Constructing Identity – The Competition for the Dipoli Student Union Building in 1961-62

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Introduction

Dipoli, the student centre of the Helsinki University of Technology Student Union (TKY), designed by Reima Pietilä and Raili Paatelainen (since 1963 Pietilä) and completed in 1966, was one of the most experimental and controversial buildings in Finland in the 1960s. At the time, the majority of the Finnish architects had a very pragmatic approach, and they were suspicious of all kinds of theorising and formal experiments. Pietilä's design methodology, on the other hand, was a combination of intuitive expression, morphological and topological analyses, linguistics and ambivalent symbolism, which annoyed many of his colleagues. He wrote that Dipoli was a revolt against the Bauhaus-based standard architecture, which had ended up on a far too safe middle way in the late 1950s.¹ Pietilä's ideas got warmer reception abroad: he had an extensive international contact network, and his projects were widely published in the international architectural magazines.

TKY turned out to be an ideal client for Pietilä: the technology students were more than willing to support experimental architecture, and they had resources to carry out the project. However, the project was complicated by the fact that both the architects and the client had little experience in implementing such a large and complex building. In this paper I am trying to clarify what was the student community's impact on the Dipoli project. The competition program was tailored for the specific needs of TKY, and it was almost impossible to design a well functioning building using conventional typologies. Pietilä's and Paatelainen's aim was to design a building, in which the technology students could identify with. Therefore, they wanted that Dipoli would have a radically different character

than the rational university buildings. This did not fully agree to the visions of the University and the campus planner, Alvar Aalto, which complicated the competition process to some extent. After the competition the feed back of the student community modified the project significantly. The main sources of this paper are the archives of the Finnish Museum of Architecture and the Aalto University Student Union and Pietilä's descriptions of the design process.

The Student Union

TKY was a very exceptional organization to built such a complex public building as Dipoli. In Finland student unions have had a well-established legal and economical position since the 19th century. Each union must have a Representative Council, which is elected in free elections held every second year, and a Board for the daily administration. All undergraduate students are automatically union members and obliged to pay an annual membership fee, which guarantees regular incomes for the unions. The oldest organizations, such as TKY, have gathered substantial fortunes over the decades. Thus, young student activists may decide on major investments, for example, to construct spectacular buildings. Since the mid 19th century the student unions have built a unique series of club houses, and Dipoli can be considered as a culmination of that series. The alumni of the student unions have also tried to influence the decion-making either as official advisors or behind the scenes. For example, the TKY Representative Council did not dare to make a contract with Pietilä and Paatelainen before the Finance Committee, composed of alumni, had evaluated the feasibility of the project.ⁱⁱ

TKY had built an own club house, called Poli, in the Helsinki city centre at the turn of the century. The muscular stone building, designed by Karl Lindahl and Walter Thomé in the National Romantic style, evoked both admiration and disapproval – just like Dipoli 60 years later.ⁱⁱⁱ Poli was a major effort for the Student Union, and it inspired successive generations of technology students to increasingly ambitious building projects, such as Dipoli. Poli's castle-like architecture gradually became a vital part of the identity of the student community. Therefore, Pietilä and Paatelainen wanted to recreate that atmosphere in Dipoli to help the student traditions settle down in Otaniemi.^{iv}

Reima Pietilä and Raili Paatelainen

Also the architects, Reima Pietilä and Raili Paatelainen, had little experience in designing large public buildings. They had founded a joint practice only a few months earlier, and Dipoli was the first project, which they designed together from the very beginning.^v At that time they did not have any employees: first ones were hired in end of 1962 when they were commissioned to design three major buildings: the Kaleva Church, Dipoli and the Suvikumpu Housing.^{vi}

Reima Pietilä (1923-93) graduated from the Helsinki University of Technology (TKK) in 1953. Therefore, Dipoli must have been a fascinating project for him, although he had not been particularly active in TKY while studying. After the graduation, Pietilä joined the Finnish CIAM group, called PTAH, which was virtually the only arena for theoretical architectural discussion in Finland. At the same time it was a kind of courter force to the dominance of Alvar Aalto. The members of the group shared an interest in the formal aspects of architecture, such as harmonious propotions and modularity. In 1958 the group members founded a multilingual theoretical magazine Le Carré Bleu to attend the international discussion. It was published in Helsinki until 1961 and thereafter in Paris.^{vii} As a member of the PTAH Pietilä also participated in the CIAM activities: in 1954 he took part in a summer school organised by the Italian group in Venice and two years later in the 10th congress in Dubrovnik. After the dissolution of the CIAM he kept in touch with the members of the Team Ten, but did not attend their meetings until the 1970s.^{viii}

