The effects of newly developed, state-of-the-art Information and Communication Technologies on organisational learning (to learn) processes

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Keywords

Abstract

The paper describes a methodology and a software system that support a particular form of learning (to learn) processes, namely Continuous Improvement (CI) processes. Continuous Improvement is the planned, organised and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance (Boer et al.). Full-blown CI includes both vertical (e.g. the top-down strategy-driven process of setting goals to the improvement activities and the bottom-up process of reporting the results of improvement initiatives) and horizontal (e.g. dissemination of experiences and results obtained from improvement activities) communication processes. The software system presented in this paper aims to provide a solution to this through the use of advanced ICT technologies.

Introduction

Organisational learning is an information and knowledge intensive activity. It involves generation, acquisition, storage, maintenance, retrieval, transfer and distribution of knowledge and information.

Viewed from that point, it seems that ICT systems can play an important role in, and significantly facilitate organisational learning processes. However, so far, information systems tend not to be intentionally used to support such processes. Possible reasons are:

- Organisational learning involves not only explicit knowledge but also knowledge that is tacit, less structured and not quantified.

- Unlike other types of processes (e.g. production, administration, accounting), organisational learning processes have not been examined as areas for application of ICT technology.

This paper is focused on a particular form of learning (to learn) processes, namely **Continuous Improvement (CI)** processes.

In this paper Continuous Improvement (CI) is used in a broad sense, and defined as:

> ' ... the planned, organised and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance' (Boer *et al.*, 2000).

CI is about using all the innovative potential in the organisation in order to continuously improve the performance of the company. There are many key aspects that describe the current understanding of CI. However, the core of CI is **development and learning**.

The paper is based on an EU-funded project called *CIntranet* (IST-1999-55011), which has developed an intelligent, web-based software system (with embedded methodology) that supports continuous improvement (i.e. learning to learn) processes within firms. It presents, analyses and discusses selected results from the implementation and 'operational' effects of the CIntranet system in four medium-sized companies.

Background of CI [1]

The first activities that had to do with CI go back as far as at least the 18th century. Most activities then were stand-alone attempts like suggestion boxes, hardly based on 'scientific' approaches. At the beginning of the 20th century, Frederick W. Taylor started the development of what is now known as Scientific Management. Taylor and his followers recognised the need of CI and the involvement of the workforce therein. However, CI never became a part of day-to-day life, except for a special group, the industrial engineers.

After World War II the US-government started helping Japan rebuild its industry. A major part of that involved the transfer of Scientific Management principles and techniques to Japan, to no great effect, though. Only when the first Quality Control Circles (QCC) began to appear, in the early 1960s, the development of *kaizen* as the Japanese form of Continuous Improvement has become to be known, really took off. QCCs, small groups of volunteers making suggestions for improvement, appealed much more to the group-oriented Japanese culture. The effects: much higher rates and levels of improvement, resulting, eventually, in the entrance of Japan, Inc., to the global scene.

Japanese investment abroad, the desire to imitate their apparently successful management systems, and changes taking place in market, competitive and wider societal environments are major factors explaining the renewed and rapidly growing interest in the West for Continuous Improvement. Western industry has always had a strong preference for radical innovation. However, radical innovation rarely brings companies lasting advantage. Radical innovations are usually highly visible to competitors and, thus, relatively easy to imitate. Improvements originate and remain within the company and can thus develop into a considerable cumulative advantage that remains safely proprietary (Schroeder and Robinson, 1991). Furthermore, there are huge investments and risks involved in radical technological and organisational innovations and companies can no longer afford nor rely on that. CI requires little investment (but great effort to 'learn to improve' and to maintain this maturity process) to achieve better performance, not through the occasional expensive and risky quantum-leap change, but

through continuous, gradual improvements of existing practices to achieve better performance. Finally, many companies don't make the best use of their human resources while at the same time employees require ever-richer jobs in terms of responsibility, development potential, and participation in decision-making. The core principle of CI is: **wide-spread participation aimed at making the best use of the human resource, 'unleashing the hundred-headed brain' so as to achieve a lot of innovative potential more or less for free.**

So, what does CI do for companies?

