

Reducing the Risk of Misalignment between Software Process Improvement Initiatives and Stakeholder Values

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Abstract

Software companies who want to improve software process capabilities (SPCs) need a systematic method to make informed investment decisions on software process improvement (SPI) initiatives. Such decisions should aim at creating maximum stakeholder values. Existing software process assessment models such as CMMI and SPICE give an overview on relevant SPCs but do not help in aligning the investment decisions on SPI initiatives with stakeholder values. This echoes in our research experiences with the Finnish software companies. To address this problem, we present a method with tool support that may help companies align stakeholder values with SPCs and SPI initiatives. The proposed method has been developed based on the well-established “Quality Function Deployment” (QFD) approach. We report on experiences from applying the method and tool support in project workshops with SPI specialists and a Finnish software company. The experience with the proposed method suggests that it particularly helps to reduce the risk of misalignment by identifying those SPI initiatives that are most beneficial to stakeholders. The tool support provided with the proposed method also generated positive experiences in increasing the usability of the method and helped companies in the elicitation and prioritization of stakeholder values.

Keywords

Software Process Improvement, Risk Management, QFD.

1 Introduction

Company executives need to invest in change initiatives that are most likely to improve those core capabilities of the company that have considerable impact on benefits provided to customers and other success-critical stakeholders. Change initiatives include, but are not limited to, SPI initiatives and aim at improving a company's performance in delivering stakeholder values. Software quality teams often struggle to convince senior management to grant funding for SPI programs for lack of getting a clear picture of tangible benefits [9]. Even if there is common understanding on needed investment in SPI programs, senior management and the SPI team still may fail to invest in “right” capabilities, i.e., capabilities that best improve the value to stakeholders. By investing in right capabilities companies may diminish risk of spending financial assets on change initiatives that do not provide evident advantages to stakeholders.

While there are many potential benefits of SPI initiatives, one of the major risks is to focus on initiatives that have only marginal effects on capabilities of the company and bottom-line benefits. We refer to such misled focus as “misalignment of SPI initiatives and stakeholder value”. Software process assessment models, such as CMMI or Spice, are useful to give an overview on relevant target candidates in software process areas (SPAs) and provide feedback on process maturity to motivate SPI initiatives [3]. However, research work conducted at Software Business Lab (SBL)¹ through annual software industry surveys (OSKARI)², and several project-specific industry collaborations with Finnish software companies, found a) only little overlap between CMMI/Spice SPAs and the companies’ needs for improvements of core capabilities, b) considerable risk of investment into SPI initiatives that provide little tangible benefits to company stakeholders, and c) very little method and tool support, which can be used with experts from different domains (e.g., business and IT) in the company, for the evaluation and alignment of SPI initiatives. Based on these practical insights, in this article, we present a method for eliciting and aligning stakeholder values with a company’s software process capabilities to identify the most promising SPI initiatives. Stakeholder value is the part of value-based requirement engineering activities which includes: *“identification of success-critical stakeholders; eliciting their value propositions with respect to the system; and reconciling their value propositions into a mutually satisfactory set of objectives for the system”* [2]. The proposed method is largely based on “Quality Function Deployment” (QFD) principles and is supported with a prototype tool for more efficient data collection and analysis. The method comprises two iterations:

I) The first iteration helps to understand the alignment/impact between stakeholder values and SPCs,

II) The second iteration helps to understand the alignment between SPCs and SPI initiatives.

Based on the analysis of alignment data from both iterations, the decision makers are more likely to make an informed decision on investing in “right” capabilities, which shows a strong connection between SPI initiatives, SPCs, and stakeholder values. Furthermore, the accompanying tool support intrinsically fosters an improved common understanding between senior management and SPI teams on the value of SPI initiatives. The main contribution of the proposed method is in its applicability in the real-world context. We report on initial experiences of executing the method and tool in a pilot workshop and a Finnish software company. The method and tool are undergoing further empirical examinations in Finnish software companies and SPI specialists in the research project - VASPO³.

The remainder of this paper is structured as follows. Section 2 summarizes related work on stakeholder values, SPCs, SPI, and QFD and presents the main research focus. Section 3 presents the method and illustrates its steps. Section 4 presents and discusses experiences on the application of the method and a few limitations of the method. Section 5 concludes the paper with directions for further research.

