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Aalto University Undergraduate Centre
The Accessible Renovation of Alvar Aalto's Heritage

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Abstract. The main building of the former Helsinki University of Technology (TKK) designed by Alvar Aalto is part of the cultural heritage in Finland. The building underwent a major renovation in 2011–2015 and has now become an awarded Undergraduate Centre for the modern interdisciplinary education of Aalto University. This paper presents how the architectural masterpiece from the 1960's was renovated and updated into a modern and accessible university building. Particular attention was paid for entering the building by wheelchairs, prams and pushchairs. The successful renovation was awarded in 2015 by the '*Esteetön Suomi -palkinto*' (Accessible Finland Award), given every two years as a mark of recognition to activities or locations implementing the principles of accessibility and universal design for all on a broad scale and in a nationally significant way.

Keywords. Accessibility, architecture, enabling environment, heritage, inclusion, renovation

1 Introduction: Science and art together with technology and business

In this paper, we will present the successful renovation project where an iconic architectural masterpiece of *Alvar Aalto* from the 1960s was renovated and updated into modern enabling learning environment. The major result is that the renovated facilities support accessible blended learning in an enabling environment. Particular attention was paid in the renovation to the multi-functionality and transformability of the facilities, as well as solutions supporting learning and knowledge work. We use the *Activity Theory* and collaborative knowledge construction as the frameworks for practical renovation work to explain accessibility in an inclusive academic culture. Thus the objective of this paper is to show which kind of theoretical frameworks may be useful in highlighting the current challenges in the campus renovations of higher education in supporting learning for diverse students. In conclusion, we suggest that these challenges and their solutions found by the community and stakeholders should be addressed explicitly in the strategy and planning process of a university organization by agile and participatory co-design methods. In parallel, we will present a challenge for designers, educators and developers: Make diverse students active members of academia by collaborative renovation practices.

Aalto University was established by merging the *Helsinki School of Economics, Helsinki University of Technology* and the *University of Art and Design Helsinki* in 2010 as a priority project in the Finnish university renewal. The name Aalto University (*Aalto-yliopisto* in Finnish

and *Aalto-universitetet* in Swedish) pays homage to the life and work of architect Alvar Aalto (1898–1976) and the importance of his multidisciplinary work both nationally and internationally: He was one of the most important proponents of organic design already in the twentieth century (Design Museum, 2016). The Main Building of the former Helsinki University of Technology (TKK) designed by Aalto is part of the cultural heritage in Finland and the history of international modern architecture (Figure 1). The inauguration of the Main Building took place in 1966 and it underwent a major renovation in 2007–2008 and 2011–2015. Recently, the building has become an awarded Undergraduate Centre for the modern interdisciplinary education of Aalto University. The '*Esteetön Suomi -palkinto*' (Accessible Finland Award) is given every two years as a mark of recognition to activities or locations implementing the principles of accessibility and *Design for All* on a broad scale and national importance. The competition jury including representation from The *Finnish Association of People with Physical Disabilities*, The *Building Information Foundation* (RTS), and the *Finnish Association of Architects* (SAFA) chose the building as the winner in 2015.

Figure 1. Aalto University Undergraduate Centre. Aalto University/Tuomas Uusheimo

The Undergraduate Centre serves and brings together thousands of Bachelor students at Aalto University's six schools from the fields of science, technology, business, arts and design. The BA students of the School of Business transferred to conduct their studies in Otaniemi in 2016 and other BA students will follow in 2017–2020. The renovation endeavour, which took several years and progressed in phases, shaped the highly regarded building into the enabling environment supporting today's learning and working. Although the renovation was completed by the end of the year 2015, the work for improved accessibility continues in maintenance.

2 Transformation of the national heritage into a collaboration hub

Aalto University has exposed a clear, strategy based vision to increase equity and equality on all activities of the campus; a barrier-free campus and enabling environment has been a goal both in the campus strategy of the university and *Aalto Campus and Real Estate* Aalto CRE (Figure 2).
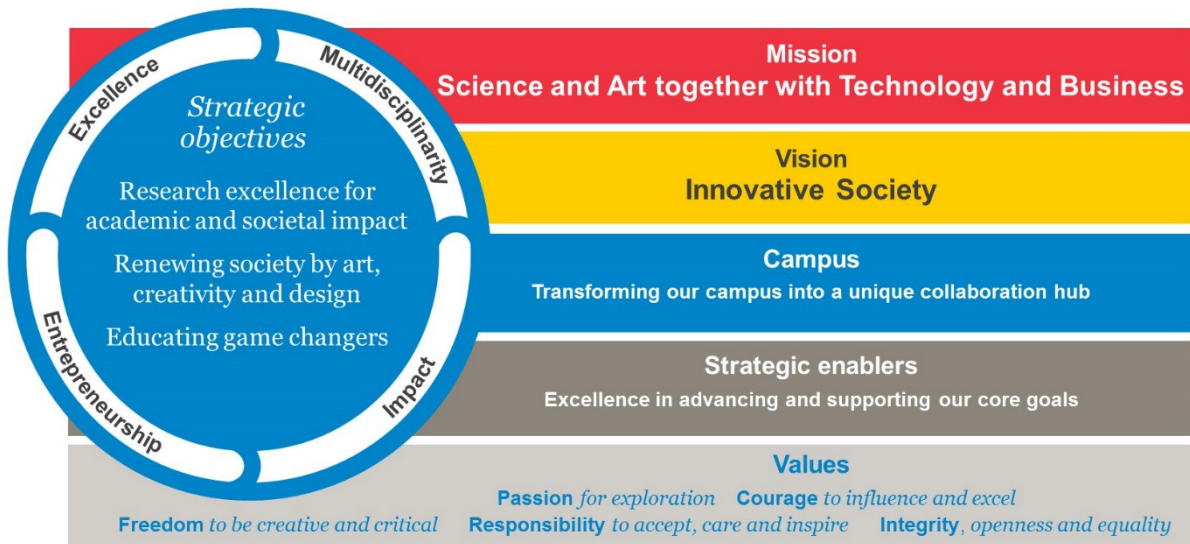

Figure 2. Foundations of Aalto University. Strategy update 2016–2020.

