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Goal alignment in process improvement

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ABSTRACT

Process improvement should improve an organisation's ability to achieve its business goals. While mapping an organisation's strategic goals through various layers of management is common, such mapping does not seem to continue through to their processes that create value to the organisation. Despite a number of process improvement methods being available, and almost two decades of experience with those methods, many process improvement projects do not end successfully.

We explore the impact process assessment has on process improvement. In particular, we study the alignment of an organisation's process goals to its business goals; and the contribution of process assessment to this goal alignment. This paper illustrates the data gathered through industry survey reflecting the lack of focus on and alignment of organisation's business goals throughout process improvement. The results indicate that there is little knowledge and experience in industry in aligning the process goals and organisation's business goals. This, in turn, could explain the unsuccessful process improvement efforts or perhaps even the skepticism towards process improvement in general.

1. Introduction

Business creates value for its customers and an organisation creates value for its stakeholders through its value-adding work processes (Rummler et al., 2009). However, processes need continuously to undergo changes and refinements in order to increase their ability to deal with the requirements and expectations of the market and of the company stakeholders, leading to the need for continuous process assessment and improvement (Fuggetta, 2000).

Process improvement is an applied academic field with theoretical heritage from the Total Quality Movement (Lepmets, 2007) aiming to increase efficiency (ISO/IEC 15504-1, 2004) and performance of an organisation. Process assessment is related to process improvement as a way to identify the current state of processes, the critical process problems and to establish improvement priorities (Humphrey, 1989). Process improvement has long been troubled by poor alignment between an organisation's business goals and its goals on the operational level. An organisation's processes may end up as a burden rather than advance the business where process improvement goals are not aligned with business goals (Dyba, 2005).

There are a large number of process models (CMMI v1.3, 2010; ISO/IEC 15504-2, 2004) and process improvement methods (Reinertsen, 2009; Schroeder et al., 2008) available, but aside from some studies (Brodman, 1996; Goldenson and Herbsleb, 1995; Goldenson and Gibson, 2003; Herbsleb et al., 1994) there is little recent research available that evaluates the impact of these models and methods on organisational performance in industry. Despite a general agreement that in order to succeed in process improvement, the improvements have to be aligned to and support the achievement of the business goals of the organisation (Gray and Smith, 1998; Rummler et al., 2009; Shaikh et al., 2009; Sterman et al., 1997; Weiss et al., 2002), nowhere is it said how this alignment can be achieved in practice. In this paper, we explore the impact of model-based process assessment on process improvement, more specifically on the alignment of the process goals and the organisation's business goals.

Companies involved in process assessments often become too focused on internal considerations and lose touch with the customer focus (Gray and Smith, 1998). Rummler et al. believe that the root cause for the lack of success in process improvement is that most people still do not recognise and understand that organisations are systems and do not realise the implications of this on how organisations should be planned, designed and managed. This, in turn, means that the value of process concepts continues to be misconstrued and misapplied (Rummler et al., 2009). Processes are part of a larger organisational system and therefore cannot be tinkered with in isolation but should be modelled, improved, and managed in the context of the total value creation system of a business – as a contribution to that total value creation system (Rummler et al., 2009). In this paper, we are not talking about how

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to model a process or the technology for performing a process, nor the tools and techniques for managing projects. We are looking at the processes from the viewpoint of process improvement and process assessment, focusing on the alignment between the work processes and the organisation's business goals.

The motivation for this study is based on the lack of a comprehensive understanding and practice in aligning process goals with the business goals of an organisation. Process improvement has several critical success factors (Arent, 2000; Dyba, 2005; Grover, 1999; Herbsleb et al., 1994; Iversen, 2000; Kinnula, 2001; Lepasaar et al., 2001; O'Hara, 2000; Rainer and Hall, 2002; Varkoi, 2000; Zahran, 1998), and we believe that goal alignment is one of them. Too often are processes assessed in isolation focusing on the improvement of that single process without considering its impact on all the other processes and on the organisation's business goals. We suggest that process assessment presents an opportunity to see the big picture – the organisation as a system and therefore contributes to the goal alignment between process improvement and an organisation's business. The following section describes the background to process thinking and process goals. Research that is closely related to the current study is discussed in greater detail in Section 3. Sections 4 and 5 illustrate the research question, the research method, the research approach, and the limitations of the study presented here. A description of the data obtained from industry and the data analysis for hypotheses testing is provided in Sections 6 and 7. The data analysis results are discussed in Section 8, which leads to various possibilities for future work summarised in Section 9.

2. Background to processes and goals

Rummler describes the essence of process engineering as "identifying and improving the work required to deliver organisational results" as he expressed some frustration with the business process management/process movement that seems to ignore these basics (Rummler et al., 2009). He further argues that "process" should start with the desired results and work backward to identify and redesign the steps that must produce those results. While it easy to envisage that processes which are well aligned to an organisation's goals could be devised, experience with business process re-engineering (Al-Mashari et al., 2001) demonstrates how difficult it can be to design and implement such processes. Further it is unlikely that any organisation could design a well-aligned process at their first attempt, illustrating that some form of goal alignment in process improvement is required.

2.1. Process modelling, process assessment, and process improvement

Process modelling, business process modelling and to some extent workflow modelling are all ways to "identify and redesign the work that produces organisational results" (Rummler et al., 2009). The starting point is an absence of working or workable processes, where a new approach is needed in order to establish more efficient and effective processes. Rummler et al. acknowledge and discuss different initiatives that have arisen since 1990 before concluding that each has contributed something to process modelling but each has also diverted attention to specific aspects. For example, workflow modelling has provided tools with which to document, navigate, change and test processes, but has diverted attention to the extensive and complex functionality of the tools and away from the basic problem of creating, changing and saving process maps as a means of modelling processes, their scope, responsibilities and the interactions between them (Rummler et al., 2009).

CMMI contains a process assessment model as well as a process reference model and process measurement scale whereas the ISO/IEC 15504 series do not include or contain a process reference model but do include separate process measurement scale (ISO/IEC 15504-2), process assessment model (ISO 15504-5 and ISO 15504-6) and a process assessment method (ISO 15504-3). The process assessment method associated with CMMI is the SCAMPI method. For convenience, in this paper we refer to the publication in which the assessment model or improvement method can be found.

