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SMART REGIONS

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ABSTRACT

Smart Regions is based on the vision of a more cost-effective public administration. This vision comes after a period of de-industrialization and a growing population in cities. A growing population in growing cities requires better public services. At the same time there is a growth of new information technologies, which creates a new its own market, and which forms the basis for new industrial growth.

This article describes the results of a survey conducted in cooperation with the Public Roads Administration, Municipality of Aalesund and Sunnmøre Regional Council. The overall aim was to investigate whether the Smart Grid is a generic concept that is transferable to other public services. It was then studied the basic ideas that are underpinning for Smart-term now used conjunction with Smart Technology, Smart Media, Smart Grid, Smart House, Smart Transport, Smart Cities and Smart Regions. The survey is based on workshops, participation in international conferences, a systems analysis of concept models and development of simple simulation models for testing the concept models for Smart Grid and Smart Transport.

The study concludes that the concept of Smart Grid in the energy sector is only a symptom of a more profound reform process in public services. The explanation is that information technology integrates data and organizations at a higher level. When the whole community uses the same data, the same technology and the same analysis, they will choose select similar organizational concepts. Integration of organizations at a higher level leads to a system perspective on the management of cities, economic development, environment and ecosystems, where the data that forms the basis for decisions. This leads to the management of organizations change focus from a function-oriented and to a system oriented organizational model.

1 INTRODUCTION

In 1980 Alvin Toffler published the best seller "The Third Wave" (Toffler, 1980). The point from Toffler was that an industrial period was over, and new information technology was about to lay the foundation for a new industrial period. This period he formulated the code.

1. Needs adaptation: From mass production to demand personalization of services and products
2. System integration: For products and services
3. Flexibility: Asynchronous managing services and manufacturing
4. Decentralization: For control and production
5. Consumer and producer (ProCumer): A is a producer and consumer of goods and services.
6. Open innovation: An open local learning based innovation

It was not long before many manufacturing companies started to notice this trend. We got a transfer to the order-based production and new concepts such as Just in Time Production, Total Quality Management and Business Processing Reengineering. It now seems as if the idea of Smart Cities is a symptom of fundamental structural changes in public services. A structural change as the industry faced in 1980, the transition from mass production to an order based production.

The concept of Smart Cities can be attributed to pilot projects in the US, Asia and Europe. The purpose has been to solve the traffic problems, create new industrial growth and facilitate a better life for those living in major cities. Despite many sample projects, Smart Cities is yet a vision. A vision of a more cost-effective public infrastructure, improve the environment conditions, improve the quality of life and a vision for new industrialization. This vision does not come by chance. After a period of de-industrialization, towns are service purveyors of a growing population, which is not able to finance sustainable public services. At the same time there is rapid growth of new information technology. This growth creates its own market, and provides a basis for industrial growth.

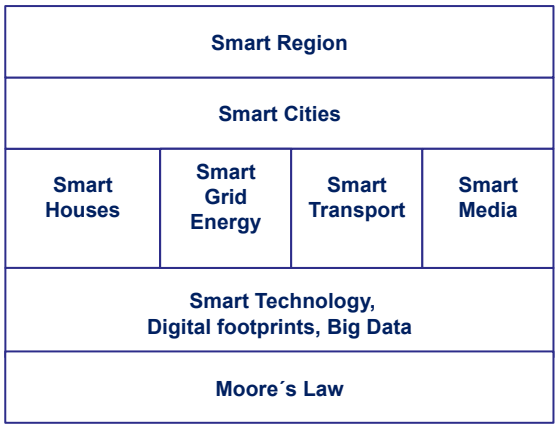

Figure 1. Relationship between Smart Technology and Smart Regions.

The concept of Smart Cities and Smart Regions is a subject with many perspectives. The approach here is the range of new information. It may seem that information technology has worked as an integrator of services in the technological leap. The first came with the development of the microprocessor in 1970 which integrated electronics and mechanics and modified products and all industrial production. The second leap came in 1990 where the internet transformed service industries. It may seem that Smart Grid is a symptom of a new leap, which will reshape services in public administration.

