

## **Agile Process Management in the Manufacturing Industry. A New Paradigm in Industrial Operations Management?**

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### *Abstract*

*This theoretical paper examines the origins of the agile business process management approach in the of the organizational theory and the differences between traditional business management approaches and agile management approaches. Theories such as the Team Theory or the Human Relations Approach contain agile as well as non-agile components, although the concept of agility was not yet in existence at the time these theories emerged. Consequently, the overall conclusion of this theoretical paper is that agility was a latent paradigm in a long course of discussing business process management rejecting the rigid workflow organization approach demanded by the Taylorism and Fordism. Consequently, this paper can be complete with the hypothesis that agility has developed from a latent paradigm to a manifest paradigm in the last years in the context of reengineering in IT industry.*

### *Introduction: Business Process Management in the Context of Digitization*

The further development of human-to-human, man-to-machine, or machine-to-machine networking is constantly creating new challenges for organizations. Current technologies in the age of digitization, such as cloud computing, Big Data, and Industry 4.0, enable increasingly faster interaction and synchronization of manufacturing processes. The ever-increasing digitalization of communication and interaction makes it possible to capture and execute activities in business processes more flexibly and quickly, and to carry out human-based and automated activities in increasingly complex process chains, because ICT offers the possibility that data and information are available in real-time to virtually all parties involved (people and machines). The digitization of processes enables the ever-increasing networking of people, organizations and machines<sup>1</sup>. Automated decision-making is supported by Big Data and processes and stakeholders are networked together. Interactions between people can occur completely virtually and independently of the location, so that throughput times of processes are significantly reduced. In addition, feedback from process participants, which is recorded during the execution of the process, for example, can be directly analyzed and used for process improvement. Process management is thus directly influenced by the change in digitization.<sup>2</sup> Agility is considered the central factor in business process management.

The challenge in the context of industrial manufacturing initially lies in the effective and efficient integration of all involved human resources and machine tools. This integration of man and machine into an ecosystem of data and information is a decisive success factor in these highly agile processes. However, the necessary balance between flexibility and stability is not adequately ensured by the traditional methods of business process management (BPM). Both current research and application-based

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<sup>1</sup> Comp. BMWI (2015) / Vom Brocke & Schmiedel (2015)

<sup>2</sup> Comp. BearingPoint (2015)

studies show the inadequate integration of all stakeholders, their lack of understanding and low acceptance of BPM.<sup>3</sup>

A business process consists of a set of manual, semi-automated or automated activities carried out in a company.<sup>4</sup> By implementing these activities, a defined goal is pursued, taking certain rules into account. The activities are performed by resources. It differentiates between personnel and non-personnel (machine) resources. A task is fulfilled or not fulfilled when one or more activities are performed.<sup>5</sup> If at least two resources perform an activity, a collaborative business process exists. A distributed business process is characterized by the fact that it is not executed locally, but at two geographically different locations. If a business process is carried out exclusively within a single company, this describes an internal business process. If at least two companies are involved in the execution of a business process, this means an over-the-company business process.<sup>6</sup>

### *Traditional Approaches to Business Process Management*

However, despite the generally acknowledged task of business process management, a standardized definition of the concept of business process management is not available in the academic literature.<sup>7</sup> It depends on the perspective of the observer how the distinction between the individual approaches such as Continual Improvement Process, Lean Management, Total Quality Management, or Six Sigma<sup>8</sup>. Nevertheless, independent from the perspective of the observer, the term is used as a collective term for all activities in the company that support continuous monitoring and improvement of processes.<sup>9</sup> Consequently, business process management is - in a radically compressed definition - the design and controlling of business processes.

Weske (2012) describes business process management as a cycle of four phases: evaluation, design analysis, configuration, and disposal. In addition to the four phases, Weske (2012) introduces two meta levels to which business process management is subordinated: strategy and organization and the design process map. As a result, business process management can be structured from the organizational strategy to the implemented business process.

