The importance of Technological Transfer Tempo for Desirable Organizational Adaptation – a Study of the Relations Between Technological Innovation and Organizational Development and Change

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Abstract

The main claim of the paper is to argue that Technological Innovation in an organization enforce organizational development and change (Levin, 1997: Levin & Greenwood, 2005).

Design and operation of new technology result in an organizational development process. The main managerial challenge is to make use of the technological innovation process to create the desired learning process in the organization. As Susman (1983) argues, this kind of socio–technical design is a search for the best solution, involving at the same time conflicting requirements of the technological - and social systems, in the search for a joint optimization. To achieve this, technological innovations cannot take place in a too high tempo, making an organizational adoption difficult.

To document our claims, results from one case project are presented from a juice manufacturer in the southeast region of Norway. The case describes the organizational changes taking place in the organization following a fast innovation process regarded as a pure technological project.

The case supports our claims that an organizations development will follow any technological innovation. It is however, necessary to run the organizational development (OD) processes in a conscious way, parallel with the technological innovation, to secure that the OD processes take place in the required direction to initiate planned organization learning and change and in the desired tempo.

Introduction

This paper focuses on the ability of an organization to adapt to a technological transfer process, and argues that technological diffusion involves substantial investment in human activity.

The unit of the analysis is the organization. The aim is to deal with the technological transfer as it might be seen from the perspective of the recipient company.

We argue that technology and organization create a seamless web, where the whole process is a social learning and development process. Based on this a set of managerial challenges are developed to ensure that the result will be a desired organization development. The case example show how a fast technology process in a juice producer mill led to a poor organizational adoption.

Technological Transfer is based on human activity

Technology is the material artifacts, how to use the artifacts to reach desired goals, and the knowledge of how to utilize it, (Levin, Fossen, Gjersvik 1994). Emerging from this definition is knowledge that technology links with human activity. A close study on how technology is developed, lead to different models for explaining how technology is formed in a social process.

Hughes (1987) focuses, from a systems approach, on how actors in large technological systems interact to make the new technology possible in describing the development of the distribution of electrical energy for lightning, Pinch & Bijker (1987), involving key actors -of the technological development, - raising money and - establishing companies to distribute and sell energy to potential users.

In line with Bertalanaffy (1998) a system is a structured assembly of components and sub-systems, which interact through interfaces. The elements and their interactions constitute a total system. Organizations are open systems and interact with their environment. They exhibit the character of steady state, wherein a dynamic interaction of systems elements adjust to changes in the environment.

In the socio – technical systems perspective one tries to understand problems within an organization as matters deriving from the relations between the social and the technical sub-systems (Trist and Bamfort, 1951). The organization is viewed as a system. The social system is humans in the organization and the relations between them. Levin, Fossen and Gjersvik (1994) claim that this first of all has something to do with the individual's needs and wishes related to his of hers working conditions, and secondly with inter-human relations as, safety, support, involvement, status, power and social networks.

As Susman (1983) argues, the socio-technical system design is a search for the best solution, involving the same time conflicting requirements of the technical and social systems. This often means that one has to compromise with the requirements of a perfect technology, in order to get a well - functioning social system. It may be necessary to make other technical choices in order to achieve a joint optimization of the overall system. From this, a technological innovation will take place in the interplay between humans and machines, in the search for a joint optimization.

Emery & Emery (1974) claim that socio-technical design concept serve as a reference when analyzing parts of a whole, where the whole is represented by the industrial production of an enterprise. This context requires a selection to be made regarding how to use the technology, independent of its complexity.

A formulation of socio-technical design is given by Elden et al (1986): 'A socio-technical design implies that the human is regarded as a social individual with necessary and important relations to fellow workers, superiors and subordinates. The human being is part of a larger community. He or she has capabilities of both thinking and of carrying out manual tasks. At the same time the individual can develop itself through learning based on new experiences. The technology has to be designed in such a way that is useful when utilized by human beings'.

