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School as a Service: Platform for Learning in Upper Secondary Education Operating on Aalto University Campus

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Abstract—This paper is located within the theoretical framework of real estate economy, urban design and architecture, exploring their shift from products to services, and as a consequence, to co-creation of customer value. We will concentrate on innovative school premises for secondary education as service platforms at Aalto University campus.

New demands for school education and new ways of learning challenge conventional spatial solutions. In accordance with schools having faced considerable changes in their pedagogical principles in Europe, one can expect a justified change from a traditional school building to more flexible environment supporting varying needs and social learning. This paper explores the themes of networked services, service platforms, and flexibility through a case study, *School as a Service* (SaaS), developed and implemented in the City of Espoo, Finland, in collaboration with Aalto University. It describes the concept, its design process and the evaluation of its users' experience at the current stage of the experiment in 2019.

SaaS is designed as a platform for learning, which has the capacity to react to the changing needs of the schools, offers new kinds of social and interactive learning experiences and fosters learners to take active role in their education. Leaning on the engagement platform, this practice offers a user-based, cross-disciplinary approach to learning, supported by digital tools and framed with sustainable environment. The real estate concept is based on the optimization of the use of spaces and temporary solutions, by sharing the school facilities with Aalto University in its campus, integrating an upper secondary school with university premises and community.

Keywords—platform economy; learning environments; service-oriented architecture, shared resources, co-design

I. INTRODUCTION

At the end of the nineteenth century, Maria Montessori was one of the first educators to start the process of adapting educational spaces to learning methodologies. Since her attempts, many architects and pedagogues have conducted research on the topic, resulting in a wide range of new school typologies. However, the majority of these 20th century studies and design innovations on learning spaces rely on the conception of the school as an autonomous building -school as a product- where all the functions are settled. Nowadays, the advancements in management systems and digital tools, the shift from product to platform thinking, as well as the current concerns with sustainable urban development and the proper use of existing resources, open new possibilities for school typologies where the learning environment surpasses the tight frontiers of a singular plot and connects to the urban environment. This shift, from school as a product to *School*

as a Service, brings platform thinking to educational architecture, creating a platform for co-creation and embracing a culture of sharing.

This paper presents the Haukilahti upper-secondary school integrated within Aalto University campus (Espoo, Finland), currently operating as flexible and smart platform for learning based on the *School as a Service* concept (Fig. 1). *SaaS* is a unique and innovative endeavor in its idea of temporarily occupying urban areas and buildings, where the school is seen as a service for learning, not just a physical framework. This user-based, cross-disciplinary approach to learning environments fosters sustainability, and advances diversity and the optimization of the use of space with temporary solutions.

The study of the environment where education takes place intersects two distinct fields of knowledge: architecture and education. *SaaS* has been developed in collaborative design process with pupils and teachers, researchers in pedagogy, architecture and service design, as well as real estate companies and public authorities. It is a response to the specifics of learning in Finland — ‘social education’, project-based learning, community learning, and to the sustainable development strategy for the Aalto University Campus.

SCHOOL AS A PRODUCT STAND ALONE SOLUTION

All required resources
collected together to
establish a school.
Learning is decoupled
from the community.

Product Innovation
Stand alone solutions
Isolated operations
Facility management

SCHOOL AS A SERVICE SYSTEMIC SOLUTION

School is using
available shared
resources within the
community.

Aspects of social
learning are
important, school is
flexible and
scalable.

Learning together.

Service Innovation
Resource operator
Value co creation
Flexible solution

Figure 1. From school as a product to School as a Service, visualisation of the concept by Shiyang Shao and Huan Want, Aalto University.

After discussing the background on learning environments and service architecture, the paper will present *SaaS* as a case study. The design process will be showcased, identifying the stakeholders and the activities that have taken place since 2014, leading to the current implemented operational model. Lastly, we will evaluate the user-experience at the current stage of the experiment in 2019.

SaaS is an attempt to bring service thinking to the Aalto campus' development and is currently informing the shift towards an interconnected sustainable campus, where new and existing resources (social, digital and physical: buildings, green areas, transport infrastructures, etc.) create an evolving platform for learning. *SaaS* intersects real estate economy, urban design and architecture, exploring the shift in the built environment from products to services. The spaces for value co-creation emerged from the new management approach, where existing resources are used, supporting the idea of sharing through the real-time allocation of spaces and renting agreements, and follow the strong focus on service-oriented architecture by Group X at Aalto University.

