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Conference on Systems Engineering Research (CSER 2014)

Eds.: Azad M. Madni, University of Southern California; Barry Boehm, University of Southern California;
Michael Sievers, Jet Propulsion Laboratory; Marilee Wheaton, The Aerospace Corporation
Redondo Beach, CA, March 21-22, 2014

Towards global deviation management in product development using pulse methodology: A case study

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Abstract

Problem solving is an important part of product development. Efficient deviation management together with efficient synchronization can increase the problem solving capabilities of companies. In this paper, we present a deviation management methodology called pulse methodology, which is widely used for product development management in Sweden. It is based on identifying deviations with traffic-coded magnets on a whiteboard and synchronizing the company with frequent meetings. We describe both the baseline pulse methodology and a specific adaptation case of it in a Swedish product development company where this research was carried out. Results showed that pulse methodology manages deviations in local projects efficiently and brings further benefits to the company. The aim of this research is to make the case company more efficient at managing deviations in global projects; specifically help them use pulse methodology for also global projects. In order to do so, we proposed improvements on pulse methodology to make it feasible to be used for global projects. The results have implications to all companies that use or want to use pulse methodology for managing deviations in global projects.

Keywords: Lean; knowledge boundaries; synchronizing organisation; integrative events; boundary objects

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1. Introduction

Pulse methodology, introduced by Scania in 2003, is a widely used deviation management methodology in lean product development in Sweden. However, outside Sweden this methodology is not well known. One of the main reasons for that is the lack of information in the literature. Most of the information in literature about pulse methodology is in Swedish. Therefore, along with the main contribution, this paper forms a frame of reference of pulse methodology for the English literature.

The main contributions of this paper are: describing an adaptation case of pulse methdology inside global product development settings, and prescribing improvements towards making the company use the methodology globally. This paper forms the first half of a research for making the case company, a Swedish product development company, more effective at managing deviations globally. The research results are gathered by over six months of participant observations and series of interviews. The company has been using the methodology over one year for their local projects and convinced that the methodology brings value. Now they want to start using pulse methodology for global projects as well. Therefore this research aims to find if the current way the company using pulse methodology is feasible to be used globally, if not find out the necessary steps towards achieving this.

The structure of the paper is as follows. First, the background knowledge about deviation management, pulse methodology, and similar methods to pulse methodology are given. After that, how the research was carried out is explained under the research methodology heading. We presented how pulse methodology can be used in global product development settings, under the research results and analysis heading. Improvement points for pulse methodology are also presented under this heading. The paper continues with the discussion chapter where we discussed the followings: the methodology acceptance, the improvement points, and the effects of pulse methodology. The paper concludes with validity and conclusion chapters where we presented why the results are valid and what are the conclusions, respectively.

1.1. Deviation management

Problem solving comprises a major part of product development activities. Not only foreseeable problems need to be resolved but also the arising of unexpected problems needs to be dealt with. In this context, deviation means an unforeseen change in the current state that needs to be tackled. The typical deviation management process starts with the detection of the deviation. Thereafter, as the second step, internal stakeholders should be informed regarding this deviation. The third step involves providing a clear definition of the deviation at hand by discussing it with the internal stakeholders. Only after the third step, can the deviations be defined as problems. Lastly, the fourth step encompasses the problem solving. Good deviation management assures a correct and clear definition of the problem at hand and solves the problem earlier as a result of early identification and having effective tracking and follow-ups on deviations.

1.2. Pulse methodology

Pulse methodology synchronizes the organization by making use of planning boards and short frequent meetings. The planning board used in the methodology is called pulse board and the meetings are called pulse meetings. Pulse meetings help carrying out the second and third steps of the deviation management process: informing internal stakeholders about the deviations and defining the deviations. These meetings also initiate and follow up on the fourth stage, i.e. problem solving stage, by synchronizing the organization regarding the progress of the problem solving process.

