Functionalism and Technology
The Case of the Paimio Sanatorium

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The question concerning technology was most essential to the Functionalistic discourse in the late 1920s and early 1930s. Antonio Sant'Elia's Futurist manifesto had paved the way for new buildings designed to take full advantage of every technological and scientific resource available. The Futurists had also formulated a new ideal of beauty with a taste for light, the practical, the ephemeral, and the fast moving. Sigfried Giedion dealt with the change of paradigm within architecture from monumental to rational building. He focused on the meaning of the new industrially produced materials, as well as on the redefinition of the role of the architect within an industrial society. Building types, especially residential, Domino, Existenzminimum, standardisation, design for industry, rational building, hygiene, and social concerns were often topics discussed in the Functionalistic writings. Michel Foucault has pointed out that a very narrow meaning is given to the concept of "technology" in architectural studies. One should not limit the concept to hard technology only, but also include social organizations within it.[1]

In this study, I have understood a building as a technological metasystem, including physical objects or artefacts, activities or processes, and know-how.[2] A building is an outcome of a technological process. However, architecture appears to be the product of an artistic intention, not purely of necessity as in building. Architectural savoir deals with several aspects, such as the history of the profession, evolution of the science of construction, and a rewriting of aesthetic theories. It is my intention here to open new perspectives into the relationship between Functionalist architecture and technology by applying theoretical frameworks used in studying the history of technology. An analogy to the Actor Network Theory (ANT) developed by Bruno Latour and Michel Callon is presented together with the implications of Thomas Hughes' concepts dealing with the development of technological systems, and the possibilities which the social construction of facts and artefacts (SCOT) open for interpretation of architecture. My comprehensive empirical data is related to the most famous work of Finnish Functionalism, Pai-

mio Sanatorium (1929–1933) by Alvar Aalto.

Reinforced concrete skeleton and architect

Bruno Latour's central message is that the social sciences have forgotten technology and the non-human agents. In this manner, they have lost important opportunities to understand society and its changes.[3] Such distinctions as social/technical, modern/postmodern, are produced by the actors themselves and for this reason do not serve as resources for explaining phenomena. Latour opposes Martin Heidegger's understanding of technology. For Heidegger, technology dominates humans, the natural world and even the natural sciences. In his philosophy, technology frames (Gestellen) our understanding of reality. Latour used a simple, well-known example ("Guns kill people") to demonstrate the impossibility of speaking of any sort of mastery in our relations with non-humans, including their supposed mastery over us. In this chapter, I follow Latour's line of thinking presented in Pandora's Hope[4] and suggest an analogy to his example.

If I state: "By using a reinforced concrete frame good Functionalistic architecture is (was) created", architects would reply: "Reinforced concrete doesn't make architecture; architects make architecture." The first slogan is materialistic: the reinforced concrete acts by virtue of material qualities irreducible to the social qualities of the architect. The sociological view would instead emphasize the moral qualities of the architect: a good architect would make good architecture out of any material. In the first version the reinforced concrete frame adds everything to the action. By contrast, the sociological version renders the reinforced concrete skeleton a neutral carrier that adds nothing to the action. The materialists, according to Latour, would thus make the intriguing suggestion that our qualities as subjects, our competence, our personalities, depend on what we hold in our hands. The materialists insist that we are what means we possess. For the sociologists, the reinforced concrete frame adds something, though not to the moral state of the architect. Latour states that for the sociologists one's moral state is a Platonic essence: one is born either a good architect or an untalented one. In this account, what matters is what you are. The reinforced concrete frame only speeds the act but doesn't modify one's goal. In real life, the materialists would agree that the human actor is to some extent transformed by the material. The reinforced concrete frame could serve as a source of inspiration for the architect. However, without the reinforced concrete frame no good Functionalistic architecture would exist. Even the sociologists agree that the material adds something to the process.

Latour describes four ways of technical mediation. The first one is a program of action, a series of goals, steps, and intentions. He states that if the agent is human and his goal is interrupted for whatever reason, he makes a detour, a deviation – and a third agent emerges from a fusion of the other two. Which goal will the

new composite agent now pursue? It may return to either agent's previous goal or adopt a new one corresponding to neither agent's program of action. (You only wanted to make architecture but now, with the reinforced concrete frame within your reach, you want to make Functionalist architecture). Latour has used the concept translation in the meaning of displacement, drift, invention, mediation, the creation of a link that did not exist before and that, to some degree, modifies the original two.

