## Technological Style is History

The effort to comprehend innovation across cultures and time highlights the importance of the explicating factors external to technology. It becomes relevant to nuance or differentiate the understanding of social and cultural responses to adopted technologies by recognizing that technology shapes culture, and just as importantly that culture shapes technology. By looking at a recent transfer of technology this reciprocal exchange is elaborated by considering the cultural or contextual influence in the adaptation of technology. In this connection the notion of technological style is revisited by questioning whether it pays due attention to the non-technical factors of the process? In order to compensate for the deficiencies of the technological style as a sensitizing device the concept of sociotechnical style is introduced – a concept more in tune with resent research in technology studies.

The Swedish historian of technology Svante Lindqvist finds the significance of the transfer of technology (TOT)[1] cannot be underestimated - it might be "*even more important*" than technological innovation (Lindqvist 2010: 181f). Certainly, TOT as a phenomenon appears to be intimately interlinked with innovation across cultures and times (Pacey 1990; Misa 2004) and technological change (Hughes 1983). The effort to comprehend TOT in all its complexity unquestionably seems laudable and thus preoccupying scholars from many different fields (Seely 2003). Therefore the question must be how to define TOT?

The late professor emeritus at Harvard Business School Richard S. Rosenbloom outlined TOT as the "*acquisition, development, and utilization of technology in a context different from that in which it originated.*" (Rosenbloom 1967: 603). Rosenbloom's definition captures the basic dynamics of TOT. However, when scrutinizing the transfer process, more seems to be at stake. According to the acknowledged historian of technology Melvin Kranzberg TOT is more than a transfer of a technological artefact. The origins of the transferred technology must be taken into consideration:

[1] My abbreviation.

"*the hardware carries the gospel along with it, not in the sense of particular religious ideas but in the sense of a whole set of socio-cultural attitudes and material paraphernalia. For it is difficult, perhaps impossible, to disengage the technological force from the socio-cultural baggage that follows behind and with it.*" (Kranzberg 1986: 38)

Thus the transferred artefact carries along with it a cultural baggage of for instance differing views of human nature, and engineerical traditions (Didier 2009). Philosopher Don Ihde wants to recognise TOT as "*basic cultural and existential interchange*" (Ihde 1993: 34) and so do the economist Aqueil Ahmad and sociologist Arthur S. Wilke (Ahmad & Wilke 1986: 89). These authors seem to echo Lewis Mumford's old dictum that a technological artefact or machinery should be viewed as an "*instrument of culture*" requiring cultural assimilation before being embedded in human praxis (Mumford 1946: 323). The economist and prominent historian of technology Nathan Rosenberg also wants to grasp the particularities of TOT. Rosenberg warns against the widespread reduction of TOT to a mere question of relocating "*a piece of hardware*" (Rosenberg 1972: 61f). He finds that the adaptation is *the* essential aspect of TOT, not to be underestimated. The modification of the transferred technology is a necessity in order to make it function in its' new environment, wherefore determining the success or failure of a transferred technology (Rosenberg 1976: 174).

The British historian Arnold Pacey finds these modifications inevitable and states that transferred technology is *always* modified in order to function under the conditions in the recipient country (Pacey 1990: 51). The Norwegian professor Knut H. Sørensen notes that a technological artefact is re-invented or re-innovated in the process of adapting it (Sørensen 1990: 127). He and his professorial colleague Merete Lie deem appropriation inevitable if a technology should be used in a local context (Lie & Sørensen 1996: 17). They call this process *domestication* (Lie & Sørensen 1996: 10). Professor Margrethe Aune comprehends the domestication as a reciprocal process, in which both "*technology and humans are affected, and in which both technical and*

*social features are changed.*" (Aune 1996: 92).[2] Like Aune sociologist Werner Rammert views the adaptation of a new technology as a two-way interaction involving not only technology shaping culture, but also that culture shaping technology (Rammert 2002: 174f). He stresses the latter aspect of technological adaptation finding that cultural shaping of technology influences the development of technological artefacts "*more frequently*" than previously recognized (Rammert 2002: 175). Yet Lewis Mumford considered this two-way interchange characterizing adaptation of technology in his magnum opus *Technics and Civilization* stating that the adoption of a technology is not a matter "*of making social institutions keep in step with the machine: the problem is equally one of altering the nature and the rhythm of the machine to fit the actual needs of the community.*" (Mumford 1946: 367). Thus he eyed the aspect of cultural shaping already in the early 1930's[3] finding as he did technology or the machine as a cultural artefact. Neither Mumford, nor Rammert focus explicitly on the cultural exchange caused by international TOT, as is the focal point of this paper.