Pietilä's first independent project was the Finnish Pavilion at the Brussels World's Fair in 1958. The modular wooden building was based on the architectural ideas of the PTAH group, and it received a plenty of positive attention in the international architectural magazines. However, Pietilä soon began to feel that the means of the modular orthogonal architecture were too restricted. In 1959 he won the competition for the Kaleva Church in Tampere with a highly experimental design, which consisted of concave wall units of different sizes, creating an impression of a concete cathedral. Bold sculptural designs were quite popular in Finland at that time, particularly in the church competitions. Pietilä was, however, unique in combining an intuitive expression with systematic morphological analysis.

After winning the competition for the Kaleva Church Pietilä set up a joint practice with architect Raili Paatelainen (1926-). She had graduated from the TKK in 1956 and worked in several architectural offices in Finland and in the UK. The couple was married in 1963 and worked in close cooperation until Reima Pietilä's death in 1993.

The Otaniemi project

Dipoli was is essential part of the Otaniemi campus, the largest university campus in Finland. TKK's buildings in the Helsinki city center were severely damaged in air raids in 1944, and four years later the Finnish Government decided to move TKK and the Technical Research Centre of Finland (VTT) to Otaniemi, about 10 km from the city centre. Alvar Aalto won the town planning competition held in 1949. His project was based on the Anglo-American campus model, but he also took into account the agricultural landscape of Otaniemi. The buildings were placed either along the edged of open fields or in the middle of wooded hills. Two old alleys were also integrated into the design. In the middle of the campus Aalto designed a large festival field, which was delimited by the main buildings of TKK and VTT, a library and a small shopping centre. A wooded hill on the eastern side of the festival field was reserved for the Student Union Building. Aalto drafted a U-shaped asymmetrical building, whose courtyard opened towards the TKK Main Building. A field on the south of the hill was reserved for parking.^{ix} Aalto had specified already in his competition entry that red brick should be the dominant material in Otaniemi. In the TKK Main Building and the Main Library it was complemented by marble claddings, granite plinths, wooden windows, doors and grilles and copper roofs and flashings. Pietilä and Paatelainen used slightly simpler and rougher material palette in Dipoli: copper, concrete, granite and wood.

The technology students were very exited about the campus project from the very beginning, and TKY began to relocate its activities to Otaniemi. The first dormitories and a temporary restaurant, both designed by Heikki Sirén, and a sports hall, designed by Aalto, were completed for the 1952 Olympic Games. The success these projects gave TKY courage to carry out even more ambitious projects, of which Dipoli was by far the largest. Aalto was quite upset when he heard that TKY had hired Sirén to design the Student Village. Later, the relationship warmed, and he designed several buildings for the Student

Union.^x He even agreed to be a jury member in the Dipoli competition, which was highly unusual.

The first laboratories for VTT were completed in the mid-1950s, but the construction of the university buildings progressed much slower: in the early 1960s only a handful of buildings had been completed. Aalto's office had made a first set of drawings for the TKK Main Building in 1955, but the construction began only in 1961. He designed also the shopping centre, which was built south of the Dipoli site in 1961.^{xi}

Drafting a program

In analysing Dipoli critics and historians have usually focused on contextualism, spatial structure and metaphors and ignored its functionality. However, its exceptional architecture would not have made any sense without an exceptionally complex program. The competition proved that it was almost impossible to design a well-functioning building using conventional typologies. Pietilä and Paatelainen, on the other hand, did not care about standard types. Therefore they were able to develop a highly effective layout, which minimised internal distances, decentralised entrances and made it easy to combine and separate rooms if necessary. Over the years Dipoli has proved to be a highly flexible building, which has been possible to use in the most varied ways.

