A Finnish Technology Roadmap of Building Services

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ABSTRACT

Building services create customised, user-oriented and controlled conditions for the various activities taking place on real estates and related premises.

This paper presents an outlook of building services trends in Finland. The outlook of the future development of building services is presented in the form of technology roadmaps. Overall, the building services roadmap consists of six separate roadmaps. The 'meta-roadmap' summarises the results of the research project. The sub-level roadmaps are for building services systems and equipment, for networked building services, for building services life-cycle design processes, for the interfaces from building services to both buildings and their infrastructure, and for the business models and service concepts of building services.

The time-scale for each of the roadmaps was divided into three: state-of-the-art, short-term (1-5 years), and long-term (5-15 years). A long-term vision was created for each roadmap. This paper gives an overview of the roadmaps focusing on the 'meta-roadmap' and the roadmap of building services systems and equipment, and business models and service concepts. Drivers, markets, products and solutions, and technologies were considered in these roadmaps. In addition, the major development paths in building services are summarized in the paper.

1. INTRODUCTION

Building services create customised, user-oriented and controlled conditions for the various activities taking place on real estates and related premises. These include, for example, the supply of air, water, heat, energy, lighting and information, electrically controlled security and access services, as well as other services that are based on the movement of matter, electrons, sound waves etc. Building services consist of technical systems and equipment, as well as services relating to them. (Paiho et al. 2007)

Technology roadmaps identify, evaluate and promote the development of collaborative projects within and between industries to fill technology gaps and/or capture technology related opportunities (Emerging Industries 2001). Technology roadmapping is a flexible technique that is widely used within industry to support strategic and long-range planning (Phaal et al. 2004). The approach provides a structured (and often graphical) means for exploring and communicating the relationships between evolving and developing markets, products and technologies over time.

For example, High-Performance Commercial Buildings (2000), NAHB (2002), and Vision 2020 (2000) have presented roadmaps which have connections to building services and relevant technologies in the area. But Paiho et al. (2007) presented a first Finnish technology roadmap of building services. Before the study,

such a national roadmap did not exist. The main outcomes of the study are presented in this paper focusing on the 'meta-level' and aspects related to building services systems and equipment.

The roadmaps were developed in a systematic process which included information collection, identification of technology scenarios and potentials, and formation of the roadmap (Paiho et al. 2007). First, number of references were collected and analysed. Then, three workshops took place, where experts in different sectors were given tasks which gave material for the formation of the roadmaps. This was done by a smaller team. The draft report was presented to selected customers. Their comments were taken into consideration while preparing the final version of the roadmaps.

2. ROADMAPS

Overall, the building services roadmap consists of six separate roadmaps (Figure 1). The first of them is a 'meta-roadmap' summarising the results of the research project (Paiho et al. 2007). The meta-roadmap thus serves as a research umbrella under which the more detailed thematic roadmaps are presented. There are four sub-level roadmap themes and five actual roadmaps. The first roadmap is for building services systems and equipment. The second theme is ICT and software, consisting of roadmaps for networked building services and building services life-cycle design processes. The third sub-level roadmap analyses the interfaces from building services to both buildings and their infrastructure. The fourth sub-level roadmap examines the future development trends for the business models and service concepts of building services.

2.1 Meta-roadmap

A long-term vision up to 2020 was created for each roadmap (Paiho et al. 2007). The vision of the meta-roadmap (and also for the whole project) was defined in the following way:

- The building services will be mainly purchased with service contracts which guarantee defined indoor conditions.
- Life-cycle management of the building services will be based on the product model technology. Virtual construction will enable effective visualization of both the design solutions and its realization.
- The building services will utilize natural resources effectively, low-energy technology will be in use, and the systems will be able to utilize low-exergy energy sources.
- The building services systems will be mainly connected with wireless solutions, they will be modular, they will be installed with plug-and-play principles, and they will easily adapt themselves to other systems.
- The equipment will be situated according to standard routing and installation solutions, they will communicate with each other, they will control the conditions and will be controlled based on the usage, they will improve themselves automatically or will inform the service provider on the maintenance need.
- The building operating system will collect, process, maintain and share the necessary building services data and information wirelessly and a two-way communication will be utilized. The data and information will be utilized in life-cycle management of building services and for production of services which will be based on building services.

