



Cities as Sustainable Service Platforms

A Framework for Institutional Service Delivery in the Urban Context

Jarmo Suominen^{1,2}(✉)

¹ Aalto University, Espoo, Finland
jarmo.suominen@aalto.fi

² Tongji University, Shanghai, China

Abstract. Cities are complex systems of infrastructures and entities, which are usually developed independently, focusing on their efficiency. Cities deliver various services, such as health care, education and transportation. These services are delivered through urban entities such as hospitals, schools, universities and care homes, each built and managed independently. As a consequence, even though there might be enough resources in the built environment, there might be a lack of access in terms of actual service delivery. This is due to the trend that many times urban innovation happens by building new instead of using existing resources in more sustainable ways. Recently, new digital technologies and platforms have emerged to enable the sharing of various resources. However, since resource sharing has emerged on the customer side, institutions are still largely controlling their own independent resources. This article analyzes opportunities for institutional resource sharing and the role of service operations and platform applications. The research reveals new opportunities for operating environments and proposes a new service-oriented model for organizing institutional service delivery and using cities as sustainable service platforms.

Keywords: City · Service platform · Sustainability

1 Introduction

Cities are complex networks of various resources and infrastructures. They have systems for housing, transportation, sanitation, utilities, land use and communication. Their density facilitates interaction between people, government organizations and businesses. Urban resources are being developed through independent projects, driven by their own purposes and efficiency. This approach has been relevant in the past, enabled by land use strategies and driven by city planning and real-estate models of operation. As a consequence, cities could be illustrated as archipelagoes, environments of independent islands, each island creating its own isolated entity. This has caused cities to expand in order to enable new needs and demands to be fulfilled. However, due to the development of digitalization and new postindustrial value-creating processes, there is a shift of needs for physical resources. Now, many urban environments are facing the paradox of having too much space but not enough access.

While the processes of creating value are changing, many of the needs that in the past required controlled and managed physical environments are changing as well. Workplaces and environments for education and health care, administration and accommodation will face dramatic changes with regard to the need for space and control. Office hotels and co-working solutions have been evolving partially to solve this challenge. Customer-oriented services such as Airbnb and Uber have also been enabling the use of resources owned and managed by individuals. This has opened new opportunities in new markets and application areas. However, most of the current applications are still focusing on the customer side of resource sharing, while institutional sharing remains underdeveloped.

Urban environments have numerous resources that are managed and used by various institutions. As an example, even a small urban entity might have public resources such as schools, day care centers, libraries and police and fire stations, which could be used as a more integrated platform for public service delivery. The focus in this article is on how to use combinations of public and private resources as a service platform for institutional service delivery. If cities could overcome traditional borders between organizational silos and procurement, a new approach could take place. The hypothesis of this research is that by utilizing urban assets as a platform for public service delivery, cities will become more accessible and sustainable.

2 Objectives

The objective of this research is to analyze urban structures as environments for institutional service delivery. Currently, each service provider manages, controls and even owns its own entities, causing competition over the supply of similar resources. This is partially due to the nature of institutional procurement and management processes of the past, but the situation also arises because of the symbolic and operational values of a service provider owning its own entities. This type of thinking could be rooted in *goods-dominant logic*.

Goods-Dominant Logic: The purpose of an activity is to make and distribute units of output, preferably tangible. Goods are embedded with utility (value) during manufacturing. The goal is to maximize benefits through the efficient production and distribution of goods. [1]

This logic has been influenced in many ways by how cities are today – environments of independent “products” connected by enabling infrastructures. As a consequence, cities have oversupplies of certain resources, at certain locations, and a lack of resources in other locations. City-planning processes are in place to balance supply and demand, but needs will change over time. Some locations and resources may lose, while others will increase their relevance over time. In order to be able to deliver services in sustainable ways, a new logic is needed.

Service-Dominant Logic: Goods are a distribution mechanism for service provision. Goods derive their value through use – the service they provide. The customer is always a co-creator of value. This implies value creation is interactional. Value is always determined by the beneficiary. Value is idiosyncratic, experiential, contextual and meaning laden. [1]

Based on service-dominant logic, the “products” of cities, such as buildings, could be seen as platforms for value creation. Buildings are evaluated through their instrumental rather than absolute value. This difference affects how the built environment could be developed, what interactions cities are for and what technologies they will use. By separating activities from environments, the built environment could be analyzed from a service-platform point of view. The analysis should cover all the levels of the environment, starting from spatial and building layers and reaching up to areal and city layers.

3 Methods

Service-dominant logic identifies two main elements for service delivery: *operant resources* and *operand resources*. Operant resources are primarily knowledge and skills – competencies. In general, these are resources that produce effects. Operand resources are primarily physical resources – goods. These are resources upon which an operation or act is performed to produce an effect [1]. In their article “A Spatial Model of Effectiveness Criteria: Towards a Competing Values Approach to Organizational Analysis,” Quinn and Rohrbaugh proposed a framework for organizational analysis for operant resources [2]. The model suggested that dimensions of control-flexibility and internal-external focus underlie conceptualizations of organizational effectiveness (Fig. 1).