## Transfers as a matter of style

Unlike Rammert and Mumford the distinguished historian of technology Thomas P. Hughes wrote about TOT to a great extent (Hughes 1962; 1983; 1987 & 1995). Although he doesn't use the term 'cultural shaping' explicitly, he does seem to have grasped the complexity of this process and its' "*cultural factors*" (Hughes 1983: 405). With his concept *technological style* the historian wants to understand how technology emerges from "*time and place*", thus how a technological artefact is shaped by factors external to technology (Hughes 1977: 212). He includes "*geography, economics, administrative, structure, legislation, and contingent historical events*" among these factors shaping technology (Hughes, 1977: 214).[4] These factors are not to be seen as determinants, but rather as interacting with technology and with each other in "*complex and systematic*" ways (Hughes 1977: 214). In a historical exposition he demonstrates how the composition of contemporary

[2] Lie and Sørensen find that TOT might cause changes and breaking of routines; however, they also acknowledge that a transferred technology can help sustain stability, and thus has preserving qualities (Lie & Sørensen 1996: 3).

[3] The American edition was published in 1934.

[4] Hughes stresses that other factors may influence technological style (Hughes 1977: 230).

technical components, business administration, forms of organisation, local politics and law as well as historical events have influenced three specific power systems in the US, England and Germany, given them different, but distinct technological styles (Hughes 1977: 230). In his acclaimed work *Networks of Power* Hughes further elaborates on how non-technical factors influence TOT asking whether technical factors alone can explain as failed attempts of transfers? (Hughes 1983: 65). The liberal legislative conditions in America, which influenced Thomas Edison's design of power systems, seemed to obstruct transferring them to England, where legal conditions were distinctly different (Hughes 1983: 61 & Hughes 1987: 69f).[5] Again Hughes finds that technological style relevant to take into account in order to explain what hampers the transfer process, since these non-technical factors shape technology:

"*Technological style can be defined as the technical characteristics that give a machine, process, device, or system a distinctive quality. Out of local conditions comes a technology with a distinctive style.*" (Hughes 1983: 405).

The adaptation process becomes a question of replacing the technological style of the transferred artefact with a technological style closer to the environment in the recipient culture. He explains how the Gaulard-Gibbs transformer had to be "*stripped*" of its British characteristics in order to adapt it to the local conditions in the recipient countries (Hughes 1995: 453). In the United States the Westinghouse Company eventually succeeded in adapting the transformer to local conditions, giving it an American style (Hughes 1987: 67). Thus seen in relation to TOT Hughes find that technological style can extend the comprehension of the adaptation, thus he stresses that adaptation to the local conditions or cultural context in the recipient countries "*culminating in style*" (Hughes 1987: 68).

The story of the transfer of the Gaulard-Gibbs transformer is by no means unique; the Israeli historian Alex Bloch explains how in the late 1950's the French Fouga Fighter had to be adopted to the local environment in Israel, revealing early indications of a

[5] Professor Ian Inkster talks of cultural constraints in the TOT process finding that the cultural background of the transferred technology can in be seen as inhibitive in some cases (Inkster 2007: 123).

national technological style (Bloch 2004: 26). Likewise Arnold Pacey describes how transferred steam trains became suited to Russian conditions be re-inventing their cylinder system (Pacey 1990: 152). The historian of technology Thomas J. Misa describes how the British colonial authorities in India imported costly British style bridges of wrought-iron trusses over masonry piers to India instead of using timber trestles with timber being abundant in the Bengal (Misa 2004: 117f). The Norwegian professor Per Østby describes how cars from various countries were "*interpreted, transformed, and then culturally integrated into Norwegian society*", thus shaped by "*national, regional, and local particularitie*s" (Østby 2004: 248f) and thereby he agrees with his colleague and countryman Knut Sørensen finding that adaption culminates in style. Sørensen describes how the car was made into a distinct Norwegian car when introduced to the Nordic country (Sørensen 1990: 8).

With his concept of technological style and his comprehension of external factors shaping the transferred technology in the adaptation process Hughes seems to provide the theoretical foundation to account for the non-technical factors of TOT. These factors seem to influence the outcome of the process and therefore must be seen as essential elements of TOT (McIntyre & Papp 1986; Seely 2003; Lindqvist 1984; 2010). Even so Svante Lindqvist finds that only a few modern studies of TOT take these factors into consideration in the effort of grasping the phenomenon in all its' complexity (Lindqvist 2010: 182). In order to compensate for this lack I suggest a digression to a modern study of TOT: the transfer of a South Korean robot to Denmark and Finland in 2011-12.[6]

## Asian robots travel to Europe

The social robot EngKey was constructed by the Korean Institute of Technology (KIST) to teach English to school students in Korea. Seated in another room a teacher in control of EngKey was to direct real-time robot interaction with the students in the classroom.

