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I'm Moving

Authors

- Ben De Meester (IDLab, imec – Ghent University)
- David De Block (iO)

Contributors

- Raf Buyle (ADV)
- Liesbeth D'hondt (BOSA)
- Marc Bruyland (BOSA)
- Veronique Volders (ABB)
- Pieter Vanhoutteghem (BOSA)
- Stefanie Kerckhof (ADV / ABB)
- Gertjan De Mulder (IDLab, imec – Ghent University)
- Sitt Min Oo (IDLab, imec – Ghent University)

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OBJECTIVE

Via this initiative, the stakeholders wish to model the way governments on several levels can interact in an interoperable way concerning procedures and procedure steps, especially in cases where several government agencies and levels are involved. We will work on the procedure 'I am moving' as a base use case on which other procedures can be further developed.

The objective is to make the data and procedures accessible and executable and to define standard interfaces (APIs) and procedures that simplify collaboration and integration of the various services and tools. In addition, we want to make the data and procedures easily reusable across different governmental levels and public and private partners.

INTRODUCTION

Governments are digitally transforming at a fast pace. This transformation brings the opportunity to move towards a more inclusive and efficient government.

Imagine you move from Liege to Brussels. As a citizen, you enter an administrative burden. Many public and commercial stakeholders are involved in this process, and you must deliver the same information repeatedly. One of the reasons is the current architecture of many e-government applications:

- Regulations are deeply hidden in the application logic,
- Personal data is hidden in application-based databases, and
- Interoperability is very limited.

e-Government applications guiding users to various public services ("user journeys", e.g., updating an ID card after moving across cities) have hard-coded and non-personalised user journeys with high maintenance costs to keep up with, e.g., changing legislation. Specifically in Belgium, user journeys span different administrative levels, increasing the implementation complexity and cost.

We present the next iteration of the OSLO-STEPS vocabulary: a semantic specification to describe user journeys as a composition of individual steps, which in turn provide enough information to reason about the data requirements and/or data processing functionality needed for each step individually, and the user journey as a whole. We focus on the “I’m moving” use case, as this describes a real-life procedure that touches different administrative levels.

By increasing the interoperability of user journeys as such, the different steps can be individually managed and semantically described per organisation, and journeys can be composed from these individual steps. A semantic standard makes sharing and exchanging data between different stakeholders

easier. Each stakeholder can directly use and interpret the data of the other. This stimulates the exchange and reuse of data and reduces the cost of the exchange. Hence, we improve the situation for

- The citizen
    - The online presence can be organised around the tasks he/she want to execute (life events)
    - User experience can become seamless and tailored via the touchpoint of my choice (no wrong door)
    - Services could be based on the most up-to-date data and regulations
- The application owner:
    - The application can be based on the most up-to-date data and regulations without additional development effort
    - The application can consume relevant regulations of different government levels / institutions
    - The TCO of the application decreases (keeping it up-to-date with the law)
- The policymaker:
    - It becomes easier to create and manage machine readable regulations
    - The transparency of regulations increases
    - Machine readable regulations can be shared between different government levels / institutions. This could evolve towards a “once-only for regulations”
    - Regulations can be built on top of other regulations

After presenting the related work, we detail the followed method, introduce the extracted requirements, explain the resulting model, provide an end-to-end example, and provide conclusions and future work.

Related Work

After reviewing the (more general) organisation and (public) service modelling standards, we provide an overview on business rule modelling standards and best practices, after which we present some OSLO-STEPS history.

Organisation and (Public) Service Modeling Standards

Public Organization concepts are defined in the Core Public Organisation Vocabulary (CPOV), designed to support the exchange of basic information about individual public organisations (v2.1.0, 2022)[1]. It aspires to become a common data model for describing public organisations in the European Union. An OSLO extension Organisatie (2019)[2] and federal extension Public Organization (2022)[3] are available.

Starting from CPOV, an OSLO and federal application profile were created: Organisatie Basis (2019) and Public Organization (2021)[4].

Public Service concepts are defined in the Core Public Service Vocabulary (CPSV). Since its latest release (v1.01, 2013)[5], no new definitions needed to be added, neither in its OSLO version Dienst[6]. However its respective application profile (CPSV-AP) is currently at version v3.1.0[7].

Starting from CPSV-AP (v2.0, 2016), an OSLO and federal application profile were created: Dienstencataloog (2019)[8] and Public Service (2021)[9].

Based on Dienst and Public Service, the implementation model IPDC-LPDC was created (2022)[10]. It is used to exchange public service data between IPDC (v3) and LPDC, and describes how to communicate to and from the local products and services catalog (LPDC) and the intergovernmental products and services catalog (IPDC).

The Algoritmeregister of the Dutch government is a registry of public services[11], comparable to IPDC, part of a larger network of algorithm registries[12]. The current data standard does not seem to have a semantic reflection[13].

