The PrICE Tool Kit: Tool Support for Process Improvement

Mariska Netjes, Hajo A. Reijers, Wil M.P. van der Aalst

Eindhoven University of Technology,
P.O. Box 513, NL-5600 MB, Eindhoven, The Netherlands
{m.netjes,h.a.reijers,w.m.p.v.d.aalst}@tue.nl

1 The PrICE Approach

Process improvement is an important means to obtain competitive advantage and improve customer satisfaction. The PrICE tool kit provides support for process improvement and has been developed to show the feasibility of the PrICE approach. The approach for Process Improvement by Creating and Evaluating process alternatives (in short: the PrICE approach) describes the concrete steps that have to be taken to get from the *as-is* process to the *to-be* process. A common view on process improvement roughly distinguishes four phases: (1) framing the process of interest, (2) understanding the current (*as-is*) process, (3) designing the new (*to-be*) process, and (4) implementing the new process [15]. Many approaches and methods for process improvement are used in practice, but most of these do not address the concrete design of an improved process. The PrICE approach supports phase (3) of a process improvement project: designing the *to-be* process [15].

The *as-is* model, the input of the approach, is the result of phase (2) of a process improvement project: understanding the *as-is* process [15]. The *as-is* model should contain information on the control flow, the data, the resources and the performance of the process. The PrICE approach consists of four steps:

1 **Find applicable redesign operations**: a redesign operation supports a particular type of redesign creation. Applicable operations can be found with process measures or process mining. Process measures provide a global view on the characteristics of the process and their values may reveal weaknesses in the process [5]. Process mining provides a powerful means to find bottlenecks and other redesign opportunities in the process [1, 2].
2 **Select suitable process parts**: specific parts of the process model that can be redesigned with one or more of the applicable redesign operations are identified. Process mining can also be used to support this step of the approach. In addition, requirements are set on the process parts that can be selected for redesign to be able to create correct alternative models. The user is guided in the selection of such process parts.
3 **Create alternative models**: the applicable redesign operations are performed on selected process parts, thus, creating alternative process models.

A formal foundation for the creation of process alternatives is developed to ensure the correctness and to provide a base for the implementation of the tool kit. This formal foundation has been published in [6].

4 **Evaluate performance of alternatives**: the created alternative models are simulated to predict their expected performance. By comparing the simulation results, a quantitatively supported choice for the best alternative model can be made. A simulation plan has been published in [4]. The developed tool support enables simulation in batch, i.e., the simulation of any number of alternatives without user interaction.

The output of the approach is a model of the *to-be* process which is selected from the alternative models based on the performance evaluation. This *to-be* process is the input for phase (4) of a process improvement project: implementing the new process [15].

2 Relevance

Current redesign practice is performed in a highly participative fashion where management consultants encourage business professionals within a workshop setting to think of one or more alternatives for the *as-is* process. The role of the external consultants is to moderate the workshop, to stimulate people to abandon the traditional beliefs they may have about the process in question and to mobilize support for the upcoming changes. Sharp and McDermott, for instance, describe the lack of methodological support for this practice as follows: "How to get from the *as-is* to the *to-be* [in a BPR project] isn't explained, so we conclude that during the break, the famous ATAMO procedure is invoked – And Then, A Miracle Occurs" [15]. The consequence of this lack of support is that the design of the *to-be* process becomes a subjective and non-repeatable act resulting in abstract process designs without an accurate estimate of the expected gains. Because the same steps are followed in our approach that are present in the current practice of process redesign, it seems viable to support the interaction between business professionals with the PrICE approach and tool kit. The application scenario we envision is that in a workshop a set of attractive redesign alternatives is created with support of the PrICE tool kit. The creation of alternative models is a highly interactive activity. A process model can never capture all information that is relevant for process redesign. The user is involved to ensure that the alternative models are feasible. The tool automates the parts that do not need user interaction and supports the user in creating alternative models in a systematic manner. During a break or afterwards, all or a selection of these alternative designs are simulated in batch, i.e., without further user interaction.

