

# Agile Process Management: Framework and Methodology

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## Abstract

Agile Process Management (APM) is an approach to facilitate flexible execution of business and knowledge work processes by linking process models and business rules.

The eGovernment domain is in particular suited for this approach as service provision is well defined by law and other regulations. Moreover only few services are automated yet. This is mainly due to the fact that governmental services often are knowledge intensive and performed task oriented but not process oriented.

The APM framework provides support for business people (e.g. Administration Officers) to conceptualize the respective knowledge, taking into account the specific requirements of these experts regarding formalization and explanation, but at the same time ensure machine processing. Considering results of research on expert systems, business process management, business rules and service standardization the APM enforces the eGovernment purpose.

## Introduction

Even though eGovernment services are well defined, well documented and execution of one service type (e.g. application for move) is quite *similar* for the various service providers, such as the different municipalities, no two services are *identical*.

Although there are binding legal rules and regulations every administration has to obey, administrations have the liberty of *how* to act on it. This is fostered by two things:

- a) Yet most of the eGovernment services are performed task oriented and not process oriented and
- b) often eGovernment services are knowledge intensive processes, with their specific requirements (Davenport, Jarvenpass, Beers 1996). Dealing with people's concerns, for example, means dealing with different circumstances every time.

This may be also one explanation why eGovernment services don't improve as expected: only very few services are automated to a degree that allows execution via the internet. However, it is common knowledge that administrations have to handle budget cuts. This article provides an approach to boost eGovernment service automation based on business processes, but keep the necessary liberty and flexibility of execution by using business rules. We focus on a framework and methodology for knowledge formalization and design, aiming for an executable implementation as a proof of concept.

## Agile Process Management

The Agile Process Management (APM) approach combines business and knowledge work processes to facilitate the execution of flexible processes by linking process models and business rules. The goals are:

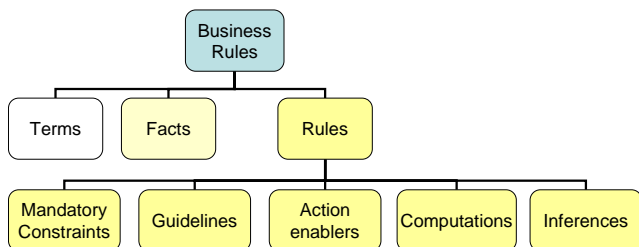
- to soften the strictness of business process structure to handle
  - exceptional and unpredictable situations
  - high variability of input and output
  - highly complex tasks
  - innovative, long-running processes
  - new experiences
- to formalize the weakness of knowledge work processes to increase
  - decision support (providing comprehensive but task oriented knowledge)
  - compliance with rules and regulations
  - consistency of decisions
  - transparency and traceability of work
  - process automation.

Flexible process management has been discussed for a few years. (Abecker et al. 1998 and Abecker et al. 2000) and (Dengel 2001) focus on process-oriented organizational memories for context-aware knowledge delivery and

access in order to support decision making while Endl (2004) promotes the substitution of process models by business rule engines in order to achieve flexibility. The APM approach discussed here is new with respect to

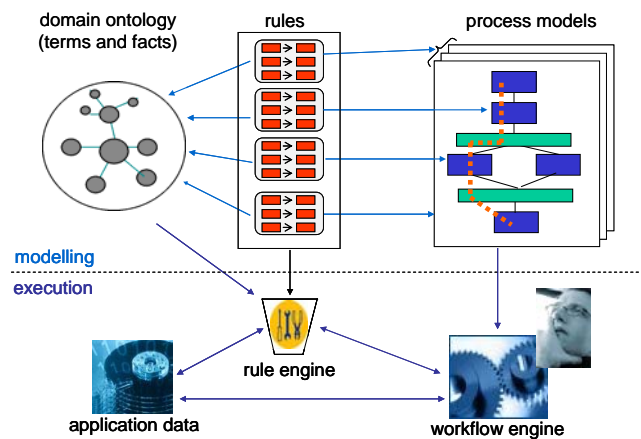
- the eGovernment domain (cf. governmental service structure and organization)
- sharing of knowledge models extravagating organizational boundaries (e.g. between public administrations on various federal levels)
- combining strict process models with flexibly executable business rules
- integrated knowledge models from design to execution
- covering the spectrum of informal, text-based knowledge to formal, executable knowledge
- user suitable preparation of used or required knowledge for process execution (e.g. explanations for fired rules or provision of cases to support decisions).