The so-called Dipoli Committee drafted the original program in early 1960. The scheme was could be described as an ideal model for a student union building: It would consist of a large number of rooms of different sizes and natures: banquet halls, a student restaurant, a first-class restaurant, a beer-cellar, an auditorium, foyers, club rooms of various sizes, offices, staff apartments and various secondary spaces. It was also important that would be easy to combine facilities and to use them simultaneously without disturbing each other. The Committee estimated that the surface area of the building should be about 8000 m². Thus, it was about four times larger than Poli and significantly larger than any similar building in Scandinavia.^{xii} The Finance Committee, which consisted of TKY alumni, was asked to evaluate the Committee 's report. It considered that the scheme was too ambitious and urged to reduce it.^{xiii} A new committee drew up a slightly reduced program, which was used in the competition announced in January 1961.^{xiv}

The programming was delayed also by the Swedish-speaking student association Teknologföreningen (TF), which considered whether it would participate in the Dipoli project or build an own club house. For historical reasons, the Swedish-speaking students were afraid of losing their autonomous status within the Student Union, and an own building was one way to protect it. Until the late 19th century the Polytechnical Institute, the predecessor of the University of Technology, had been an entirely Swedish-speaking institution. At the turn of the century it became bilingual, and soon the overwhelming majority of the students spoke Finnish. This was followed by a fierce power struggle between the Finnish and Swedish speaking students, which crippled the Student Union's activities for many decades. The relationship became to warm up only in the late 1930s, when TKY built a separate wing for TF in the courtyard of Poli.^{xv}

The Dipoli Committee hoped that the coexistence would continue also in the new Student Union Building and reserved a separate wing for TF.^{xvi} However, in September 1960 the TF Board, encouraged by the industrialist Wilhelm Wahlforss, decided to acquire a piece of land about 500 m from the Dipoli site for its own building. The TKY Board objected two separate buildings, as it feared the fragmentation of the student community and difficulties in raising funds for both projects.^{xvii} Fortunately, the controversy was resolved quickly: TF agreed to change its plot to an another piece of land on the northern side of Dipoli, which facilitated the co-operation but reduced the size of the Dipoli site by about half. Fundraising for the projects was also organised in collaboration.^{xviii} The competition for the TF building was held soon after the Dipoli competition had been resolved in 1962. To create a harmonious entity TF even invited Pietilä to the jury. The first prize was awarded to the architect Kurt Moberg. His bold concrete building, called Urdsgjallar, was completed almost simultaneously with Dipoli.^{xix}

Integration or differentiation

It is a little surprising that the competition program does not mention anything about the architectural character. The program, however, explicitly stated that the Student Union Building should be a harmonious pair to the TKK Main Building. The jury seems to have appreciated it already as a masterpiece, which feels little strange – at the time Aalto's office was still working on the final plans. As the Student Union Building was located on a higher ground, the jury stated that it should not be higher than two stories. It also

recommended, that competitors would use the same facade materials, which would be used in the Main Building, i.e. brick and copper.^{xx}

Most of the award-winning architects respected the jury's recommendations and submitted more or less Aaltoesque designs. Pietilä and Paatelainen, on the other hand, were not willing to follow Aalto's guidelines uncritically. In their opinion, the Student Union Building should have a distinct architectural character, so that the students could feel it as their own building. Thus, they tried to find a balance between integration and differentiation. The building was divided into two volumes: a low rectangular volume, which contained offices, club rooms and other everyday activities, linked the building to Aalto's buildings by following their scale and geometry. The banquet hall, restaurants, meeting rooms and foyers were situated in a higher and geometrically much more complex volume. In the first elevation sketches Pietilä colored the rectangular volume in red, indicating that it would have brick facades.^{xxi} Later he decided, however, to clad the entire building with copper, perhaps to hide the building in the surrounding forest. Copper was also widely used in Otaniemi, so there was no need to justify its use. Nevertheless, Dipoli's copper strips have a dark brown colour, which give it quite different character than Aalto's buildings.