Business Process Management (BPM) systems provide a broad range of facilities to enact and manage operational business processes. Ideally, these systems should provide support for the complete BPM life-cycle: (re)design, configuration, execution, control, and diagnosis of processes. However, based on an extensive evaluation of the FileNet P8 BPM Suite, we have show in [1] that existing

BPM tools are unable to support the full life-cycle. Especially the diagnosis and the (re)design phases are not sufficiently supported. Diagnostic support is lacking for the search for weaknesses in the process and the generation of improvement suggestions. Furthermore, in the design phase, the creation of the redesign alternatives is not supported. The PrICE approach provides an integrated approach for the diagnosis and the design of business processes. The first two steps of the PrICE approach provide support for the diagnosis phase while all steps support the redesign part of the design phase [1].

3 Main Features

The main features of the PrICE tool kit are 1) the use of process mining to find redesign opportunities, 2) the user guidance in the selection of process parts, 3) the creation of process alternatives, 4) the construction of the process alternatives tree, and 5) the evaluation of the alternatives with simulation. Figure 1 depicts a screenshot of the user interface of the tool kit. The lower part displays

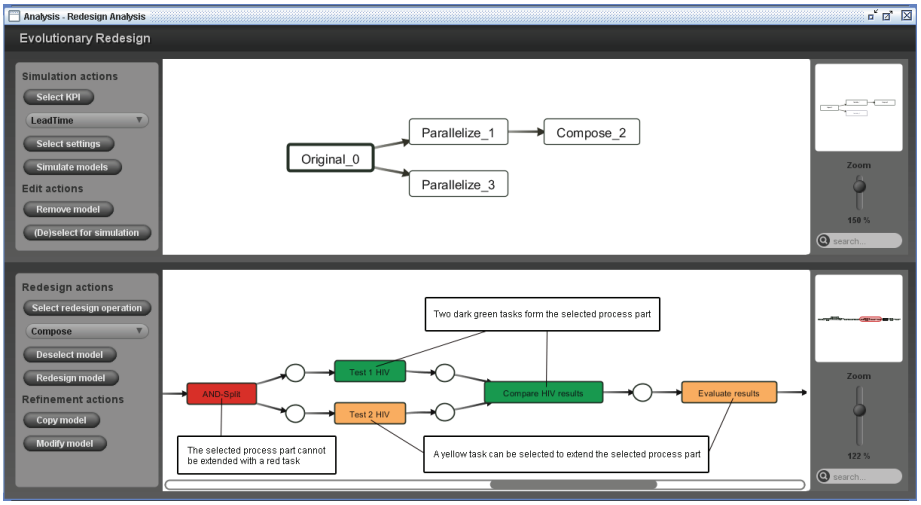

Fig. 1. A process part that is selected for the application of the compose operation

the process model for which an alternative will be created and provides the options to create a process alternative. After the selection of a redesign operation, a process part for redesign is selected by the user by clicking on the tasks in the process model. Colors are used to guide the user and show which tasks may be added to the current selection to form a process part (see Figure 1 for an illustration). This way, it is ensured that the input for the creation of a process alternative is such that a correct alternative model can be created. The upper part of Figure 1 shows the process alternatives tree. The selected node in the tree

corresponds to the model that is displayed in the lower part. After the creation of an alternative model, the tree is updated with a new node representing this alternative. The upper part of the user interface also provides the options for the evaluation of the alternatives in the tree. One can select a subset of nodes for simulation or simulate the complete tree. A simulation study is performed in batch, i.e., all selected models are simulated without user interaction. Afterwards, the simulation results are displayed on the tree nodes. In addition, colors are used to guide the user in finding the best performing alternative(s).

