Effects from introduction of business process support systems and how they can be measured

Ilia Bider¹ and Erik Perjons²

¹IbisSoft AB, Box 19567, SE-104 32 Stockholm, Sweden
ili@ibissoft.se

²Royal Institute of Technology, Department of Computer and Systems Sciences
Forum 100, SE-164 40 Kista, Sweden
perjons@dsv.su.se

Abstract. What could be expected from the introduction of business process oriented way of working? How to prove that the expectations have become the reality? The paper tries to answer these questions by introducing a number of parameters that can be measured before, during and after the introduction of the new way of working supported by a computerized system. Changes in the parameters in a specified direction will show whether the expectations have been met or not. The suggested parameters describe the internal, human-related structure of an organization, which the authors believe will be greatly affected by introduction of the process-oriented way of working. The paper shortly describes the parameters and discusses how they can be measured.

1 Introduction

According to BMPS’07 CFP, adequate process (support system) design means that a process (system) has the ability to fulfill its stakeholders’ expectations. To be of use, this statement should be backed by ideas/methods of how:

− these expectations can be expressed, and
− their satisfaction can be measured.

In this position paper, we focus on what in general can be expected from the introduction of the business process oriented way of working backed by a computerized support system. We suggest a method of how such general expectations can be expressed and measured that is independent from the particular system architecture and details of the process design.

According to [1], the business process oriented way of working means genuine cooperation between all process participants independently of which department they belong to, and whether a particular process instance follows the standard pattern or deviates from it. It also means motivated involvement of process participants who understand their own roles in the process and the roles of others, including management. Further, business process orientation as a way of working means that the experience gathered from previously completed processes is directly used in operational practice.
The obvious way of expressing and measuring a general type of expectations is with the help of some general “economic” parameters, like increase in productivity, turnover, profit, or decrease in costs, working force, etc. These parameters constitute a backbone of so-called return on investment (ROI) approach to introduction of computerized systems. However, there is a major drawback of using this approach when introducing business process-oriented way of working. It can take a while before the new way of working is fully introduced. Thus, changes in the values of economic parameters will not be visible directly after the support system installation.

As the world does not stay still waiting while you are introducing a new way of working, other factors, outside the organization, can influence the economic parameters as well. For example, a change in the domestic or world economy can cause a change that may considerably outweigh the changes due to internal reasons. Therefore, it is difficult to relate changes in the values of economic parameters to the introduction of a business process support system.

To avoid taking into consideration the external influence, we need to choose parameters that characterize the internal structure of an organization, and are independent of the external world. These need to be parameters that have clear, but indirect relation to the economic parameters. We believe that parameters that fit well for this purpose are those that reflect the structure and efficiency of (a) internal communication, (b) human resource usage and (c) knowledge gathering and sharing. The position paper suggests a number of such parameters and discusses possible methods of their measurement. These parameters and methods were developed in the frame of the INKA project aimed at integrating knowledge management and business process support [2]. They are not fully tested yet, neither we had enough time to compare our parameters and method to other measurement frameworks.

There are two types of methods appropriate for measuring the parameters that we suggest:
- Methods based on investigation of (arti)facts, e.g. mining systems logs.
- Methods based on personal opinions and feelings, e.g. investigations based on interviews and questionnaires.

Due to the lack of space, we do not discuss measurement methods in further details in this paper. However, we supply the paper with an appendix that contains some examples of questions appropriate for measuring suggested parameters using a questionnaire.

The paper has the following structure. Section 2 presents a model of an organization that has been specially designed to explain the parameters. Section 3 defines the parameters. Section 4 contains concluding remarks and plans for further work. Appendix shows examples of questions for a questionnaire.

## 2 Model of organization

This section presents an abstract model of an organization that we use for defining parameters. The chosen level of abstraction is high, therefore, the model does not reflects any particular details of real-world organizations. The sole purpose of the
model is to present basic organizational concepts and relationships between them, so that we can clearly explain the meaning of parameters introduced in the next section.

