**Efficiency of project health checks (PHCs) as an early warning system in practice: A case study in Norway’s telecommunication industry**

**Introduction**

From studies of the history of projects that have resulted in either failure or remarkable deviations from their goals, it is clear that projects do not result in total failure in a relatively short period of time. Projects largely fail for non-technical reasons such as issues of negotiation, team capabilities, and communication (Walley, 2013 ).One approach to avoid project failure or deviation from the original goal is to attempt to detect possible signs of project failure during the early stages of a project, in order to take the necessary corrective measures. Such signals, which can be seen variously as an expression, an indication, a proof, or a sign of the existence of some future negative issues, are defined by Nikander (2002) as “early warning signs.” The detection of early warning signs is a major challenge for project managers, who have to respond to them in order to prevent any undesirable outcomes. Although it has not been proven that identification of early warning signals is a guarantee against project failure, there are a number of literature resources that consider attention to the signals and efforts to respond to them contribute to project success.

Various researchers have introduced different approaches that we (the authors of the present paper) believe may be used as possible means for detecting early warning signs in projects. Some of these approaches include risk analysis (Niwa 1989; Nikander 2002), project success/failure models (Pinto and Slevin 1988; Lewis 1993), project assessment methods (Cooper *et al*. 1997; Cooper 2005; Miller and Lessard 2000; Klakegg *et al.*, 2010), earned value management (Vanhoucke (2012), decision support modeling of early warnings (Nikander and Eloranta, 2001), performance measurement (Andersen and Fagerhaug, 2001), and project health checks (PHCs) (Mian *et al.* 2004; Construction Industry Institute, 2006; Jaafari, 2007). Although these methods have been mentioned as possible early warning sign identification approaches, very few literature sources have directly demonstrated the link between project early warning and these methods.

Since the focus of this paper is on project health checks as a tool, we endeavor to explain the state of the art of this approach in the literature and based on the information found we analyze the case studies presented in the subsequent sections of the paper. Our research is based on the literature sources dealing with the concept of PHC and we examine the utility of this tool, which has been developed by the case company as an early warning (EW) system, by presenting a case study of two projects operated by the company in Norway’s telecommunication industry. This is done in order to identify the factors that influence the level of efficiency of the tool as an early warning system in practice. The reason we have chosen to focus on the telecommunication industry is that in the past three decades, due to the recent wave of liberalization and privatization in the world, the telecommunication industry has turned into a dynamic environment and is rapidly growing (Graack, 1996). In this rapidly changing industry, the availability of state-of-the-art technological know-how, innovations, and domestic and international market access are critical to a company’s competitive success (Pennings *et al.*, 2005). Since the PHC concept is based on continuous improvement of the management processes, tools, and skills, its implementation can aid the leading of a project towards success.

The case studies and the process of applying PHCs within them are reviewed and analyzed in order to illustrate the usefulness of PHC as an early warning system that can give indications of possible future problems in a project and hence allow initiatives to be taken to resolve the problems before they can lead to project failure. This in turn, can contribute to project success.

The remainder of the paper comprises six sections. In the next section, we describe the research purpose, scope, and methods. This is followed by a literature review covering the concepts of early warning and PHCs, and the link between them is presented. The case study is described in the subsequent two sections: the first of these sections includes information about the case projects and a short history of the project, and the second section comprises the findings and results of the analysis. Thereafter, the discussion and research conclusions are presented in respective sections.

**Research objectives and methodology**

The main objective of this paper is to investigate the effectiveness of the application of a project health check tool for indicating the areas in which a project has potential for facing problems. We also question the extent to which the tool is able to provide the responsible party with enough information to enable them to take the appropriate corrective action in order to avoid failure. In order to do this, we apply the tool developed by the case company in collaboration with the PUS project, a research project conducted in Norway during the period 2006–2010[[1]](#footnote-1). The design of the tool is based on the ten critical success factors in projects, demonstrated by Pinto and Slevin (1988). The purpose of PHC is to give a helicopter view of a project’s performance and highlight critical success factors for monitoring, improvement, and follow-up. The key goal is to improve these areas continuously (Bharj, 2007). The tool consists of 20 questions that can be used to check how project participants experience their work situations. The questions can be used in different phases of a project, as a kind of an early warning system. The main research questions to be answered regarding the specific cases are:

* What are the results of PHC implementation in projects?
* Does the implementation of PHCs as a tool contribute to the identification of early warning signs?
* What are the shortfalls of using PHCs and what are advantages?