Hammer<sup>10</sup> describes business process management as a comprehensive system for managing and transforming organizational processes base on two pillars: Business Process Reengineering (BPR) and Continual Improvement Process (CIP).<sup>11</sup> Business Process Reengineering defines a radical reorganization<sup>12</sup> of the core processes of an organization. Business processes are fundamentally rethought and, if necessary, radically redesigned Unnecessary business processes are completely discarded and restructured within the framework of reengineering.<sup>13</sup> The focus is on a possible

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<sup>3</sup> Comp. Weidmann (2016)

<sup>4</sup> Comp. Wiedmann (2016), p. 38

<sup>5</sup> Comp. Wiedmann (2016), p. 38

<sup>6</sup> Comp. Wiedmann (2016), p. 38

<sup>7</sup> Comp. Singer & Zinser (2010)

<sup>8</sup> Comp. Becker et al. (2000) / Hammer (2010) / Dumas et al. (2013) / Marchildon & Hadaya (2015)

<sup>9</sup> Comp. Balzert et al. (2011), p. 4

<sup>10</sup> Comp. Hammer (2010)

<sup>11</sup> Comp. Neumann et al. (2003) / Hammer (2010) / Balzert et al. (2011)

<sup>12</sup> Comp. Ko (2009)

<sup>13</sup> Comp. Neumann et al. (2003)

innovation and the question of why business processes are executed in a certain way.<sup>14</sup> With all its radicality, Hammer points out a step by step introduction of the innovation in order to minimize a possible risk of the failure of the redesign.<sup>15</sup> The second pillar of business process management is the continual improvement process cycle. This cycle describes four phases plan, do, act, and check), which can be used for a continuous improvement of business process, which Hammer sees a revolutionary approach to the management of an organization, since a reflective approach is described instead of a trial-and-error principle.<sup>16</sup>

The concept of Lean Management stands for an approach of a permanent, consistent and integrated set of principles, methods and measures that can be used to plan strategic aspects as well as operational aspects along the entire value-added process.<sup>17</sup> Here, the goal is to avoid waste of resources such as material, money or time. In addition to the goal of avoiding waste, the Lean Management tries to achieve a flexible and cost-reducing production.<sup>18</sup> For this purpose, Lean Management uses different management principles such as the management of processes for standardization and automation.<sup>19</sup>

The Total Quality Management (TQM) approach is defined as company-oriented philosophy based on quality and on the participation of all organizational members with the aim of achieving long-term success through customer satisfaction and through the benefit of all organizational members and society.<sup>20</sup> According to the overarching goal of customer satisfaction, all processes and process participants are aligned to this goal.<sup>21</sup> TQM uses both technical tools such as statistical evaluations, data analysis, and others, as well as non-technical activities (social tools) such as integration of all employees, increase of teamwork and other approaches to achieve the goal and to monitor the activities carried out for this purpose.<sup>22</sup> In the literature, these components are also defined as 'hard' and 'soft' components.<sup>23</sup>

Six Sigma, from management's point of view, primarily means an increase in company profitability<sup>24</sup> aiming at reducing costs and improving process.<sup>25</sup> The activities within Six Sigma are developed and executed through the so-called DMAIC cycle (define, measure, analyze, improve, and control).<sup>26</sup> The approach is based on mathematical methods based on measured data as the basis for process improvement. Six Sigma is therefore a management system for process improvement by means of statistically defined quality targets and thus a method of quality management.

The mentioned concepts (Lean Management, TQM, Six Sigma, Business Process Reengineering, and Continual Improvement Process) are mainly used to optimize process efficiency in terms of cost reduction, higher lead times, higher output quality

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<sup>14</sup> Comp. Tønnessen (2014)

<sup>15</sup> Comp. Hammer (2010)

<sup>16</sup> Comp. Hammer (2010)

<sup>17</sup> Comp. Womack et al. (1991) / Pfeiffer & Weiss (1994)

<sup>18</sup> Comp. Komus & Kamlowski (2014)

<sup>19</sup> Comp. Bösenberg & Metzen (1995) / Liker (2004)

<sup>20</sup> Comp. DIN (2009)

<sup>21</sup> Comp. Rothlauf (2010)

<sup>22</sup> Comp. Anvari et al. (2011)

<sup>23</sup> Comp. Psychogias (2007) / Anvari et al. (2011)

<sup>24</sup> Comp. Koch (2011)

<sup>25</sup> Comp. Revere et al. (2004)

<sup>26</sup> Comp. Conger (2015)

and profitability. These traditional approaches are distinguished in particular by their sequential execution of several distinct phases. For example, if a business process needs to be automated, a detailed analysis (for example, setting goals, quality criteria, etc.) is generally started. The business process is then modeled in a second phase. The implementation is then carried out.