In Figure 2, there is shown the meta-roadmap. There four aspects are considered over time, namely: drivers, markets, products and solutions, and technologies. The time-scale is divided into three: state-of-the-art, short-term (1-5 years), and long-term (5-15 years).

Currently, the building services are mainly based on individual technology-driven solutions from different suppliers, from which different designers then compile the building-specific systems. Inter-equipment communication is nearly nonexistent, and the equipments are not compatible with each other. The building services market is fragmented into highly specialised fields, and its basic mechanism is driven by suboptimisation. The development of service business models is not very advanced.

In the short-term (1–5 years), the role of low-exergy technology, low-energy buildings, product modelling and other ICT, as well as

measurement and sensor technology, will be emphasised in modular building services in particular. In products and services, different ways of packaging and branding user-oriented services, solutions for nondisruptive repairs and maintenance, as well as integrated user interfaces and other integrated solutions, will be of greater significance. In market activities, the emphasis will be in the development and supply of different service concepts.

In the long-term (5–15 years), the focus will be on product model technology applications, low-exergy technology, integrated infrastructure and the utilisation of sensor networks and new materials. Product solutions underline integrated and user-oriented services, which are assembled by collecting the required information from wireless equipment and supported by inconspicuous and adjustable user interfaces. The main business ideas in the market focus on comprehensive deliveries and packaged services. A competitive business plan will be based on managing the service performance and productivity of a real estate.

2.2 Roadmap of building services systems and equipment

In the roadmap for building services systems and equipment (Figure 3), the main drivers during the whole time-scale of the roadmap are energy- and eco-efficiency requirements, the needs of the existing building stock, customer requirements, utilisation of ICT, demographic changes and labour shortages.

Currently, the markets are fragmented. In the future, importance properties of systems and equipment will increase. In addition, EU-driven regulations play an important role in the energy-efficiency of buildings. Business will be done through networks. Also general globalization is changing the markets.

Currently, the modular building services and the LED technology have mainly only been piloted. The most advanced technology solutions are for example the heat recovery, the low-energy building concept and the heat pump but generally only minor development in HVAC-systems is typical.

Both in the short-term and in the long-term, the utilization of the low-exergy technology and the new energy storage technology may improve the building energy-efficiency significantly. Product model technology during the whole life-cycle of buildings will play an import role. User-interfaces based on new technologies will make the human-interaction easier. Future systems also need to be service reliable. New solutions for non-disruptive repairs are also needed.

In the short-term, distributed building services systems, such as VRF-systems, and LED lighting solutions will become more common. Other important products and solutions are new routing and installation systems, and improved and generalized access control systems.

In the long-term, distributed energy production equipment, such as fuel cells and micro-chp, will develop. Also products based on new materials will improve energy-efficiency. In addition, building services will mainly utilize wireless communication solutions. In new construction, comprehensive building services concepts will become common.

2.3 Roadmap of business models and service concepts

In the roadmap of business models and service concepts (Figure 4), new possibilities of ICT are an important driver already now. In the future, ICT will enable new services for indoor condition management. In addition, there will be services for individual, solvent and demanding customers.

In the markets, there are currently different doers which compete mainly on price. The shortage of labour has increased interest for education. In the short-term, the business will move towards value networking which is also needed in the service markets in East Europe and in Asia. In the long-term, supplier owned virtual companies will provide tailored integrated services.

In products and solutions, the top state-of-the-art services include services for example for energy monitoring, safety, and renovation and maintenance. In the short-term, there will be several new services such as sales

support systems, services for occupants, product model based operation and maintenance services, and customer-oriented condition services. In the long-term, there will be integrated services for different market segments. Well-tailored niche systems and services will have global markets. In addition, building life-cycle services and services for recreational dwelling will become more in common.