In order to achieve the research objective, our research is designed upon several case studies conducted within the Norwegian telecommunication industry. The methodology used is a case study approach based on archival material, structured interviews, and semi-structured interviews. This research is data-based research, which has led to conclusions that can be verified by observation or experiment. The aim is not merely to describe a situation but rather to understand the conditions under which events occur (Yin, 2009).

*Case study selection*

According to Seawright and Gerring (2013), a typical case study focuses on what that exemplifies a stable, cross-case relationship. Our aim has been to find a typical case of the application of the PHC tool so that we can better explore the causal mechanisms at work in cross-case relationships in general. For the purpose of our research, we have chosen among both cases that have already implemented the PHC tool and cases that are currently applying it. This has been done in order to examine the results of implementation of the tool while simultaneously observing the way it is utilized and its potential for improvement. It is important to mention that since the tool is still not well known in the industry, at least in Norway, and currently not many firms are applying it, our case studies have been rather limited. Nevertheless, we have endeavored to perform an inductive analysis taking into account all the limitations and constraints.

*Data collection*

According to Yin (2009), a prerequisite for attaining robust results from a case study is to have multiple data sources that can be triangulated to ensure the validity of the results. For our study, data were gathered from archival material and semi-structured interviews. These techniques are described in more detail in the section headed “Case study.”

Since one source of data for this study has been the results of the application of the PHC tool in earlier stages of the case projects, archival material has been significant. Progress reports and health check reports provided information on the following aspects:

* The results of the use of PHCs in earlier stage of projects
* The phases which PHCs were implemented
* How the use of PHCs provided early warnings of possible future problems
* The types of problems that were avoided by using the PHC tool.

Interviews are one of the most important sources of information in case study research (Yin, 2009). In our study, semi-structured interviews were organized to investigate the way the PHC tool had been implemented in the case projects and evaluate its usage as an early warning system. For our research, the respondents were chosen among mainly top management and full-time employees in central positions in the project, as we considered it very important to make conscious decisions about who and how many were invited to respond to the project health checks in order to ensure the validity and reliability of the data collected.

The following aspects were also questioned:

* Weaknesses of the PHC tool in specific situations
* The points where the PHC tool could be improved or better implemented
* The reliability of the results obtained from the health checks
* The level of usefulness of the PHC tool as an early warning system.

*Analysis of the results*

The data obtained from the archive material and interviews were analyzed using a qualitative approach. The data, which presented the results of the use of PHCs in previous projects, were used to shed light on the implementation of PHCs in practice and how they are perceived in a real working environment. The trend indicated the performance of the project for each aspect assessed by the PHC tool during the time in which the assessments had taken place.

The information derived from the interviews mainly exhibited the process of implementation of the PHC tool, together with the challenges and possible areas for improvement. It also revealed how the utilization of the approach had acted as an early warning system in the studied projects. In the following section we present both of the case study results in more detail.

**Literature review**

*Concept of early warning in projects*

Early warning is a broad concept. It applies to almost any area where it is important to obtain early indications of developments that will become manifest in the future, and that are usually negative. The concept of early warning in a management context was first discussed by Ansoff (1975) and was later supported by Nikander (2002) in his doctoral dissertation. Ansoff stated that strategic surprises do not appear out of the blue; rather, it is possible to predict their occurrence with the aid of signs called “weak signals,” which he defined as “imprecise early indications about impending impactful events” (Ansoff and McDonnell, 1990, P.20). All that is known is that some threats and opportunities will undoubtedly arise, but their shape and nature and source are not yet known” (Ansoff and McDonnell, 1990, P.385).

Nikander (2002, p. 49) stated: “an early warning is an observation, a signal, a message or some other item that is or can be seen as an expression, an indication, a proof, or a sign of the existence of some future or incipient positive or negative issue. It is a signal, omen, or indication of future developments.” He devised a preliminary model illustrating the character of the early warnings observations (Figure 1), which sees project events as a time-bound consecutive stream of events. Information about the stream can be obtained at any given time (e.g., early warnings of potential future project problems). Such information can then be processed and responses will be required in order to influence the flow of the project. According to Ansoff, a crucial factor in choosing a response appears to be the time available for responses before the potential problem significantly impacts the project.