The underlying innovation in this development is Moore's Law, which leads to an exponential growth in the development of new information technologies. This new technology forms the basis for new technological platforms such as Smart Technology Digital track and Big Data. This forms the basis of new organizational concepts such as Smart House, Smart Grid Energy, Smart Transportation and Smart Media. The new concepts now form the basis of what we have classified as Smart Cities and Smart Regions. (Yndestad, 2014)

2 DATA AND METHODS

The material for this study is based on information from the participation in a seminar, conferences and literature studies. It was not made a scientific analysis of this material, but considered as a basis for a structured analysis based on general systems theory.

The challenge in this analysis has been to reduce a very complex subject, down to a few simple principles. The method for this reduction has been to model topics of general systems theory to provide an overview of relationships between organizations. This analysis has looked specifically at the difference between a function-oriented paradigm and system-oriented paradigm. It is further made with simple simulation models to identify generic optimization methods. Examples include simulation of Smart Grid and Smart Energy Road Traffic with PSO algorithm (Particle Swarm Optimization).

3 RESULTS

3.1 Smart Media

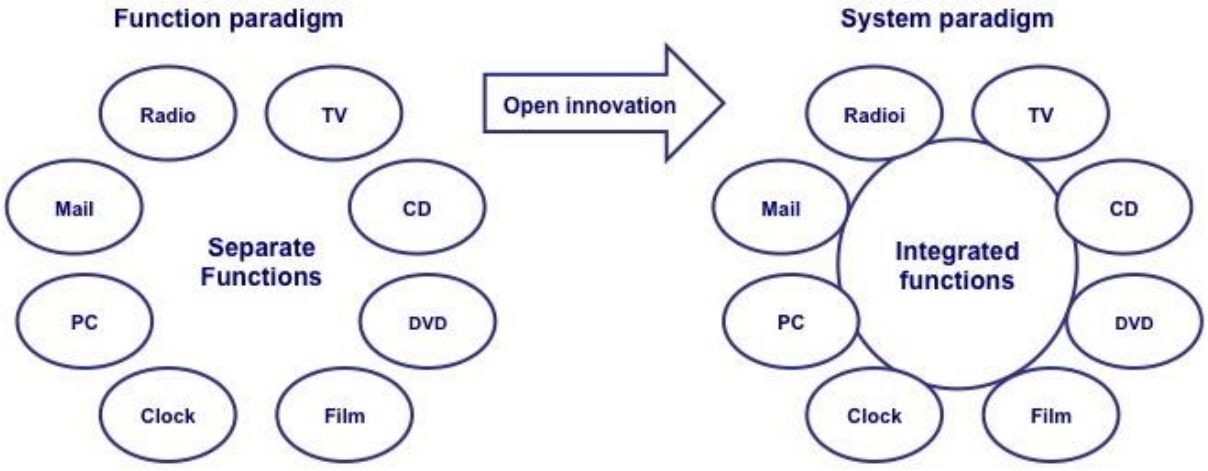

Figure 2. Innovation processes towards Smart Media.

Functional paradigm:
Feature-Oriented technology services can be considered as electronic equipment. Machines that exerts control of information, based on a machine-oriented thinking. This technology now controls everything from dishwashers to factories and energy. It is the same mindset that has formed the basis for the development of TV, CD, DVD, film, radio and newspapers. This feature-oriented thinking can be formulated with the model

$$Y(t) = H(Media)X(t)$$

Where X(t) represents producers of information, H(Media) a technological platform that conveys information and (t) a set of consumers that information. This feature-oriented programming is based on code

1. Specialization: Some manufacturers X(t), we provide a specialized technology to many consumers, Y(t).
2. Synchronization: There is a synchronization of the transmission of information
3. Centralization: There is a centralized transfer of information between producer and consumer.
4. Closed innovation: Innovation is related to producer services.
5. Costs: All services have parallel costs.

The strange thing is that the same control-oriented mindset also affects the design of our organizations.