2 Related work and research issues

There has been no dearth of software process models and improvement programs. Although all have some specific merits and argumentation, many of them have failed to convince the practitioners on the models’ practical use. Among these, SPI programs have been most talked about, whether it is just “prestigious” to quote company’s investment in SPI programs or “self satisfying” with continuous improvement. It is quite difficult for senior managers to see the “measurable” benefits, the problem addressed by a few scholars [4], [12]. However, here, we are addressing another practical concern of the practitioner that has been hardly addressed by SPI research – how to best align stakeholder value propositions against SPCs and SPI initiatives. Our proposition, in the form of an applicable method, is mainly based on research in the Finnish software industry. The next subsection captures the relevant background issues related to the two iterations of the proposed method.

¹ www.sbl.tkk.fi

² <http://www.sbl.tkk.fi/oskari/index.htm>

³ The research work is carried out under Finnish national research agency – Tekes’ funded project referred to as “Value-based Software Process and Organizational Change Management” (VASPO). More information about the VASPO project is available at www.vaspo.fi

2.1 Stakeholder value and software process capabilities (SPCs)

SPI initiatives are waste of money and energy if they are not useful to stakeholders. Stakeholders could be customers, programmers, executives or others who are in the scope of the SPI program. Stakeholder value is often depicted by success factors of SPI. Here, we distinguish stakeholder value with added emphasis on usefulness of offerings of SPI to its key beneficiaries. This is in line with Boehm [2] who argues that main failures in software projects are caused by value-oriented shortcomings since projects often fail to consider stakeholder values. The stakeholder values may range from user involvement, clear statement of requirements to executive management support, and proper planning depending on the stakeholder [3]. If we take examples of SP assessment models such as CMMI and Spice, we see little overlap between process areas of different such models. As a result they are limited in improving company's SPI capabilities. Within CMMI, for example, the SPAs in lower level of maturity ladder are well aligned to creating tangible stakeholder value such as software project planning, requirements management, software quality assurance, and software configuration management. CMMI and the related material proves a good cook-book of SPAs for practitioners; where to start, which order to execute, how to assess progress etc. But when it comes to measurement of increase of value produced, there seems to be a discontinuation between levels 1-3 and 4-5. On the lower levels it is evident that focusing on basic project management (incl. requirement management, configuration management, project planning, measurement and analysis etc) and further focusing on process standardization (incl. decision analysis and resolution, risk management, organizational areas, verification and validation, etc.) is likely to produce a significant improvement in both productivity and quality. However, at higher maturity levels, the alignment of SPAs seems to be weaker. For example process change management and technology change management are not well aligned. Nonetheless, beyond process models, stakeholder values also need proper alignment with SPCs.

The development of SPCs to address the change and organizational inertia must be done somewhere outside the scope of CMMI. On the higher CMM levels how can the SPI actions be valued? The issues will get very hard to understand and SPI initiatives hard to justify for people whose expertise is in the business disciplines instead of software engineering disciplines. A simple, clear and informative method together with a tool for data collection, analysis, and visualization is required i.e. for almost daily use to remind which initiatives seem most important, why and how they are selected. If we consider customers, a company should focus on "what capabilities do we need to develop for adding value for the customer" and view customers' strategic behaviour as a process of identifying and developing SP capabilities that company employs to "create unique level of value for selected customers and other stakeholders" [8]. This indeed requires multiple groups' involvement within the company to develop common understanding of stakeholder needs and values which in turns develops capabilities and competitive advantage [10]. Consequently, the alignment of stakeholder values and SPCs is essential for selecting the SPCs that become "right" candidates for SPI initiatives.

In the proposed method, we give opportunity to stakeholders to brainstorm and decide on aggregated consensus about the values they want to focus on when aligning with SPI initiatives, attempting to address the need of an informative method. This is captured under iteration I of the proposed method. In the next sub section we look at the relevant background behind iteration II, i.e., aligning SPCs and SPI initiatives.

2.2 Software process capabilities (SPCs) and SPI initiatives

Aligning stakeholder values with SPCs is not enough. There is considerable risk of investment into SPI initiatives that provide little tangible benefits to company stakeholders This is likely to happen if there is not proper alignment between SPI initiatives and relevant SPCs.

