list of the areas and the examples can be seen from the Chapter five.

3.1 Methods

In the interviews, the company representatives were asked to evaluate the topics according to their usefulness, challenges and current state in a scale of 1 to 5. Usefulness implies how profitable the companies see the co-operation in a certain area (1=unprofitable, 5=highly profitable), challenges implies how challenging the companies see the co-operation (1=no challenges, 5=almost impossible) and the current state implies how much co-operation there is in the area at the moment (1=no co-operation, 5=fully integrated).

In the workshop one of the objectives was to gather concrete suggestions of how the companies could co-operate and to generate discussions between the companies about the concrete suggestions. First, the participants chose four most interesting areas of co-operation for closer review and were asked to write down suggestions under each topic. Next, each participant could place four K (=kiinnostaa=interests) -letters and four E (=ennakkoluuloja=prejudices) -letters for the suggestions. Finally, the topics and suggestions were discussed.

3.2 Results

Interviews

A bar graph of the average values of usefulness, challenges and current state of the co-operation areas gathered in the interviews is represented in the Figure 41.

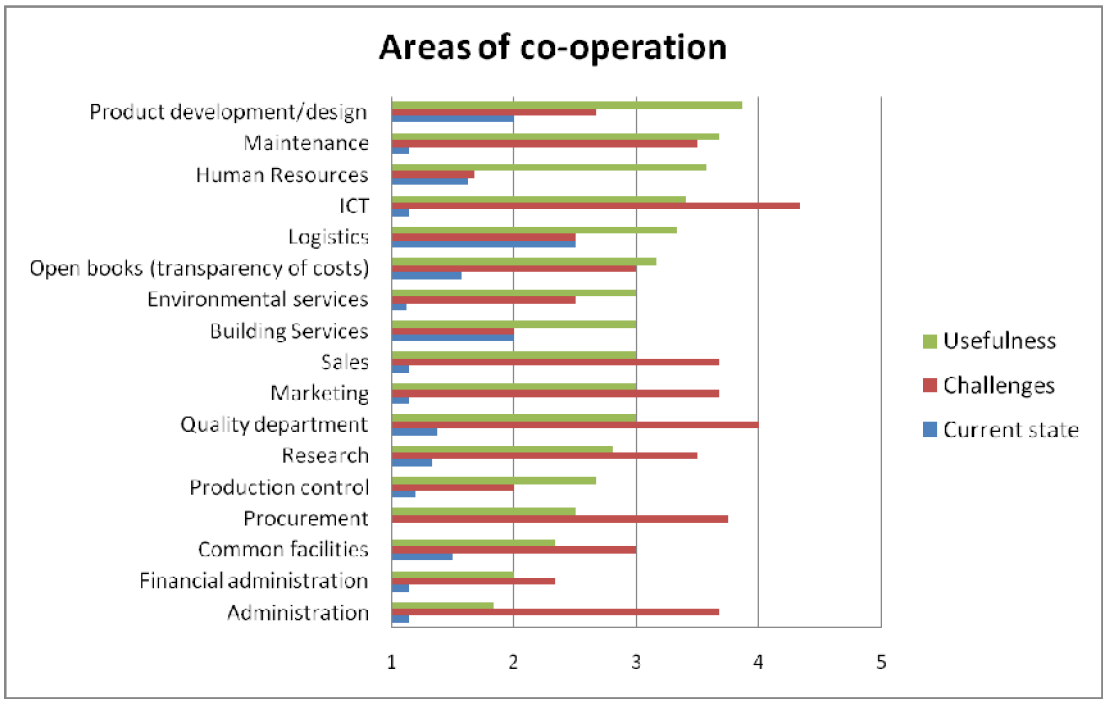


Figure 41: Areas of co-operation

The interviewees ranked product development/design the most profitable area of co-operation (average values of usefulness 3.9, challenges 2.7, and current state 2). Two approaches for product development/design recognised from the answers: new product development in co-operation with other companies and increasing customer-supplier co-operation in design for manufacturability of existing products. New product development is related to the objective of the network to increase the business and to get new customers. Some co-operation in design for manufacturing of existing products already exists explaining the value of current state (2).

The second most profitable area of co-operation was maintenance (average values of usefulness 3.7, challenges 3.5, and current state 1.1). Shared maintenance resources could bring cost reductions for the companies that nowadays use external maintenance with often too long waiting times. Shared supervision and monitoring of machinery could enable unmanned operations for example during night-time. The need for multi-skilled workforce was seen as a challenge in shared supervision and maintenance. Another challenge is how the resources and costs are shared.

The third most profitable area of co-operation was human resources (average values of usefulness 3.6, challenges 1.7, and current state 1.6). Personnel pool and personnel exchange with other companies was considered interesting, but concerns about challenges such as occasional overcapacity, the need for multi-skilled employees, and the simultaneous need of resources were expressed. Common recreational activity, which would bring affinity between staff members, common recruitment and the increase of common personnel training were also seen interesting.

Co-operation in ICT (average values of usefulness 3.4, challenges 4.3, and current state 1.1) were seen both profitable and very challenging. Topics in this field included a common IT support, automation of data entry and the improvement of the information flows in supplier network. Information security issues rose prejudice against ICT. In logistics (average values of usefulness 3.3, challenges 2.5, and current state 2.5) some co-operation already exists. However, the co-operation could be increased especially for avoiding unnecessary storage and improving co-operation in transportations.

Open books (average values of usefulness 3.0, challenges 3.2, and current state 1.6) between companies were seen possible if common rules could be agreed. Environmental services (average values of usefulness 3.0, challenges 2.5, and current state 1.1) such as common waste management could bring cost savings for the companies located near to each other. However, scepticism remained whether the cost savings would be significant enough.

Common sales (average values of usefulness 3.0, challenges 3.7, and current state 1.1) and marketing (average values of usefulness 3.0, challenges 3.7, and current state 1.1) resources were seen important if the supply network begins to manufacture and sell their own products. The weakening of the independence was seen as a challenge in common sales and marketing.