Process assessment (CMMI v1.3, 2010; ISO/IEC 15504-3, 2004) and process improvement (ISO/IEC 15504-4, 2004; Oktaba et al., 2007; SCAMPI, 2001), the subject of this research, starts after processes have been modelled, deployed and used. It is only after the processes have been in use that there can be an assessment of how well they serve their purpose. While it is true that a process can be improved without an assessment, the formal process assessment methods try not only to identify and treat the symptoms of process problems but also their underlying causes. Process improvement then builds on the findings of process assessment by determining the process changes that will serve the organisation's best interests at the time.

2.2. What is a process?

Early concepts of process considered how the division of labour would increase production (Smith and Erwin, 2010). Taylor's famous Scientific Management (Taylor, 1911) aimed to increase prosperity for both worker and their employers through increased productivity. Quality, along with improved output, became the focus of processes during the Second World War (Beer, 1968; Heyel, 1982). The focus on quality as a goal of improvement continued with the work of Deming (1986) who observed that reducing the number and severity of defects during the production processes also improved productivity and reduced production costs. Deming observed that improving quality of the product or service had a side effect of improving the productivity and reducing costs. Process goals can therefore be divided into two types: those that relate to product or service attributes, and those that relate to the overall system of processes. The granularity of processes can vary considerably, sometimes encompassing the entirety of software development from problem definition to final deployment as a single process, and at other times used in a finer grained sense as described in ISO/IEC 12207 (2008) or ISO/IEC 15288 (2008) in which processes have to achieve a single specific purpose. In this research, we use the term "process" in the manner of ISO 12207 or ISO 15288.

2.3. Goals of individual processes

The primary goal of each process is to achieve its stated purpose. However, there are also goals of quality, time and cost to consider. The purpose of the process may be to develop an architecture of a system that can be achieved reasonably easily. But to develop an architecture of a system that will be fit for purpose when it is eventually built and to do so with a minimum of errors within a reasonable time for an acceptable cost are also goals of the process. Achieving them is not accidental and, in addition to that, the goals themselves are always changing as industries develop better ways of working. For the most part, improvements in software quality have been achieved, among a number of other innovations, through the Personal Software Process (Humphrey, 1994), adoption of different methods of specifying requirements (Gilb, 1988), different methods of project estimation and planning (Boehm et al., 1995), better tools and languages. These are improvements to or substitutions of activities within an established set of processes. Some domains, e.g. medical software (MediSPICE) or

automotive (AutoSPICE) (Johannessen et al., 2011; Sivakumar et al., 2011) require additional activities and even additional processes to achieve the required goals.

2.4. Goals of systems of processes

Improvements in one of the processes may prove counter-productive for the system of processes as a whole so attention also needs to be paid to those goals that relate to the system of processes as a whole. These may be goals to repeat past successes, to perform faster than the competition or to adapt to different circumstances easily. As an organisation's processes achieve higher levels of capability repeatability improves and variation reduces (Goldenson et al., 2003) but there is no guarantee that improvements in product quality will be accompanied by a reduction in time or cost.

Ferdows and De Meyer (1990) observed that some manufacturers seemed able to achieve several process capabilities simultaneously rather than maximise the achievement of only one as predicted by trade-off theory that prevailed at the time. They proposed a "sand-cone" model of process capability in which an organisation could pursue different process capabilities in a sequence of quality, dependability, speed, and cost efficiency. Subsequent work supported the notion of cumulative capabilities but indicated that there were environmental contingencies in their pattern (Flynn and Flynn, 2004). The differing cumulative capabilities in the examined regions of the world indicate that manufacturing processes, at least, can and are directed toward specific goals of quality, flexibility, time or cost.

2.5. Goals of process improvement

Process improvement methods can be directed at improving specific processes, the system of processes as a whole, or at improving the achievement of the goals of these processes. A process improvement method such as Six Sigma (Schroeder et al., 2008) seems primarily to be directed at specific process problems. By contrast, "Lean", with its highly publicised attention to different forms of waste is more concerned with achieving the purpose of the system of processes as a whole (Reinertsen, 2005). At the lower levels of capability, CMMI and ISO/IEC 15504, largely concentrate on improving the system of processes as a whole whereas the upper levels, levels 4 and 5, provide a specific method with which to detect and remedy process problems but do not restrict the subject or purpose of those methods. None of these process improvement methods deal directly with process goals or goal alignment.

3. Related research on goal alignment

This research focuses on the goal alignment between an organisation's business and its processes, evaluating the impact of process assessment on this goal alignment. Thus, this research is first and foremost related to goal alignment in process improvement and process assessment, and secondly to strategic planning and strategic alignment between strategic and operational goals.

Rummler et al. (2009) describes process management/improvement as the work required to deliver organisational results claiming that the processes are, in fact, the key to an effective performance of an enterprise. Process improvement is the action taken to change the organisation's processes so that they more effectively and efficiently meet the organisation's business goals (ISO/IEC 15504-1, 2004). The purpose of process assessment is to identify areas of the highest priority for improvement and to provide guidance on how to make those improvements (Humphrey, 1989). Process assessment models, such as CMMI and ISO/IEC 15504 provide the basis for an orderly explanation as well as a framework for establishing problem priorities (Zahran, 1998) but they do not provide proper guidance on how organisations should define their processes based on their strategic priorities (Barreto and Rocha, 2010).

Process improvement initiatives should be integrated with the overall strategy of the firm (Sterman et al., 1997) and addressing the organisational needs (Shaikh et al., 2009) where processes are viewed in the context of the development and client organisations (Gray and Smith, 1998). Weiss et al. suggest deriving assessment goals from the goals of the organisation undergoing assessment, thereby providing an understanding of and feedback on a wide variety of issues ranging over product quality, organisational morale, productivity and customer expectations. Taking this wider focus on processes is important in order to reinforce the feeling that the recommended improvements create benefits for the organisation (Weiss et al., 2002).