A main characteristic of our APM approach is the integration of domain knowledge, process models and business rules. Von Halle (2001) suggests a classification of business rules distinguishing terms, facts and rules where rules are further divided into constraints, guidelines, action enablers, computations and inferences (see Figure 1). Terms and facts correspond to domain knowledge and can be represented as ontologies (Figure 2).



**Figure 1: Business Rules Classification Scheme (von Halle 2001)**

Business processes can be used to define sets of business rules that are executed together (cf. Morgan 2002). In our approach we can associate sets of rules either to groups of processes, a whole process or a particular activity in a process (see Figure 2). These associations define the scope of validity of the rule set. When executing an activity the rules associated to the activity and the process the activity belongs to are executed.



**Figure 2: APM modeling and execution**

A first demonstrator has been implemented using the Xpert.Ivy<sup>1</sup> workflow management system and the OntoStudio<sup>2</sup> ontology engineering system using F-logic as rule formalism (Kifer et al. 1995)<sup>3</sup>. As an example the Swiss eGovernment service ‘Announcement of Move’ is taken to illustrate the APM approach.

### Governmental Service Structure/Organization

Municipalities are very sensitive regarding national and federal regulations. However, to meet budget needs, municipalities are forced to tighten their service provision. One possibility is the promotion of standards, similar to eBusiness (e.g. EDI, ebXML). For instance in Switzerland, the eCH association (cp. <http://www.ech.ch>) supports the unification of eGovernment services by working on standards for data exchange and providing example process models. Although this is a very welcome effort there are some serious obstacles:

- Focusing on what is common, the distinctive features have to be neglected
- As the provided (service) descriptions are in natural language, they cannot be used without transformation into a formal representation to become (at least) the base for automation.

In addition, the task oriented eGovernment service provision plus the knowledge intensive work are leading to some more problems:

- Only very few administrative processes are automated; process structure and flow often are determined simply by a list of open issues, responsibilities and due dates.

<sup>1</sup> <http://www.soreco.ch/ivy/pro/soreco/WebSite/index.jsp?navId=Products/xpertivy>

<sup>2</sup> <http://www.ontoprise.de/content/index.html>

<sup>3</sup> In the FIT project, funded by the EU within the context of the Information Society Technologies (IST) programme (IST-027090) we will implement a system based on Semantic Web standards and evaluate it in pilot applications.

- The knowledge needed to perform a specific task (get access to data, run queries etc.) usually is supported by ICT but encapsulated in a special application.
- In contrast, the knowledge needed for decision making spans over departments or applications as it is bound to people or locations and not only to a part of it (e.g. to assess an application for social welfare should consider not only the applicant's financial situation (recorded in the tax department) but also her social situation (supporting a disabled family member what is recorded in the social department) or place of residence (recorded in the registration office).

With the APM approach we provide a methodology to transform functional and expert knowledge into business rules and process knowledge into business process models taking into consideration the sensibility of independent administrative entities (departments but also municipalities). At the same time we aim to improve eGovernment service provision.

### APM Methodology

As there has been done already a lot of research on knowledge capturing during the 80ies for building expert systems (Jackson 1999, Giarratano & Riley 1998) and new attention is given to it recently by the business rules community (Ross 2003, Morgan 2002). The APM approach is based upon these results but focuses on knowledge formalization, design and execution as depicted in Figure 3:

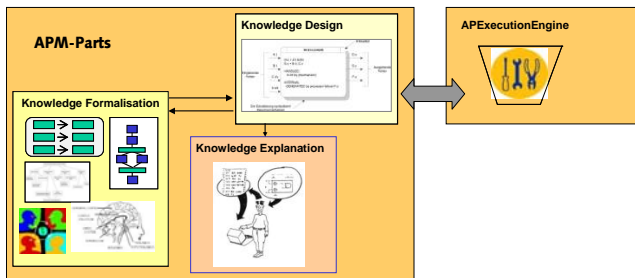


Figure 3: APM parts

This view on knowledge formalization is well known through the CommonKADS (Schreiber et al. 2000) approach but enhances it with respect to the specific requirements of the eGovernment domain (e.g. federalism structures, kind of expert knowledge, way of service execution).

