DEPARTMENT OF TECHNOLOGY AND BUILT ENVIRONMENT

In search of continuous improvement implementation Tools:

Results of the 2nd international continuous improvement survey

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Abstract

Purpose

The overall purpose of this paper is to investigate the implementation of Continuous Improvement (CI) in companies from Sweden, Netherlands, Spain, Italy, Australia and United Kingdom.

The research questions

Does the usage of CI tools depend on different CI ability?

Methodology – This paper used the 2nd international CI survey to analyze CI behavior. The analysis was made by comparing the tools in clusters defined by different CI abilities.

Findings – The major finding is that different CI tool usage depends on the different CI ability

Keywords - Continuous Improvement (CI), Continuous Improvement (CI) abilities, Continuous improvement (CI) tools

Acknowledgement

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1. Introduction

1.1 Background

The late-twentieth-century environment poses many challenges to all kinds of organizations and this turbulence and uncertainly is unlikely to diminish (Bessant, J. et al 2001). Besides, increased global competition, where high quality and low cost are at premium, led to increased interest in continuous improvement (Naceur, J. 2001). Today, organizations are in a constant need to maintain a low cost of quality, reduce waste, trim production lines, and speed up manufacturing to achieve and maintain competitiveness. Much of this can be done through the implementation of continuous improvement (CI), which we define as a culture of sustained improvement aimed at eliminating waste in all organizational systems and processes, and involving all organizational participants (Nadia, B. et al 2005).

Continuous improvement (CI) can be defined as a company-wide process of focused and continuous incremental innovation sustained over a long period of time. Being essential for meeting customer's varying needs, CI is considered an integral part of TQM (Anderson et al., 1994; Ahire, 1996). The intensity of global competition has led to an even greater interest in continuously improving products, services, and processes (Garvin, 1993; Misterek et al., 1990).

Traditional manufacturing focused on such system to reduce waste and improve product quality that is the main target which production line most concentrated on it. It also has been involved in continuous improvement theories. Modern CI methodologies (also called CI programs or tools) target a wide range of activities in the organization and offer varying benefits. Some of the popular CI initiatives are Six Sigma, Lean Production, Balanced Scorecard, and Lean Six Sigma (Nadia, B. et al 2005).

CI means incremental innovation in production process for improving business performance and capability. As more and more enterprises pay attention on CI, it become more particular and systematic. As the CI maturity model are proposed

(Bessent & caffyn, 1997), it provide theoretical guidance to the further research and analysis of CI. The CI maturity model describes five-stage capability levels in the development process of CI, and these capability levels contains 6 CI abilities, each ability has their own constituent 34 behaviors. The maturity model indicated that when a firm want to implement continuous improvement, they must improve their CI capability, this depend on enhance their CI ability. When comes to enhance CI ability, it is necessary to imply innovation in the company's constituent behaviors first.

CI tools as a technique and measure in the company's development process plays a very important role. Company use many kinds of method/technique or management measure to improve CI behaviors/activities in different production situations, therefore, CI tools are used for reinforcing CI behavior. Because enhance CI ability depend on improve CI behaviors, consequently, CI tools plays important role to strengthen CI ability.

The research of CI started from long time ago and many research topics focus on the USA quality operation and Japanese "Kaizen", but the CI research in other countries like countries in Europe and Australia are paid few attention. In order to cover this gap, this study is aim to analyze the CI development situation in countries of Europe and Australia and how to enhance the CI in these areas. Objective of the detail analysis focus on how do the tools relate to and enhance CI ability and whether different ability use different tools as well, the analyze result will play a positive role in continuous innovation. From this study, the result will help to perfect CI research area and supply an experiential assistance for the company which implements continuous improvement.

Background of 2nd international CI survey

The 2nd international continuous improvement (CI) survey base on the 1st international CI survey which is a cross continent survey includes 543 companies spread across 10 countries on 3 continents. Most of the subjects are European companies, the rest of them from Asia and Australia. The 2nd international CI survey was based on the constructs of CI maturity model. It contains many details and experiences about how to enhance CI in different companies of different

countries. This paper emphases some of questions in this survey to implement analysis such as 34 CI behavior represent in different companies of countries, different ability in different companies of different countries, 13 problem solving CI tools in different companies of different countries and the details of how they are used to improve CI activities.

1.2 Purpose and research questions

Purpose

The overall purpose of this research paper is to investigate the implementation of Continuous Improvement (CI) in companies in six countries and to explore the use of continuous improvement (CI) tools in these companies.

Research questions

How do the use of CI tools relate to the CI ability of the company?

2. Theory

2.1. Terminology

Continuous improvement (CI), as the name implies, adopts an approach to improving performance that assumes a never-ending series of small incremental improvement steps. (Nigel S, et al, 2006) This concept can be applied to improvements across many dimensions of manufacturing, it could be used to demonstrable benefit in improving quality, flexibility, delivery performance, service performance, product development cycles and inventory management.(John Bessant, et al) During the research, improvement is the activity of closing the gap between the current and the desired performance of an operation or process.(Nigel S, et al, 2006) Furthermore, Continuous improvement (CI) is the planned, ongoing, incremental and companywide change of existing practices aimed at improving company performance.(Boer et al.2000)

2.2 Continuous improvement abilities and associated behaviors

The continuous improvement (CI) abilities involve problem-solving skills, active participation, and improvement activities. There are several key routines associated with continuous improvement (CI) and their constituent behaviors which has been list in following table.

Table 1 Key routines associated with CI and their constituent behaviors

Organization ability	*Constituent behaviors*
A: Getting the CI habit: Developing the ability to generate sustained involvement in CI	• People make use of some formal problem finding and solving cycle • People use appropriate tools and techniques to support their improvement activities • People use measurement to shape the improvement process • People (individuals/groups) initiate, and carry through to completion, improvement activities – they participate in the process • Ideas and suggestions for improvement are responded to in a clearly defined and timely fashion – either implemented or otherwise dealt with • When something goes wrong the natural reaction of people at all levels is to look for reasons why rather than to blame the individual(s) involved
B: Focusing CI: Generating and sustaining the ability to link CI activities to the strategic goals of the company	• Individuals and groups use the organization's strategy and objectives to focus and priorities their improvement activities • Everyone understands what the company's or their department's strategy, goals and objectives are. • Before embarking on initial investigation and before implementing a solution, individuals and groups assess the improvements they proposed against strategic objectives to ensure consistency. • Individuals and groups monitor/measure the results of their improvement activity and their impact on strategic or departmental objectives • Improvement is an integral part of the individuals' or groups' work, not a parallel activity..
C: Spreading the word: Generating the ability to move CI activity across organizational boundaries	• Individuals and groups are effectively working across internal (vertical and lateral) and external divisions at all levels. • People understand and feel ownership of the company's processes. • People are oriented towards internal and external customers in their improvement activity • Specific improvement projects are taking place with customers and/or suppliers. • Relevant improvement activities involve representatives from different operational levels. • The organization uses supplier and customer feedback as a means to improving company performance