II. BACKGROUND

A. The Flexible Learning Environment (JOT)

Numerous studies have been dedicated to qualities of school environment. Effects of colors, classroom shapes, furniture layouts, lightning, and school buildings programmes are studied in detail [1]. Interestingly, the effect of certain design of physical environment on student's achievement is an open question. No recent studies provide evidence of the impact of aesthetic qualities in design on cognitive growth [2], [3]. Unlike aesthetic appearances, some fundamental qualities of physical environment can cause strong negative effect on healthy learning [1]. Stephen Heppel, expert in learning, reports that poor lightning, wrong temperature, inappropriate sound volumes, humidity, Co2 level and air pollution cause strong negative impact [4]. Once these factors are attained on a comfortable level, the minimum standards for positive learning are met and other physical variables are less significant [1]. However, examinations and suggestions on a positive school environment in most studies are limited to the product qualities of a school.

New demands for school education, emerging ways of learning, and the evolution of IT challenge the conventional built environment. Despite the availability of studies regarding school architecture, the research project called *The Flexible Learning Environment* (Joustavat Oppimisen Tilat, JOT) was launched by the City of Espoo (2014) to develop an environment supporting continuous learning and well-being at schools. Concepts of flexibility, accessibility and ownership were studied from the digital, social and spatial perspectives. In this section we present the key results from its final report [5], used in design of *School as a Service*.

Flexibility of the physical facilities defines the spatial concept. Space does not determine activities within it, rather it supports various types of learning situations, enabling space renewal when users and activities change. Spaces are designed from a user-centered perspective, depending on their needs, and, contrary to traditional subject-specific spaces, are

activity-oriented. Organization of facilities is guided by users: placement, design and accessibility should be planned by the school community, not the management organization. At the same time, facilities should inspire users' learning, which happens not only in the privacy of a school building but in a public place as well. Not just a single classroom, but the whole school environment, even outdoor spaces and yards, should give comfortable feelings, being a common space for all school actors. The report suggests to increase sense of ownership by collaborative projects for school development.

An emphasis on development of the skills—hard and soft—for the future requires collaborative teaching and learning, and, therefore, social flexibility. Pupil's everyday life present a source for learning and inspiration, therefore, non-experts in school teaching are valuable and should be involved into learning. Concept of social accessibility promotes openness of the of the school community towards new members, and their natural integration. The spaces and the *culture of doing* enable easy interaction between individuals and groups. Social ownership and common social identity strengthen individual's personality, to the extent that even if the physical premises change, own culture, norms, roles, behavior and traditions would still unite the school community. School's identity and culture defines and evolves through mutual events, concerts, and, especially, in participation in planning of facilities and activities.

Possibilities of evolving technologies are the key to the learning environment. Digital flexibility advocates for technology as a natural part of learning and everyday life. Socio-digital solutions support the use of the environment and help with remote connections and communication of information. Modern pedagogy benefits in many ways from the opportunities created by digitalization. Digitalization, for example, facilitates the implementation of diverse information practices, such as the creation and sharing of community knowledge, uniting various allocated learning environments and members.

According to JOT findings, user-driven school activities are the base for engaging learning process, school social life and formation of school identity and culture. Flexible and adaptable spaces, supported by digital tools, support the process facilitating socialization.

B. Sustainable Development Strategy at Aalto University.

When Aalto University was established in 2010, three major Finnish universities (Helsinki University of Technology TKK, Helsinki School of Economics and the University of Art and Design Helsinki) merged together. The development of the Otaniemi campus in the city of Espoo—original venue of TKK—became a key focus to create home for a new vibrant and open community. The decision to concentrate the activities of the university to the former TKK Otaniemi campus in Espoo—called nowadays Aalto City—was motivated to encourage interdisciplinary collaboration. The development of the Campus, lead by Antti Ahlava, was acknowledged from the beginning as an exceptional opportunity to test innovative ideas in a holistic manner.