Figure 4 depicts the CommonKADS Model Suite extended by the context-concept-transformation model and the concept-artefact-transformation model. Knowledge, communication and design model will be customized for the semantically enriched description of Agile Processes. Focussing on knowledge formalization the CommonKADS context models will be used as is.

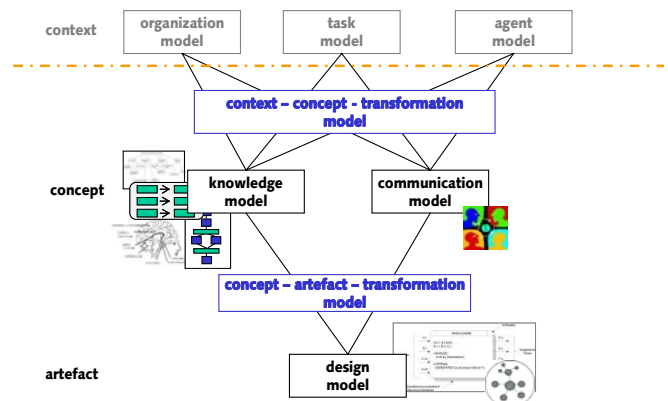


Figure 4: Enhanced CommonKADS Model Suite

### Context-Concept-Transformation-Model (CCT model)

The context-concept-transformation-model addresses requirements regarding

- business rules discovery and simplification
- delimitation of rules and processes
- uncertainty
- privacy
- perceivability

As business rules often determine process flow but process entities may trigger rule execution, it is not easy to decide what aspects should be modeled as business rules and what within a process model. Therefore one of the challenges is to provide easy understandable guidelines to distinguish rules and processes.

Another challenge is modeling uncertainty. For instance, the handling of an application for move includes a rule stating that a certain document (called 'certificate of residence') has to be deposited at the municipality and to be delivered to the applicant in case of deregistration. Following von Halle's classification (von Halle 2001) a formalization of the rule is this guideline:

**IF** a person has deposited her certificate of residence **THEN** receipt **should be** provided before handing over the certificate of residence.

Most likely a person, *not* providing a receipt but being a reputable Swiss, moving within one canton, living quite a time on the old place will be getting this certificate of residence *without* questioning.

To automate the rule execution, indicators have to be defined for evaluating the facts the rule is based on, e.g. the 'weight' of reputation based on facts like the a person is Swiss, moving within one canton etc.

Whereas this is a well-known question already addressed by expert systems (e.g. Clancey 1983) there are problems in the eGovernment domain not being regarded yet:

There are serious concerns about the restriction of autonomy of decision that must be addressed as well as concerns of making personal 'rules' public. Therefore it must be guaranteed that the automated execution of rules will not be of a disadvantage for the citizen and can be

overruled by personal intervention, while logging of these decisions must be provided. Decision log may be used for improving weightings then.

Modelling eGovernment knowledge implies another challenge regarding knowledge representation: eGovernment experts are no specialists (in a sense considered by expert systems) but generalists and therefore not used to formal, viz abstract representation of their knowledge. Therefore executed process steps and business rules need to be provided in an easy understandable and traceable way.

The CCT model provides formalisms / guidelines for the knowledge ‘capturing to representation process’.

For example: where to find sources for business rules, how to identify and define terms, how to determine and describe facts, how to ensure consistency, what kind of explanations to offer?

Therefore the CCT model provides a procedure model adapted for the government domain to support administration rule detection hidden in various documents or even in the heads of the public administration officers, in database schemas or system requirement specifications. Considering already existing models, amongst others for example (Ross 2005) the CCT model reduces negligible steps like ‘develop business tactics’ (ibid.) but add activities like

- ‘coordination of definitions’ (e.g. inter-municipal or between a Municipality and the Canton),
- ‘proposal for standardisation’ (e.g. contributing to eCH),
- ‘use case selection’ (e.g. evaluating use cases for explanation support).

