
Relating learning, knowledge creation and innovation: case studies into knowledge productivity

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Abstract: This study explores which learning processes contribute to the improvement and innovation of an organisation's procedures, products and services. It aims to find the variables that promote or inhibit these learning processes.

For this purpose, a conceptual framework was developed. This framework helps to better understand learning processes that lead to improvement and innovation and to stimulate knowledge productivity in practice. In this article, we first present the conceptual framework. Next, we present the results of 16 reconstruction studies deployed in various organisations in The Netherlands, China and Indonesia. The results confirm that the elements in our framework play an important role in developing and using new knowledge that is needed for improvement and innovation.

Keywords: knowledge productivity; learning; innovation.

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1 Introduction

In an economy where knowledge is dominant, daily operations in organisations should be designed to support *knowledge productivity* (Kessels, 1996; 2001). This process entails identifying, gathering and interpreting relevant information, using this information to develop new skills and then to apply these skills to improve and radically innovate operating procedures, products and services. Learning is at the heart of this process: tracing relevant information, and developing and applying new competencies are based on powerful learning processes.

Can we cultivate the ability among individuals and teams to be knowledge-productive systematically? Can learning situations be designed to promote knowledge productivity? In our research programme, we explore how to stimulate and support the learning processes an organisation needs for the improvement and innovation of its products, services and processes. The key questions of this research are:

- Which learning processes contribute to the improvement and innovation of operating procedures, products and services?
- Which variables promote or inhibit these learning processes?
- How can these learning processes be stimulated by targeted interventions?

In this paper, we describe our research framework, as well as the methods and results of 16 case studies in various organisations in The Netherlands, China and Indonesia. We conclude with a reflection on the implications for further research.

2 Theoretical framework

Knowledge productivity depends on the competence of individuals and groups to gradually improve and radically innovate operating procedures, products and services. Producing knowledge is in itself not enough. In an economical sense, knowledge only has value when it is linked to action. The application of knowledge to products, services or processes is what makes knowledge productive.

The knowledge productivity concept therefore is based on the view that knowledge is a personal competence: “knowledge needs to be understood as the *potential for action* that doesn’t only depend upon the stored information but also on the person interacting

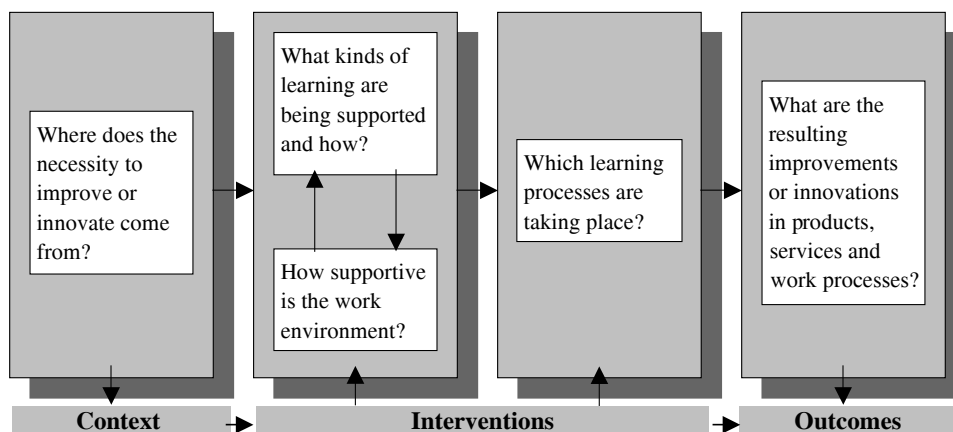
with it” (Malhotra, 2000, p.249). In this research, we focus on how organisations can develop the ability to achieve such changes on the learning processes that contribute to the ability to be knowledge-productive. A specific innovation, improvement or invention – possibly patented – may be of great economic value, but the true value lies in the *ability* to generate such improvements and innovations rather than in the actual innovation. Developing the ability to innovate is therefore a key challenge for individuals, teams and organisations as a whole.

2.1 Towards a framework for knowledge productivity

During the past few years, we developed a preliminary conceptual framework for knowledge productivity, which we are now testing, improving and validating. This framework is based on work and insights from various domains (human resource development, organisational sciences, learning theories).