The standard SP and SPI models such as CMMI, SPICE etc. rightly address the SPC issue. If used effectively, they help identify key SPCs. However, they seem to be limited in helping to identify SPCs that are "right" for the company to address and invest in. Subsequently, often companies invest money and effort in "less important" capabilities and fail to capitalize on the key SPCs. Some of the critiques on SPI models show that assessments could be "wasteful". For example, Fayad and Laitnen [5] argue

that CMM's practices are idealized practices and the real-world organization compares their practices with an artificial list of practices that are just "ideal" and therefore some practices may not fit the "assessment criteria". It is also noted in our experience and the literature that business value from SPI programs is difficult to assess due to very few data points about the actual costs of such programs quoted by Fayad and Laitnen [5] as "*tantalizing possibilities rather than established facts*". We, rather than reflecting on worthiness of SPI costs or SPI models, address the issue of aligning the investment in SPCs that need improvement. Particularly, lack of systematic method and tool support makes the alignment even harder. We address this issue in our method under iteration II. We execute overall method by proposing a practical tool based on Quality Function Deployment (QFD) approach. In the next subsection we summarize our use and position on QFD.

2.3 Quality function deployment (QFD)

We have used QFD to develop tool support for the proposed method as the QFD helps to concisely structure communications and link together information [6], similar to the structure the alignment challenge posed above. Subsequently, QFD can help in aggregating consensus-based alignment on SPI initiatives. QFD is a comprehensive method that takes into account stakeholder interests within the whole company horizontally and vertically, reflects market demand by using various types of specifications and production process variables which leads to production operations planning [6]. QFD application in software industry is not extensively reported by scholars; however several papers add valuable content to the body of knowledge in this domain. For example, Richardson et al. [11] offered a QFD-based method for SPI in small companies built on self assessment of software processes. Liu et al. [7] used software QFD (software domain adapted) as an approach to connect business goals and CMMI maturity levels by prioritizing requirements from multiple perspectives. The increased use of QFD method in practice has yet not been sufficiently facilitated by efficient tool support. Here, we have compromised some functions in tool support from the original QFD method to make it practically more usable in workshops with company executives. For example, QFD's requirement on capturing full feature set seems too time consuming and complex in scenarios with multiple stakeholders from different domains, like SPI initiative investment projects usually are. The tool addresses this complexity constraint through reducing the scope of the QFD method to its core feature, the alignment matrix and the planning matrix, which indeed suits our method very well.

2.4 Research focus

Evident from the argumentation in this article so far, the main research issue gathers around alignment of 1) Stakeholder values and SPCs and 2) SPCs and SPI initiatives. In this article, we are addressing these issues by presenting a method with tool support for proposed alignment and particularly experience of executing the method in the commercial setting. In the next section, we present the alignment method with a practical example.

3 Method description

In this section we explain and illustrate all steps of the proposed method, which is used in a workshop in which the SPI stakeholders participate. The method consists of seven sequential steps and is divided in two iterations. Figure 1 shows an overview of both iterations. On the left, it shows alignment matrix of stakeholder values and company's SPCs, that is an outcome of iteration I of the method. On the right, it shows the alignment matrix of SPCs and SPI initiatives, that is an outcome of iteration II. Figure 1 also depicts that the SPCs identified in iteration I are used in iteration II to map them against candidates for SPI initiatives. The impact symbols shown on the figure represent the degree of impact between row and column entities. Here, we describe all seven steps of two iterations detail. Figure 1 also shows the synopsis of the steps. The screenshots (based on the tool support) for both iterations

are presented in Appendix 1.⁴

Iteration I: Aligning stakeholder values with SPC

1. **Elicit stakeholder values:** The stakeholders are presented with a list of known value propositions and asked to expand the list by adding values which are specific to their company's context. The compiled list then undergoes a two-staged reduction process (similar to the established in EasyWinWin approach [1]): firstly, each participant votes for the stakeholder value propositions to identify the 10 highest voted factors. Secondly, group negotiation, supported by a moderator and a software tool, prioritizes the identified top 10 factors.
2. **Organizational planning:** Stakeholders rate their company's current performance in delivering each of the stakeholder values identified in step 1. They further set the planned target level for a particular value that should be achieved through one of the improvement initiatives. Stakeholders have the option to include external benchmarks or competitor ratings to set new targets. The performance rate uses a scale from 0 to 5, similar to SPICE's levels, where 0 refers to the company not meeting the stakeholder value at all and 5 refers to fully delivering the value.