A **Procedure** is specified as the practical steps a civilian needs to pursue to follow a specific Public Service. Automatisch Advies is an application of the Flemish government to automatically give advice on

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1 https://joinup.ec.europa.eu/collection/semic-support-centre/solution/core-public-organisation-vocabulary/release/210

2 https://data.vlaanderen.be/ns/organisatie/

3 https://vocab.belgif.be/ns/publicorganization?lang=nl

4 https://belgif.github.io/thematic/models/public%20organisation/index_en.html#changelog

5 http://purl.org/vocab/cpsv

6 https://data.vlaanderen.be/ns/dienst/

7 https://semiceu.github.io/CPSV-AP/releases/3.1.0/

8 https://data.vlaanderen.be/doc/applicatieprofiel/dienstencataloog/

9 https://belgif.github.io/thematic/models/public%20services/index_en.html

10 https://productencatalogus.data.vlaanderen.be/doc/implementatiemodel/ipdc-lpdc/

11 https://algoritmes.overheid.nl

12 https://algoritmeregister.amsterdam.nl/, https://ai.hel.fi/en/ai-register/, https://cidai.eu/en/a-proposit-dels-registres-dalgoritmes-en-les-administracions-publiques-locals/

13 https://www.algorithmregister.org/standard

why procedures can or cannot be successfully completed[14]. The open proceshuis is aimed to be a registry of optimised procedures using reusable components.

Such a procedure is typically detailed using a User Journey[15] or Business Process Modeling Notation (BPMN), however, these are visual reflections of procedures, and do not contain enough information to be automatically interpreted as a working procedure.

A **case** can be defined using the OSLO Dossier vocabulary (2021)[16] and accompanying Dossier application profile (2021)[17]. Case management systems are primordial to follow-up on the status of a followed procedure.

Evidence (e.g., of correctly completing a procedure) concepts are defined in the Core Criterion and Core Evidence Vocabulary (CCCEV v2.00)[18]. The evidence of the SDGR's 21 procedures is further investigated in the Once-Only Technical System (OOTS)[19]. The Consent application profile explicitly includes an expiry model to CCCEV[20], which could link to retention policies.

Business Rule Modeling Standards and Best Practices

Procedures partly contain business rules. What follows is a short state-of-the-art review on business rule modelling standards and best practices (Figure 1).

[14] https://www.vlaanderen.be/digitaal-vlaanderen/onze-oplossingen/automatisch-advies
[15] E.g., http://gzg-prod.azurewebsites.net/sites/default/files/documenten/Blauwdruk_Rijbewijzen.pdf and http://gzg-prod.azurewebsites.net/sites/default/files/documenten/Blauwdruk_Wettelijke_Samenwoning.pdf
[16] https://data.vlaanderen.be/ns/dossier/
[17] https://data.vlaanderen.be/doc/applicatieprofiel/dossier/
[18] https://semiceu.github.io/CCCEV/releases/2.00
[19] https://ec.europa.eu/digital-building-blocks/wikis/display/OOTS/About+OOTS
[20] https://purl.eu/doc/applicationprofile/consent/