Strategic planning is the definition of goals, investments and plans based on the analysis of strengths, weaknesses, opportunities and threats related to an organisation that specify the series of concrete steps needed to realise the strategic vision of the organisation (Mintzberg, 1994). Strategic alignment became a popular concern due to the inability of organisations to realise the value of their IT investments. Henderson and Venkatraman (1993) suggested a strategic alignment model that defines strategic choices in four fundamental domains of business strategy, information technology strategy, organisational infrastructure and processes, stressing the need for continuous adaptation of the business and rearrangement of the internal infrastructure according to the trends of the external environment. Kaplan and Norton (2000) argue that especially now in the information age where businesses are increasingly creating and deploying intangible assets, organisations need to show how they convert their initiatives and resources such as corporate culture and employee knowledge into tangible business outcomes, suggesting the use of strategic maps and balanced scorecards. COBIT (Control Objectives for Information Technology) describes a set of generic business goals and a set of IT goals linked to the business goals, illustrating good practices in management, measurement and control of business and IT goals (Fortuna and Mohorcic, 2009). Based on Guzmán et al. (2010) there are only few relevant case studies illustrating the alignment between a company's strategy and its process improvement initiatives that are quantitatively controlled by a measurement programme and the appropriately integrated information needs of senior management. Guzman et al. propose a methodology (Balanced Objective-Quantifiers Methodology) which is based on the principles of the Balanced Scorecard, the Goal-Question-Metrics approach (Basili et al., 1994; van Solingen et al., 2002) and Practical Software and Systems Measurement (2000). It maps each strategic goal to a process improvement goal with quantitative measurement in order to understand the achievement of the strategic goals (Guzmán et al., 2010). Barreto and Rocha (2010) also look at goal alignment and suggest decomposing long-term strategic goals into medium-term tactical goals and short-term operational goals together with automated measurement of goal achievement in software improvement. Although Barreto and Rocha focus on goal alignment in product improvement, and Guzman et al. on the measurement of goal achievement they both conclude that in order to get a clear understanding of how each job links to the overall objectives of the organisation, enabling everyone to work in a coordinated, collaborative fashion towards achieving the company's desired goals (Kaplan and Norton, 2000), realistic strategic goals must first be defined and communicated.

Our study extends on various works describing different approaches for measuring process improvement and innovation (Börjesson et al., 2007; Dyba, 2000; Freeman et al., 2004; Hall et al., 2000; Subramanian et al., 2007), and is also closely related to works

describing strategic planning and alignment of strategic goals to operational goals.

4. Research question and hypotheses

In the current study, we evaluate the impact of process assessment on the success of process improvement. The study focuses on how well an organisation's business goals are identified, communicated, and aligned to the process goals and if process assessment contributes to the goal alignment.

Process assessments are used to determine the capability of a process to reach this goal (Barafort et al., 2002). For that purpose, a process assessment should revisit and communicate the organisation's business goals. It should prioritise the goals of process improvement and increase the alignment between the organisation's process goals and its business goals. Rummler et al. (2009) points out that when process improvement projects are conducted directly with the senior executives of the business units, things will happen quickly, with no resistance, focusing on critical business issues such as total customer satisfaction, value creation and growth of the business. This is only possible when business-critical processes are improved. For the rest of the processes, most of which are enabling processes, process improvement rarely involves managers, management commitment and support is usually sufficient.

Our research question is as follows:

Is process improvement that follows a process assessment positively related to the alignment of process goals and the organisation's business goals?

In order to be able to answer the research question, the following hypotheses were defined:

H1. Process improvement goals are set and met more often when process assessment has been conducted prior to process improvement.

H2. Process assessment is positively related to awareness of an organisation's business goals.

H3. Process assessment is positively related to the alignment between process goals and the organisation's business goals.

H4. Process improvement after process assessment is positively related to the alignment between process goals and an organisation's business goals.

5. Research method and approach

This research is descriptive in nature with characteristics of both analytical and evaluative research. The data were gathered using the survey method. Although different research strategies overlap and case studies could also have been used for this study, Yin (2002) points out that the survey strategy is an advantage when the research goals are predictive regarding their outcomes. In case studies the "how" and "why" are the questions being studied and explanations are the typical outcome, rather than the "what" of "how much" and "how many", which are the typical questions for the predictive survey approach. In this study, we aimed to find out "what" the impact of process assessment is on the success of process improvement, and "how much" process assessment contributes to the alignment between an organisation's business goals and its process goals.

As survey approaches tend to provide for generalisability but lack internal validity we increased internal validity by providing a detailed background description of each respondent and asking additional verification questions.

Our survey questionnaire was targeted at all organisations worldwide as processes (the way one works) are being improved everywhere. The questionnaire was sent to 44 researchers, consultants and quality managers working in process improvement and to the international software and systems standardising subcommittee of the International Standardization Organization (ISO/IEC JTC1 SC7) with the request to submit and distribute the survey further within their respective professional networks.

In order to verify that the survey method fits to the study, a pilot study was conducted. A dozen international experts from industry and research were asked to review the survey and give feedback about the relevance of the survey questions in terms of the hypotheses described above. There were many improvements made to the questions and, more specifically, to the scales used in the survey as a result of the pilot study.

The survey questionnaire is divided into four parts. The first part aims to gather demographic information about the organisation and the respondent. All survey questions were mandatory except for the contact information; thus the survey was anonymous.

The questions in the second part explore the respondents' understanding of process improvement. Process improvement can be either a personal improvement to the way one works or a rigorous improvement programme that the whole organisation is undertaking. We asked when, by whom and how process improvements are initiated and how progress is measured. In order to be successful in process improvement, an organisation needs to address several issues to support process improvement. We address some of these issues described in more detail in (Pries-Heje and Johansen, 2007) that are related to goal identification and alignment, and motivation in our survey questionnaire. This will allow us to recognise the organisational support that is provided to the process improvement and possibly explain its success or failure. This part allows multiple responses from the predetermined list of choices to be selected; "other" could also be selected together with a description in case no suitable option was listed.

The third part targets process assessment. From this part forward, the Likert scale is used with value options ranging from "Strongly agree" to "Strongly disagree" and additional options of "I don't know" and "Not Applicable". The questions in this section are exploring the respondents' understanding of process assessment goals. We also asked empowerment-related questions to find out whether involvement in process assessment (in decision making about which processes to improve, for example) inspires respondents to work towards achieving the improvement goals as well as the organisational business goals.

Finally, we wanted to know how improvements were implemented and how the improvement projects/programmes/initiatives ended. We wanted to find out whether the respondents knew what were the goals of the process improvement and if these goals had been achieved. Many improvement programmes are never completed because implementing improvements after process assessment requires the organisation to invest a lot of work and time. We wanted to find out if improvements had been implemented and at what point (if any) process improvements had ended. Although, process improvements should ideally be continual, there are various organisational reasons for improvements not to be carried out further at some point. The primary aim is to find out how the goal-related variables of process improvement are related to process assessment.