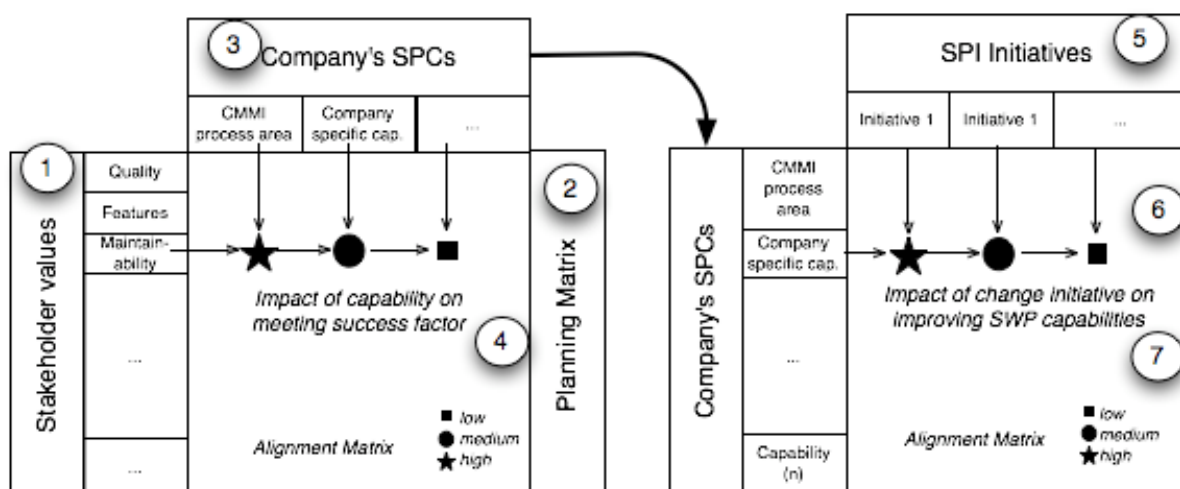


Figure 1: Overview of the method for aligning stakeholder values, software process capabilities, and SPI initiatives.

3. **Elicit company's SPCs:** The method provides a list of SPCs from the CMMI process areas by default. Like in Step 1, stakeholders are again asked to expand and edit the list with their company-specific SPC. Through this expansion process the method enables the stakeholders to combine the advantages of the more generic CMMI framework with their own more specific context. Similar to step 1, the expansion is followed by reduction through voting and prioritization.
4. **Align SPCs with stakeholder values:** Extracting results from step 1 to 3, a matrix is presented with stakeholder values as rows, and SPC as columns. The cells in the matrix are rated with strong, medium or low alignment symbols. The symbols refer to the impact of a SPC on the company's ability to meet a particular stakeholder value. The process of filling the matrix with impact symbols follows the previous prioritization of the stakeholder values and capabilities, with the most important items tackled first. Based on the impact symbols, cumulative impact of SPCs are calculated for each stakeholder value. The SPCs are then prioritized accordingly. The prioritized SPC list is referred to as "chosen SPCs".

Iteration II: Aligning SPCs with SPI initiatives

5. **Elicit SPI initiatives:** The stakeholders are provided with default set of SPI initiatives by the software tool and are asked to expand them with company specific initiatives. Like in previous steps (1 and 3), the expansion of the list is followed by a reduction.

⁴ For detailed worked out example with screenshots, please refer to www.vaspo.org/alignmenttool

6. **Align SPI initiatives with chosen SPCs:** SPI initiatives identified in step 5 are arranged in matrix form against SPCs identified in step 3. This gives the opportunity to analyze impact of SPI initiatives on improving the SPCs. The stakeholders use the same impact symbols as in step 4 to fill the matrix, starting from the most important SPI initiatives and SPC.
7. **Choose the SPI Initiatives which have the strongest impact on improving chosen SPCs:** The first matrix (step 4) helps decision makers to determine which SPCs have the strongest impact on stakeholder value. We refer to these capabilities as “chosen SPCs”. The second matrix (step 6) presents SPI initiatives and their impact on improving the “chosen SPCs”. SPI initiatives with the strongest impact on the “chosen SPCs” are then considered best candidates for SPI investment. Different patterns of impact on SPCs from an SPI initiative are evaluated from the matrix before making the decision on investment.