Continuous Improvement is a learning process requiring the participation of all employees at all levels in the organisation, aimed at ongoing improvement. CI is a strategy for companies to increase the effectiveness of their (human) resources, in terms of the innovative contribution of employees to improve present practices and, through that, company performance. Thus, CI provides the possibility not only to meet present demands for responsibility, involvement, empowerment and continuous learning, but also through that reduction of waste (i.e. defects, set-up time, inventory, handling-time, breakdowns, lead-time), its principle business-related objective. As the example in Exhibit 1.1 shows, making many small steps may take quite some time but also be more than worthwhile if the eventual outcome is world-class performance.

The key to CI is development and learning. Consider the following:

One or two children are tossing around with a ball. More children join in and the play turns into a match. Most children don't have any clue of the rules of the game, no skills, no sense of tactics and team play; they simply enjoy the game and don't get any payment other than a pat on the shoulder by their friends or parents.

Some years later, having become a member of a football club, the game has become more serious. The previously disordered group of children experiences what it is to play as a team. Their skills improve during training sessions as well as through learning by the experience of playing matches against other teams. After a first success, a championship, flowers, a medal perhaps, and a promotion to a higher league, the team have some trouble adjusting to the higher level, but they survive, and learn new technical skills and, in particular, improve their team skills. They start getting a sense of tactics. At this stage, the role of the coach is very important, not only at the training sessions but also during the matches, giving directions from the touchline. By and by the team improve, and at some stage they find themselves as champions of their country, which allows them to play in the champions league the next season. At that stage, there are still medals and a bunch of flowers, but football has become a profession and the team is paid quite well. A few years on, after some disappointing experiences the team has grown to an unbeatable squad of highly skilled, physically and psychologically strong professionals, who can read the game and are able to change tactics as and when required during the match, with very little coaching required.

After winning the champions' league for the second time they manage to win the world championship after a thrilling match, in front of an excited crowd, in Japan …

This pattern, a group of school children playing football gradually evolving into a world-class team bears remarkable similarities with the development of CI:

- At the *macro-level*: the evolution of what started with some simple attempts to improve the performance of organisations to what seems to be the current concept of CI.
- At the *micro-level*: the way in which companies gradually learn to become a mature CI organisation.

Exhibit 1.1   CI is a learning process (adapted from Boer *et al.* 2000)

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[1] Much of this section is based on Boer *et al.* (2000), chapter 1.

A recent survey shows that CI is mostly implemented in larger companies (Gieskes *et al*., 1999). However, there is no reason to believe that it would not be important or achievable for smaller companies. The problem is that smaller companies still seem to lack the knowledge to implement and sustain a CI process (Gieskes *et al.*, 1999). Aimed at closing this gap, CIntranet has been designed as an affordable software-supported tool for SMEs to start and sustain CI.

CIntranet

Early 2001, a CRAFT-funded research project called CIntranet (Using Intranet technologies to support Continuous Improvement in SMEs – CRAF-1999-70204) was started by a consortium involving 4 SME companies (two in Netherlands and two in Greece) and 2 technology development partners (I2S SA, Greece and TSM Business School, The Netherlands).

The task of the consortium was to develop a software tool to assist SMEs with the alignment, co-ordination and dissemination of their Continuous Improvement (CI) activities, experiences and results.

If anything, CI is a learning process. Companies that want to make full use of the lessons learned from CI activities taking place within their organisation, will be required to disseminate these lessons as quickly as possible throughout their organisation. These lessons may derive from:

a) Experience obtained from performing CI activities (do's and don'ts; good and poor improvement practices).

b) The improvement results themselves (improved practices), which may be beneficial elsewhere too, either directly or in an adapted form.

c) The actual contribution of CI to the improvement goals and, through that, company performance improvement.

Lessons (a) and (b) require horizontal communication (knowledge dissemination). Lesson (c) requires both horizontal and vertical communication (bottom-up, in the form of management information). As a result the company will gradually improve its improvement activities and capabilities, optimise its CI effectiveness (wheels invented anywhere will not be re-invented elsewhere), and better able to co-ordinate and align its improvement activities in view of its CI goals and company strategy.

The basic approach incorporated in the CIntranet methodology and the software is to help companies identify (market) performance gaps, to analyse their present operations and, through that, to identify the causes of gaps, and to generate and manage improvement activities aimed at closing performance gaps. In so doing, the CIntranet software combines support for:

- A vertical communication process of process of goal-setting and deployment (top-down) and feeding back information on the company's performance (bottom-up), to start and continue improvement activities.

