Structural Analysis of Approaches for Worker Participation

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Abstract – **The participation of workers is one of the main topics of manufacturing enterprises. The goal is to increase the satisfaction, motivation and thus the productivity of workers, to use the creativity and the knowledge of the whole workforce to improve processes and to reward workers for their commitment. The approaches for worker participation vary widely. Examples would be surveys about labor conditions, participation in planning processes for the layout of their workplaces or employee profit sharing. In the course of a rising spread of lean production systems the degree of participation increases. The common consent for participation declines as more responsibility is assigned to the worker. In this paper the different forms of participation will be described and clustered. Furthermore, criteria for the selection of adequate methods of participation will be derived.**

Keywords – **Employee Involvement, Lean Production, Participation**

I. INTRODUCTION

A. *Definition and Goals of Participation*

Participation means to allow workers to take active part in planning and decision processes. [1] The person concerned should participate in the change process. [2] A wide range of approaches to participation exists. [3] Participation is generally considered as a win-win situation. The enterprise and the worker should benefit from these approaches. The main advantages of participation for workers and enterprises are:

- A higher motivation of workers can be realized. [1], [4] Because workers can design their work environment, the intrinsic motivation will rise. Due to higher motivation the identification and the commitment to tasks will increase and the productivity may be higher. [2], [5]
- The trust of workers in management and enterprise will rise as their needs and wishes are addressed in participation. [6], [3]
- The tacit knowledge of workers and their creativity can be used to improve the production processes. [5], [7], [8]
- The externalization of tacit knowledge and the spread of this knowledge to the whole workforce will lead to a higher qualified staff. [2], [9]
- To generate a higher willingness to change on the shop floor. Due to an active communication and participation resistance against change projects can be minimized. The workers are protagonists and not just chessmen of the management. [2]
- A higher acceptance of the results of a planning process is given by means of participation. [1], [9]

Besides the participation of workers in planning and decision processes, financial participation and co-determination exist. Financial participation refers to the situation, when workers share the profits of the enterprise. Co-determination is often statutory as in Germany, where representatives of workers can decide in the board of directors. [10] These forms of participation are considered as indirect, because workers elect representatives [3]. However, the decision process in the board is often not comprehensible for the shop floor workers because information is missing.

B. *Participation as a factor of labor conditions*

Rohmert described the hierarchy for the appraisal of human labor in four levels. [11] The first level is the practicability. The requirements determined by the work system have to be within the general, physical limits of human capabilities. The practicability is mainly dependent on the individual capabilities and physical condition of the single worker. [1] The second level is the tolerability of work. The workload is adequate and does not lead to any physical or psychological damage during the entire working life. [12] The third level, the reasonability, appraises if work is adequate to the prevalent social and moral concepts. The highest level is satisfaction. The focus is on the individual worker instead of considering the whole workforce. There is no general objective rating of satisfaction, since it is rather subjective and depends on individual motivation and how employees personally perceive their labor conditions. [4]

One sub criteria for satisfaction besides incentives or responsibility is the participation of workers. Due to the characteristics of satisfaction, the participation approaches cannot be divided in beneficial and unfavorable. One worker may like to be involved into the decision process about the layout of his personal workplace, meanwhile another worker favors doing his routine job and not to be involved in such tasks. [4]

C. *Cluster according to Wegge*

Wegge identified five levels of participation as shown in figure 1.

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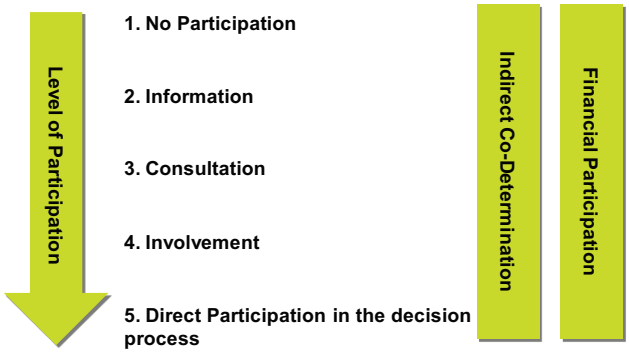

Fig. 1. Level of participation [13].

