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Kaikaku - Radical Improvement in Production

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***Abstract*—**Considering today's increasing speed of change, radical and innovative improvement - Kaikaku, is a necessity parallel to continuous incremental improvement - Kaizen, especially for SME's in order to attain the competitive edge needed to be profitable. During 2011, a qualitative single case study with the objective of realizing a kaikaku in production has been conducted. The case study was run as a one year project using a collaborative approach including both researchers and company representatives. The case study was conducted with the purpose of gaining further knowledge about kaikaku realization as well as its implications. The empirical results provide insights about the great productivity results achieved by applying a specific kaikaku realization approach. However, it also sheds light on the difficulty and contradiction of combining innovation management and production system development.

***Keywords*—**Kaikaku, Radical improvement, manufacturing, innovation capability

I. Introduction

THE speed of change is increasing today, implying that it's of great importance that manufacturing companies strive to achieve radical improvements within their production systems resulting in the competitive edge needed to survive on today's market.

This is emphasized by Watanabe, former CEO at Toyota Motor Company: "In today's reality when the speed of change is to slow we have no other choice but to carry through radical changes" [1]. Accordingly, a company's ability to compete on today's global market is depending on the capability of combining (1) continuous improvements, characterized by incrementally improving existing products and production processes, with (2) radical improvement, characterized by development of new innovations and making use of new opportunities, [2]. Besides, in order to flourish over the long run, most companies need to maintain a variety of innovation efforts within their organizations [3]. This is further emphasized by Hoerl and Gardner [4] arguing that organizations that are seeking long-term success will need a balanced approach to business improvement, including methods for basic problem-solving, continuous improvement, as well as systems to identify opportunities for disruptive innovation. Hence, the combination of both kaizen and kaikaku seems vital: with radical improvement quickly achieve results and jump-start critical initiatives, and with continuous improvement sustain results and gradually improve [5-7]. Consequently, radical and innovative change in the production system (Kaikaku in Japanese) is not only a possibility, but a requirement when maintaining competitiveness in Swedish production [2].

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II. Theoretical Background

Consulting the literature, Kaikaku as a phenomenon has been discussed by a number of researchers, yet using different terminology; i.e. Kaikaku, Radical change, Radical Improvement, Radical Innovation and Breakthrough Improvement [2, 5, 8-9]. Compared to Kaizen, characterized by small step improvements, being process and people oriented as well as continuous, Kaikaku, on the contrary, is characterized by episodic occurrence, bringing about fundamental change, intend dramatic results and being driven by top-down initiatives [2]. Further, Kaikaku has been described to aim at a spectacular and very rapid productivity improvement in a focused area of production [8]. In the well-known and popular publication "Lean Thinking", Kaikaku has been further explained as a means to radically improve an activity in order to reduce waste, or to "eliminate muda" [9]. Thus, Kaikaku as a phenomenon has to some extend been described in consistency, yet using different terminology.

However, a problem raised in the literature is the cultural differences of kaizen and kaikaku. Kaizen, which is mainly considered as incremental innovation [10], is characterized by exploitive initiatives focusing on cost reduction and profit increase, having a more formal and systematic structure as well as a culture of efficiency and low risk [3]. Kaikaku, at the other hand, which is considered a radical innovation approach, is characterized by exploration, focusing on innovation and growth, applying a more adaptive structure and having a culture of risk taking, speed, flexibility and experimentation [3]. Since kaizen and kaikaku implies two different cultures regarding the innovation perspective, there is the question about how to manage these cultures. According to McLaughlin [10], the coexistence of innovation cultures, facilitating both kaizen (incremental innovation) and kaikaku (radical innovation), will encourage the growth of an ambidextrous organization, stating -"this might be the ultimate goal of high performers upholding a philosophy of continuous improvement" [10]. Continuous improvement in this particular case does not only constitute kaizen, incremental improvement, but also kaikaku, radical and innovative improvement [11]. Hence, continuous improvement is viewed as an evolution and aggregation of a set of key behavioral routines in order to be run effectively, and not as a short-term activity [11].