Managers use pulse meetings to get information about the status of the organization. This can be compared to doctors getting information about the status of their patients by getting the patient's pulse. The methodology is therefore called pulse. Engineers resemble to doctors, organizations to patients, and meetings to taking pulse. This analogy can be elaborated on further as follows. If doctors take pulse of their patients with shorter intervals, then they can follow the changes on the patients' status better, so that when it is needed they can take measures just in time. Just like that, engineers can follow the changes on the organization's status and if needed take measures and act accordingly just in time. Checking the status of an organization frequently is important in order to act on right

time and take measures. The analogy above applies for the following example as well. Doctors take pulse of patients in critical condition more frequently comparing patients with non-critical conditions. This is because the statuses of the other patients do not change as fast as those in critical conditions. Therefore there is not a need for doctors to check non-critical patients' statuses that frequently. It is the status of a patient that sets the time intervals between consequent pulse measurements. Again, just like, it is the status of an organization that sets the frequency of pulse meetings. If there are projects or products that are in critical conditions and having fast changing statuses, managers should have more frequent pulse meetings.

Pulse meetings are short, weekly meetings. They are the integrative events of pulse methodology. Oppenheim[1] describes integrative events as "meetings where all current deviations are openly discussed, mitigated, and the work comprehensively coordinated, verified for consistency with value proposition". The main reason of having these meetings is to synchronize the organization. As mentioned in the previous paragraph, having more frequent meetings is better at synchronizing the organization comparing less frequent meetings. Therefore pulse methodology prefers having short frequent meetings to long meetings with long intervals. Fifteen minutes being the average, the meetings are limited to half an hour. This requires a fast paced meeting where attendees briefly share information without getting into details. In order to create this fast pace, it is recommended to have the meetings standing up. The topics of the meetings are the current deviations of the organization, and the progress towards solving them. Limiting the topics helps the meeting to be fast paced and short. Besides the main topics, attendees can also solve deviations and take quick decisions (e.g., resource allocation) during the meeting.

Pulse boards are the boundary objects of pulse meetings. Bechky[2] describes boundary objects as artifacts that enable knowledge sharing across knowledge boundaries. Outside the pulse meetings, they are publicly displayed in the workspace. This use of pulse boards is similar to the information radiators as described in Cockburn[3]. Fig. 1 shows an example of a pulse board. Attendees of pulse meetings gather around the pulse board. They update the board as they share information regarding their statuses. Pulse boards also help the meetings to be structured. Attendees talk with the order of where their responsible project is situated on the board. Assuming an example pulse board that has horizontal lines representing the projects running in the organization. The meeting would start with the attendee who is responsible for the project in the first row. Likewise, the meeting will end with the attendee responsible for the project in the last row. Pulse boards store all the important information discussed at the pulse meetings. Structure of the pulse boards can be summarized as follows: cells created by the intersections of rows and columns that represent different aspects of the company (e.g., products and departments), and color magnets resting on these cells showing the status of these cells. For example, assuming a board that has rows representing projects and columns representing departments. In such a board, the magnets resting on each intersection (cell) would give the information about the status of the products in the related department. The number of different colors and their meanings can change at different companies. Possible colors and their meanings are as follows:

- **Red:** New deviation; big deviation
- **Yellow:** Deviation with a solution on the way; small deviation
- **Green:** Solved deviation; no deviation
- **White:** No deviation; no activity

Fig. 1. pulse board

1.3. Similar methods

There exist similar methods to pulse meetings as for example stand-up meetings, visual planning, scrum, and obeya rooms. The mentioned methods have in mind to create effective meetings that spread a clear picture of the subject[4].

Daily stand-up meetings, or daily-scrum, are used to spread a quick update to the whole team by gathering them together. More important than just sharing status and progress is the underlying commitment. Stand-up meetings will also increase the possibility to find obstacles that might provide the team members from reaching the goal[4].

Visual planning is often known as a physical planning board filled with post-it notes that hold information of different activities and deliverables. One of the major benefit is rich communication that is established through frequent face-to-face communication and by sharing and creating an overview of the different tasks in the team. The visual planning meeting helps the team to coordinate the task efficiently[5,6].

Highlighting activities and helping team members reaching their goals by using visual planning is a part of the obeya. Obeya, or 'big room', collects the project planning and communication in one room to attain efficient synchronization and management[7,6]. Introducing visual planning in companies with product development is often a first step in to lean product development[5].

2. Research methodology

In this descriptive qualitative research paper we followed the guidelines of Maxwell[8]. Maxwell suggests using triangulation in qualitative research. This method requires collecting data from a variety of sources and methods[9]. Following this suggestion, the authors used interviews and observations for the data collection in order to create variety in the data collection methods. The authors interviewed in total 21 people who have different roles and responsibilities in order to create variety in the sources of interview data. Likewise, in order to create variety in the observations, two of the authors resided in the premises of the case company for six months.