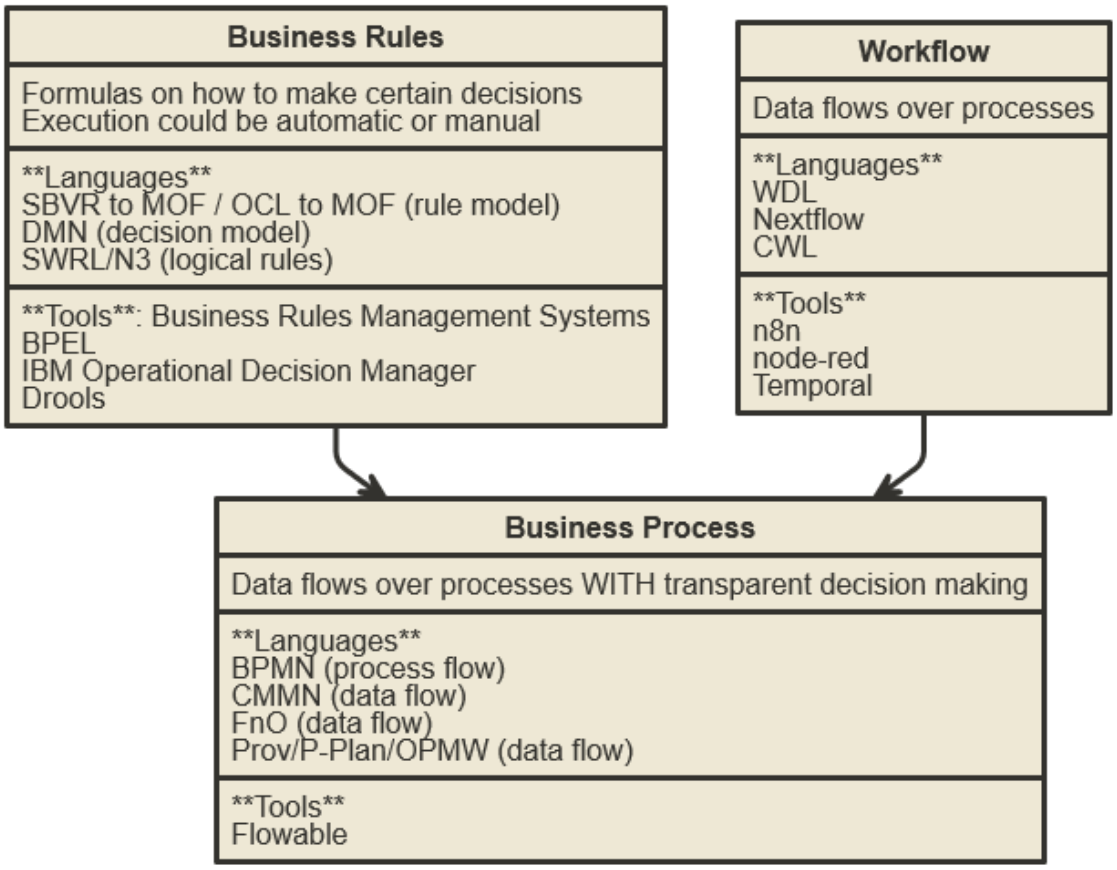

Figure 1: overview of interaction between Workflows, Business Rules, and Business Processes

We separate between three concepts (definitions and wording are specific for the scope of this report):

- **Workflows** are sequences of tasks that are executed. Within a workflow, it is specified how data flows over processes
- **Business rules** are formulas on how to make certain decisions. The execution of these formulas could be done automatically or manually.
- **Business processes** are sequences of tasks with transparent decision making. Procedures in the scope of this report can be seen as business processes, i.e., the combination of workflows with business rules.

Workflows

The Workflow Description Language (WDL) is a Domain-Specific Language (DSL) which focuses on scalability, and strives to make common patterns simple to express and understand by various types of users, while also admitting uncommon or complicated behaviour[21]. Nextflow is also a DSL which focuses on reproducibility and scalability[22]. The Common Workflow Language (CWL) is a well-adopted language focusing on interoperability, reproducibility, and scalability[23].

There's a myriad of tooling, with examples such as n8n[24], node-red[25], and Temporal[26].

Business Rules

In business process modelling, the key phase is writing business rules. The Semantic of Business Vocabulary in Rules (SBVR) is an adopted standard of the OMG and typically used to formalise complex compliance rules[27]. This rule model can be aligned to OMG's Object Constraint Language (OCL)[28], a formal specification language used to describe expressions and constraints on object-oriented models[29]. OCL is a side-effect free language which has a mathematical foundation (first-order logic), and thus related to Semantic Web rule languages such as SWRL[30] and N3[31].

The Decision Model Notation (DMN) is related to SBVR-like models. However, compared to SBVR which relies on more formalised rules, DMN allows to capture less formal processes, e.g., including the interaction with a human-in-the-loop.

OASIS's Web Services Business Process Execution Language (WS-BPEL) is a standard to deploy business rules in an execution environment[32]. Related tooling are IBM's Operational Decision Manager[33] and Drools[34]. Within these systems, there is a clear division between defining the Business Object Model (i.e., the definition of the used terminology such as 'Person' and 'age'), defining the Business Rules (i.e., the

[21] https://openwdl.org
[22] https://www.nextflow.io/
[23] https://www.commonwl.org/
[24] https://n8n.io/
[25] https://nodered.org/
[26] https://temporal.io/
[27] https://www.omg.org/spec/SBVR/
[28] Bajwa, I.S., Bordbar, B., & Lee, M.G. (2011). SBVR vs OCL: A comparative analysis of standards. *2011 IEEE 14th International Multitopic Conference*, 261-266.
[29] https://www.omg.org/spec/OCL/
[30] O'Connor, M.J., Knublauch, H., Tu, S.W., Grosof, B.N., Dean, M., Grosso, W.E., & Musen, M.A. (2005). Supporting Rule System Interoperability on the Semantic Web with SWRL. *International Workshop on the Semantic Web*.
[31] https://w3c.github.io/N3/spec/
[32] http://docs.oasis-open.org/wsbpel/2.0/OS/wsbpel-v2.0-OS.html
[33] https://www.ibm.com/docs/en/odm/8.9.2?topic=models-overview-bom-execution-object-model-xom, https://www.ibm.com/docs/en/odm/8.9.2?topic=bom-introducing-business-object-model
[34] https://www.drools.org/

definitions of the rules using that terminology such as 'a Person's age must be more than 21'), and the eXecution Object Model (i.e., the mapping between the business rule description and the (web) service calculating the decision).

Business Process

The most known language to describe business processes is the Business Process Modeling Notation (BPMN)[35]. This visual notation allows us to describe the process flow of highly-structured processes, i.e., where the sequence of tasks is pretty much fixed. Where BPMN allows to visually represent processes from the business point of view, User Journeys visually represent processes from the customer point of view. Both represent the (imperative) control flow of a process.

On the contrary, data flow modelling is more declarative and allows for less strict representations of business processes. Case Management Model and Notation (CMMN) is complementary to BPMN in this regard, as it allows to represent processes where the sequence of tasks is less strict[36]. Trisotech clearly visualises the complementarity between DMN, BPMN, and CMMN (Figure 2)[37].