Even today there are enterprises without any participation - level one. The second level of participation is the information of workers. The information may be that a change project is conducted or that a certain decision was made. The third level is the consultation. The workers are asked for their opinion, for example in surveys or workshops. The management is free to include the worker´s opinion or not. If there are formal or informal rules for considering the opinion of workers the participation level involvement is reached. Direct participation is given, if the worker's vote is equally considered as the management's opinion. Parallel to the level of participation and rather independent from them are the financial participation and the indirect co-determination. [13]

D. *Participation in Lean Production Systems*

In the last decades many manufacturing enterprises in Europe and Northern America try to adopt Lean Production Systems (LPS). These LPS are based upon the Toyota Production System (TPS), which was identified as the key element for the success of the Japanese carmaker in its development to the world's largest and most profitable large scale automobile manufacturer. [14] Main goal of the TPS is the elimination of waste in production processes. Besides other measures the participation of all workers is therefore needed. In the continuous improvement process every worker should try to improve his working environment every day, with the goal of higher productivity and better quality. [15] Critics argue that lean production entails an increasing work load, a higher responsibility, an intensification of work, a lower motivation, and a constant pressure for improvements. [16], [17] Workers` unions declare lean production as "management by stress". [14]

The acceptance of all participation methods is therefore not given anymore. Some stakeholders, like workers` unions or individual workers, emphasize the negative aspects of participation, especially if responsibility is transferred to the workers.

II. CHARACTERIZATION OF PARTICIPATION METHODS

As described in the previous chapter a general acceptance of all participation methods is not given. Furthermore, effort and benefit of methods must be questioned for every case. In the next step criteria for characterizing participation methods are derived. The criteria can be used later on to identify the adequate participation method for a specific problem.

One of the goals of participation should be to integrate all workers concerned into the planning or decision process. [2] Often, the integration of all relevant workers would result in high expenses and a long duration of the decision process due to the high number of people concerned. [5] Instead a group of representative workers is chosen to participate in the planning process. In such cases it is highly important for the acceptance of the project results to communicate who was chosen and why. For the success of the participation measures a continuous participation is necessary. [2] Short-term attempts to use tacit knowledge or to enhance workers participation will not lead to the desired results. In most cases a change of leadership and enterprise culture is necessary to adopt participation effectively.

A further criterion for the selection of an adequate participation method is the amount of tacit knowledge needed. Knowledge can be divided into explicit and tacit knowledge. Explicit knowledge is not bound to a person. It is describable and can be documented and transferred easily. Furthermore, it can be stored in databases, documents or graphics. Tacit knowledge cannot be transferred easily. It is bound to a person, based on personal experience and not accessible for other persons. [18] One main goal of participation is to use the tacit knowledge of workers, which may be based on many years of shop floor experience, to improve processes and work environment. [19] Participation methods vary widely concerning the extent of externalization of the tacit knowledge.

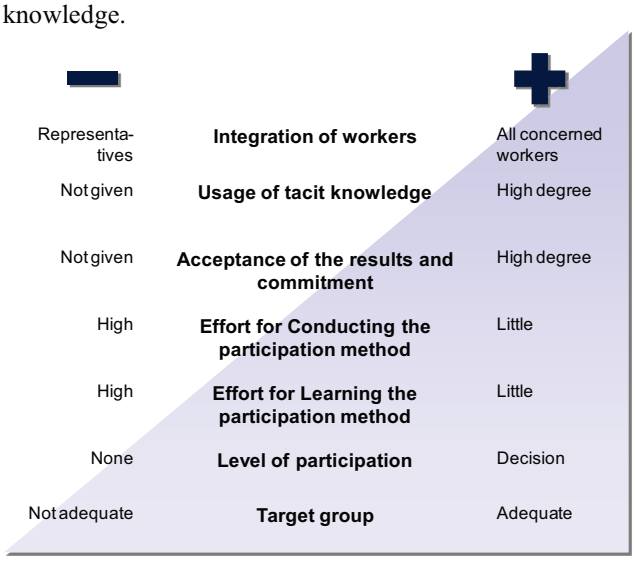

Fig. 2. Characterization of participation methods.

