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STATE OF THE ART CONCERNING THE INTEGRATION OF METHODS AND TECHNIQUES IN QUALITY MANAGEMENT – LITERATURE REVIEW AND AN AGENDA FOR RESEARCH

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Abstract

Quality management is becoming more and more important for the manufacturing as well as the service industry. In the last couple of years manifold approaches for quality management have been developed such as Six Sigma, Total Quality Management (TQM), Lean Management or KAIZEN for example. The increasing variety of quality management methods leads to challenges for quality managers since enterprises often use several approaches in parallel. Integration becomes a mean in handling this variety of methods and can lead to value-creating synergies. Nevertheless, integration in quality management is a poorly understood discipline yet. The main problem is a lack of guidelines, helping a practitioner in integrating heterogeneous approaches in a value-creating and systematic way.

This paper approaches the complexity of the topic by taking a closer look at existing efforts concerning the integration of quality management methods and techniques. Based on the findings a research agenda is derived.

Keywords: Quality management, integration, quality technique

1 Outline of the problem

Quality management has developed significantly over the last few decades and has become a topic affecting the whole enterprise (Dale 1999, p. 9). Manifold approaches in quality management have been introduced recently such as Six Sigma, Lean Management or Total Quality Management (TQM). These approaches differ in their underlying philosophy, principles or objectives amongst others (see e.g. Andersson et al. 2006). While Six Sigma has a strong customer focus, Lean Management is more concerned with process speed and waste elimination for example (see e.g. Andersson et al. 2006).

The increasing variety of quality management methods leads to challenges for quality managers (see e.g. Johannsen 2010). Often they do not know which methods are suited best for solving a specific problem. The reason can be found in the lacking theoretical foundation of the discipline (see Klefsjö et al. 2008). At the same time, methods in quality management may seem trendy at certain times, leading to an inconsiderate adoption of specific methods (Sandholm 1999, p. 437). As a result, enterprises often use more than just one method for quality management (Harmon 2007, p. 314). The parallel use of multiple methods is also described in empirical studies (see e.g. Kumar/Antony 2008). Nevertheless, quality managers are frequently overstrained coordinating these different approaches. In addition, due to a lack of resources, employees do not have the time to devote themselves to the implementation or application of more than one approach (Gijo/Rao 2005, p. 722). Achievements received by the application of a method (such as Six Sigma) are quite frequently undone by another method (for example Theory of Constraints) used in a subsequent project (Samson/Challis 2002, p. 16). These problems arise since – contrary to other fields of research such as data modelling or method engineering – the topic of integration is neither theoretically founded nor dealt with systematically in quality management. Clear guidelines on how to combine different methods or techniques do not exist. This becomes obvious as the literature describes different ways of integrating a given set of methods, such as Lean Management and Six Sigma for example (see e.g. Arnheiter/Maleyeff 2005; Pepper/Spedding 2010). To systematically approach the topic of integration in quality management, an extensive literature review is conducted. A literature review helps in creating a firm foundation for advancing knowledge and uncovers areas for further research (Webster/Watson 2002, p. xiii). It is therefore considered as an appropriate methodology for presenting the state of the art concerning the integration topic in quality management. By this literature review the following research questions are being addressed¹:

- 1) What is the *motivation* for integrating different quality management methods and techniques? This aspect is important since additional work may be necessary prior to integration. If weaknesses of a quality management method should be eliminated by means of integration for example, the weaknesses of the method considered are to be systematically laid open first.
- 2) What *methods* and *techniques* are usually being integrated? As the integration of certain methods and techniques is frequently addressed in literature, hints at the value-creating character of certain combinations (of methods and techniques) can be derived (e.g. Six Sigma and ISO 9000). This can facilitate the search for value-creating combinations of methods and techniques.
- 3) In what *ways* are quality management methods and techniques being integrated? After having identified what techniques and methods are usually being integrated, the preferred way the integration is performed is of crucial interest. If a certain way of integration is predominant for a given set of methods and techniques, this can be an indicator for a best practice integration approach.