The typology of the campus is currently changing from a decentralized, department-based solution, to a distributed and

more integrated structure which is user and culture based. The aim of this shift has an emphasis on diversity, usability, where the mixed users meet, and emergent changes are catalyzed [6]. The campus has served as a small city—with a wide range of interconnected systems and varied users—where new approaches to urbanism, architecture, technology and sustainability could be designed and implemented. For Aalto's community of academics, Otaniemi is an innovation lab where scientists, designers, engineers and economists learn together and create ideas for the future. Over the years, an increasing amount of teaching and research activities are allocated for campus development, with many courses, assignments and theses focusing around different aspects of the campus, investigating possible ideas and plans for development. Teachers and researchers, students, real estate companies, and public and academic authorities, together with the future inhabitants, have been all part of the collaborative processes aimed at developing a model community and ideal smart city [7]. The University Campus is working as a test laboratory for Urban Development, with the goal to create societal impact.

The university aims to develop a sustainable campus of the future, meeting the contemporary economies. In the recent decades a shift is happening from product economies to service and experience economies. Vargo & Lusch identify the Service-Dominant logic in the market, where services or competences are exchanged and tangible goods have become vehicles for service provision [8]. According to the theory of experience economy, rich emotional and memorable experiences define the value of a product or a service [9]. Both types of economies are based on the thinking that humans value experiences over tangible goods. In other words, the value is not added during production, it is created during the experience of using. The consequent changes in concepts of spatial solutions follow the evolution in advanced economies. Professor J. Suominen brings the term *service architecture*, describing architecture as a condition for value co-creation, and changing the orientation from product value of a building to customer value [10]. According to this concept, building is no longer a standalone solution, rather a recourse that enables service operations, where the value is co-created and determined by the users.

One of the innovations that addresses this change is the *Building as a Service* or BaaS principle, described by Ahlava, Suominen and Rossi [10]. BaaS is the result of a shift from product-based to instrumental value in real estate development—or service orientation. A solution is no longer based on the product itself, but in its ability to serve the customer; completely changing the way buildings and spaces are designed and used. As part of its strategy for university premises, Aalto University began offering service-oriented solutions and spaces in Otaniemi. The buildings start to form an ecosystem of resources managed and enabled by new service operations. The University strategy is to develop shared premises for open innovation, inviting non-academic partners to locate their units and personnel in buildings on campus, sharing premises for mutual benefit. A new internal renting model has freed spaces as shared resources for study, business, housing and services. Such practice increases cross-

disciplinary collaboration and fosters scientific research, creating a dynamic social environment - Campus as a platform/service.

School as a Service is the highlight of the campus ecosystem and an example of service architecture for value-co-creation. It contributes to the sustainable development strategy in the Otaniemi Campus by embracing the sharing of premises between existing and new communities, improving use-ratios and learning well-being.

III. THE SCHOOL AS A SERVICE CASE-STUDY

The *School as a Service* concept idea for education and use of the space was formulated by J. Suominen based on service-dominant logic, addressing the new educational demands and aiming to facilitate engaging learning processes on campus [10]. *SaaS* approaches school not as a building but as an educational service. In accordance with Service Dominant Logic, students and teachers are seen as active participants of the leaning processes and are involved in concept co-design and open dialogue with more formal stakeholders: city authorities, school and university administration, as well as researchers. The architecture of *SaaS* is based on *Building as a Service* idea, where buildings have an instrumental value to support learning activities, forming an agile and inspiring network of new and existing local resources. City of Espoo decided to develop a fully functioning pilot learning ecosystem based on *SaaS* idea and integrate a pilot school within the Aalto University campus.

A. Description and timeline of SaaS

As described, *SaaS* concept is based on the idea of an ongoing learning and development by all stakeholders through co-creation, open dialogue and reflection during the process. Through the past years it has been evolving through collaborative development by children and teachers, university staff and students, educational, design, real estate economy experts, school administration and city authorities, local community and businesses. *SaaS* has been forming through several projects, described further chronologically (Fig. 2.)

The phase of co-creation of a new vision of school education started in 2014. The Education and Cultural services of the City of Espoo initiated the research project called Flexible Learning Environment (JOT) and involved local authorities, an educational board and two research groups from Aalto University—architecture (Group X) and built environment—and Helsinki University. The objective was to achieve educational innovation and fulfil the demands for new schools in the area.