System paradigm:
Smart Media is based on a common integration of the services in real time on the same technological platform. Here is the same technology platform as the mediator of TV, CD, DVD, Film, radio and newspapers. There is growth in electronic capacity by Moore's Law, which has formed the basis for Smart Technology, Smart Media, Big Data and Digital tracks. When many online services to access the same data, we get a system integration services. This may be formulated with a simple system model:

$$S(SM, t) = \{N(MT, t), S(MT, t), L(t)\}$$

Where S(MT, t) represents a set of media services, N(NT, t) represents an overall network of services, L(t) a landscape of users, and S(SM, t) represents the total integrated Soon Media system. A typical Smart Media system will consist of units, S (HT, t) = {TV, Radio, Film, Music, PC}, N (MT, t) = {Internet}. In other words, the network between services N (MT, t) allowing for an open integration of information services in e common platform. Smart Media represents a system-oriented thinking, based on the code.

1. Additional customization: There is a market-driven development.
2. System integration, specialization is transferred from the individual services, and a common technology platform.
3. Flexibility: There is no synchronous data transfer between consumers and producers.
4. Decentralization: There is a decentralized system where all producers and consumers of information.
5. Consumer and producer: Everyone is in principle consumers and producers of services.
6. Costs: A cost-effective system customized needs.
7. Open innovation: An open innovation for new services.

Smart Technology is electronics is based on a system-oriented thinking. It has the ability to adapt to changes in the environment by monitoring their own performance. Instead of making things right, like a machine, it tries to do the right things. This customization is normally done by the technology adapts cost functions. The scope of this is that the Smart Media leading to major structural organizational changes for those who produce and consume media services. An open innovation conducting a system-oriented approach and a basis for new information services (IEEE Computers. January 2007, July 2013, March 2014).

3.3 Smart Houses

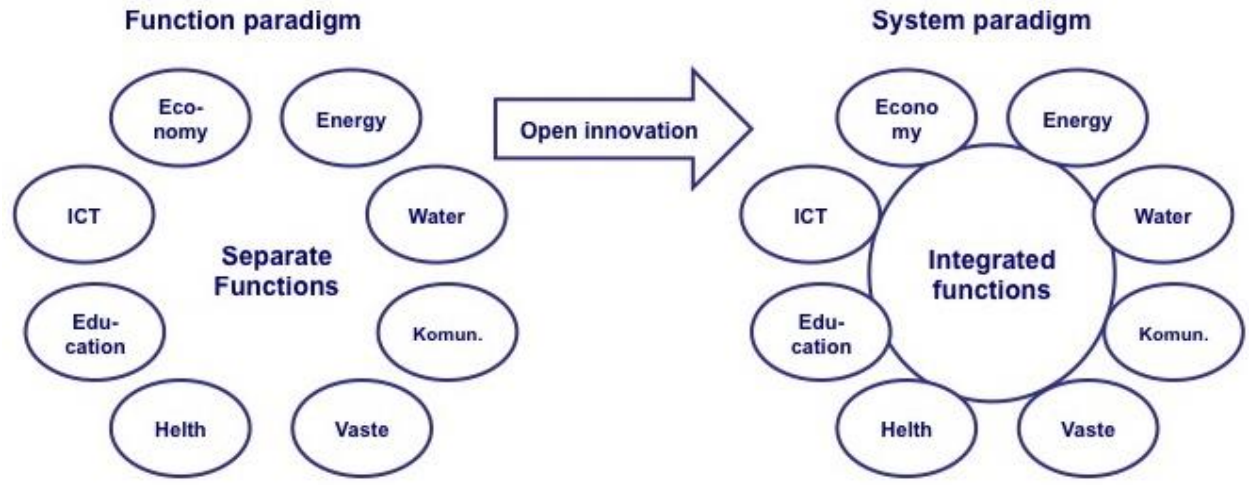

Figure 3. Smart Media

Functional paradigm:
The historical concept of services in the house has been sharing resources into separate services. Separate services for resources such as light, heat, sink, waste, water, transport, information and the like. That is a feature-oriented paradigm, where consumers are users of a set of external services. Standard resources provided to the homeowner's electricity, water and drainage.

$$Y(t) = H(House)X(t)$$

Where X(t) represents some producers of the service, H(House) represent the service's technology platform Y(t) a set of consumers of the service. This feature-oriented programming is based on code

1. Specialization: Some manufacturers provide specialized services to many consumers.
2. Synchronization: There is synchronization in the transmission of services such as water, energy and waste.
3. Centralization: There is a centralized control of resources between producers and many consumers.
4. Closed Innovation: Innovation is related to producer of resources
5. Costs: All resources provided are parallel costs for the consumer.