4 Architecture

The PrICE tool kit is implemented as part of the Process Mining (ProM) framework [9]. In ProM, a generic process format, called high-level (HL) model, is available to specify the control flow, data, resource and performance perspectives. Several modeling languages can be used to model such a HL model. Protos [7] is one of these languages. We implemented a HL model for a Protos model, which is called a HL Protos model. The use of one of the many mining plugins is another possible means to obtain a process model and process information. The discovery of a complete simulation model from an event log [13] is an example of this. Such a simulation model is implemented as a HL PetriNet model. We use Figure 2 to sketch the technical infrastructure of the tool kit. At the top left

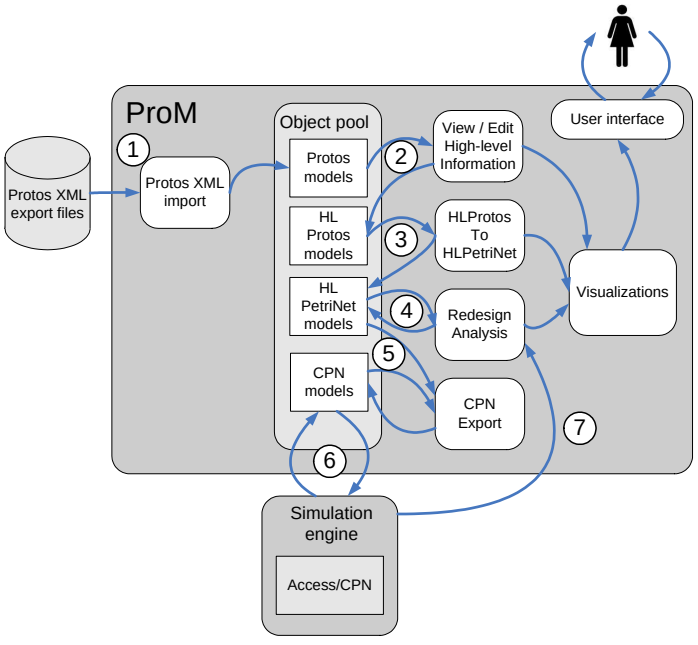

Fig. 2. Tool kit architecture

side of Figure 2, indicated with (1), a Protos model is imported to the object pool in ProM and converted to the HL format (see (2) in Figure 2). HL models are displayed by the Edit / View High-level Information plugin [13]. Then, the control flow of the HL Protos model is converted to a Petri net, thus creating a HL PetriNet model (see (3) in Figure 2). The functionality for the creation and evaluation of alternative models is implemented with the Redesign Analysis plugin (see (4) in Figure 2). For the evaluation of the performance of alternative models we use Colored Petri nets (CPNs). The collection of alternative models is converted to CPN models with the CPN Export [12] and analyzed using CPN tools [3] (see (5) in Figure 2). CPN Tools provides support for the modeling and simulation of business processes. A simulation engine for the automatic simulation of multiple CPN models is used for performance evaluation (see (6) in Figure 2). We built the simulation engine on the Access/CPN framework [16]. The simulation results are returned to the Redesign Analysis plugin (see (7) in Figure 2).

The PrICE tool kit has been developed as a research prototype. It has been implemented on top of the ProM framework [9] which supports among others process mining techniques [2], the storage and reuse of objects and the conversion of models. Furthermore, it is open source, making it easy to plug in new pieces of functionality. This allowed us to implement a rather mature prototype in terms of interoperability between the PrICE tool kit and other tools, user interface and supported modeling languages. The tool is freely available for download since mid 2009, but we are not aware of any use of it by others to support process improvement. So far, we tested the PrICE tool kit with a number of processes. We also tested whether it is feasible to create realistic redesign alternatives with the PrICE tool kit. For this test, we used a redesign project that is described in [11]. The project describes a real life business process that is executed at a mental healthcare institute and the creation of seven possible alternatives for the original process. We succeeded in reproducing five of these alternatives. This outcome gives a first indication that the PrICE tool kit is useful in supporting process redesign projects in practice. Currently, we are working together with Pallas Athena [7] to evaluate the approach and tool kit in real business settings.