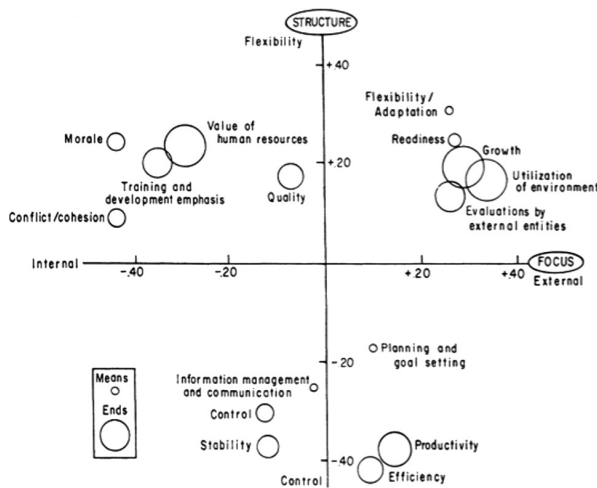


Fig. 1. Quinn Rohrbaugh framework

The main parameters of the framework are focus and structure: focus shifting from internal efficiency to external effectiveness, and structure shifting from a control-driven static model to a flexible, adaptable model. These parameters have been used to analyze the operant resources of institutions to evaluate their objectives. An adaptation of this

framework is then developed to analyze operand resources as physical environments for service delivery (Fig. 2).

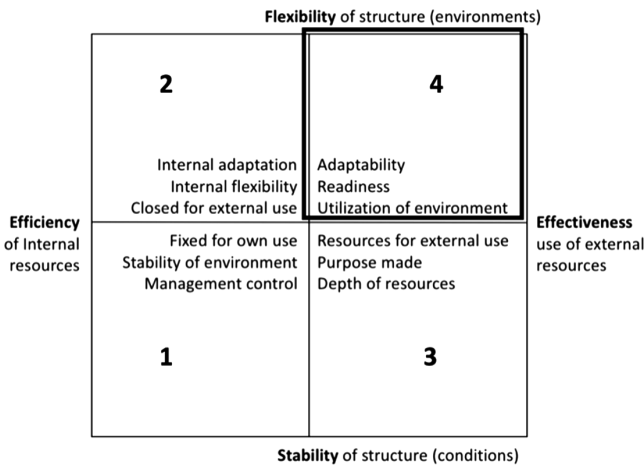


Fig. 2. Quinn Rohrbaugh framework adaptation by Suominen

As a result of this research, a comparative analysis has been made to evaluate the suitability of the service platform (operand resource) for the objectives of the activity (operand resource). In the case studies, the focus is on understanding the environments of given institutional operations. In this framework, environments are evaluated through the following categories.

3.1 Evaluation Categories for Characteristics of Service Platforms

On the case study references, service platforms are evaluated and categorized, based on the adapted framework, within categories defined by core parameters, focus and structure.

Static Model: Efficiency of Internal Resources/Stability of Structure. The static model is fixed for internal usage, without internal flexibility. This is typical for many solutions of the past, which are based on a predefined brief and built for that purpose only. This drives static and predictable solutions and enables traditional processes of management and control of the facility. Typically, the solution is not adaptable for any internal or external change and therefore has high investment and planning risk.

Internal Model: Efficiency of Internal Resources/Flexibility of Structure. The focus is on internal issues, while the structure is flexible. Internal flexibility allows internal adaptation to needs. This has consequences to internal development potential and the role of human resources in it. This is typical for many quite recent solutions. By increasing internal flexibility and adaptation, the quality of outcomes could be higher. The internal focus may lead to very deep network structures that are not easily

accessible for external stakeholders. Flexibility of conditions is typically achieved by transformable or multipurpose solutions in the physical environment.

External Model: Effectiveness of External Resources/Stability of Structure. The focus is on effectiveness and external resources. Solutions are open to external stakeholders, however, while the structure is static and based on control. This requires external stakeholders to learn and understand the characteristics of a given solution. It is open and available for external use, but with internal control. The benefits of this concept are that it utilizes its own available resources and thus increases the usage rate of those resources. That itself could be seen as a sustainable approach in urban development. Entities are no longer isolated, standalone institutions but are shared with other stakeholders as well. This is also an example of a sharing economy application in a built environment.

Dynamic Model: Effectiveness of External Resources/Flexibility of Structure. The focus is on external effectiveness, and the structure is flexible. The solution is adaptable, flexible and capable of utilization of the resources available in its environment. This type of solution is capable of creating value with the environment and flexible to adapt to changes. The resolution of the solution is higher: Instead of defining the solution as a building or independent entities, it could be defined as a network of resources. When organizing the solution as a network, a new type of network management and service operations are needed. Instead of operating one entity at a time, new opportunities will emerge when approaching the solution with a resource operations point of view.

3.2 Network Structure

In order to evaluate the capabilities of the various network structures, analyses of physical environments have been conducted. In spatial analyses, “space syntax” tools have been used. Space syntax encompasses a set of theories and techniques for the analysis of spatial configurations developed by Hillier et al. at The Bartlett, University College London [3]. The general idea is that spaces can be broken down into components, analyzed as networks of choices and then represented as maps and graphs that describe the relative connectivity and integration of those spaces – especially integration, which measures how many turns have to be made from a spatial segment to reach all other street segments in the network, when the shortest paths are used. This has been used to represent the depth of the spatial network structure.