In the following section 2 basic concepts are being presented. Afterwards the methodology of this paper is introduced in more detail. In section 4 the main findings of the literature review are being shown and discussed. The paper concludes with a summary, pointing out limitations, and an agenda for future research.

¹ These research questions can also be found in (Johannsen 2010) as part of a larger research.

2 Basic concepts

In the following, a short explanation of the terms “quality management method”, “quality technique” and “integration approach” is given. These will be referred to in the paper several times.

- *Quality management method*: In quality management there is no general understanding of the term “method” (Johannsen 2010). In addition, terms like “methodology”, “quality concept” or “quality initiatives” can be found, amongst others. Nevertheless the definition of de Mast (2004, p. 199) can be used to provide a theoretical foundation. A quality management method therefore consists of concepts (e.g. critical-to-quality factors (CTQs) in Six Sigma), steps defining a procedure model (e.g. Define, Measure, Analyze, Improve and Control – DMAIC), rules for establishing results (e.g. how CTQs are to be defined properly), and tools (e.g. fishbone-diagram). Examples for quality management methods are Six Sigma, TQM or Theory of Constraints (TOC).
- *Quality technique*: Quality techniques and tools serve particular tasks (McQuater et al. 1995, p. 38), for example the analysis of problems within a business process. According to McQuater et al. (1995, p. 38) a tool has a clear role while a technique has a wider application. This differentiation is hard to keep up in practice and brings unnecessary complexity to the subject (Johannsen 2010). Thus, in this paper, only quality techniques are spoken of when addressing quality tools according to McQuater et al. (1995, p. 38) as well. A quality technique is therefore a mandatory element of a quality management method (see de Mast 2004, p. 199). Well-known quality techniques are Quality Function Deployment (QFD) or the fishbone-diagram for example.
- *Integration approach*: In this paper, integration is referred to as the combination of different quality management methods respectively techniques. The way this combination is reached is described by the integration approach. This can be the amalgamation of different methods resulting in one new method or the establishment of interfaces between methods for interchanging results for example.

3 Methodology of the literature review

Literature reviews have already proven useful in different areas of research, generating promising results and a base for further research (see e.g. Braun et al. 2009; Zellner 2011). Cooper (1988, p. 109) introduced a taxonomy for characterising literature reviews based on their “(1) focus”, “(2) goal”, “(3) organisation”, “(4) perspective”, “(5) audience” and “(6) coverage”. The importance of this taxonomy for writing a literature review in a structured way is emphasized by vom Brocke et al. (2009). According to the taxonomy by Cooper (1988) the focus of this work is on theories and practices used for integrating methods and techniques in quality management (1). The goal is to generalize and integrate the findings (2) while it is argued (4) that the integration of quality management methods is often poorly understood or rarely done by many enterprises. The review is organised (3) to answer the research questions in a sequential order and follows the approach described in the subsequent section. It is hoped that the results are helpful for researches and practitioners (5) in the field of quality management. Conducting an exhaustive review in quality management is almost impossible to do due to the extensiveness and tradition of the discipline. Therefore selective citation (see Cooper 1988, p. 109) is used as described below (6). This literature review comprises a five-step procedure as described by Cooper/Hedges (1994, p. 9-14): (I) formulation of the problem, (II) collection of the data (literature sources), (III) data evaluation, (IV) analysis and interpretation of the data and (V) publication of the results of the analysis. The problem has been dealt with in section 1 of the paper. The following sections address the other steps named above.

3.1 Data collection

The process of data collection is of particular importance for a literature review (see vom Brocke et al. 2009; Braun et al. 2009; Zellner 2011).