In this framework (Figure 1), we distinguish the following elements.

Figure 1 Conceptual framework for knowledge productivity



2.1.1 Outcomes for the organisation

The assumption behind the idea of knowledge productivity is that, in order to have long-term success in today’s knowledge economy, an organisation needs to continuously improve and from time to time radically innovate its products, services and work processes (Drucker, 1993; Nonaka and Takeuchi, 1995). Knowledge productivity becomes visible in concrete improvements and innovations.

The distinction between gradual improvement and radical innovation is inspired by the work of Walz and Bertels (1995). Gradual improvement elaborates on what is already present and leads to additional refinement and specialisation. Radical innovation is based on breaking with the past and creating new opportunities by deviating from tradition. Therefore, the results of knowledge productivity can be measured in terms of improvement and/or innovation of products, services and processes.

2.1.2 Learning processes

These results depend on the development and utilisation of the knowledge that is needed to realise the desired improvements and innovations (e.g., Leonard-Barton, 1995). In this learning process, we distinguish three elements (Kessels, 2001; Nonaka *et al.*, 2001):

- 1 identify, gather, exchange and interpret relevant information
- 2 use this information to develop new competencies
- 3 apply these competencies to improve and radically innovate.

This means that knowledge productivity not only comprises producing (creating) knowledge, but also making knowledge productive (application).

Such learning processes surpass the individual level; they take place on the team of organisational level (e.g., Dixon, 1994), are situated in practice and are social in nature (Brown and Duguid, 1991; Wenger, 1998).

2.1.3 Learning support

Previous research (Kessels, 1996; Kessels *et al.*, 1998) indicates that the kind of learning that is at the heart of knowledge productivity, can be supported by a *corporate curriculum*: a learning environment that develops the competencies needed to be knowledge-productive. This is not a formal curriculum prescribing the programmes and courses that workers should attend. Rather, it involves transforming the workplace into an environment where learning and working integrate. Such a corporate curriculum should serve seven related learning functions:

- 1 acquiring *subject matter expertise* and professional knowledge directly related to the organisation's business and core competencies (e.g., a bank's financial services or the care provided by a hospital)
- 2 learning to *identify and deal with new problems* using the acquired subject matter expertise (e.g., switching to a new tax system or introducing customer-oriented patient care)
- 3 cultivating *reflective skills* and meta-cognitions to find ways to locate, acquire and apply new knowledge (asking questions like: How do we learn from our experiences? Why is it that we excel in developing sustainable energy but are unable to convince those around us of its value?)
- 4 acquiring *communicative and social skills* that help people access the knowledge network of others, participate in communities of practice and make learning at the workplace more productive
- 5 acquiring skills to *regulate motivation, affinities, emotions and affections* concerning working and learning (it is important for knowledge workers to identify personal themes and ways to develop them)
- 6 promoting *peace and stability* to enable exploration, coherence, synergy and integration; employees should receive the opportunity to master and elaborate a plan, idea or operating procedure. However, too much peace and stability might bring about overly one-sided specialisation and an excessive internal focus, complacency or laziness

- 7 causing *creative turmoil*, which leads to radical innovation. Creative turmoil also results from a powerful drive to resolve a tricky question. The cause is often an existential threat: a matter of winning or losing, surviving or going under, being in or out. However, not all unrest is creative turmoil. Disturbance alone, without the drive to innovate, is irritating; too much creative turmoil may yield a thousand new ideas but leaves little opportunity to elaborate any of them. The learning functions peace and stability and creative turmoil are clearly conflicting, even though they are supposed to offset one another.

A large-scale Dutch study in the healthcare and welfare sector provides support for these seven learning functions (Van Lakerveld *et al.*, 2000). This research shows a clear relationship among these seven elements of a learning environment (the elaboration of the corporate curriculum) and the ability of an organisation to improve and innovate (knowledge productivity). It identifies the learning functions as seven distinguishable variables that together form a coherent concept.

