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From continuous improvement to continuous innovation: a (retro)(per)spective

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Abstract: The new name of the industrial game is continuous innovation. But what is continuous innovation? And how can we manage and organise for it? This article addresses these questions by, first of all, defining continuous innovation as the ability to combine operational effectiveness and strategic flexibility – exploitation and exploration – capabilities that have traditionally been regarded as antithetical. Next, an old debate between organisation theorists on the question of whether it is at all possible to combine the two capabilities in one system is summarised to conclude that the majority of scholars argue that it is difficult, perhaps even impossible, to achieve continuous innovation. However, some authors have challenged this stance and have provided some useful thoughts, though little empirical evidence, as to how operational effectiveness and strategic flexibility can be combined to produce continuous innovation.

The question of how empirically supported knowledge could be developed is approached firstly by briefly discussing the bodies of theory underlying the current thinking about continuous innovation, namely organisational theories of innovation, learning, and continuous improvement. Then, the papers presented at the 1995, 1998 and 2000 (Euro)CINet conferences will be analysed to show how these fields are gradually converging into what would more appropriately be labelled continuous innovation (instead of improvement). The analysis also shows that the field has a couple of serious weaknesses that need to be addressed if the research community involved really wants to contribute to the art and science of continuous innovation. The paper concludes with a summary of this analysis, presented as an agenda for further research.

Keywords: Continuous improvement; learning, operational effectiveness; strategic flexibility; continuous innovation; research methodology.

Reference to this paper should be made as follows: Boer, H. and Gertsen, F. (2003) 'From continuous improvement to continuous innovation: a (retro)(per)spective', *Int. J. Technology Management*, Vol. 26, No. 8, pp.805-827.

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1 Introduction

In ever more industries, customers demand a high variety of fairly priced but high quality, increasingly customised or even unique products, delivered quickly and on time (see e.g. [1]). Consequently, companies are increasingly required to combine *operational effectiveness* and *strategic flexibility*. We associate the term operational effectiveness with the capability (embedded in the configuration of products, market approaches, processes, (human) competencies, technologies, organisation and management systems) to satisfy *today's* customers' demands in terms of function, price, time, quantity, and place [2]. Operational effectiveness requires excellent *exploitation* [2,3] capabilities. We understand strategic flexibility as the capability to develop new configurations of products, market approaches, processes, technologies and competencies, organisation and management systems that enable the satisfaction of (*the-day-after-*) *tomorrow's* customers [2]. Strategic flexibility requires excellent *exploration* capabilities [2,3].

The combination of these capabilities will have major consequences for the design and functioning of organisations. A few years ago, Corso and his colleagues (see e.g. [4, pp.76–78]) coined the term 'Continuous Product Innovation' to denote the continuously evolving and significantly cross-disciplinary, cross-functional and cross-boundary process 'aimed at innovating products within a family'. Also essentially referring to multiple-product innovation, Brown and Eisenhardt [5] note that for many firms, "change is not the rare, episodic phenomenon described by the punctuated equilibrium model but, rather, it is endemic to the ways these organisations compete".

The challenge to combine operational effectiveness and strategic flexibility – exploitation and exploration – will require ever more companies to go beyond continuous product innovation. They will need to develop what we would like to call *continuous innovation*, the ongoing process of operating and improving existing, and developing and putting into use new configurations of products, market approaches, processes, technologies and competencies, organisation and management systems. In other words, continuous innovation is the ongoing interaction between operations, incremental improvement, learning and radical innovation aimed at effectively combining operational effectiveness and strategic flexibility, or 'exploitation and exploration'.

We believe that continuous innovation will have a huge impact on the functioning of organisations. According to Boer [2, p.28]:

“The one-way links between strategy and operations, through implementation, and between innovation and production, will need to make place for two-way learning processes. With environmental change coming ever less predictable and ever faster, operations will have to learn to adapt much quicker to strategic response. The other way around, with environmental challenges coming into the organisation at all levels, companies will have to learn to react to, handle and incorporate in their strategy ‘emergent’ aspects much more adequately. Similarly, learning between the two key operational (day-to-day) processes, innovation and production, will become much more important as well. ‘Throw-over-the-wall’ practices will make place for intensive collaboration, with product innovators listening very carefully to the (much more pro-active) voice of their customers, the producers. The producers, in turn, will develop much more flexible (agile) systems that are able to cope with the uncertainty related to the company marketing a broad and varying product portfolio with many unique products to ever changing market segments. The ensuing organisation will be essentially open, with suppliers, customers and even competitors becoming part of the system. Consequently, there will be a major role not only for intra-organisational but increasingly also for inter-organisational learning.”

Developing actionable knowledge about the organisation and management of continuous innovation presents a major challenge for practitioners and academia. It is good practice *not* to reinvent the wheel, but to build on relevant practices and theories. Accepting the definition of continuous innovation formulated above, the central question addressed in the present article therefore is:

What do we already know about the theory and practice of continuous innovation, and what can we learn from that in terms of directions for further research?

The next section summarises an old debate among organisation theorists on the question as to whether it is possible at all to combine operational effectiveness and strategic flexibility effectively in one system to produce continuous innovation. The majority of scholars argue that it is difficult, perhaps even impossible, to achieve this goal. With good reason, however, our position in the debate is that companies must do just this, whether they like it or not. And, indeed there are a few authors suggesting not only that combining the concepts theoretically is possible, but also *how* operational effectiveness and strategic flexibility could be combined. However, only one or two authors underpin their argument with empirical evidence. In other words, the actionable knowledge practitioners need to design, implement, or develop effectively towards, continuously innovative organisations is largely lacking.

