

Linköping University Post Print

Organizational learnability and Innovability: A system for assessing, diagnosing and Improving Innovations

SuMi Dahlgaard Park and Jens Jörn Dahlgaard

N.B.: When citing this work, cite the original article.

Original Publication:

SuMi Dahlgaard Park and Jens Jörn Dahlgaard, Organizational learnability and Innovability: A system for assessing, diagnosing and Improving Innovations, 2010, International Journal of Quality and Service Sciences, (2), ISSUE 2, 153-174.

<http://dx.doi.org/10.1108/17566691011057339>

Copyright: Emerald Publishing Group

<http://www.emeraldinsight.com/>

Postprint available at: Linköping University Electronic Press

<http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-62962>

ORGANIZATIONAL LEARNABILITY AND INNOVABILITY: A SYSTEM FOR ASSESSING, DIAGNOSING AND IMPROVING INNOVATIONS

Su Mi Dahlgaard-Park¹ & Jens J. Dahlgaard²

¹Institute of Service Management,
Lunds University, Sweden

²Division of Quality Technology and Management,
Linköping University, Sweden,

Abstract

Purpose

The purpose of this article is to present and discuss the development of a system for assessing and improving Technology Development and Innovations. The system components comprise:

1. A framework or model for assessing, measuring, diagnosing and improving Innovation Enablers and Results.
2. A simple methodology for data collection, data analysis and prioritizing improvement areas.
3. An index for measuring the performance level of innovation, learning and lean (ILL) and the potentials to increase that level.

To improve innovation, which is the most complex challenge for today's organizations, there is a need for such a system.

Design/methodology/approach

The first two system components have been developed and tested during a period of 10-15 years in several industrial companies as well as service organizations. The last component has recently been developed to satisfy a need of all type of organizations.

Findings

With the last development, the ILL index, the 3 components comprise *A System for Assessing and Improving Innovations*. As with any other system the system-components are interrelated.

Keywords: Self-assessment, innovation, new product development, strategy, learnability¹, and innovability²

1. Introduction

The purpose of this paper is to present and discuss the development of a system for assessing and improving *Technology Development and Innovations*. The article reports on the development of a methodology and an associated measurement instrument for data collection, data analysis and diagnosing for prioritizing improvement areas. As parts of the measurement instrument an overall index for measuring and diagnosing the performance/ excellence level of *innovation, learning and lean* (ILL) has been developed and tested in several companies. Some of the test results will be presented in sections 5 and 6.

The conceptual framework/ model behind the measurement instrument was originally developed based on the specific enabler criteria of the European Excellence Model adapted to the innovation area (Dahlgaard-Park & Dahlgaard, 2008; Martensen et al., 2000; 2007). The areas to address (= the key performance indicators) under each criterion were the result of a comprehensive study of innovation

¹ *Learnability* means ability/capability to learn or 'learn to learn skills'. As we could not find a concept which possesses these two meanings in one, we 'created' the new word *Learnability* for this important meta skill.

² *Innovability* means ability/capability to innovate. As the ability to innovate becomes increasingly important in the constantly changing world, and as we could not find a suitable word for this meta skill, we 'created' the new word *Innovability*.

literature combined with the case companies' experiences. Based on case company experiences, data analyses and literature studies a simpler model was developed - *the 4P Excellence Model adapted for Innovation*. Section 2 will present this model and discuss some important literature references used in developing the suggested framework/ model.

After the initial model building (section 2) the background of the "4P" model will be presented in section 3, followed by a presentation and discussion on the epistemology and ontology of the "4P" model in section 4. The simple approach for measuring and diagnosing innovation excellence will be presented in section 5 together with results from a Danish manufacturing company. In Section 6 the overall index for measuring and diagnosing the performance/ excellence level of innovation will be presented and test results from a few companies will be discussed. The paper will then be finalized in section 7 with a final discussion and validation of the "4P" model.

2. Literature Study and the "4P" Excellence Model

Based on extensive literature studies and data analyses related to the European Excellence Model adapted for Innovation (Martensen & Dahlgaard, 2000; EFQM, 2005), Dahlgaard-Park & Dahlgaard, 2005), Martensen et al, 2007; Dahlgaard-Park & Dahlgaard, 2008) and extensive discussions with leading innovative companies we have developed the model for measuring and diagnosing innovation excellence shown in figure 1.

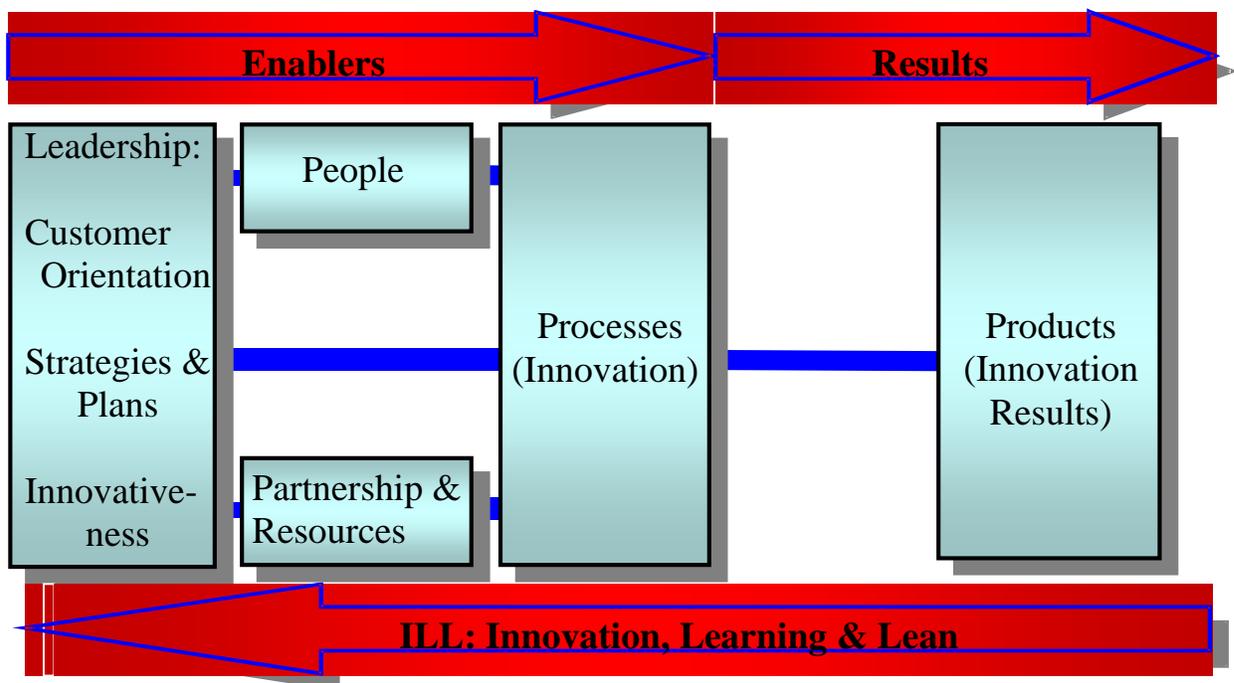


Figure 1: The "4P" Excellence Model adapted for Innovation and New Product Development

It follows from figure 1 that the model consists of the following four enablers or driving factors and one result factor (=Products comprising all form of *Innovation Results*):

1. Leadership,
2. People,
3. Partnership & Resources,
4. Processes.

Under the first driving factor – Leadership – we identified for our context (innovation) three critical success factors – *Innovativeness*, *Customer Orientation* and *Strategies & Plans* – which should have a high priority and hence a specific leadership visibility in order to assure sustainable innovation excellence.

