



CHANGES IN DEVELOPMENT APPROACHES OF TECHNOLOGY AND
WORK ORGANISATION AND THE IMPACT ON PERFORMANCE

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CHANGES IN DEVELOPMENT APPROACHES OF TECHNOLOGY AND WORK ORGANISATION AND THE IMPACT ON PERFORMANCE

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ABSTRACT

The paper analyses the joined data and results of two separate studies together covering the change actions of 49 Swedish manufacturing companies during a ten-year period, 1988-1997. The purpose is to reveal the long-term change patterns of synchronous or non-synchronous change of technology and work organisation. The results are that during the studied ten-year period a lesser percentage of companies pursue synchronous change than non-synchronous. The general change pattern is indicating more focus on change of organisation than on technology, and this tendency has grown stronger in recent years. The results presented in this paper also indicate that synchronously changing companies during 1988-1997 tend to have had greater performance increases during recent years than non-synchronously changing companies.

INTRODUCTION

Two decades of research generally indicates that organisational issues, for example human resources, training, education, group technology, horizontal and vertical integration are related to the success or failure of the implementation of new and more advanced technologies, see for example (Kochan, 1988), (Osterman, 1991), (Hörte and Lindberg, 1994). Still the opinions differ on important strategic change and development issues such as when to initiate organisational and technological change and how to relate them to each other in time, focus and amount. Generally changes and their consequences such as impact on performance have been studied during shorter time periods, (Brödner, 1988), (Warner et al, 1990), (Hörte and Lindberg, 1992), leaving long term patterns unrevealed.

There are two important aspects to consider when discussing time, focus, and amount related issues of change or development of technology (T) and organisation (O). These are synchronous change and balanced change.

Synchronous refers to the process of change, how the change of technology and the change of organisation are related in time. If technological and organisational developments are pursued parallel changing both dimensions (T&O) at the same time the change is considered to be synchronous. One problem here is to determine if change, generally speaking, is or is not synchronous in the meaning of change in T and change in O happening at same time. When for example does an organisational development start? When the thought first is formed in the heads of the decision makers, when it is implemented in the heads of the majority of the workforce, or when it is physically carried out in the

company giving visual effects? Therefore time is more realistically thought of as a time period for which changes in the two dimensions technology and organisation are examined. If changes are undertaken in both dimensions during this period the development is considered to be synchronous.

Balanced on the other hand does not refer to the process but to the static or at a specific point in time existing difference in technological and organisational status. If the amount of development of the technological and organisational status at one point in time is equal, the status is considered to be balanced or “in balance”. A problem here is to decide when the amount is equal. How does one determine if the technological status is equal or not equal to the organisational status? There is no obvious answer to this question. Talking of amount during the change process there is however three roughly separable cases:

1. O-change but no T-change, since this means a higher amount of O-change following the logical principle of “something being more than nothing”.
 2. T-change but no O-change, following the same reasoning as above.
 3. T&O-change, where there are an undefined amount of change in both dimensions.
- The two first cases are by definition interpreted as non-synchronous changes while the third is synchronous, see also figure 1.

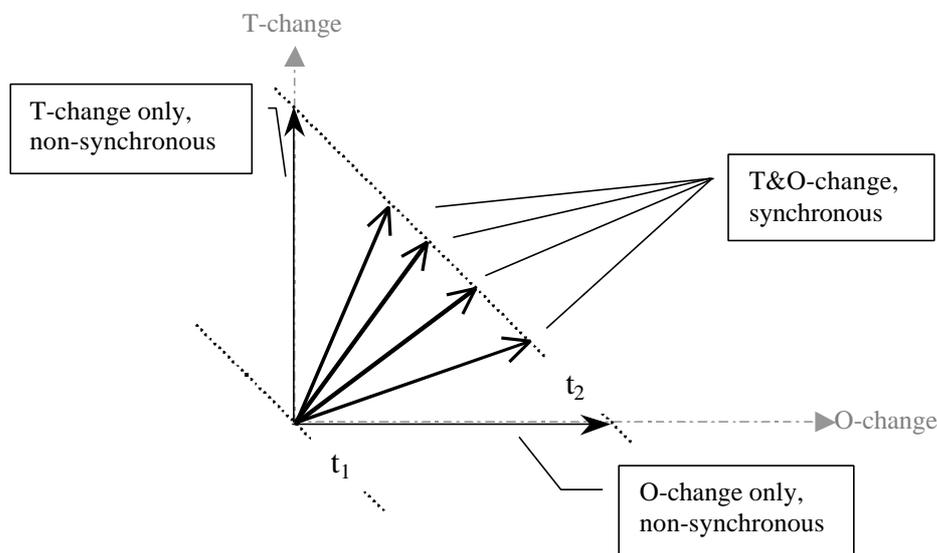


Figure 1. Two different change-patterns, synchronous and non-synchronous illustrated. “t₁” and “t₂” represent two different points in time.