Figure 1. Nikander’s preliminary model of the character of early warning in projects (Nikander, 2002)

Little has been mentioned in the literature to date about the exact time that early warning sign identification should start in a project’s life cycle. According to Lewis (1993), the prerequisites of project success are that matters must be in order before the project is initiated. We believe that in cases where early warning signals are identified in the early stage of a project there will be sufficient time for project managers to take appropriate actions in the subsequent stages of the project. For example, if warning signals related to cost and time limitation are identified in the early stage, budget estimating can be done more accurately in the initiation phase. In addition, identifying of early warning signs can be a guide to planning deliverables, baseline schedules, and baseline budgets in the planning stage. Identification of early warning signs related to technical issues can aid the responsible persons to make better decisions regarding risk management and the production of key variables in the execution phase. Clearly, the challenge lies in the possibility of detecting the early warning signs and their level of reliability.

According to Nikander (2002), which is consistent with our own findings, very little literature deals explicitly with early warning in projects and project management. However, the project management literature does include some statements that directly or indirectly refer to the concept and its identification approaches (Table 1).

Table 1. Categorization of sources of early warning signs in projects

The choice of the right approach is very much dependent on the project itself and its organization and context.

*Project health assessment tools and early warning sign identification*

Some researchers have identified several sources that take up the concept of PHC and describe its contribution to ascertaining projects’ health, some of which are described more in detail below in this section. The literature studies show that the tool can be applied in various domains such as information techology (IT) (Flinn, 2010; Jordan and Silicock, 2005; Betts, 1999), construction (Almahmoud *et al*., 2012; Mian *et al*., 2004; Betts, 1999), and telecommunication (Andersen *et al*., 2005).

Humphreys *et al.* (2004) developed a construction project health model that enables an immediate evaluation of project health by identifying the root causes of a project that is not performing as expected and suggests a means for returning the project to better health. The model is based on a four-stage process that begins with a broad and rapid assessment of the current health of the project, followed by a more thorough analysis of the areas recognized as unhealthy, which in turn enables suggestions to be made for a solution and finally continuous monitoring of the condition (Figure 2). The suggested model is derived from a physical health model for humans that use critical success factors, key performance indicators, contributing factors, and secondary performance indicators. The model tends to look for signs of poor performance rather than good performance and thus suggests remedies for returning the project to better health. Poor performance can be seen as an early warning sign of future problems that will demand a remedy as a corrective action to prevent project failure.

Figure 2. Construction project health (Humphreys et al., 2004)

The Construction Industry Institute (CII) developed a project health indicator (PHI) tool, in 2006, which has been presented as a tool that is a predictive evaluator of future project risk. It utilizes a prioritized list of measures and a weighting system based on the statistical correlation of those indicators to project health and phase. The project health indicator tool is a management process that implements periodic project reviews based on composite and individual scoring systems. The tool, which does not rely only on hard data and allows projects to identify issues earlier, has a broader application than conventional project management tools. Rather, it attempts to fill the gap between the project definition rating index (PDRI) and traditional project control methods. Project managers can use PHI at all levels of project organization to assess project health.

The CII’s 43 indicators, which are introduced as “leading indicators,” are defined as follows: “*Fundamental project characteristics and/or events that reflect or predict project health. Revealed in a timely manner, these indicators allow for proactive management to influence project outcomes*”. The five key project outcomes are stated as cost, schedule, quality/operability, safety, and stakeholder satisfaction. It should be noted that CII (2006) is the only one to date that has clearly mentioned the PHC tool as an early warning system.

A separate PHC tool, introduced by Jaafari (2007), denotes how systematic a project team is in its management of project variables. The aim of Jaafari’s tool is to define the management of project variables systematically in order to determine whether a given project is healthy (in cases managed systematically) or not healthy (in cases managed haphazardly). The framework is intended to shift management focus from measuring performance effects to learning from project behavior as a complex system, and to focusing on the state of managerial approaches such as the enabling factors (Almahmoud *et al.*, 2012). The role of PHCs is presented in Figure 3.

Figure 3. Role of project health checks (Jaafari, 2007)

The PHC, developed by Jaafari (2007), consists of 18 criteria, including business and strategic assessment as well as project implementation assessment. Each management area of a project can be assessed according to these criteria to ensure systematic management of project business concerns and that management of project implementation is in alignment with project business goals. The PHC can also be used as part of an organization’s strategic management and business improvement exercises (Betts, 1999).