The network structure of physical environments was chosen to be analyzed because of implications of given structure to actual behavior. Deep structures with disconnected resources don’t support interaction in the same way than shallower and more connected structures. Deep structures also indicate internal focus, environments supporting strong internal ties. While shallow structures are enabling weak ties to be included in value creation to increase external effectiveness. In the article, *The Strength of Weak Ties* [4] the degree of overlap of individuals’ personal networks is discussed from the point of view of how it varies as a consequence of the strength of one individual tie to one another. Strong ties are links between us and people we know well and work closely with. Weak ties are those which we don’t interact often with. They are people we see or

communicate with only on occasion. The advantage of communicating with weak ties is that they are links to other groups who know different things, from different networks than we do bring us new ideas and connections. Author Mark Granovetter suggested an application of the argument on weak ties to the study of innovation diffusion. This argument applies not only to the diffusion of innovations but to the diffusion of any ideas or information. The impact of this principle on the diffusion of influence and information, mobility opportunity, and community organization is explored. Stress is laid on the cohesive power of weak ties. While most network models deal with strong ties, Emphasis on weak ties lends itself to the discussion of relations between groups [4].

4 Case Studies: Tangible Service Platforms

When analyzing physical environments from the platform point of view, the hypotheses is that the architecture of the solutions should be open and flexible, utilizing the resources of the environment and enabling flexible adaptation for changing conditions. As an assumption, solutions that focus on the effectiveness of external resources within flexible structures are most suitable for the elements of urban service platforms. This requires that a particular type of service architecture and network structure is taken into consideration in all levels of city planning and architectures (Fig. 3).

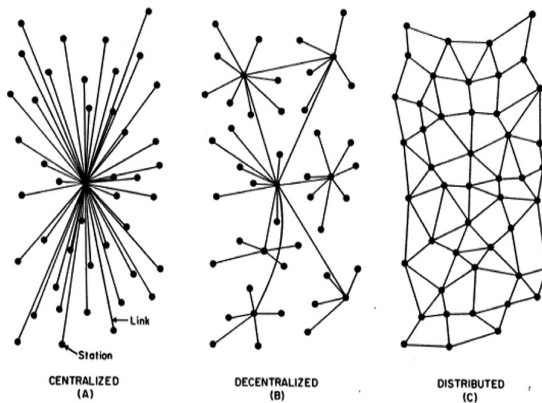


Fig. 3. Network typologies for centralized controlled, decentralized efficient and distributed effective structures.

In city planning, it would be beneficial to develop already existing service-intensive environments further, creating access and proximity for diverse service entities. In mobility and transportation planning, the location of service hubs would be most relevant when they support developed service environments. On the building level, the accessibility of resources requires open architectures and shallow network structures. Case studies have been made on various layers of urban environments, on the levels of spatial, building, areal and city scale. Solutions have been evaluated from the point of

view of both the network structure and the internal efficiency/external effectivity orientation (based on the proposed framework). Condensed summaries of each research area follow.

4.1 Space as a Service (Spatial Level)/Case: MIT Buildings on Campus

This section of the case study deals with the building issues of accessibility and affordances of existing resources. In the article *Methods and tools for evaluation of usability in buildings* [5] authors are presenting various tools for analyzing the usability and manageability of buildings. However, in order to understand the building as a service platform, new methods are needed. For this research, the network structures of a total of 12 buildings on the campus of the Massachusetts Institute of Technology (MIT), Cambridge, were analyzed. Solutions were categorized based on the network structures, which were compared to the operational objectives of each environment. The buildings were analyzed by using a space syntax program with the floorplans. The aim was to identify the main elements of the solutions in terms of structure and focus. Structures were categorized based on the parameter of control/static–flexibility/dynamic and the axis of focus on internal efficiency–external effectiveness.

It is evident that these two analyzed case examples had different goals; however, the aim of the study was to understand the capabilities of any particular network structure in terms of accessibility and suitability for value co-creation. This approach favors the open and connected structure of MIT’s Media Lab over the clustered and more closed structure of MIT’s Picower Center. From the point of view of orientation to internal efficiency/external effectiveness, it seems that the focus of MIT’s Picower Center is more on internal efficiency, while MIT’s Media Lab focuses on external effectiveness (Fig. 4).

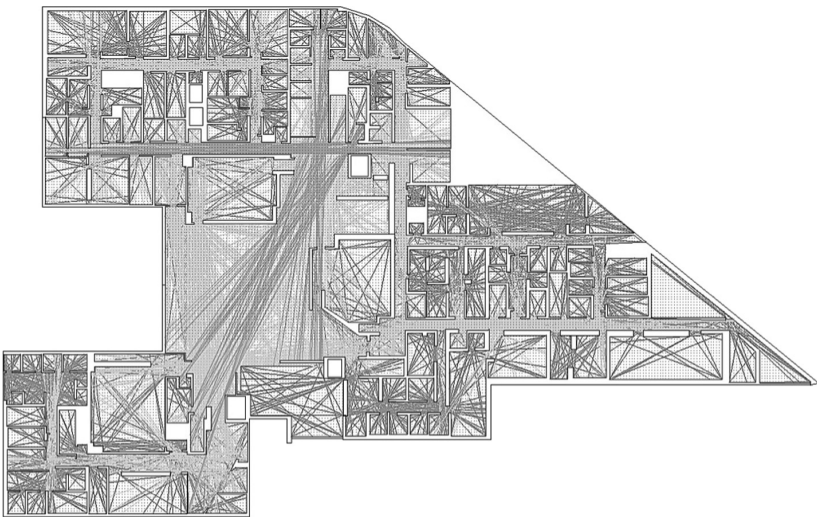


Fig. 4. Network structure of MIT’s Picower Center.

Solution is decentralized and focused on internal efficiency. Resources are deep in the network structure. Accessibility for external use is low. At Picower, the floorplan analyzed was the main floor for interaction. It contains a main lobby, entrances to three auditoriums and sub-entrances to three main departments, which are isolated from one another (Fig. 5).