The third hybrid entity is someone else. In ANT, the translation is wholly symmetrical. The architect is different working with the reinforced concrete skeleton and the reinforced concrete skeleton becomes something else (good architecture in an architect's hands). There is symmetry between the agents. Through action, the reinforced concrete skeleton ceases to be only abstract knowledge and potential possibilities. Abandoning the subject-object dichotomy helps us understand collectives. In ANT, responsibility for action is shared among the various agents. If action is a property of associated entities, it is unfair to say, "architects make good Functionalist architecture". Making Functionalistic architecture is a property of the whole association of entities that includes material techniques, social organizations, and human actors. Action is not a property of humans, but of an association of actants. In reality, all agents have several goals (subprograms). The interaction is complex. The agents offer each other new possibilities, new goals, and new modes of action.

Following in the footsteps of Bruno Latour, one could discuss Alvar Aalto's early intentions to carry out a design based on a reinforced concrete frame during the years he worked and lived in the city of Turku in Southwestern Finland (1927–33). The Standard block of rental flats, the Southwestern Finland Agricultural Co-operative building and theatre and the Turun Sanomat newspaper office offer a field in which to investigate Aalto's evolution. All these buildings

have reinforced concrete frames, different in each case. Some persons appeared in several projects, e.g. Emil Hartela, the structural engineer. However, the goals and associated entities varied. The reinforced concrete frame of Paimio Sanatorium (1928–33) allows one to reflect on the relationship between the architect and the engineer in the design project. Reinforced concrete embodies abstract scientific knowledge. The architect was influenced by the engineer who was able to make calculations. On the other hand, it was the building company which had the experience. The construction manager, Arvi Ahti, who got the commission to realize the reinforced concrete frame of Paimio Sanatorium, was a close member of Mr. Hartela's family. These men had years of experience co-operating together. Constructing the seven-story wing of narrow, cantilevered sun-terraces balanced around one row of columns was an unforeseen project. An anecdote reveals something of the doubts that the young Aalto had: on a stormy autumn day he needed to drive to Paimio just to be sure that the structure had not collapsed![5] For Latour the most important meaning of technical mediation was crossing the boundary between signs and things. In the case of Paimio Sanatorium, the reinforced concrete frame made possible the non-bearing outer walls, which enabled the large-scale openings and finally the big windows allowed sunlight into the building which killed the tuberculosis bacteria. In this manner architecture was at the service of medical care. Aalto seems to have been talented enough to convince other people of the rationality and economy of his design and intentions, including the artistic ones. Latour remarks that for an outsider admiring the result the way the goal was achieved was not substantial. The agents delegate goals to other agents. Delegation is actorial, spatial, and temporal. The one who gave shape to the situation vanishes when the project is finished.

Innovations in wood

Alvar Aalto and Otto Korhonen, founder and owner of the Huonekalu- ja Rakennustyötehdas furniture manufacturing company, became collaborators in the late 1920s in Turku.

They started making experiments by bending

wood. The huge commission to manufacture the furniture for Paimio Sanatorium was a life belt for Otto Korhonen's factory during the years of recession in the early 1930s. For Aalto this provided a way to finance the development of his type of furniture. Aalto's most important patented innovations deal with different methods of bending wood and wooden furniture.[6] These innovations can be considered a cluster, a variation on the same theme. This activity began in close cooperation with the experienced and knowledgeable furniture manufacturer Otto Korhonen. Thomas Hughes has made an extensive empirical study of American innovators. In his book American Genesis, A Century of Invention And Technological Enthusiasm, the general themes deal with holistic system builders, the impact of Taylorism and Fordism, and he even discusses architecture and art. Hughes has characterized the different styles of invention. He makes a distinction between radical and conservative innovations. Radical inventions often led to the creation of new technological systems, whereas the conservative ones aimed at improving existing systems. Aalto's inventions dealing with methods of bending wood can be seen as conservative ones. Nevertheless, they lead to a change of production methods at Otto Korhonen's factory. Tailoring furniture and interiors set the stage for the serial production of standardized furniture. The manufacture was still based on manual work. The established manufacturers

rarely funded the radical invention of an independent inventor, because they sought inventions that improved the use of existing machines, devices, and processes.[7] Knowing the critical problems when developing technological systems is important. There have often been mentors who have alerted inventors to critical problems. In Aalto's case, the mentor was Otto Korhonen. Korhonen gave Aalto an insider's view of the technical qualities of the material and also a model for patenting. It is difficult to reconstruct the relationship between the two men because no letters remain.[8] Alvar Aalto's grandfather Hugo Hamilkar Hackstedt might have given him a role model and his friend Lasslo Moholy-Nagy inspiration, which are the influences Göran Schildt has underscored.