Besides this purpose EngKey was reprogrammed (and renamed Silbot) to facilitate cognitive exercises as a way of treating or slowing down age-related illnesses such as

[6] This is the subject of my PhD-dissertation to be published in 2018. The following empirical examples will be based on participant observations, research interviews and close reading of written sources including unpublished evaluation reports conducted by the author.

dementia among elderly citizens. The idea was to let the elders solve different cognitive tasks using tablets with the robot as an instructor. This use of the robot was promoted by the director of KIST to representatives of the municipalities of Helsinki, Finland, and Aarhus, Denmark. Supervised by KIST test beds were built in the Finnish capital and the second largest city in Denmark and elderly citizens were recruited as test persons for cognitive exercises which were carried out between the fall of 2011 and winter 2012.[7]

The test results in the two Nordic countries varied significantly: To the disappointment of their Korean collaborators the Finish project team chose to return the robot after the test period expired. Silbot was deemed unready for recreational services in the Finnish capital.

Despite noting Silbot's technical and cultural challenges in their evaluation report the municipality of Aarhus bought three exemplars of the robot after the test period and they still work with the Silbot today (or rather an updated version of Silbot). Should these examples merely be presented as unsuccessful and successful transfers? The details of the transfer processes seem more interesting than this conclusion alone. Interviewing central members of the Finnish project team helps to elaborate the evaluation results and it gives an idea why the transfer of Silbot to Finland failed. Besides plain technical problems the robot did not meet the needs of the elderly test persons. The robot's ability to fight or halt dementia never tested out of reluctance by the Finnish project team - instead the robot was seen as amusement to the elderly citizens. However, it was noted that the participants lost interest in the robot and concentrated solely on solving or winning the cognitive games. According to both users and the project team the robot was deemed unnecessary, underdeveloped and *too* expensive. The Finns stressed that transfer of the robot was a push-project and that it lacked "*flexibility*", because the robot could not easily be adapted to the environment in the test centre. Even small adjustments in the test-setup in order to suit the needs expressed by the personnel responsible for the care of the elderly citizens required many hours of programming.

[7] Originally two robots were transferred from South Korea to Denmark and Finland – Silbot and Mero. Due to technical problems Mero was not used throughout the test period in Denmark. Mero was used in Helsinki, but sent back with Silbot after the test period expired. In this paper I concentrate on the use of Silbot in both of the Nordic countries.

Although KIST had programmed Silbot to speak Danish, its' use of the language caused concerns in Aarhus. There were examples of the robot "*scolding*" the elderly citizens when they did not complete the cognitive exercises within the given time frame or openly criticising some participants, thus being insensitive to their physical and/or mental illnesses. These language problems overshadowed the effort to create a positive learning environment for the elderly citizens. The conclusion stated that Silbot ought be "more adjusted" to "*Danish culture*", as the "*cultural dimension*" was seen as a "*serious challenge*". The robot was sent back to Korea for re-education and returned to Denmark disciplined and well behaved, according to the leader of the project team. Despite apparent technical challenges the Danes continued using the robot for cognitive exercises after the test period. They regularly reported its' defects to KIST, who then appropriated and reprogrammed some of the cognitive games. The Danes raised their expectations for the future design of the robot. These expectations were largely met by the Koreans in the design of the present version of Silbot, which has since replaced the original version transferred to Aarhus.

Returning to the discussion of TOT as being a cultural interchange and a case for cultural shaping how should one understand the transfer of Silbot from Asia to the Nordic countries in this perspective?

The three-month test in Finland, which ended with the robot being sent back, does not seem to have been an occasion for adaptation or noticeable cultural shaping of the technological artefact; at least these efforts now seem futile.[8] However, in some ways the TOT process from South Korea to Denmark still seems in progress and as noted the room for directly shaping the robot according to the Danish cultural needs still exists. Thus two way-exchange between Denmark and South Korea or the dual process of culture shaping and cultural shaping continues. There seem to be room for what Arnold Pacey would call a "*technological dialogue*" or "*inventive exchange*" (Pacey 1990: 8) between Aarhus and Seoul, which he deems crucial to the adaptation efforts (Pacey 1990: 204).[9]

[8] The Finnish project team managed to programme the robot to speak in simple Finnish sentences. Perhaps the most striking result of TOT to Finland was that many of the elderly participants bought tablets after the test period ended.