The main challenges in the renovation project were the design principles or rather practices from the 1950s and 1960s. Although Aalto himself had been flexible with changing requirements (Nykänen, 2007, 2014; Penttilä, 2008), financing and policy concerning higher education, the time was different: Students were mainly male and even the very idea of female students or students with disability seem to have been absurd or non-existent for educators and politicians of the 1950s. The building is full of stairs and therefore was severely disabling environment for wheelchair users and people with vision impairments before the renovation. Hence, accessibility has been taken into account in many ways to re-design the Undergraduate Centre into an enabling and barrier-free environment. The extent of the renovation was approximately 45 000 m^2, the main designer was *NRT Architects Ltd* and the main contractor was *NCC Construction Ltd*. The renovation project undergone in 2011–2015 was successful due to shared principles. The solutions of the renovation were developed with respect to the original architecture and cultural history values in cooperation with Aalto CRE, the *Alvar Aalto Foundation* and the *National Board of Antiquities*. The cooperation was necessary because in connection with the renovation, several museum rooms still containing the original furnishings by Aalto were left in the building. The official accessibility audit in U and A wings was made by *Kynnyskonsultit* in 2012. Students, faculty, staff and other stakeholders using the premises were given an

opportunity to participate in conceptualising and designing the spaces in symposiums, workshops and discussions. Often solutions that work on new constructions and technologically sophisticated environments may generally be ineffective in listed buildings and low resource settings. Thus the best strategy for achieving accessibility is usually incremental improvement: Initial efforts should focus on removing basic environmental barriers. Once the concept of accessibility has become ingrained, and as more resources become available, it will be easier to raise standards and attain a higher level of universal design. Aalto University, ACRE, Architects NRT Ltd and NCC Ltd agreed the following precepts: accessibility initiatives need to be taken into account by utilizing and addressing affordability, the availability of technology, knowledge, cultural differences, and the level of development.

2.1 Renewing society by art, creativity and design

The Aalto University strategy postulates that the open and experimental collaboration ecosystem on the campus will attract students, faculty, staff and partners worldwide, supporting the production of new knowledge and innovation. The aim is to build a vibrant campus centre that offers attractive opportunities for partnering, collaboration and sharing ideas and experiences. Exposed development actions include the following themes:

1) Structure the campus to support thematic, multidisciplinary clusters and open innovation.
2) Promote new ways of working, shared spaces for a diverse spectrum of users, mobility, flexibility, co-creation and wellbeing.
3) Create high-quality attractive spaces with integrated digital solutions to offer inspiring and productive user experiences.
4) Develop experimental spaces together with experts and users to build an exemplary university campus supporting sustainable development.

In addition, the university has an implementation plan for accessible learning that is based on the Finnish legislation, University strategy and equality plan, general policies on accessible learning, accessibility guidelines and best practices. Particular weight is put on how the diverse users experience the campus as a work and study environment. Hence, continual iteration on the communities of practice (Wenger, 1998) level among all stakeholders was seen to be essential. As a result, the experiences *of co-design* are promising: Architecture and real estate management are the foundations for success in inclusive teaching and learning. Co-design equals with participatory design and similar methods where users are co-creative partners collaborating with renovation experts (Raike & al., 2009). Especially old buildings expose even unseen problems

due to rare materials, changed standards and forgotten working methods. The following simplified diagram is a reaction to explain the complexity of the iterative process of the renovation by design terms where renovators met challenges through the project. Start the process from top and continue clockwise (Figure 3):
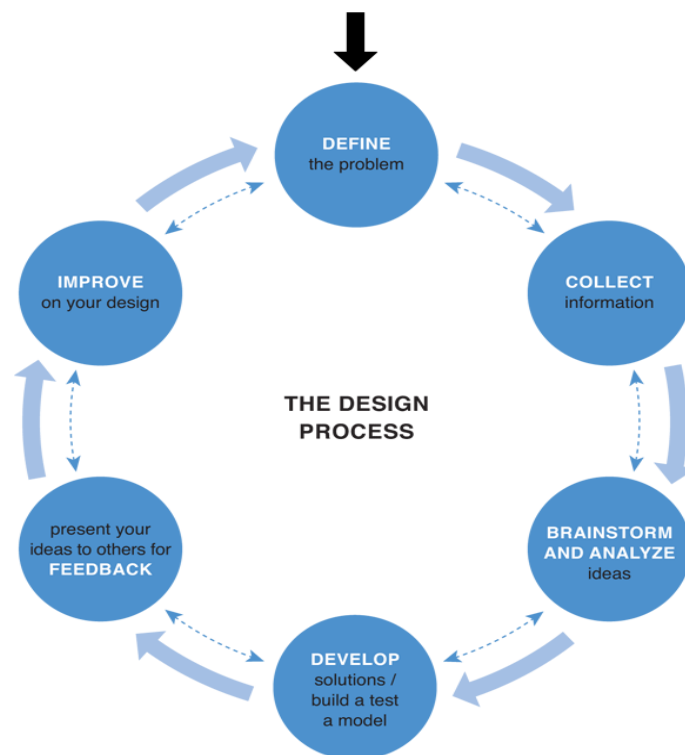

Figure 3. The Design process. Source: Chicago Architecture Foundation, http://www.discoverdesign.org/design/process

1) **Define** the main problems of accessibility. The main problem with the Undergraduate Centre was the excess use of stairs and the lack of ramps and elevators. However, it was not possible to enable before renovators were able to see what features disable. Architects needed to meet the diversity of users to define the project.

2) **Collect** information once the problems have been defined. An accessibility audit was made, faculty, staff and students interviewed. Workshops and symposia were arranged. Photographs were taken and plans sketched for future renovation projects. It was essential to meet users and collect information on the natural environment in the building.

3) **Brainstorm** and co-design spaces with the faculty, staff and students. Results of the interviews and workshops were analysed. Renovators had to decide how all the collected data and information would impact the renovation of the building.

4) **Develop** solution scenarios and personas and demonstrate them to stakeholders who will be the future users.

5) **Collect feedback** and continue collaboration and discussion with the community members.

6) **Improve** and revise the renovation plan when new evidence is available and feasible. University representatives and the architects worked closely with the general contractor responsible for the renovation. It was useful to have an iterative collaboration with other partners like acoustical and electrical engineers, interior and lighting designers, landscape architects and audio visual designers and engineers involved in the renovation.

The integrated architecture and real estate management are the foundations for success in inclusive teaching and learning as exposed in the implementation plan for accessible learning, university strategy and equality – all based on the Finnish legislation. Moreover, the continuing iteration of the plans amongst user communities seems to be essential as well. The main challenge is to encourage and empower students – the most important user group – by collaborative renovation practices. Therefore, we suggest challenging the community to agile and participatory co-design methods. Merely architectural and design concepts are not sufficient in a complex renovation project but they assist in translating the non-physical design problem into the physical building product. A renovation project for improved accessibility will face critical issues, themes and problem essences from social, cultural and medical domains. Thus some other factors along the human factors need to be considered like the academic function, form and spaces, affordances and last but not least: economic constraints. These could be addressed with co-design methods where users are taken as partners (Ylirisku, Vaajakallio & Buur, 2007). Since many elements and factors fall under these categories, much consideration should be paid to the broader general issues, along with the technical details. The broadest issue is the question of equity and equality and how they are linked to the renovation principles.