The range of this paradigm is that the consumer has little direct impact on the design of services.

System paradigm:
At around 2010, where was a paradigm-shift. This shift started a systems integration of services via electronic networks. The implementation of electronic network laid the foundation for new innovation. Networks were developed for the integration of media services, has suddenly formed the basis for the control of light and heat. This would leave the basis for the idea of the Smart House. Smart Technology optimizes overall management of housing resources. This may be formulated with a simple system model:

$$S(\text{Smart House},t) = \{N(H,t),S(\text{Housekeeping Services},t),S(\text{Smart Technology})\}$$

Where S(HT, t) represents a set of services in connection with a house where S(HT, t) = {Media, Heat, Car, Water, Climate, Economy,,,,}. N(H, t) = {Internet}. In other words, the network N(H, t) which forms part of the basis for an integration of resources. Smart Technology forms the basis for exerting an optimal management of housing resources. This is the optimal management for making the house can be characterized as a Smart House. Smart House represents a system-oriented thinking, based on code:

1. Additional customization: There is a cost driven personalization of the services of the house needs.
2. System integration: All services in the Smart House are integrated on a common technology platform.
3. Flexibility: There are no sync services and new services can be integrated as required.
4. Decentralization: All services have an autonomous self-regulation. There is no central control outside the house.
5. Consumer and producer: Smart House is in principle consumers and producers of all services.
6. Costs: There is a cost-effective system adapted housing needs.
7. Open innovation: There is an open innovation for new services

The scope of this concept is that the Smart House, a business service. This will have consequences for the design of public services such as energy, roads, water and sanitation.

We see a similar integration process being conducted in connection with the development of smart technology. Smart Technology is based on an integration of computers and electronics. Smart House represents an integration of services and technological equipment. There is also Smart Technology that manages housing resources in an optimal manner over time. There is so integration of services via networks that form the basis for an open innovation of new services. This flexibility in the development of new services means that one leaves a function-oriented paradigm and establishes a system oriented paradigm. Smart House is then simultaneously a new system component in the development of the one here associate with the term Smart Grid Energy and Smart Cities. (Wikipedia: Smart Home http://no.wikipedia.org/wiki/Smarthus; Valmot, 2013).

3.4 Smart Grid

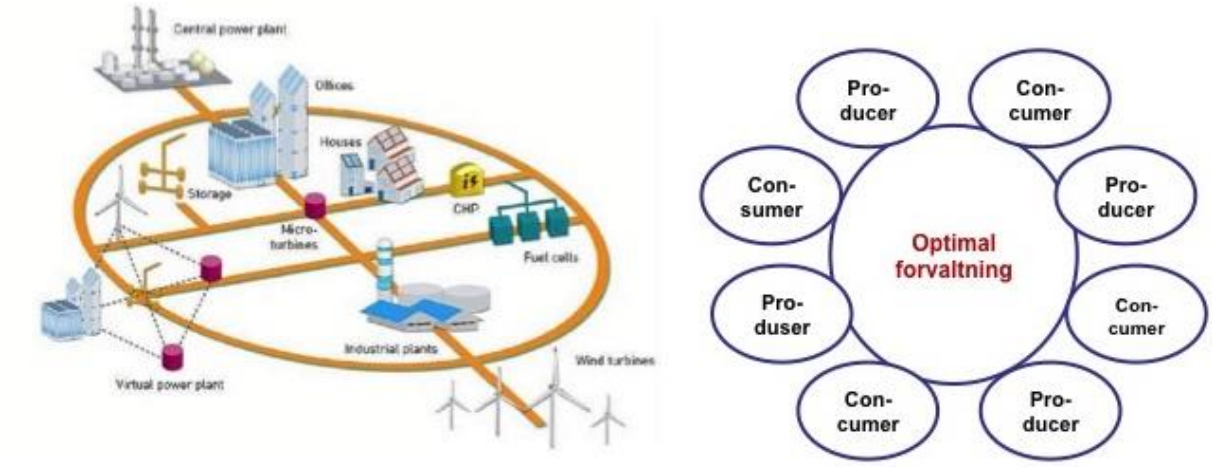

Figure 4. Typical Concept for Smart Grid Energy.