By *organization*, we mean a number of persons that have a common business. These persons are called *employees*. We assume that an organization has some kind of *static structure*, which means that employees are grouped in *departments*, which, in turn, may be part of more general departments. We further assume that each department has a *manager*.

We abstract from the principles of how the departments are arranged. The organization may be functionally oriented, where departments reflect functions, like sales, development, production, or resource-oriented, where departments reflect qualification of employees, e.g., sales-persons, engineers, etc. In the first case, both sales department and development department may have engineers employed. In the second case, all engineers are located in the engineering department, and they can get assignments for a development project, as well as for a process of pursuing a potential customer.

Employers complete *activities*. A series of activities aimed at reaching a *goal* is called a *process*. How much the initial goal has been satisfied when the process has been finished is called the process’ *result*.

Different activities that belong to the same process can be completed by different employees. In order to coordinate their work in the frame of a process they need to communicate/collaborate. Some employees are assigned to be responsible for completing activities of a certain type. An employee that has completed, or is assigned to be a responsible for completing at least one activity in a process is called a *process participant*.

Some activities are carried out as a reaction on *events* that are initiated outside an organization, for example, when a customer contacts the organization. These activities are, usually, completed by an employee(s) who is responsible for taking care of external events. Other activities are planned in advance and carried out later. Responsibilities for completing these activities are allocated to employees by a manager or according to some business rules. When making allocation, the manager, normally, takes into consideration how many activities are already planned for different employees, as well as how time-consuming each of these activities is going to be. Planned activities can be re-planned, for example, by changing the responsible or time for completion. Re-planning includes also removing activities from the plan without executing them.

In Figure 1, our organizational model is visualized graphically. The upper part of the figure shows the static part of the organizational structure, in which a department can contain sub-departments. Below, there are “faces” that represent employees. Employees belong to departments and they are allocated to activities. The lower part of the figure shows a chain of activities that forms a process. The two activities to the left have already been completed, while the two dotted activities to the right are planned but not yet completed.

When activities are being completed, employees interact with each other in order to synchronize their work in the frame of a process. Some activities may require more than one employee, but in our simplified model we presume that only one employee is engaged in execution of an activity. The frame around the figure represents the border of the organization. Some activities may also include communication with persons outside the organization, but this is not shown in the picture.
3 Parameters

This section presents a set of parameters for expressing the expectations and measuring the actual impact of introduction of a process-oriented way of working.

3.1 Collaboration between employees

Definitions:
- An arrow in figure 1 is called a transition.
- The number of employees who were engaged in a process divided by the number of activities that has been completed during the process is called the participation level of this process. The values of participation level are between 0 and 1.
- A pass is a transition for which the employee who completes the activity before the transition is not the same as the employee who completes the activity after the transition.
- The number of passes divided by the number of transitions in a process is called the interaction level of this process. The interaction level shows how often employees are interacting with each other in the frame of the processes. The values of the interaction level are between 0 and 1.

The average values of the participation and interaction levels over all processes in an organization reflect the level of collaboration between employees in the organization.

Note that participation level and interaction level are relatively independent from each other. For example, the interaction level can be high even when there are only two employees that are engaged in the process.

3.2 Collaboration between departments

Definitions:
- The number of departments who were engaged in a process divided by the number of activities that has been completed during the process is called the
**interdepartmental participation level** of this process. The values of *interdepartmental participation level* are between 0 and 1.

- A *pass* that involves two employees who belong to two different departments is called an *interdepartmental pass*.
- The number of interdepartmental passes divided by the number of transitions in a process is called the *interdepartmental interaction level* of this process. The values of the *interdepartmental interaction level* are between 0 and 1.

The average values of the *interdepartmental participation level* and *interdepartmental interaction levels* over all processes in an organization reflect the level of collaboration between departments in the organization.