Light et al.[10] suggests using purposeful selection (aka. purposeful sampling[11], or criterion-based selection[12]) for selecting interviewees in qualitative research. In this method, researchers select interviewees among the ones that are indispensable, which means that they are the only ones who have the information, in order to provide the information sought that no one else can provide[8]. By using the purposeful selection, the authors selected and interviewed 11 process administrators, 6 project managers, 2 portfolio owners, and 2 line managers among the employees that attend the pulse meetings. The authors followed the guidelines given in Maxwell[8] also for preparing the interview questions; Maxwell suggests that interviewers should put themselves in the interviewees place and should think how would the interviewees would understand and reply each question. Maxwell also suggests adjusting the questions by getting feedback. The authors adjusted and finalized the questions by getting feedback from other researchers who have worked with the case company before.

Authors joined and observed 25 pulse meetings of the company. Furthermore, two of the authors resided in the company premises for six months in order to observe the pulse meeting attendees' behaviors, and processes related to pulse methodology.

3. Research results and analysis

In this chapter, we will analyze and present the results of interview and observation studies we have done in the case company.

3.1. Pulse methodology in the case company

The case company is a product development company that has around 850 employees locally and around 8000 employees worldwide. Currently they are running around 40 large projects and around 150 small projects. They have adopted pulse methodology in the third quarter of 2012. They began using pulse methodology at the highest management level. In the beginning they where against moving from their old way, i.e. having long and detailed meetings using slideshow presentations, to pulse methodology. The methodology got acceptance from all the

managers that attend to the pulse meetings after they see the benefits of it. Thus they continued adaptation of the methodology towards the lower levels of the company structure.

The company structure is as follows. The company is divided into lines. Lines comprise departments, and departments comprise groups. Group managers (GM) manage groups and report to department managers (DM). Likewise, department managers manage departments and report to line managers (LM) who manage the lines. Projects run across the lines and project responsible manage them in different levels of detail. Coordinators work in the department level and manage projects in department detail level. They report to project managers (PM) who work in the line level. Chief project manager (CPM) manage projects on the top level and get report from PMs. Fig. 2 summarizes the company structure.

The company adopted and adjusted pulse methodology according to its structure. The structure of the adjusted pulse methodology as the company uses is as follows. There are three levels in the company pulse structure: project portfolio, line and line department. Each one has its own meetings and pulse board called with the same name of its level. Project portfolio pulse, where projects are lead and managed by CPMs, manages all the projects in the company at line level. Likewise, line pulse, where projects are lead and managed by PMs, manages all the projects in the lines at department level; and line department pulse, where projects are lead and managed by coordinators, manages all the projects in the departments at group level. Fig. 2 summarizes the pulse structure of the company, and its connections with the rest of the company structure.

The pulse boards serve the company with the following roles: share knowledge between divisions as a boundary object, keep the current status of the company as a database, visualize the current status of the company as a visual management tool, and provide a summary of the company to the higher managers as a report. Fig. 1 is an example of the company's pulse boards, where X-axis represents projects and Y-axis represents divisions. Red magnets represent a new deviation; yellow magnets represent a deviation with a solution on the way; green magnets represent solved deviations. The summary of the deviations and the rules of pulse meetings are always attached to the pulse boards. As mentioned, each cell in the pulse structure in Fig. 2 represents a pulse board. Each pulse board has Y-axis that is comprised of the divisions it manages, and X-axis that is comprised of the projects they are part of.

Pulse methodology synchronizes the company via pulse meetings. Pulse meeting attendees synchronize each other by briefing about the following topics: problems, risks, and questions. Examples to these topics can be given respectively as follows: a new product failing at tests; risks of not catching up with deadlines; and some employees do not know how to proceed with their tasks and asking for guidance. They use the word deviation as the umbrella term for all these topics. As seen in Fig. 2, the synchronization is done in three levels of the pulse structure: line department, line, and project portfolio. The company is synchronized in the base level, on Tuesdays, by each department synchronizing its groups separately via line department pulse meetings. The attendees of these meetings are: the DM, GMs who report to this DM, and coordinators who are responsible for the projects of that department. If the attendees cannot solve a deviation in that level, they escalate it to the next level (i.e., line department meeting) to ask for the higher managers' help. Line department meetings are held on Wednesdays, the day after the line department meetings. Each line holds its own line pulse meetings, which synchronize the company in the mid level. Line pulse meeting attendees are: the LM, DMs that report to that LM, and PMs who are responsible for the projects of that Line. Likewise, if a problem cannot be solved at this level, it is escalated to the next level (i.e., project portfolio pulse meeting), where the company is synchronized at the top-level via synchronizing lines. Project portfolio pulse meetings are held biweekly on Fridays. The attendees of these meetings are LMs and CPMs.

