CONTINUOUS IMPROVEMENTS IN SWEDEN: RESULTS OF THE 2ND INTERNATIONAL CONTINUOUS IMPROVEMENT SURVEY

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ABSTRACT

This article reports findings from the Swedish part of the 2nd International Continuous Improvement Survey. Based on Bessant's evolutionary model of continuous improvement behaviour, the continuous improvement capability level of the Swedish engineering industry is estimated. The data analysis shows that there is a need for progression towards higher continuous improvement capability levels. Therefore, the specific abilities to develop in order to support such a move forward are clarified. In addition to an illustration of manufacturing practices in Sweden from a continuous improvement horizon, this article contributes to the field of operations management in two respects. Firstly, this is the first attempt to replicate the work of Bessant by means of a large-scale survey study, and it is shown that changes in continuous improvement abilities contribute to the enhancement of plant operating performance. Secondly, the study further elucidates the relationship between Total Quality Management practices and performance. Unlike previous studies, this article shows that given committed executives, the use of Total Quality Management tools and techniques for systematic problem solving and strategy deployment has an outstanding capacity to predict the contribution of continuous improvements to operations efficiency on the plant level.

This article is an excerpt from a detailed working paper that can be requested from the authors.

1. INTRODUCTION

An important contribution to the area of continuous improvements (CI) is made by the CIRCA programme in the UK (for details, see Bessant, 2003). Findings extend beyond existing TQM research and call attention to continuous improvement behaviour patterns. The advantages of such an emphasis are twofold. First of all, it confers insights into how continuous improvement capability can be developed in an organisation. Secondly and more importantly though, it also explains how the established capability can be developed and sustained over time. There are numerous examples in the literature of how customer focus programmes have run out of steam. The CIRCA programme research results show how to overcome obstacles of this kind. It is done by pointing out that the essence of progression along the CI road is learning, i.e. acquiring, practising and repeating continuous improvement behaviours until they become ingrained as 'the way we do things around here' – the culture of the organization (Bessant, 2003).

Table 1 summarizes the CI road according to the work of Bessant (2003). Progression towards higher CI capability levels in the model involves adding new routines to the core set of behaviour patterns of the organisation. Specific behaviour patterns cluster together and reinforce each other to create a certain CI ability. Thus, in order to increase the CI capability, organisations have to develop certain abilities by changing their behaviours. In total there are 34 behaviours and 8 abilities (for details, see Bessant, 2003).

The main purpose of this article is to report findings from the Swedish part of the 2nd International Continuous Improvement Survey. The focal point of our study has been the patterns of continuous improvement behaviour among Swedish engineering industry companies that contributes to enhanced plant operating performance. Our intention was that such a focus would help us shed light on our research questions. Our first question was:

1. What is the CI capability level in the Swedish engineering industry?

If this level could be estimated and a need for progression towards higher levels was identified, our second research question was:

2. Which are the CI abilities that would support such a move forward?

Continuous improvement capability level	Characteristic behaviour patterns
Level 1 - Pre-CI Interest in the concept has been triggered (by a crisis, by attendance at a seminar, by a visit to another organisation, etc.) but implementation is on an ad hoc basis.	Problems are solved randomly; no formal efforts or structure for improving the organisation; occasional bursts of improvement punctuated by inactivity and non-participation. Solutions tend to realise short-term benefits. No strategic impact on human resources, finance or other measurable targets. Staff and management are unaware of CI as a process.
Level 2 - Structured CI There is formal commitment to building a system which will develop CI across the organisation.	CI or an equivalent organisation improvement initiative has been introduced. Staff use structured problem solving processes; a high proportion of staff participate in CI activities; staff has been trained in basic CI tools. Structured idea-management system is in place. Recognition system has been introduced. CI activities have not been integrated into day-to- day operations.
Level 3 – Goal-Oriented CI There is a commitment to linking CI behaviour established at the local level to the wider strategic concerns of the organisation.	All the above plus: Formal deployment of strategic goals; monitoring and measuring of CI against these goals; CI activities are part of main business activities. Focus includes cross-boundary and even cross-enterprise problem solving.
Level 4 - Proactive CI There is an attempt to devolve autonomy and to empower individuals and groups to manage and direct their own processes	All the above plus: CI responsibilities devolved to problem solving unit; High levels of experimentation
Level 5 - Full CI Capability Approximates a model ‘learning organisation’.	All the above plus: Extensive and widely distributed learning behaviour; systematic finding and solving problems and acquisition and sharing of learning; widespread, autonomous but controlled experimentation.