This research² started with a topic-based search as promoted by Webster/Watson (2002, p. xvi). In that context it is reasonable to query scholarly databases (see vom Brocke et al. 2009, p. 9). The following databases were focused: *EBSCO-Host*, *Emerald Insight*, *Elsevier*, *Springerlink*, *Science Direct* as well as *Google Scholar*. These databases have been chosen since they do not only provide access to a large amount of electronic articles but also cover the full range of quality management related journals listed in the VHB-Jourqual³. In addition, access to relevant conference proceedings is granted. This was considered important because conference proceedings in the field of quality management contain case studies, giving insights into the practical implementation and integration of quality management methods and techniques. The following search strings – as well as combinations of them – have been used: “*integration*”, “*quality management*”, “*integrated*”, “*quality approach*”, “*integration of methods*”, “*method combination*”, “*quality techniques*”, “*improvement methodologies*”, “*quality management methods*”, “*methodology*”, “*TQM*”, “*Six Sigma*”, “*Lean Management*”, “*Theory of constraints*”, “*EFQM*”, “*Kaizen*” and “*Work-Out*”. Similar to literature reviews in other fields of research (see e.g. Braun et al. 2009) specific time frames were of particular interest. For this paper, scientific publications as well as case studies from 1990 to 2010 have been considered for the following reason: The topic of integrating methods in quality management has only been dealt with for a short time. Widespread methods like Six Sigma or TQM have their origin in the 1980s and have become famous strategies throughout the 1990s. Quality itself became a management discipline not until the late 1980s after having been a subject in production only. Therefore the situation of being confronted with a multitude of methods that need coordination has not been a topic prior to this era. Thus the research focused on the time slot mentioned. For finding relevant literature the abstracts as well as tables of contents have been scanned. The attention was directed at international publications to avoid a country-specific imprint. In doing so, 82 papers were retrieved from the following databases, with duplicates already sorted out (see table 1). In table 1, a paper is assigned to the database it has first been retrieved from (in cases of duplicates).

Database	Search	Hits
<i>Emerald</i>	all fields	46
<i>EBSCO-Host</i>	all fields	26
<i>Google Scholar</i>	-	9
<i>Elsevier</i>	keyword/all publication types	1

Table 1. Data collection – Hits in databases

After that a common step in literature reviews (see e.g. Braun et al. 2009) is to scan the citations of the papers found as suggested by Webster/Watson (2002, p. xvi). By that seven further journal articles as well as a book chapter, that had been cited more than once by authors and – after doing transverse reading – seemed relevant for answering the research questions, were added to the collection.

3.2 Data evaluation

These 90 publications were then read in detail to determine whether they were relevant for answering the research questions. A publication was considered as relevant if the author(s) described the motivation for integrating certain quality management methods/quality techniques (in the sense of section 2) and/or the way the integration was actually performed (integration approach). Finally 53 publications were considered for further evaluation. Table 2 shows the sources these papers came from⁴. The data evaluation as well as the upcoming analysis phase were supported by the *qualitative content analysis* according to Mayring (2000). This approach was chosen to consolidate the individual statements of

² This research has basically been part of a more comprising research as presented in (Johannsen 2010). In this paper the focus of the sources selected is slightly different, since here international publications are to be considered exclusively.

³ <http://vhbonline.org/service/jourqual/>

⁴ Braun et al. (2009) presented such a categorisation of sources in their review to provide transparency concerning the publications considered. This listing of sources was considered as helpful for the investigation at hand as well.

the authors which usually leave room for interpretation. Available data is condensed to those contents that are essential to the goals of a paper (see Mayring 2000).

Journals: Business Process Management Journal, International Journal of Quality & Reliability Management, The TQM Magazine, Journal of Manufacturing Technology Management, Training for Quality, Journal of Business & Industrial Marketing, International Journal of Health Care Quality Assurance, Measuring Business Excellence, International Journal of Operations & Production Management, European Journal of Innovation Management, Management Decision, Quality Progress, Public Money & Management, Managing Service Quality, Journal of Operations Management, International Journal of Productivity and Performance Management, Journal of Process Mechanical Engineering, Industrial Management and Data Systems, Managerial Auditing Journal, Environmental Quality Management, Production Planning and Control, Manufacturing Engineering.

Conference proceedings: International Conference on Construction Industry Development.

Table 2. Sources of the publications considered

4 Analysis and interpretation of the data

Step four in the procedure according to Cooper/Hedges (1994) is the analysis and interpretation of the data. Thus the findings concerning the research questions are described and discussed in the following.

4.1 Motivation for integration in quality management

At first the motivation for integrating quality management methods and techniques is dealt with.