Functional paradigm:
In the 1800s the industry located to local energy sources. It was then a natural ownership between producer and consumer of energy. In the early 1900s initiated a large-scale hydropower development. This development led to a feature-oriented large-scale production with few producers, many line transfers and many consumers. The outcome of this was that the cities could grow beyond places where the energy was produced. The development of energy networks has thus been an important factor that influenced the location and development of all communities, right up to the present time. This concept can be formulated with the simple model

$$Y(t) = H(Energy)X(t)$$

Where X(t) represents the manufacturers of energy, H(Energy) represents the energy distribution network and Y(t) a set of energy consumers. This function-oriented paradigm is based on code

1. Specialization: A specialized technology to many consumers.
2. Synchronization: There is a synchronization of the transmission of energy from producer to consumer.
3. Centralization: There is a centralized transfer of energy from the few producers to many consumers.
4. Innovation: Innovation is related to producer of energy and producer of technology
5. Costs: The consumer has little impact on costs.

System paradigm:
The large growth in a centralized energy management has also meant that we have had a vulnerable energy. Modern society depends on a stable supply of energy with minimum costs. In the USA and in the EU we can now by a new concept for energy management which has been designated Smart Grid. The concept of Smart Grid in 2008 was defined as: "Electric power Network that intelligently integrate the actions of all users connected two it Generators, Consumer-by utilizing two-way communications, new control technologies, distributed computing and Associated sensors, including such equipment installed on the premises of network users."

The goal of the Smart Grid is to develop a more long-term, robust and flexible energy management. It is as ICT, or what we have called Smart Technology, which will form the basis for a smart energy management, optimize the overall energy management, safeguard energy administration's own safety, and repair errors that occur in the network. This means that the Smart Grid is based on a symbiosis between energy technology and Smart Technology. Smart Technology is here based on new instrumentation, new communication systems and artificial intelligence. Management of energy Soon Grid can be formulated with the simple system model:

S(Smart Grid, t) = {N(Grid, t), S(Nodes, t), L(t)}

Where N(Grid, t) represents the energy network, S(Nodes, t) represents Smart technology that optimizes the energy flow in the network, and L(t) represents the landscape for network distribution. In this concept, in principle, all nodes S(Nodes, t) producers and consumers of energy. This code seems to have some similarities that remind us of the development of the Internet in the 1980s. Some typical features are:

1. Additional customization: Selection of energy is related to local needs and cost effectiveness.
2. System integration: There is a system integration of energy supplies from different technological platforms.
3. Flexibility: There is a high degree of flexibility in the management and production of energy.
4. Decentralization: All local energy consumption is in principle based on a local decentralized management.
5. Consumer and producer: Everyone is in principle consumers and producers of energy.
6. Costs: There is a cost-effective energy in real time.
7. Open innovation: There is an open innovation for the production of new services

The new players in the innovation process are the new energy consumers. A group is Smart House. In Germany, for example, cooperatives show profits in their own energy production. This energy production can be so great that there is currently a research topic to ensure a stable supply voltage. On the production side sees a envisioned a network of small and large energy suppliers who, hour by hour, optimizes its own energy production by climate models and the expected selling price. Smart energy networks have technology in real-time optimize line capacity to reduce overall energy loss, vulnerability monitoring and repairing network faults. The second group car industry, which has a rapid growth in the production of electric cars. It seems as though Smart Garages are part of energy management in smart houses. The expected result is a more stable energy while cheaper energy (IEEE Intelligent Systems. 2011; Federal Energy Regulatory Commission staff report, 2006; Rikke Stoud Platou and Maren Sleire, 2011; S. Massoud Amin, BF Wollenberg, 2005).

