Hybrid IDEF0/IDEF3 Modelling of Business Processes: Syntax, Semantics and Expressiveness

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Abstract

A description of the process dimension of a notation for business process modelling that integrates aspects from IDEF0 and IDEF3 in a novel way is presented. The features of this notation include black box modelling of activities in the style of IDEF0 and glass box refinements of activities using connectors for specifying process branching in the style of IDEF3. The semantics of the notation is given by a mapping to a place/transition net. The notation is shown to be as expressive as a Standard Workflow Model ([4]).

Introduction The last few years have shown an increase in the interest of applying information technology to business process management. In our opinion this state of affairs is caused by two factors: i) the need of a better integration between business processes and information systems; ii) the high complexity of the organizations and their underlying business processes. Consequently, formal modelling should be an essential activity for a better management of business processes.

IDEF0 and IDEF3 bring complementary features to business process modelling. Traditionally, IDEF0 was used for producing a function model of a new or existing system or subject area ([3]), while IDEF3 was a technique for producing a dynamic model of the system ([5]). These techniques have been proposed to be used either independently or together. Originally, the integration has been defined in an ad-hoc way, by referencing IDEF0 activities from within an IDEF3 model ([5], page 145).

In this paper we show that it is possible to define a notation for representing business processes that enhances IDEF0 with facilities from IDEF3 that is both easy to use in practice by the business analysts and sufficiently rigorous to allow a formal analysis. A mapping of this language to low-level Petri nets - place/transition nets (P/T nets hereafter) is provided. This mapping allowed the establishment that this language is as expressive as the Standard Workflow Model defined in [4].

Syntax We started with IDEF0 to produce a function modelling component, by constraining those aspects of IDEF0 that we considered problematic. Then we extended it to incorporate the modelling of dynamic aspects with facilities from IDEF3.

The most basic modelling component is the black box. It models an activity with inputs and outputs. A glass box view is attached to each black box, to model the logic of selecting the inputs participating in the activity and the logic of generating the outputs produced by the activity. A glass box view has three components: an input tree of connectors, an output tree of connectors and a single input/single output activity. There are one-to-one mappings between the sets of inputs of a black box and the set of leaves of the input tree and between the set of outputs of a black box and the leaves of its output tree.

Additional facilities of this notation are: presentation of the process model at different levels of detail using IDEF0 activity decompositions and the assignment of resources (humans or machines) to activities via IDEF0 bundled mechanism flows. More details can be found in [2].

Semantics An important result obtained in [2] is that every level of detail is a decomposition of the root activity of the process model. The dynamics of a process model corresponding to a level of detail can be defined by mapping to P/T nets. The mapping is described in [2] by means of an algorithm for translating a level of detail of a process model to a labelled P/T net. The algorithm translates activities into transitions labelled with activity names and flows into places. The translation of input trees and output trees may produce additional places and null transitions. The initial marking of the P/T net system assigns a single token to each place with no input transitions and no token to the rest of places.

The mapping of the notation to P/T nets allows the study of the expressiveness of the notation. A recent in-depth study of control flow structures in workflows has defined Standard Workflow Models as a general framework for analyzing the properties of workflow languages ([4]). Standard Workflow Models are interpreted in terms of labelled P/T nets and workflow termination is interpreted as reaching an empty marking. In order to allow the comparison of our work with Standard Workflow Models we modified slightly the mapping from [2] by adding one additional null transition for each place with no output transition in the resulting P/T net.

The mapping to P/T nets and the connection to Standard Workflow Models allows the definition of the properties of executions of a hybrid IDEF0/IDEF3 model: deadlock, infinite loop and successful termination, defined in ([4]). Moreover, it appears that the concept of termination generalizes and replaces the older concept of soundness of Workflow Nets introduced in [1].

Expressiveness It is not difficult to see that every Standard Workflow Model can be represented as a hybrid IDEF0/IDEF3 model and that every hybrid IDEF0/IDEF3 model can be represented as a Standard Workflow Model.

Mapping a hybrid IDEF0/IDEF3 model to a Standard Workflow Model is done as follows: i) for every input i of the model we add a null activity with no inputs and that has i as single output; ii) for every output o of the model we add a null activity with no outputs and that has o as single input; iii) every connector and activity are mapped to processing elements in the Standard Workflow Model.

Mapping a Standard Workflow Model to a hybrid IDEF0/IDEF3 model is done as follows: i) every join is mapped to a multiple input/single output null activity with the input tree equal to the join itself; ii) every split is mapped to a single input/multiple output activity with the output tree equal to the split itself; iii) activities are mapped to activities.

In [4] are defined a mapping from Standard Workflow Models to Standard Workflow nets - a special class of P/T net systems and a framework for comparing the expressiveness of labelled P/T net systems using bisimulation. Using these results it is possible to compare the expressiveness of hybrid IDEF0/IDEF3 models with Standard Workflow Models and to establish their equivalence.

Conclusions The most important result is the definition of a notation for business process modelling with three important features: i) the elements of the notation are the well known boxes, arrows and connectors employed by IDEF0 and IDEF3 which are widely used in the practice of business process modelling; ii) the notation has a formal semantics defined in terms of P/T nets which make it suitable to formal analysis; iii) it is as expressive as the recently proposed language of Standard Workflow Models.

In our opinion hybrid IDEF0/IDEF3 has one advantage over Standard Workflow Models: it is more modular by grouping the joins and splits with activities in the form of input and output trees of connectors. One can easily imagine a software tool by which a user may choose to hide or show the glass box view of an activity. Hiding brings to the user an IDEF0 functional model of the system, while the expansion of black boxes into glass box views displays a dynamic model suitable for analyzing the dynamic behavior of the system.

References

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