5. DISCUSSION

The roadmap process helped to recognize seven large development paths of building services:

1. The markets will polarize into a "low-end" market filling the minimum requirements, and a customer-oriented "high-end" market.
2. In construction, there will be a shift from contracting and price competition towards property and service competition.
3. Information and communication technology (ICT) will be tightly integrated into operation and control of building services as well as into life-cycle management.
4. Increased customer requirements and possibilities provided by improved financial situations will increase building services technologies and related services in buildings.
5. User requirements will be better taken into consideration in design of building services systems and equipment and in the development of user-interfaces.
6. Aging people in aging buildings is a great challenge. Flexible renovation services and new product and service solutions can help to meet this challenge.
7. Tightening eco- and energy-efficiency requirements necessitate efficient and economical use of raw materials, recycling, improvement of eco- and energy-efficiency of buildings and building services, utilization of low-exergy energy sources, and interfacing to regional and local distributed energy production.

6. CONCLUSIONS

This paper presented an outlook of building services trends in Finland. The outlook of the future development of building services was presented in the form of roadmaps. Overall, the building services roadmap consists of six separate roadmaps. The 'meta-roadmap' summarising the results of the research project was presented. In addition, the roadmaps for building services systems and equipment, and for business models and service concepts were discussed. In the discussions, seven large development paths of building services were stated.

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REFERENCES

Emerging Industries (2001). Technology Planning for Business Competitiveness. A Guide to Developing Technology Roadmaps. 19 p. ISBN 0 642 72151 3

High-Performance Commercial Buildings – A Technology Roadmap. A 20-year Industry Plan for Commercial Buildings (2000). Representatives of the commercial building industry. 20 p.

NAHB Research Center (2002). PATH Technology Roadmap: Energy Efficiency in Existing Homes. Vol. 2: Strategies Defined. Partnership for Advancing Technology in Housing.

Paiho, S., Ahlqvist, T., Lehtinen, E., Laarni, J., Sipilä, K., Ala-Siuru, P., Parkkila, T. (2007). Building services roadmap. Technologies and markets. VTT Research Notes 2379. 55 p. + app. 60 p. ISBN 978-951-38-6910-6 (in Finnish, English abstract)

Phaal, R., Farrukh, Cl. J. P. & Probert, D. R. (2004). Technology roadmapping – A planning framework for evolution and revolution. Technology Forecasting & Social Change

Vision 2020. The Lighting Technology Roadmap Roadmap – A 20-year Industry Plan for Lighting Technology. 2000. (DOE/GO-102000-0982). 20 p.