A PHC can be applied at any point in the life of a project; a project can be assessed from the conceptualization phase through to the completion and operation phase. Assessments of a given project/program performed at different points in time can be archived and plotted to observe trends. The tool can also be implemented as a benchmarking tool, as it allows the project planners to select an appropriate target in terms of the management approaches. The questions in the health check can be modified according to the project in order to perform a more accurate evaluation of the project’s situation.

When a project is in its formation stage, the application of a PHC will guide the planners to adopt optimal approaches to the management of the enabling factors. As the project evolves, the application of PHCs helps to diagnose the areas of poor capability and managerial performance, or misalignment of resources with project goals and priorities. Hence, the management team will be able to introduce measures to realign the managerial approach and address any shortcomings identified.

Several authors have highlighted PHCs as a useful tool for following up the trend of project progress, while others have scrutinized the concept of PHCs. These authors’ work is briefly presented below.

Turner *et al.* (1996) believe that health checks can be used at the organizational level for monitoring how well the organization supports change projects which are established for management of the change process.

Betts (1999) has proposed a strategic health check for IT management in the construction industry, which is intended to lead project managers toward more effective strategic IT exploitation by gauging the current position of the company. The health check is meant to ease the successful application of IT by ensuring that the right people are given the right opportunity at the right time.

Jordan and Silcock (2005) believe that the application of a health check is a proactive defensive action on the part of an organization, and is proven to be far more cost effective than recovery and restoration. The focus of their work is the IT domain and they believe that by applying the health policy it is possible to cope with many IT risks with unavoidable consequences that cause organizational failures.

Wateridge and Atkinson (2009) have developed a practical guide which explains how project health checks can be designed and used to manage both the technical and people processes involved. In order to do this they have presented a PHC blueprint that enables users to establish their success criteria, manage stakeholders, manage any people issues, and use the established project management techniques and methodologies.

According to Kerzner (2011), although metrics such as cost and time may provide a reasonable indication of project status at a specific time, the use of such metrics for forecasting the future produces “gray” areas and may not indicate future problem areas. This in turn can prevent the successful and timely completion of a project. The simple solution may be to perform periodic health checks on the project. Project health checks focus on the future and the items to be searched within the use of this tool are the possible destructive issues and possible cures for them.

Lastly, Basu (2013) states that in line with quality audit, performance management, and maturity or excellence models there is evidence for the value of well-structured checklists for performing holistic health checks. Such processes can greatly contribute to continuous improvement. If done correctly, using good metrics, periodic health checks eliminate ambiguity, thus enabling the true status of a project to be determined.

In the next section, we discuss the link between PHCs and early warning in projects by describing how the measurement of project health indicators can provide indicators of future problems in projects.

*The link between PHCs and early warning*

As mentioned in the preceding section, proactive and defensive actions taken by organizations have proven far more cost beneficial than recovery and restoration (Jordan and Solicock, 2005). A health policy that recognizes the benefit of prevention over cure can be a good approach for identifying the early warning signs of problems in projects. Kerzner (2011) also draws attention to this issue by stating that one of the benefits of health check is that sufficiently early identification of problems allows sufficient time for corrective actions to be taken.

The use of PHCs at different project phases, such as the initiation, planning, and execution phases, will indicate whether the project is “healthy” or “unhealthy”. If it has passed the limit, it is an early warning for the project and the project manager should take corrective actions in order to avoid failure. The limits should of course defined by the project managers in advance.

The link between PHCs and EWs has been thoroughly discussed by the CII (Construction Industry Institute 2006). According to the CII, the leading indicators defined for the PHI tool provide real-time early warning signs of an unhealthy project. These indicators are meant to provide additional insight into the health and vitality of a project. This can help to ensure that a project meets the desired performance targets and adds value for all participants in the project development process.