By *sustainable innovation excellence* we mean that innovative new products or services are developed in a way which both in the short term and in the long run satisfies the customers and other stakeholders, such as employees, suppliers and society, in a balanced way. Hence it is obvious that the basis for developing new innovative products is a *customer care culture (Customer Focus)*, which starts with the identification of the potential customers' problems and needs and ends with customer satisfaction and loyalty. Everyone involved in innovation should have an open, constructive, positive attitude towards its customers and make sure to understand customers' needs and problems (EIRMA, 1993, p. 45).

Regarding the influence of people on the innovation process and hence on innovation results this aspect is supported by several studies (Cooper & Kleinschmidt, 1988; Wilson, 1990; Cooper & Kleinschmidt, 1991; Cooper, 1998). One of the primary tasks in the future for leaders and its people will be to integrate creativity and learning in the innovation processes, and motivate and manage knowledge, learning and creativity in relation to its people. *Learning* helps to increase the capacity of a person's creativity. *Creativity*, on the other hand, is the foundation for building a learning organisation, and is the underlying driver behind all improvements and innovation. To have success with that integration leadership is needed at the top level as well as at the department levels and at the team level. That is the reason why we have integrated the sub factor *Innovativeness* under the leadership factor.

It is a management responsibility – top management as well as middle management – to build an innovative culture, with norms and values, which supports innovation and new product development. Such a culture is not a coincidence. It is the result of intentional long term activities. It is the result of careful thinking, reflection, planning, measurements and follow-up from top level to projects and process level. The plans for building the right innovative culture should be a part of the yearly strategic planning and follow up process (*Strategies and Plans*) where the deployment process follows the *Hoshin Planning* methodology (Dahlgaard & Dahlgaard-Park, 1999; Dahlgaard-Park & Dahlgaard, 2001), and where an extended PDCA cycle with a culture PDCA loop is integrated (Martensen & Dahlgaard, 1999).

The difference from the model in figure 1 and the European Excellence Model (EEM) is that the model in figure 1 only has 4 *enabler factors* compared to the European Excellence Model's 5 enabler factors, and only one result factor – *innovation results* – compared to EEM's 4 result factors. The reduction of the number of factors/ criteria was done in order to simplify the model so that it has a more clear focus on innovation compared to the EEM. Another reason was that we experienced in case after case that both managers and employees needed a more simplified excellence model than the EEM which of many was regarded as too complex to understand.

The types of results to be included under *innovation results* should always be related to *the products* coming out or not coming out of the innovation processes. It is important here to understand that we here include also results related to enablers like the human dimension (motivation, learning, innovativeness) and failures of different kinds, which we here relate to the concept of *lean* (Dahlgaard & Dahlgaard-Park, 2006). Such lean results are not only covering general failures or wastes of the company's manufacturing activities but are all closely related to failures and wastes related to the company's innovation activities.

When deciding on what to include under innovation results *flexibility* is a key word, and hence the decided areas to include should be related to the context and *the company's strategic goals*, which should be determined by balancing the existing competitive challenges and the different stakeholders' needs and interests. Hence the concept of *sustainability* should be used here in order to assure both long term and short term customer and other stakeholders' satisfaction meaning that the company in its innovation and new product development activities is building *Sustainable Innovation Excellence*.

In the *feed-forward loop from Products/services to Leadership* we stress that a focus should be on a combination of Innovation, Learning and Lean results (ILL), where *Innovation* focuses on traditional innovation results, *Lean* on mistakes, barriers, problems, costs of poor quality etc. and *Learning* on what can we learn and improve in order to enhance innovation capabilities such as speed to market. Having this combined focus will assure that the organization systematically will increase its learning capability (*Learnability*) as well as innovation capability (*Innovability*). *The feed-forward loop means here that Leadership* will be based on the input from ILL and hence be prioritized on the right things in the next leadership planning and follow up cycle. Hence we may call ILL *the backbone of the leadership PDCA cycle* in the "4P" Excellence Model adapted for innovation and new product, service and other developments.

Regarding *Learning* in Innovation and New Product/Service Development it seems to be rare that companies reflect and learn from their failures (Antoni et al, 2005). Project members, who have went through a long and maybe troublesome development process, seem too early to be assigned to a new development project before they have had the opportunity to go through a formalized project review process where learning experiences are discussed, documented and disseminated for future use. Without such a project review process there is a high risk that bad processes and procedures will be repeated with too many mistakes as a result. Together with such a formalized project review process, which will take place at the end of each project, we recommend strongly that reflection and learning is built into innovation and new project development as part of a so-called *Stage-Gate Process* (Cooper, 1993; 1999), where learning elements are analyzed, documented and disseminated after each gate. When doing that it will also be natural to integrate the learning results from the past into *the yearly feed-forward loop from Products to Leadership*. By integrating learning results into the strategic feed-forward loop it is assured that *learning moves from fads to facts and improved sustainable innovation*. Tidd & Bessant (2009) have also regarded learning as a new highly important success criterion for sustainable innovation and hence decided to write quite a new chapter on *capturing learning from innovation* in the new 4th edition of their book.

Regarding *Lean* we agree with Cooper (1993; 1999) as well as Morgan & Liker (2006) that a critical success factor in new product development/ innovation is *learning to see product development as a process* (Morgan & Liker, p. 330) and hence to continuously improve that process in order to remove non-value added activities (= waste). To assure that lean thinking and lean planning are integrated in innovation and new product development processes *Lean* has to be integrated into *the feed-forward loop from Products/Services to Leadership*.

One of the "4P" model's main messages is that before companies try to improve their processes they must improve the areas of leadership, people and partnerships. This message is well in accordance with Peters' and Austin's simplified excellence model which comprises the following 4 critical factors of excellence (Peters & Austin, 1985):

- **PEOPLE**, who practice
- **Care of CUSTOMERS** and
- **Constant INNOVATION**.
- **LEADERSHIP** which binds together the first three factors by using **MBWA** (Management by Wandering Around) at all levels of the organization.

The “4P” model in figure 1 is also well in accordance with the “3 cornerstones of performance” identified by Robert Cooper (1999) in his extensive empirical research on identifying the critical success factors in new product development:

- High Quality New Product Process
- New Product Strategy
- Resource Commitment

Last but not least the “4P Excellence model in figure 1 is based on empirical verifications during a period of about 10 years starting with Post Denmark’s program for TIQ = Total Involvement in Quality in 1998 (Dahlgaard & Dahlgaard-Park, 2004) and continuing with other cases like self-assessment at a Danish Hospital in 1998 (Dahlgaard-Park & Dahlgaard, 1999), the Danish company Grundfos’ selfassessment and improvement program of its Technology and Innovation Centre in 1999 (Martensen & Dahlgaard, 2000; Dahlgaard-Park & Dahlgaard, 2008), and several other cases from Denmark, Sweden, Japan and Iran. Sections 5 and 6 will document some of these empirical findings.