Table 1. A model of stages in the evolution of CI capability and their characteristic behaviour patterns. Table content based on Bessant (2003). © John Wiley & Sons Limited. Reproduced with permission.

The expected contributions to knowledge by answering these questions are threefold.

First, we are helping our readers understand what abilities to develop among Swedish engineering industry companies in order to enhance their CI capability.

Secondly, we are helping our readers to assess the validity of Bessant's evolutionary model of continuous improvement behaviour. The model has previously been replicated by means of an implementation case study on a large South African mining company (De Jager et al., 2004). The model was found valid and implementation resulted in significant performance benefits for the case company. However, our study would be the first attempt to replicate Bessant's model quantitatively with a large-scale survey study. Stepwise regression analysis is used and replication has taken place if it is shown that changes in CI abilities contribute to enhanced plant operating performance. The following hypothesis is suggested:

- Developing CI abilities is related to improved plant operating performance.

Thirdly, we are helping our readers to further understand the relationship between TQM and performance. This issue has been studied extensively over the years within the operations management field. Of more recent studies, the work of Kaynak (2003) is of particular interest. Not only does she explain how TQM practices contribute to enhanced performance, she also provides a comprehensive literature review of antecedent studies on the topic published in major US and European journals. From the latter we learn that previous studies have produced mixed results and as a consequence it's important to define the following three aspects. The first is to specify the operationalization of TQM, i.e., whether a single construct was used, such as 'winning a quality award', which was the case in Hendricks and Singhal's (2001) study, or whether a multidimensional construct as in Anderson et al.'s (1995) study was used. Secondly, performance must be defined, i.e., whether financial performance of the firm is measured as in Easton and Jarrell's (1998) study or plant operating performance is measured as in Ahire and O'Shaughnessy (1998). Thirdly, the analytical framework must be defined, i.e., whether structural equation modelling is used for studying direct/indirect effects on various levels of performance, as in the work of Kaynak (Kaynak, 2003), or if multiple regression analysis is used to predict different practices' impact on performance, as in the work of Samson and Terziovski (1999).

In terms of the above alternatives, our study has a multidimensional construct, measures plant operating performance and uses multiple regression analysis. In comparison to the 20 listed studies in Kaynak's review, our approach most resembles the work of Samson and Terziovski (1999). The difference is that they based their TQM construct on the Malcolm Baldrige National Quality Award (MBNQA) criteria, whereas we focus on high involvement continuous improvement behaviour patterns.

2. METHODOLOGY

The unit of analysis for the Swedish part of the survey was 'manufacturing plants' with more than 50 employees (ISIC codes 27-35). The production manager was judged to have the best general view of the researched issues. Therefore the instrument was distributed as a postal survey to a random sample of 200 plants and addressed to the 'production manager'. Data were collected during the spring of 2003 and the total response rate amounted to 69% by the 30th of June 2003. 127 usable answers were collected. The instrument measures the organization and operation of CI, support for and tools used in improvement activities, the effects of improvement activities, company background and general characteristics of the organization. The instrument can be downloaded from the Internet (www.continuous-innovation.net).

The following five steps were taken to analyse the data:

1. Factor analysis to condense Bessant's 34 continuous improvement behaviours into a smaller set of empirically induced CI abilities, which were to be used as the independent variables in the subsequent stepwise regression analysis. See Table 2.
2. Factor analysis to derive the performance indicator, which was to be used as the dependent variable in the subsequent stepwise regression analysis. See Table 3.
3. Stepwise regression analysis to predict changes in the performance indicator in response to changes in CI abilities. By this step we also tested the initially stated hypothesis. See Table 4.
4. Plotting the median values of the continuous improvement behaviours that constitute the derived CI abilities, in order to enable:
   - an estimation of the CI capability of the Swedish engineering industry
   - an identification of the abilities to improve in order to enhance the CI capability of the Swedish engineering industry. (See Figure 1.)
5. Presentation of descriptive statistics on: means to establish CI, use of CI tools, CI motives, business objectives, changes in customer/market demands and CI incentives in order to further support the estimation of the CI capability of the Swedish engineering industry. None of these statistics are presented in this excerpt due to the size restrictions.