- A horizontal communication process of exchanging experience obtained from performing CI activities (do's and don'ts; good and poor improvement practices) and improvement results (improved practices).

The CIntranet software tool consists of several modules, which are described next. Exhibit 1.2 illustrates how they are connected.
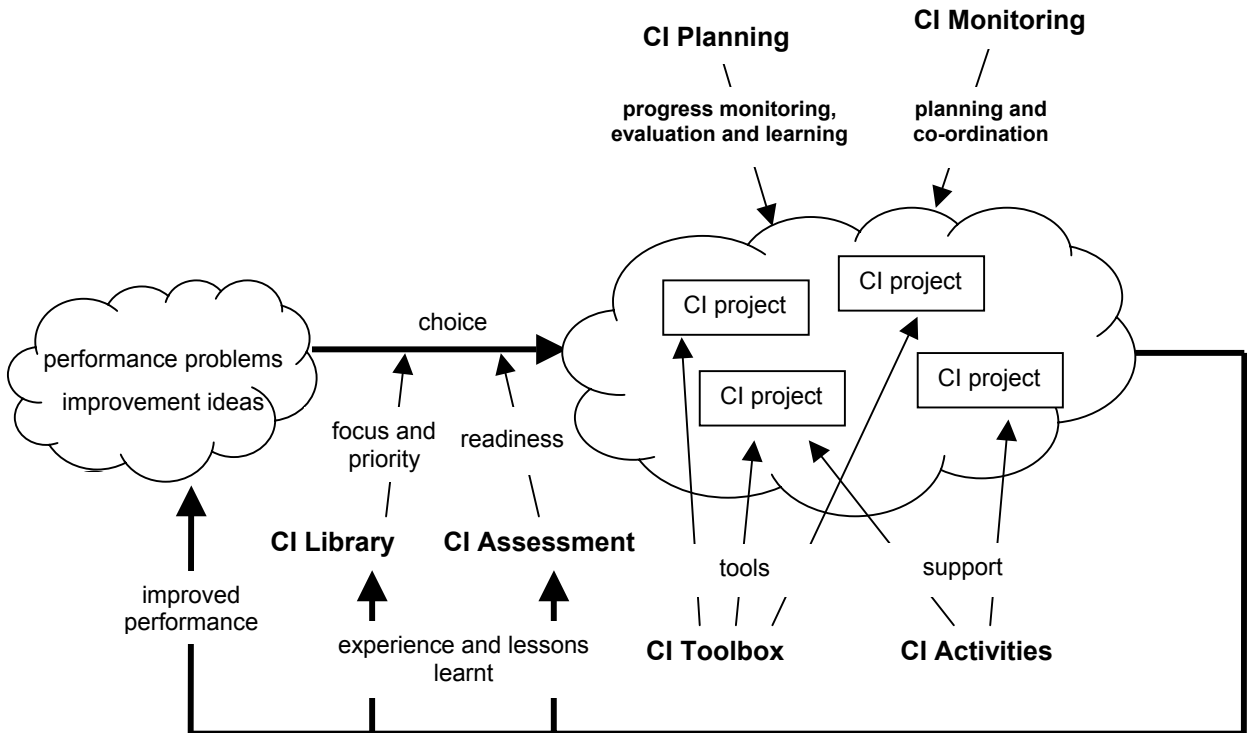
Exhibit 1.2   The relationships between the CIntranet modules

CI Library

This database helps companies manage and disseminate information concerning:

- Company strategy, goals and objectives. Widespread awareness of this will enable everyone to prioritise improvements and focus them on their contribution to the company's strategic goals and objectives.
- Experiences obtained from, and the results of, improvement activities: do's and don'ts, good and poor improvement practices, success stories, contribution of improvement activities to company performance.

CI Assessment Module

The aim of this module is to support companies assessing their CI capability, by establishing the abilities of individuals and departments:

- To motivate CI activities.
- To focus CI activities on the company's strategy and objectives.

- To collaborate across the borders of their department with other departments and even other organisations, including suppliers and customers.
- To improve the CI capabilities on individual, departmental and organisational level.
- To learn through improvement activities.