5.1. Limitations

The sampling method used in this study imposes a limitation on the generalisability of the results. As it was impossible to determine the companies interested in process improvement, determining the sample from that population is equally impossible. Non-probability sampling was used instead, more specifically its snowball technique. 44 researchers, consultants and quality managers in our

Table 1
Core business area of the respondents' organisations.

	Frequency	Percentage
Software development	11	17.5
IT service provider	13	20.6
Software developer and IT service provider	16	25.4
Banking and finance	3	4.8
Other, e.g., consultancy, R&D	20	31.7
Total	63	100.0

Table 2
Size of respondents' organisations.

	Frequency	Percentage
Micro (<9)	5	7.9
Small (10–49)	6	9.5
Medium (50–249)	10	15.9
Large (>250)	42	66.7
Total	63	100.0

professional network were contacted and requested to distribute the questionnaire among professionals in their network. Some of them responded to the survey themselves and others distributed it to larger groups of practitioners.

This research looks at companies who have undergone process change or process improvement either with the help of process assessment models or without them. There is a wide variety of international standards, models and methods for process improvement that companies can use today. In our data analyses, we focus only on two of them, CMMI and ISO/IEC 15504. Since we explore the impact of process assessment, we focus on these two widely known and maintained process assessment models. Both ISO/IEC 15504 and CMMI are used extensively in industry for process assessment purposes. ISO/IEC 15504 is the only international standard for process assessment at the moment. CMMI has evolved from the concepts of software maturity frameworks in the 1980s and has therefore enduring underlying ideas behind it. Although an organisation could also use these two models as best practice libraries, in this paper we focus only on their application in process assessments.

6. Data obtained—description of data

An online survey was used to collect data from industry about the goals set, communicated, and aligned in process assessment and process improvement initiatives. After five months, 63 completed responses were received, over half of them from companies developing software or/and providing IT services (Table 1).

Over half of the responses came from large organisations employing more than 250 employees (66.7%), 15.9% from medium-sized organisations employing 50–249 employees and 17.5% from both small (with 9–50 employees) and micro (up to 10 employees) organisations (Table 2). Enterprise size classification used here is based on the European Commission Recommendation 2003/361/EC regarding the definition of SMEs (EC, 2003).

Since cultural aspects play an important role in process improvement initiatives, we also sought information about the location of the respondents' organisational headquarters. The geographical distribution of the responses is: 70% of the responses came from Europe with Finland being the most active respondent, 12.7% of the responses came from USA, 4.8% from India, and 8% from Mexico, Australia, and Peru combined.

In order for us to understand the conditions in which companies support process improvements more, we also sought information about the standards and frameworks implemented by the organisations. Table 3 illustrates the responses about the standards, models, and frameworks used in the respondents' organisations. The survey allowed the respondents to choose as many responses as were relevant in their case. The majority of organisations use their own knowledge and experience in process improvement, followed closely by ITIL, CMMI, ISO 9000 and Lean. The popularity of ITIL (the most popular framework in IT Service Management, itSMF, 2010) and CMMI corresponds to the core business areas of the respondents, the majority being IT service providers and software developers (Table 1).

As Jones (1996) points out, it is not wise to start process improvement if managers do not calculate the return on investment or collect data to demonstrate progress. There are various ways to measure progress (Statz, 2005). Table 4 illustrates how process improvements were measured among the respondents' organisations. In almost half of the cases, process improvements were measured based on the customer and stakeholder satisfaction, followed closely, to our great surprise, by evaluating the achievement of the organisation's goals. Standard or process model based assessments indicate the strengths and weaknesses in processes and suggest how to improve them. Standard or model based process assessments were carried out in 27 cases out of the overall 63 responses, only slightly less than the number of respondents who conducted process assessment prior to process improvement (51%) or the number of respondents who initiated process improvement after conducting a process assessment (46%).

7. Data analysis

Appendix A lists the questions, and their possible responses, that yielded the data used to test the hypotheses. The questions are described using their question label and response sequence number with the question code, the latter being referred to as items in this section. The range of questions and responses used in this analysis includes items J1–J6, L1–L12, M1–M8, N1–N5, P1–P6, S1–S2 and V1–V6.

Out of these items, we were able to compute two factors: the first one is the responses in which process assessment was carried out prior to process improvement (J4) and where the international standard ISO/IEC 15504 was used (L3); and the second one is where process improvement was initiated by process assessment (M8) and where the process model of CMMI was used (L4). These two factors explain 71.5% of variance (Appendix B). We have labelled these factors PA_SPICE and PA_CMMI, respectively. Both factors are comprised of two items. The values for the factors vary from zero to two, representing the presence of neither one of the items (0.0), one of the items (1.0) or both items (2.0) in the composition of the factor in each correlation analysis conducted.

The data in this study have been analysed using nonparametric statistics since they are nominal and ordinal, and central tendency and variability cannot be obtained. In order to measure the strength of association between variables measured at the ordinal level, we

Table 3
Standards, methods and frameworks used ($n = 63$).

Own experience and knowledge	PSP/TSP	ISO/IEC 15504	CMMI	Six Sigma	ITIL	CoBIT	ISO/IEC 20000	ISO 9000	Lean	Theory of constraints	No improvement methods used
41	6	18	31	15	33	9	9	24	23	6	2

Table 4
Measuring process improvements ($n = 63$).

Improvements are not measured	Measuring personal performance and/or productivity	Evaluating the achievement of product or service quality requirements	Evaluating the achievement of project or service performance objectives	Measuring project productivity	Conducting model/standard based process assessments	Evaluating stakeholder/ customer satisfaction	Measuring organisational productivity	Evaluating the achievement of organisational goals	Calculating the return on investment for process improvement
6	25	25	26	21	27	34	16	31	11

Table 5
Correlation matrix of process assessment factors, and setting and meeting process improvement goals.