2.2 Towards innovative society following in Aalto's footsteps

The Aalto University Otaniemi campus is located in the City of Espoo in the vicinity of technology and media corporations such as Kone Ltd, Fortum Ltd, Neste Ltd, Capgemini Finland Ltd and Rovio Ltd. The campus has expanded to include innovation accelerators like collaborative workshops, technology parks, business incubators and facilities for start-ups. As a result, nowadays some 11,000 people work and 14,000 study in Otaniemi and the campus is under an intensive building and renovation era that should continue until 2025. The forest campus is more than 50 years old, based on the urban plan by Alvar Aalto. The plan for the Otaniemi campus had a long history before the realisation. Moving the University of Technology

(TKK) from the centre of Helsinki to a more spacious area in the outskirts of the city or, for example was already discussed in the 1910's and escalated during the Second World War and the expanding activities of TKK. As the city grew, various plans were made for moving to the outskirts of Helsinki to districts that were at the time largely undeveloped. After the Second World War, TKK and the *Technical Research Centre of Finland* (VTT) needed substantial amounts of land to build laboratories to expand the operations due to the rapid advance of technical sciences but the city of Helsinki did not give permission to substantial growth in the centre. Finally, an architectural competition was held in 1945 and Alvar Aalto won the first prize for a new campus based on his vision of a campus based on the structure of large-scale landscape on site. In his plan, the main building of the university is located on a hill at the site of the former manor house as the dominant of the landscape. Other clusters of buildings are placed in a loose manner following the geometrical lines of the borders between fields and forest. The planted lines of trees from the gardens of the manor house remain part of the main pedestrian connections in open valleys, separated from car traffic, which takes place on the ridges of the landscape. In the manner of classic Greek city planning, the buildings are visually and optically connected to the contours and sight lines of the landscape.

The Finnish State bought the lands of Otaniemi Manor from KOP bank to serve as the campus of the TKK and the VTT in 1949. In the 1950s and '60s Otaniemi became one of the most prominent sites of Finnish architecture (Böök, N., Lehtovuori, P., Mannerla-Magnusson M., Meriniemi, M., Mälkki, M. 2014). Aalto designed the Otaniemi campus in 1949–1966 and completed the TKK main building in 1965 (Figure 1, Figure 5, Figure 7). Alvar Aalto's office was also in charge of the *Otahalli* sports hall (built for the Olympics 1952) and of several other buildings as the Library (under renovation in 2015–2016), *Saha, Valimo*, the Shopping Centre, and the Water Tower. The campus development began with housing for students in a student village called *Teekkarikylä* in Finnish. The first functions of the TKK moved to Espoo in 1955 and finally the move from Helsinki to Espoo was finished in 1974 (Panu Nykänen, 2014). The original plan can still be experienced today, including many architecturally remarkable designed by other Finnish architects such as Reima and Raili Pietilä, who designed *Dipoli*, and Heikki and Kaija Sirén, who designed the oldest dormitories, the *Servin Mökki* restaurant and the *Otaniemi chapel* (Aalto University, 2016).

2.3 Alvar Aalto's creative contribution to renovators

Aalto designed towards economy and efficiency in 1950's and towards rationalism in the 1960's (Böök, N., Lehtovuori, P., Mannerla-Magnusson M., Meriniemi, M., Mälkki, M. 2014). MacKeith (2013) outlines Aalto's design approaches and distinctions by three comparative examples: form and ordering principles at the scale of the site and program; environmental responsiveness to climate and natural light in particular; and tectonic approaches from structure and enclosure to secondary elements and details. MacKeith (2013) explains how Aalto's creative doubt in the virtues and sustainability of technological solutions and his realistic understanding about environmental conditions is equally visible along the same spectrum. A similar dialogue on the relevance of nature and response to the natural environment is also evident. MacKeith illustrates this by two Alvar Aalto quotes:

> "*Standardization borrowed from the domain of pure technology, which has recently invaded architecture, is of an entirely different nature. This invasion springs from the fatal misconception that architecture is a form of technology. It is not ... In fact, the problems of architecture cannot be solved at all with the methods of modern technology ... Of course, architecture uses technology, but it does so by applying various technologies simultaneously, and its principal goal is to bring these technologies into harmony. Architecture is thus a kind of super-technical creation, and the harmonization of many disparate forms of activity is central to it.*" (Alvar Aalto in MacKeith 2013)

Alvar Aalto strived to synthesise rationalist architecture with an organic language of form and used this skill to combine materials and make the landscape part of the building. The Main Building and Library complex of TKK can be considered one of the main works of Alvar Aalto, a designed, creative contribution reaching from the town planning level all the way to small details. The chief materials are dark red brick, black granite and copper, that has turned in green verdigris during decades (Figure 1, Figure 5 and Figure 7). For Aalto, "*every project at TKK is a dense juxtaposition of theater and courtyard typologies allowed to patina, weather and soften into a near-natural constructed landscape*" (MacKeith 2013).

The focal point of the campus and the university centre is the auditorium building with two large halls A (Aalto Hall, Figure 4) and B, which result from the division of the planned large festival hall. Its staircase-like ascending rows of windows suggest an amphitheatre from the outside (Figure 5).

Figure 4. Aalto Hall. Aalto University/Tuomas Uusheimo

Figure 5. Aalto Hall of the Undergraduate Centre. AaltoUniversity/Tuomas Uusheimo

According to the competition programme in 1949, the Main Building should include "a 1000-seat festival hall (also intended for congresses), two auditoriums with foyers, a student canteen

with a kitchen, a so-called General Department (for the first and second year students), and Departments of Architecture and Civil Engineering" (Penttilä, 2008, 23). Beside these, the building has the smaller lecture and faculty rooms and laboratories. All tuition rooms are in adjacent buildings grouped about small internal courts (Figure 6) and the building is surrounded by three squares: Elissa Square in the north, Alvar Square in the south and Aino Square in the west (Figure 7).

Figure 6. Aalto University Undergraduate Centre, 1st floor. Tuition rooms are in adjacent buildings grouped about small internal courts.