D: CI on the CI system: Generating the ability to manage strategically the development of CI	• Ongoing assessment ensures that the organization's process, structure and systems consistently support and reinforce improvement activities. • Senior management make available sufficient resources (time, money, personnel) to support the continuing development of the company's improvement system. • When a major organizational change is planned, its potential impact on the organization's improvement system is assessed and adjustments are made as necessary.
E: Leading the way: Generating the ability to lead, direct and support the creation of and sustaining of CI behaviors	• Managers support improvement processes by allocating sufficient time, money, space and other resources. • The organization recognizes in formal but not necessarily financial ways the contribution of employees to continuous improvement. • Managers lead by example, becoming actively involved in the design and implementation of systematic ongoing improvement. • Managers support experimentation by not punishing mistakes, but by encouraging learning from them • Managers at all levels display leadership and active commitment to ongoing improvement.
F: Building the learning organization: Generating the ability to learn through CI activity.	• Everyone learns from their experiences, both good and bad. • Individuals seek out opportunities for learning/personal development (e.g. active experimentation, setting own learning objectives). • Individuals and groups at all levels share (make available) their learning from all work and improvement experiences. • The organization articulates and consolidates (captures and shares) the learning of individuals and groups • Managers accept and, where necessary, act on all the learning that takes place • People and teams ensure that their learning is incorporated into the organization by making use of the mechanisms provided for that • Appropriate organizational mechanisms are used to deploy what has been learned across the organization

Source: Bessant and Caffyn, 1997

CI abilities involve problem-solving skills, active participation, how improvement activities are linked to strategic goals and mechanisms for transforming learning across the entire organization. (Bessant.J. et al 2001). There are different implementation levels at different companies. A few companies are able to identify problems and even capable to solving the problems efficiently. Some organizations still stay at beginning part of implementing continuous improvement (CI). The following table describes the different levels of development for continuous improvement (CI) abilities.

Table 2 Stages in the Evolution of CI

CI 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 organization, etc, - but implementation is on an ad hoc basis	Problems are solved randomly; No formal efforts or structure for improving the organization; Occasional bursts of improvement punctuated by inactivity and non-participation; solutions tend to realize 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 organization	CI or an equivalent organization 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 has not been integrated into day-to-day operations
Level 3 – Goal oriented CI There is a commitment to linking CI behaviors, established at 'local' level to the wider strategic concerns of the organization	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 developed to problem solving unit; High levels of experimentation
Level 5 – Full CI capability Approximates to a model 'learning organization'	All the above plus: Extensive and widely distributed learning behaviors systematic finding and solving problems and capture and sharing of learning; Widespread, autonomous but controlled experimentation
Source: Bessant, J. Caffyn, S. Gallagher, M. (2001)	

2.3 Continuous improvement (CI) tools

Companies or organizations gradually search for methods to improve the manufacturing processes in order to achieve organizational objectives.

Continuous Improvement Tools include various types that can be used by a company to help effect the improvement effort. A variety of problem solving tools are being used to assist with CI activities. The most widely applied tools are those used for display and visualization (e.g. charts, histograms); process mapping (e.g. flow diagrams); creativity and idea generation (e.g.brainstorming); standardization (e.g. job descriptions, manuals); and problem identification tools and checklists. The least commonly used tools are Quality Function Deployment, 5S (proper arrangement, orderliness, cleanliness, cleanup, discipline), and tools for prioritising and consensus reaching (e.g. weighted selection,voting). The actual usage of tools broadly reflects their perceived importance, though process mapping tools in particular are rated as less important than their widespread application would suggest. (Caffyn.et al. 1999)

In this thesis, 13 problem finding and solving tools are used in target company's improvement-activities. The tools are as follow:

1. Problem identification tools/checklists (Checklists is a tool for recording and organizing data. e.g., waste)
2. 7 basic quality tools (fishbone diagrams, histograms, pareto analysis, flowcharts, scatter plots, run charts, control charts)
3. 7 "new" quality tools (Affinity Diagram, Interrelationship Digraph, Prioritization Matrix, Matrix Diagram, Process Decision Program Chart, Tree Diagram, Activity Network Diagram)
4. Process mapping tools. (It offers a clear picture about what activities are carried out as part of a process, where such activity is carried out and how they are performed.)
5. FEMA (Failure Mode and Effect Analysis)
6. QFD (Quality Function Deployment)
7. Creativity tools/ idea generation tools

8. Display/ Visualization tools
9. Standardization tools
10. 5S (sorting, systematizing, shining, standardizing, sustaining)
11. Simulation
12. Six Sigma
13. SPC—Statistical Process Control

2.4 Literature review

The research of this thesis based on some academic articles, they indicated that there are several levels of CI, according to ability of different CI level, there are many corresponding CI behaviors. CI tools are used for enforcing and promoting the behavior so that they can help to promote CI ability then rise into a higher level. Different CI tools are used in different CI ability.

Analysis and research to prove the point of view need theoretical references consulting basis are as follow:

1．Bessant, Caffyn and Gallagher (2001): As continuous improvement evolved , incremental changes happened to promote CI, and it divided into 5 capability levels (pre-CI, Structure CI, Goal oriented CI, Proactive CI and Full CI). Different levels have their different ability (Getting the CI habit, Focusing CI, Spreading the word, CI on the CI system, Leading the way and Building the learning organization) for continuous improvement. Each ability contains many constituent behaviors, efficient behavior can help to promote CI.

CI ability of company moved to a higher level need to change their behavior pattern. Using effective CI tool to improve corresponding CI behavior is the key point. By contrast extensive planning through a group made up of representatives from different levels in a company. This article indicated that two full-time CI facilitators were appointed and over a six-month period a systematic and structured approach to implementing CI was developed. Components included:
--A basic training module designed to introduce problem- solving skills and then to practice these skills, first on ‘classroom’ projects and then on small-scale

workplace problems,

-- Identification and training of shop-floor problem solving teams,

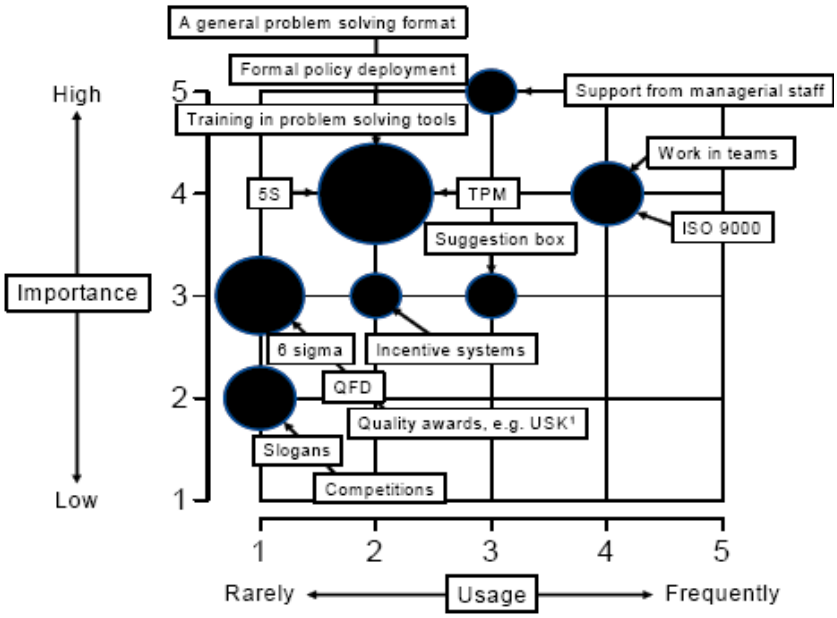
-- Facilitator training for CI team coordinators,

-- Development of an 'idea management system' which identified the ways in which employee suggestions could be recognized, evaluated and implemented with minimum delay,

-- Development of a reward system which offered simple ways of recognizing and thanking employees for suggestions and reinforcing the behavior, whilst also allowing for an equitable share of any major benefits which followed implementation of a particular idea.

2. Dabhikar and Bengtsson (2006): There is close correlation among CI levels, CI ability and CI behaviors. To enforce CI ability in a company depends on implementing efficient corresponding behaviors, CI ability can be consummated and improved when a company perfect its CI behaviors. Thus, the CI levels can be promoted depend on their corresponding ability. Therefore capability level of the company will move into a higher stage.