	PA_SPICE	PA_CMMI
S1	−.152	−.227
S2	−.073	−.135

Note. The correlation matrix illustrates the Spearman rho correlation coefficients obtained from the dependent variables of the study. PA_SPICE is a factor that represents the population that carried out process assessments with ISO/IEC 15504. PA_CMMI is a factor that represents the population that carried out process assessments with CMMI. S1 represents an item of "process improvement goals were set" with lower values describing higher frequencies. S2 represents an item of "process improvement goals were met" with lower values describing higher frequencies. * Correlations are statistically significant when $p < 0.05$. ** Correlations are statistically significant when $p < 0.01$. $N = 63$ responses.

used the Spearman's rho correlation coefficient which is a special case of the Pearson product-moment coefficient where data are converted to ranks before calculating the coefficient. The data analysis was conducted using the IBM SPSS Statistics data analysis tool.

In order to answer the research question, we calculated the Spearman rho correlations between the two factors, which we called PA_SPICE (process assessment with SPICE) and PA_CMMI (process assessment with CMMI), respectively, and the items from the survey necessary for testing the hypotheses.

H1: Process improvement goals are set and met more often when process assessments have been conducted prior to improvements.

In order to support or reject this hypothesis, we looked at the correlations between the two process assessment factors and items S1 and S2, which illustrate the frequency of setting and meeting process improvement goals.

Figs. 1 and 2 illustrate two histograms each, which show the frequency of setting and meeting the process improvement goals among the population of the survey. Three columns are displayed for each point of frequency on the histograms. The vertically striped columns of the histograms stand for the highest values of the factors, i.e. the population where both items were present (the process assessments were conducted and either CMMI or SPICE was used). The white unfilled columns in the histograms represent the population where only one item was present in the factor (either process assessment was conducted or CMMI or SPICE was used), whereas the chequered columns stand for the population that neither conducted any process assessments nor used CMMI or SPICE.

Fig. 1 illustrates the responses regarding the frequency of setting process improvement goals among the survey population that conducted process assessments (high values of PA_SPICE and PA_CMMI factors) and those who did not (0.0 values in both factors). Fig. 2 illustrates the responses regarding the frequency of meeting process improvement goals among the survey population that conducted process assessments (high values of PA_SPICE and PA_CMMI factors) and those who did not (0.0 values in both factors).

In Figs. 1 and 2 we can see that process improvement goals were set and met frequently, in 75% and 73% of the cases, respectively, regardless of whether process assessments were conducted or not (the process assessment factor values). The frequency of setting and meeting the process improvement goals was slightly higher when process assessments were conducted with CMMI than when process assessment was not carried out with CMMI.

Table 5 illustrates that neither of the factors that describe respondents who conducted process assessments (PA_SPICE and PA_CMMI) is significantly correlated to the items of setting and meeting the process improvement goals (S1 and S2).

We can therefore conclude that H1 is not supported based on our data. Process improvement goals are set and met frequently regardless of whether process assessments are conducted before process improvement or not.

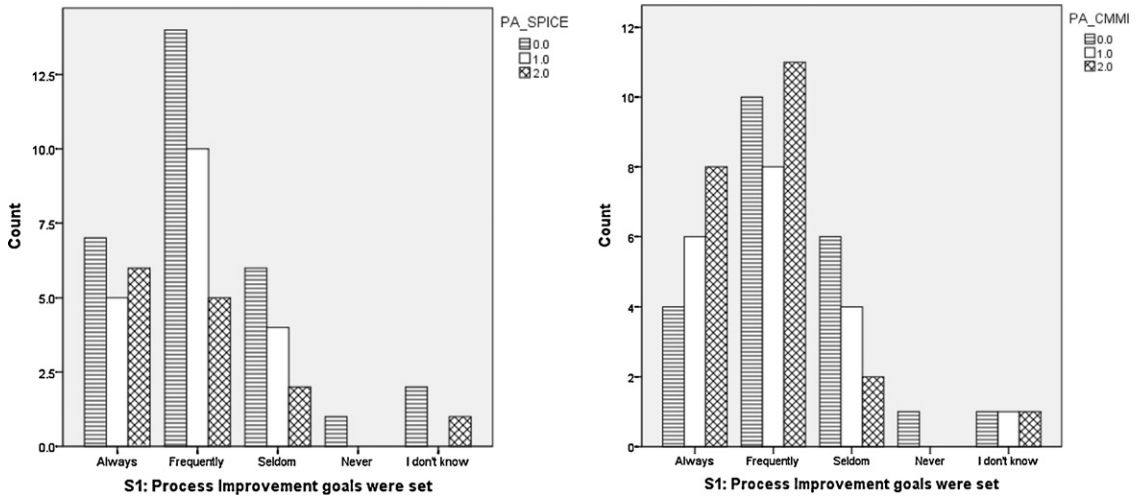

Fig. 1. Frequencies of setting process improvement goals among respondents who conducted process assessments.

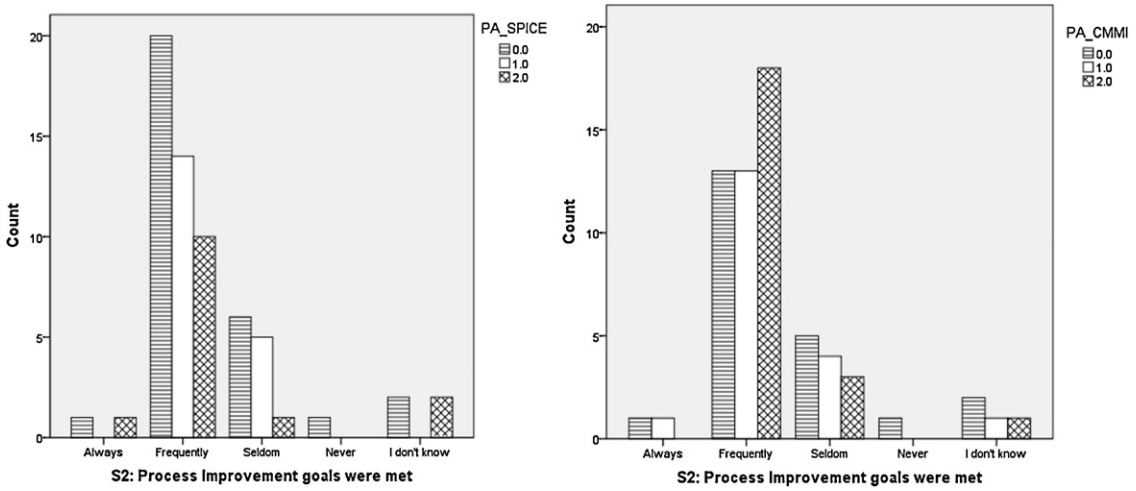

Fig. 2. Frequencies of meeting process improvement goals among respondents who conducted process assessments.