The Tavistock Institute committed itself to do practical research using the socio-technical system design principles in the Norwegian Democracy Project in Norway in the 1960s. The Democracy Project carried out a set of experiments at different kind of industry located both in urban and rural areas (Elden, 1979; Thorsrud, 1970). The results from the Norwegian Democracy Project had a major impact on how to organize industrial work in Scandinavia. A central realization from the project was that participative approaches were necessary in order to increase the industrial democracy. This approach became a design criterion for all interventions in industrial organizations. New management ideologies are developed, focusing on good social relations (Vanebo and Bush, 1988). This main concept from the project is still valid, 'the socio-technical thinking is building links between the technological system and the organization' (Levin, 2002).

In line with the socio-technical thinking technological innovations will create organizational changes, even if this is not the main purpose. However, within this perspective it is possible to change focus and more actively utilize a technological innovation project to achieve planned organizational changes. The authors claim that this can be an efficient tool.

From a social constructivists position development of new technology is regarded as a social product, involving actors that are social and politically conscious. This position maintains that it is critical to understand the social processes taking place, in order to promote the knowledge of the development of the new technology. The focus is on the variety of technical knowledge in question and the social actor involved, rather than regarding technology development from deterministic and imperative perspectives. In these processes conflicts are natural elements. From a social constructivists position shaping the technology are never neutral ones. Conflicts do not necessarily mean that a battle is taking place, but are seen as positive and necessary elements for technological development. The existences of a controversy between different groups of actors can mean that they are representing groups with recognized different views. We present the social constructivist theory from two well known approaches: first from the SCOT (social construction of technology) position, given by Pinch & Bijker (1987) and a further elaboration of this position on technology development, given by Latour (1987).

Pinch &Bijker model technological development as a complex social process where actors, engineers, marketers and the business community interact in the same processes to develop the new technology. The appearance of the new technology is seen in relation to the different meanings constructed by different groups of relevant actors. In this complex process a social understanding emerges that one solution is the best. Closure is formed in a process of

consensus, in which the majority of actors have the power to state that the technology is fully developed.

A further elaboration of this position is given by Callon & Law (1982) and Latour (1987). They argue that actors first come up with strategies supporting their own interests for deciding what the new technology should be. In the process of translation their alliances. Larger alliances are built to have a decisive influence on what the new technology should be. Through the translation of interests and alliances held together, new technology is shaped, formed by conscious human actors. Latour points out that his model does not regard how the truth is discovered by the researchers, but how the truth is constructed from the statements that the actors make seeking support in creation of alliances.

Development of technology is, according to the argumentation above, a social process where the developed technology cannot be separated from the actors involved in shaping it. The intangible factors and the artifacts that make up the technology will put requirements on the user. The ability to use the technology depends according to Levin (1997) on mangers' and workes' understanding of what knowledge is built into the machines and tools and to achieve necessary skills and motivation to operate it efficient. An involving culture has to support this process, Schein (1992). These are the crucial points in technology transfer.

Research Method and Data Collection

To document this crucial point, the current study has to conduct an interview based survey to collect employees' opinions and attitudes at a case company, a Juice Producer Plant in Norway. The intention for interviews is data collecting in order to analyze the process of the technology transfer, particularly a new installation of technical equipment for a new Juice production line and how this new technology transfer has made impact for organizational changes and behavior. The research in the company has been going on for one year as a part of a large research project, called value creation 2010. Thus, observations and workshops have together with the interviews been important sources of knowledge to understand the challenges in the company regarding installation of a new technology.

The interview survey was introduced to sampled employees and the questions were asked through an interview guideline, consisting of 4 sections; questions for backgrounds, questions for initiation of this technology transferring project, questions for organizing and managing the project and questions for organization's adaptation for this technology transferring,

The research team has sampled the survey informants from the case Juice plant. There are two major groups of the survey informants, those from the plant management and those from the plant working force/production lines. By plant management, it means including administrative director, accounting director, marketing director and the chief of quality assurance. By plant working force/production lines, it means plant manager, production manager, representative for trade union, site managers and maintaining responsibility.