Workshop

In the workshop, the participants chose the following topics for more detailed review:

- A: Human resources, common facilities, common resources and maintenance;
- B: Product development, design and research;
- C: Sales, marketing and coverage;
- D: ICT, production control and logistics

The topic A (human resources, common facilities, common resources and maintenance) gathered the most suggestions. The least suggestions were offered under the topic C (sales, marketing and coverage), but the suggestion that interested the most in a whole workshop was related to marketing: *a market survey, where the capability of the network can be utilized*. Other topics that gathered some interest among the participants were:

- to carry out product development project professionally and in controlled way for example with simple products
- use of shared logistics
- capacity view to the network
- shared maintenance (building services and machinery)
- common employee register/expertise register

The discussion of the co-operation areas and concrete suggestions in the workshop are presented more detailed in Workshop 4: Upper-Savo, Group work 2: Potential areas of co-operation.

3.3 Conclusions

Respondents took into account different aspects when the areas of cooperation were discussed. In the interviews the cooperation was considered both vertical, between suppliers and customers; and horizontal, between the network companies. In the workshop, in which the main suppliers were not represented, the co-operation was contemplated mainly horizontally. The cooperation in different areas was considered to bring cost savings, generate knowledge, improve capabilities, enable growth, and enable building up new business.

In the workshop the concrete suggestion which caught the most interest, were related to networks objectives to build up new business. The *market survey* was rated the most interesting proposal and was seen as a necessary step when seeking new business opportunities. The need emerged to survey the potential markets for the network's potential emerged. Also the need for the survey of network capabilities was discussed in the workshop. The capabilities of the network and the level of ambition in capabilities need to be clarified.

The second most interesting proposal in the workshop was *to carry out pilot product development project* together with other network companies. By completing the pilot project the network could also clarify their capabilities; what capabilities already exist and what are still needed.

Human resources gained visibility in the interviews and in the workshop. A common concern was how to get professional labour. The companies could increase their visibility by co-operating in recruitment. Flexible labour exchange between companies was also considered interesting, but it also involves lots of challenges such as need for multi-skilled employees and management of confidential information. Shared investments in employee training would increase knowledge and learning from others.

Some topics that were seen profitable in the interviews, did not receive endorsement in the workshop. In the interviews co-operation in ICT was seen profitable but also very challenging. In the workshop the participants had prejudice against the proposals related to ICT. The prejudice was probably caused by the fact that the ICT was seen only as IT systems and there were not any IT professionals present at the workshop. The IT development projects were considered challenging and risky. Co-operation method development was considered as the primary objective and IT system development as secondary.

Also shared sales were considered profitable in the interviews but did not gain visibility in the workshop, probably because it is not included in the first steps of building the cooperation.

4. CSM-Hotel concept and Upper-Savo co-operation model

Common facilities is important feature in CSM-Hotel concept where different companies operate sharing flexibly their resources and using common resources like logistics, waste management and administrational services to create cost savings. This way the companies operating in the hotel could concentrate on their core competence. Companies in the area have recently invested to their own facilities and are not ready to invest to CSM-Hotel type implementation. Also one of the main contractors has experience in working in the same facilities with a subcontractor and they found it did not bring considerable advances while day to day working was challenging. This brought some scepticism on realizing CSM-Hotel type implementation in the area. Still some ideas from CSM-Hotel concept can be apply to the environment where the companies operate in separate facilities. In the second CSM-Hotel-workshop held in TUT possible co-operation areas in CSM-Hotel were categorised to those that need common facilities and those that can be implemented even without common facilities (Figure 46).

In current situation collaboration in Upper-Savo would resemble more traditional SME collaboration models than CSM-Hotel approach. Companies near each other can strive for cost savings by using some common resources and generally companies can increase collaboration, for example, by common product development work, training, marketing and benchmarking. Varamäki et al. have identified fife different SME co-operation models and according to Varamäki it is important that companies know to what kind of co-operative model they strive for because prerequisites for successful co-operation are differently emphasized in different types of co-operation (Figure 42).

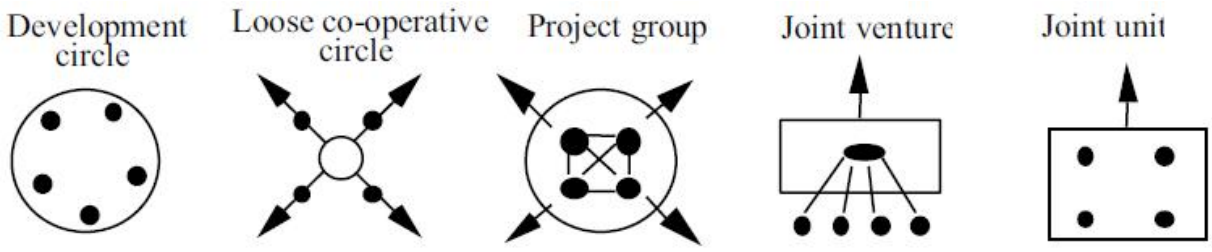


Figure 42: Different models of inter-firm co-operation (modified from [Varamäki])

Natural first step for companies would be co-operative circle where companies meet regularly and co-operation aims at learning from each other and transferring knowledge through discussion and practical examples [Varamäki et al.]. This would also create connections and knowledge about different companies which would make it easier to develop collaboration between companies further. According to this survey common future objective of the companies in Upper-Savo is to grow and seek new business opportunities with new products and customers. Taking this as premise next step could be project group that aims at developing a joint business by combining complementary resources and skills of partners [Varamäki et al.]. This idea was proposed also by company representatives during workshop that was held in Upper-Savo. Project could start with module or sub assembly from one of the current main contractors. This would bring more experience of collaboration and production of larger ensembles in network and in future it would be easier to create and produce products to new markets. From this level of collaboration, depending on what is the current situation in the markets and how formalized collaboration companies want to pursue, collaboration could lead to formalised project group, joint venture or back to co-operative circle [Appendix 2, Figure 52].

Co-operative circle in the area could work as a Virtual Organisation Breeding Environment (VBE), a concept presented by Camanriha-Matos et al. [Camanriha-Matos et al.]. There participants adopt common operating principles and infrastructures so that they increase their preparedness to rapid configuration of temporary alliances for collaboration. When business opportunity is identified by one of the companies, virtual enterprise can be formed rapidly from suited companies in the VBE. Virtual enterprise is defined as temporary alliance of enterprises that come together to share skills or core competence and recourses in order to better respond to business opportunities. This co-operation is supported by computer networks. [Camanriha-Matos et al.]

