

Towards a methodology for Kaikaku realization

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ABSTRACT

In today's globally competitive market where the speed of change is increasing it is of great importance that manufacturing companies are striving to achieve improvements in their production systems resulting in competitive edge. One way of doing this is to strive for radical change by becoming more innovative. Today however, there's a lack of modern methods guiding companies to be not only innovative and creative in their production development process, but also increasingly more innovative while using it. Hence, the objective of this paper is to present and discuss a preliminary first draft of a Kaikaku realization method, primarily based upon Concept Modelling and research within the domains of Operations Management and Strategy, Innovation theory and Change theory. The result is a sequential work process that provides guidance from an initial "current state" of production to a more desirable "future state" based upon an aggressive target that is set in line with the production strategy. Finally, future research is discussed, implying that more research should be subjected to the actual work process as well as the main support provided in the process - aggressive target setting and facilitation of innovative thinking.

Keywords: Kaikaku, Method development, Production development, Innovative thinking

1. INTRODUCTION

In today's globally competitive market where the speed of change is increasing it is of great importance that manufacturing companies are striving to achieve improvements in their production systems resulting in competitive edge. One way is to learn to be more innovative and creative in their production development process while achieving radical performance improvement. Today, a methodology for radical innovative improvement – Kaikaku – is therefore a necessity, parallel to continuous improvement, Kaizen, for especially SME's (Small and Medium sized Companies) in order to attain the competitive edge needed to be profitable. Kaikaku is a radical improvement characterized by fundamental changes in the production system where a significant increase in performance is achieved. This paper presents the current results from the three year long "Kaikaku project" (Vinnova Dnr: 2009-03978) regarding a preliminary methodology for Kaikaku realization within the area of production system development.

There is a lack of modern methods guiding companies to be not only innovative and creative in their production system development, but also increasingly more innovative while using it. Yet, manufacturing companies need to learn how to be more innovative and creative in their production development process while achieving radical performance improvements within their production systems. This is emphasized in the vision report 2020 by ManuFuture [1] indicating that the innovation activity in manufacturing is too weak today.

1.1 Kaikaku in literature

Yamamoto [2] states that it's widely recognized that there are two approaches to production system improvement today: incremental and continuous improvements – Kaizen – and infrequent but radical improvement – Kaikaku. The basic characteristics of Kaizen imply small step improvements, are process and people oriented as well as continuous. Kaikaku at the other hand is characterized by episodic occurrence, bringing about fundamental change, intend dramatic results and being driven by top-down initiatives.

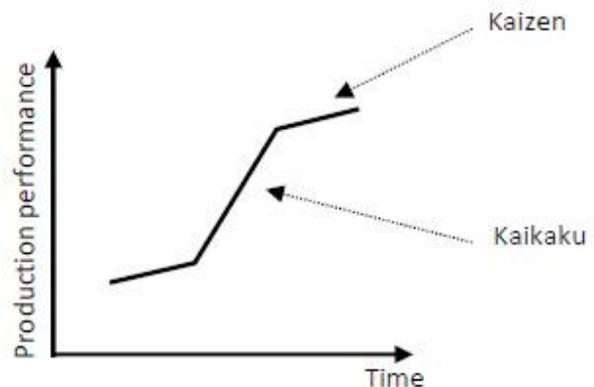


Fig. 1: Basic characteristics of Kaizen and Kaikaku [2].

Yamamoto states that both Kaizen and Kaikaku needs to be carried through effectively and efficient in order to gain and sustain internationally competitive production. Likewise, Harrington [3] argues that one of management's biggest challenges is to provide an environment in which both breakthrough improvement

(Kaikaku) and continuous improvement (Kaizen) can exist.

According to Bicheno [4] a traditional idea is that breakthrough improvements/major event improvements (such as Kaikaku) take place infrequently in response to a major change such as the introduction of a new product or in response to a “crisis”. Bicheno further implies that Kaikaku aims at spectacular and very rapid productivity improvements in a focused area. Moreover Bicheno states that it is an enforced breakthrough that in a way cannot fail since expectations and opportunities are all in place; “no” and “it can’t be done” are simply not accepted.

Womack and Jones [5] describe radical improvement (Kaikaku) in “Lean thinking” as a radical improvement of an activity to eliminate muda (waste), for example by reorganizing processing operations for a product so that instead of travelling to and from isolated “process villages”, the product proceeds through the operations in single-piece flows in one short space.