[9] There doesn't seem to have been a foundation for a continuous dialogue between Finland and South Korea. Actually, KIST never answered when the Finns asked if they could buy the cognitive games without the buying the robot.

Does the empirical example in this paper reveal the adaptation of Silbot culminating in a distinct technological style? The answer to this question seems ambiguous. Indeed, the Silbot 3.0 varies distinctively from the robot transferred to Aarhus in 2011 - most significantly in its' physical appearance. The transferred robot was egg-shaped with a kind robot face, while the present version is shaped as an hourglass and has a reflective female face. Is this the case of the recipient stripping the robot of its' national characteristics in order to adopt it to the local conditions? Has Silbot thus been given a Danish technological style?

Certainly, Silbot has been stripped of some of its characteristics as some of the cognitive games have been altered. They now include Danish songs and national stories about Vikings and runic stones to be remembered by the participants. The duration of the games has been extended, but maybe more interestingly, the Municipality of Aarhus are planning to require the right to the cognitive games used in the robot-system. The idea is to locate the programming of these games in Denmark hoping this would make them even more relevant to Danish culture and eventually to cut the dependence on the technical support from Korea. In this sense the cultural shaping, or one could say technological styling, does seem to continue without a near end in sight or the culmination in a technological style. This failure to locate a distinct technological style as the result of the TOT between Seoul and Aarhus could fall back on Hughes' notion of technological style being only a relevant device in a historian's toolkit, when she or he looks back and tries to write technological history. Yet Hughes himself suggests that the concept can be used by other academics e.g. sociologists (Hughes 1987: 68f). The problem for sociologists, anthropologists and academics alike seems to be that they, unlike historians study processes, not necessarily outlined in time. The culmination in style might therefore be difficult to identify. Even the phenomenon of TOT seems difficult to delimit: the question must be, when is a transferred technology fully adapted?

## A change in style

The concept of technological style seems to be fertile as a heuristic or sensitizing device, because it allows the researcher to identify influencing factors external to technology. The German Professor Hans-Liudger Dienel concludes the same and describes technological style as a comparative grid or raster (*Vergleichsraster*) (Dienel 1995: 30). Yet Dienel finds Thomas Hughes' definition of technological style too narrow (Dienel 1991: 101). The problem is that Hughes focuses on the "*technical characteristics*" that gives machinery or a system a "*distinctive quality*", where Dienel prefers Lewis Mumford's definition of (technological) style formulated in the early 1920's:

"*the reasoned expression in some particular work, of the complex of social and technological experience that grows out of a community's life.*" (Mumford, 1921: 264; quoted in Dienel, 1990: 101)

In Mumford's definition of style, the social and the technical seems to be inseparable, whereas in Hughes' understanding the social is implicit in the technology as one of the many components of technological systems. Indeed the social dimension also seems latent in the adaptation process, where social agents and their actions are secondary to the cultural factors, and not easily accounted for (Hughes 1977: 214). Lindqvist finds it urgent to comprehend technology as a cultural and social phenomenon (Lindqvist 2010: 186). He equates social and cultural factors as decisive factors to the result of technology transfer (Lindqvist 2010: 185).

I suggest that Hughes' concept of technological style can be re-construed to compensate for these apparent deficits by renaming it *sociotechnical style*. Now this might seem a cosmetic change. However, I find the sociotechnical style as a heuristic device can account for the social construction of technology, which seems to be a part of the transfer process as well as the social elements of the adaptation process underlined by Lindqvist and others (Lubar, 1983; Hecht, 1996). Sociotechnical style satisfies the Science and Technology-research that came after Hughes' introduction of technological style in the 1980's – thus a focus on sociotechnical style implies the recognition of technological artefacts as sociotechnical ensembles, where "*the*

*technical is socially constructed, and that the social is technical constructed.*" (Bijker 1995: 273)

Thus the result of the cultural shaping (I suggest that this process should be understood as a social shaping process mediating cultural factors)[10] of a transferred technology is a culmination in sociotechnical style: A set-up where the social and the technical are recognized as intertwined, as Mumford found, and with a shape distinct of its' time and place.[11] This re-construed style concept would hopefully pave the way for historians and social scientists alike, using the concept of style as Hughes initially hoped for (Hughes 1987: 68). If so, historians would thus be able to describe the sociotechnical styles of technologies, whereas social scientists would recognise cultural shaping or sociotechnical styling of technologies, as these are adapted to human praxis.

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[10] This is actually close to Hughes' way of describing the process, without ever using the phrase "*social shaping*" (Hughes 1977: 214).

[11] Actually sociotechnical style also connotes Hughes' notion of the seamless web recognizing that the technical and social are overlapping "soft categories" (Hughes 1986: 287).

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