2.1.4 Work environment

As the corporate curriculum is not situated in an isolated learning centre, but integrated in the work environment, it becomes necessary to look at conditions in a work environment that support the learning functions of the corporate curriculum. Based on our research thus far, we formulated three provisional development principles for a work environment that supports a corporate curriculum (Kessels, 2001):

Enhancing reciprocal appeal (the social context)

Knowledge-productive workplaces are rich learning environments in which the social context fosters collaborative efforts. No single manager, instructor or trainer, however, is exclusively responsible. Participants work hard to maintain their reciprocal appeal, which means that they do their best to provide each other with a fruitful learning environment. Important characteristics of this social context for learning seem to be: reciprocal respect, appreciation and integrity, sufficient safety and openness for constructive feedback and confrontations. The communicative and interactive skills of the participants are required to meet high standards.

Searching for a passion (the content component)

People are clever only if they want to be. A knowledge-productive environment encourages people to find their passion. Knowledge-productive environments encourage cultivation of a personal, substantive theme. Such an individual theme inspires curiosity and enables information to be traced more quickly. It facilitates establishing connections with attractive, professional networks and stimulates exceptional achievements where others might give up. Designers and knowledge workers need to become competent to navigate through the diffuse arena of affinity, motivation, passion and ambition to be able to achieve high-quality improvements and innovations.

Tempting towards knowledge productivity

Cultivating reciprocal appeal serves primarily to create a favourable social context. Searching for a passion establishes the foundation for substance. But what can you do to encourage people to work systematically and focus on the social context and the substantive component? The desire to guide, manage, control and monitor is becoming increasingly difficult to fulfil. The growing interest in self-guidance is apparent in both work and learning contexts. This leads us to ask how we can tempt each other towards knowledge productivity. The main objective is to become able to design a workplace that develops sustainable instruments, useful for dealing with future issues: the competence to become cleverer, learning to learn, organising reflection, increasing reflexivity and basically applying knowledge to knowledge development.

Context

The corporate curriculum and the design of a supportive work environment will be influenced by the context of the organisation. This context provides the reasons for innovation and improvement and also influences the direction the organisation takes and the challenges that come up as a result of these. The triggers for investing in improvement or innovation primarily come from outside the organisation (*e.g.*, market, technological, social, environmental, political developments), but can also stem from internal challenges and ambitions (*e.g.*, problems in work processes, worker satisfaction/retention, change in vision and ambition).

Interventions

In this research, we are not only looking to clarify factors that facilitate or inhibit knowledge productivity. We are also exploring which kinds of interventions in the work environment, corporate curriculum and knowledge processes can promote knowledge productivity.

3 Knowledge productivity in 16 innovation projects: lessons from practice

During the past few years, we have examined 16 projects in which an innovation or improvement was realised in practice. These 16 cases vary widely across business sectors and cultures. We deliberately chose to do the cases in this variety, to explore and validate our framework across contexts (see Table 1 for an overview). In each case, a specific innovation or improvement was identified and reconstructed.¹

To reconstruct the cases, all people involved in the case were interviewed and a document analysis was done. For each case, a case report was written and validated. The results per case are summarised in a detailed and overall matrix that allowed for a cross-case analysis. The focus of the analysis was twofold:

- 1 Are the elements of the conceptual framework recognisable in the cases and what role did they play? (aimed at validation and extension of our framework)
- 2 What are the critical elements in the cases that stimulated or hindered knowledge productivity? (aimed at finding levers for intervention).