Sections 3 and 4 will now “dig” more into the background, use and theoretical foundation of the “4P” excellence model. Section 3 will suggest how it may be used to design a people oriented strategy for building sustainable organizational excellence.

3. Background of the “4P” Excellence Model: Why “4P”?

Many research results have shown that one of the main reasons for failure in implementing quality management or other advantageous managerial frameworks is due to insufficient understanding and involvement of employees. Furthermore the importance and recognition of employees as organizations’ greatest asset (Dahlgaard-Park 2002) is increasing. In spite of the increasing recognition for importance of people dimension, there are not many managerial frameworks where the people dimension is focused. From this viewpoint we feel that there is a need to develop a people oriented quality strategy or model to be used as a guideline for strategic planning, implementation, measurement and follow up when companies are trying to build *organizational excellence*. Such a model should clearly signal that the first step in building organizational excellence is to build quality into people, and that “the people first policy” and “total development of people” are essentials for achieving organizational excellence (Dahlgaard-Park, 2002).

Dahlgaard-Park & Dahlgaard (1999) suggested a model of organizational excellence, called “*the 4P*” model, in which the people dimension is recognized and emphasized as the primary enabler. According to the model building quality or excellence into the following 4P develops Organizational Excellence (OE): 1. People, 2. Partnership/ Teams, 3. Processes of work, 4. Products / service products.

“The 4P” model is suggested based on the recent awareness on human resources and their role in the organizational context as the basic unit for any organizational improvement activity. From this viewpoint it is argued that the first priority of any quality or excellence strategy should be to build quality into people as the essential foundation and catalyst for improving partnerships, processes and products. But what does that really mean? In order to answer that question we need to understand human nature, human needs, human psychology, environmental and contextual factors of human behaviors because the project of “building quality into people” can only be carried out when we have a profound knowledge of people and psychology (Deming, 1993).

The quality strategy should preferably be implemented multidirectional, i.e. through a top-down, middle-up-down and a bottom-up strategy. The strategy should follow the Policy Deployment

approach (Hoshin Kanri), which has both the top-down and the bottom-up strategy included. Such an approach provides a framework for building quality into the following three levels (Dahlgaard-Park & Dahlgaard, 1999):

1. Individual level,
2. Team level, and
3. Organizational level.

An efficient quality strategy aiming at improving “the 4P” can only be developed based on an understanding of the interrelationships and interactions between individuals, teams, and the organization and the critical contextual factors at each level.

Figure 2 below illustrates these interrelationships and the process of building these different levels. The figure indicates that building Organizational Excellence (OE) starts with *building Leadership*, which means developing (educating/ training) and/or recruiting leaders with the right values and competencies. The next step is to develop and/or recruit *People* with the right values and competencies. Especially on the value dimension leaders’ behaviours determine if core values (as for example trust, respect, openness etc.) will be diffused and will become a part of the organizational culture (Dahlgaard-Park & Dahlgaard, 1999). *Building Partnership/Teams* means that teams are established and developed, so that each team is able to practice the right and needed values and competencies, and *Partnership* is established in all people relationships - within the team, between team members (intra-team), between teams (inter-team) and with other people or groups outside the team (suppliers, lead customers etc.). *Building Processes* means that leaders, individuals and teams day by day try to practice the needed values and competencies based on the principle of continuous improvement and the company’s mission, vision, goals and strategies. *Building Products/Services* means building quality into tangible and intangible products/services through a constant focus on customers’ needs and market potentials, and to practice the principles of continuous improvement parallel with innovativeness in new product development. The foundation (building leadership) supports the four other factors represented by “the 4P” and all together the 5 factors comprise a roadmap to the “result” called *Organizational Excellence* (OE). It is assumed by the model, that all 5 factors are necessary for achieving organizational excellence.

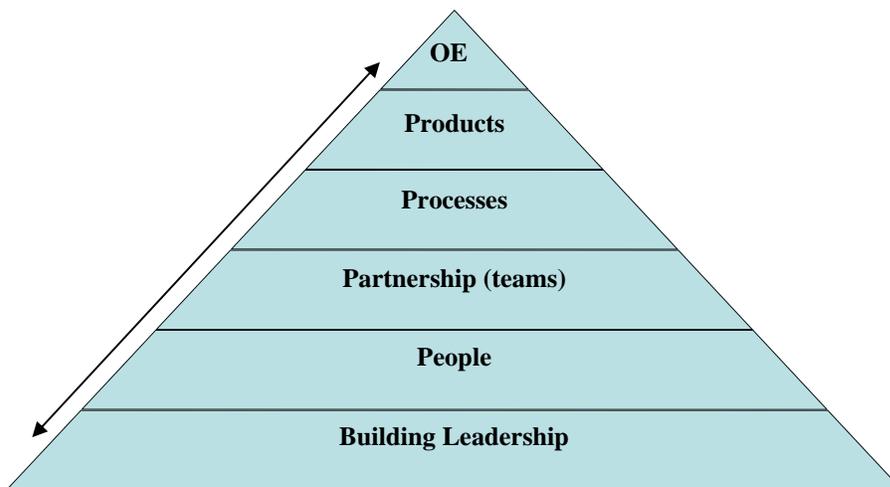


Figure 2: Building Organizational Excellence (OE) through Leadership and “the 4P”

4. Epistemology and Ontology behind the “4P” Model

In this section of the article we will reflect on our paradigms and assumptions which the “4P” model is based on.

One of the basic assumptions behind *the “4P” model is the principles of open systems theory* that recognise the importance of interrelationships, processes, contingency and integrative aspects between various parts of a system (Deming, 1993; Luhmann, 1995). More specifically we adopt the purposive and goal seeking socio-cultural system view (Buckley, 1967) in which organizations are supposed to intentionally searching and receiving information and making efforts in order to keep moving toward their goals. The positioning of *Building Leadership* in the “4P” model should be understood from this point of view, as we recognise the decisive influence and authority of leadership in shaping goals and designing the vision, mission and strategy for achieving the goals. Although we recognise the decisive role of leadership in shaping the vision, mission and organisational culture, the influence and interaction aspects of all levels and subcultures should not be underestimated. The multidirectional approaches of *the “4P” Model* are based on this view.

Seen from this perspective all activities and interactions are information exchange activities, which organizations try to utilize in order to not only maintain their existing standards and processes (morphostasis), but also to improve and change (morphogenesis) (Buckley, 1967:58-62; Scott, 1981/2003: 90-91). In order to continuously improving the system’s capability and energy, information from the outside environment are utilized to restore, maintain and improve structures, processes and routines. In this way energy are “imported” from the outside and are being utilised for work which is valuable for the customers and other stakeholders – internal as well as external stakeholders. Without this continuous import of energy there is, according to the second law of thermodynamics, a risk that the system spontaneously will move towards a state of increasing *entropy* – a state of maximum disorder – a state where energy cannot be turned into value-added work.