In fact, Dipoli could be interpreted as Pietilä's dialogue with Aalto's architecture – or a substitute for a genuine dialogue, in which Aalto was not willing to participate. The Finnish architects of Aalto's generation shared an highly pragmatic way of thinking, and they were suspicious of all kinds of theorising and formal experiments. Pietilä challenged them with his theoretical articles, experimental projects and provocative comments. Nevertheless, many architectural features of Dipoli can be traced back to Aalto's projects of the late 1950s: the confrontation between the rectangular and free form geometries to the Wolfsburg Cultural Centre (1958-62), undulating concrete vaults to the Vuoksenniska Church (1955-58) and sculptural volumes to the Essen Opera House (1959), to name only a few. Pietilä, however, tried to make Aalto's themes even more expressive by exaggerating them. Abroad Pietilä even pretended to be Aalto's successor.^{xxii}

A cavemen's dwelling

Pietilä and Paatelainen intended that Dipoli's interiors would to act as a counterweight for the rational and anonymous university buildings. The result was a highly complex and

disorienting spatial structure, which consisted of interlocking halls and foyers, meandering corridors and numerous nooks of various sizes. The architects assumed that a technology student, who used the building every day, would learn quickly to find the different routes through it. For a guest, who arrived to Dipoli for the first time, the experience could be highly confusing. Pietilä wrote that "a guest perhaps feels himself as an outsider, because he has already been brainwashed to adapt to the commercially programmed, anonymous and universal design. The Student Union Building is a nook for a closed group, which, however, has to sell to keep up. The house has not been designed to be so terribly smoothly polite, like an actual full-time congress centre would be. The 'Technology Student Passage' on the ground floor is a passage for a technology student, in which a guest is only a visitor."^{xxiii}

Earlier I already mentioned that the National Romantic architecture of Poli had became a vital part of the identity of the technology student community. Pietilä and Paatelainen tried to recreate its medieval atmosphere in Dipoli, so that the student traditions could be relocated there. They developed modern interpretations for its architectural features: vaults, nooks and rough stone walls. The competition program did not encourage to such traditionalism in any way. Nevertheless, Pietilä wanted to study, whether such a thorny issue as tradition could be worked with modern means. Therefore, he smuggled the idea of tradition transplantation to the modern hygienic Dipoli project trough his competition entry.^{xxiv}

Pietilä and Paatelainen often used humorous and ambivalent competition pseudonyms, such as 'Be Gentler, Mountain Zone Meridian', 'Strips of Birch in a Dug-Out' or 'Snow Speaks on the Mountains'. Their pseudonym in the Dipoli competition was 'Wedding March of the Cavemen', which referred to the cavernous look of the main halls and foyers. Thus, the technology students compared with cave men, which might have been interpreted as an insult – it also reminds of Adolf Loos's and Le Corbusier's argument that engineers were modern primitives.^{XXV} The technology students, however, did not take the metaphor too seriously, and it soon became an essential component of the project's brand. Dipoli's architecture also inspired new traditions – just like Poli had done. For example, a secret society called Luolamiehet (Cavemen) was founded in 1962.^{XXVI} The same theme was used in the naming of the premises – for example, the first-class restaurant was initially called Luolamies (Caveman).

Naturalism

The construction of the Student Village and fundraising for it were an enormous efforts for the TKY. One might even say that the Otaniemi project transformed the identity of the whole technology student community: suddenly, urban technocrats had to become modern pioneers. The first dormitories were built in the middle of an almost pristine forest, and public transport and commercial spaces were inadequate for a long time. It created a peculiar student culture, which was often criticised for its insularity.^{xxvii} Pietilä and Paatelainen knew the situation pretty well, since both had live in Otaniemi in the 1950s.^{xxviii} Dipoli could be interpreted as a monument for that heroic pioneer period. Pietilä wrote that "Dipoli must not be seen as a pervading, evened-out totality, a civilised urban architecture. A person who has a fixed image in his mind of a grid of street corridors easily feels lost and becomes ill in Dipoli. If one understands that the interior of Dipoli is like a rocky spruce forest that surrounds it, one can easily cope in the building."^{xxdx}

Pietilä's and Paatelainen's fundamental idea was that Dipoli would be an extension of the natural landscape. For example, the undulating roof reflects the forms of the bed rock of the site, and the framework of the large glass walls follow the rhythm of the surrounding trees. Massive rock formations at the foot of the building and in the foyers implant the building firmly in the ground. Instead of a solid facade Dipoli has a layered transition zone, consisting of broad cantilevered eaves, balconies, undulating glass-walls, window sills and deep entrance recesses, which dissolve the border between the building and the surrounding nature.^{xxx} Dipoli was situated almost in the centre of the wedge-shaped plot to leave a relatively wide unbuilt zone around it. Pietilä and Paatelainen even imagined that only narrow paths would have meandered between the trees to the various entrances.