Core elements in our conceptualisation of continuous innovation are continuous improvement (CI), learning and innovation. Whilst innovation theory is an established area of research, CI and learning are relatively new areas. Most theories on organisational learning and learning organisations are normative, but hardly validated rigorously, or are based on anecdotes and a few widely cited case studies. In contrast, the theory on continuous improvement has a much stronger empirical basis. This article will therefore focus on CI theory. We will analyse the papers presented at the 1995, 1998 and 2000 (Euro)CINet conferences [6] in order to show that this area is developing rapidly and actually converging with organisational theories of innovation and learning and is thus moving into the direction of continuous *innovation* theory. At the same time, however, the field also has a couple of serious weaknesses that need to be addressed if the research community involved really wants to contribute to the art and science of continuous innovation. The paper concludes with a summary of the analysis, presented as an agenda for further research aimed at developing actionable continuous innovation theory.

2 Continuous innovation; can the dream come true?

According to March [7]:

“[a] system that specializes in exploitation will discover itself becoming better and better at an increasingly obsolescent technology. A system that specializes in exploration will never realize the advantages of its discoveries ... Exploration and exploitation are linked in an enduring symbiosis ... Each interferes with the other ... [and] organizations persistently fail to maintain an effective balance between the two.”

From this quote two things can be inferred. Firstly, systems, i.e. companies, specialising in either exploitation or exploration will underperform. Secondly, however, it is difficult to combine the two capabilities effectively. Indeed, exploitation and exploration have widely been considered as *antithetical*, and many scholars have ascertained that it is essentially impossible to overcome this problem. Examples include:

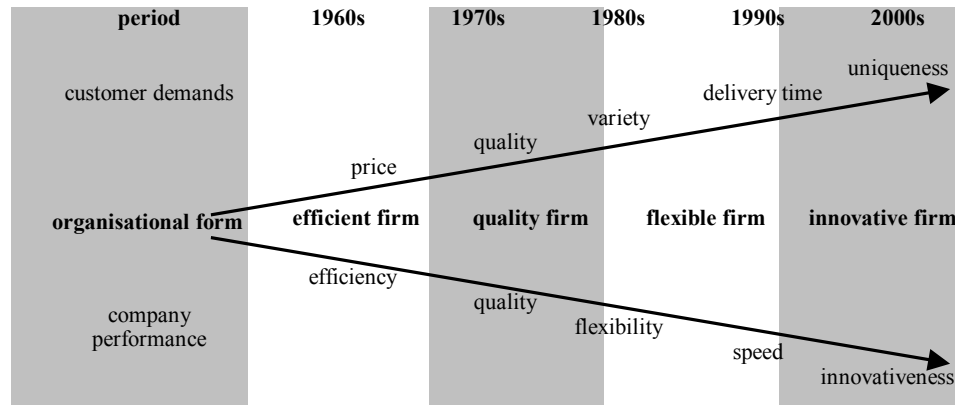
- Porter with his three either/or strategies: cost leadership, differentiation and focus. Companies pursuing these strategies have very different characteristics. It would therefore be impossible to combine them organically into one and the same system without losing competitive edge [8].
- Skinner, who maintained that “[a] factory that focuses on a narrow product mix for a particular market niche will outperform the conventional plant, which attempts a broader mission” [9].
- Burns and Stalker, who found that mechanistic management systems prosper in stable conditions, whilst organic systems would perform better in changing conditions [10].

Other scholars arguing, albeit rather implicitly so, for ‘*commensurability*’ of exploitation and exploration are:

- Mintzberg, whose divisionalised form at first sight seems to hold the middle ground between exploitation-effective forms, such as the simple structure, the machine bureaucracy and the professional bureaucracy on the one hand, and the exploration-effective adhocracy configuration on the other [11].
- Miles and Snow, who identified a configuration they labelled the analyser, which would be able to combine some of the explorative capabilities of so-called prospectors, and the exploitative qualities of, what they called, defenders [12].

However, both the divisionalised structure and the analyser assume a *moderately* uncertain environment. It is therefore questionable whether these forms will survive in tomorrow’s complex and dynamic markets.

Fierce proponents of commensurability or, rather, the *need* to combine the incombable, are Bolwijn and Kumpe [1]. They concluded that after the efficient firm of the period until 1975 or so, the quality firm of the late 1970s and the early 1980s, and the flexible firm of the late 1980s and the 1990s, it is now the era of the innovative firm (see Figure 1, [13]). The core of their argument is that each phase builds on and encompasses the strengths of its predecessor. Thus, the innovative firm would be able to combine efficiency, quality, flexibility, speed and innovativeness.

Figure 1 The evolution of market demands and (required) competencies of firms

Source: adapted from Bolwijn and Kumpe [1]

An analysis of data collected through the first International Manufacturing Strategy Survey (IMSS-I) categorised 83 (19%) of the 443 firms participating in the study as strategically flexible firms [14,15]. These firms combine multi-focusedness, process ownership and process integration. Compared to firms that had adopted none or only one or two of the three characteristics, strategically flexible companies are consistently better in their:

- improvement capability on a wide range of operational performance criteria
- ability rapidly to shift competitive and manufacturing priorities from one set of goals to another.