Another assumption in relationship with the “4P” model is the aspect of organisational reality. The quality movement has often been explained and characterised as a quality evolution from a rather mechanical view with a focus on objective and rational elements to a more holistic and organic view with a focus on both subjective and objective elements of organizational reality (Dahlgaard-Park, 2006). TQM can be explained as an ongoing process of fusion between western and eastern ways of seeing, thinking, interpreting, understanding, and doing. It is argued (Dahlgaard-Park et al 1999) that the rational and logical approach is a heritage from the western tradition mediated by pioneers such as Shewhart, Deming and Juran, and the more holistic and humanistic approach is a heritage of the eastern tradition, mostly transmitted by Japanese practices. As a result of this quality evolution, which also comprises the fusion between western and eastern traditions, TQM as well as the various Business Excellence Models came to recognise this multifaceted reality. The multifaceted reality means here that the various aspects of organizations, e.g. subjective, irrational, objective, logical, rational, emotional, formal, and informal aspects are all recognised as representing organisational reality, and are thereby candidates for consideration (potential areas to address) in relationship with implementing TQM and building organizational excellence.

As many theoreticians still seem to misinterpret excellence models by seeing these models only from a one-sided ‘reductionist’ view, we emphasize that *the “4P” Model* should be viewed as an integrative model where the distinctions between subjective/mental and objective/physical as well as between micro/individual and macro/collective aspects of reality are abandoned. Instead of dichotomies between these aspects we suggest an integrative approach where subjective and objective as well as micro and macro aspects are to be seen as a dynamic continuum of organizational reality, and thereby as parts of the reality.

As can be seen from table 1 below the various elements of the “4P” Model can be interpreted as parts of the dynamic continuum between the micro-macro and the subjective-objective pole of organisational realities. The micro/individual – macro/collective continuum is shown vertically and the subjective/intangible – objective/tangible continuum is shown horizontally.

Because the table may be misinterpreted as four distinctive areas we emphasize the importance of interactions and interrelationships among and between the four areas. The micro/subjective area of organizational reality involves individual persons’ mental processes such as perceptions, thoughts, intentions, beliefs, motives, willingness, desires etc. These realities are often difficult to observe, as they are mostly intangible. The micro/objective area of organizational reality involves the more tangible aspects of individual processes such as behaviour and interaction patterns. The macro/subjective area of organisational reality involves intangible collective processes e.g. norms, values, political interest of groups, departments and organizations. The macro/objective area involves tangible collective organizational realities such as vision, mission statements, the visible part of organisational cultures in terms of the way of celebrating success and failures, the way of using symbols, work processes, rules, routines, technology, manuals, structures, collective behaviour patterns, communication channels, reward systems, products, profits etc.

Table 1: The “4P” and the Four Aspects of Organizational Realities

	Subjective/ intangible	Objective/ tangible
Micro/ Individual	Individual feelings, perceptions, assumptions, values, thoughts, intentions and will, beliefs, motives, meaning creations, desires, motivation, commitment, loyalty <i>(Building Leadership, People and Partnership)</i>	Individuals’ patterns of behaviour Leadership behaviour and patterns, Patterns of interactions Patterns of partnership Individual work processes Individual work performance <i>(Building Leadership, People, Partnership and Processes)</i>
Macro/ Collective	Groups, departmental and organizational norms, values, political interest, power relationships, informal power structure, conflicts, interpersonal-, inter group meaning creations <i>(Building Leadership, Building People, Building Partnership)</i>	Vision, mission statement, Symbols, Ceremony, Traditions, Patterns of inter group /inter departmental interaction and partnership, Patterns of inter organizational partnership, Groups, departmental and organizational work processes, Training and education programmes, Rules, Techniques, Communication channel, Structures, Manuals, Technology, Routines, Products <i>(Building, People, Partnership, Processes and Products)</i>

Seen from the “4P” model, large parts of *Building Leadership* and the first two Ps - *People* and *Partnership* building - belong to the micro areas, and large parts of the last two Ps - *Processes* and *Products* - belong to the macro areas of organizational realities. However, as the organizational realities are not divided into different categories or levels, they are overlapping in all areas. Thus the most important point is that all four aspects of realities are important, and there are mutual interrelationships between all four areas.

The micro/subjective realities will often be *key performance indicators* and input for micro/objective realities and vice versa. Similarly micro/subjective realities are also closely interrelated to macro /subjective realities. Individual persons can initiate an action (micro objective) driven by some personal motives, intentions and willingness (micro subjective), however those personal motives might have been shaped, modified and constrained by the organisational culture

(macro subjective) or the existing hierarchical structure (macro objective). In other words, individuals' behaviours and actions are often constrained and shaped by the organisational environments. Thus interrelationships between them are multidirectional and not a clear linear cause-and-effect or enabler-results relationship. These relationships can be explained as an ongoing process of 'becoming' (Sztompka, 1991) where feedback and feed-forward flow constantly at all levels through interactions. Various processes identified in knowledge creation such as externalisation, internalisation, sympathy, socialisation, combination, articulation (Nonaka & Takeuchi, 1995) etc. are some main mechanisms in interactions that make this becoming or emergence possible.

Although we are careful and reluctant to make priorities at any level, we can observe from table 1 that the impact of *Leadership* is obvious within and between all four levels. This is the reason behind our argument of leadership to be considered as the foundation of the "4P" model indicating that *Leadership* is the most critical and influential factor of the model.

5. A Simple Methodology for Measuring and Diagnosing Innovation Performance Excellence

This section will suggest how it may be possible to measure and hence diagnose innovation performance excellence. The methodology suggested is based on a TIQ philosophy (Total Involvement in Quality) because it is our experience and strong conviction that break-through improvement programs should be based on such a philosophy. The methodology will be explained by using the Danish pump manufacturing company Grundfos as an example. This company has been quite successful during the last 10-15 years and has grown organically every year, having now more than 17.000 employees worldwide. The company started its TQM program in 1996 and has become quite well known in Europe for its innovative use of the EFQM Excellence Model. In 1999 the company was recognized with the Danish Quality Award, and in 2006 Grundfos received the European Excellence Award. So this example is from one of Europe's best managed companies.

Grundfos is a good example to show what to measure depends on the context. In the following example Grundfos had decided to run a questionnaire self-assessment survey in the relatively new established technology centre which is responsible for technology innovations and new product developments. What to measure in this self-assessment questionnaire survey was therefore related to the enablers and results of the technology centre where results are related to finished and unfinished projects from the last 4 years.

We have examples from companies in Sweden, Iran and Japan where the scope of measurements has been narrowed down to one project only or to a specific process. In this case the results and enablers included in the questionnaire survey are related only to the selected project (or the selected process).

Questionnaire Design

During the spring of 2000 the questionnaire self-assessment survey was run in the Grundfos Technology Centre. The final version of the questionnaire comprised 80 questions formulated as statements related to innovation and new product/ technology development, which was a reduction from approximately 300 questions in the prototype questionnaire.

The questionnaire was developed during a period of a year through a close co-operation with 4 managers from the innovation area. During this period a prototype of the questionnaire was developed and 15 people tested the prototype by filling out the questionnaire. Through simple data analyses, feed back and discussions with the managers the final version of the questionnaire was developed (Martensen & Dahlgaard,2000; and Martensen et al.,2007).