In the development path that was sketched during workshop held in Upper-Savo it was envisioned that collaboration could eventually lead to joint venture where participating companies jointly owns the firm that runs joint business and through witch collaboration between companies can be organized. Joint venture would operate as a system integrator in the area acting as a frontage for the network and its core operations would be product development, sales, marketing and procurement. Joint venture could also have some own production like assembly. Companies in the area would remain independent, but through joint venture the network could offer new larger ensembles and modules to old and new markets. Joint venture would use primary participating companies as resources, but can also use other resources when it is beneficial. As joint venture would be owned by firms in the network it would also benefit them even if they do not participate in production of some products. If companies form independently CSM-Hotel type implementation in the future,

more experience from close collaboration with each other is needed, and it could be more realistic development step if joint venture is first formed.

5. Complete list of the co-operation areas and the examples

- Common facilities
  - Break rooms
  - Meeting rooms
  - Canteen
  - Occupational health care
  - Day care center / nursery
- Administration
  - Secretarial services
  - Translation services
  - Legal services
  - Patent services
  - IPR
- Financial administration
  - Invoicing
  - Accounting
  - Calculation of salaries
  - Reporting
  - Filing
- Open books (transparency of costs)
- Marketing & Sales
- Procurement
- Human Resources
  - Recruitment
  - Training
  - Occupational safety and health
  - Personnel pool
  - Personnel exchange with other companies
  - Recreational, cultural and sport activities
- Building Services
  - Electrical and network infrastructure
  - Air-conditioning, heating, cooling
  - Electricity supply, water supply and gas distribution
- Maintenance
  - Condition monitoring
  - Maintenance & inspection
  - Repair works
  - Spare parts
- Environmental services
  - Waste management
  - Recycling
  - Training & consulting services
  - Information services (eg. statistics)
- Logistics
- Production control
- ICT
  - Cloud Services
  - IT support
  - CAD / CAM
  - ERP
- Quality department
  - Quality Management System Services
  - Audits
  - Quality Certificates
- Research
- Product development/design

References of the Appendix 1

[Varamäki et. al.] Varamäki, E. & ;Vesalainen, J. (2003), "Modelling different types of multilateral co-operation between SMEs, Entrepreneurship and Regional Development", Vol. 15(1)

[Camarinha-Matos et. al.] Camarinha-Matos Luis, Afsarmanesh Hamideh, Galeano Nathalie & Arturo Molina (2008). Collaborative networked organizations - Concepts and practice in manufacturing enterprises. *Computers & Industrial Engineering* 57:1, 46-60.

Appendix 2: CSM-Hotel Workshops

Introduction:

During the CSM-Hotel -project, four workshops were held with the themes closely related to development of the concept. The first workshop was held in Fastems Oy Ab, Tampere on 8.12.2010. Following workshop was held in TUT / Tampere on 21.1.2011. After these workshops the Executive Board of the project outlined that another two workshops should be hold during the project. These were carried out in such a way that the third workshop was held in Tieto Corporation, Espoo on 7.6.2011 and the fourth in HT-Laser Oy, Vieremä on 16.8.2011.

Workshop 1: Fastems Oy Ab

The topics of the first workshop were:

- What are the arguments to attract entrepreneurs to the CSM-Hotel?
- What are the biggest obstacles or prejudices for the action in CSM-Hotel?

All the arguments given in the workshop were analyzed using grouping diagram method (Figure 43). The method is used when one wants to find the most important things from the large number of ideas, opinions or topics. The diagram groups together naturally related topics and then defines a single concept that ties topics to each other.

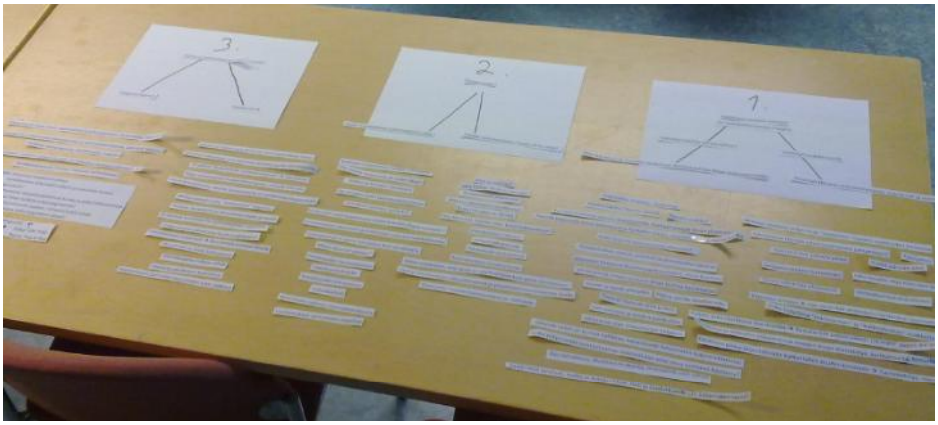


Figure 43: Grouping charts built on from the arguments

The participants of the workshop consider that the most important arguments for what the hotel would attract entrepreneurs were that the CSM-Hotel has an existing infrastructure and through that the framework of the operations is ready. In addition, in the CSM-Hotel it is possible to grow, expand and take collaboration to the next level.

Unknown risks of the new approach and integration of various areas were seen as the biggest prejudices of the concept. In addition it was discussed about the revenue model, the costs and the benefits of the concepts.

Finally, the workshop participants were given three positive and three negative votes and they were able to give those votes to the arguments of the workshop. Here are the TOP 3 arguments from both subjects which received the most votes:

What are the TOP 3 arguments to attract entrepreneurs to the CSM-Hotel?

1. Ready infrastructure; information, testing, TRD, eco (the same in all countries)	11 votes
2. CSM-Hotel corner stone's (Cost efficiency, attractiveness, technologies, etc.)	7 votes
3. Information (High-level input, data refinement)	5 votes

What are the TOP 3 obstacles or prejudices for the action in CSM-Hotel?