Yamamoto [2] defines Kaikaku as follows:

“Kaikaku is an infrequent but radical improvement where fundamental changes occur in the production system and a dramatic performance increase is obtained. Initiated often by top management, fundamental changes are made through reformations or replacements of the system by introducing new knowledge, work methods, strategies, production technologies, or equipment and so forth. The performance increase as a result of Kaikaku is often 30 to 50 % or more”.

Further, Yamamoto has developed a model consisting of four types of Kaikaku where the phenomenon of Kaikaku is described from a macro level, which is from a plant or a production system perspective. Within this model, Kaikaku is categorized in two dimensions. The y-axis defines whether it’s an infrastructural or structural type of Kaikaku (the area of the change) and the x-axis defines whether the Kaikaku is incremental or radical (the innovativeness of the change).

The area of the Kaikaku	Structural	Kaikaku type I “Structural change”	Kaikaku type III “Structural change beyond the state of the art”
	Infrastructural	Kaikaku type II “Infrastructural change”	Kaikaku type IV “Infrastructural change beyond the state of the art”
		Incrementally innovative	Radically innovative

Innovativeness of the outcome by Kaikaku

Fig. 2: Model of four types of Kaikaku [2]

The incrementally innovative Kaikaku occurs when “off-the-shelf” solutions that is new to the company but not

to the industry in general is introduced to the company. These solutions might be company-wide improvement initiatives like Lean Production, Six Sigma and Total Production Maintenance (TPM) which are infrastructural solutions, or technical equipment such as automation technologies that are structural changes. The radically new Kaikaku occurs when a newly formed production system is not only new to the plant, but also to the industry in general. The solutions within this category might be new production flows or new work methods if infrastructural, or entirely new and innovative technical equipment if structural.

Most Swedish manufacturing companies are working with continuous incremental improvements in production today. However, not many companies are working in the same structured manner striving for great leaps through innovative thinking within their production development process. According to Yamamoto most companies have made some kind of radical improvement in the past, yet a structured guidance for conducting Kaikaku is often insufficiently provided. Instead, companies have to rely on a number of skilled and experienced individuals, consultants and/or system suppliers to be able to realize radical improvements. The Kaikaku-type model helps to understand the phenomenon of Kaikaku in a more structured way and moreover, that the model could provide a platform for further investigations on how to realize Kaikaku. Further, Yamamoto [2] emphasizes that more future research should be focused on how to realize Kaikaku.

1.2 The Kaikaku project – a Vinnova funded research project

In December 2009 a three year long research project was initiated and granted (Vinnova Dnr: 2009-03978). The project, “Kaikaku – Innovative Production Development”, focuses on innovative production development as a way to realize the production strategy. The project is structured in different work packages carried through by four PhD-students in collaboration with a Kaikaku project team. The project team consists of about 15 people from different research areas such as Production Development, Spatial Design, Innovation and Creativity as well as several companies and research organizations such as Mälardalen University, Swerea IVF, Deva Mecaneyes and Volvo Construction Equipment. The team members hold positions such as professor, senior researcher, PhD-student and consultant.

The expected results in the project are very close linked to the questions formulated in the different work packages. At a comprehensive level, the expected results can be interpreted as identifying why and when a Kaikaku is needed as well as how to realize a Kaikaku. Furthermore, the project will investigate how to be more innovative and creative in the production development process as well as how to integrate Kaizen and Kaikaku within a lean transformation. To clarify, the research team’s overall objective is to develop a framework/basis on how to carry through a Kaikaku.

1.3 Purpose and objective

It is of great interest to convert knowledge and research results into applicable tools and methods applicable in industry. The purpose of this paper is therefore to present and discuss a preliminary first draft on a framework and a method for Kaikaku realization.

The objective of the kaikaku methodology development is, in the long term, to create a tool/support available for researchers and industry in order to make production more competitive by realizing a Kaikaku when necessary.

2. METHOD

The methodology used in this paper as well as in the entire project is a multidisciplinary approach. Regarding the development process of the Kaikaku realization method, an iterative approach is applied. Moreover, this paper also consists of "Concept modelling" as a method to create a requirement specification on the Kaikaku realization method.