4.1.1 Findings

Using the *inductive category development* according to Mayring (2000) the publications were analyzed regarding the authors' motivation for dealing with integration. The statements derived were categorized. This resulted in ten categories which were free from interferences. The categories turned out to be combinations of four main motivations triggering the integration process (see Johannsen 2010). Most authors used a combination of these main motivations and did not stick to one reason only (see Johannsen 2010):

- *Fear of missing trends in quality management (motivation 1):* In few publications it is mentioned that a company was already using established quality management methods but introduced further methods because they seemed “trendy” at that time (see Pfeifer et al. 2004; Snee/Hoerl 2003). The claim of an enterprise to be open to innovation plays an important role concerning this matter. But also the customer can be the driving force to adopt a “fashionable” method (such as Six Sigma).
- *Weaknesses in existing methods and techniques (motivation 2):* In addition authors mention weaknesses in existing methods or techniques (see e.g. Pfeifer et al. 2004; Bendell 2006; Black/Revere 2006; Revere et al. 2004; Tan/Pawitra 2001; Tan/Shen 2000; Tontini 2007). According to these authors, the weaknesses can be eliminated through the integration with additional methods or techniques. The weak points are explicitly taken as the trigger for integration. Taking a closer look, three types of weaknesses are being addressed (see Johannsen 2010): At first, it is criticised that some methods – especially TQM – lack operationalisation. As a result, employees do not know how to handle the method in improvement projects. This can be mitigated by operational-oriented approaches like Six Sigma for example (see e.g. Black/Revere 2006; Pfeifer et al. 2004). Other approaches lack steps for producing the required results (see Revere et al. 2004), for example activities for measuring process performance. In addition, the application of certain methods and techniques is based on assumptions, concerning customer requirements for example (see e.g. Tan/Pawitra 2001; Tan/Shen 2000; Tontini 2007). Whether these assumptions are realistic often remains unclear. In all these cases integration is seen as a means to eliminate these problems.
- *Synergies between methods and techniques (motivation 3):* The majority of the authors justifies the integration with value-adding synergies between different methods (see e.g. Ehie/Sheu 2005;

He et al. 2000; Larson/Kerr 2007; Bevan et al. 2005; Black/Revere 2006; Tan/Pawitra 2001; Bosch/Enríquez 2005; Bhuiyan et al. 2006; Khan et al. 2007; Arnheiter/Maleyeff 2005; Smith 2003; Kumar et al. 2006). The value-adding synergies are based on the interchange of results between the approaches. For example, Theory of Constraints produces results concerning the constraints within a business process, which can be used for Six Sigma projects, especially when developing ideas for improvement (see Ehie/Sheu 2005). In summary, a method or technique “A” produces an output which serves as an input for method or technique “B”.

- *One method is the prerequisite for introducing another one (motivation 4)*: Some authors claim that the introduction of holistic quality management methods (e.g. TQM) requires a stepwise implementation of certain methods and techniques first (see e.g. Low 2001; Czuchry et al. 1997; Ho et al. 1995; Klefsjö et al. 2001; Ho 1999). Very often TQM is addressed in that context, while other approaches (such as 5-S for example) are seen as the basis for an all-embracing TQM implementation (see e.g. Ho 1999), or as Czuchry et al. (1997) state, a specific method can be seen as the starting point for implementing holistic approaches in quality management.

4.1.2 Discussion

It becomes obvious that in most of the cases synergies between quality management methods are the trigger for integration (see also Johannsen 2010). Only few authors explicitly took “fashion” as a driver for implementing additional methods. The motivation plays a key role in determining what steps are to be taken during integration (see also Johannsen 2010). While weak points in specific methods require the search for appropriate approaches eliminating these weaknesses (see for example *motivation 2*), the analysis of possible input-output-relationships is dominant in other cases (see for example *motivation 3*). Taking a closer look at the main motivations identified, it is striking that only two aspects actually emphasize the value-adding character of integration (*motivation 2* and *motivation 3*). In case of *motivation 2* weak points of methods and techniques are to be eliminated. In case of *motivation 3*, the result of the integration is supposed to work better than any of the methods or techniques used separately.