Aalto was an independent innovator who worked on his own. The co-operation between Korhonen and Aalto came to a sudden end in 1935 when Korhonen died. "Improvements relating to furniture and the like" was the name of the patent that was widely applied in Paimio. The so-called Paimio chair is produced according to this method. Korhonen and Aalto also managed to develop in 1932–33 the "Improvements relating to a Process of bending Wood and to Articles made thereby", in other words the L-leg, which later on became the basis of Aalto's furniture design. However, the L-leg was not applied in Paimio. The cabinetmakers worked as their assistants. Patents created a relation between the inventors and the technicians, which is characteristic of the modern world.[9] As innovators, Korhonen and Aalto's approach was empirical. Hughes would classify this pair of innovators as professionals because their income depended on the furniture manufacture.[10]

According to Hughes, inventor's imaginations and eureka moments often involve the use of metaphors which have often been visual or spatial. "A good metaphor implies an intuitive perception of the similarity in the dissimilar." Scientific discovery and technological invention depend heavily on metaphor.[11] Alvar Aalto's early patents and his standard drawings[12] open a perspective from which to discuss the relationship between designer and industry. It is easy to distinguish contradictions and similarities between the international discourse and local circumstances.[13]

Industrial steel windows

SCOT gives the tools to unfold the technological meanings Alvar Aalto constructed in his design in Paimio. Machine-aesthetics, international ideology, rationality, and hygiene are possible interpretations. Historians of technology often seem content to rely on the manifest success of the artefact as evidence that there is no further explanatory work to be done.[14] It is the obstacles in implementation that give an idea of the interpretative reality of a technological process. The case of Paimio Sanatorium also allows examining how technological meanings were shared among international groups of professionals. A key concept for SCOT is a relevant social group. All its members share the same set of meanings attached to a specific artefact. The artefact in question should have some meaning to the social group. Once the relevant groups around an artefact are identified, they are described more in detail. In particular, the problems each group has with respect to the artefact are worthy of study. Each problem may have several solutions. In SCOT the developmental process of a technological artefact is described as an alternation of variation and selection. The relevant groups interact. The result is a "multidirectional" model in contrast to linear explanations often used explicitly in many innovation studies and implicitly in much of the history of technology. The "successful" stages in the development are not the only possible ones. Following the developmental stages of an artefact, one may notice growing or diminishing degrees of stabilisation.

Steel windows were used extensively in the Paimio Sanatorium. They were manufactured at the Chricton-Vulcan shipyard in Turku. The rolled steel profiles were imported and the windows tailor-made.

Finland was suffering from a deep recession in the early years of the 1930s and the construction committee of the sanatorium, formed by 52 municipalities in South-western Finland, had demanded that local labour and materials should be used in the project. At the time steel windows had become an emblem of modernity among Finnish architects. The domestic market was taken over by Finnish machine workshops. However,

there was no mass market in Finland and no serial production, only tailor-made systems were realized.[15] The steel windows were more expensive and elitist. The correspondence between the Harkopp & Krüger Company and Aalto reveals that the author was fully aware of the heat loss of steel windows. By contrast, the technical suitability to the Nordic climate of wooden windows was well known and there was an abundance of this local material.

The Functionalistic discourse, which emerged in the industrialized countries of Western Europe, stressed the rational production of building materials. The international discourse was more important to Aalto than using common sense in the agrarian local context. He consciously constructed an extensive steel window system on the most public (the most photographed) parts of the building. Wooden windows, the more economic solution, were used in the less public areas of the sanatorium, such as the patients' rooms.

The project was published in several architectural magazines before the Second World War. These articles shared Aalto's way of thinking. Both the text and photographs, first presented in the Finnish Arkkitehti magazine, were absorbed into the discussion.