A synchronous change between time one, t₁, and time two, t₂, does not automatically lead to balance, not even if the amount of change in the two dimensions during the change process are equal. This depends on the status in the beginning of the change. A balanced status at t₁ and synchronous change between t₁ and t₂ does not either guarantee the reach of balance at t₂. This depends on the amount of technology development and the amount of organisational development during the change process, illustrated in figure 1 by giving the arrows different slopes.

Synchronous (change process) and balanced (status) are illustrated in figure 2. Left in figure 2, the developments of two companies during two time periods are illustrated. During t₁-t₂ both companies are undertaking synchronous change. During t₂-t₃ however

Company A changes O but not T while Company B changes T but not O. In both cases the change is non-synchronous. In t_1 both companies have a balanced status but in t_3 this is just the case for Company A since, as shown in the right, balance in each point in time means equal amount of T and O.

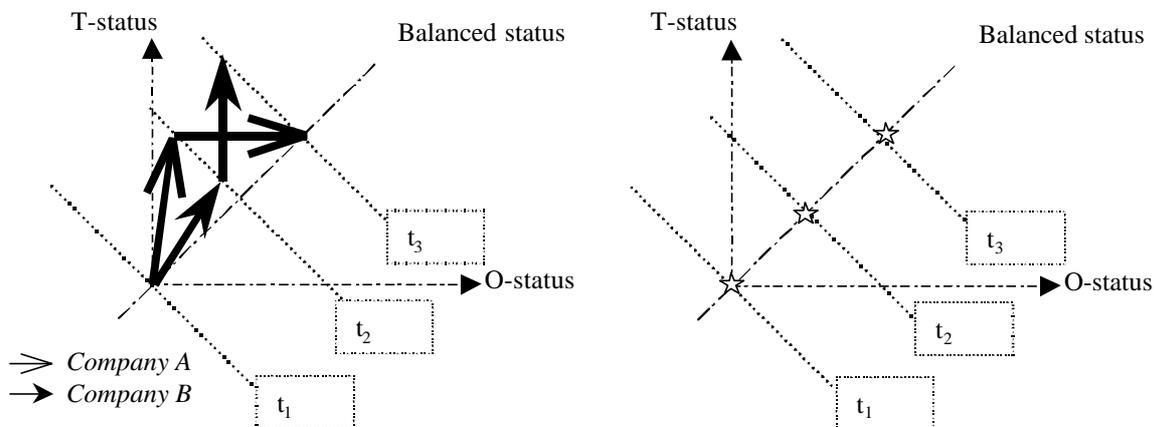


Figure 2. Synchronous and balanced change.

If the companies in figure 2 are examined only for t_1 and t_3 the change will, in both cases, appear to be synchronous, although when also considering the status at t_2 , the changes in fact both are non-synchronous.

PURPOSE

The purpose of this paper is to reveal the long-term change patterns of 49 Swedish companies, for which the change actions during a ten-year period are known. More specifically we seek the answers to three questions:

- Q1:** Do companies pursue a synchronous or a non-synchronous change when a ten-year period is regarded?
- Q2:** What change patterns emerges during a ten-year period when the status after five as well as ten years are known?
- Q3:** Are there differences in impact on performance of synchronous and non-synchronous change?

RESEARCH METHODS AND EMPIRICAL BASIS

The paper analyses the joined data and results of two separate studies of 49 medium sized or large Swedish manufacturing companies, mainly operating in the engineering industry.

The first study covers the time period January 1988- June 1992. Data were gathered during the summer of 1992 using retrospective questions. The second study covers the time period autumn 1992 - autumn 1997. Data were gathered during the vintner of 1997. In both studies, data were mainly gathered through structured telephone interviews addressing the companies' production and/or personnel manager.

The estimation of each company's status on the two dimensions technology and organisation and the corresponding changes during each five-year period, were independently coded by at least two different members of the research group.

There are slight differences in the way the dimensions are defined and the operationalisation of the dimensions, i.e. the measuring scales used to determine position or status of technology and organisation, in the two studies. In the study covering 1988-1992 “technology” mainly refers to the degree of computer integration and in the study 1992-1997 mainly the degree of automation. In the 1988-1992 study the other dimension “organisation” refers to and focus on group organisation and the degree of responsibility and authorisation groups have. In the 1992-1997 study the degree of decentralisation, how devolved the work organisations are, is focused. Even though the scales used are not identical, they can be related to each other. When addressing the issue of synchronous change, as in this paper, a separation between T-change only, O-change only and T&O-change is made. The distinction between these three is the same in both studies.