### 3.3 De-facto organizational structure

**Definitions:**

- A situation when an employee asks somebody (including himself/herself) to complete an activity is called *issuing a request*. A request can be issued, for example, by oral order, polite question, email, or planning in somebody else’s, or his/her own calendar.
- A situation when an employee gets a request from somebody (including himself/herself) to complete an activity is called *receiving a request*.
- An average value of the requests issued by an employee divided by the requests received by him/her over a certain period of time is called the *standing* of this employee during this period. A low value of *standing* for an employee indicates that this employee is governed by others. A high value of *standing* means that he/she governs other or/and him/herself.

The distribution of *standing* over employees reflects the *real (de-facto) organizational structure* of an organization. If *standings* of different employees differs much, it is a sign of hierarchical de-facto organizational structure. If the difference in *standing* is small, it is a sign of flat de-facto organizational structure. Note that *standing* does not indicate whether an employee is completing qualified or non-qualified tasks; even a highly qualified employee may be subjected to detailed-level control.

### 3.4 Unrealistic planning

**Definitions:**

- An act of changing the timeframe, or changing the responsible for an already planned activity, or removing it all-together is called *re-planning*.
- The number of acts of re-planning over a certain period of time divided by the number of activities planned during this period is called the *level of unrealistic planning* during this period. A high value of this parameter indicates bad planning habits in the organization.
3.5 Distribution of workload

Definitions:
- The number of activities completed by an employee during a certain period of time is called the workload of this employee over this period.

The distribution of this parameter over the employees reflects how well human resources are used in the given organization, e.g. whether there are overloaded employees, while others are under-loaded. However, the parameter does not take into consideration complexity of activities. It can only be used to compare the workload for employees that complete the same types of activities. In order to compare the workload for different categories of employees the activities need to be weighted.

3.6 Stress

Definitions:
- A subjective feeling of an employee that he/she has more activities to complete than he/she can handle is called stress. The level of this feeling is called the level of stress.
- The number of activities that are planned for an employee for a certain period of time divided by the number of activities actually completed during the same period is called the stressfulness of environment for this employee. Note that this definition simplifies the matter as it does not consider complexity of activities.

The two parameters level of stress and stressfulness of environment are related to each other, i.e. stressful environment may cause stress. However, a stressful environment does not always cause stress, and an employee can feel stressed in spite of a low value for stressfulness of environment.

3.7 Initiativeness

Definitions:
- An activity completed by an employee that lies beyond his/her obligations is called a self-assigned activity.
- The number of self-assigned activities divided by the total number of activities completed during a certain time period is called the initiativeness of the employee during this period.

The parameter initiativeness reflects how engaged the employees are. It can be used to characterize a particular employee, or a department or the whole organization, when average values are used.

3.8 Transparency

Definitions:
- An activity (planned or completed) assigned to employee A that another employee B has the right and possibility to observe is called the B-visible activity of A.
All $B$-visible activities of $A$, divided by the total number of activities for $A$ during a certain period of time is called the $A$-transparency for $B$ for this period. The values of $A$-transparency for $B$ are between 0 and 1.

The average value of transparency of all employees reflects the level of transparency in an organization. The level of transparency can be measured between managers and non-managers and between departments, using definitions similar to above.

3.9 Utilization of previous experience

Definitions:
- An act of using information in the archives when completing an activity is called utilization of previous experience.
- The number of activities that involve utilization of previous experiences divided by the total number of activities completed during a certain period of time is called the level of utilization of previous experience during this period. The values of level of utilization of previous experience are between 0 and 1.

The parameter reflects whether the employees are using previous experiences or not. It can be used to characterize a particular employee, or a department or the whole organization, when average values are used.

3.10 Goal and result awareness

Definitions:
- The number of processes for which a process participant knows the goal divided by the total number of processes in which this employee participates is called the goal awareness of this employee.
- The number of finished processes for which a process participant knows the result divided by the total number of finished processes in which this employee participated is called the result awareness of this employee.