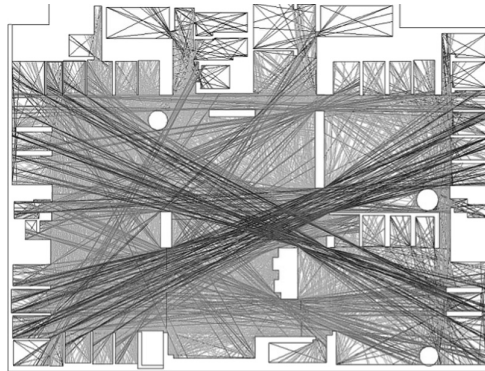


Fig. 5. Network structure of MIT's Media Lab

Network structure is distributed; focus is on external effectiveness. Resources are accessible due to the network structure and shallow depth. Resources are perceived easily by external stakeholders. As a result, this study illustrates how the focus on internal efficiency or external effectiveness has its implications for physical environments. In decentralized but clustered structure of Picower center, each cluster could function efficiently and independently. However, in terms of human interaction and social learning, this type of network structure doesn't typically support interaction between internal clusters of external stakeholders. On the other hand, more open and connected structure of Media laboratory offers opportunities for internal and external interaction. The solution of Media Laboratory also offers more opportunities to share competencies and histories of mutual activities. This type of open structure also is more open to external activities.

4.2 Building as a Service (Building Level)/Case: Entity of High School

This section of the case study deals with a value co-creation platform between a high school and learning communities at Aalto University, Otaniemi. School as a Service (SaaS) is a concept that defines a school as a network of resources rather than a standalone building. The SaaS solution is to develop the service architecture of a school based on principles of service-dominant logic [1], and it is enabled by applications of the platform economy. School as a Service is an new concept utilizing a service platform both for institutional demand and to deliver education. In this particular case, the service architecture defines the conditions for value co-creation (learning). While the brief for the school has stayed almost the same, the deployment is different. The

planning process includes mapping of local assets, identification of available resources, designing the “home base” and planning campus-wide resource usage. SaaS is a joint project with the City of Espoo to create a new concept for the use of teaching facilities and resources.

SaaS case was looking at how to organize one institutional service delivery – in this case, teaching – based on a flexible structure and external efficiency. Traditional school solutions learning is mostly decoupled from the community and delivered in a standalone platform by teachers to students. This type of solution is characterized as a product, which could be innovative and flexible, but it is based on the logic where value is embedded in the product itself. A school is usually run in isolation from the environment, and the focus is on delivery of teaching, while students are subjects of this activity. The school is operated as a standalone facility, and the structure is static, enabling control of the environment (Fig. 6).

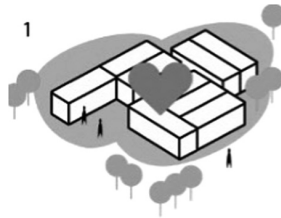


Fig. 6. School as a product

Characteristics of product-logic at a typical school include a focus on internal efficiency and a static structure, enabling control and delivery of planned activities. The focus of product innovation is on product-specific standalone solutions with isolated operations and facility management. This type of solution requires extensive planning. Most of the investments are up front, and the investment risk and planning risk are high due to the time span of the production and the potentially turbulent environment of the solution. It is based on the idea of controlling all required resources and creating the conditions for pre-planned service delivery. In this case study, however, the focus was on a flexible structure and external effectiveness.

Organization of education and delivery of teaching is currently resource consuming and static, it is based on a stand-alone solution with independent entities of education. The focus of SaaS project was on utilization of existing resources and communities of learning to enable more connected learning environments and to create value together with other stakeholders in the learning community, school is defined as a service, based on the network of resources around its home base. In practice, the study was identifying various resources of learning in close proximity of the “home base” for the school and was studying a model for resource operator, in order to enable dynamic optimization of given school institution. This defines new “service architecture” for the school. The aim of the study was to test this new solution by proposing interventions based on the goal of the solution and to evaluate them with, for example, an action research methodology. School operations were proposed to be executed in a network of resources rather than

in a traditional standalone entity. While the traditional model could be described within the product-based logic, this new hypothesis is based on service-dominant logic [1] (Fig. 7).

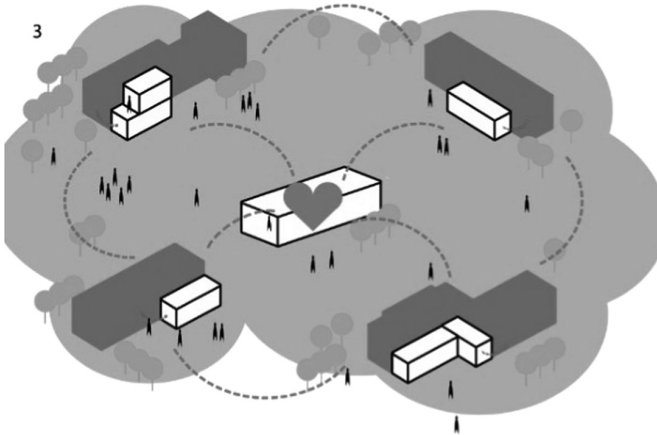


Fig. 7. School as a Service

In prototyped SaaS concept, a new service architecture defines a school as a set of resources for supporting learning. SaaS is sustainable by optimizing and recycling the use of spaces and equipment and by increasing social diversity and sharing resources with the surrounding society. The school uses available shared resources within the community (Fig. 8).