Finally, the concept of the learning organisation (e.g. [16,17]) may also provide a way to combine the two capabilities synergistically.

In the literature, many more typologies have been proposed: (see [18]) for an overview. The overall conclusion, however, remains the same; there are essentially two positions. According to the majority of organisation theorists, operationally effective exploitation and strategically flexible exploration are incompatible (antithetical). A minority argues that they are not, and only a few provide empirical evidence that this position may, in fact, hold.

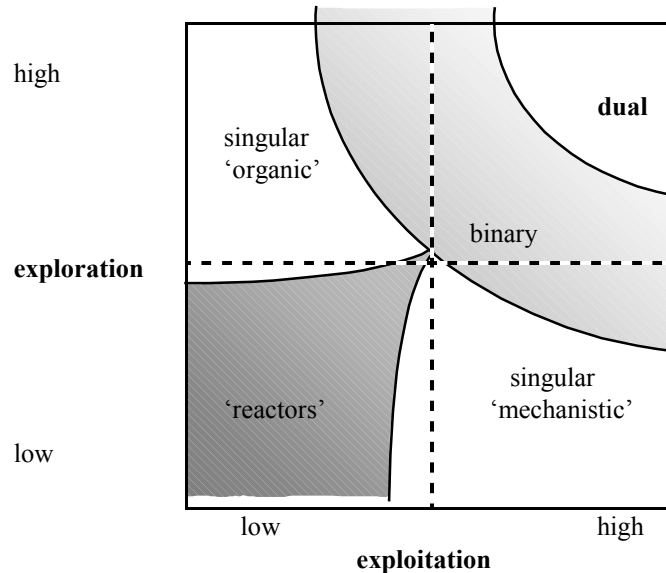
Our position in the debate is that we will need to develop forms of organisation that combine the two extremes, whether we like it or not. As Stacey [19] put it:

“When we look at the world of organizing ... you do not see ‘either/or’ choices. Instead you see “both/and” choices. Successful organizations – that is, continually innovative organizations – cannot choose between tight, formal control systems and structures on the one hand and loose, informal systems that provoke learning on the other ... they must do both at the same time.”

Very recently, Sutcliffe *et al.* [20] presented an “... evolution of [singular, binary and dual] organisational process models” and the antithetical, orthogonal and synergistic perspectives on balancing processes related to these models. The three approaches

actually represent a ‘continuum’ related to the exploitation and exploration needs of a company (see Figure 2).

Figure 2 The relationship between exploitation and exploration needs and form of organisation



The bottom left class depicted in Figure 2 probably includes Miles and Snow's [12] reactors. The two singular cells comprise the mechanistic and the organic models of organisation (cf. Burns and Stalker [10]).

Much more interesting from a continuous innovation perspective are the binary and, especially, the dual forms. Whilst binary organisations balance demands for exploitation and exploration in an orthogonal way, dual organisations do so synergistically. Examples of the binary model would be:

- The ambidextrous organisation [21], which can behave organically when the situation calls for the initiation of new ideas, and in a mechanistic way to implement and use the ideas.
- The punctuated equilibrium model [22], which “assumes that long periods of small, incremental change (i.e. product and/or process innovations) are interrupted by brief periods of discontinuous, radical change” [5]
- Imai's innovation process model in which radical systemic change is followed by long periods of maintenance and incremental improvement [23].

These three models use ‘time’ as the separator of the mode of working. The organisation can switch mode, but it takes time. Most organisations, indeed also Mintzberg's divisionalised form, use ‘spatial’ separation, having co-existing subsystems of operational efficiency and strategic flexibility operating at the same time, but in different places (subsystems such as divisions or development departments or projects).

It is much less clear how much we know about the dual model (Figure 2). The most elaborate theories on organising for a synergistic balance between short-term oriented

operationally effective exploitation and longer-term strategically flexible exploration, we found, are those on the innovative firm [1], the learning organisation (e.g. [16,17,24]) and strategically flexible production [14]. Common characteristics of the three theories are:

- They position their ‘ideal’ firm in a context characterised by a dynamic market requiring a multi-focused strategy and ongoing changes in competitive priorities. The firms maintain an open and warm relationship with their environment (customers, suppliers).
- They maintain that the balance between exploitation and exploration is achieved by stability, action ‘in the system’, and improvement of a wide range of operational performance aspects, on the one hand, and renewal, reflection ‘on the system’, and innovation supporting the continuously changing competitive priorities on the other.
- They agree on decentralisation, empowerment and teamwork as the main organisational building bricks.

At the same time however, the theories share a number of weaknesses. The most important ones are:

- The level of detail of the key characteristics is fairly low. The theories are concepts, providing ‘blue-print’ direction rather than directly usable knowledge. With the exception of the strategically flexible production paradigm [14], they lack empirical underpinning. The literature on learning organisations, for example, is mostly anecdotal, based on just a few cases (e.g. Chaparral Steel [24], and Xerox Corporation [25,20]), and the normative theories presented have scarcely been validated rigorously [26].
- The synergy of exploitation and exploration is addressed, but in a non-conclusive way. Bolwijn and Kumpe [1], for example, prophesy that “these companies have struck a balance between...” but fail to address in any detail how, and to what extent, the implementation of their recommendations will contribute to that.
- It remains unclear whether the organisation proposed is actually dual, binary or perhaps a hybrid of the two.
- The message is clear; there is a real challenge for scholars to step up their efforts and develop knowledge on continuous innovation. Given the current status of practice and theory in the area, this knowledge should be actionable [27]. Formulated as a *research* objective, the challenge is:

To develop actionable knowledge of

- 1 effective configurations of processes –people – technologies – organisation, which allow for both operationally effective exploitation and strategically flexible exploration
- 2 change strategies to actually translate this knowledge into working reality.