In contrast, integration efforts that are triggered by *motivation 1* are strongly influenced by external factors (such as customers or trends) or follow strategic developments (see Johannsen 2010). The need to integrate (that is dominant in efforts triggered by *motivation 2* and *3*) does not have to be necessarily given. Much more a situation is described where an employee is forced to deal with integration issues because of reasons named above. Furthermore, authors focusing on *motivation 4* emphasize organizational aspects in most cases. Methods and techniques are to be introduced in a successive way within an enterprise to gain the commitment of the employees. The methods and techniques that have been introduced stepwise then need to be integrated. In both cases (*motivation 1* and *4*) it is often unclear in how far synergies and weaknesses may play an additional role as well. But it is obvious that *motivation 1* and *motivation 4* describe situations where there may be no actual need for integration in the sense of *motivation 2* and/or *motivation 3*. Much more organizational, strategic or external factors move an enterprise to face integration matters in quality management.

4.2 Methods and techniques being integrated

In a further step methods or techniques that are being integrated in literature are focused.

4.2.1 Findings

In the following only such publications were considered in which the authors – at least rudimentarily – described the way they combined different approaches. In doing so, it can be assured, that not only the intention for integration was given but that the integration was actually performed, even though only conceptually in some cases. It is to be differentiated whether the authors integrated (1) methods with methods, (2) techniques with techniques or (3) methods with techniques. Possible combinations of

different methods as well as their frequency of occurrence in the sources considered are shown in figure 1⁵. It becomes obvious that the integration of Six Sigma and Lean Management is described in seven publications. Actually Six Sigma is addressed above average.

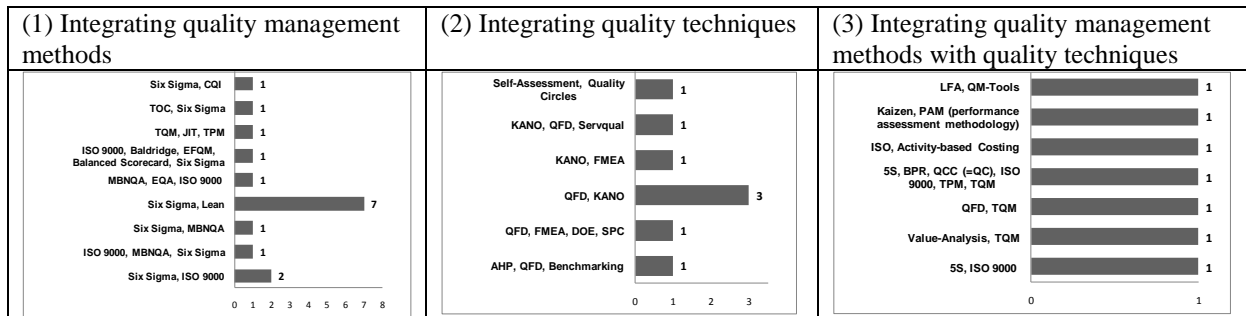


Figure 1. Combinations of methods and techniques and frequency of occurrence

4.2.2 Discussion

It can be summarized that the combinations of Six Sigma and ISO 9000 as well as of Six Sigma and Lean Management are seen as value-adding by many authors (see e.g. Pfeifer et al. 2004; Pepper/Spedding 2010). The same holds true for QFD and the KANO-Model. In those publications dealing with the integration of quality techniques (see figure 1 – (2)), the elimination of weaknesses served as the main trigger for the integration effort (*motivation 2*). In the other cases synergies (*motivation 3*) were seen between the techniques. It also became obvious that the combination of Six Sigma and Lean Management (see figure 1 – (1)) is mainly based on synergies as well. The frequency of occurrence indicates that Six Sigma is just the latest method in a series of approaches that has been developed over the last few decades, increasing the necessity to coordinate different methods (Johannsen 2010).