Name of component	Constituent continuous improvement behaviours	Component loadings			
		1	2	3	4
Systematic and Strategic CI α=0.8792 β=42.1	1) People use measurement to shape the improvement process.	0.86			
	2) People make use of some formal problem finding and solving cycle.	0.86			
	3) People use appropriate tools and techniques to support their improvement activities.	0.77			
	4) Individuals and groups monitor/measure the results of their improvement activity and their impact on strategic or departmental objectives.	0.76			
	5) A Continuous Improvement (CI) or equivalent formal improvement system (e.g. Total Productive Maintenance) has been introduced to involve all employees in ongoing improvement.	0.69			
Customer and supplier involvement α=0.5766 β=10.2	6) The organisation uses supplier and customer feedback as a means to improve company performance.		-0.81		
	7) Specific improvement projects are taking place with customers and/or suppliers.		-0.81		
Idea management and reward systems α=0.6774 β=8.8	8) Ideas and suggestions for improvement are responded to in a clearly defined and timely fashion – either implemented or otherwise dealt with.			0.82	
	9) The organisation recognises in formal but not necessarily financial ways the contribution of employees to continuous improvement.			0.81	
Strategic knowledge deployment α=0.8399 β=8.0	10) Everyone understands what the company's or their department's strategy, goals and objectives are.				-0.88
	11) Everyone learns from their experiences, both good and bad.				-0.83
	12) Before embarking on initial investigation and before implementing a solution, individuals and groups assess the improvements they proposed against strategic objectives, to ensure consistency.				-0.71
	13) Appropriate organisational mechanisms are used to deploy what has been learned across the organisation.				-0.59
	14) Managers at all levels display leadership and active commitment to ongoing improvement.				-0.56

Table 2. Factor analysis - pattern matrix for continuous improvement behaviours. Note: Coefficients sorted by size. Absolute values less than 0.5 suppressed. α=Cronbach alpha. β=% of variance explained by the component. Total variance explained = 69.1%. Note the negative signs on scores for factors 2 and 4. Question posed: To which degree to you agree with the following statements, describing the improvement activities in your organization?

Name of component	Constituent performance indicator	Component		
		1	2	3
Plant operating performance α=0.8570 β=46.3	Increased productivity	0.84		
	Reduced lead times	0.78		
	Increased production volume	0.75		
	Improved delivery reliability	0.73		
	Reduced cost	0.68		

Table 3. Factor analysis - rotated component matrix for performance indicators. Note: Absolute values less than 0.5 suppressed. Factors 'Safety and employee skills' as well as 'Supplier and customer relations' discarded. α=Cronbach alpha. β=% of variance explained by the component. Total variance explained = 70.8%. Questions posed: To what extent has continuous improvement contributed to the following areas of plant operating performance over the last three years? Scale 1-5, 1=not at all, 5=to a large extent. Plant operating performance was used as the dependent variable in the subsequent stepwise regression analysis.

	Model			
	1	2	3	4
	Systematic and strategic CI β=0.563 t=11.282*** VIF=1.000	Systematic and strategic CI β=0.514 t=10.297*** VIF=1.059	Systematic and strategic CI β=0.533 t=10.876*** VIF=1.131	Systematic and strategic CI β=0.490 t=8.264*** VIF=1.557
		Customer and supplier involvement β=-0.208 t=-4.173*** VIF=1.059	Customer and supplier involvement β=-0.207 t=-4.206*** VIF=1.059	Customer and supplier involvement β=-0.195 t=-3.965*** VIF=1.074
			Idea management and reward systems β=-0.150 t=-3.029** VIF=1.070	Idea management and reward systems β=-0.161 t=-3.249*** VIF=1.083
				Strategic knowledge deployment β=-0.119 t=-2.022* VIF=1.530
Adjusted R^2	0.315	0.354	0.372	0.379
F change	127.277***	17.416***	9.176**	4.090*