Finally, the business process model may then be published in the form of documents. The execution is then monitored during the application of the business process application. If adjustments to the new business process must be made, for example due to a failure in the implementation, the new analysis phase begins again. This sequencing of business process management leads to a high temporal distance between publication of different process map versions. Especially in an agile environment, this delay leads to loss of money, because the business process model and its application no longer correspond to the real requirements. Furthermore, in traditional approaches, users are not sufficiently integrated into the phases of business process modelling, designing, and management. Inadequate user training during modeling or implementation lead to significant acceptance problems.<sup>27</sup>

### *Agile Business Process Management and Engineering*

Questions concerning the strategic significance, the development of a process culture as well as the enabling of new business models through process management and information systems are not answered by traditional business process management approaches. However, there are also a large number of approaches which embrace and expand the concept of business process management to a holistic approach. Examples of this are the subject-oriented BPM (S-BPM),<sup>28</sup> Social BPM<sup>29</sup> and agile BPM.<sup>30</sup>

Silva et al. (2010) describe an approach to agile business process management, supported by Wiki-based technologies. In doing so, the separation between modeling and execution is abolished by the use of a common software environment. According to Silva et al. (2010) this is intended in particular to reduce the differences between a predefined business process model and the real executing authorities. To achieve this, for example, executing users can add directly generic activities required for their instance to a business process model so that this business process management approach can be described as rolling concept in which all participants can have three roles: performer, modeler and developer. Using a common software environment, business processes are modeled, automated and executed. Once an exception occurs within an instance - for example an additional approval step by management - the performer can add a generic activity to specify the exception to the predefined business process. The modification of the business process model initially applies only to the executed instance. In this way, the collaboration of all parties involved in the GPM cycle is guaranteed through the use of the Wiki-based technology.

Weber and Wild (2004) present an agile approach with a focus on business process automation. The goal is to be able to respond agile to new workflow requirements and

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<sup>27</sup> Comp. Bandara et al. (2007) / Komus (2010) / BearingPoint (2012) / PricewaterhouseCoopers (2014) / Brucker-Kley et al. (2014)

<sup>28</sup> Comp. Fleischmann (2010) / Fleischmann (2012) / Fleischmann & Schmidt (2014)

<sup>29</sup> Comp. Bramabilla et al. (2012) / Rangihā & Karakostas (2014) / Lohmann et al. (2014)

<sup>30</sup> Comp. Weber & Wild (2004) / Silva et al. (2010) / Bruno et al. (2011) / Thiemich & Puhlmann (2013) / Mevius et al. (2014)

to allow just-in-time changes to predefined workflows. The approach is based on the combination of traditional rules and case-based reasoning (CBR). The business process management cycle is divided into two parts: development time and run time. At the development time, the activities are implemented, which can already be defined sufficiently based on the existing knowledge during the development period, and redefined within a running business process. On the other hand, activities which are too time-intensive to analyze to create a sufficient basis for implementation are recorded in a simulation.

If, for example, new business process activities are to be simulated beforehand, a (time) intensive analysis is necessary to establish realistic simulation parameters (lead time, costs, etc.). As soon as the business process to be implemented has sufficient rules, it can be executed. If deficiencies (for example due to an outdated implementation) are detected by the users during execution, annotations can be recorded for the workflow. These annotations (process information) can be directly used by other users without the need to modify the implemented business process. As soon as the information collected in a case has reached a defined maturity, the information is used to update the existing business process model. After the development and abstraction of the collected information during the development period, the new workflow can be executed. The approach of Weber and Wild (2004) follows the Agile Manifesto.