2.1 Multidisciplinary approach

This paper is focused on the Operations Management and Strategy perspective of Kaikaku but is strongly influenced by Innovation and Change theory. The project organization is built on a multidisciplinary approach where researchers from several research areas parallel work on specific research questions but with the base in a mutual understanding of the concept of Kaikaku. This is made mainly through two different arenas: 1) dialog seminars where different publications are studied and the participants reflections over the text are shared and discussed due to the Kaikaku project, and 2) regular project meetings.

2.2 Interactive approach and method development

The project is coupling the research and company domain where the method development is carried out considering inputs from both, as visualized in figure 3.

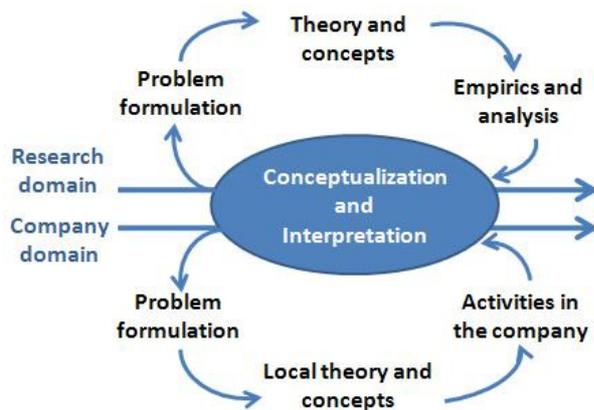


Fig. 3: Interactive research model [6]

The development method that has been chosen is the DFMTsme model. The DFMTsme (Design For Method Transfer to SMEs) model consists of six development steps that are repeated in multiple phases. The six

development steps are: 1) Requirement analysis, 2) Process modelling, 3) Selecting performance measures, 4) Compiling manual, 5) Compiling workbook, and 6) Verification, [7]. This paper reports the first phase of development.

2.3 Concept modelling

Concept modelling is described as a method to clarify terms and words relationship to each other in order to define specific terms. The method consists of a work process and a notation standard. Fundamental steps in the work process are: 1) Define project, 2) Term inventory and prioritizing, 3) Modelling and define terms, and 4) Decision and use. [8, 9]

3. FRAME OF REFERENCE

There are several areas that include different aspects of Kaikaku. In this work three has been chosen to represent the frame of reference: Operations Management and Strategy, Innovation theory and, Change theory.

3.1 Operations Management and Strategy

Operations Strategy is defined by Slack and Lewis [10] as "the total pattern of decisions which shape the long-term capabilities of any type of operation and their contribution to overall strategy, through the reconciliation or market requirements with operations resources". According to Karlsson [11] Operations can be described as the way in which products (goods and services) are produced, that is, a resource transformation converting input to a desired output. Further, Operations Management can be explained as the strategic part of putting operations in the context of a business, to develop a strategy for the operation, including how to continuously manage and improve the system.

Today, manufacturing companies are either just "operated/run" or moreover, also continuously developed and improved depending on whether the business is managed properly or not. Managed properly in this context implies i.e. a strategy consisting of improvement activities and "a vision" of a future state. As the reality for most companies are based on some kind of improvement philosophy, striving for a future and better state, there is a gap between the current – and future state of operations.

In order to develop the business from a current to a future state, there are several different improvement and change concepts available today like i.e. Lean Production. In the last decade these have gained worldwide acceptance as an approach to boost competitiveness within the manufacturing industry. Carpinetti et al. [12]. calls attention to the quality related concept Total Quality Management that is based on a systematic and iterative process of incrementally improving quality, as well as Six Sigma, which is a concept based on the use of statistical control as a mean to improve product quality and reduce the cost of non-quality. Parallel to the quality related improvement concepts, there are other management concepts

available such as Business Process Reengineering, Just in Time, Lean Production, Activity Based Costing, Balanced Scorecard, Theory of Constraints and many more. Comprehensively however, there are mainly two approaches to production improvement today, incremental and continuous improvements, Kaizen, and infrequent but radical improvement, Kaikaku [2].

3.2 Innovation theory

Innovation theory is based on Information - and Knowledge Management, [13]. Further, Innovation can be defined as “the application of knowledge to produce new knowledge”, emphasizing the need of knowledge management in organizations as a means to be innovative, [14]. This is further emphasized by von Krogh et al. [15] who state that the aim for knowledge creation is to improve the potential of creating innovations and improvements within knowledge domains. According to Dobni [16] organizations never stumble upon innovation - “they don’t inherit it, and they can neither buy nor assume it”. Instead innovation must be created and sustained.