3.1 Tool support

The above method is supported with the tool, developed largely based on QFD principles using the spreadsheet metaphor. Tool support included all method steps and is facilitated by a moderator during the workshop (similar to EasyWinWin [1]). Tool support guides a group of stakeholders through the process of constructing alignment matrices and facilitates alignment data analysis. During the construction process the tool manages the expansion and reduction of the list for stakeholder values, SPCs, and SPI Initiatives. The tool provides relevant recommendations where required and also prioritizes the value factor list based on agreements negotiated between stakeholders. Monitoring the level of agreement on a particular issue during discussions of the prioritization process contributes to more focused discussions. The tool visualizes the level of agreement for all stakeholders and allows the moderator to direct the argument to those items where consensus has not been reached. The matrix is constructed based on the given information throughout the execution with a graphical user interface. Subsequently, participants obtain the results immediately after the alignment process. Then the results can be further discussed and analysed by the SPI team and company executives for better understanding. For more information on the tool support please visit www.vaspo.org/alignmenttool/.

4 Experiences from method application and limitations

In this section, we present our initial experience with the application of the method. Until now, we have implemented the method in workshops at two instances. We also report and discuss limitations of the method. Please note that due to confidentiality of company strategy the reported data and analysis results are exemplified.

4.1 A workshop with software process experts

In the workshop in the VASPO context stakeholder participated from three Finnish universities, three Finland-based software companies, and a member from Finnish government agency. This was useful for observing implementation of the method in a mixed stakeholder group. Promising results (based on the collected feedback from the workshop) of the method’s application were:

- Six members were familiar with QFD style approach but had not used a practical tool.
- All the industry representatives showed interest in tailoring such a workshop for their company-specific context for better alignment between stakeholder values and SPI initiatives.
- Workshop participants found the method useful in real contexts, of practical value and easy to use.
- The notion of value should be cleared upfront to avoid possible different perception of stakeholder value.

- We made participants work in teams of 2 members. We found this setting generated more discussion and diverse perspectives in reaching the consensus to a particular point. This might not have happened if participants were working alone in the workshop.

4.2 A workshop with the Finnish software company

In the company workshop stakeholders participated from senior management, product management, and the quality assurance team. Promising results of the method's application were:

- Workshop participants found the method useful and easy to use.
- The connection between SPI efforts and improved value production together with the challenges found in core capabilities became better visible to the participants (especially to higher management) in a single measurable and traceable way. The method showed that they had quite differing perspectives among them on stakeholder values and initiatives which could have not been found in their "normal" setting of SPI related investment decisions.
- The moderated process was helpful both for collecting a broad range of candidates for benefits and change initiatives and for effectively reducing (selection and prioritization) the high number to the most important candidates.
- The process needs a competent moderator to guide the group and avoid wasting energy on less interesting issues. Additionally, selection of motivated group members is also important.
- Tool support was found to be useful in effectively collecting and analysing knowledge. The tool takes between 120 and 180 minutes to execute the method in one workshop. It was acknowledged that without tool support, the proposed method could take too long to be reliable. It may take five to six hours to execute the method without the provided tool support. It would certainly be very difficult to sort, filter and aggregate results manually. More importantly, participants felt that *it was very exciting and motivating to see the results on screen with such tool*.
- Tool support greatly reduced the effort and time taken to execute the method and helped focus on the brainstorming and consensus building.
- The strength of linking between change initiatives, company capabilities, and stakeholder values could easily be captured in the process. As an example, assume two of the stakeholder values as fast "product development time" and "on time delivery". One could argue that formalizing current software process may help to achieve them, or maybe an agile SPI initiative like Scrum may be used. However, through the alignment in iteration I of the method, we saw that the capability of "defect prevention" had the strongest impact on fulfilling "fast product development time" and "on-time delivery". Subsequently, we found which SPI initiative was best to improve defect prevention capability? The iteration II showed It was not Scrum but Extreme programming. Such linking of different issues would be difficult without systematic method, the proposed could be one.

4.3 Limitations

One could argue that the success of the proposed method depends on the contributions of the method users, which may induce personal bias voting and building consensus. One way to address this concern is to have a highly competent moderator. Another limitation of the method is in tool support which in current prototype stage only provides the matrices and scoring but does not help in discovering emergent patterns from the alignment data in the matrices. This feature and the tool support's web-based application are under development. Web-based individual control of votes may also help reduce the possible bias in the execution of the method.