III. Research Design

In order to analyze kaikaku realization in production, as well as its contextual implications, a single case study was conducted using five different data collection components. The study object was an SME (Small and Medium sized Enterprises) sheet metal manufacturer in Sweden.

A. Purpose and objective

Kaikaku is evidently necessary, in combination with kaizen, as a means to withstand the keen competition on today's global market. Most Swedish manufacturing companies are in some sense working with continuous incremental improvements in production today. However, not many companies are working in the same structured manner striving for great leaps through i.e. innovation. Therefore, more research is required in order to understand how kaikaku should be conducted in production, as well as how to manage the contextual implications of i.e. "maturity to change" and the different "innovation cultures" described above.

Thus, the objective of this study is to realize a kaikaku in production based on a specific kaikaku realization methodology [12]. The purpose of the study is to gain an increased understanding about (1) how to realize kaikaku in production, and (2), what major contextual implications that needs to be considered in regard to kaikaku realization.

B. Research context

In late 2009 the three year long research project Kaikaku was initiated and granted. The research project is interdisciplinary, implying that the research is coupling the areas of production development, innovation management and spatial design to the project focus - radical and innovative production development. Thus, the context in which the understanding has evolved is strongly influenced by this project context.

Further, the results presented in this paper is derived from a single case study conducted at an SME company which context is characterized by fire fighting, low improvement awareness and a low level of lean managerial skills. At the other hand, the production is characterized by a rather high level of automation and the co-workers, as well as the senior staff, possesses high technical skills.

C. Research methodology

The research project has been dependent on access to proper industrial settings to collect necessary qualitative data in order to conduct a qualitative data analysis. This type of research is commonly referred to as qualitative research [13]. The major characteristics of qualitative research can be defined as follows [14]:

- Focusing on understanding the meaning of experience
- The researcher is the primary instrument in data collection and analysis
- The research is inductive
- Rich description characterizes the end product

Thus, the researchers' perception of the world (ontology) is founded in holism, emphasizing that taking a holistic perspective considering the context is vital in order to understand the phenomenon under study. Also, a systems approach has been applied. Applying a systems approach implies that the researcher takes a holistic perspective of the system under study and recognizes that it include several sub-systems and components.

System analysis means building models of existing real systems aiming at describing, explaining and understanding them [15] which is in line with the objective of this study.

Given the objective, a case study approach employing several data collection methods is a logic and reasonable research approach [16]. The main reason to apply a case study is the possibility of an in-depth [17] as well as holistic [15] study of the phenomenon researched. Also, the case study conducted is of exploratory nature, indicating that it's primarily a pilot study on Kaikaku realization that can be used as a basis to formulate more precise research questions further on [13].

D. Data collection and analysis

The case study has been executed with one unit of analysis (case company) with the main topic "kaikaku realization". During the single case study, the following data collection methods were applied:

- direct observations
- reviewing documents
- using archival data
- participation
- telephone reflections

The direct observations were applied consistently over the case study during meetings and factory tours. Documents concerning i.e. planning, strategy and manufacture were also reviewed consistently. Archival data, including the financial database, information system and operation/process system was also used throughout the entire project. During a few specific project phases, such as the creative workshop and idea generation, participation was applied. Also, telephone reflections was used before the creative workshop where four key employees reflected on the current state of production, as well as ideas for the future, based on questions formulated in a reflection guideline.

Collecting and analyzing data is a simultaneous process in qualitative research[14, 18], where data analysis is the process of making sense of data, to create meaning [14]. Throughout the project, data has been consistently analyzed when collected. Reflections, hunches, ideas and things to pursue have constantly been written down in a "field journal" kind of memos as proposed in qualitative research [14]. There are also a number of helpful means on how to analyze data as they are being collected [19], of which, a few has been applied; Writing many "observer's comments", Write memos/field notes as you learn and Begin exploring the literature while still being in the field.

The data analysis in this study is conducted interactively based on three steps of qualitative analysis advocated by Miles and Huberman: (1) data reduction, (2) data display, and (3) conclusion drawing and verification [18]. The data reduction refers to selecting, simplifying and transforming the data and it has been done frequently in response to collected data, both at a detailed level in the different project phases as well as at a project level.