These findings can support practitioners since hints for value-adding combinations can be derived. If problems exist considering the use of a certain method or technique within an enterprise, the user recognizes which combinations of methods or techniques are seen as promising (Johannsen 2010). If, for example, an enterprise is dissatisfied with the results achieved by using KANO, a combination with QFD may overcome these problems (see figure 1).

4.3 Approaches for integrating methods and techniques in quality management (integration approaches)

In the section above, different combinations of methods and quality techniques found in literature have been highlighted. The question arises in which way these are actually being integrated.

4.3.1 Findings

Again only such publications were considered in which the authors – at least rudimentarily – described the way they combined different approaches. What is decisive – when analyzing the way quality management methods are being integrated – is the authors' interpretation of the concepts (Johannsen 2010). Magnusson et al. (2004) introduce three perspectives on Six Sigma for example. These com-

⁵ A similar figure can be found in (Johannsen 2010). The frequency of occurrence is slightly different due to the focus of this paper as described in section 3. It has to be mentioned that some authors do not solely focus on the integration of a particular set of methods (e.g. Six Sigma and ISO 9000). Instead they address further combinations within one publication (e.g. Six Sigma and MBNQA etc.). In such cases each combination described was counted separately in figure 1.

prise the interpretation as a “holistic and companywide strategy”, an “improvement method” as well as a “toolbox of quality techniques” (see Magnusson et al. 2004). This classification helps to understand the lack of standards in the field of quality management, since different authors take heterogeneous perspectives when discussing specific methods, like Lean Management for example (see e.g. Bendell 2006; Bevan et al. 2005). Different interpretations can be found for nearly all common quality management methods. Authors like Pfeifer et al. (2004), Low (2001), Black/Revere (2006) or Klefsjö et al. (2001) recognize quality management methods as holistic strategies. As a result they focus on aspects like organizational concepts, core values (e.g. process orientation), underlying philosophies, or quality goals associated with a certain method (see Johannsen 2010). Hellsten/Klefsjö (2000, p. 239) summarize these topics under the umbrella “management philosophy”. A second group of authors interprets the approaches as “improvement methods” (see e.g. LaHay/Noble 1998; Ehie/Sheu 2005; Revere et al. 2004). Here the procedure model or steps (see de Mast 2004, p. 199) of the quality management methods are paid attention to, for example the DMAIC-cycle or PDCA-cycle. Therefore an operational perspective when improving a business process is predominant. The integration is executed by the amalgamation or modification of the procedure models considered (see Johannsen 2010). A third group of authors focuses on quality techniques only. These deal with the integration of different techniques in quality management (see Johannsen 2010). Since each group builds upon a different interpretation, the approaches taken for integration differ for each group (see Johannsen 2010). Therefore each group is analyzed for itself.

Authors interpreting quality management methods as “holistic strategies”: Three approaches authors usually take when focusing on these aspects were identified.

- *Definition of a framework for quality management methods (approach 1)*: At first it can be observed that authors establish frameworks for certain purposes, e.g. product development or corporate management (Johannsen 2010). Within these frameworks, different methods and techniques serve certain purposes while interfaces for exchanging results are defined (see e.g. Cua et al. 2001).
- *Search for common core values (approach 2)*: Several authors (see e.g. Pfeifer et al. 2004; Low 2001; Czuchry et al. 1997) search for common core values (see Hellsten/Klefsjö 2000, p. 240) as a starting point for the integration. The authors then try to explore how one method can support the core values of another approach (Johannsen 2010). For example Pfeifer et al. (2004, p. 246) argue that Six Sigma and ISO 9000 share the core value of “process-orientation”, amongst other things. Therefore processes are usually visualized in the ISO 9000 documentation, which can be referred to in Six Sigma projects. The approaches get integrated by establishing corresponding input-output-relationships for the interchange of results, for example process models.
- *Definition of criteria for a case by case decision (approach 3)*: Other authors (see Bendell 2006; Karapetrovic/Willborn 2001) combine different approaches by establishing selection criteria. Depending on a given situation the criteria are used for selecting a specific approach which is then applied in a project. Based on defined selection criteria a company decides whether it uses Lean Management or Six Sigma for an improvement project for example (see Bendell 2006). While this approach may be a practical solution for enterprises in handling the variety of methods and techniques it may be discussed in how far this approach really reflects an integration approach.