[35] https://www.bpmn.org/
[36] https://www.omg.org/cmmn/
[37] https://www.trisotech.com/bpmn-cmmn-dmn-poster/

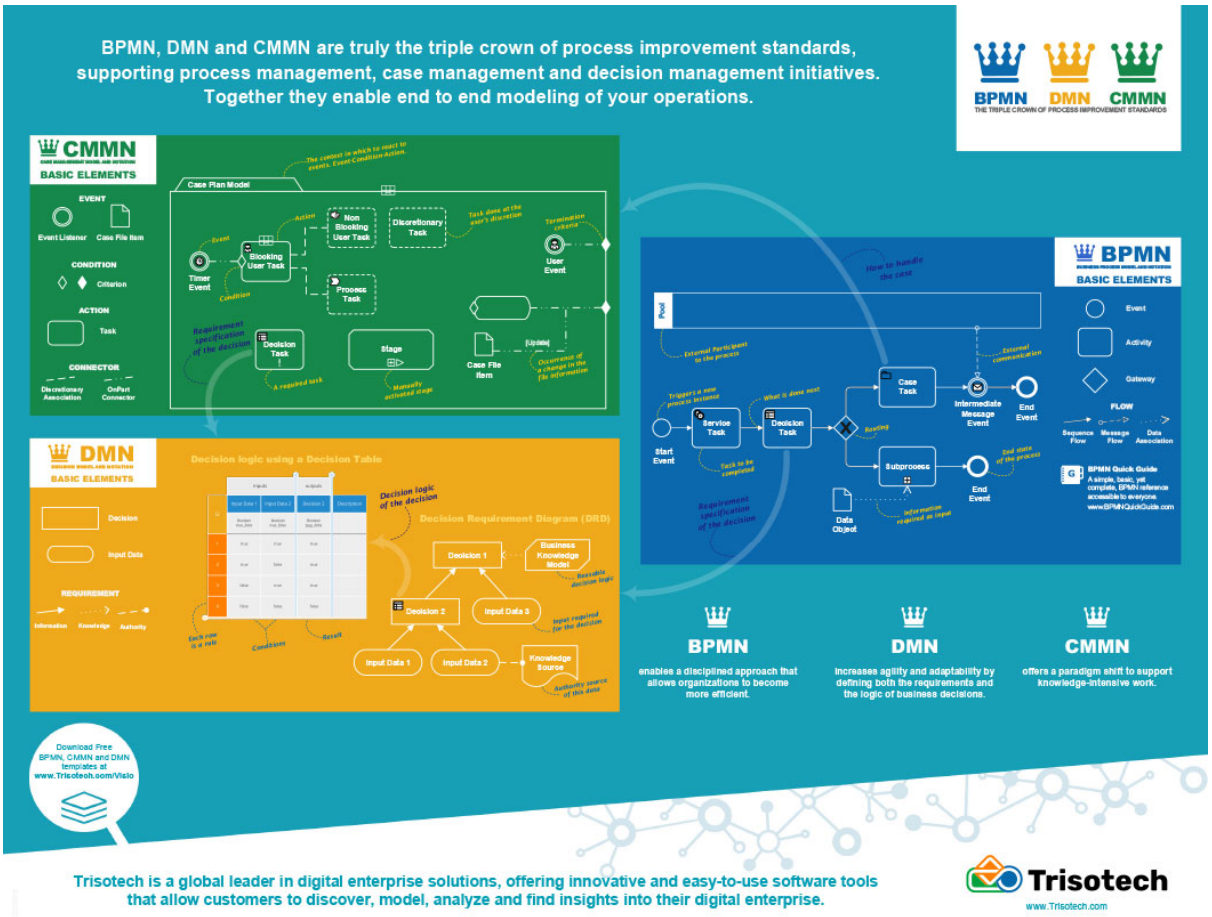

Figure 2: Complementarity between DMN, BPMN, and CMMN

Based on a data flow paradigm, multiple semantic standards have been designed to represent workflows and business processes. P-PLAN and OPMW are semantic standards to describe workflows in an abstract manner. P-PLAN extends the W3C standard PROV[38], describing workflow steps and linking them to execution traces, focusing on interoperability and reproducibility. OPMW is an extension of P-PLAN[39]: a simple interchange format for representing workflows at different levels of granularity (i.e., abstract model, instances, executions). These models are metadata descriptions, they are not designed to include enough annotations to be directly executable.

[38] Garijo, D., Gil, Y.: The P-PLAN Ontology. Technical report, Ontology Engineering Group (March 2014). http://purl.org/net/p-plan#

[39] Garijo, D., Gil, Y., Corcho, O.: Towards workflow ecosystems through semantic and standard representations. In: 2014 9th Workshop on Workflows in Support of LargeScale Science, pp. 94–104. IEEE (2014). https://doi.org/10.1109/works.2014.13

The Function Ontology (FnO)[40] allows for declaratively defining implementation-independent function descriptions using a semantic model. Any kind of function at any kind of granularity can be described in FnO. FnO allows the description of abstract functions, concrete implementations of various development contexts (e.g., an executable, a Web API, etc.), and explicit links between an abstract function and its concrete implementation. This makes FnO descriptions automatically executable. Recent work demonstrated the applicability of FnO for describing implementation-independent workflows as a composition of functions, and linking them to concrete implementations in the context of knowledge graph construction[41].