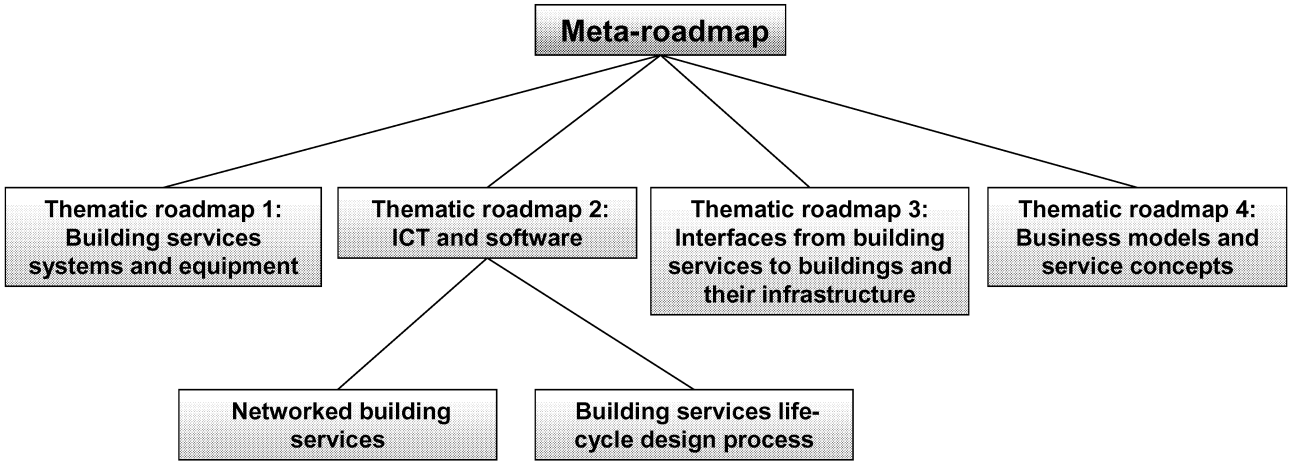

Figure 1. The general structure of the roadmaps.

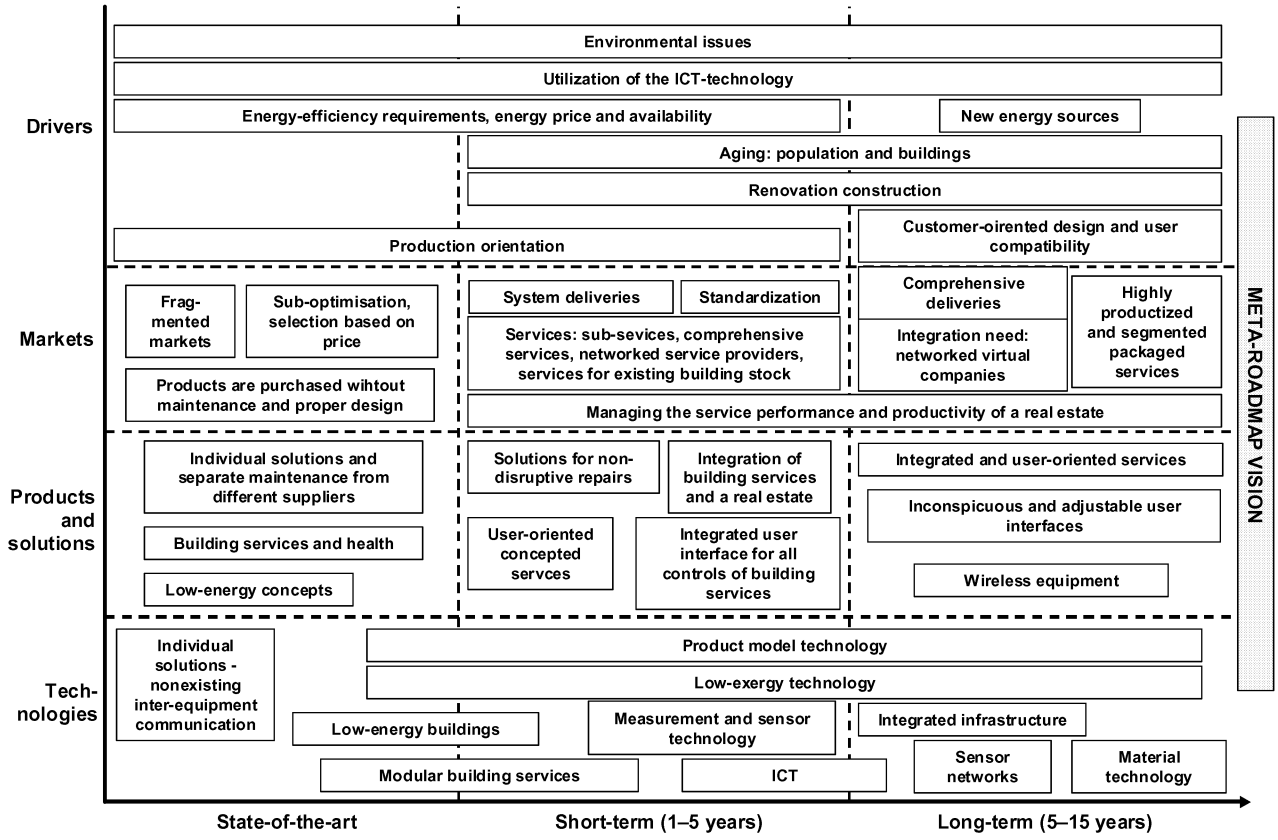

Figure 2. The building services meta-roadmap.