H2: Process assessment is positively related to awareness of an organisation's business goals.

In order to support or reject this hypothesis, we looked for correlations between the two process assessment factors and item P2, which illustrates the responses where the organisation's business goals were known after process assessment.

Fig. 3 illustrates the awareness of the organisation's goals and the factor values of process assessment conducted with SPICE

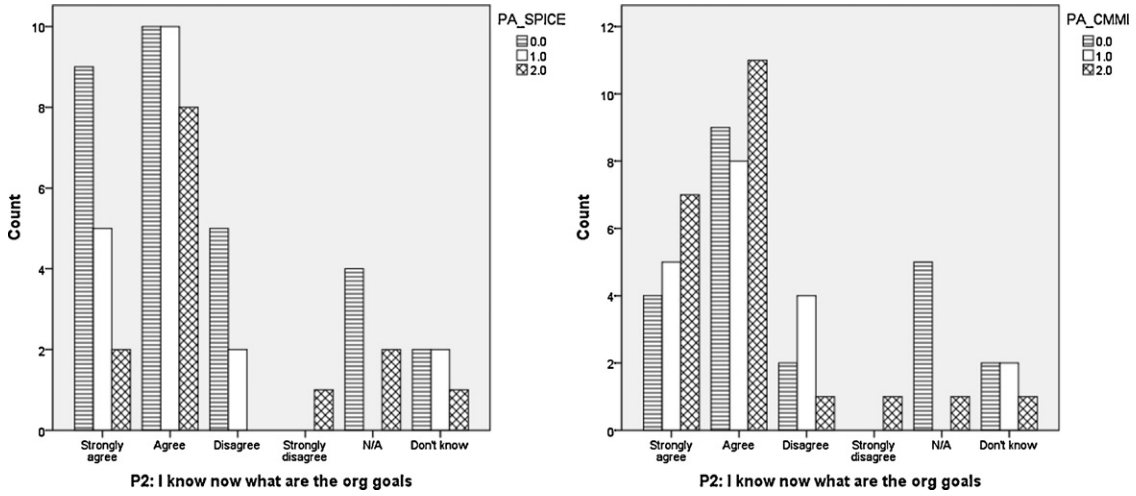

Fig. 3. Frequencies of awareness of an organisation's business goals among respondents who conducted process assessments.

Table 6
Correlation matrix of process assessment factors and awareness of an organisation's business goals.

	PA_SPICE	PA_CMMI
P2	.026	−.213

Note. The correlation matrix illustrates the Spearman rho correlation coefficients from the dependent variables of the study. PA_SPICE is a factor that represents the population that carried out process assessments with ISO/IEC 15504. PA_CMMI is a factor that represents the population that carried out process assessments with CMMI. P2 represents an item of "I know now what the business goals of my organisation are" with lower values describing higher frequencies. * Correlations are statistically significant when $p < 0.05$. ** Correlations are statistically significant when $p < 0.01$. $N = 63$ responses.

and CMMI, respectively. The respondents of the survey believe that awareness of their organisation's business goals will increase after conducting process assessment – the higher columns on the left-hand side correspond to the higher values for item P2. The respondents of the survey believe this regardless of whether they conducted the process assessments themselves or not–the respondents who had conducted process assessments correspond to the chequered columns as the higher factor values in PA_SPICE and PA_CMMI.

Also, the Spearman correlation coefficients between the process assessment factors (PA_SPICE and PA_CMMI) and the item regarding awareness of an organisation's business goals (P2) in Table 6 illustrate that there is no significant correlation between them.

We can conclude that our data does not support Hypothesis H2, i.e. process assessment is not significantly correlated to awareness of an organisation's business goals. Interestingly though, most respondents believe that process assessments should increase awareness of their organisation's business goals.

H3: Process assessment is positively related to the alignment between process and the organisation's business goals.

In order to support or reject this hypothesis, we looked at the relations between the process assessment factors and the items of P1 (I know how my work supports the achievement of my organisation's business goals after conducting a process assessment), N4 (the goal of process assessment is to align my processes to the business goals of the organisation), and N5 (the goal of process assessment is to motivate operators/developers to work towards achieving the organisation's business goals).

Table 7 illustrates that there is a significant correlation between the process assessment factors and the items of the process assessment goals (N4 and N5). The respondents who conducted process assessments believe that the goal of process assessment is to align one's work with the business goals of the organisation (N4)

Table 7
Correlation matrix of process assessment factors and alignment between process goals and organiation's goals.

	PA_SPICE	PA_CMMI
P1	.122	−.112
N4	−.279*	−.473**
N5	−.451**	−.418**

Note. The correlation matrix illustrates the Spearman rho correlation coefficients from the dependent variables of the study. PA_SPICE is a factor that represents the population that carried out process assessments with ISO/IEC 15504. PA_CMMI is a factor that represents the population that carried out process assessments with CMMI. P1 represents an item of "I know now how my work supports the achievement of my organisation's business goals" with lower values describing higher frequencies. N4 represents an item of "The goal of process assessment is to align my processes to the business goals of the organisation", and N5 represents an item of "The goal of process assessment is to motivate operators/developers to work towards achieving the organisation's business goals" with lower values describing higher frequencies. $N = 63$ responses.

* Correlations are statistically significant when $p < 0.05$.

** Correlations are statistically significant when $p < 0.01$.

Table 8
Frequencies of V3 (better understanding of the organisation's business goals after following process improvement).

	Frequency	Percentage	Cumulative percentage
Strongly agree	15	23.8	23.8
Agree	37	58.7	82.5
Disagree	7	11.1	93.7
Strongly disagree	2	3.2	96.8
N/A	1	1.6	98.4
Don't know	1	1.6	100.0
Total	63	100.0	

and to motivate developers/operators to work towards achieving these organisation's goals (N5). Unfortunately, there was no significant correlation between the process assessment factors and the operational activities supporting the achievement of an organisation's business goals (P1), indicating that the respondents have not acquired any knowledge regarding how to align their work with the business goals of the organisation after having conducted process assessment themselves.

We can conclude that our data supports Hypothesis H3 partially, i.e. process assessment is positively related to the alignment between process goals and the organisation's business goals, in theory. The data shows that the respondents believe process assessment should aim for aligning the process and organisation's goals (correlations between factors, and N4, N5) but the respondents who conducted process assessment did not learn how to do it in practice (correlation between factors and P1).