Table 1 Overview of the cases under study

Case	Project/type of innovation	Objective	Result/Impact	Persons directly involved
1. Multinational beer brewery (The Netherlands)	David Dispense System/product innovation	Develop beer dispense system for low-volume catering (=50% of the market)	Implemented new dispense system and increased sales volume by 10%-15%	Cross-functional core team of 8, 25 R&D people, involving suppliers
2. Multinational beer brewery (Indonesia)	Bintang World Class Manufacturing/process improvement	Meet increased market demands by optimising bottling line	Operational performance increased from 32% to 70%, breakdowns reduced and stock accuracy increased	Whole technical division, divided into action team, assist team and steering team
3. Natural gas producer (The Netherlands)	Producing the Limit/process innovation	Maximising production capacity while minimising cost	Raise of gas production by 400 million m ³ gas	Core team of six, cross-functional, engineering backgrounds
4. Oil company (China)	Shangri L.a: new business model for distribution/process innovation	Regain control of distribution channel	New distribution system, optimise efficiency in distribution, new partnerships with retailers	Team of 14, sales and staff people
5. Foods and Home & Personal care multinational (The Netherlands)	Integrating two production lines/process innovation	Combination of two production lines into one that makes both products more efficiently	Reduction of operators and increased production	Cross-functional team from engineering, operations, maintenance, HR, logistics
6. Foods and Home & Personal care multinational (China)	Hazeline Snow Cream/product improvement	Solve quality problem to satisfy loyal customers and attract new ones	Improved product (soap)	Cross-functional team from R&D, Quality control, production and engineering
7. Foods and Home & Personal care multinational (China)	Phinda: develop and market new beauty soap/product improvement	Become market leader (in a fragmented market where it was losing market share)	New beauty soap line introduced, leading market position	Cross-functional team from marketing, R&D, purchasing, packaging and operations
8. Dutch Railways (The Netherlands) *	New computer system for local planners/process innovation	Integral solution of planning problems and improve efficiency and timeliness	Stuck in dispute between advocates and opponents of a new direction	Group of eight: one designer of system and seven local planners from different regions
9. Dutch Railways (The Netherlands) *	New planning system for sharing infrastructure/process innovation	Standardising planning procedures throughout different planning stages (from long to short term)	New software design, accepted by participants and others in their work environment	Group of seven, one designer and six planners, participants checked new ideas with colleagues
10. Dutch Railways (The Netherlands) *	New procedures for correcting imbalances/process innovation	Train availability where it is needed, more efficient use of trains	Result not yet achieved, stuck in exchanging and discussing	Group of eight: two designers of system and six local planners
11. Network for multiple land use (The Netherlands) *	Living city/process innovation	New concepts for city planning and design, integrating various functions in a small space	Individual ideas and methods people use in their own practice, no integrative and common concepts yet	Community of Practice of ± 15 people from various organisations and disciplines
12. Network for multiple land use (The Netherlands) *	Industrial area development/process innovation	Integrating various needs in the process of developing an industrial area	Common process model for the development of industrial areas	Community of Practice of ± 15 people from various organisations and disciplines
13. Network for multiple land use (The Netherlands) *	Regional junctions/process innovation	Approach for integrating (often conflicting) demands and solving dilemmas	New process plan for the re-design of regional junctions	Community of Practice of ± 18 people from various organisations and disciplines
14. Hospital (The Netherlands)	Cardio-diagnostic unit for General Practitioners (GP)/service innovation	Providing diagnostic facilities and expertise in a way that keeps control with the GP	Facilities and processes designed and implemented, but less patients than expected and sub-optimal cooperation	Core group of three: two medical specialists and manager, limited participation by others in the process
15. Hospital (The Netherlands)	Integrating care for various patient groups/process innovation	Improving patient-oriented care and building a more flexible and multi-skilled workforce	Integration of two wards, cross-disciplinary protocols for patient care, multidisciplinary cooperation	Core team of five medical specialists and one manager, cross functional involvement of larger group
16. Hospital (The Netherlands) *	Client orientation in concern staff/process innovation	Changing from prescriptive-to client-centred approach	Better contact with clients, but also more uncertainty (innovation not yet finished)	Whole department, subgroups work on different assignments

The cases marked with ‘*’ were reconstructions of processes that were not yet finished at the time of this research. From the table, it becomes clear that in all cases, the process was an *internal* one. None of the cases deal with the implementation of externally developed solution. Therefore internal employees fulfil a key role in all of the cases. This is in accordance with the focus of our research: we want to learn more about learning processes that are involved in innovation and improvement. When implementing an externally developed innovation, much of this learning takes place outside the organisation under study. Through selecting internal innovations, we could study the whole process.

In the next sections, we describe the results of this research, following the structure of the conceptual framework. First, we focus on the context and outcomes of the cases we studied. Then, we describe which factors in the work environment supported the learning process. We also describe whether the seven learning functions of the corporate curriculum played a role and how. Finally, we reflect on the learning processes that took place.

3.1 Context and outcomes

In all cases, there was a clear need behind the initiative to innovate/improve. We could distinguish two kinds of motives. Both of them led to different improvement and innovation processes.