In reality, the idea to dissolve the border between the building and the surrounding nature was difficult to archive. The unbuilt zone around the Dipoli was too narrow to give the impression of a building in the middle of a pristine forest. Later, it has become a well-maintained lawn with single trees and wide asphalted walkways, and it requires considerable efforts to visualise the original idea.

Deadlock

The competition results were published in August 1961. The jury had eight members, of whom six were appointed by the TKY: Jaakko Rahola, Rector of TKK, engineers Antero Salmenkivi and Kalevi Korhonen, architects Clas-Olof Lindqvist and Esko K. Mäkelä and technology student Harri Hintikka. The Finnish Association of Architects was represented by Academician Alvar Aalto and architect Olli Penttilä. The jury noted that the task was exceptionally difficult and that none of the 28 entries met all the requirements. Thus, it decided to share two second prizes: one for Pietilä and Paatelainen and the other for Osmo Lappo's team.^{xxxi}

Lappo (b. 1927) had studied at the TKK at the same time as Pietilä and Paatelainen and was among the most successful young Finnish architect. He is best known for highly rationalist projects, such as military buildings, swimming halls, schools and office buildings. Also the competition entry for Dipoli had a very rational layout, but due to the complex program, small site and Aalto's urban vision he ended up using a non-rectangular geometry and single-sloped roofs.^{xxxii} The building would certainly have fit well in Otaniemi. However, it does not have any architectural features, which would indicate that it is a student union building, not a university building, a school or a course centre.

The jury's report was written in a very compact form, so the evaluation criteria remain rather vague. The only issues, which were discussed extensively, were the placement of the building and its relationship to the TKK Main Building – most likely they were matters of key importance to Aalto. Aesthetic features were commented in only a few words or phrases, so it is extremely difficult to define, what kind of architectural expression the jury considered appropriate. Pietilä's and Paatelainen's project was praised for adapting to the environment and internal arrangements. The specific nature of the building was emphasised in unique and interesting way, but it also included an unnecessary highlighting and mannerisms.^{xxxiii}

A second attempt

Immediately after the results had been released the TKY Board appointed a special committee to investigate the possibilities to continue the project. It recommended that the commission should be given to one of the award-winning architects, rather than organising

a new competition or a second stage between the prize winners. Since all award-winning designs had a potential to become a well-functioning buildings, the decisive factor should be that the project reflects the identity and traditions of the technology student community. In this respect, Pietilä's and Paatelainen's design was unbeatable. The project had also received great deal of support among the students.^{xxxiv} In October 1961 the Representative Council decided that Pietilä and Paatelainen would be asked to elaborate their project, taking into account the comments of the jury and a revised program.^{xxxv} The Finance Committee refused to give an opinion, because the competition entry were too sketchy to make a reliable cost estimate.^{xxxvi}

Pietilä and Paatelainen completed a new set of floor plans in January.^{xxxvii} In February the jury unexpectedly interfered the process and proposed that both Pietilä-Paatelainen and Lappo would be asked to study the placement of the building. Lappo is under the impression that the initiative came from Aalto, indicating that he was not that impressed by Pietilä's and Paatelainen's design.^{xxxviii} The TKY Board wanted to maintain good relations with Aalto and the University and declared a second stage.^{xxxix} Lappo was not so eager to continue the process, since TKY had clearly preferred Pietilä's project. Nevertheless, he agreed to participate in the competition.^{xl} During the second stage Pietilä and Paatelainen redesigned the whole building, and thereafter only minor changes were made to the basic layout.^{xli}

Having studied both elaborated designs the jury decided to recommend that Pietiläs' and Paatelainen's project would be chosen as a basis for the further design. The decision was justified by the functionality of its internal arrangements and by the fact that the pavilion-like building fit naturally in the campus milieu. The jury, however, severely criticised the mannerist, unrealistic and formalist features of the project.^{xlii} These contradictory remarks indicate that the jury members were divided on the project's value. The TKY representatives were probably under pressure to respect the will of the student community and give the commission to Pietilä and Paatelainen. The critical comments, on the other hand, most likely reflect Aalto's doubts on their experimental architecture. Nevertheless, he did not oppose the project so much that he would have wanted to record a dissenting opinion in the minutes. Later Pietilä recalled that after the competition Aalto had asked him, why he had not covered the entire building with a free-form roof, and not just half of it. Pietilä explained that he wanted to give the space serving rational functions rational forms

and that serving irrational functions irrational forms. "In that case I think you have made a compromise", was Aalto's reply.^{xliii}