Table 4. Stepwise regression analysis. Note: β=standardized coefficient; VIF=Variance Inflation Factor; p≤0.001=*, p≤0.01=**, p≤0.05=*. Note that negative β and t values on the idea management and reward systems factor indicate a negative association with the performance indicator. Negative β and t values for the customer and supplier involvement, as well as the strategic knowledge deployment factor, are just a logic effect of negative factor scores.**

3. Results

3.1 Setting the stage – CI in Sweden 2003

Eighty-one per cent of Swedish production managers rated the overall importance of continuous improvements as vital or of strategic importance for their business unit's performance. In 99% of the cases the main improvement activities were carried out during regular working time. When it comes to how the main improvement activities were carried out, meetings of ordinary work teams were ranked most frequent and individual improvement work was ranked least frequent. Regular improvement activities occurred most frequently in the industrial engineering, manufacturing and quality departments.

3.2 Factor analysis 1 – CI behaviours

The factor analysis resulted in a solution of four factors that collectively explained 69% of the variance (Table 2). The first factor was named *systematic and strategic CI*. It explained 42% of the variance. This means, in less technical terms, that of Bessant's original 34 behaviours, the five of this factor have the highest ability to separate the 127 companies in the sample from each other in order to further categorize them. The factor consists of a cluster of behaviours that relates to the following three aspects. First, how well the organisation understands and shares the underlying values and beliefs about CI. Secondly, to what extent people can participate proactively in CI. Thirdly, how well the organisation links its CI activities to the strategic mission and key performance drivers of the business.

The second factor explained 10% of the variance and was named *customer and supplier involvement*. It consists of a cluster of behaviours that relates to how well the organisation is able to extend CI activity across organisational borders.

The third factor explained 9% of the variance and was named *idea management and reward systems.* It consists of a cluster of behaviours that relates to what extent idea management systems such as 'the suggestion box' are used as well as to what extent the contribution of employees to CI are recognized with various forms of incentives.

The fourth factor explained 8% of the variance and was named *strategic knowledge deployment*. It consists of a cluster of behaviours that relates to what extent people learn and to what capacity the organisation develops, captures and shares learning of strategic importance among its employees.

Six of Bessant's eight original CI abilities are represented across the four derived factors. The two that are missing are 'aligning CI', i.e. the ability to create consistency between CI values and behaviour and the organisational context (structures, procedures, etc.) and 'continuous improvement of continuous improvement', i.e. the ability to strategically manage the development of CI. To our understanding, this signifies that the behaviours of these two abilities have a low capacity to explain the variance of continuous improvement behaviour in the Swedish engineering industry.

3.3 Factor analysis 2 – CI performance indicators

The factor analysis resulted in a solution of three factors that collectively explained 71% of the variance (Table 3). Since the subsequent stepwise regression analysis required only one dependent variable, we had to decide which of the three derived factors to use. We selected the first factor, which was named *plant operating performance*. It consists of the following parameters: productivity, lead times, production volumes, delivery reliability and costs. The remaining two factors were discarded.

3.4 Stepwise regression analysis – Predicting CI performance

The four factors from factor analysis 1 were selected as independent variables and the first factor from factor analysis 2 was selected as dependent variable in the stepwise regression analysis. The final regression model consisted of all of the independent variables, which jointly explained 38% of the variation in the dependent variable (Table 4).

This means that all four of our factors (empirically induced CI abilities) are associated with plant operating performance. The first variable *systematic and strategic CI* solely accounted for 32% of the variation, which means that this variable outperforms the others in predicting the contribution of CI to plant operating performance. The second runner-up, *customer and supplier involvement,* explains an additional 3% of the variation not accounted for by the other variables in the model. The third runner-up, *idea management and reward systems,* explains an additional 2%. However, here it's important to note the negative β- and t-values. These indicate a *negative* association with plant operating performance, while all the other factors are positively associated with plant operating performance. The fourth and final runner-up, *strategic knowledge deployment,* explains an additional 1%.

To summarize, all four factors are associated with plant operating performance. Developing the behaviours of the *systematic and strategic CI-, customer and supplier involvement-* and *strategic knowledge development* factors will contribute to enhanced plant operating performance. This is particularly true for the behaviours that constitute the factor *systematic and strategic CI;* they have an outstanding capacity in this respect. The behaviours of the other two factors do also have a *significant* predictive ability and should therefore also be seriously taken into account. However, the regression model also shows that continuous improvements contribute the most to enhanced plant operating performance when the behaviours of the *idea management and reward systems* factor are not emphasized. This means that organisations with the highest aptitude to improve plant operating performance have done away with their suggestion boxes and furthermore they don't consider it important to reward CI initiatives. Perhaps this is because improvements are regarded as an integrated part of the daily work for their employees.