H4: Process improvement after process assessment is positively related to the alignment between process goals and organisation's business goals.

In order to support or reject this hypothesis, we looked for correlations between the process assessment factors and the items of V3 (better understanding of the organisation's business goals after process improvement) and V4 (motivated to align our work with the business goals of the organisation following process improvement).

In Tables 8 and 9, we can see that the respondents of the survey have a better understanding of an organisation's business goals after process improvement (82.5% for V3 values of "Strongly agree" and "Agree" in Table 8) and are also motivated to align their work with the business goals of the organisation after process improvement (79.4% for V4 values of "Strongly agree" and "Agree" in Table 9).

Table 10, indicates the correlation coefficients between the respondents who conducted process assessment prior to process improvement and the items "Better understanding of the organisation's business goals after process improvement" and "Motivation to align process goals and its business goals after process improvement" (V3 and V4, respectively). There is no correlation between the process assessment factors and the understanding of the organisation's business goals and the alignment of the goals.

We can conclude that process improvement increases the understanding of an organisation's business goals and motivates people to work towards these goals regardless of whether or not

Table 9
Frequencies of V4 (we are motivated to align our work with the business goals of the organisation after process improvement).

	Frequency	Percentage	Cumulative percentage
Strongly agree	15	23.8	23.8
Agree	35	55.6	79.4
Disagree	9	14.3	93.7
Strongly disagree	2	3.2	96.8
Don't know	2	3.2	100.0
Total	63	100.0	

Table 10
Correlation matrix of process assessment factors and process improvement goal items.

	PA_SPICE	PA_CMMI
V3	−.109	−.181
V4	−.140	−.137

Note. The correlation matrix illustrates the Spearman rho correlation coefficients from the dependent variables of the study. PA_SPICE is a factor that represents the population that carried out process assessments with ISO/IEC 15504. PA_CMMI is a factor that represents the population that carried out process assessments with CMMI. V3 represents an item of "We have a better understanding of our organisation's business goals after process improvement" with lower values describing higher frequencies. V4 represents an item of "We are more motivated to align our work with the business goals of our organisation after process improvement" with lower values describing higher frequencies. * Correlations are statistically significant when $p < 0.05$. ** Correlations are statistically significant when $p < 0.01$. $N = 63$ responses.

any process assessment was conducted prior to process improvement. Our data does not support Hypothesis H4, i.e. process improvement after process assessment is not significantly related to the alignment of process goals and its business goals. Process improvement can achieve this without any prior process assessment.

To summarise the data analysis, process improvement following process assessment is not significantly related to the alignment of process goals and its business goals. Although the respondents of the survey believed that process assessment should aim at increasing the alignment between business and process goals, process assessment does not contribute to this goal alignment in practice.

8. Discussion

Although process improvement and process assessment are believed to increase the awareness of an organisation's business goals and motivation to align its operational goals to its business goals, there is little knowledge and experience in practice about how to do this. Unfortunately, there is also no coherent method or guide to follow in order to achieve this in practice. The lack of such knowledge might explain unsuccessful process improvement efforts and perhaps even the prevalent scepticism towards process improvement in general.

Several explanations are possible for the very poor to non-existent association between an organisation's business goals and process goals. Although most people agree that process goals and process improvement goals are relevant to an organisation's business goals and would like to see the two aligned, in practice there seems to be little understanding of how to do it or where to start.

Although there has been concern about the predictive validity of software process improvement methods in the SPICE Trials (Jung et al., 2002), any connection between an organisation's business goals and process improvement has relied on coincidental concern rather than on any direct representation of the organisation's business goals within the process improvement method. Given that product quality is a fundamental concern for production processes (Ferdows and De Meyer, 1990; Flynn and Flynn, 2004) this may be quite reasonable until quality is "good enough" to allow an organisation to pay attention to other capabilities such as reliability of the production system. However, the danger is that the assumed goal of product quality will overtake any concern for other business goals. For example, if an organisation relies on innovation and time to market then those process improvements that favour product quality will eventually result in processes that do not support such responsiveness and ability to innovate (Benner and Tushman, 2002). Directing process improvement efforts at an assumed goal of product quality may be an easy choice because so much information is available on quality, the need for quality, and how to achieve quality. But focusing only on quality or risk is not sufficient unless they are related to the overall business goals of the organisation.

More subtle perhaps is the possibility that systems of production, even software production, have become so large, complex and interconnected that it becomes not only difficult to question their purpose and goals but also equally difficult to make substantial changes to them. Many organisations develop software in a particular field and it can be very challenging to adapt their development processes to a radically different field. For example, those who develop telecommunications software become versed in the requirements and goals of telecommunications software to the point where those goals and expectations become embedded in the techniques and everyday activities of software development. Trying to ignore those requirements and goals in order to produce quick demonstration software in such an environment can be fraught with delay and frustration. Similarly, trying to develop life-critical software within an organisation accustomed to developing commercial reporting software can be an exercise in futility. The expectations and goals of a domain become embedded and assumed rather than explicit, able to be negotiated. Those who develop software development process reference models and software development methodologies have the advantage of knowledge and time to consider how the processes should be constructed and how they can be combined to achieve a particular purpose (Brinkkemper, 1996; Karlsson and Ågerfalk, 2004; Kornyshova et al., 2007; McBride and Henderson-Sellers, 2011) whereas those who are responsible for process improvement might have neither any knowledge about how the processes interact with the organisation to achieve specific goals nor the time in which to study the processes. Their priorities may be simply to "improve quality" or "improve time to market" rather than engage in strategic debates about how their organisation can achieve its business goals. The processes become an end in themselves instead of providing the means to achieve business goals.