This article presents a descriptive statistics on the importance and usage of different means and tools to accomplish CI.



This figure describes that:

The importance of different CI means and tools from low to high are ordered as

follow:
Slogans, competitions → quality awards, QFD, 6 sigma; incentive system; suggestion box → 5s,TPM,a general problem solving format, formal policy deployment, training in problem solving tools; work in teams, ISO 9000→ support from managerial staff

The usage of different CI means and tools from rarely to frequently are ordered as follow:
Slogans, competitions; quality awards, QFD, 6 sigma → 5s,TPM,a general problem solving format, formal policy deployment, training in problem solving tools; incentive system → suggestion box; support from managerial staff → work in teams, ISO 9000

3. Boer, Berger, Chapman and Gertsen (2000): This is a CI book use CI as a useful concept. It is widely used in many companies of different countries. This book focus on research the Europe and Australia companies, describe the function and usage of CI tools and then how to improve continuous improvement of different companies. Different company on different CI level have their own CI ability, according to different situation, different CI tools are variously used.

In this book CI tools as a technique and skills to enforce CI ability and accelerate development of company. Companies perceive various tools, methods and techniques as important and actually use them. Especially monitoring the overall CI system, support from staff functions, work in teams/work groups and the training of personnel in problem solving tools are perceived important.

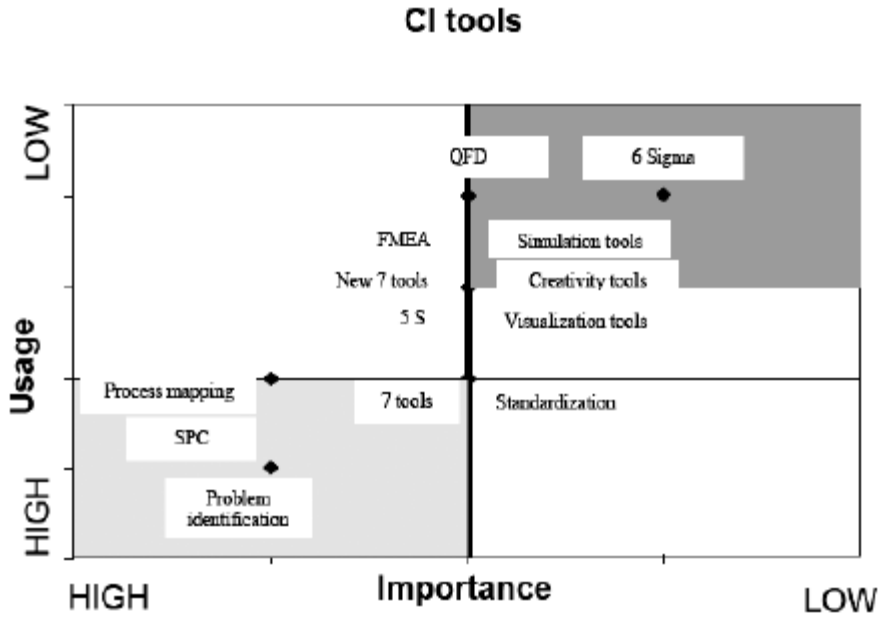
Many problem solving tools and techniques were identified as important in using CI activities and behaviors. In general there is a direct relationship between the perceived importance and the actual use. The majority of European companies prefer the more ‘simple and easy to implement tools’ such as process mapping tools. The more advanced, sophisticated and specialized tools like FMEA and QFD are less valued and used.

Survey in this book also shows that the more advanced companies generally attach more importance to the different CI tools. One apparent anomaly is that early adopters perceive the importance of problem solving tools to be higher than innovators. The question can be raised whether the innovators have a more mature judgement on the importance of such tools since they have been involved with CI for a longer time and have thus gained more experience. Another result is that the more mature a company is, the more it uses problem solving tools, especially the seven 'old' tools, seven 'new' management tools and creativity tools/idea generation tools. This is consistent with the observation that in advanced companies more personnel have been trained in problem solving tools.

4. Mariano Corso and Andrea Giacobbe (2007): Three questions are researched: the CI tools and enablers adopted in Italy; the state of the improvement activities and their evolution; the relations between CI tools, ability development and performance. It use company from Italy for instance, then according to research and analysis, it indicated the relationship between CI tools and CI ability that different CI ability companies use the different CI tools, well use of CI tool will enhance CI ability in the nature of things.

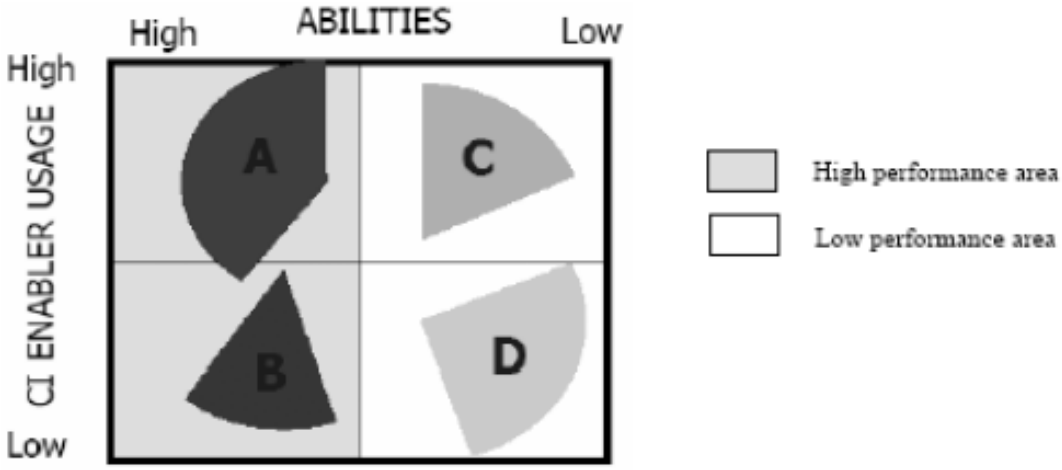
Analysis of this article was conducted for the specific tools supporting problem finding/ solving. There are 13 tools: problem identification tools/ checklists, 7 basic quality tools, 7"new" quality tools, process mapping tools, FMEA, QFD, creativity tools/idea generation tools, display/visualization tools, standardization tools, 5s, simulation, six sigma, SPC.

According to these tools, this article present a figure on the importance and usage of different CI tools.



This figure describe that three tools are particularly important and the most used are problem identification tools/checklists, tools for process mapping, and statistical process control. In contrast, quality function deployment and Six Sigma are rarely used

Further research of Corso's article (Corso,M. et al 2007), it analyze the relationship among Performances, CI tools and ability development. Results suggest that the improvement of business performance does not depend on the use of CI tools, but rather on the CI abilities firms developed. The figure which indicated the relationship among the three components was presented as follow:



Same as Corso's article (Corso,M. et al 2007), this article also mainly focus on research the relationship between CI ability and CI tools, however, this study base on research 543 representative manufacturing companies of 10 countries all over

the world, generally and systematically analyze the relationship between CI tools and CI ability, furthermore, from the research process this study also aim to analyze how do CI tools and CI ability effectively connect each other, then all different companies in different CI process can efficiently achieve perfect allocation and promote CI to higher level

3 Research methodology

3.1 Data collection

The data in this thesis is collected from the 2nd International CINet Survey and survey coding sheet which the supervisor supports us. The CINet is a global network set up to bring together researchers and industrialists working in the field of Continuous Innovation. The CINet survey was established by an international research consortium, it contains data from 543 manufacturing companies of 10 countries. These ten countries are: Australia, Netherlands, Hong Kong, Sweden, Ireland, Italy, United Kingdom, Spain, Norway and Switzerland. Thereinto, Norway (N = 14), Ireland (N = 21), Hong Kong (N = 29) and Switzerland (N = 27) supplied sample sizes are not enough, therefore data of these countries are removed from the analysis. Consequently, Only 6 countries (Australia, Netherlands, Sweden, Italy, United Kingdom and Spain) with more than 50 observations were selected.