1. What is the business logic of the CSM-Hotel?	9 votes
2. Integration (software & hardware)	9 votes
3. CSM-Hotel rules & Loss of independence	7 votes

Summary of the first CSM-Hotel workshop (Figure 44):

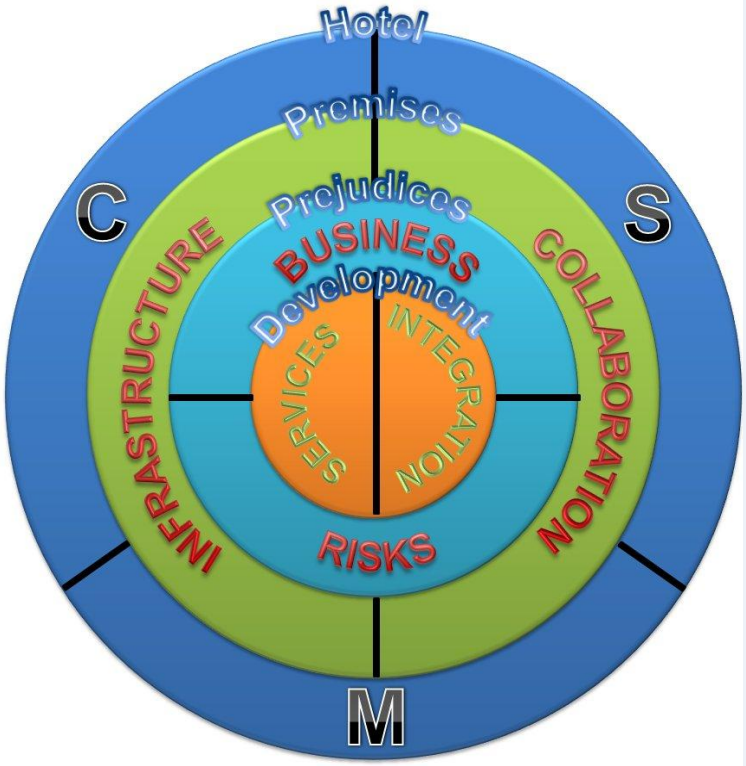


Figure 44: Summary of the 1st CSM-Hotel workshop

WS1 IN NUTSHELL:

- *Competitive and sustainable manufacturing environment constitutes the corner stone's of the CSM-Hotel.*
- *CSM-Hotel environment, including infrastructure and collaboration, was the biggest enabler of successful operations.*
- *On the other hand, business and risks related things were the biggest prejudices.*
- *Solutions that solve the challenges are related to the continuous development and in particular the successful services and integration of different parts.*

Workshop 2: TUT

In the second workshop (Figure 45) the analysis of the CSM-Hotel concept was continued based on the results of the first workshop. The participants were divided into four groups and the factors, which in the previous workshop most persuaded the concept and had caused most prejudices, were chosen as the subject matters of the workshop. Because in the previous workshop it was seen that it is possible to solve the challenges with the help of successful services and the integration of different sectors, this was chosen as the point of view of all the groups.

Figure 45: 2nd CSM-Hotel Workshop

Groups were the following:

Premises	Prejudices
1. Group: Infrastructure	3. Group: Business
2. Group: Collaboration	4. Group: Risks

Integration

A grouping method, which was already used in the first workshop, was also used to analyze the results of the 2nd workshop. Integration related arguments of different groups were listed and were grouped. In addition to the advantages and challenges, the arguments were divided into those services which are necessary from the CSM-Hotel point of view and which the hotel has to offer for the success of the integration. These were core services and a technology base containing the following matters:

Core Services

- Infrastructure
- Logistics
- HR
- Financial management
- Environmental certificate

Technology Base

- Must be offered to support services and integration!
- The Order-Delivery process must be such that others can be connected to it
- The Technology Base must support e.g.:
  - Formal & non-formal information
  - Variation of the capacity and desired growth
  - Changing of the CSM-Hotel actor

The following matters were seen as challenges of the integration:

- Integration itself
  - How much work is required?
  - How to integrate old equipments?
  - Middleware; Does one succeed?

- Combining of the different businesses and operation cultures
  - Openness
  - Similar success possibilities

- Intellectual property rights
  - Whose property is for example developing?

- Information
  - Availability and validity of the information
  - Flow and control of the information

- Environment dependence
  - The important service provider leaves
    → Will there be a major cap in services?

The following matters were seen as advantages of the integration:

- Better preconditions for the operations
  - Higher utilization of resources
  - Development of the productivity
  - New possibilities in personnel management
  - Enables new innovations

- Group power
  - Risk management
  - Divided costs
  - More advantageous offers can be negotiated
  - Common bigger network

Services

In the same way as integration arguments were handled, the service related arguments were also divided into the advantages and challenges, but in addition to it, from the service arguments it was put together a list of services and functions

- which can be distributed without the integration of the actual production (Figure 46)
- which the biggest benefit is gotten by integrating also the production (Figure 47).

Common spaces
- Break rooms
- Negotiation rooms
- Canteen
- Nursery

Administration department
- Secretary services
- Translation services
- Legal services
- Patent maters
- IPR

Financial management
- Billing
- Accounting
- Payroll computation
- Reporting
- Filing

Human Resources
- Recruiting, Education
- Work welfare, Work safety
- Staff pool, Temporary posts
- Recreational services, Culture activity, Sports

Purchasing department

Sales department

Marketing department

Research & Development

Environmental services
- Waste management
- Recycling
- Education & Advising
- Information services (e.g. statistics)

Maintenance
- Condition monitoring
- Service & Maintenance
- Inspections & Corrections
- Spare parts
- Real estate management

ICT
- Cloud services
- IT-support
- CAD/CAM
- ERP

Quality Department
- Quality system services
- Auditing
- Quality certificates

Security services
- Guarding

Figure 46: Services and functions which can be distributed without the connections of the actual production

House technique

Electricity- and network infrastructure

Air conditioning, heating, cooling

Distribution of electricity, water and gas etc.

Logistics

Material handling

Storage

Packing etc.

Control services of the production

ERP

Production planning

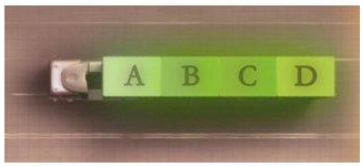


Figure 47: Services and functions from which the biggest benefits are gotten by integrating also the production

The following matters were seen as challenges of the services which are offered in the CSM-hotel environment:

- Choice of services
    - Can one choose the grade of service?