Parallel to the JOT project, in autumn 2014 and autumn 2015, Group X's at Aalto University organized two intensive collaborative workshops and architectural studio courses called *Labs for Learners*. Participants from the Royal College of Art from London brought their world known expertise in service design. Also, at that time, Group X was a partner in Human Cities EU2020 research project focused on human-centered bottom-up urban development. During these workshops, experts from both universities and the Human Cities consortium, master's degree students, professors,

service designers, and education consultants worked on investigating new ways of learning, the impact of the physical environment, the role of school social life, and tried to imagine the school of the future.

User research of both the JOT and the workshops was conducted in Etela-Tapiola secondary school - an involving research case, where high educational performance occurred in un-traditional spaces. The Etela-Tapiola school showed an example of excellence. It was well-known for flipped-classrooms, advanced mathematics and music education, wise integration of extra curricula activities in studies and active social life. At that time, the school had been temporarily placed in the *container-town* at the Aalto University campus, where the scarcely-equipped containers had been serving as classrooms and teacher's rooms (Fig. 3). The distribution of the containers on the site, in a carefree manner, formed the open yards, allowing pupils to occupy the outdoor space during free time. It is possible, therefore, that the temporary architecture of Etela-Tapiola school inspired its community, with its borderless appearance, to be open for new opportunities and learning methods (Fig. 4).

Researching Etela-Tapiola, the project groups started to evaluate the role of school facilities and to develop a new and promising school typology. They were questioning if there should even be a wall, physical and mental, between learning and curricula learning. They decided to explore whether a school can be organized as a service for continuous and social learning with flexible environment supporting varying needs. The architecture and organization of the suggested typology by J. Suominen can be at best described as a service platform: service platforms present a network of recourses for learning that are integrated when needed.

The *SaaS* service platform experimental model (see fig. 1) perfectly fitted to the Aalto University sustainable campus development strategy described above. Facilities of the

campus include a variety of underused buildings, which can be shared forming the progressive educational social environment. Its own real estate company, ACRE (Aalto University Campus and Real Estate), owns the land, manages the facilities and services in the campus and was able to offer a suitable space-use system. Moreover, the project and suggested learning platform corresponded to the demand for schools in Espoo, so the City of Espoo and Aalto University agreed to start a pilot project based in *SaaS* and invited Haukilahti upper-secondary school, which was facing renovation of facilities, to temporarily relocate to the Otaniemi campus. As the result, the implementation process was initiated already in early 2016 and the pilot school welcomed its users in the upcoming academic year.

B. Current state and operational model

The school based on *SaaS* appeared as an engaging service platform for learning. The platform is represented by physical resources: buildings, furniture, equipment, management systems for the allocation and renting of spaces, and digital tools that support learning. The platform provides flexible school facilities that are user-driven, permitting the integration of various recourses and participants. *SaaS* was ideated and is currently represented by a combination of constantly used school hub (the heart) and spaces in the Otaniemi area available on demand (Fig. 5). One of the buildings was rented from the university and renovated in 2016 to become the main hub named Laine (wave). Laine contains a welcome lobby, small café, school administration, teacher's block with hot desk organization and basic classrooms equipped with flexible furniture layout. The large informal social space Valtameri (ocean), with open layout, was opened a year later in 2017 (Fig. 6). Laine is a quiet compact three-levels building in which almost a fourth of the surface area is dedicated to the Valtameri, which can

Figure 2. The SaaS project timeline.

Figure 3. The view of container-town.

Figure 4. The site plan of Etela Tapiola School.

Figure 5. The resources of SaaS on the campus and distances from Laine.

accommodate students for an info-session or an event. Other used facilities distributed in the area, part of Aalto University learning premises, include a university level physics and chemistry labs (Fig. 7), event halls and various other external spaces. Lunch cafeteria is located in the nearby building. Access to sport facilities and services is arranged in Otahalli – the sport center of Aalto and Helsinki Universities. The most frequently used spaces are located in 80-950 meters

distance from Laine. Aalto University real estate company ACRE is responsible for the allocation of spaces, facilities management, renting agreements and accounting. They invoice local authorities for spaces used by the school and supporting services. It is important to emphasize that, instead of renting the whole space, Haukilahti school rents access to spaces on an hourly-fee basis, benefiting from a smart and sustainable management system.