During pulse meetings, the attendees gather around the pulse boards. Meetings are limited to 30 minutes. The attendees remain standing up throughout the meeting. Attendees only surface the deviations and do the follow up on the old deviations. If a deviation needs to be discussed thoroughly, they arrange further meetings with only the related parties during the pulse meetings. The attendance is strictly obligatory. Therefore if attendees cannot attend, then they should send a replacement of them. Meetings start with secretaries attaching the updated version of deviation descriptions to the pulse board and checking if all attendees are present. If not, they log this to the annual meetings memo. The pulse board decides the route of the meetings: deviations in each project and each division inside the projects are visited according to their places on the board, top-to-down and left-to-right, accordingly. Each project responsible goes in front of the board, briefs about the deviations, and asks the division managers one by one if they have other new deviations or updates.
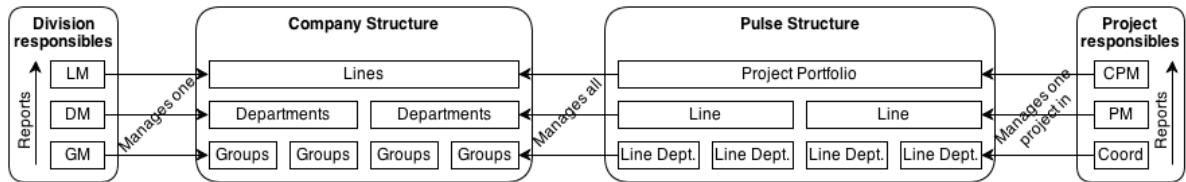
Fig. 2. The structure of the case company

3.2. Towards using pulse methodology globally

The case company uses pulse methodology for only local projects. They describe the way they manage the global projects as follows: "our regular way: lots of meetings and lots of travelling". Interviewees added that this way of managing global projects causes problems: "lots of errors occur on the way, and it ends up with poor synchronization". On the other hand the interview results shows that all interviewees are content using pulse methodology. They counted the benefits of the methodology as follows:

- **Increased transparency:** Pulse boards shows status of each division, and it is accessible for all the employees
- **Effective synchronization:** Pulse meetings make employees share their status by fixed and obligatory meetings
- **Increased visualization:** Pulse boards provides broad picture of all the deviations in the company
- **Optimum resource sharing between departments:** Pulse meetings bring effective synchronization, which then brings the possibility to see and level out the workload for each project
- **Decreasing the number of meetings:** Before pulse methodology, PMs were meeting with every division separately and creating another meeting if two or more division has to decide something together. Thanks to having regular pulse meetings, where every division at a particular level attends, number of meetings decreases
- **Reducing the time spent for meetings:** Especially PMs stated that they lowered the time they spent for meetings about 50% by pulse meetings. This is because of both decreasing the number of meetings as explained in the previous point and eliminating the need for slideshow presentation by using pulse boards to display deviations.

Considering the advantages they get from pulse methodology in local projects and the disadvantages they get from the old methodology in global projects, they want to use pulse methodology for global projects as well. We did observations and interviews to find out the feasibility of using pulse methodology for global projects. The observed situation is as follows. In some occasions local attendees attend the pulse meetings via teleconference because they are on a business trip. This situation can be compared to using pulse methodology globally; having a pulse meeting for a global project where one department in the project is situated in another country and joining the meeting via teleconference. We concluded from our observations and validated from the interviews the followings. There is no need to make any changes on the pulse methodology processes (e.g., pulse meeting structure); they are already feasible to be used globally. However, pulse methodology tools are not feasible to be used globally. We analyzed these limitations and prepared a list of improvements for the company. We will present this list under the improvements for pulse methodology tools heading in the next chapter.