3.1.1 Innovation proceeding from an urgent business problem (in Cases 2, 4, 6 and 7)

In these cases, organisations reacted to the acute, external developments in the environment, *e.g.*: market demands that could not be met (Case 2), breakdown of the wholesaler network (Case 4), or unsatisfied customers (Case 6). In these cases, there was a clear need for direct action and short-term solutions. The organisations could not solve the problem with the kind of approach and solution they were used to, but they needed to solve the problem in a new way. Innovation was a clear necessity, as a reaction to an urgent problem.

In these cases, we saw that the urgency of the external problem leads to time-pressure, focus, dedication and speed in the innovation process. As a consequence, time and space for experimentation and exploring various paths were limited. A clear direction was chosen very early in the process. As a result, the achieved change was mainly incremental (in three of the four cases). In those three cases, knowledge development built on expertise that was already available inside the company (*e.g.*, from technical centres or other business units). In one case, a radical new direction was chosen (Case 4). This necessitated the development of new subject matter expertise.

3.1.2 Innovation as strategic choice of the organisation (in Cases 1, 3, 5, 8, 9, 10, 11, 12, 13, 14, 15 and 16)

It is remarkable that, after being asked to select an important change for us to study, most organisations provided examples in which innovation was a strategic choice. The choice was inspired by external developments and/or by a new ambition of the organisation itself. In these cases, the focus was not on short-term problem solving. Rather, it was the

long-term view that was central. Innovation was a deliberate choice: a pro-active approach in order to seize an opportunity and develop a new approach to situations and issues. The choice was based on the vision that 'more of the same' would not create a lasting solution and a strong position for the organisation.

Innovation as strategic choice arose from new market opportunities (Case 1), pressure on flexibility, efficiency and cost (Cases 3 and 5), delays in train schedule (Cases 8, 9 and 10), and a nationwide problem with the use of the limited ground space (Cases 11, 12 and 13).

In these cases, there is time to explore new paths, and we saw mixed results. In the contexts where the pressure was fairly high (in terms of time or money) and desired results were relatively well-defined, the process had many characteristics of a project approach, but had new methods and extended cross-functional cooperation (Cases 1, 3 and 5). In the cases with a less clear idea about the desired output, there was more experimentation and also a diverging phase in search of the kind of approach and solution that would be best. The result of this process was either a 'breakthrough' or a 'breakdown': half of the cases got stuck somewhere in the process, and half of them came up with radically new approaches (sometimes after being stuck and having created a breakthrough out of this) that led to successful innovations.

There are three cases in which the external pressure was less tangible, and the main drive for innovation came from the organisation's new ambition. In two of these cases, new solutions and approaches were developed but the actual benefits of these in everyday work remain limited. The third case was very successful, through capitalising on personal motivation and by building a strong interdepartmental cooperation, involving almost all workers.

As a preliminary conclusion, we could state that external pressure is important to really have significant impact in daily work. However, too much pressure could stimulate working within known fields of knowledge and therefore limit innovation.

3.2 Supportive work environment

Many of the elements concerning the work environment in the cases, were linked to the three development principles for a supportive work environment (see Section 2.1). For each development principle, we summarise the factors we found in the cases. Also, for each development principle, we mention interventions that were used in some cases and that turned out to be stimulating.

This process of making explicit the supporting factors and interventions in the work environment, was done after the processes took place in practice. In practice, much of this was implicit. Although the development principles could be recognised in the reported stimulating and hindering factors, these principles and factors were seldom used consciously. This research was clearly a process of reflection and making sense after the fact, and thus in a way, also a learning process for everyone involved.

3.2.1 Enhancing reciprocal appeal

Most cases report that a crucial basis for reciprocal appeal was the subject matter expertise that people possess: respondents from almost all cases report that it was attractive to work with people who are more knowledgeable than they are in other fields. In two cases, we saw people leaving the group when they felt they could not learn enough

from the others. Personal contacts in a cross-functional setting seem to provide an important basis for knowledge productivity – they created curiosity towards others and enabled the development of new patterns for interaction.