Finally, in the context of the initially stated research proposition, the result of the regression analysis signifies that we have confirmed our hypothesis, which implies that this study corroborates the work of Bessant (2003).

4. Discussion

4.1 CI capability of the Swedish engineering industry

Our first research question was posed to estimate the CI capability of the Swedish engineering industry. We claim that Swedish plants in general are carrying out their improvement work to a capacity that at the most corresponds to the second level of Bessant's evolutionary model of continuous improvements behaviour, i.e. the structured CI capability level where there is a formal commitment to building a system that will develop CI across the organisation. The main reason for this statement is that the plants haven't yet developed enough *systematic and strategic CI ability* in to order to qualify for higher levels. A major premise that Bessant's model is founded on, is that certain abilities correspond more than others to a particular CI capability level. The *systematic and strategic CI ability* is most concerned with the second CI capability level.

The evidence to support our reasoning is that none of the behaviours of the systematic and strategic CI factor obtained mode or median values above 3.

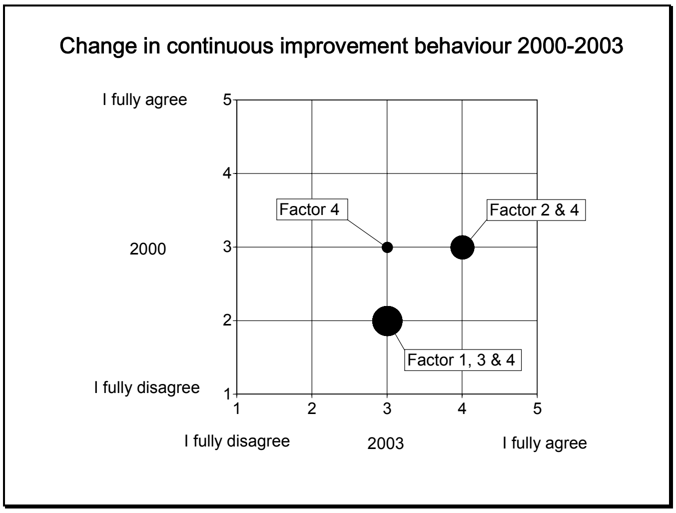

Figure 1. Median plot of change in continuous improvement behaviour 2000-2003. Bubble size corresponds to number of behaviours in each coordinate.

Furthermore, in four out of five behaviours of the factor, a full 67% of the plants can't agree, i.e., to attain the value 4 – 'I agree'. Our interpretation is that many companies seem to try to build systems that will develop CI across their organisations, for example TPM or 5S. However, the plants still haven't accomplished the establishment of these system's underlying behaviours throughout their organisations.

The other three of our empirically induced abilities (factors) should of course also be considered when the general CI capability of the Swedish engineering industry is determined.

Firstly, the plants obtain high scores on the behaviours of the *customer and supplier involvement* factor. This corresponds to routines of the third CI capability level, because at this level organisations are also expected to have a focus that includes cross-enterprise problem solving.

Secondly, the plants obtain mediocre scores on the behaviours of the *idea management and reward systems* factor, which in fact is a good thing since these have a negative association with improved performance. To our understanding the reluctance to use suggestion boxes and CI incentives corresponds to the fourth level of the model, i.e. the proactive CI capability level. At this level there is an attempt to devolve autonomy and to empower individuals and groups to manage and direct their own processes. Attempts to devolve autonomy bring about a view that continuous improvement is something that should be carried out during regular work time (not paid/unpaid overtime) and furthermore employees are expected to improve products and processes as an integrated task of their daily work. Idea management systems in parallel structures, as well as 'something extra' in the form of various incentives for carrying out one's ordinary work, thus seem redundant.

Thirdly, the plants obtain high scores on the behaviours of the strategic knowledge deployment factor. This corresponds to routines of the fifth CI capability level, i.e. full CI capability, because at this level plants are required to have widely distributed learning routines that capture and share learning throughout the organisation.