3.5 Smart Transport

Functional paradigm:
Transport was originally based on a simple and flexible concept, where transport was a result of communication between settlements and resource areas. The road was to where people congregate. The development of second generation industrialism continued demands for more efficient transport between raw materials, production and marketing. In Europe initiated a 1800s start to develop costly transport via water channels. When they were finished, they started a new

development of the railway. After the railway was extended, came a new costly period of development of the road network. Transport is something that is anchored to the contemporary technology. It is now the road network which then sets new standards for the development of settlements. At the same time, the growth in transport has become so great, that it has become a problem for cities, and a huge cost to society. This growth in transport in general and road traffic in particular, has been a key motive for developing smarter cities. A typical feature of this concept has been:

1. Specialization: Transport services are by and large based on a set of specialized transport technology such as car, ship, train, plane, etc.
2. Synchronization: Transport services are generally synchronized by the same transport technology.
3. Centralization: There is a centralized planning and management of transport systems on the same transport technology.
4. Closed Innovation: Innovation is related to the manufacturer of the service or the manufacturer of communications technology.
5. Costs: The consumer has little impact on transport costs.

System paradigm:
EU has now released an updated development program for transport in connection with the research program Horizon 2020. The design of this program is to reduce Europe's dependence on oil and improve environmental conditions. It is planned for an integrated transport system with 500 million consumers of transport services. One assumes that 18 million people are added to the current transportation system, which is threatened by actors outside the EU. One therefore sees transport as a venue for new innovation and new industrialization.

It looks like Horizon 2020, Mobility innovation, is based on the same thinking that underlies the concept of Smart Grid Energy. A seamless integration of all services based on open innovation.

1. Additional customization: There is a cost driven adaptation need of transport services.
2. System integration: There is a system integration of all types of transport services on water and on land.
3. Flexibility: There is a user-controlled flexibility in the choice of transport services.
4. Decentralization: All transport services has an autonomous self-regulation in relation to their own cost.
5. Consumer and producer: There is a greater transparency in the management of transport services.
6. Costs: Development and management of the transport network is in principle determined that its own cost in real time.
7. Open innovation: There is an open innovation for new transport services

Foreign players from Smart Technology are already underway to map the digital tracks in the road network, direct from cars and cell phones. It looks as if it is the actors behind Smart Technology and Smart Media is about to become the new players in the management of digital tracks from transport while laying down guidelines for the management of management of Transport and Communications. (IEEE Intelligent Systems. July 2011; Saleh Alaliyat and Yndestad H, 2014. Horizon 2020 Smart, Green and Integrated Transport, 2014).

3.4 Smart Cities

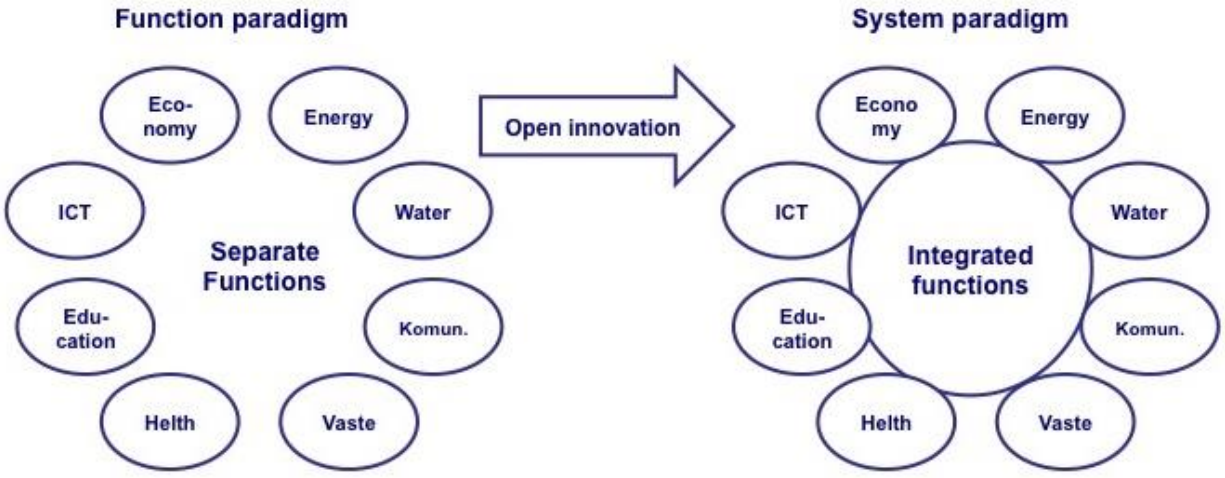

Figure 6. Concept of Smart Cities.