Thiemich and Puhlmann (2013) provides an alternative approach. Their perspective on business processes focuses on development projects in which only the overarching process structure is predefined. A business project is divided in various phases and in so-called sprints. Some of the terms and aspects used by Thiemich and Puhlmann (2013) are based in particular on the agile approach 'SCRUM'. For example, a sprint describes a predefined time period in which selected requests are implemented, for example, by the involved developers as an shortened version of predefined process parts to accelerate the process. The business project idea must be discussed and documented at the beginning of a business project. In the scoping phase, the framework conditions of the project are determined.

At this point, the budget and the project idea) is defined or described. In the 'kick-off' phase, a first process design as well as a rough release plan are created. In addition, the project team is defined within the kick-off meetings. Furthermore, the so-called 'definition of ready' and 'definition of done' are defined. The definitions serve to describe the mutual expectations. The 'definition of ready' contains rules on how the requirements must be described and an input estimate for each requirement is generated. The 'definition of done' explains the criteria that describe when a requirement is fully implemented. Depending on the size of the project, the cycle can be repeated several times. Within the cycle, a distinction is made between sprint, release sprint and release. A sprint is used to implement requirements faster as planned by neglecting other predefined goals.<sup>31</sup>

In summary, it can be said that in the traditional approaches the support of process participants with regard to approach and tools is often neglected. Method gaps can lead to insufficient up-to-datedness of business process models due to the division of planning from executing through sequencing business process modelling and business

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<sup>31</sup> Comp. Thiemich and Puhlmann (2013)

process execution, because documentations and automated process applications no longer correspond to the real requirements particularly when the firm operates in an agile environment. Furthermore, the planning process is decoupled from the process practice and process participants leading to a low user acceptance because of a lack of involvement of all process participants in the design phase. By contrast, the discussed approaches in the context of the agile approach can be defined as a rolling business process modelling and management with a significantly higher involvement of all business process parties.

### *Agility in Organization Theories*

The concept of agility can be found in a variety of theories and concepts of organizational theory. It is remarkable, however, that these are not exclusively new organizational theories, but that the oldest approaches - which can be found in the seemingly 'modern' concept of agility - having their starting point in studies from the 1920s to the 1940s. At this time, mass production developed, which reached its zenith already in the 1960s, and at the same time raised problems which ultimately led to the design of an agile organizational structure. The current section is intended to illuminate the links between the organizational theories and the corresponding agile attributes.

The Human Relations Approach theory<sup>32</sup> - and its further development as human-resource approach are two of the oldest approaches to which agility can be tracked back. In these approaches, a first-time orientation was made to humans as an important resource. The older Human Relations approach focuses on employee motivation and employee satisfaction, while the recent human resource approach already involves organizational design and transformation. Motivation, self-motivated groups, self-management of tasks, multiple qualification, continuous learning, decision-making and self-control are some of the concepts developed in this early context on and are linked to the concept of agility since the early 1990s.<sup>33</sup>

Closely linked to the human dimension are the Team Theory and the Theory of Self-Organization. Both theories deal with the organization within groups. The team theory<sup>34</sup> examines the structure of teams and their organizational form, whereby self-organized team structures with decentralized decision-making are the characteristics of agility. Yusuf et al. (1999)<sup>35</sup> determines the team as one of the ten pillars that constitutes agility in the organization and is described by the concepts of

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<sup>32</sup> Comp. Mayo (1933)

<sup>33</sup> Comp. Yusuf et al. (1999) / Vázquez-Bustello et al. (2007) / Sherehiy et al. (2007)

<sup>34</sup> Comp. Marschak (1955)