The data display, which is an organized assembly of information that permits conclusion drawing and action [18], has been done multiple times by structuring, visualizing and organizing thoughts and findings. The conclusions have emerged in the interactive model based on data collection, data reduction and data display visualized in fig. 1.

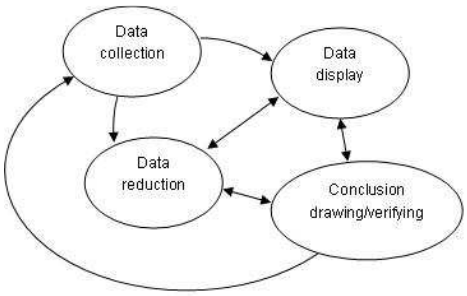

Fig. 1 Components of Data Analysis: Interactive Model [18].

Further, qualitative research applied in this type of case study always faces the threat to validity of the research. Consequently, a strategy for avoiding these threats has been systematically applied through the use of triangulation, intensive long-term involvement, and consistent respondent validation throughout the project, as advocated by Yin [13].

E. Case study design

Before initiating the described kaikaku realization project, a robot welding cell was chosen as the focus area in consensus due to mainly two reasons: (1) proper delimitations had to be made considering the time and resources available, and (2) a screening of the entire production was made, indicating that this particular area was especially important for the company. Further, the kaikaku realization project was thoroughly planned from the beginning regarding the main phases, as well as the roles of the company and the researchers. Even though there was one part responsible in each phase, there was still a collaborative approach requiring both parts to be consistently active. The kaikaku realization approach is based on a previous study on a methodology for kaikaku realization [12]. This approach primarily consists of 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 a challenging target and 3) to create an action plan to carry through. Throughout the list of activities, there is also some guidance on how to achieve the desired output of every activity, i.e. by setting a very challenging target and by promoting the participants to be innovative [12]. In accordance, the main plan of the case study including responsibilities and the main phases is presented below.

TABLE 1
CASE STUDY PROCESS

Project phases	Responsible	Supporting
Mapping the current production status	Research team	Company
Creative workshop/ idea generation	Research team	Company
Creating action plan	Company	Research team
Realizing action plan	Company	Research team
Project follow up & evaluation	Research team	Company

The first phase, mapping the current status of production, was mainly carried through by the researchers in order to get an impartial understanding. The phase contained mapping the robot welding cell in regard to four areas: (1) work process, (2) internal logistics, (3) productivity, and (4) changeover routines. The second phase, facilitating idea generation through a workshop, was planned and held by the researchers. There was one workshop facilitated during a day. The primary purpose and agenda of the workshop was to:

- Obtain a common understanding of the current state of production regarding the robot welding cell
- Come up with, and agree upon, a challenging target for the kaikaku realization
- Generate ideas for solution
- Strengthen the kaikaku project team

The event was attended by 16 individuals constituting one workshop leader, three observants taking notes, six internal staff from senior management as well as the shop floor, and six external researchers and consultants.

The action plan was then created by the case company with support and guidance from the research team. All decisions were made by the company management team, yet based on discussions with the research team experts. The action plan was then carried through during several months by the company staff. These activities were lead by the company project leader, consistently supported and/or discussed by the research team. One year after initiating the project, a follow up and evaluation phase was conducted.

IV. Empirical Results and Analysis

The project results will first be presented by the main activities that have been carried through, followed by a description of the entailed change of structures and routines at the case company. Further, a short productivity report is presented, followed by a meta-analysis of the results.

A. Activities carried through

During the project, a vast number of activities have been carried through by the case company. In order to get an understanding, the main activities carried through during the project realization phase are shortly presented below:

- Initiation of APQP (Advanced Product Quality Planning) where they are going through how the products are run in production based on the articles' current structure.
- Three whiteboards have been put up for 1) planning and visualizing jobs, 2) fixtures management and 3) improvement activities, all within the robot welding cell

area.

