Defining a Goal Reached, Energy Used value-pair as the basis of business process measures

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Abstract

For measuring the behavior of business processes or the effect of business process improvements usually characteristics like effectiveness and efficiency are used. There are many definitions of these characteristics, which makes it difficult to understand precisely what happens. In this paper an approach is proposed for a basic measurement of business processes in terms of goal reaching and resource using in conjunction, building a Goal Reached, Energy Used (GREU) value-pair. Changes in the business process architecture or supporting infrastructures will lead to a change of (patterns of) GREU-values. When identifying Goal Reached with effectiveness and Energy Used with efficiency the changes also might be explained in these classical terms.

For implementing the framework the Actor Activity Diagramming modeling tool is introduced to decompose a business process in terms of states (goals) and actors (energy). Then, with multiple instances of the business process the Goal Reached and Energy Used values are generated and logged, ready for interpretation.

Introduction

The Business Process Redesign (BPR) developments clearly have put the focus on business processes. Business processes are the vehicles through which organizations reach their primary goals that is making products or services for customers at their requests. Two starting points ask for attention. The first starting point is: organizations are putting much effort in reaching these goals as good as possible, trying to maximize customer satisfaction. On the other hand organizations pay much attention to the amount of resources they use in reaching these goals. These starting points often are indicated by the terms effectiveness and efficiency respectively. In BPR-projects the target is to improve the conditions concerning these starting points inspired by useful advice from several authors. Peppard and Rowland (1995) describe ESIA-rules (Eliminate, Simplify, Integrate, Automate) for making the business processes better, cheaper and faster while Harrington (1991) gives twelve cornerstone tools for streamlining the business processes. All advice intuitively sounds well but when analyzing the effect it is not yet clear how this works out. Does "error proofing" (Harrington's cornerstone nr 6.) improve on effectiveness or

on efficiency or on both? And how does it work exactly? Or do we need a different framework? The answers are not simple and ask for a detailed approach. In this paper we will try to answer the next question: can we define a universal measure concept for assessing business processes? In trying to answer this question we will first define the basic elements of the business process world and then introduce two characteristics: energy used and goal reached to form the basis of our framework. After introducing a modeling tool to support implementing these ideas we will end with a discussion.

Elements of the business process world

In this section we will define the basic ingredients of the business process world.

Business process

BPR has resulted in several definitions of processes or business processes. The definition of Davenport and Short: “A business process is a set of logically related tasks performed to achieve a defined business outcome” is a basic one. The definition has ingredients of goal reaching in the word "outcome" and terms of energy using in the word "tasks".
Davenports (1993) definition: “A specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs” has some more details. From the definitions we derive a number of subjects that are essential in dealing with business processes:

- The customer - producer relation
- The product or service
- Goal reached
- Energy used.

Customer – producer relation

Any instance of a business process starts with a customer requesting a product or service and ends with the delivery of the requested product or service. Thus any business process implies the existence of a customer–producer relation. This two-party relation is mentioned in other approaches. In the transaction cost theory (Wigand et al, 1997) a transfer of property rights between parties is defined: the customer gets his product and the producer gets paid for it. Dealing may belong to the exchange. In the DEMO-model (Dietz & Mallens, 2001) an exchange is defined in terms of communication. A client asks for a product or service and the producer agrees to it. At delivery the reverse takes place. The producer hands the product and the customer agrees to it. At the two phases negotiation is possible. The producer's organization is responsible for producing the product or service.

In our approach we only will focus on agreed business processes. Paths that exist because of negotiations are regarded to be business processes of their own. The customer–producer relation in fact can emerge wherever one party asks another party for something. The parties can be individuals, departments or whole organizations.

The product or service

The product or service is the physical or non-physical object of the customer-producer relation and is defined by specifications. Specifications concerning physical objects include characteristics of form, color, size, texture, material, and etcetera and admitted deviations in measures. Non-physical objects are reports, plans, complaints, questions, counseling, and etcetera. Specifications

of this type of objects include formats, used arguments, correct information, consultation, and etcetera. Furthermore also process characteristics could be part of the specifications: delivery time, milestones, specification and discussion.
Specifications are important for two reasons. The organization knows how the product should be made and the customer has an instrument to assess the product he gets. When referring to a product from a catalogue the specifications might be quite clear. However when requesting a new product, specifications have to be determined as a part of the business process itself.
A product or service that is produced has several intermediate appearances called states (Eriksson and Penker, 2000). These states appear as results of different production steps. Intermediate states should also meet specifications belonging to these states. The customer only knows these states when the process is part of the product or service. The specifications of a product or service are considered to be the first state and the product or service to be delivered the last state.