3.3. Improvements for pulse methodology

In this chapter we will present the list of improvement points for pulse methodology. We will present improvements for two areas: tools and processes. Improvements for tools form the list of improvements for the company to start using pulse methodology for global projects. Therefore we consider them as "must have". The improvements for pulse methodology tools are:

- **Space limitations:** One of the top benefits of pulse boards is that they allow one to see all information in one picture. After the company begins to use pulse methodology for global projects, the number of projects residing

on the boards will increase and possibly will not fit on the boards. Therefore a new type of pulse board that can solve the space limitation is necessary

- **Remote access:** Employees sitting in the remote offices (e.g., another country) should be able to read and write to the board themselves, without asking for help from the people sitting in the office where the board resides.
- **Automating the routines:** Project managers or coordinators currently do the routines like updating inter-connected boards. After the company begins to use pulse methodology for global projects as well, this work would be harder due to significant increase in the projects managed by pulse methodology. Therefore doing this routine work would consume more time. Therefore automating these routines is a must.

The improvements for pulse methodology processes are:

- **Expanding the grading spectrum:** Today deviations are graded between only red and yellow. New medium size deviations are graded red together with big old deviations. Pulse boards should be able to tell us where to focus most. Having wider grading spectrum (e.g., 1-5) would boost this feature of pulse boards. So that the attendees would understand better the level of each deviation and see where to focus most.
- **Documenting the lessons learned document:** Today employees search through the whole history of each deviation to get the experiences gained from that deviation. However, if each solved deviation has its lessons learned documented, then it would be a lot easier to get the experiences gained from solving this deviation.

4. Discussion

In this chapter we will discuss the followings: methodology acceptance in the company from the resistance to change point of view, possibility of the given improvement points causing rebound effects, and pulse methodology from sustainability and lean points of view.

4.1. Methodology acceptance

The resistance to change in industry is a long and well known problem[13]. The case company has experienced this phenomenon as well. Some of the changes they did regarding the meetings are as follows:

- Meeting length (long to short)
- Meeting attendees (small to large)
- Meeting tools (slideshow and projector to pulse board)
- Number/frequency of the meetings (low to high)

Following these changes, duties of the attendees also changed. For instance, project managers no longer need to spend time on preparing slideshow presentations before the meetings; putting one red magnet on the pulse board and writing details about the deviations to the document management system would be enough. This apparently reduces the workload of the project managers. Therefore it is safe to assume that they are on the side that supports the change. However, another change of the duties, which possibly created the side that opposes the change, was as follows. Before the pulse methodology, the managers (aside project managers) were joining only to intra-knowledge-boundary meetings (e.g., single department meetings). They were rarely attending to inter-knowledge-boundary meetings (e.g., multiple department meetings). However, pulse methodology requires frequent inter-knowledge-boundary meetings. This change seemingly increased the workload of the managers that attend these meetings, thus created the opponents to change. However, after a while they understood that actually pulse methodology takes less time to synchronize the company. The previous methodology required redundant work, such as having the same meeting for a couple of times with different attendees to synchronize them about the same deviation. After the managers saw the benefits of pulse methodology, they passed to the side of the supporters to change, thus the methodology acceptance completed at the management level. With this experience and managerial guidance, the acceptance of the methodology at the lower levels of the company structure was easier.

4.2. Improvement or regression

In this chapter we will discuss the improvement points presented under improvements for pulse methodology heading. We will specifically discuss their possibility of causing rebound effects.

- **Remote access:** Face to face interaction will always enrich the communication[14,15]. The remote access feature may create a rebound effect that even the local attendees may begin to use this feature instead of attending the pulse meetings in person. This would damage the quality of information conveyed. We suggest that only the distant attendees should be allowed to use this feature.
- **Expanding the grading spectrum:** With this feature, since the number of possible grades increased, finding the right grade for the deviations would be harder. A possible rebound effect is that the attendees would begin to spend longer time on discussing the grades of the deviations. This will damage the fast-paced nature of the pulse meetings.