Respondents in the questionnaire survey were asked to rank each question, formulized as statements, according to their perceived degree of *agreement* and *importance* using a Likert scale ranging from 1 to 5. On the “importance” scale, a “1” indicates that the statement according to him/her is of very minor importance, while statements that score “5” are perceived as having very high importance. On the agreement scale, a “1” indicates that the respondent fully disagrees with the statement, while a score of “5” means that the respondent fully agrees with it. To fully disagree with a statement means for the enablers that the respondent does not agree that the driver (activity) behind the question (statement) has been implemented into daily practice. To fully agree with a statement means that the respondent totally agrees that the driver (activity) behind the question (statement) has been implemented into daily practice.

Generally the importance measurements (I) can be understood as indications of the respondents’ needs and the agreement measurements (P) as indications of the organization’s performance. Any negative difference between perceived indicated performance and perceived importance ($P - I$) can be regarded as a gap indicating an opportunity for improvement seen from the respondents’ points of view.

To formulate good result and enabler statements is not so easy, and therefore each statement should be discussed within a group of 4-6 people having the responsibility for the design of the statements. Generally it is a good guideline that the result statements are formulated in relation to the organization’s strategic goals or priorities, and the enabler statements from *Leadership* to *Processes* are related to the result statements. For checking/ assuring *cause-effect relationships* between result statements and enabler statements we suggest designing a *diagnostic path* (a right-left approach) to be used for each result statement (Conti, 1997). Constructing the diagnostic path is for the beginner a time consuming process but also a very effective learning process for understanding the analysed system (a process, a project, a division or the whole company). Several managers from various companies have reported back that it was difficult in the beginning but after having constructed the first diagnostic path they realised it was first time in their lives that they had experienced such an effective learning process about the system they have been a part of maybe for decades.

Based on our experiences we have learned that a maximum of 4-6 result statements should be included because construction of the diagnostic path will be too time consuming if too many result statements are included. Also there should be a maximum of maybe 40-50 for the total number of statements because it will be too time consuming for the respondents to assess questionnaires with too many statements. So we realize today, that Grundfos might have included too many statements in the final questionnaire.

260 employees working in the technology centre as managers, project leaders or project group members were invited to participate in the survey and to fill out the developed questionnaire. Even if the questionnaire may have been to long a total of 131 questionnaires were returned giving a response rate of approximately 50%.

Using a Simple Approach to Prioritize Improvement Areas

The idea of asking the respondents both about agreement and importance is that by doing so, it is possible to rank the potential areas for improvements in accordance with the respondents’ importance perceptions. The most important areas are related to the statements where the difference (“gap”) between importance and agreement is highest. The theory behind this type of questionnaire is that the optimal situation is characterised by having equality between importance and agreement (Dahlgaard et al., 1998; 2002; Eskildsen & Dahlgaard,1998; Dahlgaard & Eskildsen,1999). An assumption behind this simple rule is that the marginal costs to reduce the gaps with one unit are the same for all statement areas. Of course this assumption is a simplification because some areas may

be easier to improve than other areas (the so-called “low hanging fruits”). Hence this assumption should be questioned when prioritizing which areas should be improved first.

If you can accept the simplified assumption you can use the simplified rule. That means if importance is significant higher than agreement you should improve the area, and if you are in the opposite situation – agreement is higher than importance – you may choose to use fewer resources or to have less focus on that area. However, a cause for having agreement measurements higher than importance may be that respondents don’t understand the importance of the statement (why the statement is important). In this case it is important that management discusses with the employees about the potential reasons why respondents may have underestimated the importance.

By using this simple approach gaps between importance and agreement were analysed and the biggest gaps were regarded as most interesting to analyse. It is assumed that the biggest gaps are signals from the respondents about where to improve first. Therefore the first step in the simple approach is to rank the statements according to the size of the gaps. Table 2 shows the statements with the biggest gaps – first the enabler statements and then the result statements.

A quick overview told us that, according to the ranking in table 2, the enabler factors should be prioritised for improvements in the following order: 1. Leadership, 2. Partnership & Resources, 3. People, 4. Processes, and 5. Policy & Strategy. The message is very clear: *‘Improve first the “soft aspects of innovation” (= Leadership, People and Partnership), before you try to improve the “hard or logical aspects” (=Processes, Policy & Strategy).*

This ranking is the same as suggested by Dahlgaard-Park & Dahlgaard in their “4P Model” for building organisational excellence (1999; 2000; 2003; 2006; 2008). The suggested ranking is also supported by the biggest gap under *innovation results* which is related to the statement “employees’ motivation and commitment have increased during the last 4 years”.

Table 2: Identification of Statements with the biggest gaps

Criterion	Statements from Enablers	(importance, agreement)	Gap
Leadership	The organisation is characterised by an innovative culture (time to think freely and follow up on own ideas, learn of experiences, risk willingness etc.), entrepreneurship.	(4.51, 3.30)	1.21
Leadership	Important information is shared quickly and accurately to the right persons - up, down and sideways in the organisation.	(4.47, 3.45)	1.02
Leadership	Creating, acquiring and transferring of new knowledge and skills are a part of the company culture.	(4.49, 3.52)	0.97
Partnership/ Resources	The resources necessary to accomplish the roles set up for the company’s innovation programme are clearly mapped out	(4.22, 3.33)	0.89
Partnership/ Resources	The company allocates consequently and visibly resources for the innovation	(4.16, 3.28)	0.88
People	The reward system related to innovation is known by everybody and reviewed and improved collectively	(3.88, 3.03)	0.85
Leadership	The organisation is always scanning the horizon and is proactively anticipating change	(4.32, 3.48)	0.84
Partnership/ Resources	The employees participate in external innovation activities, creativity discussions, creativity teams etc.	(3.98, 3.18)	0.80
People	All people try to improve and develop them-selves in order to cope with future challenges within the innovation area	(4.38, 3.66)	0.72
People	Core team members use 80% or more of their time on the innovation project	(4.21, 3.52)	0.69
Processes	Bench Marking data from “best practises” within innovation are used to set objectives for future improvements	(3.97, 3.30)	0.67
Processes	Faulty omission of key activities in the new product development process	(4.33, 3.68)	0.65

	seldom happens		
People	The innovation team consists of committed employees from different departments which participate equally in the project	(4.11, 3.48)	0.63
Processes	Design errors, production errors, communication errors, marketing errors, etc. are continuously reduced or eliminated throughout the new product development process	(4.39, 3.78)	0.61
People	Team members are empowered to make decisions about their innovation project and to participate in the planning and decision making for innovation	(4.24, 3.67)	0.57
People	People in the organisation possess a willingness to accept and adopt 'external' ideas	(4.10, 3.54)	0.56
Policy & Strategy	Visions, goals, and strategies for innovations are communicated clearly to everybody	(4.26, 3.81)	0.45
Policy & Strategy	A Policy Deployment Process for innovation is established (develop 3-5 year plans, annual objectives, departmental plans, implementation, reviews, etc)	(4.16, 3.74)	0.42
Policy & Strategy	Success criteria for the innovation programme have been formulated (guidelines, minimum standards, result benchmarks etc.)	(3.88, 3.49)	0.39
	Statements from Results:		
People	Employees' motivation and commitment have increased during the last 4 years	(4.46, 3.70)	0.76
Products/ Sales	The percentage of sales provided by innovations that are less than four years old has increased	(4.16, 3.50)	0.66
Products/ Sales	The number of innovations that provide the company with a sustainable competitive advantage has increased the last three years	(4.36, 3.71)	0.65
Products/ ROI	Return on investment (ROI) of the company's innovation programme has increased during the last four years	(4.11, 3.60)	0.51