Immediately after the jury had made its decision the TKY Board commisioned a detailed cost estimate for Pietilä's and Paatelainen's project. After examining it also the Finance Committee agreed with the jury's recommendation, and in April the TKY Representative Council chose Pietilä and Paatelainen as Dipoli's architects. The Council stated, that their design met the diverse functional requirements required by the program, as well as the expectations that the engineering students had set for the general nature of Dipoli.^{xliv}

Implementing an experiment

TKY's initial timetable for Dipoli was extremely ambitious: it should be completed simultaneously with the TKK Main Building in 1963.^{xlv} However, the prolonged competition stage made it impossible to archive the objective. Pietilä's and Paatelainen's inexperience in designing large public buildings and difficulties in reconciling project schedules also postponed the construction several times. In the spring of 1962 they were finally commissioned to design the Kaleva Church, which had to be done almost simultaneously with Dipoli. At the end of the 1962 they won the invited competition for the Suvikumpu Housing and were immediately commissioned to design the large block of flats. Therefore, the couple had to built a medium-sized practice almost from the scratch. They hired several young architects and architectural students, but for a long time they had great difficulties in organising the office efficiently.^{xlvi}

Dipoli's complex geometry and Pietilä's desire to design specific details also complicated the design process. The couple had to ask constantly to postpone the agreed schedules, which deteriorated the relationship with TKY. Nevertheless, they were willing to modify their designs radically, if it was needed to meet the building or fire regulations, to integrate the structural and HVAC systems or to reduce costs. The excavation work was began only in the fall of 1963 and the construction in January 1965. Dipoli was inaugurated in the fall of 1966.

A controversial monument

During the five-year design and contruction process of Dipoli Finnish architecture changed dramatically. In the early 1960s bold sculptural designs were quite successful in the competitions. For example, just before the Dipoli competition Timo Penttilä and Kari Virta had won the competition for the Helsinki City Theatre, and Timo and Tuomo Suomalainen reveived the first prize in the competition for the Temppeliaukio Church. Probably the organic architecture of these these three projects did not please everybody, but they did not arouse public criticism either.

In the mid 1960s a strict modular trend, the so-called Finnish Constructivism, began to dominate competitions, publications and education at the architecture schools – one of the strongholds of Constructivism was the TKK Department of Architecture, which was situated only 100 m from Dipoli. At the same time, the construction industry and the authorities required higher level of standardisation, prefabrication and flexible universal layouts. As a result, the experimental free-form architecture was more and more marginalized. For many years, the Pietiläs had great difficulties in attracting new clients.

In the anti-elitist atmosphere of the late 1960s three buildings: Dipoli, the Temppeliaukio Church and Aalto's Finlandia Hall, become symbols for eccentric and wasteful elite architecture.^{xlvii} Nevertheless, many foreign critics, such as Christian Norberg-Schulz, admired Dipoli,^{xlviii} and it was widely published in the international magazines. Paradoxically, the fierce disputes also ensured that for almost half a century Dipoli has been of the key monuments of the Finnish Modernism – as far as I know, not a single history has been written without mentioning it.

The technology students moved to Dipoli filled with enthusiasm, and for several years the building was full of activity. However, it soon became clear that the functional concept had outdated during the prolonged design and construction process. It was designed for the patriotic and unpolitical technology students of the late 1950s, but the highly politicised student community of the late 1960s and 1970s had quite different needs. The building also proved to be oversized for TKY's financial resources. Thus, many rooms were never used in such a way as Pietilä and Paatelainen had designed. For example, the Technology Student Museum was immediately converted to game rooms, the first-class restaurant became a striptease club, and the main foyer was filled with souvenir stalls. From the very beginning Dipoli was designed so that it could also be used as a

confrerence center to increase renevue. Gradually, congresses and exhibitions replaced much of the student activity. During the recession of the early 1990s TKY had to rent Dipoli for the University and move to less expensive facilities.^{xlix} In December 2013 the Student Union finally sold the building for the Aalto University to get rid of the unproductive property. Nevertheless, the flexibility of the layout has enabled quite dramatic functional changes without destroying the original spatial structure.

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