CI Activities Module

This module provides a user friendly interface and communication and co-operation facilities. The function of the module is:

- To support involvement of all members of a department in defining local improvement objectives based on company strategy and performance gaps.
- To help people at all levels propose, initiate and participate in improvement activities, and follow their ideas from suggestion to implementation. A nine-step approach to CI activities is suggested:

    1. Choice of focus
    2. Performance analysis
    3. Company analysis
    4. Conceptual design of the improvement and its implementation process
    5. Design evaluation
    6. CI capability analysis
    7. Match and go/no go
    8. Detailed design and implementation of the improvement
    9. Project evaluation

    See Gieskes *et al.* (1999) for a detailed description of these steps.

CI Planning Module

This module supports the planning and co-ordination of improvement activities at the departmental and company level. It provides the manager(s) responsible for the CI activities with management facilities supporting the consolidation and prioritisation of improvements proposed.

CI Monitoring Module

The function of this module is to support the measuring and monitoring of the results of the improvement activities. Each improvement activity is monitored and assessed in terms of its results. The related information is stored into a database. Among the items included are:

- The objective of the improvement project.
- The project plan and start as well as progress relative to plan.
- Performance before and after (e.g. number of customer complaints, cost per product unit, production per hour).
- Conclusions, results, and lessons learnt.
- Periodic review of the improvement activities.

- Assessment of the quality and quantity of participation in improvement activities (e.g. number of proposed improvements per month, per individual or department).

CI Toolbox

The CI Toolbox is an up-to-date library with a comprehensive set of practical improvement tools and techniques, such as flowcharts, histograms, Pareto, cause-and-effect diagrams, and many others.

Support center

This module enables the company to author and maintain, through a graphical, easy to use interface, a practical knowledge base for shop-floor decision-making (on-line guidance and troubleshooting). The module provides a dynamic structure, which allows new items to be stored within the framework by the company itself, without the need for external consultants. Also, it can be used as a training tool to teach employees effective approaches to problem solving and what to do in various situations when problems occur.

The main technical characteristics of the CIntranet system are:

- Java-based application using JSP/Servlet API
- DBMS system: Interbase 6.0, or, any SQL-based database
- Can run on virtually any platform supporting Java SDK 2.x. An overview of the system is shown bellow.
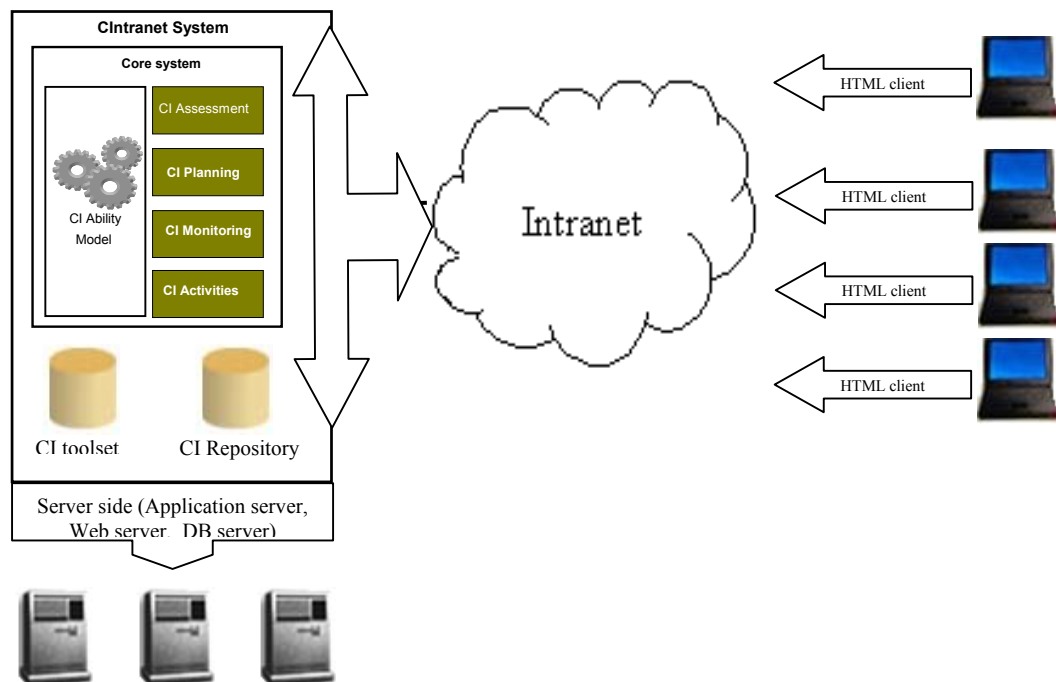
Exhibit 1.3   CIntranet overview