6. Measuring ILL – an Indicator of Overall Innovation Performance Excellence

There are several ways to measure the level of Innovation Performance Excellence at an overall level. We will in this section discuss a new alternative and illustrate the alternatives with data collected on *leadership* from the Danish hospital case referred to in section 2 (Dahlgaard-Park & Dahlgaard, 1999). We call the suggested measures for ILL, which is a measure between zero and one {0; 1.0}. If the measure is high and close to 1.0 then it indicates that the company is excellent within the areas measured, and if the measure is low it is an indication that the company is far from excellent and may be ill. The name ILL refers back to figure 1 where it can be seen in the feed-forward loop, that ILL is an abbreviation of Innovation, Learning and Lean, and we called ILL *the backbone of the leadership PDCA cycle* in the "4P" Excellence Model adapted for innovation and new product, service and other developments.

We will use the four biggest gaps from the leadership criterion as shown in table 3 below. In a real case all measurements under the various criteria of the excellence model shall be used for measuring the ILL level of each criterion and the total ILL level.

The ILL index uses the ratio of average agreement and average importance. The simple logic behind this measure is that if we are in the optimal case then the ILL index is equal to 1.0. In this example we see that the ILL index is equal to 0.81, which means that the hospital should look for improvements within these statements so that the index gradually improves with up to 19 percent points. The ILL index may be misleading if average agreement is higher than average importance for one or more statements. In this case we recommend not including the statements in the calculation of the index. Usually the reason for such measurements is that the respondents have not understood the importance dimension related to the statement area.

Table 3: An example of Measuring ILL (Danish Hospital Case)

Leadership	I Importance	A Agreement
Management always expresses their recognition when employees have made a good effort	6.15	4.75
Management makes great efforts to improve communication in the company.	6.10	4.75
Management regularly evaluates the employees' involvement in quality improvements	6.30	4.95
Management grants sufficient resources for employee education and training	5.55	5.20
Averages	6.03	4.91
Ill Index	4.91/6.03 = 0.81	

An ILL index for all criteria can be calculated in different ways. The most simple is to calculate the average of each criterion's ILL index. In this case the assumption is that all criteria have the same importance and so they should also have equal weight when calculating the total ILL index.

If the assumption of equal weights is rejected, then it will be necessary to decide on which weights to be used before the ILL index can be calculated. One possibility, which may be argued for, is that the systemic factors of the model (Leadership, People Management and Partnership & Resources) share a weight of 1/3 (= 33,3%), Processes get a weight of 1/3, and Results get a weight of 1/3.

The ILL index may be used as an overall ratio, which can be compared from period to period to show if the organization has improved and hence has become "sounder" on ILL (Innovation, Learning and Lean). As said above we regard the ILL index as an indicator measurement showing how excellent the organization is or how ill it is. The lower the ILL index the more ill is the organization.

In the following we will use the data from Grundfos (table 2) to illustrate the ILL index calculations. Table 4 below shows the average agreements (A) and average importance (I) scores from table 2 sorted into the five factors of the "4P" Model.

Table 4: Data for Measuring the ILL index at Grundfos

Criterion	Statements from Enablers	A	I
Leadership	The organisation is characterised by an innovative culture (time to think freely and follow up on own ideas, learn of experiences, risk willingness etc.), entrepreneurship.	3.30	4.51
Leadership	Important information is shared quickly and accurately to the right persons - up, down and sideways in the organisation.	3.45	4.47
Leadership	Creating, acquiring and transferring of new knowledge and skills are a part of the company culture.	3.52	4.49
Leadership	The organisation is always scanning the horizon and is proactively anticipating change	3.48	4.32
Leadership - Strategy	Visions, goals, and strategies for innovations are communicated clearly to everybody	3.81	4.26
Leadership - Strategy	A Policy Deployment Process for innovation is established (develop 3-5 year plans, annual objectives, departmental plans, implementation, reviews, etc)	3.74	4.16
Leadership - Strategy	Success criteria for the innovation programme have been formulated (guidelines, minimum standards, result benchmarks etc.)	3.49	3.88
	Averages	3.54	4.30
	Ill Index	0.82	
People	The innovation team consists of committed employees from different departments which participate equally in the project	3.48	4.11
People	The reward system related to innovation is known by everybody and reviewed and		

	improved collectively	3.03	3.88
People	All people try to improve and develop them-selves in order to cope with future challenges within the innovation area	3.66	4.38
People	Core team members use 80% or more of their time on the innovation project	3.52	4.21
People	Team members are empowered to make decisions about their innovation project and to participate in the planning and decision making for innovation	3.67	4.24
People	People in the organisation possess a willingness to accept and adopt 'external' ideas	3.54	4.10
	Averages	3.48	4.15
	Ill Index	0.84	
Partnership/ Resources	The employees participate in external innovation activities, creativity discussions, creativity teams etc.	3.18	3.98
Partnership/ Resources	The resources necessary to accomplish the roles set up for the company's innovation programme are clearly mapped out	3.33	4.22
Partnership/ Resources	The company allocates consequently and visibly resources for the innovation	3.28	4.16
	Averages	3.26	4.12
	Ill Index	0.79	
Processes	Bench Marking data from "best practises" within innovation are used to set objectives for future improvements	3.30	3.97
Processes	Faulty omission of key activities in the new product development process seldom happens	3.68	4.33
Processes	Design errors, production errors, communication errors, marketing errors, etc. are continuously reduced or eliminated throughout the new product development process	3.78	4.39
	Averages	3.59	4.23
	Ill Index	0.85	
	Statements from Results:		
People	Employees' motivation and commitment have increased during the last 4 years	3.70	4.46
Products/ Sales	The percentage of sales provided by innovations that are less than four years old has increased	3.50	4.16
Products/ Sales	The number of innovations that provide the company with a sustainable competitive advantage has increased the last three years	3.71	4.36
Products/ ROI	Return on investment (ROI) of the company's innovation programme has increased during the last four years	3.60	4.11
	Averages	3.63	4.27
	Ill Index	0.85	

From table 4 it follows that the ILL indexes vary from 0.79 to 0.85 and the lowest ILL index are Partnership & Resources (0.79), Leadership (0.82) and People (0.84), while Processes and Results have the highest index (0.85).

If these indexes are used for prioritizing areas for improvement then we have the following priorities.

1. Partnerships & Resources,
2. Leadership,
3. People,
4. Processes.

This ranking is a little bit different than the previous ranking, when the order of the gaps between importance (I) and Agreement (A) were used. The reason for the different ranking is that we in table 4 in accordance with *the "4P" Excellence Model* in figure 1 have included Policy & Strategy under the Leadership factor, and because of that Leadership is now ranked as number 2. Otherwise we have the same order.