There is not coincident that groups are divided into these two mentioned categories. This categorizing reflects two dimensions: The nature of the cased juice producer's general structure; and, the practical/physical location of this cased juice plant.

The nature of this cased juice plant is family owned private business and the company structure is rather as centralized and top-down format. There is a clear boundary between management and production lines, so the most information and messages have to cross this boundary and communication seems to be much one way based.

The practical/physical location of the plant confirmed the mentioned structure sketch, that the two groups are in fact divided into two different and depended locations, though the distance is only 800 meters. Further observation suggested there is clear definition of functions and tasks between these two groups, though job rotation is quite common practice among the plant production employees.

Reflecting and grouping the survey informants is a further and concrete step to question or verify the crucial point in technology transfer, as introduced early: The ability to use the technology depends according to Levin (1997) on mangers' and workers' understanding of what knowledge is built into the machines and tools and to achieve necessary skills and motivation to operate it efficient. This is the crucial point in technology transfer.

There are totally 8 respondents to be interviewed, whereof 1 from management and rest 7 are from plant production lines. The analysis of interview materials has been focused on mangers' and workers' understanding of what knowledge is built into the machines and tools and to achieve necessary skills and motivation to operate it efficient. The organization of data materials are following the 4 sections of the interview guide, as backgrounds (9 questions), initiation of this technology transferring project (8 questions), organizing and managing the project (17 questions) and organization's adaptation for this technology transferring (13 questions).

Case: Installation of a new Technology in a juice producer plant

Backgrounds of the project:

The background of the project was a reorganization and outsourcing process at an earlier competitor, now customer and partner.

> *"A big project initiated by a direct enquiry from company A December 2005 on outsourced production capacity."* Production

The project was important because of the increase in production volume and the opportunities implied. With cost of production equipment, supplies and industrial commodities at the same level in the market productive capacity and efficiency factor is the main competitive edge.

> *"We could have rejected the deal, but then we would have no added value and economic growth in the company. The deal gives us opportunities in the increased volumes produced."* Management

It was an ambitious project with a time horizon close to impossible. From the signed contract to production start on the new production line we are talking about four months, to meet the needs in the marked

"I doubted if it was possible – everything had to be done inside a very short time limit." Management

The by far most important partner in the project was the processing and packaging solution company delivering this new production line. They were responsible for the technical solutions, installations and in-house training. A critical point would be to by a new production line in time.

Initiation of this technology transfer project

As written earlier the background of the project was a reorganization and outsourcing process at an earlier competitor, now customer and partner. It was also an ambitious project with a very short time horizon. To make this a mission possible resources and priority were given the project.

"It was a priority project." Management

The project took place in a small company with a workforce of less than 20. The organization of the project and who to be involved were in many aspects given in this scenario; including the head of the laboratory, the production manager, market manager and managing director. The empirical material shows that

"A small organization and given who to participate in the project." Management

The informal and flat organization model is emphasized among all the subjects and assessed as both strength and a possible problem for the company.

"The process took three months. Flat organization model. Fast decision-making process but also a possible problem when owners dominate the management and the company." Management

The employee representative and the employees were informed just days after the formal agreement were signed, but not involved in the actual decision making or design processes.

"The employee representative was oriented about the project the day after the agreement." Production

Organizing and managing the project

Once the contract has been signed, there was an information meeting for employees and local trade union was also informed about the project. There were also followed by a number of activities to initiate the project. As survey informants commented, there have been assigned project groups both for commercial and technical issues, and the production managers also could initiate the project with relative short notice. Though there seemed to be no tradition to involve the employees into the project in an early, this has also been accepted both by management and production personnel. The following citations illustrated the mentioned summary.