OSLO-Steps History

In the FAST project, an IMEC subsidised project with members such as Agentschap Digitaal Vlaanderen and IDLab (IMEC / UGent), they have been working on a potential solution, called OSLO-STEPS. It is a proof-of-concept vocabulary to create cross-organisational interoperable user journeys adapted to the user's needs. Using Linked Data principles allows to decentrally describe independent steps within a user journey using states as pre-and postconditions[42].

In the context of Single Digital Gateway, FOD BOSA has created a Proof-of-Concept which proves that you can use OSLO-STEPS to automatically deploy simple governmental procedures.

Conclusions

Based on our state-of-the-art review, we conclude:

- Many regional, federal, and European standards exist that are complementary to representing procedures
- Business process modelling requires links to both workflows and business rules. The advantage of using semantic standards is that these complementary concerns can be separately developed and linked.

[40] De Meester, B., Seymoens, T., Dimou, A., Verborgh, R.: Implementationindependent Function Reuse. Future Generation Computer Systems 110, 946–959 (2020). https://doi.org/10.1016/j.future.2019.10.006

[41] De Mulder, G., De Meester, B.: Implementation-independent Knowledge Graph Construction Workflows using FnO Composition. In: Third International Workshop on Knowledge Graph Construction (2022)

[42] https://doi.org/10.1145/3460210.3493559

- OSLO-STEPS has been focussing on dataflow modelling of business processes without specific links to business rules and is as such related to CMMN, OPMW, and FnO.

Method

We used following method, based on the OSLO Process and Method, but instead of a common business workshop we conducted one-to-one interviews:

- Stakeholder interviews
- Use Cases and Requirements analysis
- Model design
- Iterative feedback to further detail the UCR and improve the model.

Interviews

We conducted interviews with six professionals within the government sector who have experience with Linked Open Data and interoperability between January 30th and February 3rd 2023.

- Raf Buyle (ADV)
- Liesbeth D'hondt (BOSA)
- Marc Bruyland (BOSA)
- Veronique Volders (ABB)
- Pieter Vanhoutteghem (BOSA)
- Stefanie Kerckhof (ADV / ABB)

Below are the key findings from these interviews:

Interoperability initiatives currently primarily focus on data exchange rather than procedures.

None of the interviewees have active experience in making procedures and regulations interoperable and machine-readable.

There is a growing demand for a standardised approach to describing procedures, such as for SDG, IPDC/LPDC.

The interviewees recognize the need for a standardised approach to describing procedures. In particular, two programs were mentioned:

- The Single Digital Gateway Regulation[43] is an EU regulation aimed at strengthening the digital single market landscape by providing online access to information, procedures, and services for both citizens and businesses. It aims to simplify and streamline access to cross-border public services, such as starting a business, moving to another EU country, or working or studying in another country. This regulation promotes the digital transformation of government services by creating a digital portal that offers users centralised access to relevant information and procedures, reducing bureaucratic red tape and administrative burdens, and facilitating cross-border interaction between citizens, businesses, and governments.
- The Local Products and Services Catalog (LPDC)[44] enables local authorities to efficiently manage and disseminate information about their products and services in one place. By reusing machine-readable information and leveraging the principles of linked open data, different services, websites, and tools can utilise the same source information. This allows for automatic updates and maintains control over the information. Additionally, an integrated LPDC makes it easy for local authorities to comply with the requirements of the Single Digital Gateway Regulation.

There is a strong alignment between the needs of the interviewees and the standard we aim to develop.

Currently, there is no LOD standard that supports the description of procedures. Currently, procedures are often documented in unstructured text or represented using Business Process Model and Notation (BPMN).

There is a clear need for a standard that enables the exchange of procedure descriptions. Unfortunately, there are currently no Linked Open Data standards that provide a comprehensive solution. BPMN and unstructured text are currently used to describe procedures.

There is a willingness to actively contribute to this standardisation process.

The Local Products and Services Catalog plans to establish a process house and actively seeks a Linked Open Data standard for describing procedures. They are also willing to actively participate in the standardisation process. Although the Single Digital Gateway is not actively seeking a Linked Open Data standard at this time, they do have a need for such a standard.

There is the hope that a semantic standard to describe procedures will bring us a step closer to the automation of many G2C processes.

The semantic description of procedures strongly aligns with the principles of rules-as-code and automatic advice provision:

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43 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.295.01.0001.01.ENG&toc=OJ:L:2018:295:TOC

44 https://www.vlaanderen.be/lokaal-bestuur/digitale-transformatie/lokale-producten-en-dienstencatalogus

- "Rules as code" refers to the conversion of rules, regulations, and policy guidelines into executable code. In this process, the rules that are typically described in documents or manuals are translated into programming logic. By implementing rules as code, it becomes possible to automate, validate, and apply them to digital systems. This offers benefits such as consistency, accuracy, and efficiency, as the rules can be directly applied to data and processes. It also enables quick adjustments and updates when rules change, allowing organisations to be more flexible in responding to changes in laws and regulations. In summary, "rules as code" enables organisations to implement and enforce rules and regulations in a structured and executable manner.
- Automatic advice[45] aims to simplify the application process for citizens, who only need to provide a few pieces of information when requesting a service. The application automatically completes the dossier with the necessary data to determine, for example, eligibility for a subsidy. Based on the data, the application provides immediate advice. This advice is forwarded to the relevant entity, which then decides how to further process the dossier. Automatic advice contributes to a more efficient and user-friendly government. By digitising such straightforward dossiers, government agencies have more time to focus on complex cases or assisting and supporting their clients, ultimately enhancing service delivery.