The acceptance of the results of the project and the commitment to the declared goals is another criterion for the success of a participation method. The more transparent the decision process, the more the participants may agree to the results.

The effort necessary to conduct the participation method is very important for the enterprise. Some methods take a long time or several meetings until a decision will be made. Besides long duration this will result in high costs. The costs have to be opposed to the expected gain.

The effort for the implementation of a participation method includes the training of workers, if the method is not intuitive, and the necessary expenses for hardware. In some cases a moderator has to be trained to lead the conduction of a method.

Another criterion for the characterization of a participation method is the classification according to Wegge. As introduced in the previous chapter, the level of participation may vary from none to decision.

The participation method must comply with the qualification and the abilities of the target group. [2] Unlearned workers need to be addressed completely different than long-term and high qualified workers.

III. PARTICIPATION METHODS IN PRODUCT AND PROCESS DEVELOPMENT

Analyses have shown that participation only leads to higher productivity if it is fitting the tasks. Participation is more effective if applied to operational improvement. Strategic tasks in product planning or research & development do not benefit as much and might be delayed because of a slower consensual decision-making. [20]

Due to the numerous positive effects of participation workers should especially play an important role in the development of products and processes. In general, workers should know best how to design the processes they are working with every day. [21], [22]

Worker participation could take place in virtually every process and every function of an enterprise. But unlimited worker participation does neither lead to unlimited productivity nor to unlimited satisfaction. [20]
The capability of participation shows a strong variation in the different areas of potential use. In order to examine the areas of possible worker participation, the product and process development according to a reference model of factory operations is introduced in figure 3. The product and process development describes the steps from product planning to production.

The first step is the product planning, where the general idea of a new product is developed. In this step, only participation of a low level takes place. When the idea of the future product takes shape, the research and development starts and the product features and characteristics are designed. Workers` knowledge can be used in this step to validate the design of the product in order to ensure producibility and quality. Therefore, various DfX methods like design for assembly, design for logistics, design for quality or design for service can be used. Workers can give hints how to design a product, which can be manufactured without problems. Another method in research and development is the virtual reality. By using this method workers can inspect the virtual product and express their improvement suggestions. Like in the previous step, workers can be asked to answer a survey to bring in their ideas, or they are just informed about future products by a newsletter.

In industrial engineering a wide range of participation methods exists. Low level participation methods are possible, but it is common to apply a much higher level of participation than in the previous steps. Virtual reality and planning tables allow workers to participate in the layout development of the manufacturing site. The future work processes can be simulated with cardboard engineering and the whole concept can be improved continuously in CIP workshops (WS). Workers' opinions play a major role in this step of the process. A major part of the workforce is involved in the design of their future work processes. After having developed the product and planned the processes the actual manufacturing takes place. This should be the core competence of workers as their knowledge has the greatest impact. In addition to the methods used before, holistic optimization is important. Nowadays lean production systems are widely spread. For most of them the continuous improvement of all processes has become the most important measure to eliminate waste and enhance productivity [22], [23]. Therefore, a continuous improvement process (CIP) is implemented and all workers are asked to constantly challenge the current way of doing things in order to find a better process. In this step of product and process development all workers can be involved. Besides the CIP other participation methods like Total Productive Maintenance (TPM) or Total Quality Management (TQM) are used to increase productivity and ensure quality.

In general the level of participation rises with the steps of the product and process development as shown in figure 3. Also the participation becomes more direct.