In addition, guiding principles will be provided for

- ‘process-rule-distinction’, e.g. checking on rule respective activity candidates, or
- ‘definition of confidence factors’, e.g. addressing concerns of making ‘personal rules public’ (cp.Engelmore 1993).

### APM Knowledge and Communication Models

The APM Framework provides a semantically enriched structure for knowledge and communication modelling. Using ontologies as basic principle, knowledge description can be done declaratively and formalized but strictly implementation independent. Following Abecker et al. (1998) we distinguish between process, enterprise and domain ontologies.

On one hand, ontologies provide means to correlate different concepts and their instances by defining qualified relations; on the other hand they enable knowledge discovery by applying rule-based evaluation methods.

Enhancing the meta-model of Endl (2004) a meta-ontology is developed to make dependences between terms, facts and rules explicit, to enforce consistency (a term used in a rule must exist) and to increase inter-changeability (e.g. a common understanding of the role of terms and facts). Providing this functionality for knowledge (and communication) modelling but only on design model level aims to support end users (e.g. public administrator) in the formalization process in a way they can understand.

Figure 5 depicts an excerpt of the meta-ontology to be used in the APM framework for structuring knowledge and communication models.

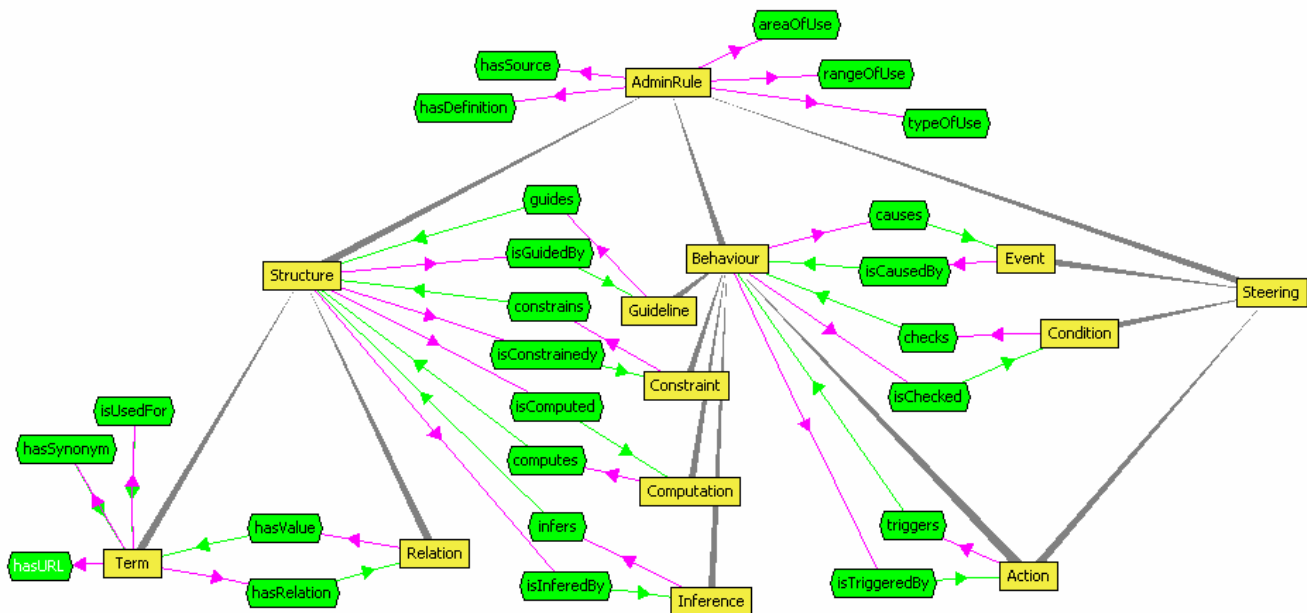
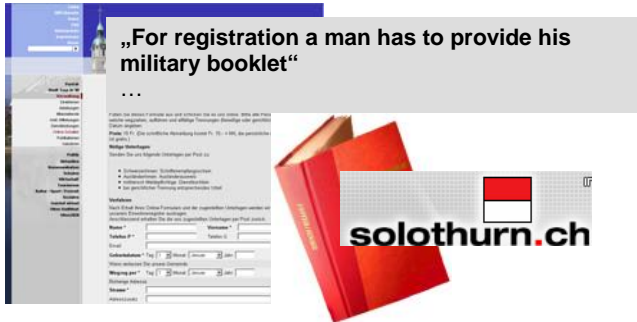