From the cases, we learn that a supportive social context is characterised by openness to new ideas and input from others, tolerance for mistakes, care and respect. Working outside the daily functional work contacts – in which position, hierarchical routines, and avoiding loss of face often played an important role – made it possible to develop such a social setting. But even then, the creation of such a stimulating social context was not self-evident. Cooperation with people from different backgrounds, in itself, is not enough to create a stimulating social setting. Teams sometimes struggled to find productive ways to cooperate. Problems of misunderstandings, loss of time, and not being able to move beyond information exchange and discussion towards the development of common new ideas, were also apparent. Some projects even got stuck because of these (e.g., Cases 8 and 10).

Interventions

We encountered two types of interventions that helped to create a working environment in which cooperation takes place on the basis of reciprocal appeal:

1 Interventions directly addressing reciprocal appeal within the team.

This happened when people were asked directly and personally to make explicit what they expect from others and what their own contribution is. This clearly had a positive effect in some of the cases. It made the reciprocal appeal visible and such a question invited people to work on the basis of reciprocal appeal (instead of based on function or position). Case 11, for example, shows how the intervention of a facilitator directly influenced the way the people involved dealt with the reciprocal appeal in the group. In this case, the facilitator asked the people within the community of practice explicitly to articulate their contribution to the process. By doing so, it became clear to one of the persons involved, that her contribution did not really add something. As a result, she left the community.

2 Introducing new methods of problem solving and cooperation.

In some cases, the introduction of a new methodology for the whole process or even of a new method in one team meeting, stimulated the creation of more attractive patterns of cooperation. In Case 3, a new methodology for problem solving gave a clear perspective on working together and created a context that was, from the start, very different from ‘normal’ work. In other cases, a deliberate intervention in a meeting, like playing a game in Case 9, got people out of the discussion mode and into a process of listening and dialoguing.

3.2.2 Searching for a passion

In every case there was a high commitment of the persons involved. They all had an apparent personal interest: either an interest in the topic (like in Cases 12, 13 and 15), and/or an interest in the core challenge because they personally experienced the issues the project dealt with in their daily work (like in Cases 4 and 5). It is this intrinsic motivation that seems to be the driving force behind the innovation processes we looked at, and that

creates the energy and commitment to get to a result in one way or another. In many cases, the intrinsic motivation was linked to a desire to show your qualities to others and to share these with them, to use your qualities and to develop them further. This personal passion in many cases provided a mix of curiosity and the determination to succeed.

Interventions

- Invite people on the basis of passion and personal interest

The combination of both having a passion for the topic involved and having a personal interest in the solution or innovation that the process results in showed to be very powerful. Where the curiosity for the content was limited, exploration of new paths and ideas was limited and a more traditional problem-solving approach prevailed (Case 2). We also saw a case (Case 14) in which the personal passion of the key players for the subject matter of their work led to an unproductive definition of the ambition. They defined the desired outcome of product/service innovation (a new diagnostic centre) instead as a process innovation (new roles of general practitioners in the diagnostic process). This could happen because the problem owners (general practitioners and patients) were not involved in the innovation process. In cases where the personal interest in the solution is less apparent or even negative, it was often difficult to keep the energy (*e.g.*, Cases 8, 11 and 16).

- Special care and trust of management

Although the motivation concerned primarily intrinsic motivation, the cases show that pride, recognition and personal career motives are also important to keep the process going. This motivation can be fed by extrinsic means such as attention or involvement of the management, and by showing trust by explicitly giving responsibilities.

3.2.3 Tempting towards knowledge productivity

Being tempted towards knowledge productivity seems to be a crucial condition for an improvement or innovation to succeed. In all cases, we found interventions, mostly done by a project leader or facilitator, that were clearly stimulating. The interventions have an apparent link with the previous two principles.

Interventions to create a positive social climate

Typically, all these interventions are focused on the creation of a new setting for the process to take place in.

- Deliberately create and foster cooperation across functions and backgrounds. This happened in almost all cases.
- Create a new setting that invites people to develop new interaction patterns and that invites people to use new methods of working. In Cases 11, 12 and 13, this happened by using a *Community of Practice* approach.

- Make it a ‘special event’ for the people involved, *e.g.*, by making it visible and recognisable. This makes them feel connected, and at the same time it makes them feel special and appreciated. Examples were found in Cases 3, 5, 6 and 7.
- Facilitate the process of working on the basis of reciprocal appeal by targeted interventions or methods (Cases 9 and 11).