In today’s reality characterized by keen competition where manufacturing companies strive for new improvements and better margins, it’s important to benchmark new ideas and new knowledge on how to find new innovations as well as how to become more innovative. Johannessen et al. [13] discusses the management of knowledge in contrast to hypercompetition, which indicates how to manage knowledge within an organization in the situation where changes in the environment changes so fast that the system has not recovered from the last change before a new change occur. Further on, Johannessen et al. presents a model in figure 4 on how to manage knowledge in order to promote innovation. This model, we have found applicable in this work and project context.

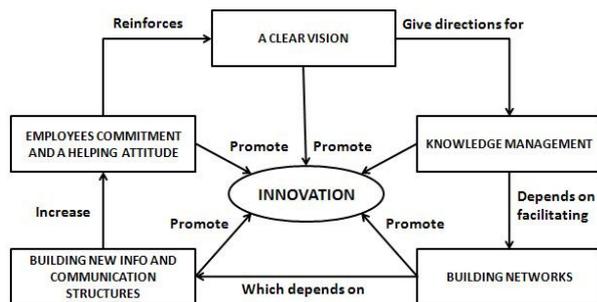


Fig. 4: The management of knowledge [13].

The essence of the model is that a clear, communicated and unambiguous vision gives the firm identity as well as a proactive attitude. The clear vision gives direction for knowledge management, which involves development, integration and application of knowledge as well as a focus on what kind of knowledge that is critical for being innovative. In order to manage knowledge, building both internally and externally individual and team-networks is crucial since ideas easier flow, helping to develop, integrate and use new

knowledge. The creation of these networks requires new information and communication structures such as intranet and internet. However, since the virtual systems are limited to the transfer of explicit knowledge (easily communicated, i.e. facts etc.), it’s vital to also create communication structures such as internal and external meeting places, where face-to-face communication is facilitated as means by which tacit knowledge (a form of skill, “know how”) can be converted into explicit knowledge.

Finally, it can be concluded that an environment in which rapid changes occurs, there’s a need of i.e. a communicated unambiguous vision, knowledge management and different networks in order to promote innovative thinking. Moreover, new knowledge is necessary to create new ideas - to be innovative, emphasizing the need of structures that supports people communicating.

3.3 Change theory

Group creativity and emergence plays an important part of development processes, such as Kaikaku projects, using a design strategy. Especially in two occasions: firstly, in the creative task of formulating a vision for the Kaikaku, secondly, in using this vision to continuously direct, align and commit the actions of the people involved in the Kaikaku, [17]. A radical improvement, as a Kaikaku is, in most cases is also a change to people. According to Beer and Driscoll [18] 70 per cent of all initiatives of changes fail. The other 30 per cent that succeed in some way do so because of that:

- Affected persons understand why
- Affected persons gets involved in the change
- Established concepts are challenged by new thoughts, models and methods
- New solutions are tested in small scale at first – the power of the good example
- Skill and expertise is available to translate change requirements into action

There are many models of how a change is managed. Visualization is important according to create a sense of willingness to change based on the reality that is shown to you. Kotter and Cohen [19] suggest that a change must take place in a series of steps:

1. Create Urgency
2. Form a Powerful Coalition
3. Create a Vision for Change
4. Communicate the Vision
5. Remove Obstacles
6. Create Short-term Wins
7. Build on the Change
8. Anchor the Changes in Corporate Culture

These steps clearly state the importance between the strategy and a structured way to realize a change.

4. TOWARDS A KAIKAKU REALIZATION MODEL

As described in the methodology section the Kaikaku development process in the project is carried out in a multidisciplinary context in several iterative steps where the method is planned to be developed incrementally during the project.