	All / Saas	
total investment / student	33 635	12 000
total investment / m2	2 746	1 424
infill / student	1 643	1 600
infill / m2	121	190
investment / student	32 314	10 400
Investment / m2	3 828	1 234
rent / student	254,02	136,78
m2 / student	12,49	8,43
rent/m2	20,32	16,23

Fig. 8. Financial analysis between product and service models (source: ACRE).

Aspects of social learning are important elements of flexible and scalable school embedded in the community. This is a systemic solution, where the focus is on external

effectiveness and the structure is flexible. Pedagogy is focused on problem-based learning, emphasizing 21st-century skills, critical thinking, creativity and communication and collaboration. This type of solution could be characterized as service innovation enabled by a resource operator. The focus is on value co-creation, and the structure is flexible. This enables new types of learning communities to emerge and increases opportunities for social learning (Fig. 9).

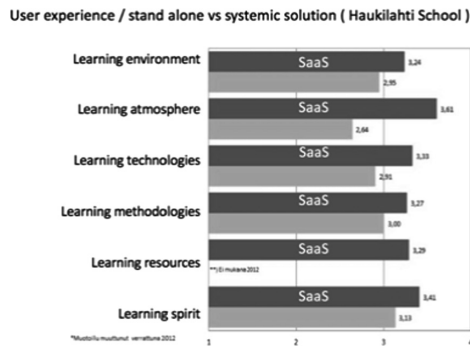


Fig. 9. Comparison between product and service model experiences (source: IRO)

As a result, School as a service solution enables more adaptable and flexible solution for the delivery of education. It fosters social learning, by extending learning community beyond traditional environments and by utilizing accessible resources at Aalto university campus. The solution was decreasing planning and investment risk, based on the adaptability of the network. It also has the impact on the increase of social density, interaction inside and between various groups and optimization of the use of local resources, enabling more sustainable development of urban communities. SaaS has received five innovation awards: The Mayors Award for Innovation, 2016; National Award for Innovation, 2016; Espoo Medal for Innovation, 2016; International Innovation Award, 2017; and Best Learning Community, Espoo, 2017. It has been recognized as a sustainable model for future learning environments by the Finnish government.

4.3 Campus as a Service (Areal Level)/Case: Campus of Otaniemi

This section of the case study deals with the structure and elements of an open service platform for innovation ecosystems in local level, at the Aalto University Campus. The relationship between innovation and design, urban systems, policies and real estate development is poorly understood. With vast investments committed to the creation of new cities, urban expansion, and “innovation districts,” it is imperative to move beyond traditional, formal, and static modes of urban planning and towards an evidence-based process focused on learning, creative human interaction and innovation – the human interaction scale.

The Otaniemi campus has emerged from a set of fixed standalone entities controlled by individual organizations and departments towards more open and accessible environment. The main design driver of the past, in terms of user orientation, has been the internal efficiency of each solution. Solutions were static and network structures deep. The core of the campus was designed by the recognized Finnish architect Alvar Aalto, and those buildings are protected and allow minimal changes in their physical appearance. However, working practices have changed dramatically since its original planning, resulting in large amounts of unused spaces. At the same time, there is a need for new environments to meet changing demands. In order to develop environments which are fostering value co-creation the concept and elements of social learning has been used as a framework for innovation capabilities of the given environment. It means that learning is the practices of communities as an issue of refining their practice and ensuring new generations of members. In the article, Social theory of learning [6] Etienne Wenger has identified concepts of belonging, becoming, sharing purpose and activities together as essential elements of human interaction as social learning.

1. *Learning as belonging, focus on community: a way of talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence.*
2. *Learning as becoming, focus on identity: a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities.*
3. *Learning as experience, focus on meaning: a way of talking about our (changing) ability – individually and collectively – to experience our life and the world as meaningful.*
4. *Learning as doing, focus on practice: a way of talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action [6].*

At the campus, learning becomes an issue of sustaining the interconnected communities of practice. [6] However, the utilization rate of most of the campus buildings has been low, on average around 30% of work hours. Thus, traditional real-estate models are best on control of given area very little sharing of resources were happening (Fig. 10).

The occupancy rate of typical campus buildings shows that most of the time, most of the spaces are underutilized and empty. In order to increase occupancy and utilization rates, a new logic was proposed and research projects established to support the development. Campus development has used SaaS as a case example of how to utilize its existing resources. A first SaaS solution was established in 2016, and a second one followed in 2017. These will be followed by additional establishments in 2019 and 2020 (Fig. 11).

By analyzing the existing network structures and the orientations of current resources at the campus, it was possible to develop a new, open and accessible campus strategy. Operand elements of the Campus as a Service platform case include institutional demand by the City of Espoo. Demand for resources to provide services for residents in Espoo, services like education, health care and sports. Aalto University is providing activities and processes for teaching and learning; teachers, professors,

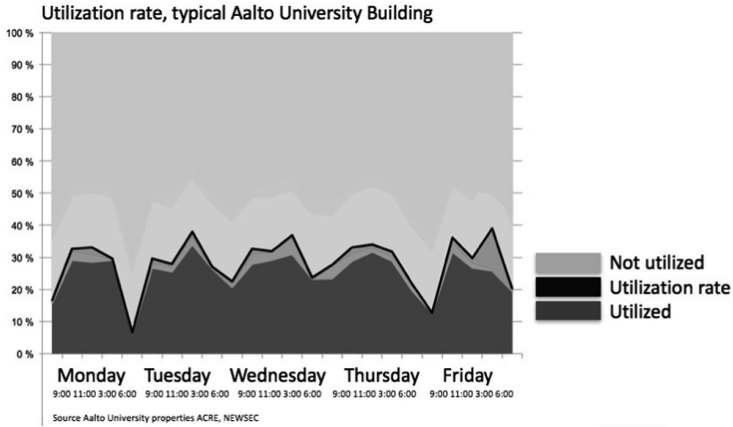


Fig. 10. The typical occupancy rate of one building at Aalto campus (TUAS building)