Table 3 Participating countries.

Country	**N**
Australia (AU)	89
Italy (IT)	60
Netherlands (NTH)	51
Spain (SP)	105
United Kingdom (UK)	70
Sweden (SWE)	77
Total	452

3.2 Analytical approach

The steps of data analysis process in this thesis are as follows

1. Calculate each company's mean value of behaviors which belong to the different organization ability
2. Taking two-step to classify the data into four clusters.
3. Taking one-way ANOVA to identify the use of tools in the four clusters representing different organization's ability.

3.3 Data analysis

Before implement analysis, the important step is to collect data that the thesis analysis need. The data about behaviors of different organization ability are the thesis need in the whole analysis. According to bessant_et_al_2001, there are 6 organization ability, thus there are different behaviors belong to each of ability.

The 2nd International survey support many questions about CI in the survey coding sheet, these questions indicated to many companies of different countries. This thesis chose 6 represent companies of countries to implement analysis, question1 data of the 2nd International survey is used in this thesis.

Question 1: To which degree do you agree with the following statements, describing the improvement activities in your organisation? It indicates many CI behaviors in organization from the representative companies of countries, and gives a degree note to check whether the behaviors are available. In this question the degree whether the behaviors implementation is adopted by people are divided into 5 grades (ranging from1=fully agree to 5=disagree).

3.4 Quality of the study

Without evaluate the quality of this thesis it would be impossible to say this thesis have contribute research result to the CI development. The way to evaluate one thesis should be contained two aspects, one is reliability, and the other is validity. Lack of validity introduces a systematic error (bias), while lack of reliability introduces random error (Carmines and Zeller, 1979)

Reliability indicates dependability, stability, predictability, consistency and accuracy and refers to the extent to which a measuring procedure yields the same results on repeated trials (Kerlinger, 1986; Carmines and Zeller, 1979).
The most popular test method for reliability is the concept Cronbach coefficient alpha (Cronbach, 1951). According to the Cronbach alpha calculate way, the CI ability levels data reliability showed as below:

Table 4 Cronbach coefficient alpha:

CI ability levels	Total	Counties					
		AU	IT	NTH	SP	SWE	UK
A Getting the CI habit	0.83	0.79	0.83	0.83	0.89	0.77	0.80
B Focusing CI	0.85	0.83	0.86	0.82	0.86	0.85	0.83
C Spreading the word	0.85	0.72	0.86	0.86	0.89	0.84	0.81
D CI on the CI system	0.78	0.77	0.80	0.71	0.85	0.75	0.72
E leading the way	0.85	0.79	0.88	0.86	0.89	0.77	0.85
F Building the learing organizaion	0.87	0.83	0.91	0.87	0.87	0.80	0.87

Based on the Cronbach coefficient alpha concept, the research measure could be accepted when alpha≥0.6. That means this research measure is reliable.

4. Results

4.1 Cluster analysis

Base on the 2nd CI survey, the paper use SPSS to classify the CI behaviors of different companies in six representative countries, and conclude mean value and standard deviation of CI behaviors in each company of countries. The table shows the result as follow:

Table5:

CI behaviors	Mean value	Standard deviation
1. A Continuous Improvement (CI) or equivalent formal improvement system (e.g. Total Productive Maintenance) has been introduced to involve all employees in ongoing improvement	3.33	1.37
2. Appropriate organisational mechanisms are used to deploy what has been learned across the organisation	3.33	1.16
3. Before embarking on initial investigation and before implementing a solution, individuals and groups assess the improvements they proposed against strategic objectives to ensure consistency	3.40	1.14
4. Everyone learns from their experiences, both good and bad	2.69	1.14
5. Everyone understands what the company's or their department's strategy, goals and objectives are	3.37	1.08
6. Ideas and suggestions for improvement are responded to in a clearly defined and timely fashion – either implemented or otherwise dealt with	3.49	1.07
7. Improvement activities and results are continually monitored and measured	3.43	1.07

8. Improvement is an integral part of the individuals' or groups' work, not a parallel activity	3.31	1.18
9. Individuals and groups are effectively working across internal (vertical and lateral) and external divisions at all levels	3.44	1.05
10. Individuals and groups at all levels share (make available) their learning from all work and improvement experiences	3.55	1.03
11. Individuals and groups monitor/measure the results of their improvement activity and their impact on strategic or departmental objectives	3.70	1.00
12. Individuals and groups use the organisation's strategy and objectives to focus and prioritise their improvement activities	3.62	1.01
13. Individuals seek out opportunities for learning/personal development (e.g. active experimentation, setting own learning objectives)	3.58	1.04
14. Managers accept and, where necessary, act on all the learning that takes place	3.25	1.06
15. Managers at all levels display leadership and active commitment to ongoing improvement	3.22	1.11
16. Managers lead by example, becoming actively involved in the design and implementation of systematic ongoing improvement	3.32	1.09
17. Managers support experimentation by not punishing mistakes, but by encouraging learning from them	3.17	1.13
18. Managers support improvement processes by allocating sufficient time, money, space and other resources	3.49	1.08
19. Ongoing assessment ensures that the organisation's processes, structure and systems consistently support and reinforce improvement activities	3.37	1.07
20. People (individuals/groups) initiate and carry through to completion, improvement activities – they participate in the process	3.42	1.04
21. People and teams ensure that their learning is incorporated into the organisation by making use of the mechanisms provided for that	3.54	0.99
22. People are oriented towards internal and external customers in their improvement activity	3.17	1.10
23. People make use of some formal problem finding and solving cycle	3.67	1.08
24. People understand and feel ownership of the company's processes	3.31	1.10
25. People use appropriate tools and techniques to support their improvement activities	3.51	1.03
26. People use measurement to shape the improvement process	3.44	1.13
27. Relevant improvement activities involve representatives from diferent operational levels	3.05	1.14
28. Senior management make available sufficient resources (time, money, personnel) to support the continuing development of the company's improvement system	3.34	1.08
29. Specific improvement projects are taking place with customers and/or suppliers	3.27	1.09
30. The organisation articulates and consolidates (captures and shares) the learning of individuals and groups	3.49	0.96
31. The organisation recognises in formal but not necessarily financial ways the contribution of employees to continuous improvement	3.34	1.18
32. The organisation uses supplier and customer feedback as a means to improving company performance	2.94	1.13
33. When a major organisational change is planned, its potential impact on the organisation's improvement system is assessed and adjustments are made as necessary	3.44	1.10
34. When something goes wrong the natural reaction of people at all levels is to look for reasons why rather than to blame the individual(s) involved	3.22	1.14

As mentioned in the literature reviews there are six stages of organizational ability. Each ability is built up by several behaviors. The table below shows the mean value of standard deviation of six abilities and their constituent behaviors in different companies of the six representative countries.

Table 6:

Behaviors	Ability	Mean value	Standard deviation
6,16,17,18,20,23,25,26, 31	1	2.260	1.205
3, 5, 811,12,	2	2.282	1.270
9,22,24,27,29	3	2.172	1.138
7,19,2,28,1,33	4	2,257	1.169
15,32,34	5	2.126	1.099
4,10,13,14,21,30	6	2.193	1.230

Automatically get four clusters after taking two-step analysis to classify the clusters. In the original data base, if one company lacks even just one instance of the behaviors we decide to omit this company. The results are shown in Table 7.