5 Links

The PrICE tool kit is made available through download and through the SHARE system [14]. A download of the tool kit can be performed from [8] which provides the latest internal version of ProM 5. Additional information can be found on [10]. With the SHARE system, an environment to test and play with the tool kit is provided. The environment includes the tool, a tutorial, a screencast and several input models for the tool. The environment can be accessed from [10] after registration.

Acknowledgement

This research is supported by the Technology Foundation STW, applied science division of NWO and the technology programme of the Dutch Ministry of Economic Affairs.

References

1. W.M.P. van der Aalst, M. Netjes, and H.A. Reijers. Chapter 4: Supporting the Full BPM Life-Cycle Using Process Mining and Intelligent Redesign. In K. Siau, editor, *Contemporary Issues in Database Design and Information Systems Development*, pages 100–132. IGI Global, Hershey, USA, 2007.
2. W.M.P. van der Aalst, H.A. Reijers, A.J.M.M. Weijters, B.F. van Dongen, A.K. Alves de Medeiros, M. Song, and H.M.W. Verbeek. Business Process Mining: An Industrial Application. *Information Systems*, 32(1):713–732, 2007.
3. CPN Tools website. http://wiki.daimi.au.dk/cpntools/cpntools.wiki.
4. M.H. Jansen-Vullers, P.A.M. Kleingeld, and M. Netjes. Quantifying the Performance of Workflows. *Information Systems Management journal*, 25(4):332–343, 2008.
5. M. Netjes, S. Limam Mansar, H.A. Reijers, and W.M.P. van der Aalst. Performing Business Process Redesign with Best Practices: An Evolutionary Approach. In J. Filipe, J. Cordeiro, and J. Cardoso, editors, *Enterprise Information Systems (9th International Conference, ICEIS 2007, Funchal, Madeira, June 12-16, 2007, Revised Selected Papers)*, volume 12 of *Lecture Notes in Business Information Processing*, pages 199–211. Springer-Verlag, Berlin, 2009.
6. M. Netjes, H.A. Reijers, and W.M.P. van der Aalst. On the Formal Generation of Process Redesigns. In D. Ardagna, M. Mecella, and J. Yang, editors, *Business Process Management Workshops: BPM 2008*, volume 17 of *Lecture Notes in Business Information Processing*, pages 217–228. Springer-Verlag, Berlin, 2009.
7. Pallas Athena website. www.pallas-athena.com.
8. ProM download website. http://prom.win.tue.nl/tools/prom/nightly5/.
9. ProM website. www.processmining.org.
10. Redesign in ProM website. http://prom.win.tue.nl/research/wiki/online/redesign.
11. H.A. Reijers. *Design and Control of Workflow Processes: Business Process Management for the Service Industry*, volume 2617 of *Lecture Notes in Computer Science*. Springer-Verlag, Berlin, 2003.
12. A. Rozinat, R.S. Mans, M. Song, and W.M.P. van der Aalst. Discovering Colored Petri Nets from Event Logs. *International Journal on Software Tools for Technology Transfer*, 10(1):57–74, 2008.
13. A. Rozinat, R.S. Mans, M. Song, and W.M.P. van der Aalst. Discovering simulation models. *Information Systems*, 34(3):305–327, 2009.
14. SHARE website. http://fmt.cs.utwente.nl/redmine/wiki/5/SHARE.
15. A. Sharp and P. McDermott. *Workflow Modeling: Tools for Process Improvement and Application Development*. Artech House Publishers, Boston, 2009.
16. M. Westergaard and L.M. Kristensen. The Access/CPN Framework: A Tool for Interacting with the CPN Tools Simulator. In G. Franceschinis and K. Wolf, editors, *Applications and Theory of Petri Nets 2009*, volume 5606 of *Lecture Notes in Computer Science*, pages 313–322. Springer-Verlag, Berlin, 2009.