The first part of the objective concerns *design* theory: the second change *process* theory.

3 The state-of-the-theory on continuous innovation

If organisation design theories provide us with a debate rather than answers, what other disciplines could provide useful insight and direction? Core elements in our conceptualisation of continuous innovation are continuous improvement, learning and innovation. Innovation theory is an established area of research; CI and learning are relatively new areas.

In innovation theory, one field of exploration is concerned with the diffusion and factors explaining the adoption rate of innovations [28,29]. Studies in this area essentially regard the adopting unit (individuals, groups, organisations, markets/market sectors, whole societies) as a black box. These studies shed little light on the (continuous) innovation behaviour of organisations. A second, potentially more promising field of innovation research, concerns intra-firm innovation. Quite some effort has been put into the search for factors explaining success and failure [30–33]. Other scholars have investigated the roles of key individuals [34–37]. A third stream, which could be called the contingency theory of innovation, has focused on organisational, managerial and other contextual factors explaining the progress of innovation projects [38–41]. Whereas these three streams regard the innovation process as a black box or, at best, use some simple process model as a basis for examining other features of innovation [42], the most recent area of interest is in developing an in-depth understanding of the innovation process itself [43–47]. The unit of analysis of intra-firm innovation is individual innovation *projects*. Only recently has the focus of (product) innovation studies started to move beyond individual projects to the whole life cycle of families of products [4]. The innovation management community has yet to make the step to studying the continuous innovativeness of organisations as a whole. Having said this, there are some elements, in particular in the contingency theory of innovation, which may become useful in the development of continuous innovation theories. Indeed, as we will show in a subsequent section, publications representing this tradition are increasingly referred to in the emerging continuous innovation literature.

As noted before, most theories on organisational learning and learning organisations are normative, but scarcely validated. Here again, however, the conceptual thinking of learning is gradually finding its way into the continuous improvement research and literature.

The next section will show that, in contrast, the theory on continuous improvement has a much stronger empirical basis and is actually converging with contingency theories of *innovation* and conceptual thinking on learning and, thus, developing in the direction of continuous innovation theory. At the same time, however, the analysis will also show that the field has a couple of serious weaknesses that need to be addressed if the research community involved really wants to contribute to the art and science of continuous innovation.

4 From continuous improvement to continuous innovation

A recent literature review presented in [48,49] led to the following conclusion [49]:

“The existing literature about continuous improvement can be categorised into three different types.

Most publications are, what can be called, *attention literature*. These publications stress the importance of incremental improvements. Often, general prescriptive conditions for continuous improvement are presented. The work of Imai [23], Robinson [50] and some of Bessant’s c.s. earlier work ([51–53]) can be categorised in this stream of literature ...

A second type of literature is descriptive literature. Most of this literature describes or proposes CI tools, techniques and practices and their application (e.g. [50,54]). The majority of this literature is Japanese or Western, mostly American, publications on *kaizen* or on comparisons between *kaizen* and Western-style CI. Others have examined the spread of continuous improvement and the practices used elsewhere, for example in Europe or Australia [55,56].

A third and currently still relatively rare type of publications aims to contribute to the development of CI theory. This literature attempts to categorise and explain empirical observations, and gives attention to the mechanisms and rules behind observations. This literature analyses ways to organise and manage CI, discussing and explaining, for example, what are improvement teams, which types of teams exist, how they function, and why they are important.” [24,57,58]

This review was based on papers, articles and books published before 1997. Since then a lot has happened as the following analysis of the papers presented at the (Euro)CINet conferences of 1995, 1998 and 2000 will show. The analysis is built on the assumptions that the development of ‘good’ theory [59] on continuous innovation requires:

- empirical, relevant, rigorous and robust fundamental and applied research on the process, organisation and management of continuous innovation
- the development and use of a rich methodological toolbox, including surveys, case studies and action research.

A total of 86 papers were presented at the three conferences. At the 1995 conference in Brighton, UK, ten papers were presented. The 1998 proceedings from the conference held in Enschede, the Netherlands, included 39 papers. Finally 37 papers were presented in Aalborg, Denmark in 2000. The discussion is organised along three lines: methodology, type of results, and theoretical content.

With 86 papers, the sample size is small. The papers were presented at conferences that invited work in the areas of improvement, learning and innovation. But, with ten of the 17 presenting in 1995 also presenting in 1998, 14 of the 58 presenters in 1998 returning in 2000, ten authors present at two, and seven authors at all three conferences, a stable community is developing. We believe, therefore, that the results presented next provide a good indication of the main trends in the area.

4.1 Research methodology

It was not always easy to classify unambiguously the method used by the authors. For example, many authors use the word ‘cases’, or even ‘case studies’, when they actually performed an interview-based survey. Also, some authors claimed to have performed one or more case studies, but actually presented a research proposal, or a conceptual framework, and used real-life examples, presented as case studies, to illustrate the

framework. Thus, Table 1 and the subsequent analysis are based on *our* interpretation of what the authors actually did.