The renovated Undergraduate Centre is still divided into three principal wings based on the original departments: general (Y wing, blue in Figure 6), geodetic (M wing, red in Figure 6) and architectural (A wing, yellow in Figure 6) with the later additions. Thus the present Undergraduate Centre comprises five wings: K-H (purple in Figure 6), Y, M, A, and U (green in Figure 6) designed by Alvar Aalto. The latest U-wing was finalized under the supervision of Alvar's wife Elissa Aalto 1975. The extension of U-wing was designed by *A-konsultit Ltd* and completed 2002. Entrances run clockwise from A to Ä, beginning from the A entrance of the K wing and ending at the Ä entrance of the H wing (This confusing letter system has caused some accessibility challenges indeed. Figure 6, accessible entrances F, M, T, U, U1 and Z).
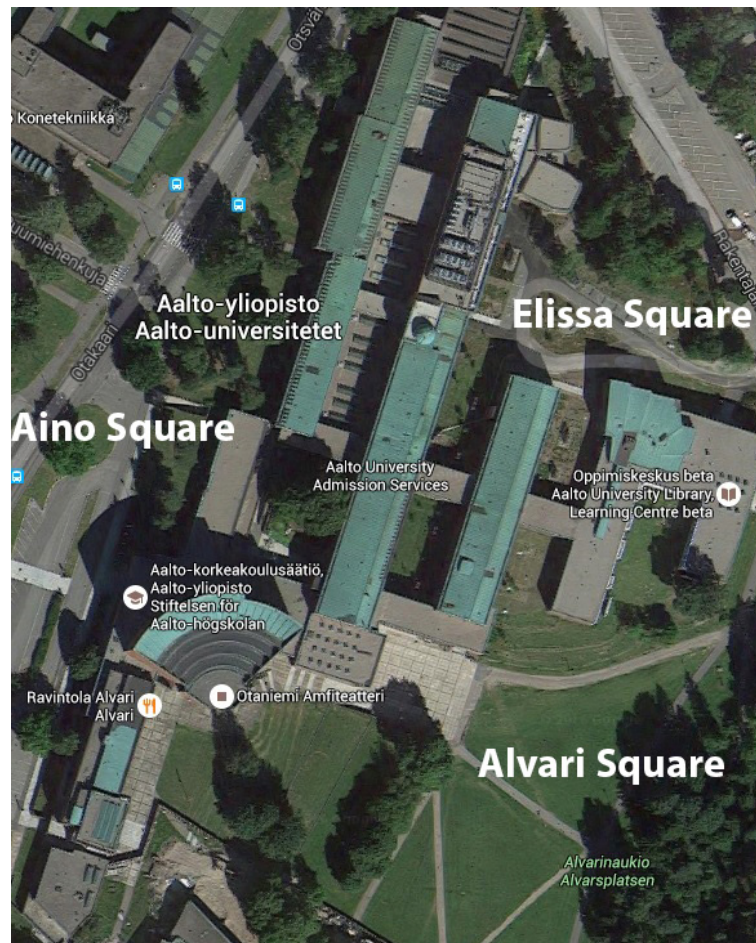
Figure 7. Undergraduate Centre surrounded by three squares. Source: Google Earth.

In addition to lecture halls and rooms, the Undergraduate Centre has premises for group assignments and more informal activities. Student services have also been placed in the building along a corridor through Y and U wings on the first floor. Language Centre and Learning Services staff work in the U wing second floor in a new type of a large, multifunctional office. However, already Alvar and Elissa Aalto understood the need to modify premises under changing situations and technology and had designed this kind of flexible office space (Nykänen, 2008). Aalto University Campus Library provides its services as the Learning Centre beta in the A wing while the original library building is undergoing a renovation until the end of 2016. (Aalto University News & Events, 2015).

3   Enabling campus environment to advance and support learning

'*Disability*' is a vague concept in academic context where learning to collaborate and learning from collaboration is a must to the community. Both old and new campus environments can either disable and exclude people with various ways or foster their full participation and inclusion in studies, research and social life. According to the *World report on disability* (WHO,

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2011) an environment – physical, social, and attitudinal – can either disable people with impairments or foster their participation and inclusion. Thus different domains and activities of the campus including buildings and roads, transportation, information and communication are interconnected – students with disabilities will not be able to benefit fully from improvements in one domain if the others remain inaccessible. The relational model comprises an individual student and environmental factors: Disability is seen as a "gap" or a misfit in the interaction between a student and the environment (Figure 8).
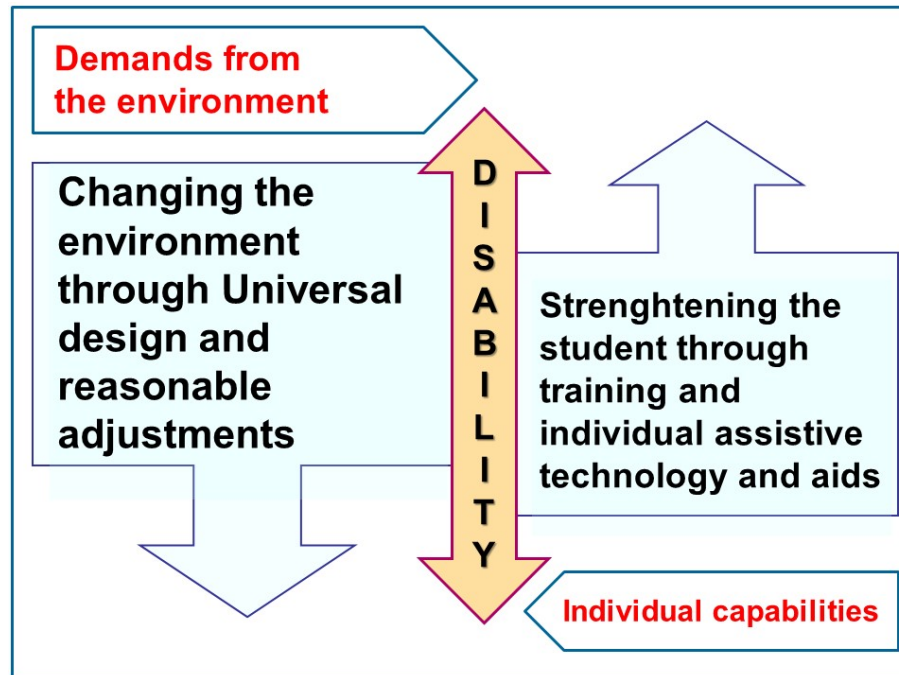

Figure 8. The relational model comprises student and environmental factors: Disability is seen as a gap in the interaction between a student and the environment. Presentation by Kjetil Knarlag at LINK-conference in 2014. Modified for Aalto University by Antti Raike.