The model presented in Figure 4 has been developed based on the PHC and project life cycle model developed by Jaafari (2007), Nikander’s (2002) preliminary model to introduce the concept of EW, and also takes into account the work done by the CII on the link between project health and early warning signs(Construction Industry Institute 2006). In the model, project events are seen as a time-bound continuous stream of events (project life cycle). Information about this stream can be obtained at any given point in time. The information can then be processed (in our case by the application of the PHC tool), and responses are required in order to influence the flow of the project. As shown in Figure 3, the health of a project is assessed at time “t1” and the information that contains the results obtained from the PHC results, is processed. In cases when the information reveals warnings of possible future problems, such as at “t3,” there is a need to respond to the warning signs by applying corrective actions to avoid the potential problem. The available time between t1 and t3 provides an opportunity for project managers to make the right decisions to respond to the detected warning sign.

Figure 4. The implementation of project health checks and early warning (adapted from Jaafari, 2007)

**Case study**

The research for this paper was first conducted in 2012 in order to evaluate PHCs as a project management tool within a telecommunication firm in Norway, where project health checks had been tested in two different projects since 2007. The health check consisted of 20 questions, which were sent for evaluation by members of the project team (Table 2). Respondents had to select their responses from one of the following six options: Irrelevant, I don’t know, Completely disagree, Disagree a little, Neither agree nor disagree, and Agree or completely agree.

Since the PHC tool had already been tested before the research was started, the results of previous tests are also analyzed within this paper. Interviews were carried out after the testing period. In addition to the dataset, the candidates’ own views, and project managers’ practical experience in the use of the PHC tool is taken into consideration. The goal was to identify how the use of the tool had contributed to the identification of early warning signs in the respective projects and consequently led to responses to them.

Table 2. Project health check questionnaire

*Summary of the cases*

The first case project’s purpose was building the next generation broadband network for mobile data. It was intended to provide even better customer experience with greater speed and less delay. The project’s purpose was to maintain the company’s status as the undisputed leader in Mobile Broad Band (MBB) services in Norway.

The project (hereafter referred to as Case 1) consisted of five subprojects. The project started in 2010 and was scheduled to be finished by 2013. All five subprojects contained five decision gates (B1 to B5) covering planning, investment decision, release for pilot customers, handover to the line organization, and project closure. After handing over the product to the line organization, the project organization had nothing more to do with the product. The first two decision gates were common to all subprojects and the rest differed according to their purpose. The model was a common project model within the firm.

The second case project (Case 2) was carried out in the same company as the first one. It was started in 2007 and was planned to be finished by 2010, but at the time when we conducted our research the end was estimated to be in 2014. The project was highly complex and by far the largest project carried out by the company. The goal was to develop a new communication solution for the business sector in Norway. The project included more than 100 project members and more than 5 vendors as contractors. The initial thought was to have a turnkey contact with one vendor but changes in the plan resulted in different contracts with five vendors. One of the complexity factors of the project was that not only was a new solution to be developed but also modifications were to be made to the existing solutions. This included making changes to more than 50 systems within the firm.

In the next section we discuss the results of the case study and explain how the use of the PHC tool aids project managers in identifying early warning signs and taking relevant actions to respond to them.

*Application of PHCs in the projects and the results*

*Case 1*

The health check was initially implemented in the first case study project in the first phase (L1) during fall 2010 and summer 2011, the period covering the planning and investment decision gates. Figure 5 shows the number of responses to the project health checks during the period between September 2010 and June 2011. The respondents were chosen among mainly top-level management and full-time staff who held a central position in the project.

Figure 5. Total number of responses in Phase 1 in Case 1

Figure 5 shows that the number of respondents decreased over time. According to the project manager, the reason for the drop was that the respondents found it uninteresting to answer the same questions as the time passed. In addition, there were signs that the project was approaching its purpose in a satisfactory manner and hence they deemed answering to the health check questions less necessary and helpful over time. Nevertheless, the respondents’ answers to the PHC did make a difference to the project. This will be explained further on in the paper.

Figure 6 presents the total accumulated score within the period in which the PHC tool was implemented and shows a downward trend until November and a sudden dramatic change thereafter. According to the interviewee, the downward trend of the project health was used as a basis for proving that the project is going wrong and there’s need for a change in order to prevent possible future problems. In fact the negative trend turned on the alarm as an “early warning.”

Figure 6. Total accumulated PHC score obtained in Phase 1 in Case 1

In November, when the PHC score was lowest, the steering committee made a decision to recruit a project risk and change manager to the project, as a corrective action to prevent possible future problems. The project found this solution useful, as is evident from the positive trend of project health in the remaining period of assessments.