Goal reached

In the context of business processes "goal reached" is defined as a product or a service entering a state meeting the specifications that belong to that state. This definition is true for the end-state when a product or service is to be delivered to the customer as well as to intermediate states. The organization is only responsible for the product or service to meet known and generally accepted specifications (ISO9000-norm). When the customers expect more than specified the organization cannot be blamed. For this reason it is important that the customers request is translated into specifications as accurate as possible. In business processes where translating requests into specifications are steps in the process like software development, precaution should be made to prevent any dispute later on. It is useful for organizations to periodically check the expectations of customers in marketing reviews, possibly leading to adaptations of the specifications or the business process architecture.
The organization that is producing the product or service - the producer - is responsible for the product or service meeting the specifications in any intermediate state. It could introduce control activities performed by quality employees or information systems to check this agreement. Measuring the goal reached is rather complex because each element of the specifications in general has its own specific different measure.

We will express a product or service in state i by the term: ps_i. In these terms than: ps_0 is a product or service in state 0, which is the starting state given by specifications and ps_n is the end-state, which is the product or service to be delivered.

Energy used

Energy is needed to bring a product or a service from one state into another state. Energy is a useful fundamental concept borrowed from physics, representing all kinds of organizational objects that are involved in the production of a product or service. The objects include: employees, raw materials, semi-finished products, computers, information systems, and etcetera, all to be expressed in units of measurement.
The term "energy" is a somewhat unusual element in the business process world but is used because of its fundamental character. Energy is used instead of cost because energy strips the business process from cost influencing factors like wages etcetera. At any time energy can be transformed into cost for a specific environment.

We will define three basic categories of energy in the context of business processes: actors, resources and information.

1. Actors

The actors are the employees of organizations that perform the activities of the business process. Actors have the competence, knowledge and skills to do so. They are responsible for that part of the business process they are allocated to. They have an autonomy with which they can influence the business process. This form of energy is measured in actor-time: seconds, minutes, days, weeks, and months.
Customers could be regarded to be an actor in the business process because they are involved in at least the beginning and the end and possibly somewhere in between. In the past organizations did not want the customer to participate in the business process because they wanted to offer service to the customer. However in this digital time there is a tendency to incorporate the customer more, for example at Internet banking. If so, the customer has a double role as participant and client.

2. Resources

Resources are all objects (except actors) that play a role in the business process. There are several kinds. There are objects that are consumed like raw materials and semi-manufactured products as well as objects that are used like buildings, machines and information systems. The use of resources is measured in machine-time, computer-time or in a quantity when consuming goods.
Information systems sometimes play a (bounded) autonomous role, for instance when generating reports or assessing states (work flow management systems). In this case their roles in the business process is better understood by regarding them to be actors.

3. Information

Information is an abstract representation of objects, like the client's data, the ordering data, the specifications and the recipe. Information is needed when performing a business process. The amount of bytes could be a measure for information.

When consolidating the energy used for a business process we face the problem of the different nature of the energy categories. A kind of normalization of measures could be necessary.

We introduce the term: e_i for bringing a product or service into state ps_i from state ps_{i-1}, that is executing activity a_i. Than by summing over all activities of a business process we find the total energy E.

Goal Reached and Energy Used framework

In a business process, activity or set of activities energy is supplied resulting in a goal (state) to be reached. This is illustrated in figure 1.

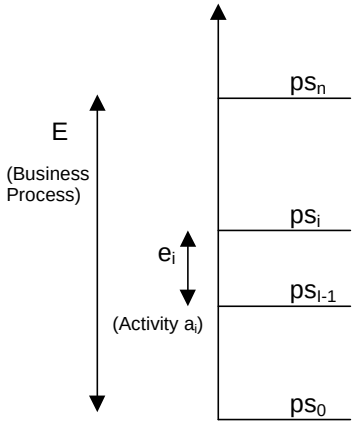

Figure 1. Goal levels and corresponding energy used

For each activity a value of Goal Reached and a value of Energy Used can be determined, resulting in a value-pair, which can be plotted in a two dimensional chart: the GREU-chart (figure 2). When executing an activity several times there will be a distribution in the Goal Reached or/and in the Energy Used values. The same behavior holds for a business process, being an arrangement of activities.
For reasons of interpretation the coordinates in the GREU-chart are chosen to give the best situation in the upper right corner.