The CIntranet engine

A core element in the CIntranet approach is that it encourages companies to consider improvement not as the occasional one-off activity, but as a learning process that must be learned. This requires the company to keep on going with performance improvement continuously *and* to learn from this explicitly and, through that, to continually raise its 'CI-maturity' level. Fuelling the 'CIntranet engine' requires that each improvement activity be thoroughly evaluated. This should not only include the outcome of the improvement activity (improved practices and performance – 1st order learning), but also the improvement activity itself (improved CI capabilities – 2nd order learning). The steps required to keep CI going are illustrated in Exhibit 1.4.
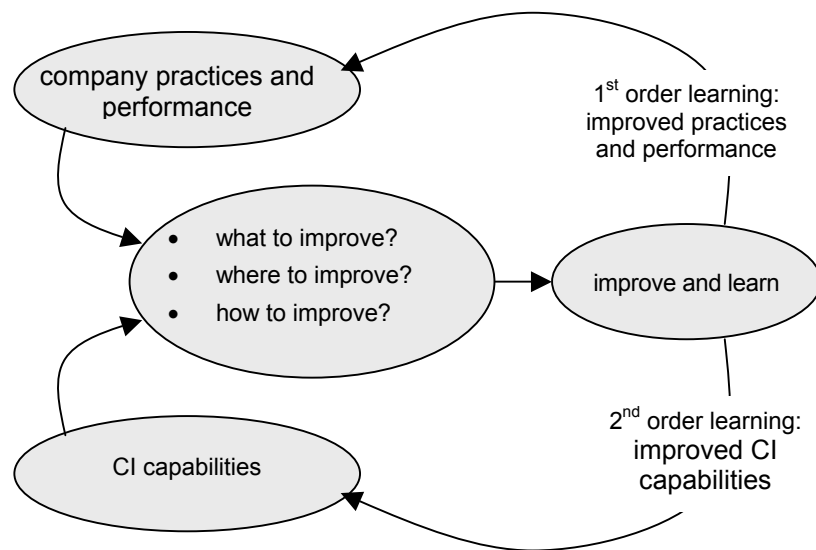
Exhibit 1.4   The 'CIntranet engine': continuous improvement and continuous learning

CIntranet application

The CIntranet system was developed for, and in close collaboration with, four SMEs to:

- Disseminate information on company strategy, goals and objectives. This enables everyone to focus and prioritise improvements based on strategic goals and objectives.

- Communicate the link between strategy and improvement activities.

- Help people at all levels to propose, initiate, participate in, and carry through to completion improvement activities more effectively and efficiently by making available to them lessons learnt previously or elsewhere in the organisation.

- Assess their CI capability

The companies represent different sectors - two food, one tool manufacturing and one printing company. However, they share a common interest in the development of a practical system to make the company-wide application of Continuous Improvement easier and more certain of working properly

(obviously, the process applying CI is the same in every sector). A very important common element is that all the SMEs had already been applying CI, in a predominantly top-down approach. Their aim now is to achieve a company-wide (bottom-up and horizontal) application of CI activities with the assistance of the CIntranet system. They expect CIntranet to help them to improve their *company performance* in the widest sense:

- Company profitability, market share, and other *market and shareholder*-related objectives. Key terms are cost reduction through quality improvement and reduction of waste, that is, unnecessary losses of time, energy, material, etc. through, for example, productivity improvement, inventory reduction, improved resource utilisation, lead time reduction, space reduction. All four companies expect to improve the major business performance indicators (cost, product quality, delivery reliability, and speed) by at least 10 % in the first six months of the implementation of the CIntranet results.

- At the basis of that are objectives related to, for example, work simplification, safety, less monotony, good housekeeping or, in short, improvement of the *quality of work-life* and the *quality of the work-environment*.

- Good housekeeping and reduction of waste, in particular of material waste through overproduction and production of faulty products or even scrap, will affect the energy and material efficiency of companies and, through that, have a positive effect on the *environment* as well.