Figure 7 shows the PHC score obtained in each area of the project over time. Apparently, the three areas in which the scores decreased over time were *project follow-up*, *conflict handling*, and *engagement and interaction within project*. Clearly, the recruitment of the project risk and change manager had a positive impact on enhancing of the areas throughout the project.

Figure 7. PHC scores by area in Phase 1 in Case 1

Later, in 2013, two more health check assessments were carried out during the second phase of the project. The respondents were chosen both from the steering committee and the project team (Figure 8). The average total PHC scores in the second phase were mainly higher than in the first phase of the project. According to the data obtained from the interviews, the results of the PHCs in the second phase showed that the plans were not realistic in order to reach the targets. The steering committee and the project team then decided to take action and arrange a planning workshop for two days, with the aim of introducing a “revolutionary plan” that would help to realize the specific milestones.

Figure 8. Comparison of PHC results in two project phases in Case 1

The results of the second assessment, in January 2013, revealed that the steering committee and the project team had quite common opinions regarding almost all issues, while the result of the last assessment, in March 2013, showed a rather high difference between the project team’s opinion and steering committee’s opinion, especially with regards to communication issues, conflicts and access to required information. The deviation may reflect the lack of a common view among the members of the steering committee and the project team during the period when the assessment was done. We assume that this in turn may have been due to the difference between the the project team’s insider perspective and the steering committee’s outsider perspective. According to Lovallo and Kahneman (2003), an outside view provides reality check on the more intuitive inside view, reducing the odds that a company will rush blindly into a disastrous investment in terms of money and time. Individuals tended to exaggerate their own talents and to believe that they were above average in their endowment of positive traits and abilities. This was perhaps the case when the project team was evaluating its own performance, and seeing the progress more slightly more positive than it was in reality.

The total PHC score per area in each assessment of Phase 2 is illustrated in Figure 9. The figure shows that the highest difference between the scores obtained from the project team and steering committee in the first assessment was found in the areas *project planning*, *conflict handling* and *communication*.

Figure 9. Total PHC score per area at different time points in Phase 2 in Case 1

*Case 2*

For Case 2, one interview was conducted with one interview was conducted with one of the eight strategic project managers in the firm. This project had experienced a large schedule slippage. According to the interviewee, this was due to high level of complexity of the project, changes in the plan, and underestimation of vendors’ resources. In this case, the health check acted as a “temperature gage” for the project, which monitored how the project team coped with the changes and challenges throughout the project. The use of the tool aids continual observations of all personnel, to ensure that they are motivated and inspired.

To date, five health check assessments have been carried out since 2011, in addition to the assessments made since the beginning of the project in 2007. Prior to 2011, project health checks were performed more frequently, but thereafter the top management team decided to perform them under two specific circumstances: either during long periods with no changes or at times of immense change. The team considered it unnecessary to repeat the checks at certain periods during the project. This was the issue when the number of respondents varied greatly from the number of invited people. This can be seen in figure 10 which presents the result of PHC from August 2009 to June 2011.

Figure 10. Total number of responses to PHC in Case 2

One of the reasons for the downward trend in the number of respondents was that the project was mostly operating at full speed, and hence those who were invited to respond to the health check had little spare time to spend time on the health check. In addition, since the project was a long-term project, a high level of trust had been built among the project managers over time and open dialogues became common for discussing problems within the project. Furthermore, “gut feelings” become more and more dependable. This was according to the interviewee one of the main reasons for the use of PHC becoming less effective. In fact the information expected to be obtained via the application of PHC was already acquired through dialogues and close communication within the project.

An important aspect mentioned by the interviewee (the strategic project manager) was that the use of other tools such as risk management, change management, and stakeholder management contributed to foreseeing the problems to a great extent. Hence, many of the project participants did not deem the use of health checks necessary. Rather, the health checks served as confirmation of what had already been identified by the project team.

Figure 11 which presents the total accumulated scores obtained from the use of PHC in the duration between August 2009 and June 2011, shows that the lowest results of health check assessment were obtained in February and October 2010. We asked the interviewee whether any early warning signs of future problems had been detected and acted upon at these specific points of time, and were informed that the period between February and October 2010 corresponded to a period of major replanning of the project, due to the delays caused by the poor quality of what the vendors had delivered. There were also major changes in the project organization. However, the early warning signs of these problems—serious delays in December 2009—had already been detected before the health check tool was applied. The PHC results were not perceived as early warnings, but as confirmation of the seriousness of the signs that would have resulted in large problems if they had not been acted upon.