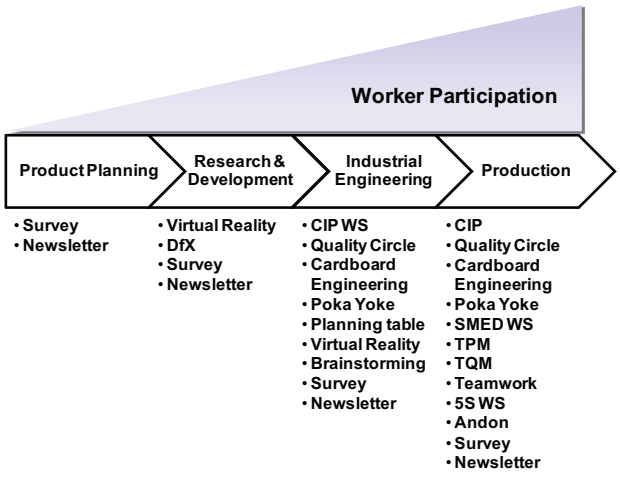

Fig. 3. Fitted use of participation methods

With each step, the tasks are less strategic and more operational. Thereby, the tacit knowledge of workers becomes more applicable to the tasks and participation should increase.

IV. EXEMPLARY ANALYSIS OF PARTICIPATION METHODS

In order to show the differences between participation methods the quite different methods planning table and survey are characterized with the above introduced scheme.

A. *Planning Table*

The so called digital factory is a contemporary issue in science and industry. Due to the complexity and the effort for learning, most methods of the digital factory are inappropriate for worker participation. [24]

A recent approach for worker participation in digital planning is the participatory layout planning of factories with the planning table. It allows involving shop floor workers in the process of layout development. Therefore, an LCD screen with a tracking system on top is mounted on a table. The LCD shows an interactive planning layout, which provides an object library with all kinds of machinery, building structures and other equipment needed to design a factory layout. All objects can be manipulated by touching the screen with either a finger or a special pen. The interrelations and logistic procedures within the factory can be defined in a material flow matrix. The developed layout with all its interdependencies can be analyzed by a set of implemented tools. In addition to the layout displayed on the planning table, a three-dimensional illustration of the factory is shown by an external 3D-projector. Hereby, it is possible to "fly" through the virtual factory and to examine the planning results in a 3D-view.

The very simple and intuitive usability of the planning table allows worker participation without the need of any previous knowledge or practice. Considering the criteria for participation methods introduced above, the planning table shows a rather low integration of workers.

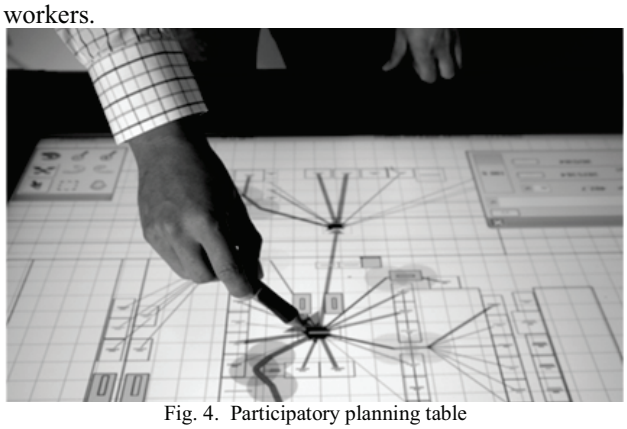

Fig. 4. Participatory planning table

Only selected representatives are able to participate in the planning process and only one worker at a time can manipulate the layout. This will certainly enhance with the implementation of multi-touch and multi-user technologies. [9]

The tacit knowledge of workers is used to a very high degree. Since workers are strongly involved in the planning process the results usually cause high acceptance among the workforce. Due to the intuitive usability the effort for learning and conducting the method is on an average level. The planning table highly involves workers in the planning process, which denotes a participation level of at least 4. In some cases, the whole layout decision might be up to the group whereby the highest participation level is reached. The combination of intuitive 2D-Layout planning and 3D projection leads to a broad field of application and makes it suitable for almost every target group.