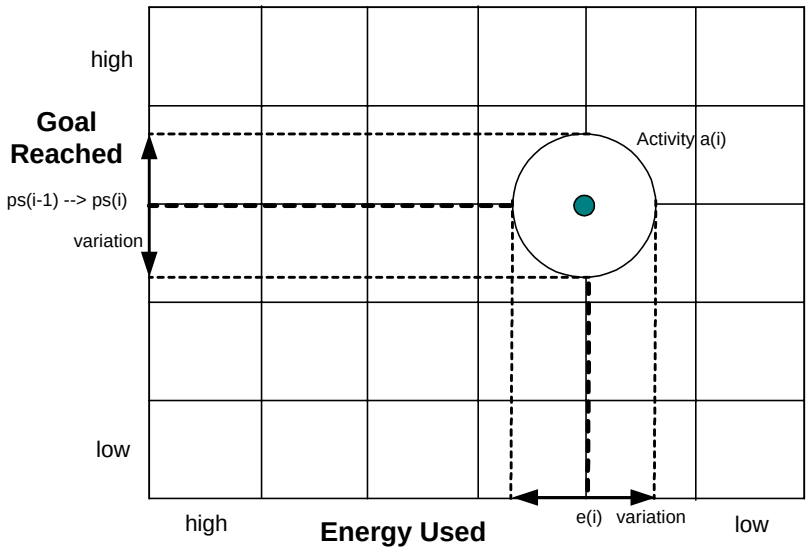

Figure 2. The GREU-chart

We will give an example to illustrate the use of the GREU value-pair. We consider a simple money transaction performed by a bank in different settings with one common Goal Reached value: a correct transaction in the end.

Setting A: correct transaction - consumed energy E1 by front office and back office actors,
Setting B: incorrect transaction, needing two correction transactions - consumed energy E2 in total,
Setting C: correct transaction forced by an additional control activity - consumed energy E3 in total,
Setting D: correct Internet transaction - consumed energy E4 by an Internet based information system. The four possibilities are depicted in figure 3.