- A new lifting device for lifting heavy fixtures and articles to and from the welding robot cell has been bought and placed.
- SMED methodology has been implemented as a means to reduce changeover times and routines. Changeovers has been filmed and analyzed. Also, new carriers have been created specifically for certain A-articles in order to optimize the changeovers for important articles. Also, one person has been hired for planning and preparing internal logistics, which in turn improves changeovers.
- Two planning meetings have been established in the robot welding area. Changeovers are now better planned and communicated to the staff.
- Fixtures of great importance to the robot welding cell (A-category articles) have been re-localized closer to the cell. Further, they have been re-marked to easier visualize the information necessary.
- A number of operators have attended education on how to run the machines. This has lead to better and easier planning. If someone is sick, another operator can take his/her place.
- In order to optimize production, efforts on programming the machine, as well as analyzing what filler material to use has been done.
- A passage between the warehouse and the robot welding cell area has been arranged in order for trucks to now being able to move goods through it, which implies a much shorter and more flexible internal logistic.
- The inventory for incoming goods for the robot welding cell area has been reduced. Today, the production manager only allows the material to be there for a couple of days, in contrast to earlier. This is in line with the efforts started recently on timing the production, finding the proper pace.
- The company has optimized the way in which they run articles in the robot welding cell which have resulted in a significantly reduced cycle time.
- A new production manager has been hired, so that the current production manager instead can focus upon being a technical manager.

B. Change of structures and routines

Based on all activities carried through, more experience and a lot of learning, there has been a lot of changes in the structures and routines in how the company works in the robot welding area today. The major structural changes done within the project can be described as:

- New routines for structuring the planning, the improvement activity and the fixture handling concerning the entire robot welding cell area has been implemented.
- Fixture management as an important routine within the robot welding production has been established.
- Through new routines in planning and control of value flows, the WIP has been reduced.
- New routines in correcting and optimizing the robot welding cell cycle time for A-articles have been introduced.
- Routines and guidelines in how to work with APQP (Advanced Product Quality Planning) has been formulated.
- SMED-methodology has been introduced as a new routine for improving changeover times.
- A new competence has been established by hiring a skilled production manager, affecting the routines and procedures run in production management.

In order to visualize and plan the upcoming orders in the robot welding area a whiteboard has been designed based on the needs, and then placed in a central area. Also, whiteboards concerning fixtures management and improvement activities has been fitted up within the robot welding area. Furthermore, fixture management was initiated in order to optimize the operating time in the robot welding cells and to fasten changeovers. Optimizations have been made by i.e. investigating which articles can be run simultaneously, and consequently, how these fixtures could be designed and/or combined in a more effective way. Also, storing and labeling the fixtures have been improved by categorization due to their frequency of use.

Moreover, the company has corrected and optimized the cycle times for the main articles run in the robot welding cell. In addition, SMED methodology has been applied as a means to radically reduce the changeover times. As a result, the welding area WIP inventory has been reduced due to i.e. better planning of jobs, shorter cycle times, better value flow and more effective changeovers. Further, the company has started to work with APQP as a means to assure the quality of new products. In this process, the quality assurance of a product is made in advance in order to avoid disturbances in production after industrialization.

During the first step of the kaikaku realization process, the current status of the robot welding machine was mapped in regard to four important areas: (1) work process, (2) internal logistics, (3) productivity, and (4) changeover routines. These areas then provided input to the workshop/idea generation, which in turn lead to the action plan that has been realized. The essence of the structural changes experienced at the case company can be addressed to one or several of these production areas. Productivity, however, will in this case be considered a result parameter rather than a production area, and consequently, being a result of the combined improvements in all production areas. Below is a table presenting the high impact improvement activities performed that contribute to new and changed structures and routines at the case company. Listed is also the connection between the improvements and the important production areas affecting the robot welding cell. Added to the initial production areas is the area of “management” or “managerial skills”.

TABLE II
RELATIONSHIP BETWEEN MAPPED PRODUCTION AREAS AND IMPROVEMENT ACTIVITIES

Production areas	High impact improvements
Work process	Whiteboards

	C/T optimization APQP Fixtures MGM WIP-reduction
Internal logistics	Whiteboards Fixtures MGM WIP-reduction
Changeover time & procedure	Whiteboards Fixtures MGM SMED
Management	New production manager

The combination of all improvements made is considered contributing to the overall robot welding cell productivity result.