4.3. Effects of pulse methodology on sustainability and lean

Womack & Jones[16] describes lean as eliminating waste. Pulse methodology eliminates five of the top ten sources of waste in product development given in Mascitelli[17]. The following list shows the addressed five wastes:

- **Chaotic work environment – constant interruptions:** If employees do not know when will they have the next meeting and have a short question to ask to a manager, they either tend to ask directly or forget it and never ask. Considering the number of people managers manage, each one asking small questions will create serious constant interruptions for them. Thanks to pulse meetings, employees know that the people they want to ask question will be present at the meeting, each week on the meeting day
- **Lack of available resources - resource bottlenecks:** The research results show that pulse meetings help leveling out the workload and optimum resource distribution.
- **Lack of clear prioritizations of projects/tasks:** Grading the deviations between red and yellow helps the company to decide which deviation to solve first
- **Poor communication across functional barriers:** The research results show that pulse methodology brings effective synchronization to the company.
- **Too many @!%&* meetings:** The results show that pulse meetings not only decrease the number of meetings but also reduce the time spent for meetings.

Eliminating waste contributes to sustainability. Furthermore, pulse methodology specifically contributes to social sustainability. In social sustainability, equality is a very important concept[18]. Pulse methodology increases equality in the company by providing transparent management, and helping to level out the workload. The case company uses the highest-level pulse board as a report to the steering committee, which makes it one of the highest managerial reports. This board being open to access for all the employees makes the management transparent. Pulse methodology synchronizes the company effectively. If managers see that any division has too many tasks, then they can distribute the work. Likewise, if they see that if any division needs extra resources, they can share the extra resources with that division. This assures the equal workload in the company.

5. Validity

This research paper used triangulation in order to increase the validity of the results. Triangulation creates diversity in the collected data by using different sources and methods. This diversity avoids the researchers from reaching conclusions that reflect only the biases or limitations of a specific source or method[8]. According to Maxwell, this broader and more secure understanding of the research subject gives far more credibility comparing to collecting data from single source with single method.

As triangulation suggests, the authors used different ways to collect data; namely, interviews and observations. Interviewing gives valid results about someone's perspective and doing observations alongside can help the

researchers to draw more inferences about this perspective comparing to only relying on the interview data[2]. Maxwell adds that, this is important for getting tacit understandings, theory in use, and the things that the interviewee is reluctant to state in the interviews. An example that fits with the statements above from this research is as follows. During interviews all interviewees stated that pulse meetings are short and fast paced therefore one needs to focus on the meeting. Meanwhile the authors observed that some attendees bringing their laptops and use them during the meeting instead of focusing on the meeting. This behavior was observed thanks to using observation alongside interviewing. Maxwell also states that, conversely, having interviewing along observations helps the observations by validating them and by giving descriptions to the observed actions and events. The continuation of the example above fits with this second statement. After observing this behavior described above, the authors asked the Pulse meeting attendees that why do they bring their laptops to the meetings. They replied that sometimes they are waiting emails with extreme importance and need to reply them back directly. Therefore they had to keep their laptops with them. This statement of the interviewees clearly validates the observed behavior and gives further understanding to it by describing why it happened.

Two of the authors remained in the premises of the case company for six months in order to observe the behaviors and processes that are connected to the pulse methodology, also during the times outside the pulse meetings. This long-term participant observation increases the validity of the data by ruling out wrong inferences, associations and theories[19].

6. Conclusion

The results show that the pulse methodology works; it helps the company to manage deviations by synchronizing the company as the methodology promises. It also brings additional benefits to the company such as: decreasing the number of meetings, reducing time spent for meetings, increasing transparency, increasing visualization, and providing optimum workload distribution. Furthermore we discussed the positive effects of pulse methodology on social sustainability and lean.

The results show that pulse methodology has the potential of increasing the efficiency of managing deviations in global projects. We made a feasibility study to see if it can be used globally. We came to the conclusion that the current pulse methodology processes can be directly used for global projects. However, the tools used inside the methodology are not feasible to be used globally. We presented the list of improvements under improvements for pulse methodology tools heading for the company to make them be able to use pulse methodology for global projects. Since the company uses pulse methodology tools as the baseline methodology suggests, we conclude that the improvements we proposed in this research applies also to the baseline methodology. We expanded the list of improvements by good-to-have process improvements. Consequently we discussed some of these improvement points about their possibility of causing rebound effects.

This paper forms the first half of a research project towards making the case company more efficient at managing deviations in global projects. As for future work, we will propose, implement, and test the solutions, which realize the improvements that we proposed in this paper.

Acknowledgements

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