Use for reference of table 3, cluster 34 behaviors into 6 groups. The data is also collected based on the 34 behaviors. (Reference list the questionnaire for the data collected at the end of this thesis.) Find out the behaviors list in the questionnaire which corresponding to the table3.

Calculate the mean value of each group, and use SPSS software's Two-step cluster analysis function to classify clusters. Then the SPSS software got out 4 clusters automatically.

Table 7: cluster Distribution

		N	% of Combined	% of Total
Cluster	1	110	28.8%	24.3%
	2	56	14.7%	12.4%
	3	133	34.8%	29.4%
	4	83	21.7%	18.4%
	Combined	382	100.0%	84.5%
Excluded Cases		70		15.5%
Total		452		100.0%

The mean value and standard deviation of different organization ability clusters shown below:

Table8:

cluster	Ability											
	1		2		3		4		5		6	
	Mean value	Standar Deviation	Mean Value	Standard Deviation	Mean Value	Standar Deviation	Mean Value	Standard Deviation	Mean Value	Standard Deviatin	Mean Value	Standard Deviation
1	3.863	0.492	3.807	0.526	3.628	0.513	4.149	0.565	3.871	0.541	3.750	0.470
2	3.094	0.335	2.942	0.467	2.674	0.379	3.100	0.498	2.987	0.508	2.953	0.335
3	2.333	0.343	2.227	0.380	2.070	0.366	2.321	0.443	2.326	0.420	2.365	0.331
4	1.707	0.351	1.542	0.362	1.472	0.326	1.647	0.421	1.586	0.435	1.692	0.361

As the grades are ranging from1 to 5, 1 means fully agree, 5 means disagree, then, the cluster 4 is the most developed CI ability, and cluster 3 is the number 2 developed, cluster 2 is the number 3 developed and cluster 1 is the last developed.

4.2 tools of different ability

The purpose for this thesis is found out the relationship between different organization ability and different CI tools. Taking one-way ANOVA to analysis whether different organization ability clusters use different tools.

There are thirteen CI tools used in the International survey. Table (in appendix) indicates that for the same tool some clusters show significant differences. Through the ANOVA analysis we can see that, based on the different CI ability level, the usage of CI tools are different. And the next step of analysis result can figure out the difference of usage for each CI tool between the groups.

Table 9:

	clusters							
tools	1		2		3		4	
	Mean value	Standard deviation	Mean value	Standard deviation	Mean value	Standard deviation	Mean value	Standard deviation
Problem identification tools/checklists	3.774	1.219	2.982	1.240	2.359	1.128	2.157	1.163
7 basic quality	4.093	1.014	3.789	1.163	3.070	1.205	3.086	1.296

tools								
7 "new" quality tools	4.623	0.627	4.514	0.678	3.871	0.962	3.679	1.035
Process mapping tools	3.830	1.122	3.407	1.111	2.843	1.294	2.488	1.158
FMEA	4.212	1.109	3.804	1.161	3.500	1.288	3.148	1.295
QFD	4.585	0.819	4.343	0.908	3.820	0.996	3.430	1.184
Creativity tool/Idea generation tools	4.509	0.669	4.131	0.991	3.508	1.130	2.861	1.174
Display/Visualization tools	4.204	0.786	3.667	1.080	3.256	1.224	2.825	1.348
Standardization tools	4.245	0.875	3.600	1.115	3.163	1.126	2.863	1.220
5S	4.255	0.927	4.009	1.151	3.260	1.372	2.950	1.242
Simulation	4.519	0.754	4.113	1.115	3.677	1.123	3.150	1.115
Six Sigma	4.736	0.593	4.362	0.921	3.960	1.240	3.725	1.273
SPC	4.130	1.260	3.561	1.340	2.921	1.319	2.580	1.368

Table 9 described based on different clusters the mean value of the usage of tools.

Problem identification tools/checklists

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 3 and cluster 4. There is a difference for the usage of this tool between cluster 1 and cluster 2, cluster1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of problem identification tools/checklists there is no difference between cluster 3 and cluster 4.

Cluster 2 gets the highest score of the mean value of usage of problem identification tools/checklists.

7 basic quality tools

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1and cluster 4. There is a difference for the usage of the tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of 7 basic quality tools there is no difference between cluster 1 and cluster 2, cluster 3 and cluster 4.

Cluster 2 gets the highest score of the mean value of usage of 7 basic quality tools.

7 "new" quality tools

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2, cluster 3 and cluster 4. There is a difference for the usage of this tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of 7 "new" quality tools there is no difference between cluster 1 and cluster 2, cluster 3 and cluster 4.

Cluster 2 gets the highest score of the mean value of usage of 7 "new" quality tools.

Process-mapping tools

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2, cluster 3 and cluster 4. There is a difference for the usage of the tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of process-mapping tools there is no difference between cluster 1 and cluster 2, cluster 3 and cluster 4.

Cluster 2 gets the highest score of the mean value of usage of "process-mapping tools".

QFD

According to table 9 and the full table in appendix , when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2, cluster 3 and cluster 4, There is a difference for the usage of the tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of QFD tools there is no difference between cluster 1 and cluster 2, cluster 3 and cluster 4.

Cluster 2 gets the highest score of the mean value of usage of QFD.

Creativity tools/Idea generation tools

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2. There is a difference for the usage of the tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4, cluster 3 and cluster 4. But for the usage of Creativity tools/Idea generation tools there is no difference between cluster 1 and cluster 2.

Cluster 2 gets the high score of the mean value of usage of "creativity tools/idea generation tools".

Display/Visualization tools

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2, cluster 2 and cluster 3, cluster 3 and cluster 4. There is a difference for the usage of tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster. Cluster 2 and cluster 4.

Cluster 2 gets the high score of the mean value of usage of "display/visualization tools".

Standardization tools

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 3 and cluster 4. There is a difference for the usage of tool between cluster 1 and cluster 2, cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of Standardization tools there is no difference between cluster 3 and cluster 4.

Cluster 2 gets the high score of the mean value of usage of "standardization tools".

5S

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2, cluster 3 and cluster 4. There is a difference for the usage of tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of 5S tools there is no difference between cluster 1 and cluster 2, cluster 3 and cluster 4. Cluster 2 gets the high score of mean value of usage of "5S".

Cluster 2 gets the high score of mean value of usage of 5S.

Simulation

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2. There is a difference for the usage of tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4, cluster 3 and cluster 4. But for the usage of Simulation there is no difference between cluster 1 and cluster 2.

Cluster 2 gets the high score of mean value of usage of simulation.

Six Sigma

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1and cluster 2, cluster2 and cluster 3, cluster 3 and cluster 4. There is a difference for the usage of tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 4. But for the usage of Six Sigma there is no difference between cluster 1 and cluster 2, cluster 2 and cluster 2 and cluster 3.

Cluster 2 gets the high score of mean value of usage of six sigma.

SPC

According to table 9 and the full table in appendix, when sig<0.01 or sig=0.01 the usage of CI tool is connected and different between clusters.

The usage of this tool between the clusters is different, except cluster 1 and cluster 2, cluster 3 and cluster 4. There is a difference for the usage of tool between cluster 1 and cluster 3, cluster 1 and cluster 4, cluster 2 and cluster 3, cluster 2 and cluster 4. But for the usage of SPC there is no difference between cluster 1 and cluster 2, cluster 3 and cluster 4. Cluster 2 gets the high score of mean value of usage of SPC.

Cluster 2 gets the high score of mean value of usage of SPC.