The interviewees believe that the proposed semantic standard would be a step forward for both domains.

Use Cases and Requirements

- R-S1: Semantic ontology
    - UC-S1: Decentralised: different policy levels (municipal, regional, federal) should be able to manage their own procedures independently
    - UC-S2: Standardised (Linked Data) machine-readable format: procedures should be automatically ingested by machines
- R-D1: Division between listing rules and deploying executable procedures
    - UC-D1: The latest version should be under governance of the authentic source, aligned with regulation where relevant.
    - UC-D2: Different organisations should be able to deploy different procedure “flavours”
- R-C1: Case management

[45] https://www.vlaanderen.be/digitaal-vlaanderen/onze-oplossingen/automatisch-advies

    - UC-C1: Following up and managing specific cases (i.e., keeping track of a person's current status in the context of a specific procedure) should be linked to the procedures that are executed.
- R-T1: Subprocedures
    - UC-T1: High-level procedure descriptions should allow to align and harmonise different procedure flavours across organisations
    - UC-T2: Low-level procedure descriptions should be optimizable.
- R-U1: A procedure is a sequence of steps
    - UC-U1: A link with prevalent visual notations such as BPMN and User Journeys should be feasible.

Model

Vocabularium

- **Organization**: Represents a collection of people organized together into a community or other social, commercial or political structure. The group has some common purpose or reason for existence which goes beyond the set of people belonging to it and can act as an Agent. Organizations are often decomposable into hierarchical structures.
    - Documentation: https://belgif.github.io/thematic/models/public%20organisation/index_en.html#Organization
    - URI: http://www.w3.org/ns/org#Organization
- **Public Organization**: Any ***Organization*** that is defined as being part of the public sector by a legal framework at any level.
    - Documentation: https://belgif.github.io/thematic/models/public%20organisation/index_en.html#Public%20Organization
    - URI: http://data.europa.eu/m8g/PublicOrganisation
- **Public Service**: This class represents the Public Service itself, as it is described in a public service catalogue. A Public Service is a mandatory or discretionary set of activities performed, or able to be performed, by or on behalf of a ***Public Organization***, publicly funded and arising from public

policy. Services may be for the benefit of an individual, a business, or other public authority, or groups of any of these. A service exists whether it is used or not, and the term 'benefit' may apply in the sense of enabling the fulfilment of an obligation. As defined in the revised version of the European Interoperability Framework, a European public service comprises any service provided by public administrations in Europe, or by other organisations on their behalf, to businesses, citizens or other public administrations.

  - Documentation: https://belgif.github.io/thematic/models/public%20services/index_en.html#Public%20Service
  - URI: http://purl.org/vocab/cpsv#PublicService

- **Rule**: The Rule class represents a document that sets out the specific rules, guidelines or procedures that the ***Public Service*** follows. It includes the terms of service, licence, and authentication requirements of the Public Service. Instances of the Rule class are FRBR (Functional Requirements for Bibliographic Records) Expressions, that is, a concrete expression such as a document, of the more abstract concept of the rules themselves.This model does not envisage instances of the Rule class as machine-readable business rules. Detailed modelling of the rules related to Public Services is out of scope of this model.
  - Documentation: https://belgif.github.io/thematic/models/public%20services/index_en.html#Rule
  - URI: http://purl.org/vocab/cpsv#Rule
- **Legal Resource**: This class represents the legislation, policy or policies that lie behind the ***Rules*** that govern the service.
  - Documentation: https://belgif.github.io/thematic/models/public%20services/index_en.html#Legal%20Resource
  - URI: http://data.europa.eu/eli/ontology#LegalResource
- ❗ **Business Process**: This class represents the machine-readable steps to be followed related to a ***Public Service***. Alternative names are life event, project, procedure. A Business Process can adhere to one or more ***Rules*** and has one or more ***Requirements*** as result.
- ❗ **Instruction**: This class represents a description of a piece of work that forms one logical step within a ***Business Process***. A step may be either a ***Business Process***, or the smallest unit of work which is scheduled based on pre/post-conditions (i.e., ***Requirements***).
  - Documentation: https://fast.ilabt.imec.be/ns/oslo-steps/index-en.html#Step
  - URI: https://fast.ilabt.imec.be/ns/oslo-steps#Step