These three indications could, on the one hand, imply a higher estimated general CI capability level for the Swedish engineering industry than we initially suggested, i.e., at the most the second level. However, based on a second major premise that Bessant's model is founded on we maintain our claim. It asserts that the CI road is evolutionary. So, in order to have established the third level, the routines that make up level two must first have been ingrained as ‘the way we do things around here’, which certainly isn’t the case.

The three indications point in another direction instead. Since routines of the more advanced capability levels have been developed to a rather high extent, it won’t be that difficult to increase the capability level for Swedish plants, when the underlying behaviours of the second levels have been developed. This brings us to our next research question and our claim in response to that.

4.2 How to move forward

If a need for progression towards higher CI capability levels was identified, our second research question was posed to point out which CI abilities (empirically induced) to develop in order to support such a move forward. We claim that the most important abilities to develop are the ones that are associated with the *systematic and strategic CI* factor. There are two reasons for this. First, to refrain from changing the behaviours of these abilities would prevent plants from establishing higher CI capability levels. This was discussed above in relation to our first research question. Secondly, the behaviours of the *systematic and strategic CI* factor outperform the others in terms of performance impact. A major premise that Bessant’s model is founded on asserts a relationship between capability level and the contribution of CI to business performance. This implies that avoiding challenging the behaviours in question also prevents plants from taking advantage of their inherent performance benefits.

Evidence that supports our reasoning is that all of the five behaviours that make up the *systematic and strategic CI* factor can be found in the coordinate with the largest development potential in Figure 1. This is also supported by the other descriptive statistics where different tools and techniques rank high in importance but low in usage. The other source of evidence that supports us is that the behaviours of the *systematic and strategic CI* factor have the highest aptitude to predict performance impact. The stepwise regression analysis shows that the behaviours of this factor have an outstanding capacity to contribute to plant operating performance. In fact, this single factor explains 31.5% out of 38%.

The behaviours of the other factors should of course also be developed since they are associated with different CI capability levels as well as plant operating performance. Therefore, a development of behaviours 6 and 7 (see Table 2) with a greater emphasis on CI in the extended enterprise, for example, would contribute to further establishing the third capability level. A development of behaviours 8 and 9 of the *idea management and reward systems* factor would contribute to further establishing the fourth capability level. A supportive effort would be to further develop formal systems such as TPM or 5S that are inline, instead of offline systems in parallel structures such as the suggestion box. Another supportive effort would be to reconsider the role of CI incentives in favour of systems that confer work development instead of monetary recognitions. A development of behaviours 10-14 would contribute to further establishing full CI capability. Efforts that would support such a move forward could, for example, be focused on building structures for capturing and sharing knowledge of strategic importance to the organisation.

However, we maintain our assertion that the companies should start with the behaviours of the systematic and strategic CI factor, since these have the greatest performance impact and furthermore also form the basis for making the most of the benefits that the higher CI capability levels entail.

4.3 *THEORY REPLICATION*

We also claim to successfully have replicated the work of Bessant by a large-scale survey study. The reason is that all derived factors (empirically induced abilities) could be associated with improved plant operating performance. A core proposition of his model is that development of CI ability has bearing on performance improvements. In our case all derived abilities explained a significant proportion of the variation in the performance indicator when subjected to stepwise regression analysis.

There are two main implications of this in terms of theory extension. First of all, the model is found applicable for describing continuous improvement behaviour and predicting its likely performance impact in the Swedish engineering industry. We have been able to point out how different behavioural routines are embedded to form an ability in the given national context. In Sweden, for example, there is a strong tradition of socio-technical principles and group work (Bäckström, 1999). And this is why idea management systems in parallel structures, as well as 'something extra' in the form of various incentives for carrying out one's ordinary work, are shown to be redundant (Hart, Berger & Lindberg, 1996; Nilsson, 1999).

Secondly, we have been able to further nuance the relationship between the different CI capability levels and their likely performance impact. The dominant view of this relationship is that it's linear (see the figure on p. 57 in Bessant, 2003). As far as plant operating performance is concerned though, we would like to suggest that instead of being linear, the curve is shaped as illustrated in Figure 2.