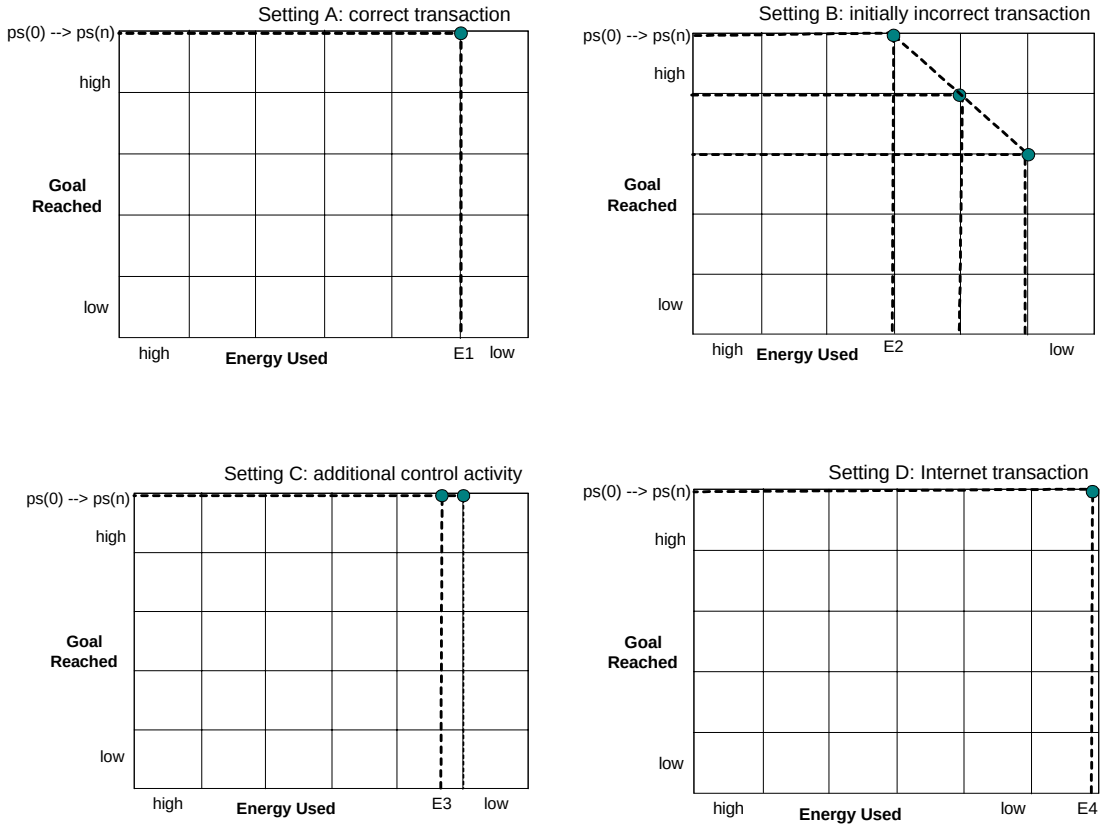

Figure 3. The GREU values in different settings for a money transaction

As shown in this example we can expect a certain GREU-value, or in practice a pattern of GREU-values to represent the way instances of a given business process architecture are executed. Changes in the business process architecture or in the supporting infrastructures, like training the actors to enhance their knowledge and skills, making the information systems more intelligent or improve the quality of information, than will cause the GREU-value averages to move and/or the value patterns to change.

When improving business processes in BPR-projects the GREU values might reveal the character of the improvement. Improving business processes always will result in shifting the Goal Reached, Energy Used values to the upper right corner. An ideal process is performed by the customer alone, with no consumption of energy by the organization.

Implementing the framework

Analyzing business processes in terms of Goal Reached and Energy Used presumes decomposition of business process into these terms. We will introduce the Actor Activity Diagramming (AAD) modeling tool, which connects well to this decomposition. While AAD reveals the architecture of the business process monitoring is necessary to gather the GREU-data for evaluating the behavior of the business process.

Modeling business processes with Actor Activity Diagramming

Actor Activity Diagramming is a modeling tool (Schaap, 2001) in which a business process is decomposed in terms of transformations and transactions. Actors bringing the product or service from one state into the next state perform the transformations. The transactions are transitions from the product or service in a defined state from one actor to another actor.
The start of the business process is sharply defined as the customer's request accepted by the producer and is called transaction à charge to indicate that the organization is charged for producing the product or service. The end of the business process is marked as the delivery of the requested product or service to the customer and is called transaction à décharge. The organization is freed from its obligation. The activities can conveniently be chosen under the sole condition that the sum of all activities is leading to the end product.
The activities of the actors represent the energy used, whereas the states are representing the goal reached. AAD reveals the architecture of the business process. Only when run-data is added an analysis of goal reached and energy used is possible.
Figure 4 represents an example business process consisting of three actors (the client included), two activities and three states, together dealing with a request. The specifications of this product are an answer including two arguments. The states represent the development of the request towards the answer. A measurement for the rate of reaching these states is also defined. The activities represent the places where the actors use energy. In this example other types of energy users like resources and information are left aside.

AAD has been derived from the Role Activity Diagram (Ould, 1995). There are some differences with other modeling tools like RAD, functional flowchart and UML diagrams. In AAD the simultaneous behavior of energy used and goal reached is made visible by the explicit modeling of transitions. AAD has a restricted symbol set on purpose to suit it well for the modeling of business processes by end users. There is no severe obligation to model all possible loops but preferably one straight business process from start to end. The complete notation of AAD is given at the website: www.bdk.rug.nl/medewerkers/d.j.schaap/aad.

Likewise Resource Activity Diagramming and Information Activity Diagramming could be defined to explore the corresponding relations between Energy Used and Goal Reached.

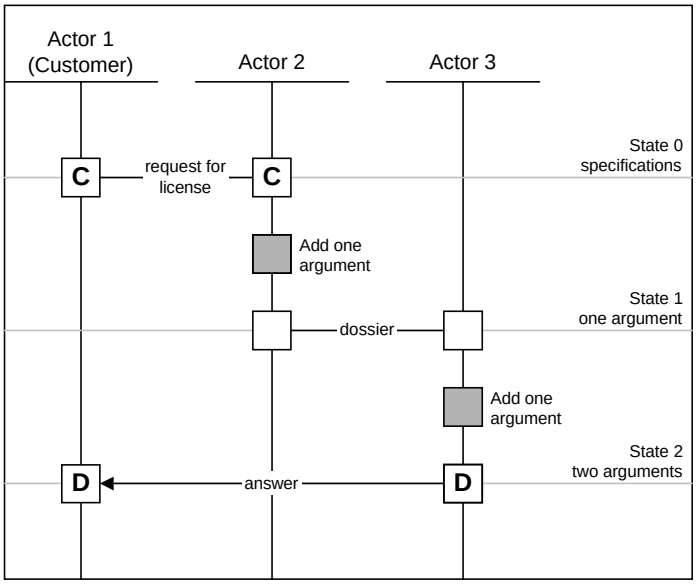

Figure 4. A example business process modeled with Actor Activity Diagramming

Monitoring

For generating data a logging system should exist where the Energy Used and Goal Reached values for each business process, activity or set of activities are logged. A logging table directly can be derived from the AAD. See figure 5.