It is at this stage of the implementation process too soon to give any definite indications as to the real contribution of CIntranet to company performance improvement, but the expectations are high.

Discussion and conclusion

There are various noteworthy observations to be made about CIntranet, the way it was developed and the ideas lying behind the methodology. The most interesting ones are presented and discussed here.

CIntranet is based on the viewpoint that a thorough analysis of performance (gaps) of the organisation forms the basis of a process of goal setting. Subsequently, improvement activities should be deployed top-down to all organisation levels, especially since the cause of insufficient performance can usually be found only through a careful analysis of primary, management and support processes. A bottom-up process of providing feedback information on goal achievement is another cornerstone of a full policy deployment process. Performance standards ought to be set by top management. This also means that performance gaps can and must be assessed at this management level, which gives direction and meaning to policy deployment in the organisation. CIntranet fully supports top-down directed performance assessment and analysis.

However, in a fully developed CI process, all levels in the organisation are involved and there is ample room for bottom-up initiatives and knowledge development and sharing. CIntranet aims to provide ample support for that. Each of the modules plays a specific role in this:

- CI Library: storage and retrieval of general CI knowledge.

- CI Assessment Module: support for developing cross-boundary collaboration capabilities.

- CI Activities Module: support involvement of all individuals and group in defining, initiating and participating in improvement activities, and follow their ideas from suggestion to implementation.

- CI Planning Module: planning and monitoring CI at and through all levels, and consolidation of results.

- CI Monitoring Module: storage and retrieval of company-specific CI knowledge.

- CI Toolbox: library of relevant improvement and improvement management tools.

- Support Center: various functionalities, including a training tool basically aimed at sharing and disseminating problem solving approaches.

CIntranet is not a management tool, not an expert system, but a computer-aided approach that leaves a lot to its users. Finding the appropriate balance between description and prescription, between process-facilitating versus expert approaches, has been one of the problems during the development of the methodology. As it is, CIntranet is not an expert system but based on a positive view of managers and employees as intelligent people. It is not prescriptive except perhaps the overall, nine-step approach (see Gieskes *et al.* 1999) suggested to approach CI activities.

A particularly strong feature of CIntranet is that the methodology is knowledge-intensive, combining theories from hitherto separate disciplines, in particular organisation theory and design, operations management (including quality management), management of innovation and change, knowledge management, and information and communication technology. In effect, CIntranet represents a 'synthetic innovation', that is, a creative recombination of existing knowledge. It was only through intensive cross-disciplinary collaboration and involvement of practitioners that these knowledge areas could be combined in a seemingly usable and useful way.

It has become very clear that the relationship between CI efforts and performance improvement is still a very problematic one. The majority of research in the field is on the implementation of CI, the development of CI-related capabilities, team-working, the use of CI tools, the spread of CI, differences between *kaizen* and Western applications, and so on and so forth (see De Lange-Ros (1999) and De Lange-Ros and Boer (2000) for an overview and a wealth of references). However, although the body of knowledge on CI is growing rapidly, most researchers seem to simply assume and take for granted that continuously improving current *practices* will lead to *performance* improvement indeed. However, apart from some anecdotes and indirect evidence (e.g. various chapters in Boer *et al.* (2000)), we did not find any tested theory on the how (mechanisms), why (explanation) and when (contingencies) of such a link. Consequently, one of the major weaknesses of CIntranet is that it is also based on belief (CI is *good* for you) rather than fact (CI *is* good for you). Further research is therefore required into the relationship between improvement and performance at all levels in the organisation.

Finally, CIntranet is limited to market performance areas. However, in today's labour market, levels of education are increasing. Partly due to that, employees are requiring and capable to exercise more

responsibility, and wish to 'have a say' in organisational decision making. This trend could be described as increasing the 'democracy at work'. Furthermore, employability and labour flexibility are high on the agendas of governments, trade unions and employers alike. Therefore and in view of today's hypercompetition, many companies have to provide a challenging work environment, 'education permanente', not only at school, seminars or workshops, but also on the job, and need committed employees who are actually involved in and taking part in the company's strategic development. Continuous Improvement seems to provide a suitable context for this. It would therefore be interesting, from a research point of view, and necessary, from a practitioners' perspective, to expand CIntranet to these areas. This will require extensive research into the relationship between ways of organising continuous improvement and less tangible performance factors.

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