Table 1 Research methodologies

	1995	1998	2000
(Multiple) survey(s)	4	8	7
Single case study	2	7	7
Multiple case study	1	10	10
Action research, incl. (simulation) games	1	2	3
Multiple methods [60]	-	-	2
Consultancy/experience-based	1	2	2
Research proposal or agenda	1	-	1
Conceptual/theory-based	-	5	3
Other [61]	-	3	1
Unclear	-	2	1
Total number of papers	10	39	37

The majority of researchers appear to prefer traditional methods like surveys (mostly interview-based, some postal surveys, and one or two software-based questionnaires either self-administered or researcher-facilitated), and single and multiple case studies. Surveys were used in four (40%) of the papers presented in 1995. In 1998 and 2000, the numbers were eight (20%) and seven (19%), respectively, which suggests that this instrument is losing ground. Instead, qualitative methods, in particular case studies, became much more popular. Single case studies provided the basis for two (20%) papers in 1995, eight (18%) papers in 1998, and seven (19%) papers in 2000. The number of multiple case studies increased considerably, from just one paper (10%) in 1995, to ten papers (26%) in 1998 and also ten papers (27%) in 2000. The number of practitioner papers was low throughout: one in 1995 and only two in both 1998 and 2000. Overall, the number of studies with a clear empirical basis has remained high: nine (90%) in 1995, 29 (74%) in 1998 and 31 (84%) in 2000.

4.2 Types of results

There are different ways of classifying the research outcomes. The approach we have chosen is presented in Table 2 and explained below. Obviously, there are many possible hybrids of the four types distinguished in the classification. However, we decided to keep the task of classifying the papers as simple as possible.

Table 2 Research outcomes

	1995	1998	2000
Descriptive 'theory'	8	30	32
Validated theory	-	2	2
Normative theory	-	-	-
Management tools	2	3	(3) [62]
Other or unclear	-	4	3
Total	10	39	37

Descriptive 'theory'

This is the largest category throughout. In 1995, eight papers (80%) presented descriptive theory. With 30 papers (78%) and 32 papers (87%) the situation in 1998 and 2000 was hardly different.

The papers in this category are typically based on one or more exploratory case studies or surveys with the results of analysis and discussion ranging from directions for further research, to testable hypotheses. Many, but not all of the papers, discussed the findings presented and included references to theory, but this was not always the case. Actually most papers were fairly inconclusive in terms of their (possible) contribution to theory, whilst many of the papers falling into this *explorative* category presented *normative* managerial recommendations, in one form or another! In both 1998 and 2000, two papers reported efforts to validate and/or refine theory either through action research (one in 1998 and one in 2000) or by validating explicitly formulated hypotheses (also one at each of the two conferences). We will come back to this phenomenon later, but would like to conclude here that many researchers do not seem to be able, enabled or attracted to finishing the research cycle of only exploring the field but also developing and validating their findings.

Validated theory

In both 1998 and 2000, there were only two papers that set out to validate theory. The two 1998 papers were organised around one or two hypotheses and used a survey instrument and quantitative analysis of data. The two 2000 papers were based on action research as a method to operationalise, validate and refine theory. We found it surprising and a bit disappointing that three of these four papers failed to present and discuss the exact nature of their contribution to theory. The exception was a paper on the CI Capability Model developed by Bessant, Caffyn and their colleagues at Brighton University.

Normative theory

None of the 86 papers presented or resulted in purely normative theory, for example in the form of recommendations to managers, consultants or other professionals working in the field of Continuous Innovation. At the same time, however, the great majority of papers formulated some recommendations for practice (mostly addressing managers). In other words, the most frequent hybrid is a combination of managerial recommendations with any of the other types, including exploratory research-based descriptive theory.

Management tools

A relatively small number of presentations discussed experiences with tools developed elsewhere or presented tools developed as part of the research, often with some (first) experiential experience with the tool.

Table 3 Research content

	1995	1998	2000
<i>shop floor CI</i>			
CI practices – state of the art (mostly descriptive)	5 (4)	-	-
Factors of success/failure, enablers/disablers of CI ‘operation’ [63]	-	6 (4)	6 (3)
Role of coaches/leadership	-	5 (2)	1 (0)
Role of participation			
• in decision making	-	2 (2)	-
• through suggestion boxes	-	2 (2)	-
Role of organisation, e.g. teams, mini-company	-	2 (2)	-
<i>CI implementation</i>			
Factors of success/failure, enablers/disablers of CI implementation [64]	1 (0)	4 (3)	5 (4)
Implementation and change patterns, strategies	3 (3)	6 (3)	4 (4)
Role of action research/learning/experimentation in CI implementation	-	2 (2)	2 (1)
<i>configurations of operations, improvement and learning</i>			
Contingencies			
• CI in operations	1 (0)	3 (1)	3 (3)
• CI in innovation, R&D, NPD	-	1 (0)	3 (3)
CI/learning configurations	-	-	3 (3)
CI and learning	1 (1)	1 (1)	2 (2)
CI and knowledge/competence development/management	-	1 (1)	4 (3)
<i>miscellaneous</i>			
CI capability (self-assessment)	1 (1)	1 (0)	-
CI and manufacturing/innovation strategy and/or policy deployment	-	4 (4)	-
CI (and) performance measurement	-	2 (2)	1 (1)
Categories of CI	-	1 (0)	-
Conflict in CI (implementation)	-	1 (0)	1 (1)
Total number of papers addressed here	10	35	34

Note: The figures in regular font refer to the total number of papers addressing the aspect mentioned in the left-hand column. The bracketed figures in italics refer to the papers that focus on *one* particular topic.