In the study 1992-1997, performance was measured using the scales from the study 1988-1992 developed by Hörte and Lindberg (1994). Both internal and external (compared to competitors) performances are regarded, measuring for example productivity, quality, absenteeism and personnel turnover.

RESULTS

In table 1 the change focus, on T only or on O-only or on T&O both, of the 49 studied companies during the two periods 1988-1992 and 1992-1997 are presented. Changes in focus between the periods are also visualised in the table using an arrow-sign.

Table 1 How companies change 1988-1992 and 1992-1997.

		1992-1997				Sum change 1988-1992
		No change	T-change (non-synchronous)	O-change (non-synchronous)	T&O-change (synchronous)	
1988-1992	No change	0	1 (T)	1 (O)	2 (T&O)	4 (8%)
	T-change (non-synchronous)	1 (T)	0 (TT)	2 (T→O)	3 (T→T&O)	6 (12%)
	O-change (non-synchronous)	3 (O)	2 (O→T)	2 (OO)	4 (O→T&O)	11 (22%)
	T&O-change (synchronous)	4 (T&O)	0 (T&O→T)	11 (T&O→O)	13 (TT&OO)	28 (57%)
Sum change 1992-1997		8 (16%)	3 (6%)	16 (33%)	22 (45%)	49

Not. “→” sign indicate change and its direction.

Between 1988 and 1992 a majority of the companies undertake synchronous change. This is also true during the following time-period, 1992-1997. More companies change synchronously than non-synchronously. There is however a slight increase in the number of companies undertaking a non-synchronous organisational focused change.

Now lets look at how the companies have changed between the year 1988 and the year 1997. All companies have changed in some respect. This is no surprise. During such a long time period as ten years this could be expected. Change is important in order to survive in a competitive environment. How do the change pattern turn out during these ten years? All but eight companies have changed both T and O and have, by definition, thereby undertaken a synchronous change. So, the change pattern changes as the time period is extended. The trend is toward more synchronous change the longer the studied pe-

riod. As most companies change synchronous, i.e. change both technology and organisation, the pattern of change for each separate company becomes more alike all the others.

If we break up the ten-year period and analyse the five-year periods separately a different picture emerges. We know that during 1988-1992 28 companies changed synchronously. We also know that in 1992-1997 the number of synchronously changing companies is 22, but that only 13 of these are synonymous to the ones changing synchronously during the preceding period. Six companies did change synchronously during one five-year period and not at all during the other. All other companies that did change both T&O during 1988-1997 did, during one or the other of the five-year periods, pursue a non-synchronous change, see table 2.

Table 2. How companies change 1988-1997. Differences between considering each five-year period during the ten-year study or not is shown.

	1988-1992	1992-1997	1988-1997, no considerations	1988-1997, considering known change in 1992
Synchronous	28	22	41	19
Non-synchronous	17	19	8	30
No change	4	8	0	0
Total number of companies	49	49	49	49

This gives us a different picture of the change pattern of the companies and how it changes as the studied time-period is extended from five to ten years. While the first review of the ten-year period indicate a rather great increase in the number of companies undertaking synchronous change the second review instead shows a slight decrease in synchronously changing companies.

In addition to the new picture of which company have change synchronously and which have not, a number of new change paths emerges in the general pattern. This is illustrated in figure 3.

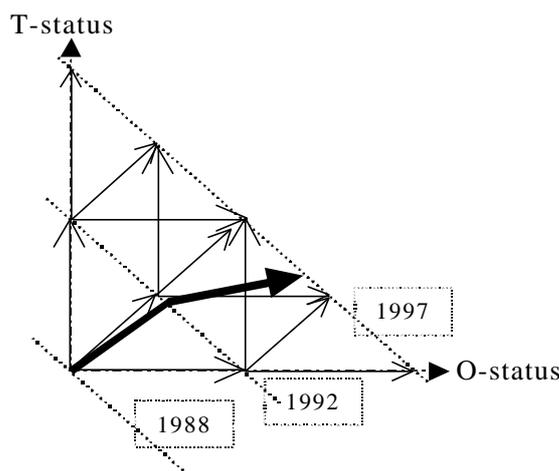


Figure 3 Schematic illustration of the change pattern. The fat arrow indicates the general change pattern.