  - An instruction (where relevant) could be further refined, e.g., the SBVR business rules description could be linked to an instruction
  - An instruction (where relevant) could be further refined, e.g., the retention policies could be linked to an instruction (e.g., following an instruction needs to happen within 30 days after completing a previous instruction)
- **Requirement**: A normal requirement is an atomic requirement. Some criteria can be expressed with several atomic requirements. A normal requirement can specify the expected value that the requirement response has to contain, or a range of threshold values within which the requirement response has to fit in. The normal requirement may apply to a certain period of time. It also can provide a list of candidate evidence that the responder can use to prove the normal requirement.
  - Documentation: https://belgif.github.io/thematic/models/public%20services/index_en.html#Requirement
  - URI: http://data.europa.eu/m8g/Requirement
- ❗ **State Shape**: A State Shape is a shape that specifies a set of triples representing a ***Requirement***, and is described as constraints.
  - Documentation: https://fast.ilabt.imec.be/ns/oslo-steps/index-en.html#StateShape
  - URI: https://fast.ilabt.imec.be/ns/oslo-steps#StateShape
- **Case**: A case is the total of work done to prepare for an administrative or business decision. As a rule, a case is reflected in a set of documents. A Case can consist of multiple ***Steps***.
  - Documentation: https://data.vlaanderen.be/doc/applicatieprofiel/dossier/#Zaak
  - URI: http://dbpedia.org/ontology/Case
  - A Case is an instance of a ***Business Process*** for a specific ***Agent***, where all concrete data and followed steps are described.
- **Step**: A procedural step is the totality of work done within a specific chronological, logical, organizational or legal part of a procedure.
  - Documentation: https://data.vlaanderen.be/doc/applicatieprofiel/dossier/#Procedurestap
  - URI: https://data.vlaanderen.be/ns/dossier#Procedurestap
- **Evidence**: Proof that a ***Requirement*** is met.
  - Documentation: https://semiceu.github.io/CCCEV/releases/2.00/#Evidence
  - URI: http://data.europa.eu/m8g/Evidence

Application Profile

- A ***Public Service*** has at least one ***Public Organization*** as competent authority
    - Documentation: https://belgif.github.io/thematic/models/public%20services/index_en.html#Public%20Service%3Ahas%20competent%20authority
    - URI: http://data.europa.eu/m8g/hasCompetentAuthority
- A ***Public Service*** can follow one or more ***Rules***
    - Documentation: https://belgif.github.io/thematic/models/public%20services/index_en.html#Public%20Service%3Afollows
    - URI: http://purl.org/vocab/cpsv#follows
- A ***Rule*** can implement one or more ***Legal Resources***
    - Documentation: https://belgif.github.io/thematic/models/public%20services/index_en.html#Rule%3Aimplements
    - URI: http://purl.org/vocab/cpsv#implements
    - This is not required, i.e., there are rules that are not an implementation of a legal resource.
- ❗ A ***Public Organization*** can instantiate a ***Business Process***
- ❗ A ***Business Process*** can have one or more ***Requirements*** as result
- A ***Requirement*** can fulfil one or more ***Rules***
    - Documentation: https://semiceu.github.io/CPSV-AP/releases/3.1.0/#Requirement%3Afulfils
    - URI: http://data.europa.eu/m8g/fulfils
    - By checking all Business Processes' Requirement's fulfilling Rules of a Public Organization, you can check which Public Services' Rules are followed.
- ❗ A ***Business Process*** can have one or more ***Instructions***
- ❗ An ***Instruction*** can consist of one or more sub-***Instructions***
- ❗ An ***Instruction*** can require one or more ***Requirements***
    - Documentation: https://fast.ilabt.imec.be/ns/oslo-steps/index-en.html#requiresState
    - URI: https://fast.ilabt.imec.be/ns/oslo-steps#requiresState
- ❗ An ***Instruction*** can produce one or more ***Requirements***

  - Documentation: https://fast.ilabt.imec.be/ns/oslo-steps/index-en.html#producesState
  - URI: https://fast.ilabt.imec.be/ns/oslo-steps#producesState
- ❗ A ***Requirement*** can have one or more ***State Shapes***
  - Documentation: https://fast.ilabt.imec.be/ns/oslo-steps/index-en.html#hasStateShape
  - URI: https://fast.ilabt.imec.be/ns/oslo-steps#hasStateShape
  - By checking an Instruction's required Requirement's State Shape, you know the actual RDF shape of the expected data for an Instruction.
  - By checking an Instruction's produced Requirement's State Shape, you know the actual RDF shape of the returning data for an Instruction.
- A ***Case*** can follow one or more ***Steps***
  - Documentation: https://data.vlaanderen.be/doc/applicatieprofiel/dossier/#Zaak%3Adoorloopt
  - URI: https://data.vlaanderen.be/ns/dossier#doorloopt
- ❗ A ***Step*** can contain ***Evidence***
- An ***Evidence*** supports a ***Requirement***
  - Documentation: https://semiceu.github.io/CCCEV/releases/2.00/#Evidence%3Asupports%20requirement
  - URI: http://data.europa.eu/m8g/supportsRequirement

FIT-GAP ANALYSIS

We visualise the extensions we introduce between existing vocabularies, application profiles, and implementation models (Figure 3). Extensions are marked in grey, existing concepts are colour-coded and their origin is detailed below.