Efficient operation in distributed spaces requires digital tools for communication and learning. *School as a Service* platform has its digital presence. The main online platform Wilma unites all students, teachers, administration and parents. It stores information about school, courses and learning performance, and allows personal messages or quick spread of information for groups. Communicating online, everybody is aware of timetables, courses, and locations on time. In addition, teachers integrate other services, suitable for class activities and distribution of learning materials. For example, Google Classroom is used in mathematics, and paperless classroom Showbie in language courses. An open access to study sources and personnel supports continuous learning and creates a positive atmosphere.

The Haukilahti upper-secondary school is currently present on campus for the third academic year with 400 pupils, 29 teachers and 6 administration members [11]. Its community took the primary role of experimenting with learning and taking advantage of the opened opportunities. The user experience is studied through ethnographic qualitative research by multiple assessment sessions, observations, interviews and workshops. The following section unveils the experience of the school community operating in the unusual environment in *School as a Service*.

C. User's experience and evaluation at the current stage

The effectiveness of the *School as a Service* platform is difficult to evaluate. In upper-secondary education in Finland, the quality of a school, the education process, and the learning outcomes are traditionally measured by the matriculation exams, which impact the ability to enter universities. The quality of teaching and the school architecture are regulated by the local standards, but there is no defined approach to evaluate the value of emerging architectural concepts and social learning. Nonetheless, in order to evaluate the value proposition of service-based solutions on the market, Rintamäki et al. [12] suggest a framework for identifying customer value. According to their hierarchically organized framework, the value increases from basic economic benefit, through functional operation, to the highest emotional and symbolic. *SaaS* will be analyzed in accordance with this framework.

Starting with economic benefit, *SaaS* fulfilled the need for affordable educational spaces in the Espoo region. Local authorities financially benefit from a solution based on renting assesses to the university premises and dealing with local actors. In *SaaS* scenario, Aalto University offers authorities a viable solution, approximately 30 percent less than constructing a traditional centralized upper-secondary school building. Simultaneously, Aalto University advances sustainable use of underused campus premises.

Figure 6. The social space Valtameri.

Figure 7. The shared chemistry lab.

One way to evaluate the functionality of *SaaS* for educational purposes is to observe the use of physical resources on the campus, and to record the emerging learning methods and collaborative projects. Operation on the platform offers the possibility to track interaction of learning community with the social and physical environment. The administration, teachers, and pupils highly value presence on university campus, exceptional quality and rare equipment of the rented spaces. They take advantage of the location and the system using actively university premises: laboratories for physics and chemistry education, studios for visual arts, halls in the university main buildings for graduation ceremonies, sports facilities for physical education, various spaces for school events and celebrations. An approximately 1200 hours of the use of external facilities are reported during the first academic year 2016-2017.

Speaking about school's advantages, students, and teachers refer to its location and spaces in a series of interviews during the years. The spaces in *SaaS* are designed to support social contacts. According to the results of multiple assessments of student's school experience, social life is one of the most important aspects of a school, which even affects the choice of institution. Ownership of the Laine

hub gives the community a sense of belonging. Social space Valtameri, the lobby with informal furniture, the café and presence in a vibrant campus, play an important role building the community. Administration invites students to co-design Valtameri space and events, welcoming their initiatives on the use of the space. This practice increases sense of personal connection. Valtameri is generally occupied by students during free time; however, administration sets formal meetings with official visitors there, as the space expresses school identity. The majority of users mention positive school atmosphere, its good modern spirit, and name it a warm-hearted school. What students would ask for are quiet spaces for relaxation and silent studying. However, many complain about the compact layout and limited area of the classrooms in Laine, and using external spaces brings some inconveniences, especially due to the distances to some labs. However, users don't see a problem if the quality of facilities at the destination or the organized events are worth it.