Interventions that address passion and personal motivation

- Invite participants based on personal interest and expertise instead of inviting them based on formal position or as representative of a functional group. This was done in most of the cases and it put the message across that expertise matters and was valued. People felt invited to use and develop their personal abilities.
- Link the core team to others inside and outside of the organisation that have a clear stake in the results (managers, clients and colleagues). This contributes to a personally felt need (people you know and that are important to you are waiting for results) and to feeling recognised as someone doing important work. It also creates a challenge and drive to succeed.
- Stimulate participants to experiment and explore new ideas. This was mainly done by making explicit that experimentation is welcomed and also by formulating the assignment in such a way that a *new* direction to solve the problem is inevitable. For example: the assignment to integrate production lines of different products (Case 5) or the assignment to fundamentally change the distribution system (Case 4).

A common characteristic of these interventions (or ‘temptation strategies’) is that none of them directly manage the innovation process itself. They all concentrate on the creation of a setting and context for the innovation process to succeed.

3.3 Corporate curriculum

In this section, we describe what we found in the examined cases with respect to the seven learning functions of the corporate curriculum.

The development of *subject matter expertise* plays an important role in all of the cases. In all the cases, people used various sources in order to gain subject matter expertise (books, internet, intranet, training, conferences, excursions to other departments within the company, *etc.*). Besides these data sources, the personal network of people involved was also heavily used to acquire subject matter expertise.

When time was short because of an urgent business problem (Cases 2, 4, 6 and 7), people tended to use knowledge that is already available within the organisation. The focus was more on finding and allocating subject matter expertise needs than on developing new subject knowledge.

In the change processes we reconstructed, people felt that their subject matter expertise was one of the few certainties in an uncertain process. That is why people tended to hold on to their subject matter expertise. It is therefore not easy to open up to new perspectives and to conflicting views: in one-third of the cases, it was hard for people to go beyond *exchanging* subject matter expertise (in Cases 8, 9, 10, 11, 12 and 13). They had great difficulty in breaking with present ways of working in order to come up with radically new approaches.

Identifying and dealing with new problems in new ways stimulated the participants to find new solutions. In the cases where experimenting and exploring was part of the process, the degree of innovation seems to be higher than in cases with a very focused problem-solving approach. However, the chances of getting stuck and not produce a practical solution also seemed to increase.

A sense of connectedness of the people involved with the experienced problem seems necessary. When the people involved felt no urge to solve the problem, they were not very good at finding or developing adequate knowledge.

The development of *reflective skills and metacognitions* did not get much explicit attention in the cases. Reflection was visible mainly during organised (group) meetings in which reflection was the main goal. In these organised meetings, the attention was mostly focused on the next steps to take in the process. We could not trace specific examples of how people reflected on the way they acquire and apply new knowledge. Our hypothesis is that most reflection was very task-oriented. Working on metacognitions was not yet reported.

As a learning process, *acquiring communicative and social skills* was not an explicit part of the cases we studied, but almost all people mentioned that open and good communication was absolutely essential for getting results. In the examined cases, these skills served mainly three goals:

- 1 To use your own network of colleagues and acquaintances in order to find and get the information you need.
- 2 To find people who are expected to contribute to the process and to involve them in a meaningful way, which they themselves will find attractive.
- 3 To be able to communicate and present your own ideas and opinion to others.

The regulation of *motivation, affinities, emotions and affections* was important in all of the cases. Personal motivation and affinity with a particular topic was the driving force behind innovations and improvements in the cases. However, most of the time, this motivation stayed implicit and no explicit attention was given to it. In one case (Case 11), we found examples of purposeful usage and development of personal motivation and affection.

Peace and stability is necessary, provided that it is balanced with a sense of urgency and with creative turmoil. The cases clearly show that peace and stability can influence the process negatively when there is too much feeling of rest. In Case 16 for example, the people involved felt no urge to change. They wonder how a change can be urgent when it already has been postponed for three years. As a result, the people involved found it hard to go beyond the exchange of information.

Case 13 shows how a certain amount of peace and stability can help the innovation process to get a new impulse. In this case, the existing stability caused people to think beyond existing frames and to realise a breakthrough.