4.1 Concept modelling

According to the Astrakan concept modelling method [9] the second step after defining the project is to make a term inventory which was carried out in a series of workshops. The terms were found mainly through brainstorming and from literature. The gross list of terms was:

- Activity
- Breakthrough improvement
- Continuous innovation
- Evolution
- Extreme production makeover
- Fundamental
- Infrequent step
- Innovation
- Japanese sea
- Kaizen
- Kaizen Blitz
- Kaizen Event
- Lean Enterprise
- Lean Production
- Learning
- Magnitude
- Maturity
- New knowledge
- New technology
- Performance increase
- Phenomena
- Production Development
- Production System Development
- Radical improvement
- Ratio of improvement
- Re-engineering
- Revolution
- Scale of globalism
- Scale of rethink
- Speed of improvement
- Transformation

In the third step the term *kaikaku* and the closest terms were selected by the team in consensus based upon the current understanding of *kaikaku* within the specific project context. A graph and a definition were derived. Some new terms were needed and introduced and the resulting graph is presented in Figure 5.

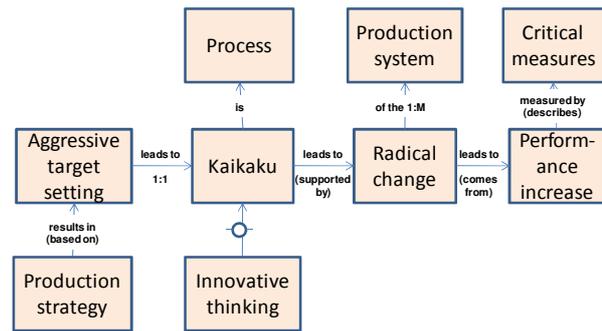


Fig. 5: Initial graph over the term *Kaikaku* and related terms.

The definition that was derived runs as follows:

Kaikaku is a process that requires aggressive target setting, leads to radical change and is facilitated by innovative thinking.

Some comments on the related terms are: “Radical change” is a significant change of one of the key components in the production system. As a “Production system” definition we use Porras and Robertson [20] 23 factors in four groups which constitute the organizational work setting: Organizing arrangement, Social factors, Physical factors and Technology. “Aggressive target setting” is coupled to both the company’s present ability and performance. According to Yamamoto [2] it should be 30 to 50 % performance increase or more.

4.2 Requirement specification of a *Kaikaku* realization methodology

In order to develop a method an objective must be set. From the definition of *Kaikaku* and from the Frame of Reference the following requirements are derived. The method should guide, support or instruct that:

- An aggressive target is set
- A production strategy is used
- A radical change in the production system is planned and performed
- The change leads to a performance increase of critical measures
- Facilitation of innovative thinking

General requirements that could be set on any improvement method are according to Grünberg [21]:

- Specialist independent, i.e. is the method dependent of specialists?
- Competence supportive, i.e. does the method support competence development within the scope of the method?
- Implementation supportive, i.e. is the method supportive for implementation?

- Measurement based, i.e. to deal with vague problem descriptions a method need to cause measurable effects.
- Object supportive, i.e. is the method clear about its objectives.
- Organizational supportive, i.e. is the method coupled to an organizational plan?

These requirements have been guiding the work package group for method development.

4.3 Suggested approach

The suggested approach regarding how to realize a Kaikaku, or radical improvement in the production system is primarily based upon three main activities. That is, 1) to identify and present the current state of the production system, 2) to come up with a future state that's in line with the production strategy, directed by an aggressive target and 3) to create a cause of actions that needs to be carried through in the pursuit of a Kaikaku.

Throughout this list of activities, there is also some support on how to achieve the desired output of every activity as well as some directions in order to make sure that the set target is to be reached.

Table 1: Kaikaku method process description

I/O, Process	Description
Input	The input to the Kaikaku project is the current state of the production system.
"Current state"	The first step in the method is to find and/or present the current state of production. The purpose of this step is to get a starting position in the Kaikaku project as well as some metric(s) to compare future state with. The main support is a data collection template that suggests what kind of data is necessary to know in order to successfully carry through a Kaikaku. Another support is a reflecting diary that provides personal insight. Collected and structured from all the group members in the company it should act as an enhancer to the current state presentation.
Input/output	The input/output is a clearly described and presented current state of the production system.
"Future state"	This activity involves creating a future state (or a vision) to aim for in the Kaikaku project. The future state is directed by an aggressive target that is set in line with the production strategy.

	The activity is supported by workshops that promote innovative thinking.
Input/output	The input/output is a clear "future state" based on the direction of the production strategy.
Cause of actions	This step involves setting up a cause of actions that needs to be carried through in order to realize the Kaikaku project.
Output	The output of the method is a radically improved production system.