The search for common core values (*approach 2*) was described most frequently by the authors. The selection based on criteria (*approach 3*) played a minor role.

Authors interpreting the methods as “improvement methods”: Four approaches for integration can be distinguished.

- *A new procedure model is developed which is based on the specific procedure model of a method to be integrated (approach 4)*: In that case the procedure model of a specific method is taken as the basis for modification (see Johannsen 2010). Ehie/Sheu (2005) for instance integrate Theory of Constraints and Six Sigma. Therefore they take the procedure model of TOC and modify it by adding phases from the Six Sigma DMAIC-cycle (see Ehie/Sheu 2005, p. 544). By that, the phase structure of the procedure model is modified.

- *The procedure model of a method is adopted completely – only activities or quality techniques are added piecemeal (approach 5):* Other authors take the procedure model of an approach which is only enhanced by certain activities or quality techniques in a piecemeal way (see Johannsen 2010). Revere et al. (2004) for instance integrate Six Sigma and the CQI-approach by enhancing the Six Sigma procedure model by certain activities concerning the measurement of healthcare-related performance metrics. Snee/Hoerl (2003) add quality techniques to the DMAIC-cycle of Six Sigma and thus achieve the integration of Lean Management and Six Sigma. Contrary to approach 4 – described above – the phase structure of the underlying procedure model is not affected.
- *A completely new procedure model is developed (approach 6):* In addition, a completely new procedure model may be developed. None of the procedure models of the methods to be integrated serves as a template (see Johannsen 2010). Bevan et al. (2005), for example, integrate Six Sigma and Lean Management by defining a new procedure model which is characterized by an own phase structure.
- *The procedure models are treated in an isolated way – input-output-relations for the interchange of results are identified (approach 7):* Authors like Larson/Kerr (2007) identify input-output relationships between the activities of the procedure models considered. In that way Larson/Kerr (2007) show how Activity-based-Costing can support ISO 9000. Contrary to authors focusing holistic concepts, the results interchanged are described in much more detail since the focus on procedure models enables a discussion from an operational perspective.

The majority of the publications focus on the development of a new procedure model or the modification of a procedure model that is used as the basis for the integrated method.

Authors focusing on quality techniques: A third group of authors focuses quality techniques only. In that context this paper distinguishes between two approaches for integration. On the one hand authors analyze the weak points of specific quality techniques. In a further step, quality techniques to overcome these weaknesses are searched for (*approach 8*) (see Johannsen 2010). For example, QFD shows weaknesses concerning the prioritization of product characteristics (see e.g. Tontini 2007; Tan/Shen 2000). This can be overcome by using the KANO-Model which helps to identify those characteristics that are of high priority for a customer. Other authors establish a framework (e.g. for product development) (*approach 9*) (Johannsen 2010). Within this framework quality techniques support the execution of certain activities (see Lu et al. 1994; He et al. 2000; Shen et al. 2000). Lu et al. (1994) for example introduce a framework for marketing planning which aims at developing innovative marketing policies based on customer expectations. For achieving this, they integrate AHP, QFD and Benchmarking techniques. Contrary to *approach 1* only quality techniques are considered in *approach 9* and not holistic quality management methods. Therefore these approaches (*approach 1* and *approach 9*) are listed separately.

Most of the publications concerning the integration of quality techniques focus on the weaknesses of certain techniques. These weak points are then eliminated by the integration with further techniques.