Thus particular attention was paid for entering the Undergraduate Centre by wheelchairs, prams and pushchairs. This kind of basic improvement of access to a building contributes to the creation of an enabling campus environment; it benefits not only people with disabilities but other community groups as well. Therefore, the prerequisites for progress in enabling campus accessibility are

1) The creation of a "culture of accessibility",
2) The effective enforcement of laws and regulations,
3) Better communication and information sharing on environment concerning the strategic enablers of accessibility:
   a. Activity towards equity, economy and efficiency
   b. Adapting to Alvar Aalto's architecture

The Undergraduate Centre premises for the bachelor's students in Otaniemi enable students to study and work in groups in a creative learning environment (Sursock et al., 2016). Well-designed easy access gives people positive user experience and first-hand knowledge about the benefits of universal design in practice. This in turn addresses negative attitudes that are a key environmental factor across all domains of accessibility.

3.1 Creation of a culture of accessibility based on Aalto's work

Accessible campus is the enabling collaboration hub that means maximised access to the services, teaching and research, as well as reliability and usability of operations. Safe, healthy and accessible operation environments on the campus serve the entire Aalto community. Alvar Aalto's original work and the renovation relating the Finnish legislation with the university strategy constitute the premises for the renovation project. Aalto University has created a comprehensive and well-functioning quality system designed to support the strategic goals. This was the assessment of the *Finnish Education Evaluation Centre* (FINEEC), which conducted an audit of Aalto University's quality system (Sursock et al., 2016). FINEEC awarded Aalto a quality label, which is valid for a period of six years starting from 13 June 2016. At Aalto University, the practice of reviewing and revising objectives and developing activities is considered a spiral, a continuous process in which each round of development takes us closer to the objectives we have set. Performance improvement, or quality management, at Aalto University and its six schools is based on the PDCA (Plan, Do, Check, Act) cycle (Deming circle), a tool for continuous improvement (Figure 9).

Figure 9. Aalto University Quality System approach: PDCA (Plan, Do, Check, Act) principle for continuous improvement.

In accordance with the Aalto University's quality system approach and implementation plan for accessible learning the accessibility work of the university is handled in a decentralised manner:

- At university level, we provide the basic services set forth in the university strategy and give advice to six schools, which decide the services of their units independently.
- Six schools develop and support the accessible operating culture as defined in the strategy by following up on the progress of its implementation.
- At the levels of departments, degree programmes and units, equal opportunities to participate in studying, research and teaching are ensured.

Training, advice and monitoring of the accessibility has been decentralised to different units of the university including the Learning Services (LES) of six schools. The LES service desk staff of each school will guide, instruct and advise in accessibility matters in more detail if necessary.

3.2   The effective enforcement of laws, regulations and guidelines in quality system

Aalto University and Aalto University Campus and Real Estate (Aalto CRE) have a plan for a barrier-free built environment complying the *section F1 (a barrier-free building) of the National Building Code of Finland,* the *Non-discrimination Act (1325/2014)* and other legislation. *Section F1 of the Finnish Building Regulations* defines a barrier-free building by regulations and guidelines (*Ministry of the Environment Decree on accessible building, adopted on the 1st October 2004*). In accordance with the Decree, the following regulations and guidelines on barrier-free building, applicable to construction, shall be enacted under *Section 13 of the Land Use and Building Act (132/1999)*:

1) *Section 117(3) of the Land Use and Building Act* postulates that "*A building must conform with its purpose and be capable of being repaired, maintained and altered, and, in so far as its use requires, also be suitable for people whose capacity to move or function is limited*".

2) *Section 53(1-3) of the Land Use and Building Decree* postulates, that "*Administrative and service buildings, commercial and service premises in other buildings to which everyone must have access for reasons of equality, and their building sites shall also be suitable for use by persons with restricted ability to move around or function otherwise*". For purposes of equality, buildings with work space shall be designed and built so that they provide the persons with disabilities with sufficient opportunity to work, taking into account the nature of the work.

The purpose of the *Non-discrimination Act (1325/2014)* is defined in Chapter 1: "*The purpose of this Act is to promote equality and prevent discrimination as well as to enhance the protection provided by law to those who have been discriminated against*."

In addition the legislation, Aalto University and Aalto CRE have agreed to observe the following principles in renovations:

- Good acoustics serve everyone but especially hearing or visually impaired persons and non-Finnish-speaking people.
- The colour scheme and materials should support prompt and safe indoor navigation. However, some fairly strong constraints exist due to the protected nature of the Undergraduate Centre.
- Sufficiently large and clear fonts are used in guidance material and general information is formatted for the clear perception of the layout of spaces and operations.
- Storage space should not block pedestrian passage.
- Ramps, if they fit in naturally with other planning, are used as a first choice in elevation differences between building levels.
- Assisting services are smoothly combined with a building's own functions and resources (wheelchair accessible taxis, speech-to-text and sign-language interpreters, personal assistants, and guide and assistance dogs).
- Hearing, seeing and mobility devices (microphone systems, special computers, mobility guiding devices, Bluetooth indoor navigation, wheelchairs etc.) are included in Bring your Own Device (BYOD) principles.

These have been taken into account in the renovation of the Undergraduate Centre and will be followed in future renovations and construction projects.

3.3   The renovation project as an activity towards equity, economy and efficiency

This chapter examines accessibility in the inclusive teaching and learning context in Aalto University. The main object of the activity was to make learning accessible for all in the Undergraduate Centre. Instead of focusing on the various disabilities, addressing the needs and the diversity of all students was adopted as a starting point in the renovation ('Define' in Figure 3). To succeed, accessibility renovation as an activity needs to take into account external constraints including affordability, competing priorities, availability of tools like the technology and knowledge, and cultural differences of the community. The renovation in higher education institution should also be based on sound scientific evidence.

Often, accessibility is more easily achievable incrementally – for example, by improving the features of a building in stages. Initial efforts should aim to build a "culture of accessibility" and focus on removing basic environmental barriers. Once the concept of accessibility has become

ingrained and as more resources become available, it becomes easier to raise standards and attain a higher level of universal design on the whole campus. Making progress in accessibility requires the engagement of international and national actors, including international organizations, national governments, technology and product designers and producers, and people with disabilities and their organizations. (WHO, 2011). An accessible operating culture is created by adhering to the following principles:

- Accessibility is developed proactively rather than reactively only after problems have arisen in the process.
- Each member of the community has the right to report any barriers identified and suggest a change in the operating culture.
- Equality is promoted continuously in all operations
- Open discussion strengthens positive attitudes and enhances expertise, which helps us solve everyday challenges.
- Aalto University as a community follows the principles of sustainable development, meaning that accessibility is in line with research knowledge and with the tacit knowledge of the community and justifiable in the different assessments of our operations.