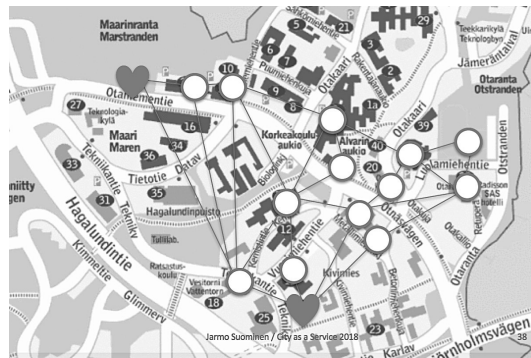


Fig. 11. Map of the resources that the first two schools use at the Otaniemi campus.

workshops connected to its innovation ecosystem. Operant resources provided by ACRE include university properties, with the university as the owner (or operator) of the resources. It typically has resources that are underutilized but accessible. By introducing the SaaS concept, where, in this particular case, a high school is creating value with a university, a new development strategy was also defined. By using the outcomes of research at the spatial and building levels and by identifying relevant stakeholders and operators, the Campus as a Service thinking starts to emerge.

The topic of this case study has been on the design of distributed systemic networks in the regeneration of local communities – a research on functionally and culturally diversified spatial design based on shared services and agent-based development. Instead of the normative planning scale approach to physical spaces, this research studies the presently acute emergent processes and interplay stemming from plot-, block- and building-level interaction to the community scale. The resolution of the study is higher, from building and areas to spaces and proximities. The research

explores the ways in which the formal environment of institutional activities responds to the needs of its users and how to improve the competitive abilities of locations, encounters, innovations and employment in communities. This means not only mapping present needs and spaces but also building a responsible, responsive, sustainable long-term model for the development of a networked culture and environment. It also studies the dynamics between the short-term needs of users and other participants in design processes and the long-term cultural and environmental possibilities and turns this into a design tool. The study has increased understanding of the networked interaction between places, and the authors will create design tools for modelling this interaction toward innovating locations.

As a result, Campus as a service study has revealed the actual rate of accessibilities of resources at Aalto Campus. Traditional deep structures are difficult to utilize on service systems, in comparison to open and accessible resources in more shallow network structures. The Study also points out issues of social learning and importance of enabling environments for local innovation ecosystems.

4.4 City as a Service (Urban Level)/Case: City of Espoo

This section of the case study deals with the city level implications of utilizing city as a service platform for various public services. Cases of spatial, building and campus design were used to design a city-wide opportunities study. The City of Espoo has been a “living lab” for many interventions in the fields of education, care and well-being. Based on the Campus as a Service model, the City of Espoo has also started the process of establishing a public/private resource-operator function, utilizing a service platform developed as a consequence of the previous case studies. The city level case study also looked at the new expansion of the public transit system in the Helsinki metropolitan area. It tested the development opportunity of a school network at Espoo designed strategically around new metro transportation hubs. This was enabled by a service model where a school is defined as a network, connected with its environment, rather than an isolated production plant for teaching. Currently, institutions for education and health care have strategies for being more flexible, adaptable and effective. However, their operational environments are static, based on control and traditional management. There is a contradiction between the objectives of the operations and their environments. On a city scale, this seems to be the case, especially because of procurement and management models supporting standalone solutions that focus on internal efficiency.

The focus of the study was on procurement, management and service delivery, as well as organizing methods for public services. The procurement process itself is different in a service-based model in comparison to a product-based model, in terms of management, budget structure and service structures. Studies have been carried out mainly through comparative analyses between traditional and new models. While traditional city development processes are focused on proactive “pre-production” phase of cities, the service-based model is utilizing the “post-production” phase because of its adaptability and flexibility. In traditional model user preferences and demand are in focus preferably before the actual planning process is starting. Participatory design is an approach to design attempting to actively involve all stakeholders in the design process to help ensure the result meets their needs and is usable. The term is used a way

of creating environments that meet better stakeholder needs. The difference on the service-oriented solution, that users could participate also after the initial design. This approach is defined as “post production” of cities (Fig. 12).

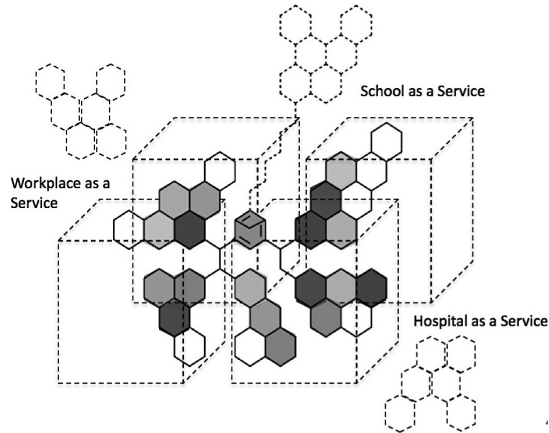


Fig. 12. City as a Service

As a result, analyses of City as a service model have pointed out the paradox between underutilized resources and existing demand for institutional service delivery. There are plenty of empty resources, but lack of accessibility and control over them. The current solution is to build more resources, instead of enabling more access to existing resources.