4.3.2 Discussion

The way authors actually integrate the methods is often only described implicitly (Johannsen 2010). Therefore rather the result of the integration is emphasized than the process of integrating the methods/techniques itself (Johannsen 2010). Accordingly the approaches taken for integration are described very generally. Guidelines on how to combine different methods or techniques cannot be found, least of all universally valid rules for integration. The results show that an approach for integration cannot be established without deciding which perspective on a quality management method is supported. It also becomes obvious that even if authors take identical perspectives on a method (see Magnusson et al. 2004) the way the integration is conducted varies. Procedure models can be amalgamated, modified or stay untouched during integration for example (see section 4.3.1). Analyzing the “integration approach” and its relation to the motivation for integration, the following results become evident: If the fear of missing trends is seen as a trigger for integration (*see section 4.1.1 – motivation 1*) often com-

mon core values are searched for (*see section 4.3.1 – approach 2*). Therefore a holistic interpretation of the approaches is dominant. The corresponding authors combine the approaches without modifying the already existing methods. Much more input-output-relationships for interchanging results are identified. If weaknesses in existing methods and techniques are to be eliminated (*see section 4.1.1 – motivation 2*) the authors adapt a more operational-oriented perspective (focus on “improvement methods” or “quality techniques”). Following this perspective *approach 5* is followed in most cases if quality management methods are to be integrated. The procedure model of the method showing weaknesses is taken as a starting basis which is then enhanced by additional activities and quality techniques. If quality techniques are focused, the weaknesses are overcome by the identification of input-output-relationships between the techniques (*see section 4.3.1 – approach 8*). Concerning *motivation 3* and *4* none of the approaches stood out but were used equally often.

Taking a look at the relation between the methods and techniques being integrated and the approaches described above, the following becomes evident: In the majority of the cases describing the integration between Six Sigma and Lean Management the procedure model of Six Sigma (DMAIC-cycle) is taken as the basis. The procedure model is then enhanced by activities and techniques from Lean Management (*see section 4.3.1 – approach 5*). In the other cases a framework is developed (*approach 1*) or common core values are searched for (*approach 2*). Six Sigma and ISO 9000 are mainly integrated by the search for common core values and the establishment or corresponding input-output-relationships for results (*approach 2*). In publications focusing the combination of KANO and QFD, output from KANO is used to eliminate weaknesses in QFD regarding the prioritization of customer requirements. Furthermore it becomes evident that a framework is established if more than two methods or techniques are being integrated (*approach 1* and *approach 9*). Similar statements cannot be derived for the combination of other sets of methods due to their limited frequency of occurrence (see figure 1).

5 Summary, limitations and outlook on further research

The aim of this paper has been to give an overview concerning integration efforts in quality management. Thus a literature review has been chosen as methodology. One limitation – typical for literature reviews – concerns the selection and completeness of the articles considered (see e.g. Braun et al. 2009; Zellner 2011). Therefore the recommendations by Webster/Watson (2002) and vom Brocke et al. (2009) have been followed to conduct the review in a systematic way and guarantee transparency concerning the results gained. Considering the rapidly growing amount of techniques and methods in quality management, integration becomes a mean in handling this variety of approaches. Nevertheless, the topic of integration has not been dealt with systematically or theoretically founded in quality management yet. Therefore the aim is to develop clear guidelines, which will help a practitioner to integrate methods and techniques (in quality management) in a structured way. In the section above, the relation between the “integration approaches” (see section 4.3.1), the methods (techniques) considered (see section 4.2.1) and the motivation for integration (see section 4.1.1) has been analyzed. It became obvious that factors like “motivation” or the interpretation of quality management methods may influence the integration and thus can be used for deriving integration scenarios. These scenarios help in bringing structure to the fuzziness of the whole subject. However, a large variety of different integration projects can be distinguished. In (Johannsen 2010) a detailed approach for integration was developed, merging several quality management methods to one final method while interpreting these as “improvement programmes/methods” in the sense of Magnusson et al. (2004). Nevertheless, further approaches are to be developed when other interpretations of quality management methods (see Magnusson et al. 2004) are supported or the merging of methods is not desired (see for example section 4.3.1 – approach 1). Thus forthcoming research will include the following tasks: At first it is intended to verify the results presented in this paper by means of empirical studies and expert interviews with industrial partners. In addition, the relation between employees’ preferences for a specific integration approach and strategic challenges of the company (e.g. conquering new markets) is to be explored in detail. Afterwards recommendations can be developed supporting a company in choosing an appropri-

ate integration approach. Clear guidelines for practitioners are then to be developed for each integration approach and need to be evaluated in cooperation projects.

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