Function paradigm:
The ideological basis for the second generation industrialization dates back to Adam Smith in the 1700s. This foundation has again roots back to the 1600s with Descartes, functionalism and the formation of the scientific method. The code for this industrialization was

1. Specialization: Manufacturing, operations, expertise, training, products, etc.
2. Division of labor: Production, products, training, etc.
3. Synchronization: Operations, Logistics, etc.
4. Mass production: In order to reduce unit costs

This code formed the basis for a sustained period of growth of large cities and laid the foundation for the design of public services. Estimates from the United Nations show that in 2050, approximately 70% of the world's population will live around 27 mega cities. This large growth in cities has also led to a major strain on infrastructure, welfare and ecosystem. In the 1980s there was an overproduction of many products. It led to the industry introduced new technologies and adapt to market with an order-based production. A similar reorganization has not yet arrived in the management of public services.

System oriented paradigm
The concept of Smart Cities came as pilot projects in the US, Asia and the EU. In EU it has been started about 50 sample projects that go under the concept of Smart Cities. In 2013, the European research program Horizon 2020 where Smart Cities included in a comprehensive research program. We see here that the smart concept is part of a series of new themes. Some examples are:

1. Eco-City: Green Infrastructure and management of ecosystems.
2. Digital City: Equivalent to what we have classified as Smart Media.
3. Social City: Smart Governance, Smart Living, Smart Economy, Smart Industry, Smart Grid, Smart Transportation, Smart Buildings, Smart Hospital, Smart Safe and Security, etc.

In this research, it may seem as if one attempts to realize a system oriented organization via the concept of Smart Governance. Despite a multitude of sample projects, where no generic model for Smart Cities. It is common for the concept of Smart Cities is that one leaves a function-oriented thinking and going over to a system-oriented thinking. That Smart Cities are managed as Systems of Systems. Management of public services in Smart Cities can be formulated with the simple system model:

S(Smart City, t) = {N(SB, t), S(ST, t), L(t)}

where N (SB, t) represents the network between services in a Smart City. This means that it is the network that defines the framework for what goes under the concept of Smart Cities. S (ST, t) represents a set of smart services such as Smart Media, Smart House, Smart Grid, Smart Transport are optimizing shared services in real time. This is a service that changes via an open innovation. L (t) represents the city's landscape. The code for this model is:

1. Needs adaptation: An ongoing adaptation analysis of data and selected cost functions in more or less real time.
2. System integration: All public services have a multidisciplinary approach to system integration in a more or less real time.
3. Flexibility: There is a user-controlled flexibility in the design of public services.
4. Decentralization: Public services are handled by a decentralized internal control.
5. Consumer and producer: Public services are consumers and producers of services in multidisciplinary systems.
6. Cost: priorities and policy choices performed with choice of cost indicators.
7. Open Innovation: Public services are research based with an open innovation treasury services.

Smart Cities are managed as systems of systems. It entails a multidisciplinary management at various level, the each level has great freedom to open innovation, within a defined purpose (Mark Dakin and Husam Al Waere. 2012; IEEE Intelligent Systems. July 2011; IEEE Computers. June 2011; Yndestad, 2011).

3.5 Smart Region

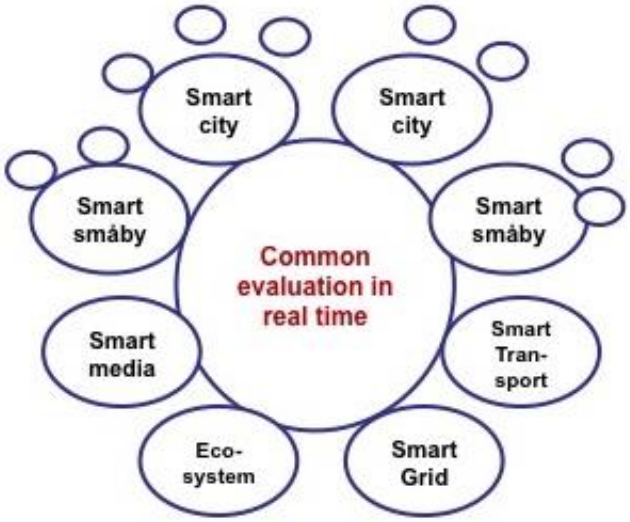

Figure 7. Concept Model for Smart Regions

Function paradigm:
The historical concept of division regions are also based on a function-oriented thinking, with the division of regions for administrative and geographical boundaries. In Norway we have three administrative levels with state, county and municipalities. Each management level is responsible for specialized tasks, divided into budgets for specialized purposes. Municipalities are responsible for a topic within a small geographical area, the county in a number of municipalities, and the state within a set of counties. Such functional structure can easily lead to costly parallel services.