C. Productivity report

The Kaikaku realization approach implies a stretched, challenging target to be set in the beginning of the project as a means to provide a sense of urgency to change, but also to try to boost creativity in order to reach new heights. For this target a proper productivity measure was to be chosen since working with productivity improvements, the most important factor is to select a suitable set of KPI's to drive the improvements [20].

However, based on phase one, mapping the current state of production, it was evident that there was a lack of productivity data and measures available at the company. Therefore, the operation/process system was back tracked comparing the expected operating time based on the manufacture to the actual operating time reported for each article run in the robot welding cell during four months. As a result, a productivity measure comparing reality to the theoretically optimal was obtained. Further, this measure not only provides an insight in productivity, but is also consistent throughout the project.

The result 12 months after starting the kaikaku realization project, about 8 months after initiating the actual action plan, shows a productivity increase of 67% regarding the products that were run when the project started. However, during the project, the number of products run in the robot welding cell had been increased by 100%, and the net operating hours had been increased by over 50 % from ~300 to ~500 hours. Even so, the productivity increase was still a respectful 55% taking all the new conditions into consideration. Even though the short period of measurement reveals some monthly deviations during the implementation of improvement initiatives, the positive productivity trend is evident. The starting-point productivity value visualized in fig.2 is indexed 100 in order to show the productivity variance over time.

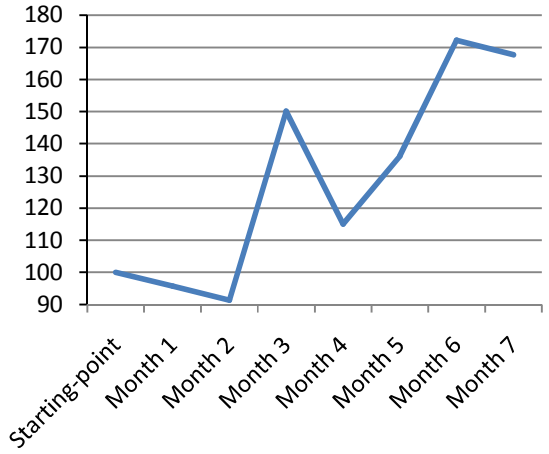

Fig. 2 Productivity over time

D. Analysis

One of the major results of the kaikaku realization project, resulted by all changes in structures and routines based on conducted activities, is the change of mindset by the involved company personnel. Today, affected operators are taking an active part in improving the robot welding cell area, which has not been the case historically. Moreover, the insight in the benefits of (1) continuously improving the current status and (2) having a bottom-up approach where a critical mass contributes has clearly become part of the senior management mindset.

By comparing the case company characteristics before and after the kaikaku realization project, it's evident that the company has increased their maturity to change, thus increased their knowledge and their improvement capability. For instance, problems were earlier solved by specialists and often in respond to a crisis, or by fire fighting. Today, new structures for improvements are initiated characterized by formal processes, measurable effects, staff participation and training/learning, which clearly indicates a leap in the improvement capability. According to the characteristic behavior patterns connected to the level of continuous improvement maturity presented in table 3, it's evident that a change of mindset in regard to change has taken place at the case company.

TABLE III
CHARACTERISTIC BEHAVIOR PATTERNS CONNECTED TO IMPROVEMENT MATURITY [11]

Continuous Improvement (CI) level	Characteristic behavior patterns
Level 1 – Pre-CI: Interest in the concept has been triggered – by a crisis, by attending a seminar, by a visit to another organization, etc. – but implementation is on an ad hoc basis	Problems are solved randomly; No formal efforts or structure for improving the organization; Occasional bursts of improvement punctuated by inactivity and non-participation; Solutions tend to realize sort-term benefits, No strategic impact on human resources, finance or other measurable targets; Staff and management are unaware of CI as a process
Level 2 – Structured CI:	CI or an equivalent organization improvement initiative has been