Figure 5: Excerpt of the APM Rules Meta-Model

Further research will be done using the meta-model in the APM part for knowledge formalisation, e.g. supporting users describing rules.

Regarding the example ‘Announcement of Move’ the registration manual for municipalities of the Canton Solothurn<sup>4</sup> was taken as a knowledge source.



**Figure 6: Knowledge source for the ‘Announcement of Move’ example**

The example shows some common problems

- rules are hidden (‘a man’ is used for ‘a person that is male and an adult’)
- rules are ambiguous (what does ‘to provide’ mean? Does it mean to show or to deposit?).

The CAT-Model aims to support the user to express rules as precise as possible (cf. Chappel 2005), e.g. forcing rules to be atomic, consistent etc. Formalizing the rule example depicted in Figure 6 using the notation determined by von Halle (von Halle, 2001) the rule shown in figure 7 (based on the respective terms and facts) is derived:

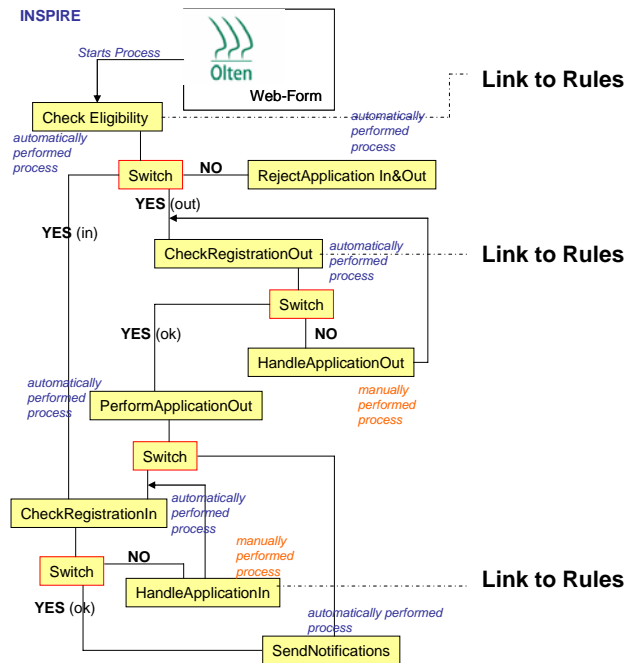
Inference	IF <condition> THEN <term1> { =   <   >   < >   in   not in   at least   at most   exactly N of } {<term2>   <value> }	IF <i>a person is a Swiss male</i> AND <i>a person is an adult</i> THEN <i>military_service Booklet</i> = <i>required</i>
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**Figure 7: Administration Rule Example**

Besides the administration rules a process model for the service has been developed. Evaluating the drafted guiding principles the distinction was made for the following reasons:

- process flow is stable (e.g. first check for eligibility, then check for (de)registration, then send notifications)
- process tasks are generic, performed in every municipality
- the task sequence is stable

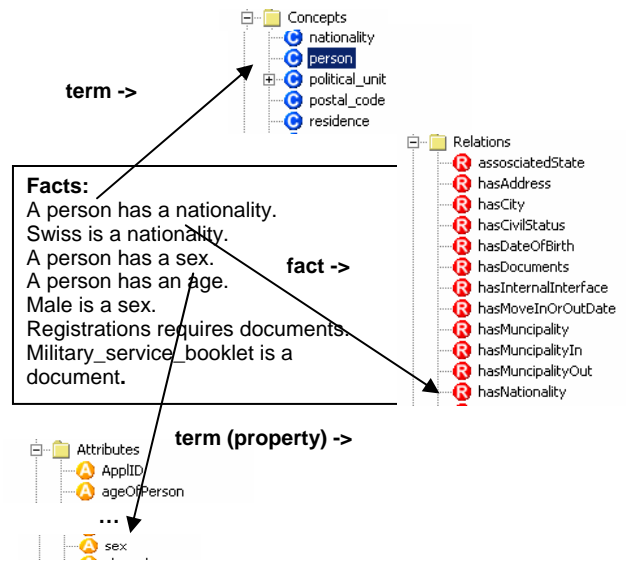
<sup>4</sup> Original title of the document: ‘Einwohnerkontrolle. Handbuch für die Solothurnischen Gemeinden’