5 Conclusions and Future work

This article⁵ reported the key experiences on applying a customized method to better align stakeholder value propositions with SPCs and SPI Initiatives. The experience from an active research cooperation showed that software companies need a systematic approach for their informed decision on identifying SPI initiatives related investments. Furthermore, software companies also need to identify investment targets that are likely to generate substantial increase in stakeholder value.

The experience with software process assessment models were found useful to give an overview on relevant SPCs, but also showed major risks of a mismatch between process areas and companies' needs for improvement of SPCs. These experiences formed motivation to develop a method that helps reduce the risk of misalignment between SPCs and SPI.

As a result, in the article, we presented a QFD-based method that supports the alignment of stakeholder benefits with SPCs and SPI initiatives. Furthermore, we reported on experiences from applying the method and relevant tool support in workshops in the VASPO SPI research project and with a Finnish software company. The proposed work is getting positive response from the Finnish software industry. At least two software companies have already requested to execute the proposed method in their setting. Subsequently, future work for this research is to conduct multiple empirical studies and find out the practical impact of the method after its implementation in the software companies. As a result, a research framework will then be developed, fully grounded on empirical validation, to realize both practical and research impact from this ongoing work.

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⁵ The longer version of this paper with detailed worked out example is available online at www.vaspo.org/alignmenttool

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Appendix 1: Example of method execution (Tool support)

The following example is based on the experience in a workshop with the SPI specialists and a Finnish software company. The example can be mapped to method description presented in section 3. Figure 2 shows Iteration 1 which includes 4 steps. Circled numbers in Figure 2 and 3 indicate corresponding steps. The moderator keeps the control of the tool and moderates the workshop.

Iteration I: Aligning stakeholder values with SPC

① (Elicit stakeholder values) shows that participants identified different stakeholder values from On-time delivery, Operating costs to Quality of support. Based on the voting the tool identifies top 10 stakeholder values and then based on moderated group negotiation, prioritized list of values are identified indicating which values are the most important (for example On-time delivery got highest importance in this example (Figure 2 shows importance in grey vertical bar)

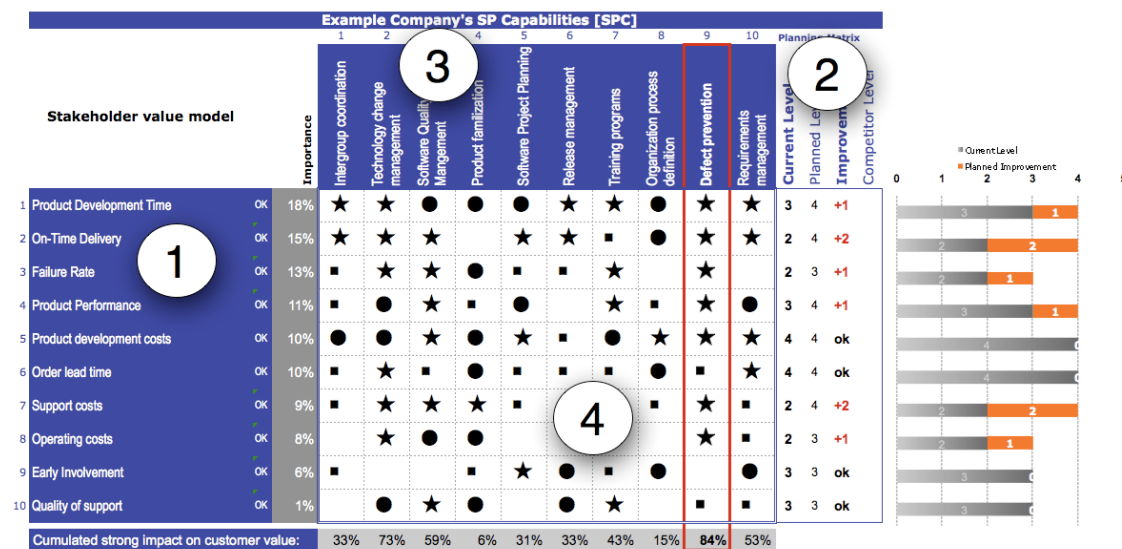


Figure 2: Iteration 1

② (Organizational planning) shows that participants rate company's performance in delivering stakeholder values. Figure 2 shows that participants rate their current level of performance and planned (targeted) level for each stakeholder value. The tool also gives an option to rate performance against the competitor or known benchmark (in Figure 2, we have not used any example).