Activity	**State before**	**State after**	**Goal Reached**	**Actor-time (Energy Used)**
1. Add one argument	State 0	State 1	100%	Time actor 2
2. Add one argument	State 1	State 2	100%	Time actor 3
Total business process	State 0	State 2	100%	Time (actor 2 + actor 3)

Figure 5. A logging table for the example business process

In general logging systems that generate these data are not available in organisations, so possibilities to extract them from transaction systems should be constructed. Workflow management systems might be helpful.

Discussion

In this paper we have tried to answer the question: can we define a universal measure concept for assessing business processes.
Goal Reached and Energy Used value-pairs seem to be useful variables to understand the behavior of business processes. The behavior of the GREU-values is such that supplying energy (actors, resources and information) is the only variable and the resulting goal (state) depends on

this variable, given by characteristics of the business process and its environment. We have not found a function describing the behavior of Goal Reached in terms of Energy Used. However we suppose that monitoring these values will reveal the character of business process behavior.
By creating Goal Reached and Energy Used values we superficially create two dimensions with the purpose to interpret in more detail the behavior of business processes or business process changes. Consequently all effects like minimizing cycle time or maximizing sales revenue are to be decomposed into these dimensions.
The exercise of confronting measures of energy used and goal reached have been done before. Harrington (1991) describes an example of processing time versus cycle time. In our framework we might consider processing time to correspond to energy used and cycle time to goal reached. Regarding them to be value-pairs has not been done so far.

Questions

For the proposed framework to be valuable conditions have to be determined. These are issues like formulated in the next questions to be discussed. The authors' view is given as one opinion.

Is the framework only suitable for main production processes?
By introducing the customer-producer relation the framework seems to be valid for customer oriented main production processes only. For secondary business processes like decision making, recruiting and sales the framework seems to be less applicable. However when defining a customer and a producer in this situation the framework also might be of value. For example in the business process making a sales plan we might define the manager to be the customer and the employees of the sales department the producer. And also for the business process of recruiting an employee we might consider the P&O manager or the department that is asking for the employee to be the customer and the P&O-staff to be the producer. In this vision Goal Reached and Energy Used values do have a meaning.

Is the framework only suitable for well structured business processes?
In well structured business processes where the distribution of tasks between the actors is more or less strictly defined for all process instances in the same manner measuring the goal reached energy used values will be uncomplicated so the framework seems to be applicable. For less structured processes it will be hard to determine GREU values, but not impossible.

Can Energy Used and Goal Reached sufficiently be operationalised?
Energy Used will be a hybrid measure of all energy-types and Goal Reached a hybrid measure of all different states within a business process. The challenge is to simplify the Energy Used and Goal Reached characteristics without loosing the link with reality. In practice factors whose influence are expected to be small in comparison with the subject of investigation might be excluded. For instance in business processes producing services the energy categories resources and information are supposed to be small compared to actors so they may be neglected.

Should Energy Used be coupled to the complexity, importance or value of goals?
The framework seems to be applicable for business processes that have a limited complexity like handling a sales order, and etcetera. However for complex business processes like for example software development the goal is not unique and sometimes moving. For the measured Goal Reached Energy Used values explanations can be found in considering the complexity of the goals afterwards. It is hard to add the complexity to the framework on beforehand.

Should the knowledge and experience of actors taken into account?
The values of Energy Used and Goal Reached also strongly will depend on the knowledge and experience of actors. Having the activities performed by experienced employees will lead to different outcomes than having the job done by novices. Like stated in the previous answer the framework only is meant for monitoring the values. The knowledge of actors might be the reason for the measured values. Including the knowledge of actors into the framework is a difficult job.

Further research

The value of the framework has to be examined and the answers to the questions have to be found by several experiments, changing parameters like product or service category, information intensive business processes, logical aspects, and etcetera. Starting with a zero measurement controlled changes of the business architecture or of the infrastructures that deliver energy (actors, resources or information) should be added to the business process and the results monitored and interpreted. The effects of these experiments should be reversible.

The notion of goal reaching versus energy using as worked out for business processes might be extended to higher levels of systems like departments or whole organizations. For any system the energy used versus goal reached may be worth considering. Classical definitions of mergers, outsourcing or networked economy might be illustrated in this way.

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