Before launching a renovation project, it is valuable to understand how the collective and cumulated knowledge of the academic community in its entirety can be exploited as a resource (Raike 2012).

3.4   Adapting to Alvar Aalto's architecture in the renovation

During the construction work of the Main Building at the 1960s, many changes to the drawings were needed (Nykänen, 2007; Penttilä, 2008). Financial thrust, altering guidelines from the client and trouble at the construction site were reasons why Alvar Aalto was asked to make changes to the original plans. Similar challenges occurred during the renovation. However, the iconic value of Aalto's work was the core of the renovation. Aalto was a master solving unexpected changes and was open to change original plans by inventing new solutions, turning a trouble to a victory. For example, a too big ventilation shaft was covered by a curving wooden grill as if it was planned to be that way originally. During decades, these spontaneously solved details turned into valuable building heritage that may not be changed. That means that new changes have to be different; they have to hide and leave Aalto's contributions visible. In the renovation work, spaces were modified differently in different parts of the building. In the most valuable parts (the

General Department and the Department of Architecture) only minor changes were executed. In the U-wing which was completed later in 1975, much larger changes were possible: The whole segments of work rooms were transformed into open flexible working spaces (Figure 10) and some auditoriums were modified by replacing fixed seats with chairs and tables (Figure 11).

Figure 10. U wing work rooms transformed into open flexible spaces. Aalto University/Tuomas Uusheimo.

Figure 11. U wing auditorium modified by replacing fixed seats with chairs and tables. Stair lift on the left. Aalto University/Tuomas Uusheimo.

However, the most difficult task was to fit in the HVAC-systems and making the building accessible. Thus some small work rooms were turned into technical spaces in order to prevent additions to the appearance of the building. Accessibility issues needed hours of planning and innovating. For example, the stage of the Aalto Hall was not a wheelchair accessible. After many plan variations, a new tunnel route was dug behind the auditorium walls directly from the main lobby to the stage (Figure 12).
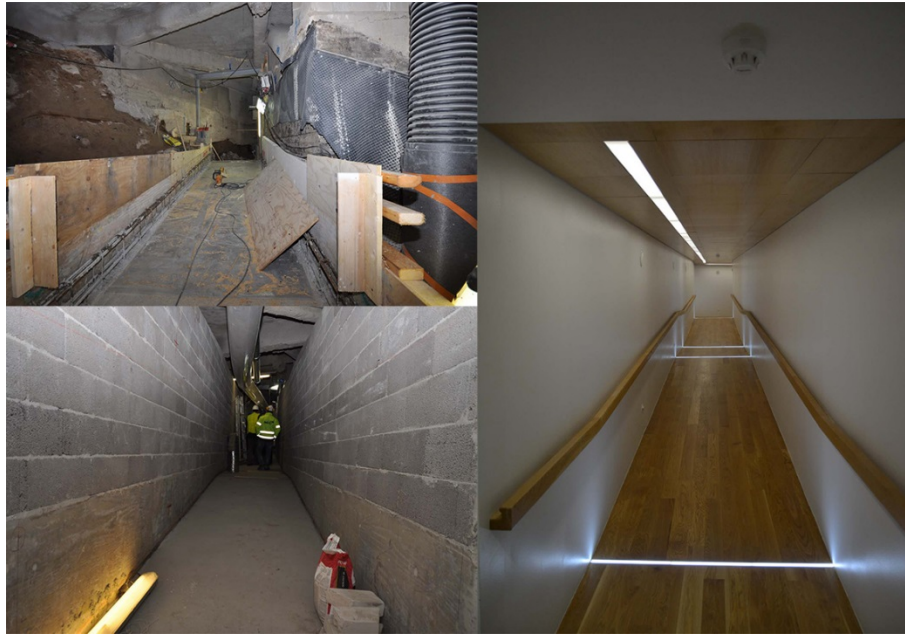
Figure 12. Tunnel to Aalto Hall stage. Aalto University/Jarmo Tiirikainen.

Since the tunnel was a totally new element in the building, it has been possible to design with new architecture: There was no need to perfectly adapt to Aalto's architecture. On the contrary, the situation was different in the design of new seats for spectators with disabilities in the same auditorium. They were designed to hide well in existing seat rows so, that the atmosphere of the Aalto Hall would have as little disturbance as possible (Figure 13 and Figure 4).
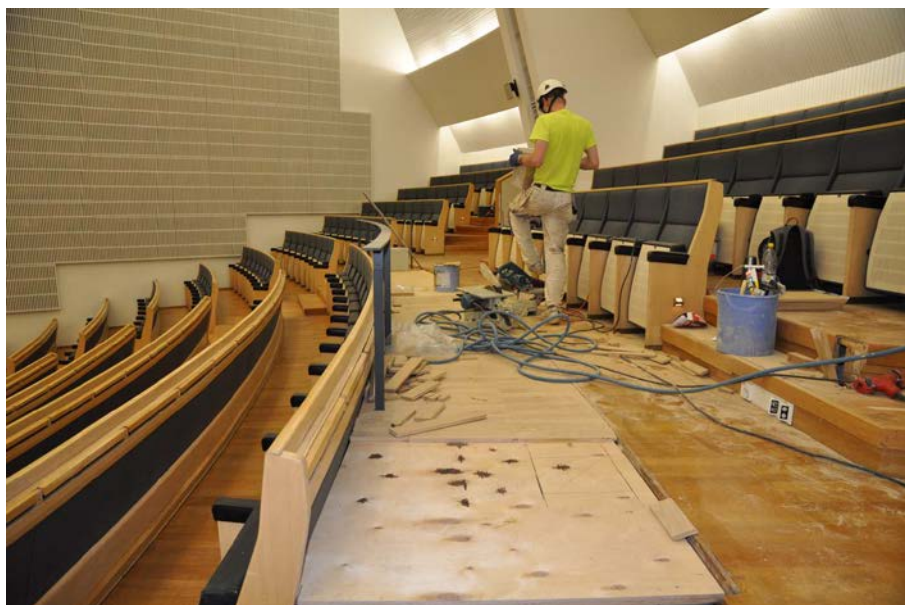

Figure 13. New seats for spectators using wheelchair were designed to hide well in existing seat rows of the Aalto Hall. Aalto University/Jarmo Tiirikainen.