**Figure 8: “Application for Move” process model**

**Concept-Artifact-Transformation-Model (CAT-Model)**

The transformation-implementation-model addresses requirements regarding the transformation of knowledge models into machine understandable representation. Research is done on representing the CAT-Model as an ontology, too, in order to support consistency of knowledge and communication models transformation into (their) design models while maximum of implementation independency is achieved.



**Figure 9: Example for CAT-Model (supporting transformation of knowledge model into design model)**

**Term**

- Concepts
  - Interface
  - Interface\_internal
  - RulesConcept
  - address
  - age
  - check\_list
  - civil\_status
  - date
  - documents
  - fine
  - guardianship
  - nationality
  - person**
  - political\_unit

**Fact**

Name: person  
 Namespace: "http://www.NewOnto1.org"

Attribute	Range
allPlacesRegistrationOnHold	boolean
civilStatus	string
firstName	string
guardingInstituteName	string
lastName	string
nationalityCode	string
needsGuardian	boolean

Relations:

Relation	Range
hasAddress	address
hasCivilStatus	civil_status
hasDateOfBirth	date
<b>hasDocuments</b>	documents
hasNationality	nationality

**Rule**

- residence\_contract\_required\_false\_rule\_BRE3
- residence\_contract\_required\_true\_rule\_BRE3
- all\_documents\_required\_false\_rule\_BRE3
- all\_documents\_required\_true\_rule\_BRE3**
- military\_service\_booklet\_false\_rule1\_BRE3
- military\_service\_booklet\_false\_rule2\_BRE3
- certificate\_of\_divorce\_required\_true\_rule\_BRE3
- military\_service\_booklet\_true\_rule\_BRE3
- certificate\_of\_divorce\_required\_false\_rule1\_BRE3
- certificate\_of\_divorce\_required\_false\_rule2\_BRE3
- certificate\_of\_divorce\_required\_false\_rule3\_BRE3
- health\_insurance\_true\_rule\_BRE3
- health\_insurance\_false\_rule1\_BRE3

Name: all\_documents\_required\_true\_rule\_BRE3  
 Namespace: "http://www.NewOnto1.org"

Rule: FORALL X, Y X["http://www.NewOnto1.org"#allDocumentsRequired->true] <- (X:"http://www.NewOnto1.org"#registration\_interface["http://www.NewOnto1.org"#movePermanent->Y] and not (equal(Y,"1"))).

Figure 10: Excerpt of design model for 'Application of Move'

**APM Design Model**

As one requirement is implementation independency, the APM design model is based on ontologies, too. Figure 10 shows an excerpt of the design model in OntoStudio. The highlighted concept 'person' is related to the concept 'documents'. The rule is one of a rule set dealing with information evaluation (with respects to documents).

**The APM Framework**

The APM framework comprises frontend and backend components. The frontend components are 'Knowledge Formalization' for modeling, 'Knowledge Exchange' for import and export of external knowledge models and 'Knowledge Explanation' for explaining the results (performed tasks and executed rules) of service execution.