And clusters analysis based on the different CI ability.

In total table 8 indicate if the organization ability is different, so the usage of the tools is different between the groups which got different CI ability.

5. Discussion

We tried to understand the relationship among the thirteen CI tools. As illustrated in table 7, table 8and table 9 indicate the usage of CI tools will be different depend on the organization's different CI ability levels. But there is a rule for this phenomenon. Through the data analysis, there are four clusters of companies. These 4 clusters mean 4 different CI ability organizations.

Compare the usage of tools between cluster1 and cluster 2. The CI tools used more in the cluster 2 organization than in the cluster 1 organization. Compare the usage of tools between cluster 2 and cluster 3. The CI tools used more in the cluster 3 organization than in the cluster 2 organization. Compare the usage of tools between cluster 4 and cluster 3. The CI tools used more in the cluster 4 than in the cluster 3 organization.

Table 9 illustrated for each CI tool, the usage of tools is most frequently in the cluster4. We can see the usage of each tool is more frequently in the higher CI ability level. And the usage of CI tools in the cluster1 is rarely.

There have been several articles mentioned if an organization implements continuous improvement, the more mature a company is, the more it uses problem solving tools. In our data analysis there are some different between theory and reality. Table 9 illustrated the different CI ability do not mean some tools will be used frequently at the beginning of CI implement and used rarely at the highest level.

Compared to the article of <Tool and abilities for continuous improvement: what are the drivers of performance>, both of these two articles try to find out what are the relations between CI tools, ability development. But Corso's article（Corso,M. et al 2007） more focus on the situation of Italy, and this article conclude five countries. The article also tries to find out the difference between three years ago and now, and suggest that the improvement of business performance does not depend on the use of ISO, but rather on the CI abilities firm developed.

The same point is most used CI tools are problem identification, SPC, processing mapping. Corso（Corso,M. et al 2007） analysis related with the performance, try to find out the reason for choose these tools, article of this related with the CI ability. Table 9 suggested that there is strong relation between CI ability and CI tools. The most used CI tool is the problem identification, it's distributed on different CI ability levels. Cluster 4 is the most developed CI ability in reality which used CI tools most frequently. Cluster 3 is the second developed one, the usage of CI tools in cluster 3 is just less than the cluster 4. Similarity can be found between these clusters. In a word, it can be realized that the CI tools are more frequently used in the higher level CI ability companies.

Based on the usage of CI tools, are the top three tools. Basically at each CI ability levels, the usage of problem identification tools/checklists, process mapping tools, SPC is the top three in the thirteen tools.

We also try to find out the reason why average score of the usage of CI tools in the most developed CI ability cluster are high. As mentioned in the article <Continuous improvement capability in the Swedish engineering industry>, the CI model (Bessant, J. et al 2001) is evolutionary, if the companies want to take advantage of higher CI abilities, the must use the lower level abilities tools at first. Then the higher CI abilities companies develop are based on the lower CI tools. That means the companies should take a great usage of lower CI tools and gradually develop. And our article is based on the theory of CI evolutionary model (Bessant, J. et al 2001) .

Compared with the article named 'Convergence or National Specificity? Testing the CI Maturity Model across Multiple Countries' also used the 2nd International CINet Survey database to analysis the convergence between several countries. There was an phenomena indicate in this article, that if one researcher consulate according to our theory he would asked the companies like : 'Let's improve our CI ability and change on the 32 constituting continuous improvement behaviors'. The shortage of this article, we just focus on the CI ability in theory. In the real world for one company, there are should be several aspects influence the decision for this company implement CI ability, as whole layout for the company, also include the internal power combat.

At the beginning to write this article, we think we will find out the level of CI ability decide the usage of CI tools. After our analysis we find out there is rule for the usage of CI tools and CI ability. All the CI tools can effectively be used in the CI ability of highest CI level, which more than the CI ability of lower CI level that less CI tools are used in it.

6. Conclusion

This article mainly concentrated on the CI tool usage based on the different CI ability in companies by a series of data analysis and the 2nd International CI Survey. There are thirteen CI tools in the survey, as problem identification tools/checklists, 7 basic quality tools, 7 “new” quality tools, process mapping tools , FMEA, QFD, Creativity tools/Idea generation tools, Display/Visualization tools, standardization tools, 5S, Simulation, Six Sigma, SPC.

CI evolutionary model (Bessant. J. et al 200l) suggested there are several stages for CI development in companies. And different CI ability stages have different character and different activities. The contribution of this article tries to find weather different CI ability means the different usage of CI tools.

According to the thesis analysis, it is assured that different CI tools depend on different CI ability of organizations. Base on this point of view, it is helpful that companies choose and implement right tools of different CI ability, thus it will bring a constant improvement and maintain a low cost of quality, reduce waste, enhance the productivity, and make a persistent competitiveness. Even now this is not enough, further development will focus on weather there is an efficient way to develop CI ability in different companies.

At the beginning of this study, the objective is focus on finding out the level of CI ability decide the usage of CI tools. After implemented analysis the result showed that there is rule for the usage of CI tools and CI ability. The most developed CI ability get all CI tools used most than lower level CI ability companies and the reason is that, the develop of CI ability is evaluation, and the usage of CI tools influence the result of the analysis.

Consequently, using proper CI tools in different CI ability can enhance the efficiency of CI behavior and then make a gradually progress of the whole company operation, continuous improvement will be better implemented and get higher promotion in organizations.

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Appendix

ANOVA

		Sum of squares	df	Mean square	F	Sig.
Problem identification tools/checklists (e.g, waste)	Between Groups	109.088	3	36.363	26.020	.000
	Within Groups	515.679	369	1.398		
	Total	624.767	372			
7 basic quality tools eg. Pareto, fishbone	Between Groups	63.874	3	21.291	15.084	.000
	Within Groups	519.446	368	1.412		
	Total	583.320	371			
7 "new" quality tools (7 MP tools) i,e, Affinity diagrams	Between Groups	53.431	3	17.810	23.922	.000
	Within Groups	268.772	361	.745		
	Total	322.203	364			
Process mapping tools	Between Groups	76.635	3	25.545	18.077	.000
	Within Groups	514.384	364	1.413		
	Total	591.019	367			
FMEA (Failure Mode and Effect Analysis)	Between Groups	41.633	3	13.878	9.180	.000
	Within Groups	547.274	362	1.512		
	Total	588.907	365			
QFD (Quality Function Deployment)	Between Groups	60.075	3	20.025	20.315	.000
	Within Groups	349.925	355	.986		
	Total	410.000	358			
Creativity tools/Idea generation tools	Between Groups	114.793	3	38.264	35.054	.000
	Within Groups	391.874	359	1.092		
	Total	506.667	362			
Display/Visualization tools	Between Groups	71.239	3	23.746	17.683	.000
	Within Groups	483.451	360	1.343		
	Total	554.690	363			
Standardization tools	Between Groups	72.000	3	24.000	19.418	.000
	Within Groups	441.247	357	1.236		
	Total	513.247	360			
5S (cleaning, sorting, systematising, etc.)	Between Groups	88.769	3	29.590	19.840	.000
	Within Groups	536.902	360	1.491		
	Total	625.670	363			
Simulation	Between	72.929	3	24.310	21.076	.000

	Groups					
	Within Groups	412.919	358	1.153		
	Total	485.848	361			
Six Sigma	Between Groups	41.813	3	13.938	11.765	.000
	Within Groups	425.300	359	1.185		
	Total	467.113	362			
SPC - Statistical Process Control	Between Groups	101.544	3	33.848	19.202	.000
	Within Groups	643.389	365	1.763		
	Total	744.932	368			