5 Conclusions

The traditional model for designing environments for service delivery is based on product-dominant logic, placing the main focus on operand resources, as physical resources operated by the actual organizations delivering services for users. In this approach, the focus is on tangible outcomes where value is embedded in the products. The approach is transactional, focusing on delivery of added value for users as subjects of service delivery. This common approach will lead to the consumption of resources and will cause cities to expand in order to obtain new resources. This model increases both investment and planning risk, relying mainly on the predictability of operational environments and on the needs of the institutions and users. This model, which could be called the product model, will also decrease areal prosperity by focusing on internal efficiency and the independence of resources, which will increase only the existence of resources rather than their use. The service-based “new” model focuses on value co-creation, where the approach is both relational and systemic and the focus is on processes and operand resources. This will create conditions where value is co-created with users and will encourage the effective utilization of the environment. The

service-based approach will focus on environments as platforms for service delivery and the effective use of existing resources. This will allow innovations in the use of environments in more sustainable ways, utilizing already existing resources by changing the resolution of development from isolated entities to connected environments (Fig. 13).

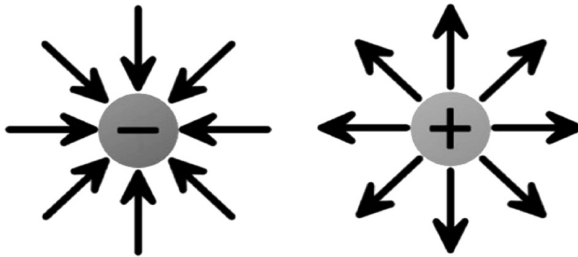


Fig. 13. Decreasing and increasing areal prosperity

An increase of areal prosperity means that service-oriented solutions could potentially optimize utilization and occupancy in close proximity to such a solution. It could enable more sustainable solutions for urban development. Eventually, within this paradigm shift, cities will be using more of what they already have, with denser usages, rather than expanding geographically and decreasing the utilization of existing resources.

As a summary, when analyzed physical environments as a service platforms certain characteristics are important. On the spatial level the openness of the solution, shallow network structure and perceivable resources will increase external effectiveness and utilization of resources. On building level solutions that are capable of utilizing also external resources, will enable more adaptable and flexible solutions. On campus (local) level, it is evident that traditional deep structures are difficult to utilize on service systems, in comparison to open and accessible resources in more shallow network structures. On city level the paradox between underutilized resources and existing demand could be addressed by innovation on usage patterns and increased accessibility to resources, rather than building new independent and isolated resources.

5.1 Service Platform Model for Institutional Service Delivery

The service platform model matches institutional demand and the accessible supply of resources. The platform model has already been utilized in various fields for commercial resource sharing. Institutional applications have not emerged so readily, seemingly because there are different issues of predictability, control and management in comparison to customer applications. Institutional service platforms should be based on the capabilities of translating demand from various operating systems to the supply side and vice versa. Such a system will benefit from machine learning capabilities, utilizing the potential of artificial intelligence for dynamic matching, leading to more optimized use of resources.

Service platform will be utilizing defined solution space which is based on availability of accessible resources with relevant choice architecture and analytics based on choices and solutions. It will eventually have an impact to the dynamics of local markets as well as to the planning processes and practices of cities.

5.2 Resource Operator Model for Service Oriented Urban Solutions

In the case of service delivery, new resource operations driven markets will potentially evolve. As the SaaS case example revealed, new competencies are needed. The existing model of school operations requires, in principle, operations for facility management, the delivery of teaching, human resources management and management to enable technologies and tools. The service-oriented model will potentially enable new markets to emerge for resource operations. Such an activity could be established as a public municipality owned organization, or as a private service company. Resource operations will allow more dynamic and flexible optimization and utilization of the environment's resources.

Resource operator model will potentially enable long-term planning by revealing a more predictable picture of available resources. On the organizational analyses framework, it will enable control of flexible resource utilization. A current example of a resource operator is existing in commercial malls, where the operator is managing the content, retailers, restaurants and other resources. The physical environment is equivalent to the service platform where the operator is balancing relevant mix of resources.

5.3 Procurement Model for Service Oriented Urban Solutions

While current models of procurement are, in many cases, optimized for management and investments of standalone entities, new models of procurement for service platforms are needed. With service-based models for platforms for institutional service delivery, the focus is on the network of resources rather than a predefined entity. Procurement will benefit from new methods and tools for analyzing various platform scenarios and their consequences in more sustainable city development socially, ecologically, financially and operationally.

The cost structure of service-oriented solution is usually different than in traditional independent "product" based model. This due to changing model of ownership and control. In the service-oriented model, institutions will need to redefine the core functions and assets they need to deliver the service. That requires the process of "asset mapping" and operational analyses, to evaluate what institutions already have and how they could be used. Eventually, this will lead to a new development for the requirements of the new procurement process.

5.4 Design Methodologies for Service Oriented Urban Solutions

Value co-creation is a focal point of service-based models. Current design and planning models are based on predictive methods for analyzing particular needs and demands. Participatory design tools are used to define design drivers for a specific project.

Understanding user needs beforehand is elementary in the purpose-driven process of producing independent environments based on product logic for service delivery. A new environmental design model is based on value co-creation and driven by the “customer journey.” This approach enables the complementary processes of service design and service architecture. Service design focuses on activities and processes of interaction, identifying relevant touchpoints of interactions. Service architecture focuses on the conditions of value co-creation, enabling activities to be executed in flexible ways, not necessarily tied to one specific building or project.