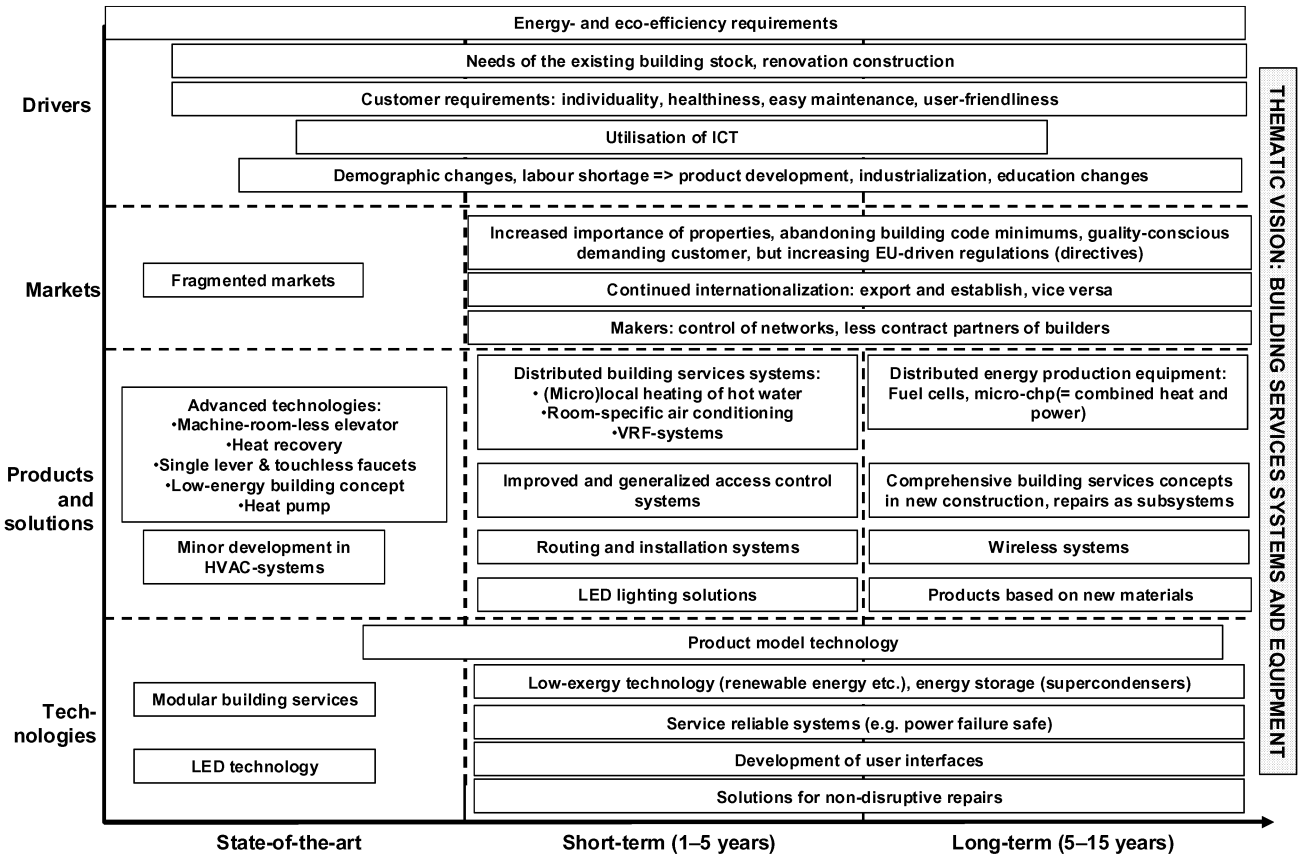

Figure 3. The roadmap for building services systems and equipment.