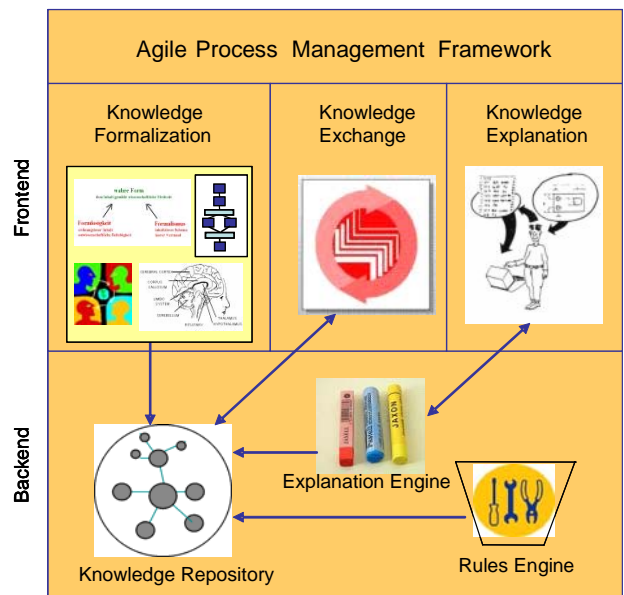


Figure 11: APM Framework

### APM Knowledge Formalization

'Knowledge Formalization', as depicted in Figure 11, is the editor for managing knowledge, communication, design, CCT and CAT Models.

### APM Knowledge Exchange

As the APM 'Knowledge Exchange' is a module that allows for import of various kinds of knowledge e.g. business rules described within a process modelling tool or the result of automated ontology creation like Text2Onto (Cimiano 2005). Export of knowledge models e.g. to a business rules engine, is based on the CAT-Model.

APM knowledge models will be based on standards (e.g. OWL-DL); therefore import and export of data can be performed using an XML-interface.

### APM Knowledge Explanation

Even though expert systems do provide solutions for some explanation aspects as execution tracing or error tracking, they fall short of Public Administration Officers' expectations with respects to

- transparency of executed algorithm (in an user understandable way)
- transparency of knowledge use (what knowledge has caused the solution)
- proof of correctness
- possibility of comparison (providing disapproved alternative solutions or cases).

The knowledge explanation component of the APM-framework aims to provide role and query specific explanations.

For example:

- a Public Administration Officer (role: Domain Expert) wants to check on an executed service. She will get the answer in a way, one not used to formal descriptions can understand e.g. by 'transforming log entries' to natural language explanations.
- a Public Administration Officer (role: Domain Manager) wants to check on the variability of executed processes. She will get information on differences and commonness of the various instances of a process.

### APM Knowledge Repository and Explanation Engine

Backend components are 'Knowledge Repository' (e.g. ontologies), the 'Explanation Engine' for populating the concepts of the explanation model with instances (basically we follow the security Assistant approach as discussed by Barzilay et al. 1998) and the 'Rule Engine' for reasoning.

Even though a business application is not part of the APM framework, an application interface is provided for linking the rule engine with a workflow engine and application data for service execution.

The rule engine comprises an interface to application systems, i.e. predicates of rules can be satisfied by content of external databases. Since variables occurring in conditions that match application data are bound, the DL-safety conditions of rules can still be valid (cf. Motik et al 2004).

### Agile Process Execution

The demonstrator of Agile Process Management implemented for the example 'Announcement of Move' has two parts: one part, affecting the (static) process (steps) has been modeled with the Xpert.ivy workflow management system. The other part (covering terms, facts and rules) is modeled with the OntoStudio ontology engineering system. A communication model isn't implemented for the demonstrator.

Figure 12 depicts the p Xpert.ivy process model. The green squares indicate tasks triggering business rules, stored in OntoBroker ontology execution environment.