Work in the facilities shared with Aalto University forced informal contacts with the university faculty and business present on campus. Merge of social environments resulted in collaboration and inspired new projects and experiments with pedagogical approaches. As the result of these connections, a large number of new courses has been developed: various multidisciplinary courses, arts and crafts, school and campus architectural design, start-up activities with world-known intrapreneurial communities, coding and many others. Various courses are organized during school holidays and meet strong interest of the students to participate. Moreover, school students can choose among the selection of courses from the university programme and record university study credits for their completion. Aalto is also interested in this new user group on campus, considering them in its projects and events. For example, emerging teachers and researchers working at Aalto have the possibility to learn from the more experienced school teachers during pedagogical training courses, attending the high school's classes. Of course, working in unusual conditions of distributed spaces, communications and experimentation with learning methods required additional hours, which are not a part of the responsibilities and curricula. It took time and effort for Haukilahti community to adapt to the new system and learn to manage activities in a new way. It is important to mention that there is no facilitator helping with integration; all projects are the result of spontaneous interactions and personal motivation to collaborate.

Recently, Haukilahti school's administration expressed an interest to brand their new community and way of learning. They have been active, invented the new methods and had overall positive experience during learning on campus in *SaaS*, and their advanced culture formed as a result of process of adaptation and community effort. Haukilahti users have their own exceptional identity of open-minded progressive learners. They express an interest to formalize the relationships with Aalto University fostering collaboration, and suggested to develop a shared online system of space reservation and to establish a registered link via association or project coordinator. They are even in favor of officially profiling their school as the "Aalto upper-secondary school".

A sense of competition especially raised when in 2017 another school—Pohjois-Tapiola upper-secondary school—relocated to the campus area.

On the basis of the study of user experience and its evaluation, it can be concluded that *SaaS* has a highly competitive advantage. It serves its stakeholders (school community, authorities, university) successfully offering high value proposition. The *SaaS* solution is economically beneficial, meeting interests of its stakeholders; its service platform organization and architectural concept function efficiently, offering possibility for exiting and memorable learning experience and school life; and school users present a bonded and friendly community with its cultural identity. Professor Stephan Heppel, during the Lab for Learners workshop (2015) noticed, that “branding is an exhibition and celebration of learning”. Learning with *SaaS* concept is branded not with signature architecture, rather with its engaged learning community and its culture.

IV. CONCLUSIONS AND DISCUSSION

As the case study presents, *School as a Service* is not limited with the traditional school architecture paradigm, it is a service for learning occurring in the unique school conditions. *SaaS* is the result of an extended collaboration between university institutions, researchers and teachers, school communities, public policymakers and real estate companies; through a long process formed by workshops, meetings, academic courses, research projects and open discussions. On one hand, with *SaaS*, the findings of the Flexible Learning Environment research project (2014) have been implemented in flexible and open progressive school, which serves local community with up to date education. As it was desired, *SaaS* opened exiting opportunities for school community and united it in active social learning. On the other hand, *SaaS* is framed within Aalto University sustainable campus development strategy and architectural research focus. It is unique in its idea of temporarily occupying available premises, embracing a culture of sharing. *SaaS* is a bright functioning example of a physical service platform solution, designed with the *BaaS* concept, meeting the demands of the market in the era of services and experiences.

Thus, *School as a Service* is more an open learning process than a finished product. The on-going evaluation from the economic, functional and symbolic-emotional perspectives recognizes high competitors' advantage. Physical conditions inspire active co-creation and unite the community, which expresses an interest to take ownership of the process and brand their learning method. Although it is difficult to evaluate value co-creation, school activities at the engaging platform can be observed and registered; new learning methods and courses are being developed, and active use of external facilities is recorded. Moreover, the project has been internationally recognized with a several awards for innovation, including the Quality Innovation Award 2016 in the Education innovations category [13].

SaaS is a viable and scalable solution, that has a potential to be adopted globally for future schools. It follows a wide scientific concern with sustainable development, proposing

an integrated and smart service platform. The concept is context dependent, it suggests to rethink the use of existing recourses, focusing on co-creating: buildings and public spaces as multifunctional physical frameworks, embracing different communities and functions simultaneously.

The concepts of *Building as a Service* and service platform have other successfully functioning examples in Helsinki Metropolitan Area and worldwide. The service architecture philosophy is beneficial for the development of health and co-working facilities, public services, or event management. Service architecture currently inspires City of Espoo to test the concept further on other types of local services, scaling to the “City as a Service” and contributing to the Smart Cities' ongoing scientific discussion.

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