Goal and result awareness can be measured for a certain employee, or a department or the whole organization, when average values are used.

3.11 Volume-related parameters

Besides the parameters defined above, there is also a need for parameters that measure the total volume of business activities in an organization. They are needed in order to take into consideration those changes in business volumes that can induce changes in the values of the proposed parameters. For example, a main reason for lower level of stress can be that the number of orders has decreased but the number of employees remained the same. Examples of volume-related parameters are:
- The average number of activities per process
- The average number of started processes per time period
- The average number of ongoing processes
The average number of finished processes per time period

These parameters can be used to normalize the values of other parameters in order to compare the values taken at different times.

5 Conclusion

How can we use the parameters defined in the previous section for expressing expectations and measuring the results of introducing the business-process oriented way of working? One alternative is to define expectations as fixed values of parameters, and then see whether we have reached them or not. Theoretically, this approach is possible, but it is hard to believe that it can be implemented in practice. A more practical approach is to expect “desirable” changes in parameters, for example, that:

- Collaboration between employees and departments will increase
- De-facto organizational structure becomes more flat
- Planning becomes more realistic
- Workload becomes more evenly distributed between the employees
- The level of stress and stressfulness of environment will decrease, etc

In order to verify whether such expectations have been met or not, we need to measure the proposed parameters several times, before, during, and after completion of the introduction of the new way of working. Both (arti)fact based, and opinion-based measurements are required. It is difficult to rely on the (arti)fact based measurements only; before the system introduction, there are no system logs. Thus we, probably, would not be able to do any artifact based measurements. Only when a business process support system is fully introduced, we can start measuring and comparing the values of parameters described above. Besides, opinion-based measurements are quite important on their own. It is one thing, to state that the “desirable” changes have been achieved based on the system logs. It is quite another matter, to say that the employees “feel” these changes.

We already have some practical experience with the suggested. We have defined means for the opinion-based measurement of parameters in form of interview questions and written questionnaires. We have used them in two organizations, and we have learned quite interesting facts about them. However, so far, none of these organizations went far enough on the way of introducing business process-oriented way of working. Therefore, right now, we do not have any confirmation that introduction of the new way of working can produce the desirable changes in the parameters.

As far as how to measure the parameters based on analysis of (arti)facts, i.e. through system logs, this issue requires separate consideration dependent on the type of the process support system, and logs it produces.

Acknowledgements: Writing of this paper was supported by the Swedish Agency for Innovation Systems (Vinnova) under the grant for a project on “Integration Business Process Support with Knowledge Management”. The authors are also thankful to the anonymous reviewers whose comments helped to improve the text.
References


Appendix: Examples of questions for a questionnaire

Question: How often have you been contacted by colleagues in your daily work, for example to inform about something, answer a question or carry out a working task? We have divided up the question in four sub-questions depending on categories of colleagues. Mark one alternative in each of the subquestions a), b), c) och d).

a) colleagues on your department  b) your manager
[ ] never   [ ] never
[ ] sometimes [ ] sometimes
[ ] often   [ ] often

c) colleagues on some other department  d) person that you are managing
[ ] never   [ ] never
[ ] sometimes [ ] sometimes
[ ] often   [ ] often

Comment: The question aims at investigating the following parameters: Collaboration between employees, Collaboration between departments, De-facto organizational structure.

Question: Do you experience that you, in general, work more, as much as, or less than your colleagues?
[ ] more   [ ] as much   [ ] less   [ ] I do not know

Comment: The question aims at investigating the following parameters: Distribution of workload and Stress.

Question: Are you distributing work-related information to your colleagues, even though it is not part of your working tasks?
[ ] always   [ ] often   [ ] sometimes   [ ] never

Comment: The question aims at investigating the parameter: Initativeness.