- To bring services into use of the production
    - Will a synergy be found in the services?
    - How to get of the new service to the environment?

- Description of services
    - Can the critical services be described?

- Availability of services
    - How to answer a varying demand effectively?

- Pricing of services
    - How are the services priced?
    - Can one guarantee that the price of services remains moderate?

- Quality of the services
    - Are the services of such nature as it has been promised?
    - Securing of the level of the service?

As the advantage of the service based operation of the CSM hotel the following matters were seen:

- Easier to make the business when the services will come ready!
    - New resources do not need to be reserved

- Synergy of the services!
    - There can be services from many different points of view

- Economics of scale!
    - The costs become smaller → Common advantage

- The cooperation strengthens!

Summary of the 2nd CSM-Hotel workshop:

As a summary of the workshop one can state that in order to successfully integrate the different actors into the same production environment, the CSM-Hotel must offer certain core services which form the prerequisites for the operations and processes of companies. In addition to enable different technical functions to integrate and work together, CSM-Hotel must have a workable technology base which makes quick and reliable integration possible.

In the workshop the coordination of the activities and the practical integration work was seen as a challenge of the integration. In addition questions rise about flow, access and management of the information as well as intellectual property rights related issues. Also dependencies at the same production environment were mentioned. Despite the challenges, the tight integration was seen as an enabler of better conditions for operations and trough the tight integration synergy benefits can be better utilized.

From different point of view gathered services were listed on those which may be offered without the integration of the actual production as well as those where the maximum benefit is obtained by integrating also the production. As challenges of the services were considered their definition, commercializing, selection criteria and also factors related to the pricing, availability and quality of service. However, because of the service-based activities used in the CSM-hotel environment, it was seen that it is easier to do business. In addition, shared services will enable close collaboration, which allows companies to better achieve the benefits of synergies and economies of scale.

WS2 IN NUTSHELL:

- *CSM-Hotel must offer certain core services!*
- *CSM-Hotel must have a workable technology!*
- *Despite the challenges the tight integration was seen as an enabler of better conditions for operations and synergy benefits.*
- *Many of the services can be offered to companies without the integration of actual production!*
- *Maximum benefits are obtained by integrating also the production!*
- *With the service-based activities it is easier to do business and achieve the benefits of synergies and economics of scale.*

Workshop 3: Tieto Oyj

Introduction:

This is a brief summary of a CSM-Hotel project related workshop held in Tieto Corp on 7.6.2011. Workshop included six participants from Tieto Corp and also six researchers from TUT/TTE. After a short briefing, participants were divided into three groups to prepare a presentation of one specific topic. Participants also took the time to see other groups' presentations and give their input on the topics.

Task assignment:

The three groups were asked to consider different aspects of information management in a collaborative manufacturing environment called CSM-Hotel. Groups had the following topics: Collaboration tools and methods, Information sharing and scalable integration, Information ownership and visibility restriction. The challenge for all teams was the consideration of multiple simultaneous use cases and objectives, and the requirements for the system to adapt to changing needs over time.

Group presentations (Figure 48):

Collaboration tools and methods. The main themes of the presentation included collection and formalization of tacit knowledge, different handling and requirements of operative and tactical/strategic information, and requirements for common information and tools. Collaboration relations can be defined as dependencies, such as work object, time dependency, or scarce resources. Certain level of trust, commitment and openness between parties are required. Tightly located supply chain enhances opportunities for improving manufacturability.

Information sharing and scalable integration. The following points were regarded most important: Private control over information, common work queues for shared resources, visible resource sharing policies, separate views of own functions and overall process, resource and material "borrowing" – internal marketplace, common already integrated systems (CAD, ERP, etc.), centralized divided databases are technically easier to implement.

Information ownership and visibility restriction. The main consideration was on what is the typical content of protectable information and which means are best suited for securing this. Companies should have means to protect their private information and the ability to control information spread to the partners. Most important practical risks are related to difficulties in exiting CSM-Hotel and securing own personnel from competitors.

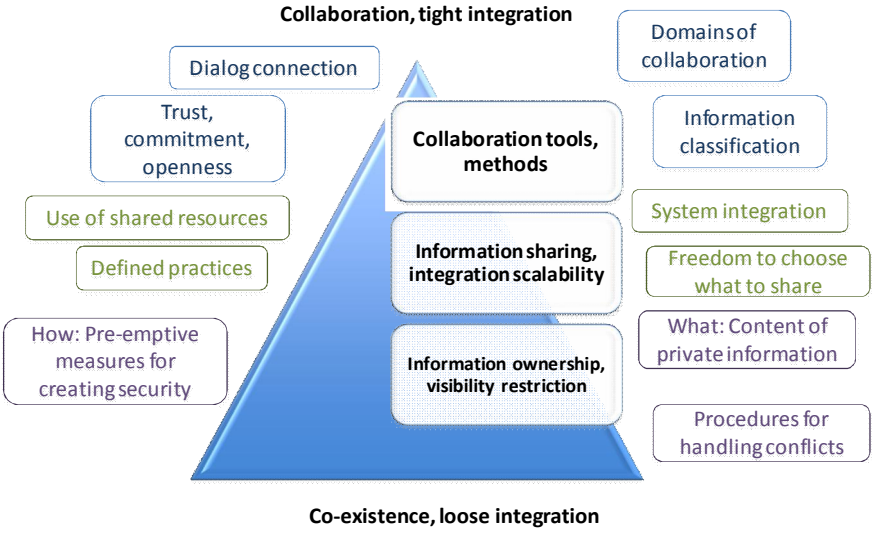


Figure 48: Topics discussed in groups

Collected summary:

The following categories rose up in importance after regrouping all individual inputs collected from the workshop: Reasons for collaboration, technical systems and collaboration tools, use of shared resources and planning, information ownership and sharing, agreements and risk management.

Both choosing the technical solutions or practices require definition of reasons for collaboration (Figure 49). From technical point of view the reasons to collaborate lead to requirements analysis. On practical aspect they define the possible gain and the incentives companies have to collaborate.