Creative turmoil was experienced especially just before and during radical breakthroughs. Creative turmoil arose from a combination of external pressure, a strong interest and a personal drive. Sometimes there was restlessness without the creative turmoil. This was mainly caused by the fear to let go of safe and familiar ways of thinking, which always provided something to hold on to in the past. In the cases, several methods were used for turning this unrest into creative turmoil:

- Organise an event with external stakeholders. In Case 11, people from outside the organisation were invited to a workshop, which increased the pressure to ‘produce results’, and also because their reputation was at stake.
- Make an excursion to the object that you want to change. In Case 13, the group decided to meet each other at one of the regional junctions for which they were finding an innovative solution. This visit radically changed the way they thought about this junction.
- Work on a physical product (like a particular design in Case 11). This stimulated everyone to make his or her views and ideas more explicit, to actively combine these with the viewpoints and ideas of the others, in order to make shared design decisions. This created an opportunity to go beyond the exchange of information and to negotiate about meaning.
- Experimenting with existing production lines in Case 7 resulted in a feeling of responsibility for attaining results. The fact that existing production lines were at stake caused pressure to present results.

3.4 *Knowledge processes*

Based on the data we have collected to this day, it is difficult to get a clear picture of the actual knowledge processes that took place. These processes are not directly visible, and take place in and between the heads of the people. Most people in the cases were also not used to looking at their work from a knowledge perspective. Reconstructing the processes was therefore difficult. Still, there are some interesting results to report.

The process of identifying, gathering, exchanging and interpreting relevant information was part of all the cases. However, using the information in order to develop new competencies was a difficult step in the process of knowledge creation. What we saw in the case studies is that it takes a lot of effort to make the step from identifying, gathering, exchanging and interpreting relevant information to developing new competencies and to actually *use* each other’s experiences and information in order to develop something new. This proved to be a vulnerable part of the process, in which we also saw participants lose their attention or even drop out. The cases that did not (yet) succeed mostly stopped at this hurdle. The cases in which people succeeded in actually using each other’s experience and information into actual improvements and innovations, were cases in which a sense of urgency was felt by participants. In these cases it was clear who had a stake in a solution.

4 **Conclusion and reflection**

The 16 case studies provide validation for the conceptual framework we presented in the first part of this article: the influencing factors that were reported in the cases, could be traced back to the framework. In Section 3, we presented examples of how these factors play a role in concrete improvement- and innovation processes in practice. The cases provided further elaboration of our framework: Section 3 adds new and more specific factors that can be incorporated into the framework.

In the successful cases, many elements of the conceptual framework were present in a positive way. However, we did not find many examples of deliberate and mindful use of these elements. They became explicit because of the reconstruction of the process we did. It would be interesting to research if a more conscious use of the conceptual framework in designing and facilitating innovation processes would lead to even more results, and especially to an increased ability to be knowledge-productive.

With respect to the elements in the cases that stimulated or hindered knowledge productivity, we can conclude the following:

- Creative turmoil drives the innovation and improvement process. The urge that people feel to develop something new, together with an external pressure, creates the motivation to start and continue. At the same time, room for experimenting with new ways of working and problem solving offers energy and new perspectives.
- The substance of the innovation process is provided by the subject matter. Subject matter development was at the heart of most of the studied innovation processes.
- The autonomy and responsibility that were given to groups involved in a process of improvement or innovation, were crucial for the process to succeed. People needed the space to make their own choices and to decide on their own way of working. The communicative skills needed for doing this successfully are of great importance but definitely not self-evident. People needed support in order to develop these communicative skills.
- It is important that people take the time to reflect upon the process they are going through. This happens mostly implicitly, but also explicitly in organised meetings. In the rush for the project, it seemed to be hard to find space and adequate ways to give shape to reflection.
- The social context for knowledge productivity is provided by the cross-functional personal contacts, care and respect, and tolerance for mistakes.
- The personal passion leading to curiosity, the drive to work towards concrete results, together with the reward and recognition, serve as reasons for people to put an effort in knowledge development.
- The organisation and its management have an important role in supporting these innovation processes. This happens by inviting people and seducing them. Directly managing the process is impossible.

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Note

- 1 The researchers who executed the case studies are, in alphabetical order: K. Derksen, K. Kwakman, D. Suriyany, B. Van der Swaluw, C. Wang, and W. Yuan.