Multiple Comparisons

Scheffe

Dependent Variable	(I) Two-Step Cluster Number	(J) Two-Step Cluster Number	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Problem identification tools/checklists	1	2	.79193(*)	.19796	.001	.2360	1.3479
		3	1.41421(*)	.19310	.000	.8719	1.9565
		4	1.61696(*)	.20786	.000	1.0332	2.2007
	2	1	-.79193(*)	.19796	.001	-1.3479	-.2360
		3	.62228(*)	.15408	.001	.1896	1.0550
		4	.82502(*)	.17222	.000	.3414	1.3087
	3	1	-1.41421(*)	.19310	.000	-1.9565	-.8719
		2	-.62228(*)	.15408	.001	-1.0550	-.1896
		4	.20275	.16660	.687	-.2651	.6706
	4	1	-1.61696(*)	.20786	.000	-2.2007	-1.0332
		2	-.82502(*)	.17222	.000	-1.3087	-.3414
		3	-.20275	.16660	.687	-.6706	.2651
7 basic quality tools eg. Pareto, fishbone	1	2	.30360	.19771	.502	-.2517	.8589
		3	1.02228(*)	.19279	.000	.4808	1.5637
		4	1.00617(*)	.20872	.000	.4200	1.5924
	2	1	-.30360	.19771	.502	-.8589	.2517
		3	.71868(*)	.15485	.000	.2838	1.1536
		4	.70257(*)	.17429	.001	.2131	1.1921
	3	1	-1.02228(*)	.19279	.000	-1.5637	-.4808
		2	-.71868(*)	.15485	.000	-1.1536	-.2838
		4	-.01611	.16868	1.000	-.4898	.4576

	4	1	-1.00617(*)	.20872	.000	-1.5924	-.4200
		2	-.70257(*)	.17429	.001	-1.1921	-.2131
		3	.01611	.16868	1.000	-.4576	.4898
7 "new" quality tools (7 MP tools) i,e, Affinity diagrams	1	2	.10862	.14493	.905	-.2985	.5157
		3	.75167(*)	.14160	.000	.3539	1.1494
		4	.94363(*)	.15244	.000	.5155	1.3718
	2	1	-.10862	.14493	.905	-.5157	.2985
		3	.64305(*)	.11385	.000	.3233	.9628
		4	.83501(*)	.12708	.000	.4781	1.1919
	3	1	-.75167(*)	.14160	.000	-1.1494	-.3539
		2	-.64305(*)	.11385	.000	-.9628	-.3233
		4	.19196	.12327	.490	-.1543	.5382
	4	1	-.94363(*)	.15244	.000	-1.3718	-.5155
		2	-.83501(*)	.12708	.000	-1.1919	-.4781
		3	-.19196	.12327	.490	-.5382	.1543
Processmapping tools	1	2	.42278	.19937	.214	-.1372	.9827
		3	.98767(*)	.19440	.000	.4417	1.5337
		4	1.34269(*)	.21054	.000	.7514	1.9340
	2	1	-.42278	.19937	.214	-.9827	.1372
		3	.56489(*)	.15560	.005	.1279	1.0019
		4	.91991(*)	.17535	.000	.4274	1.4124
	3	1	-.98767(*)	.19440	.000	-1.5337	-.4417
		2	-.56489(*)	.15560	.005	-1.0019	-.1279
		4	.35502	.16968	.225	-.1215	.8316
	4	1	-1.34269(*)	.21054	.000	-1.9340	-.7514
		2	-.91991(*)	.17535	.000	-1.4124	-.4274
		3	-.35502	.16968	.225	-.8316	.1215
FMEA (Failure Mode and Effect Analysis)	1	2	.40780	.20785	.280	-.1760	.9916
		3	.71154(*)	.20266	.007	.1423	1.2808
		4	1.06339(*)	.21849	.000	.4497	1.6771
	2	1	-.40780	.20785	.280	-.9916	.1760
		3	.30374	.16164	.318	-.1503	.7577
		4	.65559(*)	.18109	.005	.1470	1.1642
	3	1	-.71154(*)	.20266	.007	-1.2808	-.1423
		2	-.30374	.16164	.318	-.7577	.1503
		4	.35185	.17511	.259	-.1400	.8437

	4	1	-1.06339(*)	.21849	.000	-1.6771	-.4497
		2	-.65559(*)	.18109	.005	-1.1642	-.1470
		3	-.35185	.17511	.259	-.8437	.1400
QFD (Quality Function Deployment)	1	2	.24205	.16729	.554	-.2279	.7120
		3	.76523(*)	.16333	.000	.3064	1.2240
		4	1.15453(*)	.17628	.000	.6594	1.6497
	2	1	-.24205	.16729	.554	-.7120	.2279
		3	.52319(*)	.13216	.002	.1519	.8944
		4	.91248(*)	.14787	.000	.4971	1.3278
	3	1	-.76523(*)	.16333	.000	-1.2240	-.3064
		2	-.52319(*)	.13216	.002	-.8944	-.1519
		4	.38929	.14338	.063	-.0134	.7920
	4	1	-1.15453(*)	.17628	.000	-1.6497	-.6594
		2	-.91248(*)	.14787	.000	-1.3278	-.4971
		3	-.38929	.14338	.063	-.7920	.0134
Creativity tools/Idea generation tools	1	2	.378593	.175491	.201	-.11433	.87151
		3	1.001369(*)	.171460	.000	.51977	1.48297
		4	1.648674(*)	.185507	.000	1.12762	2.16973
	2	1	-.378593	.175491	.201	-.87151	.11433
		3	.622777(*)	.137857	.000	.23556	1.00999
		4	1.270082(*)	.154980	.000	.83477	1.70539
	3	1	-1.001369(*)	.171460	.000	-1.48297	-.51977
		2	-.622777(*)	.137857	.000	-1.00999	-.23556
		4	.647305(*)	.150401	.000	.22486	1.06975
	4	1	-1.648674(*)	.185507	.000	-2.16973	-1.12762
		2	-1.270082(*)	.154980	.000	-1.70539	-.83477
		3	-.647305(*)	.150401	.000	-1.06975	-.22486
Display/Visualisation tools	1	2	.53704	.19406	.055	-.0080	1.0821
		3	.94770(*)	.18871	.000	.4177	1.4777
		4	1.37870(*)	.20410	.000	.8054	1.9520
	2	1	-.53704	.19406	.055	-1.0821	.0080
		3	.41067	.15340	.069	-.0202	.8415
		4	.84167(*)	.17198	.000	.3586	1.3247
	3	1	-.94770(*)	.18871	.000	-1.4777	-.4177
		2	-.41067	.15340	.069	-.8415	.0202
		4	.43100	.16592	.082	-.0350	.8970