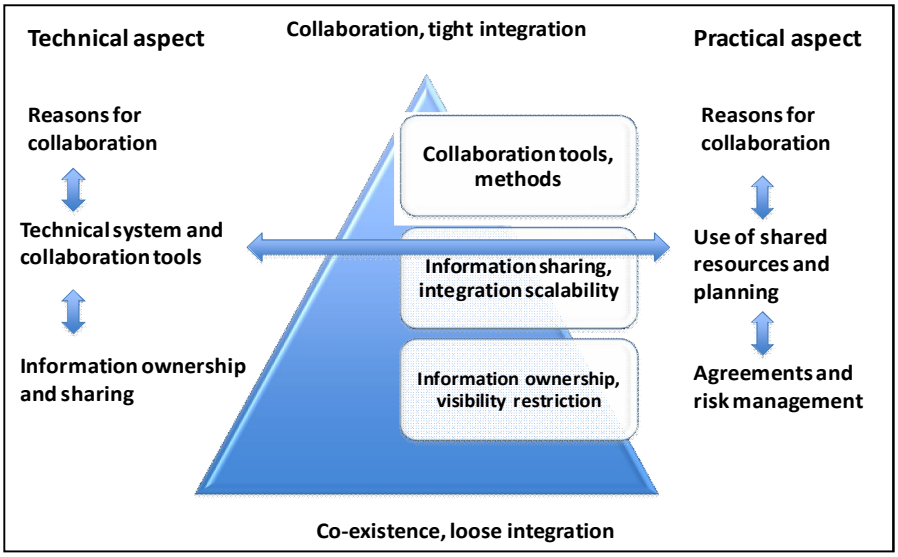


Figure 49: Reasons for collaboration

Technical system should support efficient use of shared resources, give overall control of product over supply network, allow meaningful and timely exchange of information and guarantee the required level of privacy. Participants should have large control over their private information and ability to change the information visibility over time. Table 13 highlights some of the individual notes related to main categories.

Table 13: Collected notes of general topics

Reasons for collaboration	Time dependence, product dependence, scarce resources, DfMA Operational, tactical, strategic level
Technical systems and collaboration tools	Integration scalability, utilization of tacit knowledge, customized views, database structure, CSM-H intranet
Use of shared resources and planning	Precise and timely information, commonly agreed policies, shared forecasts, logistics, worker pools
Information ownership and sharing	Public/private, common view of production, visibility of pricing / economic indicators, 1-to-1 and 1-to-many
Agreements and risk management	Trust, visibility of benefits, defined practices, selection of parties, legal contracts, internal competition

Author's Comments:

The regrouping of workshop results is subject to author's personal opinion of the most important topics raised in workshop notes and discussions. General conclusion was the importance of commitment and trust between the parties. Contractual agreements and mutually agreed practices are important for handling most anticipated conflicts, while there should be a defined practice or method for solving other disputes. The outcome of the event is an overview of the topic, as the limited timeframe didn't allow deeply technical discussion.

Workshop 4: Upper Savo

The 4th CSM-hotel workshop was held in Vieremä on 16.8.2011. Workshop included eleven participants from the Upper Savo companies and also three researchers from TUT/TTE.

Group work 1: Thoughts, expectations, motivation and objectives of co-operation

Instructions

The participants were separated into two groups. The groups discussed the section 1 title through following questions:

- Why to co-operate?
- How can co-operation support the company's own goals?
- What is expected from the co-operation and what are the objectives of co-operation?
- What are the challenges associated with co-operation?
- Open Questions?

The groups wrote down their thoughts and presented them to the others.

WS4 IN NUTSHELL:

- *The companies expect from co-operation new important customers, possibility to offer larger entities to the customers, coverage and credibility as well as learning and support.*
- *The concrete actions in multilateral co-operation that interested the companies the most were related to possibilities to build up new business.*
- *A long term goal for the companies in the network could be joint venture which has new important customers.*

Results

Co-operation was considered the opportunity to grow and improve profitability. In co-operation the companies can widen their supply and they are able to provide larger entities. A long-term objective of co-operation is to get new important customers for the network.

Co-operation enables the companies learn from each other. In addition, it is possible to develop more effectively and stay at the cutting edge when knowledge and expertise of the companies are combined. The companies also expect that co-operation makes their credibility and visibility better, which makes them more interesting actors among employees and customers.

The challenges associated to co-operation were challenge of finding common intent, availability of resources, coordinating the schedules and competitive situation between some companies. The open questions that need to be clarified were e.g. who coordinates; who is leading and making decisions; how to share revenue, costs and risks; and how much the companies are able to invest in co-operation.

Group work 2: Potential areas of co-operation

Instructions

The results from collaboration survey from the interviews were used as a basis for the group work 2 (Figure 41). First, the participants chose four most interesting topics for closer review and were asked to write down concrete suggestions under each topic. Next, each participant could place four K (=kiinnostaa=interests) -letters and four E (=ennakkoluuloja =prejudices) -letters for the suggestions. Finally, the topics and proposals were discussed.

Results

The participants chose following topics for more detailed review:

A: Human resources, common facilities, common resources and maintenance

B: Product development, design and research

C: Sales, marketing and coverage

D: ICT, production control and logistics

The topic A (human resources, common facilities, common resources and maintenance) gathered the most proposals. Many proposals were related to maintenance, recruiting and personnel training. Some interest rose for *common personnel training coordinator* (1K), *centralized machine tool maintenance* (1K), *property maintenance* (1K), *common employee register* (1K) and c*ost saving calculation of common waste management* (1K). Prejudice rose against *common development projects* (2E), *common tool shop* (2E) and *centralized property maintenance* (2E).

In the topic B (product development, design and research) a lot of interest gathered proposal: *to carry out product development project professionally and in controlled way for example with simple product* (5K). Some interest raised also for *shared product development resource* (2K), *product concept ideas / development ideas generation through analyzing existing products* (1K), *common research and development team* (1K) and *network knowledge mapping (what R&D related knowledge there is in the network already)* (1K).

The participants wrote the least proposals to the topic C (sales, marketing and coverage). The most interesting proposal there was related to marketing: *a market survey, where the capability of the network can be utilized* (7K). The participants saw the market survey

necessary starting point for the new business which the network companies have planned to build up together. Prejudice rose against *selecting common marketing manager* (4E).