Among companies changing focus following one of the paths in figure 3, the most commonly followed is a change from synchronous development of both technology and or-

ganisation toward development of organisation only. In figure 3 the fat arrow schematically illustrates the general tendency for all companies.

The performance impact on synchronous and non-synchronous change is presented in table 3. For all measures except absenteeism synchronously changing companies tend to have increased their performance more than the non-synchronously. The differences are, however, in general small.

Table 3. Synchronous change, non-synchronous change and performance impact.

	Internal Performance, companies with improved performance in percent						
	<i>Unit cost</i>	<i>Productivity</i>	<i>Total lead time</i>	<i>In time deliveries</i>	<i>Quality</i>	<i>Absenteeism</i>	<i>Personnel turnover</i>
<i>Synchronous</i>	75%	94%	89%	78%	82%	59%	29%
<i>Non-synchronous</i>	64%	88%	65%	74%	70%	70%	13%
	External performance, companies with better performance improvement than competitors in percent						
	<i>Unit cost</i>		<i>Flexibility in product change</i>		<i>Quality</i>	<i>In time deliveries</i>	
<i>Synchronous</i>	59%		65%		65%	71%	
<i>Non-synchronous</i>	48%		52%		52%	54%	

Note. The performance is measured 1992-1997, synchronous/non-synchronous refers to the period 1988-1997.

DISCUSSION AND CONCLUSIONS

Do companies pursue a synchronous or a non-synchronous change when a ten-year period is studied? The answer depends on whether we consider what we know about the changes undertaken by companies during different parts of these ten years or not. Considering all we know of the companies change actions during the studied ten-year period a lesser percentage of companies pursue synchronous change than non-synchronous. The general change pattern is indicating more focus on change of organisation than on technology, and this tendency has grown stronger in recent years. The impact on performance seems to be in favour of the synchronous rather than the non-synchronous change, as synchronously changing companies tend to have greater performance increases than non-synchronously changing. The tendencies are, however, weak for most measures of performance.

Results and recommendations on when to initiate organisational and technological change and how to relate them to each other in time, focus and amount have been presented by a number of researchers. (Ettlie, 1988), (Bessant, 1992), (Hörte, 1991), (Twigg and Voss, 1991), (Sun, 1993), (Hörte and Lindberg, 1994), (Hedlund and Hörte, 1999). Some are in favour of focus on technology or organisation separately; others are in favour of changes of technology and organisation both. What could be the reasons for these differences?

If we had simply focused on the status on each dimension in 1988 and compared it to the status in 1997 we would have interpreted a lot more companies as changing synchronously. What time period do we need to address in order to get a fair picture of the change pattern? If we regard too short time periods we will not get any pattern at all, as not technology or organisation is changed "over night". If we choose a too long time period, all companies are destined to change, otherwise they will have a hard time coping in the competitive environment. If the time period gets "long enough" all or almost all

companies probably will have to change technology and organisation both during one time or the other during this period. Thereby all changes will be synchronous. The best thing would be to follow the change at each company day by day during a long time, giving the long-term pattern as built of each separate change action taken by each separate company. As this is never realistic to do, as long time period and as many checkpoints as possible are recommended.

Another important issue connected to time is performance and time delayed effects of change. During the time-period when a particular change is undertaken the full effects of performance is not to be expected. More commonly one expect performance during change to be less then before change was initiated. How soon after change first is initiated/considered completed one can measure its' performance impact can differ depending on what is changed, technology or organisation, and if the change is synchronous or non-synchronous. The longer the companies are studied and the more that is known of actions taken "along the way" the clearer the pattern can be of the time-delayed effects of change as well as that of the change approaches.

One explanation for different and sometimes even contradicting results among studies could have to do with the length of the time-period as discussed above. It could also have to do with balance as defined in the introduction to this paper. This is discussed next.

The results of the 1988-1992 study, (Hörte and Lindberg, 1994) indicate a greater performance increase for companies focusing on human and organisational issues. As the fat arrow in figure 3 indicates the change pattern after 1992 bends toward O-change as more companies than before focus on human and organisational issues. Also, in general the companies do increase their performance. The results of the 1992-1997 study, however, do not indicate any greater performance increase in general for companies focusing on organisation, (Hedlund and Hörte, 1999). Twigg and Voss recommended in 1991 an organisational change focus, in order to balance a previously dominating focus on technology, (Twigg and Voss, 1991). Change actions taken in recent years among the companies studied in this paper seem to lead to a state of organisational dominance over technology within the companies. A possible unbalance between technology and organisation status could be a part of the explanation of these contradicting results. The question, however, when balance between the two dimensions is reached is, in it self, a matter for further discussion.

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