If each factor is regarded having the same weight then the overall index is simply the average of the indexes, and the overall ILL index is then 0.83. This is a relatively high ILL index, which also was

expected, because the company has been recognized with both the Danish Quality Award (1999) and the European Excellence Award (2006), which means that they in their application in 2006 probably got a score higher than 700 points out of the maximum 1000 points.

It is interesting to compare Grundfos' ILL index with the index from an Iranian pharmaceutical company. This company did their first questionnaire self-assessment in 2009 by using the EEM together with an adaption of the original Grundfos questionnaire statements. In total 60 statements were formulated to fit with the company's special context, and the questionnaire was run among 45 people equally from all departments and different functional, business and corporate levels. Table 5 shows the ILL indexes for each of the 9 criterions of the EEM.

Compared to the ILL indexes from Grundfos (table 4) this company has significant lower indexes meaning that they seem far from excellence. This was also expected because the company has just embarked on its journey towards excellence.

By assuming that all 9 criterions of the EEM have equal weights an overall index was calculated to 0.42, which is about half of Grundfos' overall index. Table 5 shows clearly, that there is a lot to do before excellence can be attained.

Table 5: ILL indexes in an Iranian Pharmaceutical Company

Enablers	ILL Index
Leadership	0.51
People	0.58
Policy and Strategy	0.36
Partnership and resources	0.40
Processes	0.45
Results	ILL Index
People results	0.47
Customer results	0.29
Society results	0.33
Key performance results	0.35

With the comparisons between Grundfos and the Iranian Pharmaceutical company we do not argue that the ILL index should be used for external benchmarking. We realize that such comparisons may be misleading because scoring is always influenced by national cultures, company cultures as well as the context. The ILL index is an internal company measure which can be used for internal benchmarking, priority and goal settings, and for setting overall goals too. More research is needed for understanding how different cultures may understand and use the index.

7. Discussion and Conclusions

An important finding by using the "4P Excellence Model" is: *Improve first the "soft aspects of innovation" before trying to improve the "hard or logical aspects"*. The finding is supported by literature together with our experiences and research findings presented and discussed in this article.

In case after case, when companies did their first self-assessment, we observed almost the same results: The biggest gaps were related to leadership and people oriented areas (the subjective/intangible part of table 1 in section 4. It seems as if top and middle managers too often ignore these factors and focus too much on logical *hardware* factors such as technology and economy. But a focused self-assessment approach, such as the approach used in this case, will function as an "eye opener" and top management as well as middle management will easily come to a consensus about what to improve first. After having prioritized and worked with understanding (analyzing) and

improving the soft areas then remarkable improvements in these areas will often be experienced and new priorities for improvements will be identified in the following self-assessments (Dahlgaard & Dahlgaard-Park, 2003). These new priorities may gradually be more focused on logical hardware areas (the objective/ tangible part of table 1 without forgetting the learning points from the first self-assessment run. A new and sustainable company culture will gradually emerge – a culture which is characterized by *Respect for People and Partnerships*, and *Continuous Improvements of Processes and Products*. We can also say that such a company culture can be characterized by a *Continuous focus on Learnability and Innovability*.

Our observations above may be understood simply by flaws in the existing managerial paradigms. Seen from a Meta level, *TQM and the Excellence approach* requires a fundamentally different managerial paradigm and mental model compared to earlier quality approaches. Earlier quality approaches were rooted in a positivistic and reductionist paradigm, which is well matching when focusing and understanding the formal and tangible aspects of organisations (Dahlgaard-Park, 2006). One major problem with the various excellence models and the managerial practices of these models seems to be that people still interpret these models from a positivistic and mechanistic paradigm. The high failure rate with implementation of TQM and Excellence Models seems to be related to this problem (Dahlgaard-Park, 2002). The phenomenon can be illustrated by an analogy of a doctor who tries to cure a mental sick person by carrying out a physical surgery. In order to understand the complex realities of organisations and its environments organisations need a new cure (framework) which can capture both depth (qualitative) and breath (quantitative). The suggested “4P Model” is our attempt to provide such a framework which may help to overcome organisations’ current problems when trying to implement TQM and Excellence by using existing excellence models.

With the “4P model” and its related principles we have tried to simplify the integration of tangible and intangible aspects (objective and subjective) as well as individual and organisational levels (micro and macro) into the framework. The “4P model” can be used as a guideline for implementing TQM and Excellence by integrating the paradigm level with the methodological level. The successful transformation of Post Denmark’s company culture in the period 1998 to 2004 from a bureaucratic commanding and control culture to a TQM and Excellence culture was guided by an educational framework designed by “the 4P Model” and complemented by measurements of more than 500 managers’ perceptions (mindsets) of selected critical success factors for excellence (key performance indicators) inspired by the European Excellence Model (Dahlgaard & Dahlgaard-Park, 2003). Post Denmark received in 1999 the Danish Human Resource Prize, the Danish Quality Award in 2004 and the European Excellence Prize in 2006. Post Denmark is today regarded as one of the few innovative and best managed post companies in Europe.

By taking into account the discussion and arguments above combined with our theoretical discussion in sections 3 and 4 our final conclusion is that the validity of “the 4P model” has been supported. Combined with several other cases, where we have used the simple approach for identifying and prioritising improvement areas during the last 15 years, we conclude that the “4P model” shows a valid structure or strategy for building sustainable organizational and innovation excellence.

The purpose of the article was to present and discuss the development of a system for assessing and improving Technology Development and Innovations. The system components comprise:

1. The “4P model” or framework to be used for assessing, measuring, diagnosing and improving Innovation Enablers and Results.
2. A simple methodology for data collection, data analysis and prioritizing improvement areas.
3. An index for measuring the level of innovation, learning and lean (ILL) and the potentials to increase that level.

The first two components were developed and tested during a period of 10-15 years in several industrial companies as well as service organizations. The last component, the ILL measure, has recently been developed to satisfy a need of all type of organizations. With this last development the 3 components comprise *A System for Assessing and Improving Innovations*. As with any other system the system-components are interrelated. To improve innovation, which is the most complex challenge for today's organizations, there is a need for such a system. It is our hope that the suggested system will be used within all types of organizations and all types of innovations – products, processes and services.