In the topic D (ICT, production control and logistics) topics that interested most were related to logistics and production control. Some participants were interested in *the use of common transport company* (2K), *common logistics* (1K) and *capacity view (to the network)* (2K). The participants had prejudice against the proposals related to ICT. Prejudice raised, for example, against to the proposal *to get production control systems discuss with each other* (4E).

The concrete proposals which interested or raised prejudice in the workshop are sorted under the original co-operation area topics in the Figure 50. The proposals that interested (K) the participants are green and the proposals that raised prejudice (E) are red.

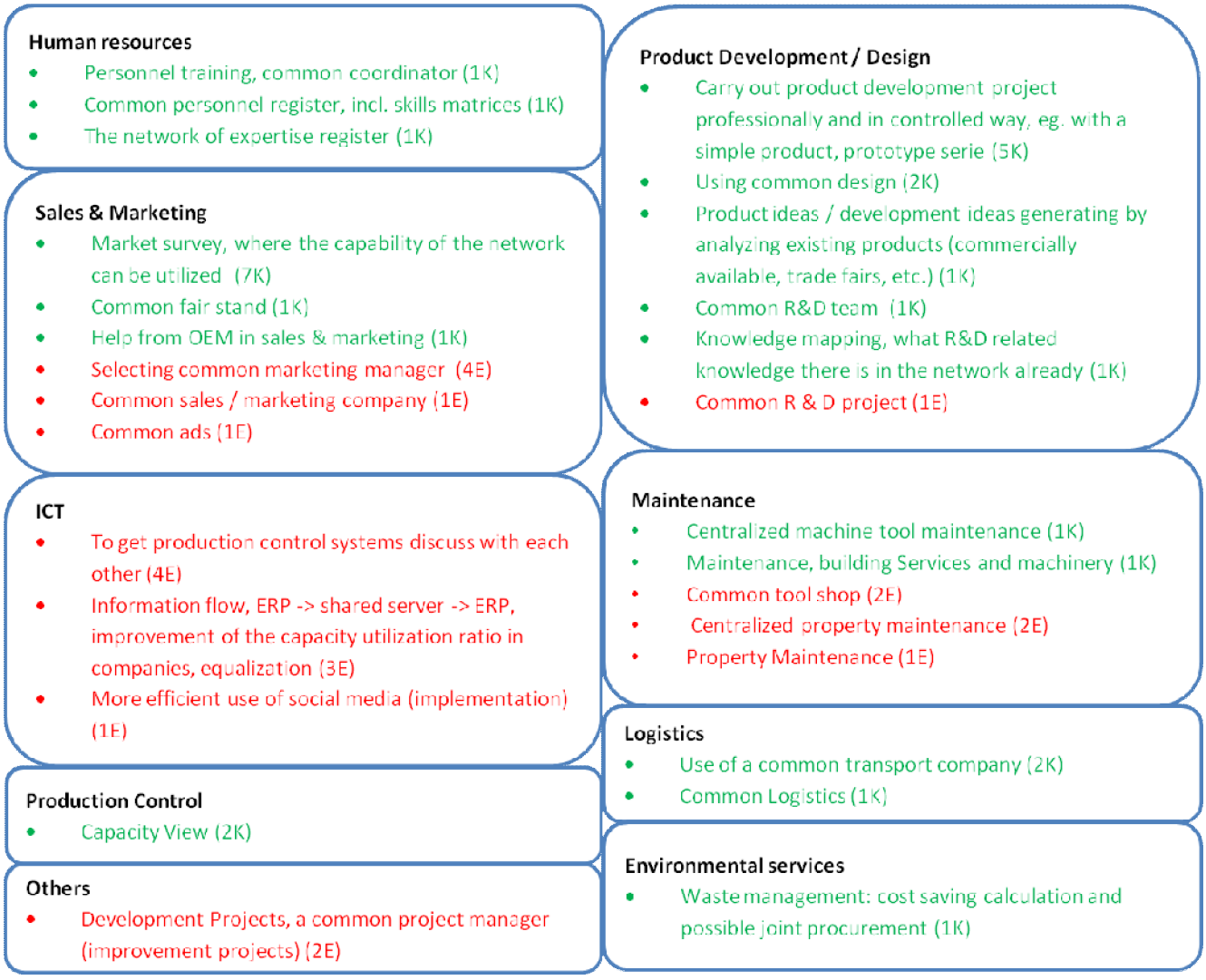


Figure 50: The concrete proposals which interested or raised prejudice in the workshop

Group work 3: Co-operation strategy (Joint venture business model)

Instructions

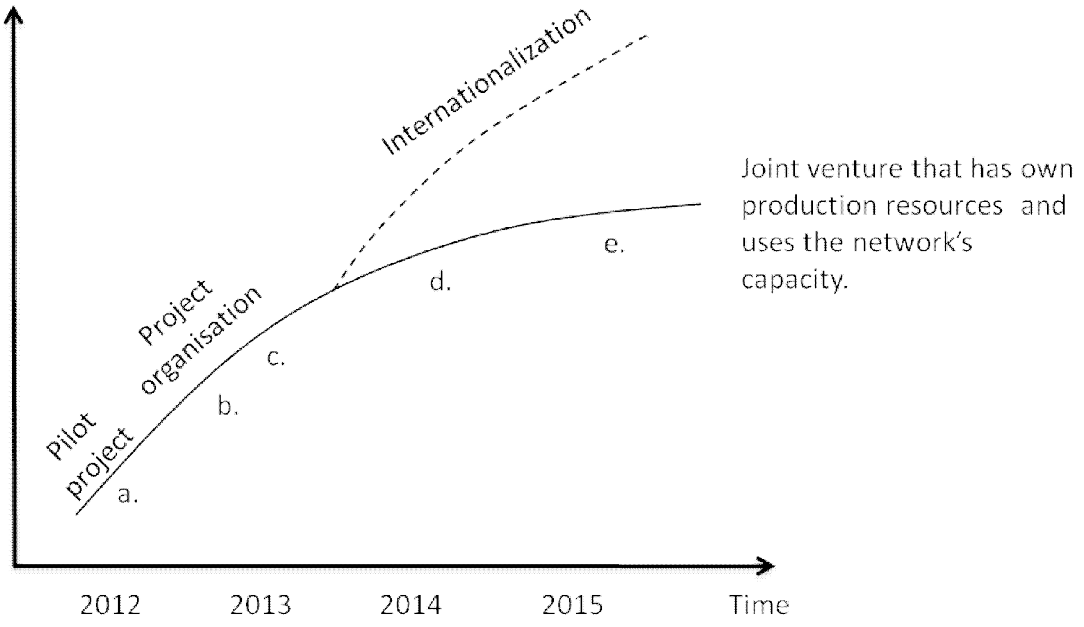
The participants were split up into two groups. The groups discussed about co-operation strategy and possible joint venture business model. The subjects discussed were following:

- Motivation (interests, expectations)
- Operations (core operations, supporting operations)
- Implementation
- Outlining the business model

Groups wrote down their thoughts and presented them to the others.

Results

Another group started to outline development path for the co-operation (Figure 51).



a. Pilot project
b. The network take care of outsourced production of some company
c. Take care of spare parts manufacturing and logistics
d. Development of own products
e. New important customers

Figure 51: Outline of the development path for the co-operation

A long-term goal of the co-operation could be joint venture. The development path that the participants planned starts from the pilot project and continues to formation of project organisation. The project organisation could take care of outsourced production of some company by using the network resources and could gradually take also care of spare parts manufacturing and logistics. The development will progress gradually towards new important customers and joint venture.

Another group approached the topic through the given questions. They named also the joint venture as a long-term goal of the co-operation. Potential core operations they named for joint venture were product development and design, sales, marketing and procurement. The companies should prepare the timetable for the implementation. Good starting point for the project is the survey of potential products and markets. The joint venture could offer products/services for new customer and/or larger entities for existing customers.

Group work 4: Next steps

Instructions

Discussion about concrete actions that should be done next. Who are responsible and when is the deadline.

Results

The resources and capabilities of the network should be mapped. Through clarifying the resources and capabilities it is easier to plan which kind of products/subassemblies the companies could do profitably together and what kind of resources and knowledge they should still acquire. Another step that was defined was to find out the possibility to get the pilot project for the network from the existing customers.

Summary and conclusions

In interviews before the workshop the co-operation was discussed separately with each company. The objective of the workshop was to bring company representatives together in order to generate discussions about the concrete co-operation between the companies. In the first section the co-operation was discussed in general level; why to co-operate, what are the expectations and goals and so on. The suggestions of concrete co-operation actions were gathered in the second section. The co-operation strategy and possible joint venture business model was outlined in the third section. Lastly, in the fourth section the next steps for the network co-operation were discussed.

In general the companies are interested in multilateral co-operation, especially when possibilities of new business are considered. The companies expect from co-operation new important customers, possibility to offer larger entities to the customers, coverage and

credibility as well as learning and support. Co-operation support the companies' goals such as growth and profitability, and continuous learning.

When discussing the concrete actions in multilateral co-operation, especially the following topics interested the companies:

- a market survey, where the capability of the network can be utilized
- to carry out product development project professionally and in controlled way for example with simple product
- use of shared logistics
- capacity view to the network
- shared maintenance (building services and machinery)
- common employee register/expertise register

A long term goal for the network could be joint venture which has new important customers. The joint venture would manufacture products/subassemblies using own and the network's manufacturing resources. The participants outlined the co-operation development path which progress gradually towards new important customers and joint venture. The next steps the participants specified are a survey of network capabilities and resources, and definition of potential pilot project.

The development path the participants outlined is quite similar with development model of multilateral co-operation that Varamäki and Vesalainen [Varamäki et. al.] have introduced (Figure 52).

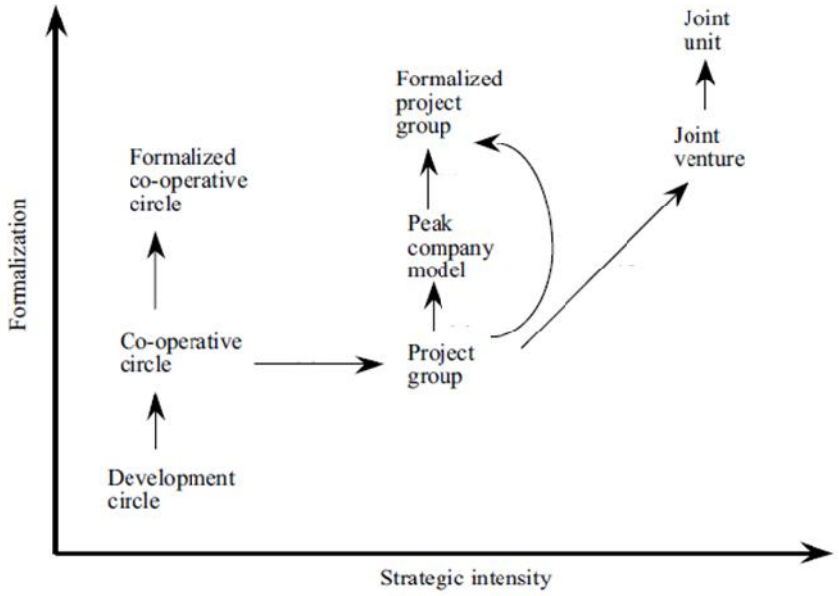


Figure 52: Co-operative arrangements according to group formalization and strategic intent (modified from Varamäki et. al.)

According Varamäki and Vesalainen the potential advantages are assumed to accumulate when a degree of formalization in a co-operative group increases. Individual and organisational learning is related to all the stages. Cost benefits can be achieved when the co-operation is in the co-operative circle level or higher, and synergy advantages can be gained when the co-operation is developed to project group level. Potential for new business and risk sharing are not able to gain until joint venture stage. [Varamäki et. al.]

The network has a lot of potential to generate new business and to develop own products. The companies need to find common intent and the co-operation requires responsibility from each of them.

References of the Appendix 2

[Varamäki et. al.] Varamäki, E., Vesalainen, J. (2003), "Modelling different types of multilateral co-operation between SMEs, Entrepreneurship and Regional Development", Vol. 15, p. 27-47