	4	1	-1.37870(*)	.20410	.000	-1.9520	-.8054
		2	-.84167(*)	.17198	.000	-1.3247	-.3586
		3	-.43100	.16592	.082	-.8970	.0350
Standardisation tools	1	2	.64528(*)	.18733	.009	.1191	1.1715
		3	1.08268(*)	.18267	.000	.5696	1.5958
		4	1.38278(*)	.19690	.000	.8297	1.9359
	2	1	-.64528(*)	.18733	.009	-1.1715	-.1191
		3	.43740(*)	.14772	.034	.0225	.8523
		4	.73750(*)	.16499	.000	.2741	1.2009
	3	1	-1.08268(*)	.18267	.000	-1.5958	-.5696
		2	-.43740(*)	.14772	.034	-.8523	-.0225
		4	.30010	.15968	.318	-.1484	.7486
	4	1	-1.38278(*)	.19690	.000	-1.9359	-.8297
		2	-.73750(*)	.16499	.000	-1.2009	-.2741
		3	-.30010	.15968	.318	-.7486	.1484
5S (clearning, sorting, systematising, etc.)	1	2	.24511	.20294	.692	-.3249	.8151
		3	.99438(*)	.19809	.000	.4380	1.5508
		4	1.30455(*)	.21391	.000	.7037	1.9054
	2	1	-.24511	.20294	.692	-.8151	.3249
		3	.74927(*)	.16185	.000	.2947	1.2039
		4	1.05943(*)	.18087	.000	.5514	1.5674
	3	1	-.99438(*)	.19809	.000	-1.5508	-.4380
		2	-.74927(*)	.16185	.000	-1.2039	-.2947
		4	.31016	.17541	.374	-.1825	.8028
	4	1	-1.30455(*)	.21391	.000	-1.9054	-.7037
		2	-1.05943(*)	.18087	.000	-1.5674	-.5514
		3	-.31016	.17541	.374	-.8028	.1825
Simulation	1	2	.40602	.18183	.175	-.1047	.9168
		3	.84181(*)	.17743	.000	.3434	1.3402
		4	1.36923(*)	.19131	.000	.8319	1.9066
	2	1	-.40602	.18183	.175	-.9168	.1047
		3	.43579(*)	.14207	.026	.0367	.8348
		4	.96321(*)	.15906	.000	.5164	1.4100
	3	1	-.84181(*)	.17743	.000	-1.3402	-.3434
		2	-.43579(*)	.14207	.026	-.8348	-.0367
		4	.52742(*)	.15401	.009	.0948	.9600
	4	1	-1.36923(*)	.19131	.000	-1.9066	-.8319

		2	-.96321(*)	.15906	.000	-1.4100	-.5164
		3	-.52742(*)	.15401	.009	-.9600	-.0948
Six Sigma	1	2	.37394	.18340	.247	-.1412	.8891
		3	.77585(*)	.17841	.000	.2747	1.2770
		4	1.01085(*)	.19277	.000	.4694	1.5523
	2	1	-.37394	.18340	.247	-.8891	.1412
		3	.40190	.14408	.052	-.0028	.8066
		4	.63690(*)	.16153	.002	.1832	1.0906
	3	1	-.77585(*)	.17841	.000	-1.2770	-.2747
		2	-.40190	.14408	.052	-.8066	.0028
		4	.23500	.15584	.518	-.2027	.6727
	4	1	-1.01085(*)	.19277	.000	-1.5523	-.4694
		2	-.63690(*)	.16153	.002	-1.0906	-.1832
		3	-.23500	.15584	.518	-.6727	.2027
SPC - Statistical Process Control	1	2	.56888	.22162	.088	-.0536	1.1913
		3	1.20837(*)	.21569	.000	.6026	1.8142
		4	1.54938(*)	.23325	.000	.8943	2.2045
	2	1	-.56888	.22162	.088	-1.1913	.0536
		3	.63949(*)	.17422	.004	.1502	1.1288
		4	.98050(*)	.19554	.000	.4313	1.5297
	3	1	-1.20837(*)	.21569	.000	-1.8142	-.6026
		2	-.63949(*)	.17422	.004	-1.1288	-.1502
		4	.34101	.18879	.354	-.1892	.8712
	4	1	-1.54938(*)	.23325	.000	-2.2045	-.8943
		2	-.98050(*)	.19554	.000	-1.5297	-.4313
		3	-.34101	.18879	.354	-.8712	.1892

* The mean difference is significant at the .05 level.

1.1. To which degree do you agree with the following statements, describing the improvement activities in your organisation? Please indicate the present situation at the right-hand side and the situation as it was three years ago at the left-hand side.

Three years ago						Today				
I fully agree				I disagree		I fully agree				I disagree
☐	☐	☐	☐	☐	A Continuous Improvement (CI) or equivalent formal improvement system (e.g. Total Productive Maintenance) has been introduced to involve all employees in ongoing improvement	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Lämpliga organisatoriska strukturer och system används för att sprida kunskap och erfarenheter över hela verksamheten	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Before embarking on initial investigation and before implementing a solution, individuals and groups assess the improvements they proposed against strategic objectives to ensure consistency	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Everyone learns from their experiences, both good and bad	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Everyone understands what the company's or their department's strategy, goals and objectives are	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Ideas and suggestions for improvement are responded to in a clearly defined and timely fashion - either implemented or otherwise delt with	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Improvement activities and results are continually monitored and measured	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Improvement is an intergral part of the individuals' or groups' work, not a prallel activity	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Individuals and groups are effectivly working across internal (verticl and lateral) and external divisions at all levels	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Individuals and groups at all levels share (make available) their learning from work and improvement experience	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Individuals and groups monitor/measure the results of their improvement activity and their impact on strategic or departemental objectives	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Individuals and groups use organisation's strategy and objectives to focus and prioritise their improvement activities	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Individuals seek out opportunities for earning/personal development (e.g. active experimentation,setting own learning objectives)	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Managers accept and, where necessary, act on all the learning that takes place	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Managers at all levels display leadership and active commitment to ongoing improvement	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Managers lead by example, becoming actively involved in the design and implementation of systematic ongoing improvement	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Managers support experimention by not punishing mistakes, but by encouraging learning from them	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Managers support improvement processes by allocating sufficient time, money, space and other resources	☐	☐	☐	☐	☐

Please continue Question 1 overlef

Three years ago: I fully agree				I disagree		Today: I fully agree				I disagree
☐	☐	☐	☐	☐	Ongoing assesments ensures that the organisation's processes, structure and systems consistently support and reinforce improvement activities	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	People (individuals/groups) initiate and carry through to completion, improvement activities - they participate in the process	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	People and teams ensure that their learning is incorporated into the organisation by making use of the mechanisms provided for that	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	People are oriented towards internal and external customers in their inprovement activity	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	People make use of some formal problem finding and solving cycle	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	People understand and feel ownership of the company's processes	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	People use appropriate tools and techniques to support their improvement activities	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	People use measurements to shape the improvement process	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Relevant improvement activities involve representatives from different operational levels	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Senior management make availabe sufficient resources (time money personel) to support the continuing development of the company's improvement system	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Specific improvement projects are taking place with custmers and/or suppliers	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	The organisation articulates and consilidates (captures and shares) the learning of inividuals and groups	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	The organisation recognises in formal but not necessarly financial ways the contribution of employees to continuous improvement	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	The organisation uses supplier nd customer feedback as a means to improving company performance	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	When a major organisational change is planned, its potential impact on the organisation's improvement system is assessed and adjustments are made as necessary	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	When something goes wrong the natural reaction of people at all levels is to look for reasons why rather than to blame the individual(s) involved	☐	☐	☐	☐	☐

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9. Which problem finding and solving tools are used in your organisation's improvement activities?
State the tools importance on the left hand side andhow often they are used on the right hand side

Importance: Important				Unimportant		Usage: Frequently				Rarely
☐	☐	☐	☐	☐	Problem identification tools/checklists (e.g. waste)	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	7 basic quality tools e.g. Pareto, fishbonediagram	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	7"new" quality tools (7MP tools) i.e. affinity diagrams	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Process mapping tools	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	FMEA (Failure Mode and Effect Analysis)	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	QFD (Quality Function Deployment)	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Creativity tools/Idea generating tools	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Display/Visulasiation tools	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Standardisation tools	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	5S (Cleaning, Sorting,Structuring, Systematisation, Stabilisation)	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Simulation	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	Sex sigma	☐	☐	☐	☐	☐
					SPS - Statistical Process Control					