It is essential how the diverse users experience the accessible Undergraduate Centre as an equal environment and see the benefits for a broader range of people. For example, after the renovation

users like parents pushing baby strollers, suppliers and restaurateurs learned rather quickly to use new curb cuts (ramps, Figure 14), automatic door openers and stair lifts (Figure 15, Figure 16).

Figure 14. New accessible entrance to A wing with a push button switch. Aalto University/Antti Raike

Figure 15. Stair lift in U wing. Aalto University/Jarmo Tiirikainen.

Figure 16. Stair lift in the main lobby, Y wing. Aalto University/Antti Raike.

In addition, clear information and signposts help non-Finnish speakers and people with learning disorders (Figure 6). Clearly, the integral planning of accessibility, the availability of information and implemented practices enhance inclusion (Verma, Hätönen & Aro, 2010). In conclusion, not only one type of new architectural language was used. All situations were separately considered and the suitable diction of architecture selected. In some cases, new additions are very close to the original design. In some other parts, the renovating architect's own design can be seen more clearly. Perhaps, have the architects of the renovation succeeded if a visitor does not notice the difference?

4   Discussion: The collaborative design activity in a renovation project

Development of inclusion is also a very practical issue of activity. The success of inclusive higher education is influenced by how all the stakeholders within an institution respond to external drivers for accessibility such as legislation, guidelines and standards (Seale 2006c). Thus we suggest an iterative cycle using a PDCA tool used in quality management (Figure 9) and the Activity Theory to realise enabling learning environment (WHO, 2011). Raike, Sunikka & Saarinen (2013) divided collaborative knowledge building on three operational domains:

1) Non-discrimination and disability: Accessibility research, in general, focuses mainly on accessibility legislation, guidelines and standards, and the rules contained within them. E.g. *The Finnish Non-Discrimination Act (1325/2014)* requires reasonable steps to be

taken to help people with disabilities to cope and advance in their career. However, the objective of higher education actors should not be only to comply with legislation but to address the needs of students (Seale 2006a, 2006b).

2) PDCA (Plan, Do, Check, Act) cycle (Deming circle, Figure 9). PLAN is gathering information on the process and on the basis of that information to plan improvement. DO is simply to carry out the plan, establishing objectives and communicating the change. CHECK means monitoring performance against the plan to ascertain if the objectives are being achieved. ACT means to standardise the changed process once it is in control and it has been determined that it actually delivers the planned improvement.

3) Actual teaching, learning, research and artistic activity taking place everywhere on the campus (STEAM). Diverse stakeholders are faced with collisions of interests and clashes of views almost daily.

Raike, Sunikka and Saarinen (2013) proposed designing *enabling blended learning environment*s (facilities including networked learning) rather than concentrating on special services or disability issues per se. This kind of approach could promote more inclusive strategies for a university. An enabling learning environment would keep the community knowledge building and innovative mind-set alive empowering the whole academic community. Inclusive research, teaching and learning are relevant for not only "disabled" (the first domain) students, faculty and staff, but for all learners of the community (third domain). The effective use of the quality management (second domain) ensures that the university allows students to learn also with unconventional methods.

Next, we break down the design elements and the collaboration with stakeholders, practitioners and community members using the PDCA cycle and the Activity Theory as a framework to get better understanding about the design requirements of the renovation project. Consider the following paragraphs in relation to the renovation project presented earlier; we reflect the complex Undergraduate Centre renovation project in the combined PDCA and activity framework. The combination of the Activity Theory (Figure 17) with the PDCA cycle (Figure 9) is based both on the practical collaboration in renovations and on the findings from co-design projects made at the Aalto University to promote inclusive and enabling environments. The aim is to improve the quality management of the university renovations when a PDCA tool is used. The main issue is when and how a renovation related task could most effectively be offered to faculty, staff and students for knowledge construction?
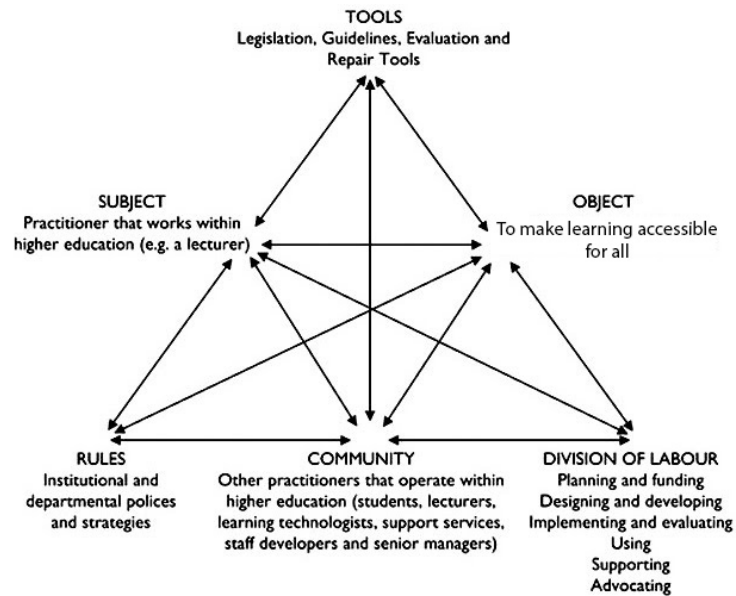
Three principles of the Activity Theory are often accepted in co-design research projects:

a) People live in a reality that is objective not only according to natural sciences but socially and culturally defined properties as well;

b) Internal activities cannot be understood if they are analysed separately from external activities, because they transform into each other. Internalization is the transformation of external activities into internal ones;

c) Human activity is mediated by tools in a broad sense and the use of tools is an accumulation and transmission of social knowledge.

The zone of proximal development is the move from the present level of development to the new potential level of development. It is determined by the cognitive tasks a stakeholder can first complete in collaboration with an advanced peer but later is able to accomplish alone. In the university real estate setting, context intelligence can be seen as an index of what a stakeholder can do and is capable of doing or willing to do while interacting with experts either in a workshop or using the collaborative tools providing feedback for renovators.

The Engeström's model of the Activity Theory (2009) is useful for understanding how a wide range factors work together to impact an activity in a renovation process. Engeström (2001) summarizes the activity theory with the help of five principles:

1) A collective, artefact-mediated and object-oriented activity system, seen in its network relations to other activity systems, is taken as the prime unit of analysis.

2) Activity systems are multi-voiced. An activity system is always a community of the multiple points of view, traditions and interests. The division of labour in an activity creates different positions for the participants, the participants carry their own diverse histories, and the activity system itself carries the multiple layers and strands of history engraved in its artefacts, rules and conventions.