There is formal commitment to building a system which will develop CI across the organization	introduced; Staff use structured problem solving processes; A high proportion of staff participate in CI activities; Staff has been trained in basic CI tools; Structured Idea-management system is in place; Recognition system has been introduced; CI activities have not been integrated into day-to-day operations
Level 3 – Goal oriented CI: There is a commitment to linking CI behavior, established at "local" level to the wider strategic concerns of the organization	All the above plus: Formal deployment of Strategic goals; Monitoring and measuring of CI against the goals; CI activities are part of main business activities; Focus includes cross-boundary and even cross-enterprise problem solving
Level 4 – Proactive CI: There is an attempt to devolve autonomy and to empower individuals and groups to manage and direct their own processes	All the above plus: CI responsibilities devolved to problem solving unit; High level of experimentation
Level 5 – Full CI Capability Approximates to a model of "learning organization"	All the above plus: Extensive and widely distributed learning behavior, Systematic finding and solving problems and capture and sharing of learning; Widespread, autonomous but controlled experimentation

Before initiating the kaikaku project the current state analysis and observations conducted provided a good insight into a non-existing continuous improvement initiative at the company. Consequently, the company mindset and behavior evidently correlated with, at most, "CI level 1" according to Bessant, implying that problems were solved randomly, that there was no formal structure of improving, and that there was a general unawareness of continuous improvements as a process [11]. This explanation is implicitly emphasized as the state of "fire fighting", which is the lowest level of maturity to improvement, expressed in the discussion on maturity to production system development presented below [21].

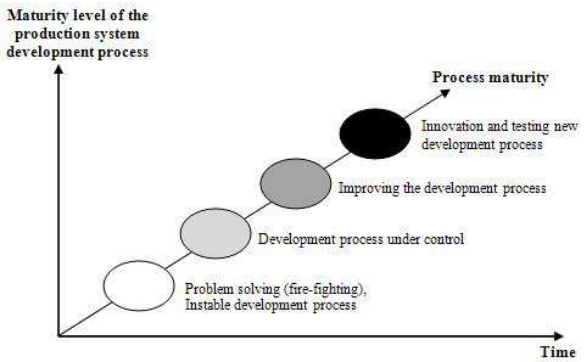

Fig. 3 The possible evolution of the production development process, adapted by Bellgran [21].

According to these "maturity to change" models, there are different stages in the maturity to change, yet described in different ways [11, 21]. In the beginning it's all about fire fighting and striving towards a stable and predictable production, characterized by behavior patterns of unawareness, a lack of routines for improvement activities as well as being reactive.

Further, the development of the company's maturity to change then evolves from fire fighting, pass local improvements, towards cross-organizational improvements strongly connected to strategy, being proactive and increasing the innovation capability.

Before the kaikaku project was initiated the mindset at the case company was all about fire fighting and being reactive, strongly emphasized by the "current state of production" insight, as well as frequent discussions with senior management members. There was no time and no resources to invest in improvement activities. Even though the company management "considered" it important, nothing was done to achieve it. Today however, the company management, as well as the operators, has a clear and outspoken focus on working with improvements in the robot welding cell area. 12 months after initiating the kaikaku project, the company has improved their improvement capability to the "CI level 2" according to Bessant [11]. Comparing the characteristic behaviors form "CI level 1", or "fire fighting", there has most evident been a change of mindset towards an insight in the means as well as the importance of constantly improving the improvement capability. The changed mindset consequently implies an increased improvement capability within the case company. Also, structures and routines have been improved in accordance with the maturity to change ladder, confirming the argument of a changed mindset.

V. Conclusion

The kaikaku realization project lead to a productivity increase of 67% (55% considering the changed conditions) for the focused area - the robot welding cell. In literature, Kaikaku has been described as episodic, bringing about fundamental change, being top down initiated [2], aiming at a very rapid productivity increase of a focused production area [8], and eliminating waste [9]. The kaikaku realization results clearly correspond to these kaikaku characteristics. Further, kaikaku has been described as radical and innovative in nature [2]. Compared to fire-fighting, being reactive and doing almost nothing regarding change and strategic improvements in production, the new state of structures, routines and mindset implies that the change carried through is both radical and innovative from a company perspective, which corresponds to a locally innovative kaikaku according to Yamamoto [2].