③ (Elicit company's SPCs) shows that company's SPCs are identified based on the available list in the tool and added company specific SPCs. The identification and prioritization followed same as in step 1.

④ (Align SPCs with stakeholder values) shows that stakeholder values are aligned with the SPC using one of three available impact symbols. (Where no symbol was used the SPC had less than minor impact on the value). The impact is decided based on moderated discussion. In the presented example the capability of "defect prevention" is identified as having the strongest impact on fulfilling the most important stakeholder values, with its cumulated strong impact being the highest. These SPCs (referred to as "chosen SPCs" in the method) are prioritised based on cumulative impact and is used in next iteration for aligning them with SPI Initiatives.

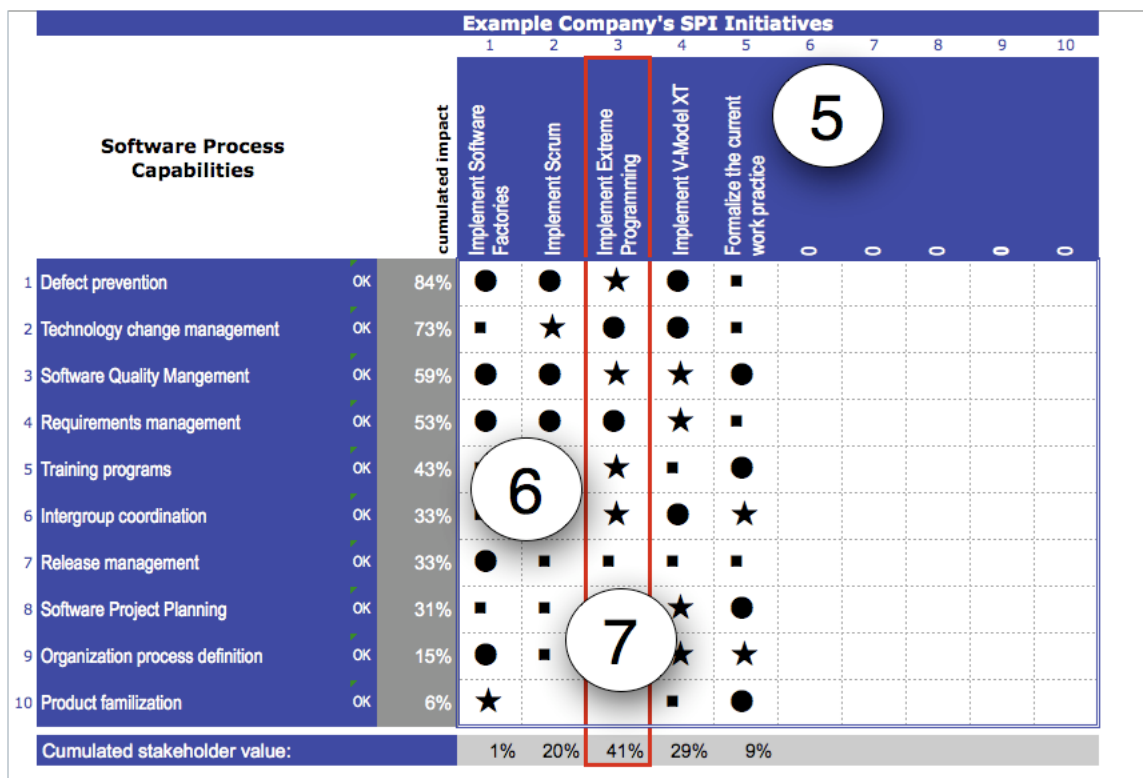


Figure 3: Iteration 2

Iteration II: Aligning SPCs with SPI initiatives

⑤ (Elicit SPI initiatives) shows that like in step 1 and 3, SPI initiatives are identified and prioritized. Figure 3 shows examples of five selected initiatives.

⑥ (Align SPI initiatives with chosen SPCs) shows that similar to step 4, the alignment is performed using impact symbols.

⑦ (Choose the SPI Initiatives which have the strongest impact on improving chosen SPCs) shows that similar to step 4, the cumulative impact of SPI Initiative on stakeholder value is counted for each SPI initiative against SPCs. For example, in Figure 3, implementing extreme programming shows highest possible impact with 41%. This concludes the method and further pattern analysis from symbols can be done. This helps decision makers to identify relevant SPCs and their alignment to SPI Initiatives.