4.3 Content

Table 3, which shows our interpretation of the research presented at the three conferences, calls for various remarks. First, we left out four of the 1998 papers and three of the 2000 papers, which we found difficult to classify as to their type of contribution. Furthermore, many of the remaining 79 papers report on more than one aspect of

continuous innovation. The figures in regular font refer to the *total number of papers* addressing the aspect mentioned in the left-hand column. The figures between brackets refer to the papers that focus on *one* particular topic. Consequently, none of the figures adds up to the total number of papers addressed here. This also means that all the percentages (number of papers relative to $n=10$ (1995), $n=35$ (1998) and $n=34$ (2000)) in this subsection are indicative if they refer to papers addressing two or more different aspects of CI. Only the percentages in italics are accurate as they relate the number of single-topic papers to the total number of papers addressed here.

Half of the 1995 papers (50%) were based on a preliminary analysis of the 1995 EuroCINet survey [56], presenting the state of the art of continuous improvement in Europe. Some of the same authors presented the results of a more focused or detailed analysis of the survey data in 1998. With a total of 17 (49%) addressing, including 12 (35%) entirely focusing on, factors explaining success and failure, or enabling or disabling CI 'operation', or the role of management, participation or organisation, the 1998 conference can be considered the 'heyday' of shop floor continuous improvement. In 2000, the numbers dropped to seven (21%), and three (9%), respectively.

We were greatly surprised that the number of papers linking CI with manufacturing or innovation strategy and/or policy deployment dropped from four (11%) in 1998 to zero papers paying more than superficial attention to this important issue at the CI2000 conference!

Implementation and change are given due attention: in 1995 four papers (40%) addressed CI implementation, with three (30%) focusing on the process of change. In 1998, the number of papers addressing implementation issues such as factors of success/failure, enablers/disablers, patterns of change, change strategies or approaches, e.g. including action research/action learning or experimentation, had grown dramatically to 12 (34%), with eight (23%) of those focusing entirely on the topic. In 2000, implementation accounted for 11 (32%) papers and was the single focus of nine (26%). We found this quite pleasing, given the observation [54] that the difficulty does not come with the concept itself, but rather with its implementation, and the consequent need to develop both design and change *process* theories on continuous innovation identified earlier in this article.

There are two clearly emerging, mutually reinforcing and partly overlapping topics. The first is contingency and configuration research, which developed from one (10%) paper and four (11%) papers addressing the subject in 1995 and 1998 respectively, to nine (26%) papers, all focused on this particular subject in 2000. Partly overlapping with this category is the integration of CI and learning theories. This includes:

- studies aimed at identifying configurations of CI and learning – zero in 1995 and 1998, three (9%) in 2000
- studies addressing continuous improvement as a learning process – one (10%) paper in 1995, one (3%) also in 1998 and two (6%) papers in 2000
- studies on the role of continuous improvement, learning and knowledge management in more radical innovation processes, including product innovation and organisational change – no papers in 1995, one (3%) in 1998 and three (9%) focusing on this topic out of a total of four (12%) addressing the topic in 2000.

In other words, the total number of papers explicitly positioning CI as a learning process, i.e. in a continuous innovation context, is increasing from one (10%) in 1995 and two (6%) in 1998, to nine (26%) in 2000. In the majority of these papers, one (10%) in 1995, two (6%) in 1998 and eight (24%) in 2000, this was the main topic of the work presented.

Taken together, the two research trends (i.e. contingency/configuration and CI/learning) indicate that the research focus is shifting towards understanding the functioning of configurations of operational, improvement and innovation processes. In 1995 there were two papers (20%, one of which or 10%, focused). This had grown to six (17%, three of which or 9%, focused) papers in 1998, while 2000 saw 15 (44%, 14 of which or 41%, focused). Given our definition of continuous innovation, it is exactly this understanding that provides the cornerstone to developing continuous innovation design theory.

Table 4 summarises the analysis and shows that, with a total of more than two-thirds of the papers presented in 2000, *design* (configurations) and process (implementation) have become the main research topics while shop floor CI is clearly losing ground as an area of research. The continuous improvement community is on its way to becoming a continuous innovation discipline indeed.

Table 4 From continuous improvement to continuous innovation

	1995		1998		2000	
Shop floor CI	5 (4)	50% (40%)	17 (12)	49% (34%)	7 (3)	21% (9%)
CI implementation	4 (3)	40% (30%)	12 (8)	34% (23%)	11 (9)	32% (26%)
Configurations of operations, improvement and innovation	2 (1)	20% (10%)	6 (3)	17% (9%)	15 (14)	44% (41%)

Note: The figures in regular font refer to the total number of papers addressing the aspect mentioned in the left-hand column. The bracketed figures in italics refer to the papers that focus on *one* particular topic

Table 5 confirms and actually reinforces this tendency. The Table was constructed simply by counting the number of papers in which reference was made to *relevant* work of the author(s) mentioned. Please note that with the term ‘relevant’ we mean, for example, Schonberger’s work on Japanese management [65], not his co-authored book on production management [66]. Furthermore, we counted multiple references as one. For example, many papers include multiple references to the work of Bessant, Caffyn and other members of CENTRIM. However, all these references were counted as one. What does Table 5 indicate?