3) Activity systems take shape and get transformed over lengthy periods of time, that is, the problems and the potential of an academic community can only be understood against the history of university. Thus, renovation work needs to be analysed against the history of its local organization and against the more global history of the higher education concepts, procedures and tools employed and accumulated in the local activity.

4) The central role of contradictions as sources of change and development. Contradictions are not the same as problems or conflicts. Contradictions are historically accumulating structural tensions within and between activity systems. When an open activity system adopts a new element from the outside (for example, a new technology or a new object like a Bluetooth navigation system), it often leads to an aggravated secondary contradiction where some old element (for example, the rules or the division of labour) collides with the new one. Such contradictions generate disturbances, but also innovative attempts to change the activity.

5) The possibility of expansive transformations when activity systems move through the relatively long cycles of qualitative transformations. As the contradictions of an activity system are aggravated, some individual participants begin to question and deviate from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort. An expansive transformation is accomplished when the object and motive of the activity are reconceptualised to embrace a radically wider horizon of possibilities than in the previous mode of the activity. A full cycle of expansive transformation may be understood as a collective journey through the zone of proximal development of the activity. (Engeström 2001).

In order to reach an outcome like an enabling learning environment for a multi-lingual body of students, it is necessary to produce certain objects (e.g. experiences, knowledge, and physical products). Instruments (artefacts) mediate the subjects' (stakeholders') activity (e.g. tools used, documents, mobile devices and schedules) with the community (university organization or the student community). Also, the community may impose exposed or hidden rules that affect activity like the BYOD and 24/7 principles. The individual student or a staff

or faculty member as a subject works as a part of the community to achieve the object in this framework (Figure 17). Any activity normally features a division of labour, i.e. the roles of faculty, staff, students and external stakeholders. We applied Engeström's systemic model of activity due to dimension of blended learning that should take place in the Undergraduate Centre. Based on Aalto University experiences, Raike, Sunikka & Saarinen (2013) modified the PDCA cycle (Figure 9) slightly further (Figure 18) when the activities of the academic year and challenges of the personal views in the practices of science, technology, engineering, art and mathematics (STEAM) with the evolving construction of collective academic knowledge are taken into account.
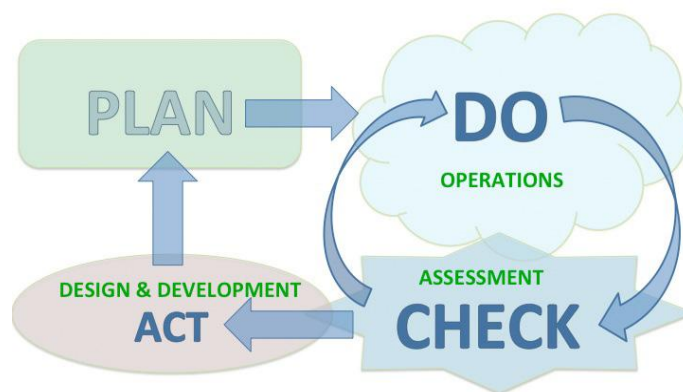

Figure 18. The modified PDCA cycle for students and staff facing every-day challenges on the campus.

The modified sub-iteration in 'Do-Check' cycle includes the systemic model of activity presented in Figure 17 and the simplified design process presented in Figure 3. The inner 'Do-Check' cycle should be supported by the university management and organized promptly and lightly inside the whole renovation project. This would give a real opportunity for the community and stakeholders to propose incremental improvements and innovations for the next design and development round. Taking into account the sub-iteration cycle and the more general PDCA-cycle, our recommendations for creating enabling learning environments in higher education are the following:

1) PLAN: Analyse what types of academic tasks might be the most conducive to fostering intellectual development. Prepare the syllabus with teachers so that a flexible personal study plan is easy and possible to construct. Contact staff organising first year activities and faculty in schools in order to define the zone of proximal development.

2) DO: Support field-based research to obtain data on the diversity of the student body especially within technologically enhanced learning environments. Collaborate with

researchers at your own university. Collaborate also with different service organizations (library, campus and facilities, IT and communication) in order to solve practical issues.

3) CHECK: Evaluate how the earlier experiences and syllabus affect learning within the university. Check and follow how a personal study plan is composed and how it supports learning.

4) ACT: Practice co-design methods with students to reveal the social, cultural, and political character of the design process for learning tools.

These rather simple administrative modifications can give voice to the expertise of students and staff and turn student motivation into academic activity with the support of university management, faculty and staff.

5 Conclusion: Renovation project as a collective knowledge construction

The academic community is multiplied in networks of interacting activity systems present on campus. It is a source of trouble and a source of innovation, demanding the actions of translation and negotiation (Engeström 2001). Campus renovators are confronted with a pluralism of values, both in management and in their interaction with a diverse academic body. The essential knowledge construction is to refine knowledge artefacts like plans, surveys and reports and address the complex problems of the renovation to the future users of the building. Williams & al. (2010) believe that collective intelligence, defined as the general ability of the group to perform a wide variety of tasks, stems from how well the group works together. According to their research, those groups whose members had greater levels of "social sensitivity" were more collectively intelligent. Thus, what matters in renovation is what experts can do with the academic community and other stakeholders (i.e., collaboration), especially with the use of technology to augment accessibility. The knowledge construction for accessibility addresses the need to educate renovators and future users for a practice in which knowledge creation and innovation are incessant. The knowledge construction of a renovation project may be defined as the production and continuous improvement of ideas of value to a community, through means that increase the likelihood that what the community accomplishes in the renovated building will be greater than the sum of individual contributions and part of broader cultural efforts of the university. This is the core reason to modify the administrative PDCA quality tool in the activity theory framework. The knowledge construction in the present renovation project took place in student groups, academic teams, and faculty communities of practice, either in workshops or using feedback tools and interviews. Within the planned, given and defined project, stakeholders

constructed necessary knowledge in their role as a partner in the co-design process. Thus, a renovation project is not a simple entity that exists independently of the community and its stakeholders; especially faculty need to be concerned about the possible insufficiency of the appointed learning environment where students interpret and evaluate complex and even contradictory information and make decisions vis-à-vis the multifaceted problems of the university and academic studies.

> *"The TKK landscape and buildings can all be seen as assertions of a worldly, wise acceptance of limits and contingencies, bespeaking the presence of the human in material form, and the consequent vulnerability, indeed mortality, of our lives*." (MacKeith 2013)

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