The Kaikaku realization approach is a first draft of the expected project result, yet providing an understanding of necessary input, output and support. Furthermore, the model applies the ideas from both Kotter [18] and Johannessen et al. [13] since the model aims at both: 1) providing a current state, which according to Kotter is a necessity when creating a sense of willingness to change, as well as 2) formulating and communicating a clear, unambiguous vision (or future state) which Johannessen et al. stresses as an important part in knowledge management, hence the capability of being innovative.

5. DISCUSSION

There have been several discussions within the Kaikaku project team regarding different aspects of Kaikaku, both academically and practically. For instance, is a proposed 2-year Kaikaku project that is being carried through in several smaller steps (Kaizen) really a Kaikaku? Therefore, it's interesting discussing whether it's a big difference between a planned and directed number of Kaizen activities (an entire Kaikaku) and "regular" Kaizen activities that would have been carried through without a Kaikaku initiative to begin with. This is definitively a question that the project team will continue to discuss and also answer along the project timeframe.

Another interesting area of discussion is whether our model can support different company contexts. The purpose is that the model always is demanding, irrespective of the level of maturity/leanness of the company in question. Yet, it has been discussed whether the "current state" is limiting the ideas in phase two – "future state". Is it better to have a more open minded approach and investigate all kinds of future states such as finding new markets, new products, and a better sales organization, or is the best focus to promote new ideas within the production development context? Is the "current state" somehow limiting the level of innovative thinking? Is there any difference between companies at different maturity levels? Is there any difference in method/procedure between the first and second time a company carries through a Kaikaku? These questions have been discussed thoroughly in different constellations during the first months of the

project. Even though it's of great interest to look into what a Kaikaku realization method/procedure is able to achieve within a wider context, yet production development is the main context that first needs to be subjected to further research.

Regarding the content in the presented Kaikaku realization approach, there are several questions that need to be answered during the method development process. Considering the first activity, "current state", it's still a question about exactly what should be described, as well as in which detail level. Moreover, it's interesting to investigate how it should be presented in order to provide the best foundation for the Kaikaku project. However, today the current state is described by answering and presenting a number of important questions that is put in a template based on the content in several process mapping templates such as PPA [22] and Read a Plant – Fast [23].

6. CONCLUSIONS AND FUTURE RESEARCH

Overall, we can conclude that a Kaikaku realization method could be rather extensive considering the many aspects of a radical and innovative change. However, this paper presents a first draft on the Kaikaku realization method providing an insight in the most important aspects of Kaikaku. This is based upon the concept modelling, that is, the basic framework on how to realize a Kaikaku by the project team set definition. Essentially, the framework provides the core of a Kaikaku realization method: 1) a preliminary guidance on how to sequentially carry through a Kaikaku by starting with a current state of production, creating an unambiguous vision followed by a cause of actions on how to reach it, as well as 2) what main support is required while working through the sequential realization process.

As seen in the concept modelling, the most important input to Kaikaku is an aggressive target that is set in line with the production strategy. This is also in line with the initial Kaikaku project expectation – how to realize the production strategy through a Kaikaku (Vinnova Dnr: 2009-03978). Even though Yamamoto provides some guidance on what an aggressive set target could be in a Kaikaku context [2], more research has to be subjected to exactly what an aggressive target is, as well as how to come up with the "right" target or "right" measure(s). Finally, the "facilitation of innovative thinking" is also required in the Kaikaku realization process. Even if the presented model provides some information on how to enhance innovative thinking in an industrial context, more research is necessary in order to further develop the method in this area.

To sum up, there are mainly two objectives for further research within the Kaikaku realization method development. First, the sequential work process needs to be further developed and explained, that is, going more into detail regarding the specific activities that should be carried through within the Kaikaku realization. Secondly, more research needs to be done regarding the essence in the method, that is, the main support required within the process: 1) how to facilitate

innovative thinking and 2) how to set an aggressive target that's in line with the production strategy.

7. ACKNOWLEDGEMENTS

This study is given financial support by Vinnova through the Kaikaku project as well as by Swerea IVF, employer of the authors.

The authors would also like to thank the entire Kaikaku project team for valuable discussions providing more insight into the complexity of a radical and innovative change. Furthermore, the authors would like to thank the participating companies making it possible to apply the Kaikaku material in a real industrial context.

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