"There has been assigned two project groups, one for commercial and another for technical issues" Management

"The company has a simple organization structure, rather characteristic as informal meetings with a horizontal organizational structure" Production

"There has been held totally 5 project meetings" Management

"The most employees were not much involved in the project"

"The employees could not influence or participate in the choice of technological solutions for the project." Production

Distinctive views on a best way to do project suggested by different organizational levels. However, the distinction and disagreement seem to appear between management and operator level, regarding a best way to accomplish to project, and understanding of employees involvement for the whole project, especially at an early phase. The following citations have indicated clearly different views of the same issues, whether concerning the decision making process, organizational structure as a whole, the involvement of all employees to the project, the importance and necessity of training activities.

"The project should be set up as first priority and involve in everyone in the company and giving the information after signing the contract'…if you are not involving in the decision making process, you just sit there and waiting, a bad culture." Operation

"The whole process spent 3 months; we have a horizontal organizational structure and quick decision process, but at the same time a possible problem that the company owner dominates the management and the process." Management, this statement indicates common understanding from the management on this point of view forth issue

"There would not be delayed if the employees were participated or involved in more, neither would be worse to keep this project secret for the employees and they did not have such expectations or network for." Management, this citation shows apparently disagreement with production manager on this point of view

"I believed the process would be delayed if all employees and local trade union are involved in the project since there would be more people to involve in." Production

"Training activities for the new installation machine has been a poor dimension. There was no training course before the machine was installed in the factory, so the company management should have to priority the training package with machine subcontractor." Production

Despite of top-down communication format, the employees made good efforts at all. Despite of top-down communication format, the employees appear to be cooperative and understandable, or at least say, acceptable for this format of communication. The handling of most critical project phase in summer 2006 confirmed this fact. As we can see the citation below, the employees made good efforts for restructuring of shifting arrangement, from 2 to 3 in order to save the situation for the company.

"The most critical project phase was at beginning of May 2006, when we have no products at our restore, at the same time it was high season and new orders are

coming and on top of that we have the new machine to deal with. The employees were agreed to restructure from 2 to 3 shifts in the summer to save the situation, so here management and employees stood at the same side." Management

Organization's adaptation of this technology transferring

Once a technology transferring process has occurred in an organization, it usually follows by significant impact for the organization and its environment. As a result, an organization's adaptation has to be made in order to meet the technology transferring. For this adaptation process, it is essential for everyone in a company to understand this process and thus important to motivate all employees to work together to handle the changes resulted by the process.

A common observation/picture of the current situation. In a changing organization development process, it is vital to approach a common view, at least a common understanding of current situation in order to act cooperatively. The research team has asked the same questions for different actors in the organization, and received same and different responses on different issues. As for the company's structure, culture, the ways of communication and starting new projects, as well as daily routines, there seems to be a common observation/picture of the current situation. The following citations from the interview survey have demonstrated this trend:

"It is a nature reaction among the employees that the project would result more work to do. We succeed because our production managers were engaged in for extra shift work……motivation of money for extra shifting work." Management

"There was less negative reaction than what we expected among the employees for this project. Project started quickly and rumors spread fast." Production

"In September/October were employees able to operate equipment and technology completely." Production

"The daily control followed by the shift itself as self-organized, due to our professional and good shift leaders." Production

Different opinions and views on the adaptation process and the project organization. A common observation/picture is not necessarily a common understanding, so the following citations illustrated clearly disagreement between management and production on the same issue, for instance, the view of success for this project.

The company should not use this project as a model for further project, we should have tried to buy more time to initiate project, and at least training activities should have be taken place earlier." Production

"The company should use this project as a model for further project, especially tempo of the project, and we did very well, the other companies would not be able to do the same project, great satisfaction with our customers." Management

The need of employee involvement into the project and need for an involving culture. Though many informants, including management claimed the organization has a horizontal structure and this is an efficient structure to do the task, there is however a need of

employee involvement into the project and need for an involving culture. As the following citations have indicated, it is not an entire healthy process that employees are not able to receive the information that they feel their desire to receive, and this is a negative element for job motivation. There is apparently a need for further communication and dialog inside of the company, especially when operation workers made their improvement suggestions for increasing productivity, but not been able to receive encouragement and feedback.