References

1. Antoni, M. Nilsson-Witell, L. & Dahlgaard, J.J. (2005), "Inter-Project Improvement in Product Development" (2005), co-authored with Nilsson-Witell, L. and Antoni, M., *International Journal of Quality and Reliability Management*, Vol. 22, Issue 9.
2. Buckley, Walter (1967), "*Sociology and Modern Systems Theory*". Prentice Hall, Upper Saddle River, New Jersey, US.
3. Conti, T. (1997), "*Organizational Self-Assessment*", Chapman & Hall, London, UK.
4. Cooper, R.G. (1993). *Winning at New products: Accelerating the Process from idea to Launch*, Second Edition. Reading, Massachusetts: Addison-Wesley Publishing Company.
5. Cooper, R.G. (1998) *Proceedings of a seminar on: Winning at new products*, 20-21 January, Copenhagen, Innovation Management.
6. Cooper, R.G. (1999). *Product Leadership*, Massachusetts: Addison-Wesley Publishing Company.
7. Cooper, R.G. & E.J. Kleinschmidt (1987). "Success factors in product innovation". *Industrial Marketing Management*, 16, p. 215-223.
8. Cooper, R.G. & E.J. Kleinschmidt (1987). "What makes a new product a winner: Success factors at the project level". *R&D Management*, 17, 3, 175-189.
9. Cooper, R.G & E.J. Kleinschmidt (1988). "Resource allocation in the new product process". *Industrial Marketing Management*, 17, 3, 249-262.
10. Cooper, R.G & E.J. Kleinschmidt (1991). "New product processes at leading industrial firms". *Industrial Marketing Management*, 20, 2, 137-147.
11. Dahlgaard, J.J., Kristensen K. & Kanji, G. (1994), *The Quality Journey – a journey without an end*, Productivity Press, Madras, India.
12. Dahlgaard, J.J., Kristensen K. & Kanji, G. (1994), *Fundamentals of TQM*, Chapman & Hall, London, UK.
13. Dahlgaard, J. J. & Eskildsen, J. (1999), "Scoring Business Excellence", *European Quality*, Vol. 6, no. 1.
14. Dahlgaard, J.J., Dahlgaard-Park, S.M. & Edgeman, R. (1999), "Leadership, Business Excellence Models and Core Value Deployment", *Quality Progress*. Oct. 1999.
15. Dahlgaard, J.J. & Dahlgaard-Park, S.M. (1999), "Integrating Business Excellence and Innovation Management – Developing a Culture for Innovation, Creativity and Learning", *Total Quality Management*, vol. 10, nos. 4 & 5.
16. Dahlgaard, J.J. & Dahlgaard-Park, S.M. (2003), "The "4P" Quality Strategy for Breakthrough and Sustainable Development", *the 7th QMOD Conference*, Monterrey, Mexico.
17. Dahlgaard, J.J. & Dahlgaard-Park, S. M. (2004), "The 4P Quality Strategy for Breakthrough and Sustainable Development", *European Quality*, Vol. 10 no. 4, UK
18. Dahlgaard, J.J. Dahlgaard-Park, S.M. & Martensen, A. (2006), "Measuring and Diagnosing Innovation Excellence – Simple contra Advanced Approaches - A Danish Study", *the 9th QMOD Conference*, Liverpool, UK.
19. Dahlgaard, J. J. & Dahlgaard-Park, S.M. (2006), "Lean Production, Six Sigma Quality and Company Culture", *TQM Magazine*, vol. 18, Issue 3, 2006.
20. Dahlgaard-Park, Su Mi (1999), "The evolution patterns of quality management", *Total Quality Management*, Vol. 10. Nr. 4. July.
21. Dahlgaard-Park, S.M. & Dahlgaard, J.J. (1999), Building a Healthcare Culture for TIQ (Total Involvement in Quality), *First National Conference for Quality in Healthcare*, Troina, Italy.
22. Dahlgaard-Park, S. M. & Kondo, Y. (2000), "Re-conceptualization of Human Needs and Motivation – a Need for a New Renaissance", in *The Best on Quality*, Vol. 11. ASQ Quality Press, Milwaukee.
23. Dahlgaard-Park, S.M. & Dahlgaard, J.J. (2001), "Core Value and Core Competence Deployment",. *International Journal of Management Systems*, Special Issue on Leadership,

Vol.13, nr.1. 2001

24. Dahlgaard-Park, S.M. & Dahlgaard, J.J. (2005), Management Control Theories and the EFQM Excellence Model, *European Quality*, Vol. 11 (3)
25. Dahlgaard-Park, S.M. & Dahlgaard, J.J. (2006), In Search of Excellence – Past, Present and Future, in: H. Schnauber (ed.), *Kreativ und Konsequent*, Hanser Verlag, München, Wien
26. Dahlgaard-Park, S.M (ed.) (2006) Transformation and Consistency in the Quality Movement, Special Issue, *The TQM Magazine*, Vol. 18, Nr.3.
27. Dahlgaard-Park, S.M. & Dahlgaard, J.J. (2008), “A Strategy for Building Sustainable Innovation Excellence - A Danish Study”, in Klaus J. Zink (Ed.), *Corporate Sustainability as a Challenge for Comprehensive Management*, Physica-Verlag, Heidelberg, Germany.
28. Deming, W. E. (1993), *The New Economics*, Center for Adv. Engineering Study, Cambridge, MA, US.
29. EFQM (2005), “The EFQM Framework for Innovation – Measuring and Improving Your Ability to Innovate”, European Foundation for Quality, Bruxelles, Belgium.
30. EIRMA (1993) *Total Quality in R&D*. Paris: European Industrial Research Management Association (EIRMA).
31. Eskildsen, J. & Dahlgaard, J.J. (1998), “A Practical Diagnosis of Business Excellence”, *European Quality*, Vol. 5, no. 6.
32. Luhmann, Niklas (1995), *Social Systems*, Stanford Univ. Press, Stanford, US.
33. Martensen, A. & Dahlgaard, J.J. (1999), “Strategy and planning for innovation management - a business excellence approach”. *International Journal of Quality and Reliability Management*, Vol. 16, No. 8, 1999, pp. 734-755.
34. Martensen, A. & Dahlgaard, J.J. (1999), “Strategy and planning for innovation management - supported by creative and learning organisations”. *International Journal of Quality and Reliability Management*, Vol. 16, No. 9, 1999, pp. 878-891.
35. Martensen, A. & Dahlgaard, J.J. (2000), “Towards Innovation Excellence - A Danish pilot study on Modelling and measuring innovation performance”, *Proceedings of the 3rd QMOD Conference, Aarhus, Denmark, and “Establishing crucial norms”*, *Journal of Product Innovation Management*, 10, 4, 273-290.
36. Martensen, Anne, Dahlgaard, Jens J., Dahlgaard-Park, Su Mi & Grønholdt, Lars, “Measuring and Diagnosing Innovation Excellence – Simple contra advanced approaches -A Danish Study”, *Measuring Business Excellence*, Vol. 11, no. 4, 2007.
37. Morgan, J.M. & Liker, J.K. (2006), *The Toyota Product Development System – Integrating People, Process, and Technology*, Productivity Press, New York, US.
38. Nilsson-Witell, L., Antoni, M. & Dahlgaard, J.J. (2005), “Continuous Improvement in Product Development: Improvement Programs and Quality Principles”, *International Journal of Quality and Reliability Management*, Vol. 22, Issue 8.
39. Peters, Tom J. & Austin, Nancy (1985), *A Passion for Excellence – The Leadership Difference*. HarperCollins Publishers, London, UK. Wilson, E. (1990). *Product definition factors for successful designs*. Thesis, Stanford University, US.
40. Scott, W. Richard (1981), *Organizations: Rational, Natural, and Open Systems*, Upper Saddle River, Prentice Hall, New Jersey, US.
41. Sztompka, P. (1991), *Society in Action – The Theory of Social Becoming*. Oxford: Polity Press. Social Becoming
42. Tidd, J. & Bessant, J. (2009), *Managing Innovation – Integrating Technological, Market and Organizational Change*, 4th ed., John Wiley & Sons Ltd., Chichester, UK.