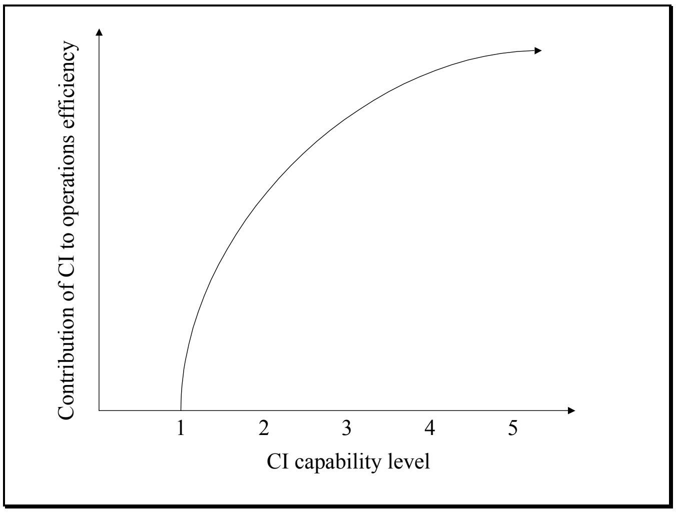

Figure 2. Relationship between CI capability level and contribution of continuous improvement to plant operating performance.

The reason is that each empirically induced ability corresponds more than the others to one of the model's five capability levels, as discussed previously. This implies that plants may expect a very high performance impact as a consequence of fully establishing the second capability level and as they progress along the CI road toward levels 3, 4 and 5 they will continue to benefit, but not at such a dramatic pace as at the lower levels of the model.

This finding bears resemblance to an internal debate within the ABB Group, when this multinational launched their world-renowned customer focus programme that aimed at reducing all lead-times by 50% (Bélanger, Berggren, Björkman, & Köhler, 1999). In brief, the problem was that plants that at the beginning hadn't carried out any previous rationalizations and furthermore, had not developed any CI capability, found it rather easy to meet the target. However, on the other hand plants that previously had worked hard over a long period of time developing CI capability and continuously perfecting their processes found it far more difficult to meet the target. The latter group claimed the target was unfair because they had to work much harder. The similarity to our curve is that plants starting from scratch can expect a high performance impact in return on efforts invested, but as their capability matures they will continue to benefit, but not at such a dramatic pace as at the lower levels of the model.

Then what's the performance benefit of establishing higher CI capability levels? We believe that higher CI capability levels still entail dramatic increases in performance impact, but in areas of strategic importance other than operations efficiency, for example time-to-market, high volume production ramp-up time and employee attitude towards change. The extent to which this is true, though, is to be analysed in another study.

4.4 Results in relation to existing TQM research

In the Introduction we positioned our study in relation to antecedent work on TQM practices and their relation to performance. Our approach most resembled the work of Samson and Terziovski (1999). On a general level our results are similar to theirs. TQM practice intensity explains a significant proportion of the variation in plant operating performance. On a detailed level, though, our results are contradictory. Their study suggests that 'soft issues' such as the MBNQA categories of leadership, management of people, and customer focus were the strongest predictors of performance and 'harder categories' such as strategic planning and information and analysis had a negative or no performance impact at all. Their conclusion from those findings was that behavioural factors such as executive commitment could produce competitive advantage more strongly than TQM-tools and techniques.

In view of the results of our stepwise regression analysis we do not quite agree. On the contrary, we would like to suggest that high involvement in systematic and strategic continuous improvements has a very strong impact on plant operating performance. Furthermore we don't claim that executive commitment can't produce competitive advantage. From the descriptive statistics in the detailed working paper it's evident that leadership issues such as support from managerial staff, regular shop floor visits by management and face-to-face communication obtain far higher mean values on importance and usage as compared to many of the other measured enablers. Therefore, and in contrast to the work of Samson and Terziovski, this leads us to the following conclusion instead. Given committed executives, the use of TQM tools and techniques has an outstanding capacity to predict the contribution of continuous improvements to operations efficiency on the plant level.

5. Concluding remarks

The evolutionary model of continuous improvement behaviour stems from a resource-based strategy view. As a consequence, CI capability is a source of competitive advantage. The role of strategic management is therefore to develop CI capability and at the same time adapt it towards a changing environment. This article has pointed out key abilities of significant importance to develop for increased CI capability in the Swedish engineering industry.

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