There is also the strong possibility that goal alignment has been seen as a concern of the organisation's structure, something to be resolved within the management hierarchy and not needing to be extended into the production system. Recently there have been attempts to consider how an organisation's business goals can affect its software development processes and how they might be manifested in the processes (Clarke and O'Connor, 2011; Stallinger et al., 2011). In both cases the underpinning model assumes that the organisation is in full control of its production system, that its business goals can be managed by its management and that they, in turn, can control how the production system achieves those goals. When software is developed entirely within one organisation this might be true. However, software development, like almost any other production, is seldom completely under the control of a single coherent organisation. Organisations have gradually changed their mode of operation from a divisional form to a matrix form. Recently, there has been some indication that further changes to a process-based form are imminent. Each of these changes brings with it the need to change approaches to the governance and management of the production system with which the organisation creates value. In a process-based production system individual processes could be performed by employees, contracted consultants, external specialist organisations or other forms of external suppliers. Setting performance goals and managing those goals with such a diverse collection of participants is unlikely to be achieved through simple means or even using one of the established forms of control (Eisenhardt, 1985; Ouchi, 1979). Rather, some form of alliance may be required in which the various participants share the risk of the project, process or activity. Such risk sharing would need to contain and express the organisation's business goals and their manifestation in the process goals.

9. Summary and future works

Process improvement has been part of the software engineering domain for two decades now and there is still much doubt about the effectiveness and efficiency of this approach. The biggest criticism concerns the inability to clearly articulate the business impact of process improvement and the return on investment of process assessment and process improvement. We believe that process improvements that aim to meet their organisation's business goals are more relevant for their business success. Do organisations that improve their processes align their process goals with their business goals? Does process assessment help raise awareness of the business goals and increase the understanding of how operational processes contribute to achieving business goals? These were some of the questions that motivated us to conduct this study on goal alignment in process improvement.

This study illustrates the theory and provides empirical data about the alignment of process goals and its business goals in process improvement. We focused on the role of process assessment in goal alignment. The data were gathered from industry using a survey approach over a period of five months. Responses were received from 63 respondents. The data analysis indicates that process assessment should, in theory, aim to align operational processes to an organisation's business goals and motivate developers and operators to work towards achieving their organisation's business goals. In practice, there was no correlation between conducting process assessments and such goal alignment. It is therefore painfully evident that there is currently no comprehensive method or guideline in industry that would allow meeting the objective of process improvement, i.e. to change processes in such a way that they can meet the organisation's business goals more efficiently and effectively.

This study points out various research directions that can be pursued to construct a model for achieving goal alignment in process improvement: What role does an organisation's structure and size play in goal alignment? How can process assessment measure the characteristics of processes in terms of their achievement of an organisation's business goals? And how can we improve the process assessment process in order for it to have a positive impact on the success of process improvement? To what degree does the goal of product quality support an organisation's business goals, and how can we relate process improvement to the achievement of product quality requirements? In other words, how can we change the way processes are viewed, from singular/standalone organisational-level processes to the systematic, intertwined set of processes that carry the essence of an organisation's business?

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Appendix A. Data used in the hypotheses testing with survey questions and response choices

J: How do you initiate improvements? (choose all that apply)

J1: Discussing informally with colleagues about the ways to improve
J2: Discussing and planning at a project/operation team meeting
J3: Brainstorming in a department meeting
J4: After processes have been assessed against an international standard or process model
J5: After an organisational audit
J6: Implementing industry best practices or an enterprise architecture framework

L: Which process improvement models/methods are used in your organisation? (choose all that apply)

L1: Our own experience and knowledge
L2: PSP/TSP – personal/team software process
L3: ISO/IEC 15504
L4: CMMI
L5: Six Sigma
L6: ITIL
L7: CoBIT
L8: ISO/IEC 20000
L9: ISO 9000
L10: Lean
L11: Theory of Constraints
L12: No models/methods were used

M: Before improving your processes, did you do the following:

M1: Identify the process improvement goals
M2: Identify the process improvement scope
M3: Identify and communicate the organisation's business goals to the staff
M4: Decide upon the change strategy for the organisation
M5: Get management's support and commitment for the improvement
M6: Allocate roles and responsibilities for the improvements in the organisation
M7: Set the scope of change in the organisation
M8: Conduct a process assessment

N: What do you personally believe is the goal of evaluating processes/process assessment? (Likert scale from "Strongly agree" to "Strongly disagree", "Not Applicable" and "I don't know")

N1: The goal of evaluating processes is to evaluate my work in the organisation
N2: The goal of evaluating processes is to evaluate the current state of the processes
N3: The goal of evaluating processes is to plan more effective ways to work
N4: The goal of evaluating processes is to align my processes to the goals of the organisation
N5: The goal of evaluating processes is to work towards achieving the organisation's goals

P: How well do the following statements describe your overall attitude towards evaluating processes/process assessment? (Likert scale from "Strongly agree" to "Strongly disagree", "Not Applicable" and "I don't know")

P1: I know now how my work supports the achievement of organisation's goals
P2: I know now what are the goals of the organisation
P3: I know now what is the current state of the processes
P4: I know now how to improve the processes I am involved in
P5: It is just the management's way to check how we work
P6: Nothing happened after the assessment was completed

S: What is the frequency of the following statements concerning the process improvement goals? (Likert scale from "Always" to "Never" and "I don't know")

S1: The process improvement goals were set
S2: The process improvement goals were met

V: How well do the following statements describe what you feel about process improvement? (Likert scale from "Strongly agree" to "Strongly disagree", "Not Applicable" and "I don't know")

V1: We improve processes all the time in small steps without a formal improvement method
V2: Improvement should not be based on standards and models because we know best how to improve our own way of working
V3: We now have a better understanding of organisation's goals
V4: We are more motivated now to align our work with the goals of the organisation
V5: We are frustrated because the implementation of improvements is not monitored and impact not measured
V6: We are frustrated because improvements were not implemented after process assessment

Appendix B. Computing factors on process assessment

Tables B.1 and B.2.

Table B.1
Rotated component matrix.[a]

	Component	
	PA_SPICE	PA_CMMI
J4: Process improvement was initiated with process assessment	*.744*	.295
M8: Process assessment was conducted prior to process improvement	.351	*.722*
L3: ISO/IEC 15504	*.880*	−.010
L4: CMMI	−.022	*.895*

Extraction method: principal component analysis.
Rotation method: varimax with Kaiser normalization.
[a] Rotation converged in 3 iterations.
Correlations between the items computed to two factors illustrated in *italics*.

Table B.2
Total variance explained.

Component	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	1.875	46.874	46.874	1.875	46.874	46.874	1.452	36.302	36.302
2	.986	24.653	71.528	.986	24.653	71.528	1.409	35.226	*71.528*
3	.599	14.963	86.490						
4	.540	13.510	100.000						

Extraction method: principal component analysis.
The variance explained by the two factors is illustrated in italics.

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