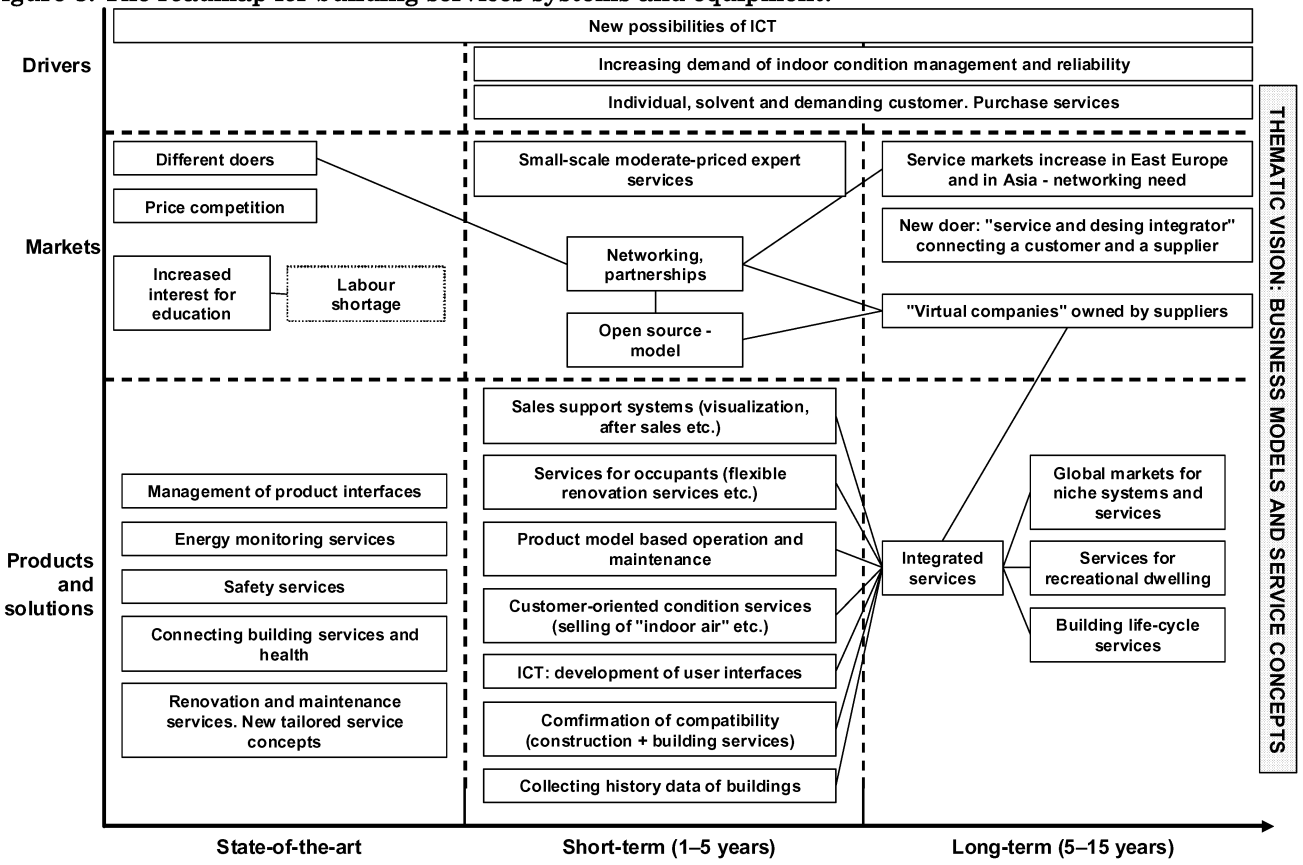

Figure 4. The roadmap for business models and service concepts.