Service design is representing the solution by illustrating all the essential components of the service, including physical elements, interactions, logical links and temporal sequences. It identifies sequences of actions and actors’ roles in order to define the requirements for the service and its logical and organizational structure. Service architecture therefore is focusing on environments of value creation and is representing the solution by means of planning documents for actual interventions and constructions on the physical environment (Fig. 14).

ENVIRONMENTAL DESIGN BLUEPRINT

1. Operand Resources by SERVICE ARCHITECTURE
Resources upon which an operation or act is performed to produce an effect
Primarily physical resources, goods, etc.

2. Operant Resources by SERVICE DESIGN
Resources that produce effects
Primarily knowledge and skills

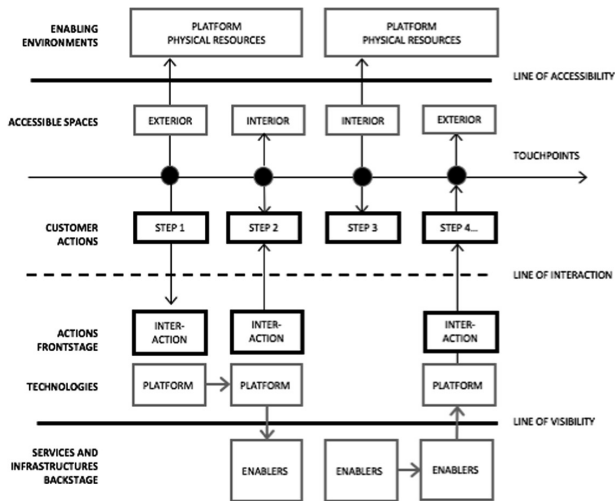


Fig. 14. Environmental design blueprint (Suominen 2017)

The environmental design blueprint combines aspects of service design and – architecture and focuses on value co-creation, enabling the use of service-oriented solutions and the utilization of more sustainable ways of using environments. The blueprint model combines activities and their environments into one framework and enables matchmaking between an organization’s aims and its environments as operating systems. A focus on value co-creation should be seen in all layers of society and the urban environment. Value is created among individuals, organizations and networks in a given environment.

5.5 City as a Sustainable Service Platform

Currently, a definition of a “smart city” is that it uses different types of data collection sensors to supply information that is used to manage assets and resources efficiently. This includes data collected from citizens, devices and assets that is processed and analyzed to monitor and manage traffic and transportation and information systems, schools, libraries, hospitals and other community services. These “smart” technologies will enable smarter usages of a city. However, for smarter and more sustainable cities in the future, the innovation lies in usages. It is as important how cities are used as how they are being built. Cities are facing similar challenges in changing the logic of institutional service delivery than industrial organizations are facing by changing focus, cultures and processes, like illustrated in the article the transition from product to service in business markets [7].

Service model will enable cities utilizing existing resources in more sustainable ways increasing local prosperity and social cohesion by creating value together. This paper has presented a synthesis of ongoing research for a new model of service architecture for physical environments. This development has already had an impact in opening new markets, economic opportunities and technological innovations for urban service platform tools and operations. This study illustrates how the focus on internal efficiency or external effectiveness has its implications for physical environments and open structure is more open to external activities and effectiveness. Systemic solutions are decreasing planning and investment risk, enabling more sustainable development by utilization of available resources. Traditional deep network structures are difficult to utilize on service systems, in comparison to open and accessible resources in more shallow network structures. The city as a service model aims to solve the paradox between underutilized resources and existing demand by institutional service-oriented delivery solutions.

5.6 Next Steps

A new explanatory theory for empowering communities, crucially based not on areas or buildings but on dynamic relationships between people and the built environment, is needed. People utilize their environment not according to its physical characteristics but by recognizing familiar patterns – relationships. These relationships are based on space and use. There is a need for a usable theory of relationships and their controllable dynamics in spaces and communities. There is a need for the development of new spatial concepts and typologies that can accurately describe and positively guide the value creation of urban design for its users, and a need for new design methods and concepts to support the planning and design of more efficient, sustainable and valuable networked and innovation-producing places and communities for the future. As a consequence of case studies presented here a model of a campus where accessible indoor spaces are included in the community sphere are being developed. This requires more extensive and cross disciplinary research of service and operational models. New service platform for sustainable resource sharing for institutions is also being developed to enable city to become a service platform.

References

1. Lusch, R.F., Vargo, S.L.: Service-dominant logic as a foundation for building a general theory. In: *The Service-Dominant Logic of Marketing: Dialog, Debate, and Directions* (2006)
2. Quinn, R.E., Rohrbaugh, J.: A spatial model of effectiveness criteria: towards a competing values approach to organizational analysis. *Manag. Sci.* **29**(3), 363–377 (1983)
3. Hillier, B., Hanson, J.: *The Social Logic of Space*. Cambridge University Press, Cambridge (1984). ISBN 0521367840
4. Granovetter, M.: The strength of weak ties: a network theory revisited. *Sociol. Theory* **1**, 201–233 (1983). <https://doi.org/10.2307/202051>. JSTOR 202051
5. Blakstad, S., Hansen, G., Knudsen, W.: Methods and tools for evaluation of usability in buildings. CIB W111 Usability of Workplaces. Phase 2. CIB Report, Publication 316 International Council for Research and Innovation in Building and Construction CIB General Secretariat, The Netherlands (2008)
6. Wenger, E.: *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press, Cambridge (1998). ISBN 978-0-521-66363-2
7. Jacob, F., Ulaga, W.: The transition from product to service in business markets: an agenda for academic inquiry. *Ind. Mark. Manag.* **37**(3), 247–253 (2008)