Figure 11. Total accumulated PHC scores in Case 2

Figure 12 presents the PHC score obtained per area in the same period as earlier assessments and the spider web graph in Figure 13 provides an overview of the areas with the lowest scores, which had potential for causing future problems.

Figure 12. PHC score per area in Case 2

The areas in which the lowest scores were obtained included project planning, project follow-up, and capacity and competence. Theoretically, these areas demand special attention and are probably areas in which relevant corrective actions should be taken.

Figure 13. Total PHC score per area in Case 2

The interview results showed that the lowest score among the project areas was in capacity and competence. According to the interviewee, this factor was the central cause of problems in the project. The company had struggled considerably with the poor quality of what the vendors offered and at the same time had had little possibility to hire more competent people internally, and therefore many of the existing resources had too much workload. The constant need for re-planning was directly related to this issue. As a consequence of the problems caused by lack of competence, the project follow-up actions also faced shortages.

Similar to Case 1, in Case 2 the project managers believed that applying a health check was a great support for their gut feelings. In this specific case, the health check only and precisely served as confirmation of what had already been identified, and the scores were seen as the consequence of foreseen problems.

In the next section we discuss how the utilization of the PHC tool acted as an early warning system in the case projects, and its strengths and weaknesses. In addition, we offer suggestions for improvements to the tool for better identification of early warning signs in projects.

**Discussion**

As stated in the Introduction, the research objective of this paper was to investigate the results of implementing the PHC tool in two case projects and observe how it has acted as an early warning system. Also, it was of interest to identify the strengths and weaknesses of the tool in practice. The initial assumption, as mentioned, was that the results of the PHC can be an indicator of the level of seriousness of the threats to project success and can aid project managers in taking corrective actions sufficiently early to prevent problems.

The results of the case studies show that in practice the PHC tool does not always offer novel information about a project’s status. In Case 1, the downward trend in Figure 6, which reached its lowest point in November , as mentioned by the interviewee - acted as an alarm for future problems and provided the project managers with adequate information to allow them to take the appropriate actions in order to prevent undesired events. However, this was not the only source of early warning, as the health check acted as a trigger for further investigation into corrective actions that could be taken to prevent possible future problems. Although gut feelings were recognized as the most important source of early warning, the PHC results were perceived as confirmation of this awareness. The results show that the tool can be employed to prove the need for corrective actions. The results also reveal that it is not always easy to demand that changes should be made based only health check diagnoses. There is always resistance against acceptance that undesired events are forthcoming. The results of a PHC can serve as additional proof to substantiate the need for change.

The results of the second case study (Case 2) were slightly different from what was concluded from the first case. According to the interviewee, in this particular case the application of the health check had “*only*” acted as confirmation of what had already been identified through the use of other approaches, such as risk management, stakeholder management, change management, and progress follow-ups. Thus, the results obtained from the health check were a *consequence* of the foreseen problematic situation and not a predictor of it.

Looking at the two cases, it is apparent that although the projects were performed within the same company and using the same methodology, the results obtained from the application of the health check tool differed in some aspects. We believe that this was at least in part due to the different characteristics of the projects. Table 3 shows that the level of complexity of the second case was higher than the first case. This factor was definitely influenced by the larger number of vendors involved in Case 2.

Table 3. Specifications of the two case projects

At the same time, the communication and dialog level was indicated as being higher (as also revealed from a comparison of Figures 7 and 12). The difference may be due to the longer duration of the second project, which may have been a driver for the development of better communication and dialog among project members. The higher experience of project managers in the second case may be a further reason why they identified problems prior to the use of the health check tool. The gut feelings and other obvious signs, such as delays and poor quality, had already made it clear that some future problem was likely to arise. The constant need for replanning in Case 2 was another reason that rendered the PHC results less reliable. The solution would have been to have a new round of questions, customized for the new situation, after each change had been made to the original plan.

We can conclude from our evaluation of the case study results that the PHC tool cannot act adequately and effectively as an early warning system under all circumstances. Different factors, such as those listed in Table 3, can strongly influence the level of efficiency of the tool.