VI. Discussion

An interesting discussion on kaikaku is how the requirements on the realization approach are affected by the level of maturity to change in the evolving CI-process the company is striving towards. The systematic approach applied in this project implies benefits in case of planning and preparation of the kaikaku realization. Besides, the approach makes it relatively easy for the company to comprehend and manage the entire realization progress. However, a considerable implication in the approach applied is the difficulty of (1), having a very structured approach and (2), working with creativity and innovation.

This is emphasized by the creative idea generating work shop, resulting in an average action plan characterized by quite non-innovative ideas, such as:

- Implementing basic structures and routines for improvement work
- Enhancing the customer focus perspective
- Improving the change over-procedures by applying the SMED-methodology
- Investing in new technology

Therefore, the kaikaku realization approach applied in this project is likely to bring a company of this specific context to at most "CI-level 3". However, in order to reach higher levels of maturity to change, the approach to kaikaku realization most likely need to be concordant with the aspects of both innovation management and production system improvement, yet within the context of improving production systems already in operation. Being concordant to innovation management aspects in this case implies exploration, being flexible and adaptive, taking risks and experimenting [3], which is not the case of the applied kaikaku realization methodology. This emphasizes both the difficulty and the contradiction of running an improvement project within the highly controlled production context where everything tends to be very systematic, and in parallel facilitating creativity and innovation which in turn is a more evolving process characterized by contingency and learning [10].

Consequently, there's a question about whether the change carried through really is a kaikaku by definition. As stated in conclusion, it is a kaikaku by definition as it was understood beforehand, that is, mainly referring to the description of the kaikaku aim and result. However, gaining further insight into the innovation aspect of kaikaku, it's evident that a methodology for kaikaku realization should be characterized by exploration, focusing on innovation and growth, applying a more adaptive structure and having a culture of risk taking, speed, flexibility and experimentation [3]. Consequently, the improvement carried through corresponds to the described kaikaku result characteristics, yet not to the methodology characteristics described in literature. Hence, the concept of Kaikaku as well as a methodology to realize it needs further research.

An important contextual implication regarding Kaikaku realization is the evolving maturity to change and the different cultures addressed to it. According to the literature, kaizen and kaikaku implies different cultures and different mindsets [10]. First, a kaizen culture is said to be a prerequisite to even work with kaikaku. This is in line with the conclusions drawn regarding the maturity ladder, implying that the basic time and resources necessary to improve has to be in place long before trying to realize a kaikaku. However, the kaizen culture is also said to restrain kaikaku since the mindsets are so different, meaning that having a mindset of incremental innovation is restraining the radical innovation capability. Also, being innovative and increasing the innovation capability has shown to be difficult throughout the project.

Thus, this particular case study supports the idea that kaizen needs to be in place first, due to the practical issues encountered in the context of improving a production system already in operation.

The results clearly implies that what kind of improvements can be made at a company is to a great extend dependent on the maturity to change, that is, the current improvement capability including different cultures and mindsets. At companies striving for a stable production, and having lots of "low hanging fruits" to pick on their way on creating a kaizen culture, it's likely that the kaikaku approach to change won't provide the results desired, at least not regarding the level of innovation. Consequently, all companies should, irrespective of their current status, always try to increase their improvement capability and climb the maturity ladder. The company striving for a Kaikaku characterized by radical innovation should preferably be at the level of maturity to manage change that implies that they need to challenge their current ways of working, thus already being highly competent in kaizen - incremental innovation. Consequently, the question on how to manage these cultures in co-existence in regard to the later stages of the evolving improvement capability process needs further research.

VII. Future Research

The kaikaku realization approach applied in this project evidently provides satisfying results for companies within this specific context, which is, characterized by a low level of maturity to change and a low improvement capability. However, in order to reach higher levels of improvement capability, the innovation management perspective has to be incorporated into the production system development. Thus, more research is required in how to manage these competences within a production system development context when striving towards kaikaku realization.

Also, there's a question on how to manage the different cultures of innovation addressed to the maturity to change process. Research indicated that a kaizen culture needs to be in place before striving for radically innovative kaikaku. However, when reaching the level implying radically innovative kaikaku, the existing kaizen culture is restraining the radically innovation capability since the mindsets are quite opposing in nature. Consequently, more research is needed in how to manage co-existing cultures striving for an ambidextrous improvement capability.

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