This function-oriented structure was built during a time of stable communities, long journeys, and poor communication. Over a period of 50 years there has been a significant transfer of jobs from the 2nd Generation industrialization and public service industries. The result is that we have a very expensive public sector. Meanwhile, new information led to all access the same information in real-time. So there is now a completely different basis for how one can exercise public services.

Large regions are not necessarily the same as cost effective regions. Large municipalities are not the same as cost municipalities. Scaling of organizations is based on a function-oriented thinking. Larger units can easily result in less flexibility and greater cost, if they are not smart organized.

System paradigm:
In 1980 launched the Michael Porter's theory of industrial clusters. The theory of industrial clusters was based on the notion that the web hosts of businesses, which together produces a joint product. In the Northwest were identified in a marine industrial cluster to the fishing industry, a maritime industrial cluster to the shipping industry and an industrial cluster in connection with the furniture industry. Later it developed new industrial clusters to aquaculture and offshore services. The theory of industrial clusters represented a change from a function-oriented thinking, to a system oriented product philosophy. Instead of each company ran the serial production for stock, began now to regard production subsystems, which will fit into the larger

industrial systems. The result is greater flexibility, less vulnerability, and everyone could share a total GDP.

If one pursues this line of thinking, a Smart Region formulated with a simplified system model:

$$S(\text{Smart Region}, t) = \{N(\text{Smart Region}, t), S(\text{Smart Cities}, t), S(\text{ST}), t), L(\text{Location})\}$$

Where N(Smart Region, t) represents a network of public relations. In this model, it is again the network that defines the framework for the region. S (Smart Cities, t) represents a set of Smart Cities. S(ST) represents a set of smart services such as Smart Transportation and Smart Grid. L(Location), the landscape and the ecosystem that surrounds the region. A region, which is managed as systems of systems, is characterized with the code.

1. Additional customization: The region takes responsibility for their own sustainability compared to other regions.
2. System integration: The region takes responsibility for system integration of Smart Cities, Smart Grid, Smart Transport, natural resources OSV.
3. Flexibility: There will be local flexible solutions as an alternative to large-scale solutions.
4. Decentralization: Public services are handled by a decentralized internal control.
5. Consumer and producer: Region balances his role as a producer and consumer of resources to other regions.
6. Cost: priorities and policy choices performed with choice of cost indicators.
7. Open innovation: Public services are research based with an open innovation treasury services.

Smart Regions represents system integration at higher levels. At the same time a system element in linking to other regions. This means that each region must take responsibility for safeguarding an open innovation in their own region on their own terms, while at adapting to an open innovation in other regions.

5 DISKUSJON

Smart Regions examined the ideas behind smart concept and the ideas behind the concept of Smart Grid are a generic concept that can be used to develop more cost-effective public services. The results of the survey indicate that there is also such that the concept Smart Grid is a symptom of a more underlying development process that affects structures in public social planning. This development can be traced back to Moore's Law, where the growth in electronic circuits, doubled in two years. Growth in electronic packaging density, introduces growth in the integration of data. Growth in the integration of data, leads to integration of organizations at higher levels. Integration of organizations, leads to an interdisciplinary and system approach to management of public services. In the 1970s led this integration instrumentation via microprocessors led to a reorganization of industrial production. In the 1990s brought the Internet to a reorganization of the service industries. It seems as if the idea behind Smart Technology, Smart Grid, and Smart Transport in coming years will lead to a corresponding transformation of public services. That's when the interaction between these new concepts that form the basis for the one here described as Smart Cities and Smart Regions. It is as the network of open innovation that leads to that public services must adapt to a common code of need customization, integration, decentralization, consumer and producer at the same time, cost-effectiveness and research development of public services.

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