> *"There has been done very little for create ownership attitudes among the employees. This is a family company with no tradition for employee involvement."* Production

> *"There has been a built culture…..that management is located in another building……have no information until you absolutely must get……we have meetings with management about the need for information, but nothing happened."* Operation

Discussion: On the Speed of Technological Transfer tempo

In the actual technology transfer project it was demonstrated that different actors had different knowledge and understanding of problem situations, signaling poor and not unified culture in the organization. In the company culture there was no tradition to involve the union and employees in the strategic or operative decision processes. This seemed to create problems with anchoring and ownership of the results among the employees at the end of the project with lack of motivation to operate the technical equipment at a high efficiency. We claim in line with Schein (1992) that it is important to create a sustainable and involving change culture to accomplish fast technology transfer projects. This requires involvement of the employees in all decisions, especially those with impact on their own working situation. The low involvement of employees could be due to different factors: lack of knowledge among the management of the importance of doing so, a belief that involvement of the employees could delay the project or the employees as a group could not be trusted. According to the empirical material the necessary skills to operate the new technology was given at the end of the project. As this was a new technology, even to the supplier, with a lot of technical problems, the result of technology was not in fact implemented four months after finishing the installation of the new technology the employees had the sufficient skills to operate the machine. On this background we argue that the speed of the project might have been slowed down, to create a good anchoring and ownership of the project results and a motivation to operate the new technology at a high efficiency. The empirical material shows that the operating efficiency of the new technology turned out to at the same level, and not very high, as for the other similar machines at the plant. This could mean that this actual project did not create improved and including working processes. The workers adopted the existing working praxis on the other machines.

Finally, we argue that this project was both successful and unsuccessful. It was successful in the way that the employees were able to operate the new technology, and unsuccessful because project did not result in any organization development processes.

Conclusions

In some technology transfer project it is necessary to keep a high speed. This should be balanced against the ability of management and employees understanding of what knowledge is built into the machines and tools and to achieve necessary skills and motivation to operate them efficient.

An open and involving company culture based on trust is a necessary mechanism to support fast technology transfer processes.

Reference

Bertalanaffy, L. 1998. General Systems Theory. New York: George Braziller

Callon, M. J. Law. 1982. on Interest and their Tradition Enrolment and Counter Enrolment. Canadian Journal of Sociology 22

Elden et al. 1986. Mennesker i arbeid. Oslo: Universitetsforlaget

Elden. M. 1979. Three Generations of Work Democracy Experiments in Norway. In C. Cooper and E. Mumford (eds): Quality of Work in Eastern and Western Europe. London: Associated Press

Emery, F. M. Emery. 1974. ParticiativeDesign: Work and Community Life Canberra getting Coal. Human Relation 4

Hughes, T.P 1987. The Evaluation of large scale Technological Systems. MIT Press. Cambridge

Latour, B. 1987. Science in Action. Harvard University Press

Levin, M. 2002. Enhancing Innovations. In M. Levin (ed) : Researching Enterprise. Development.: Amsterdam: John Benjamin Publishing Company

Levin, M. Ø. Fossen. R. Gjersvik. 1994. Ledelse og teknologi.Oslo: Universitetsforlaget

Pinch, T.H. W.E. Bijker. 1987. The social construction of facts and artifacts. MIT Press. Cambridge

Schein, E.H. 1992. Organizational Culture and Leadership. San Francisco: Jossey – Bass.

Susman, G. 1983. Action Research: A Sociotechnical Perspective. In G. Morgan (ed) Beyond Method – Strategies for Social Research. Newbury Park: Sage

Thorsrud, B. 1970. A strategy for research and social change in Europe. An Industrial project report in Norway. Social Science Information

Trist & Bamfort. 1951. Some Social and Psychological Consequences of the long wall Method of Coal Getting. Human Relation 4

Vanebo, J.O. T Busch. 1988. Organisasjon, Ledelse og Motivasjon. Oslo: Tano

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