First of all, there is a radical decrease in the number of papers referring to Imai’s seminal work on *kaizen* [23] or, as we prefer to call it, shop floor level CI. Even if we take in Robinson’s CI in operations [50], Schonberger’s lessons in simplicity [60] and Womack *et al.*’s work on lean production [67], the number of papers referring to Japanese management concepts, including *kaizen*, has decreased, from 32 (with 22 referring to Imai [23]) in 1998, to 14 (six of which refer to Imai) in 2000. In contrast, the number of papers referring to the work by Bessant and his colleagues (e.g. [51–55]) is stable, at 15 for both conferences. However, the role of their work has changed considerably. In 1998 it was mostly used to define CI and to ascertain that ‘there is a new and important phenomenon that we need to pay attention to’, along the lines of, what

De Lange-Ros [48,49] called ‘attention literature’. The 2000 papers tend actively to use the CI Capability Model in the form published by the CENTRIM group [54], or in modified form, as one, or even the, theory used to model the research presented in the paper.

Table 5 Research background (references, in number of papers)

	1998	2000
<i>Continuous improvement</i>		
Bessant (<i>et al.</i>)	15	15
Imai	22	6
Robinson A.	5	2
<i>Japanese concepts</i>		
Schonberger (<i>et al.</i>)	3	1
Womack (<i>et al.</i>)	2	5
<i>Learning</i>		
Argyris/Argyris & Schön	9	5
Kolb	5	4
Leonard	2	3
Nonaka (<i>et al.</i>)	4	7
Senge (<i>et al.</i>)	6	5
<i>Innovation</i>		
Burns & Stalker	-	1
Cooper (<i>et al.</i>)	-	4
Hage & Aiken	-	3
Van de Ven (<i>et al.</i>)	1	2
Wheelwright/Clark	-	6
Zaltman <i>et al.</i>	-	3

Source: [68]

At first sight, Table 5 hardly substantiates our observation that CI is increasingly regarded as a learning process. In 1998, 31 single or multiple references to the most influential writers on organisational learning could be found [16,69–73]. In 2000, this number was 26. However, a deeper look reveals a change similar to the one indicated above. In 1998, many presenters referred to the learning literature to indicate that they *regarded* CI as a learning process. In 2000, many more authors *studied* CI as a learning process, making active use of the theories to which they referred. Again, however, none of the authors set out to contribute to or challenge the current knowledge of organisational learning or learning organisations, which is fine, of course. We find it a bit disturbing that we could find no discussion of the usability and usefulness of learning theory for improving our understanding of CI, incremental innovation or continuous innovation! Most authors postulate, albeit it implicitly, that CI is, or can, or should be studied as a learning process. We are not sure if this is a form of scientific laziness or due

to the status quo of organisational learning theory (see, e.g. [74]). Anyway, we find this an important challenge for further research.

A final observation concerns the (re-)entrance of innovation theory. In the 1998 proceedings we counted one relevant reference, to Van de Ven [46]. In the 2000 proceedings, 19 single or multiple references were made to the authors mentioned in Table 5 [10,33,38,39,45,46,75–78]. This is clearly a reflection of the transition the field is going through, from continuous improvement to continuous innovation. It seems to us that ‘climbing-on-the-shoulders’ of these ‘grand old men’ of innovation research is a very sensible way of boosting the field. The work referred to concerns not only studies of factors of success and failure of product innovation (see for example much of the early work by Cooper and his colleagues, e.g. [33]). Reference is often also made to research on innovation and change in the wider sense, including work on the *process* of innovation (e.g. [45,46]) and organisational and managerial *contingencies* affecting these processes (e.g. [10,38,39]). This is very fortunate, in our opinion, as we regard the development of process-based contingency theories of continuous innovation as one of the major challenges for the future of the field.

In various papers, the (analytical) distinction between CI ‘in operation’ and CI implementation is not always clear. This may be due to the dual character of CI. On the one hand, CI has much to do with improvement in the value chain, including R&D and NPD, manufacturing and assembly, marketing, sales and distribution, both within firms and on the inter-firm level. On the other hand, companies and their employees (may) learn from CI activity (double loop learning [64]). Further, companies may deliberately choose to manage the implementation of CI, or the process towards becoming a learning organisation, or any other kind of technological and/or organisational change, as an incremental innovation or a learning process. It is by no means certain that factors of success and failure, enablers and disablers, forms of leadership and of organisation, and also, for example, conflict, play the same role in these three variants. Although theory development on this seemingly important issue is needed, again, various papers addressing the influential factors just mentioned, lack unambiguous clarity.

5 Discussion

What can we learn from all these ‘data’? The questions we would like to address here are:

- Are we making progress? If so, in which areas particularly?
- Which areas deserve further investigation?

Progress

One impression is that research in the field of continuous innovation leaves a lot to be desired, especially in terms of types of results. There is still a lot of descriptive work and too many researchers fail to make the step to develop and validate their theories. All too often, also, researchers present normative managerial implications based on descriptive studies.

In terms of content, the previous section has clearly demonstrated that the field is moving in the direction of continuous innovation, with ample attention to the two core issues: design and process theories.