In summary, the planning table allows a very high participation level and supports workers in the intuitive usage of their tacit knowledge. The very low number of participants is a major disadvantage of this method. The whole participation profile is shown in figure 5.

B. *Survey*

A method with a completely different participation profile is surveying the workforce in order to receive their opinions and ideas. The advantage of a survey is the possibility to integrate as many workers as requested.
But questionnaires have to be designed with care. The accuracy of the results strongly depends on the wording and design of the questionnaire. [25], [26]

Questionnaires usually ask workers closed-ended questions, which impede the usage of tacit knowledge. Since questionnaires do not allow workers to bring in their detailed ideas of processes, the acceptance of the results is rather low. Usually, the worker's opinion can hardly be tracked down in the results of the survey.

The effort for conducting a survey depends on the extent of the questionnaire and the chosen sample size but is comparably low. For workers there is almost no effort for learning.

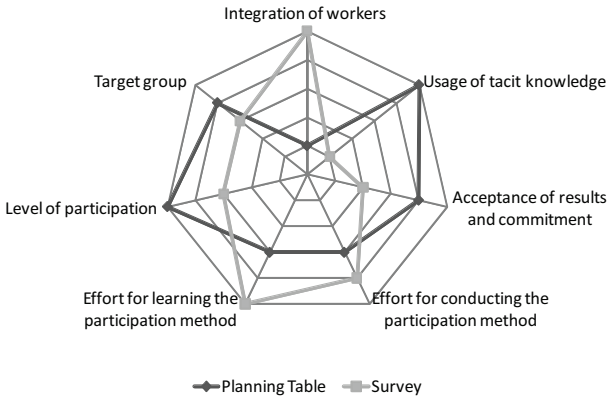

Fig. 5. Participation profiles

The level of participation is three because only the worker's opinion is surveyed and there is no real involvement in the decision itself. With the above mentioned accuracy in questionnaire design the survey can be fitted to the target group properly.

C. *Method Selection*

The characterization of methods with the participation profile can be applied for a thorough method selection. Therefore, an ideal method is described in all seven criteria. This ideal does generally not have the highest degree in every criterion. In some cases, an integration of many workers or a high participation is not beneficial. Furthermore, some effort for learning might be volitional and is seen as on-the-job training. The ideal method forms a target area in the participation profile, which can be compared to the established methods.

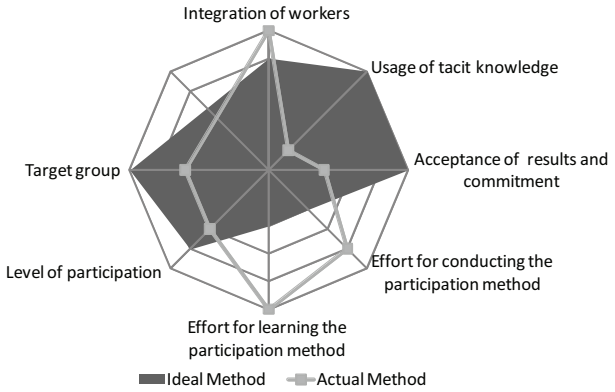

Fig.6. Method selection

V. CONCLUSION

Due to the numerous benefits of participation more and more enterprises try to use the creativity and the knowledge of their workforce. But the approaches to workers` participation vary widely. Furthermore, the suitability of workers` participation changes according to the different phases of the product and process development. In this paper the main criteria for characterizing participation approaches were derived in order to simplify the selection of an adequate method. Some of the main aspects are the usage of tacit knowledge, the acceptance of results and the integration of the workers concerned. For the enterprise the effort for conducting and learning the method is also very important. Based on these characteristics the participation profiles of two exemplary methods, the planning table and the survey, were derived. According to the requirements of a problem the selection of an adequate participation approach can be based on these profiles.

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