Complexity is one essential factor that influences the accuracy of the results obtained from the use of PHCs. According to Piperca and Floricel (2012), two types of complexity, produce turbulent dynamics that can impact a project unexpectedly; one stemming from the number of distinct elements as well as the number and nonlinearity of relations between these elements in a project and the other stemming from the project environment and its relation to the project. We believe that the health check tool utilized in complex projects tends to overlook the potential problems that may arise due to this aspect and thus it can only act as a supplement to the gut feelings of the project team members.

However, it should not be overlooked that in general increasing complexity consistently seems to make the detection and interpretation of early warning signals increasingly more difficult (Klakegg *et al*., 2010). Poor understanding of the high level of uncertainty involved in complex projects and the lack of competence at seeing through complexity are the main reasons why project assessment methods fail to pick up early warning signs (Klakegg *et al.*, 2010).

In addition to the data provided by the interviewees on the usefulness of the PHC tool, the interviewees also pointed to some specific weaknesses of the tool. First, the scores given by different parties are quite relative. In some cases, a project with more problems than others may receive higher scores from the respondents, which will decrease the credibility of the results. Second, some questions need to be customized to each particular phase of a project because otherwise they will not provide any useful information. For example, there is little sense in having questions regarding goals, when a project has already passed its planning phase and is in the execution phase. Third, there is a need for continuous modification of the health checks as a project progresses in order to engage the project team in responding to the questions better and finding them useful for the project’s progress. Some issues should be assessed throughout the whole project duration, while additional questions may be needed according to the specific phases or special situations.

We have mentioned that it is very important to have a large variety of roles among health check respondents in order to have a holistic view of project performance in all areas, such as subproject managers and lower level project participants. This is due to the fact that each and every project resource is vital to project success, and individuals with different roles see the project from their own point of view where some positions allow for seeing things that others do not. Also, there have been suggestions that health check questions should be differentiated according to different resources, such as technical staff and management staff. One idea, which came from one of the interviewees, was also to add some resources at a larger distance from the core of the project, in order to include the “outside view,” which according to Lovallo and Kahneman (2003) provides a reality check on the more intuitive side, reducing the odds that a project will face serious problems. This can also contribute to obtaining more valid results by moderating the delusional optimism that is likely to develop by only having an insider’s view of the project.

It is worth mentioning that although the literature sources regarding the application of project health check in projects mainly include projects from the construction industry (Almahmoud et al., 2010; Choi, 2007; CII, 2006; Humphreys et al., 2004; Mian et al., 2004 and Andersen et al., 2002), authors find no reason which can prevent the application of this tool in other industries. Since the PHC concept is based on continuous improvement of the management processes, tools, and skills, its implementation can aid the leading of a project towards success. According to Wateridge and Atkinson (2009), Problem-proofing any type of project demands the use of an effective series of health checks throughout the project's life.

A further issue that should not be overlooked is the fact that different industries experience different challenges when managing projects, and therefore managers from diverse industries focus on various project management processes and complete projects with a different level of project success (Zwikael, 2008). We (the authors) believe that the health check tool should be customized to specific industries and types of projects in order to perform efficiently and be able to capture relevant information for project managers.

**Conclusions**

The findings from this study suggest that the project health check tool can, under specific circumstances, be helpful to project managers for identifying early warning signs of problems. However, there are also many factors that influence its level of efficiency at different points in time. The tool also seems to require modifications in certain areas of a project. The strength of the tool lies in its focus on soft issues such as communication and dialogue, conflict handling, and interactions within the project. Since Projects largely fail for non-technical (Walley, 2013), therefore a focus on soft issues is to a great extent a contributing factor to project success. There is definitely a need for updating the obtained results from the use of PHCs when a project is finished, in order to evaluate the overall performance of the project within the areas that the health checks take into consideration.

Areas for further research on this topic include performing action research and thus modifying the PHC tool while it is being implemented, in order to observe closely the shortfalls and examine the level of validity and reliability of results. It is also of interest to test the tool in other industries, in order to explore its efficiency as an early warning system.

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1. PUS is a short form of “Praktisk styring av usikkerhet i prosjektsett fra prosjekteiers perspektiv [Practical uncertainty management in a project owner’s perspective].” The project was collaborative venture between the Norwegian Center of Project Management (NSP) and the Research Council of Norway. [↑](#footnote-ref-1)