Having said this, it is also obvious that the field is in its ‘pre-paradigmatic’ stage. There is as yet no unity in terms of definition, operationalisation, measurement and method. It is therefore inevitable to find:

- many good pieces but little *coherent* mid-range *theory*, let alone ‘grand theory’ of continuous innovation.
- much explorative, *descriptive* research and few attempts to validate findings through quantitative or action-research.

Having said this, continuous innovation will be a major and immediate challenge for many companies, and the CI research community seems indeed to be moving in this direction.

Further research

Our analysis raises a couple of intriguing challenges and questions.

The first ‘challenge’ is to be patient, and become less fashion-driven. It is not enough to start exploring and describing the field. Much more effort should also be put into developing and validating theory. Although the research community represented here seems to have left the study of *shop floor CI*, we are no way convinced that this also means that this sub-field is fully understood. On the contrary, we think that this topic still deserves a lot of attention, in particular in terms of the development and validation of theory and management concepts and tools based on these. This development is not necessary merely for the sake of further clarifying the topic; a workforce with high CI and learning capabilities is one of the cornerstones of the continuous innovation capabilities organisations need to survive in future.

The second challenge is to continue the work on *configurations* and the influence of contingencies, and to also link this research to CI, learning and continuous innovation *performance* and the longer-term effects on operational performance.

Thirdly we should like to see more *processual research* in the firm belief that the effectiveness of managing any process, including that of continuous innovation, depends a great deal on deep knowledge and understanding of that process.

Fourthly, CI is increasingly conceptualised as a *learning* process, and it seems to us that the main questions are:

- Is CI best conceptualised as a learning process, or are there superior ways of understanding the activity, for example, modelling CI as an (incremental) innovation process? Until recently, this was the dominant view. Furthermore, innovation processes have been conceptualised in many different ways, including activity-stage, departmental-stage, decision-stage, conversion process and response models [42]. Or would it perhaps be more useful to try and combine multiple views? After all, even the most radical innovation processes comprise a wealth of incremental change or even routine activities.

- How do CI and learning relate to, and how can they be used to enhance or facilitate, or even be embedded in, non-routine processes, in particular more 'radical' *product innovation*, R&D and NPD processes?
- How do CI and learning relate to more radical *organisational change* processes? For example:
 - Can CI and learning be used to prepare the ground for, and facilitate the progress of, organisational development and change?
 - Are the implementation of CI and efforts to become a learning organisation in itself to be considered as a radical change that could, or perhaps even should, be organised and managed best as an ongoing improvement and learning process?

A fifth issue that is already emerging, albeit slowly, is related to the network-economy. An ever-increasing number of companies have reconsidered their core business (or core competences) and are consequently engaging in different forms of collaboration with other firms. Emerging concepts, in terms of scientific and managerial interest, include supply chain management, co-manufacturing and co-design, extended enterprise, dynamic network, and virtual company. We have little doubt that the concepts of CI, learning, innovation and their combination in continuous innovation on the *inter-firm level* will soon move to a much higher position on the industrial agenda than they are now. Consequently, this will generate new research questions and, thus, a new extension to the field.

A final question that we would like to mention here is a possibly important form of *innovation capability*. Consider the combination of:

- increasing speed of change and innovation: innovation of products, adoption of technological innovations, adaptation to changes in the market place
- the 'back-to-core-business' process many companies are going through.

One effect of these two phenomena, especially in high-speed and highly dynamic and perhaps even volatile industries, will be that inter-firm networks will be highly dynamic as well, in terms of which companies are involved and the time new partners get to be up and running. This may require ever more companies to develop what could be called, 'plug-and-play' competence, i.e. such a high level of 'adapt-ability' that they are attractive partners for such networks [79]. We expect that this ability will require quite a bit more than 'just' being a learning organisation and the challenge to researchers is to identify, and develop insight into the characteristics of such organisations.

6 Conclusion

Many companies need to prepare themselves for a different future. As a result, they will be increasingly required effectively to combine operational effectiveness and strategic flexibility, exploitation and exploration, to produce continuous innovation. These capabilities have widely been considered as *antithetical*. Organisational theory does not have adequate solutions. Consequently there is an urgent need for actionable continuous innovation theories. Mainstream innovation theory has yet to make the step towards

developing such theories; organisational learning theory is too conceptual to be of immediate use. Recent developments in continuous improvement theory are much more promising.

A few years ago, the majority of publications basically concerned shop floor-level continuous improvement in manufacturing operations. Today, the scene has changed dramatically, with the majority of researchers included in the analysis presented in this article studying the design and implementation of what is appropriately called continuous innovation, not only of products but also of processes, technology, organisation and management, and even markets. We have little doubt about this premise and obviously hope indeed that the CI research community will (be allowed to) play an important role in the transition. Fundamental to that role is that the researchers and research units involved continue and even step up their efforts to produce empirically based, relevant, rigorous and robust fundamental and applied knowledge on the process, organisation and management of continuous innovation.

Acknowledgement, apologies and further reading

The argument developed in this article would not have been possible without 86 papers written by many more authors. We thank these authors for their contributions and apologise for the oversimplified, black and white way in which we had to present their work. Readers who would like to get a much richer picture of the work performed in the CI research community are strongly recommended to access the conference proceedings [80–82] and journal specials [55,83–85] through which selected conference papers have found their way to the wider community.

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