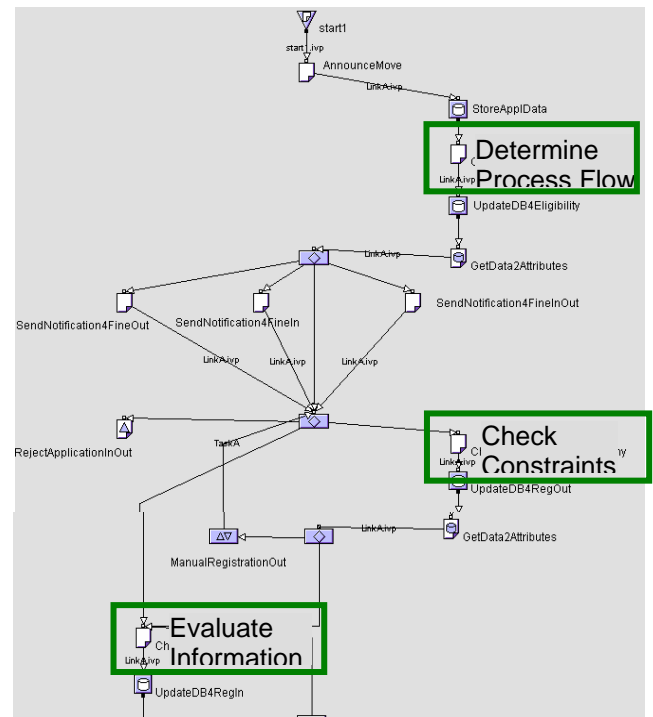


Figure 12: Process model 'Announce of Move'

The 'Announcement of Move' example comprises tasks without link to the rule engine (e.g. simple database look ups) and three exits to OntoBroker, marked with green rectangles. Rules are triggered to

- determine the process flow (e.g. get value for switch condition)
- check constraints (e.g. for deregistration)
- evaluate information (e.g. consistencies between data provided).

To determine the process flow information about the location of current and future residence an applicant has provided is checked. To do so, <current\_city> and <future\_city> are provided as input data to the rule engine to get the switch value. Four results are possible:

1. <current\_city> is in Switzerland
2. <current\_city> isn't in Switzerland
3. <future\_city> is in Switzerland
4. <future\_city> isn't in Switzerland.

Based on the result <1, 2, 3 or 4> the process continues with deregistration and registration (both cities are located in Switzerland), or with deregistration but no registration (<current\_city> is in Switzerland, <future\_city> is abroad), or with registration without deregistration (a foreigner moves from abroad to Switzerland), or neither registration nor registration can be performed (<current\_city> and <future\_city> are abroad). The return value is the value taken for the switch condition by Xpert.ivy.

Within the same step another rule is triggered inferring whether the canton(s) must be notified or not. In case a person moves from or to abroad, or the move is from one canton to another this information has to be sent to the concerned cantons.

To check constraints for deregistration rules are triggered dealing with data updates normally stored in legacy systems (e.g. a registration application of a municipality). An application of move may concern a permanent move of residence or only a temporary stay (e.g. for a few month doing a job somewhere). Depending on the status of person's residence, actions have to be taken:

1. <current\_residence> is permanent
2. <future\_residence> is permanent
3. <current\_residence> is sojourn
4. <future\_residence> is sojourn.

In case <current\_residence> and <future\_residence> are permanent, update will be performed (e.g. the applicants <current\_address> gets status <moved\_out>). In case <current\_residence> and <future\_residence> is sojourn, the legacy system is retrieved for the applicants permanent residence. If none is found, deregistration will not be performed but an notification sent, requesting information on permanent residence. In case <current\_residence> is permanent and <future\_residence> is sojourn an additional data entry will be made. Finally in case <current\_residence> is sojourn but <future\_residence> is permanent the status <stay\_ended> may be set.

Information evaluation is the third rule set modeled for the demonstrator.

Depending on the applicants' characteristics other documents are needed. For example, if an applicant

- is male with age between 18 and 40, a military booklet is requested for registration
- is divorced, a divorce certificate must be provided for registration

- is female and single, only a certificate of residence is needed for registration
- is female and single and registering in Olten, health insurance information is requested.

As the example shows, combining business rules and process models allows for a straightforward process model while specifics are handled with rules.

That approach contributes to keep the process model stable (in many cases only business rules are modified, e.g. a new document for registration is required). It supports consistency between activities executed by the workflow engine and manually (or with other applications) performed tasks, e.g. updating a citizens address information as shown above.

## Conclusion

With the APM framework three central obstacles (federalism structure, weakly structured, task oriented processes and knowledge-intensive tasks) to eGovernment improvement can be overcome. Combining process models for the common and business rules for the specifics, eGovernment service automation can be enforced. Based on standards developed by the eCH association basic process model can be provided but adapted by the municipalities clearly guided by the prepared methodology.

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