Bijker and Pinch have claimed that a closure in technology involves the stabilisation of an artefact and the "disappearance" of problems. To close a technological controversy, one need not solve the problems in the common sense of the word. The key point is, whether the relevant social groups see the problem as being solved. Advertising can play an important role in shaping the meaning and a rhetorical move can be important.[16]

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Aalto claimed the double glazed stripe windows of the patients' wing would be easy to clean. This rhetorical move helped the medical experts stabilize the meaning of the steel window as hygienic ones. The architects' international community stabilised the problem of Paimio Sanatorium as a successful response to the challenge of Functionalism by publicising it widely.

Conclusion

By testing different frameworks applied in the studies of the history of technology, the mute object began to speak and the "black box" to unfold. Recognising the actor networks around a technological process, as well as the concepts of interpretative flexibility and closure mechanism, the notion of social group can be given empirical reference in the cultural study of technology. The example of the steel windows suggested that there was no direct connection between Functionalist ideology, which stressed economic solutions, and architectural form.

This study raises several questions that might be addressed in future studies of the history of architecture.

Notes

1. Foucault, Michel, 1982, "Space, Knowledge and Power, interwiev with Paul Rabinow", Architecture / Theory / since 1968 edited by K. Michael Hays. Cambridge, Massachusetts: The MIT Press, 2002 (2000), pp. 428–439.
2. Frederik W. Taylor's guiding principle was also to design a system of production involving both men and machines that would be as efficient as a well-designed, well-oiled machine.
3. Ylikoski, Petri, "Bruno Latour ja tieteentutkimus", Tiede ja edistys 4/2000, pp. 298–310.
4. Latour, Bruno, Pandora's Hope, Essays on the Reality of Science Studies, Cambridge, Massachusetts: Harvard University Press, 1999, pp. 174–215.
5. Törrönen, Sirkka, Varsinais-Suomen tuberkuloosipiiri , Kalevanniemen lastenparantola 1920–1962, Paimion parantola 1933–1983. Salo: Varsinais-Suomen tuberkuloosipiirin kuntainliitto, 1984; Koskela, Minnamaria, Paimion parantola – rakennus kuin "lääketieteellinen instrumentti". Pro gradu, University of Helsinki, 1998.
6. The information on Aalto's patents is based in my article that will be published in the yearbook of the Alvar Aalto Foundation in 2003. The manuscript for the Innovative

Aalto Exhibition held at the Innogallery of the National Board of Patents and Registration Nov. 20, 2002 – March 30, 2003 is also based on my unpublished article. More information: http://www. prh.fi/en/innogalleria.html

7. Hughes, Thomas P., American Genesis, A Century of Invention And Technological Enthusiasm, New York: The Penquin Group, 1989, p. 83.
8. Not at Alvar Aalto archives nor at the archives of the Huonekalu- ja rakennustyötehdas.
9. Fiorani, Eleonora, "Theoretical Notes on Patent", Rassegna 46, 1991, Patent and Design, 1991, pp. 12–17..
10. Hughes, op. cit., p.21.
11. The quotation is from Aristotle's De Poetica, in Hughes, op. cit., p. 76.
12. The so-called standard drawings by Alvar Aalto have to do with three projects: the Standard block of rental flats, the Turun Sanomat newspaper office and the Paimio Sanatorium. They include drawings for lamps, windows, doors, furniture and details. Elina Standerskjöld's two articles "Alvar Aalto and Standardisation" and "Alvar Aalto's Standard Drawings 1929–32", Acanthus, Helsinki: Museum of Finnish Architecture, 1992, pp. 74–88 and pp. 89–111.
13. Thomas P. Hughes, Networks of Power, Electrification in Western Society, 1880–1930, Baltimore: John Hopkins University Press, 1983.
14. Trevor Pinch and Wiebe Bijker "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology Might Benefit Each Other" in Bijker, W., Hughes, T. and Pinch, T. (ed.), The Social Construction of Technological Systems. New Directions in the Sociology and History of Technology. Cambridge, Massachusetts: The MIT Press, 1987 (1989), p.22.
15. Pinch and Bijker "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology Might Benefit Each Other" in Bijker, W., Hughes, T. and Pinch, T. (ed.), op. cit., p.44.
16. Pinch and Bijker "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology Might Benefit Each Other" in Bijker, W., Hughes, T. and Pinch, T. (ed.), op. cit., p.44.