<sup>35</sup> Comp. Yusuf et al. (1999)

teamwork, cross-functional teams, cross-company teams, and decentralized decision-making. According to Vázquez-Bustello et al. (2007), team-related work is an element of the dimension of the agile human resources, but is found in the two attributes teamwork and motivation constituting a close link. Within agile organizational structures, teamwork often appears in combination with self-organization. Characteristics of self-organization such as small autonomous units, multi-skilled employees with changing roles, the high status of communication and flexibility, as well as a flattening of the hierarchies are found as attributes of agility<sup>36</sup>. A particularly prominent position seems to be the self-organization within the agile software development. The Agile Manifesto (2001), a basic document of agile software development, is one of the twelve principles of agile software development: "The best architectures, requirements, and designs emerge from self-organizing teams".<sup>37</sup>

### *Conclusion: Agility as Latent Management Paradigm in the Manufacturing Industry*

In summary, it can be noted that theoretical concepts of the organizational theory originated in the industrial era are included in the concept of agility. The theories discussed in the previous section are, however, much more extensive and contain only a few elements which are congruent with the concept of agility; they contain agile as well as non-agile components, although the concept of agility was not yet in existence at the time these theories emerged.

A distinction can be drawn between theories which contain a higher proportion of agile elements, as is the case with self-organization theory. Other theories have a smaller proportion of agile elements. For this paper, theories were chosen whose agile content is high, since the topic of the work involves the presentation of agile elements in older organizational theories. The agility could thus be interpreted as a collection which, in addition to various components, also includes agile elements of older theoretical concepts in combination with other concepts.

It should become apparent in the course of this paper's reasoning that agility is a conglomerate of a multitude of individual concepts and is also open to the inclusion of new approaches such as the mass customization or the virtual organization. Conboy (2009) states that "many different agile methods, variants, and derivatives exist, and yet it is not so much the number of methods that causes the problem but the fact that these are so disparate"<sup>38</sup>. In "many ways, the terms flexibility and agility are very similar and have been used interchangeably throughout the literature."<sup>39</sup>

According to Conboy (2009), the concept of agility contains all the properties of flexibility plus the attributes of reactivity, proactivity, and positive attitude towards environmental changes. However, on closer examination, the concept of agility also includes other aspects that support the model of flexibility. This includes some concepts of continuous education such as continuous learning, knowledge management and the generation of knowledge. In addition to reactivity, speed and competence, flexibility is just one of the basic characteristics of agility.<sup>40</sup>

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<sup>36</sup> Comp. Vázquez-Bustello et al. (2007)

<sup>37</sup> Comp. Agile Manifesto (2001)

<sup>38</sup> Comp. Conboy (2009) p. 330

<sup>39</sup> Comp. Conboy (2009), p. 336

<sup>40</sup> Comp. Sharifi & Zhang (1999)

Also, the concept of Lean Production, has included some characteristics of agility. Elements found in both approaches are the importance of the narrow (and lean) supplier and customer relationship and the flattening of hierarchies in organizations associated with the shifting of decision-making processes into the lower hierarchy levels. Highly motivated, well-educated and informed employees are an integral part of both concepts, but the idea of welfare and employee satisfaction does not have the same importance in lean production as in agility.<sup>41</sup> The agile concept, as well as Lean Management aim at reducing resources, time and costs, although not with the same exclusive focus on costs.<sup>42</sup>

It should have become clear that agile ideas were created in theories and concepts before the concept of agility was discussed in its current form. However, one difficulty arises from the fact that the literature does not define what is meant by the concept of agility. Many scientists develop their own variant of agility definition, which forms the basis of their investigations. Agility is a conglomerate of different theories and concepts. The oldest of the theories discussed here have shown a 70-years history. Therefore, the overall conclusion of this theoretical paper is that agility was a latent paradigm in a long course of discussing business process management rejecting the rigid workflow organization approach demanded by the Taylorism and Fordism.

Consequently, this paper can be complete with the hypothesis that agility has developed from a latent paradigm to a manifest paradigm in the last years in the context of reengineering in IT industry. It can be assumed, that his manifest paradigm may further refined in the following years in the context of further technological innovations allowing further process innovation. However, further research should be committed to better distinguish new concepts from existing allowing also to better define the new content in the term agility as a difference from older concepts of business process management to avoid the suspicion of transitory trend wording.

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<sup>41</sup> Comp. Conboy (2009)

<sup>42</sup> Comp. Conboy (2009)

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