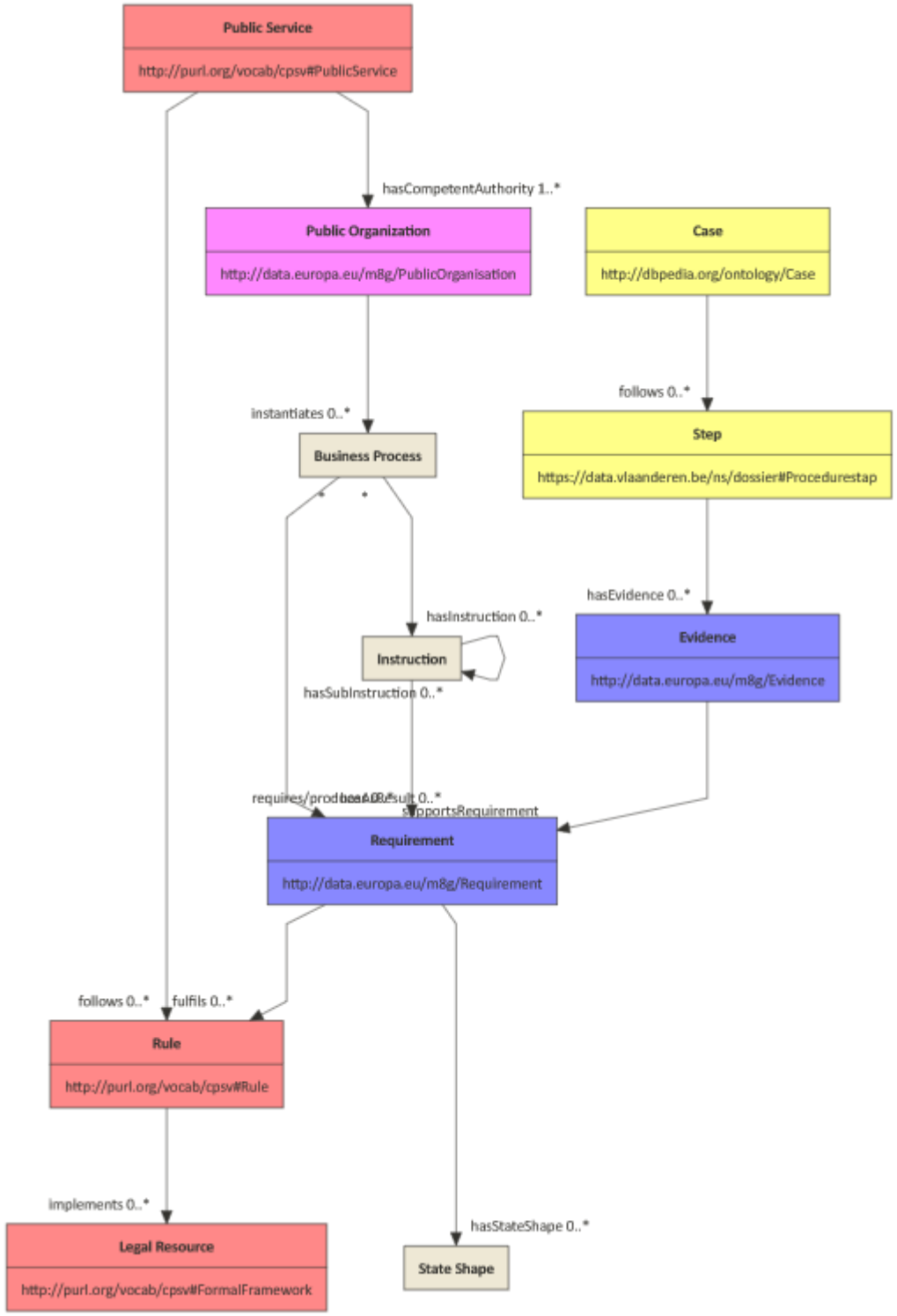

Public Service
http://purl.org/vocab/cpsv#PublicService
hasCompetentAuthority 1..*
Public Organization
http://data.europa.eu/m8g/PublicOrganisation
Case
http://dbpedia.org/ontology/Case
follows 0..*
instantiates 0..*
Business Process
Step
https://data.vlaanderen.be/ns/dossier#Procedurestap
hasEvidence 0..*
hasInstruction 0..*
Instruction
Evidence
http://data.europa.eu/m8g/Evidence
hasSubInstruction 0..*
requires/produces/hasResult 0..*
supportsRequirement
Requirement
http://data.europa.eu/m8g/Requirement
follows 0..*
fulfils 0..*
Rule
http://purl.org/vocab/cpsv#Rule
implements 0..*
hasStateShape 0..*
Legal Resource
http://purl.org/vocab/cpsv#FormalFramework
State Shape

Figure 3: Overview of extensions on existing vocabularies, application profiles, and implementation models

- Red
    - Vocabulary: CPSV v1.01
    - Application profile: CPSV-AP v3.1.0 / Dienstencataloog / Public Service
    - Implementation model: IPDC-LPDC
- Pink
    - Vocabulary: CPOV v2.1.0 / Organisatie / Public Organization
    - Application profile: Organisatie Basis / Public Organization
- Purple
    - Vocabulary: CCCEV 2.0
- Yellow
    - Vocabulary: Dossier
    - Application profiel: Dossier

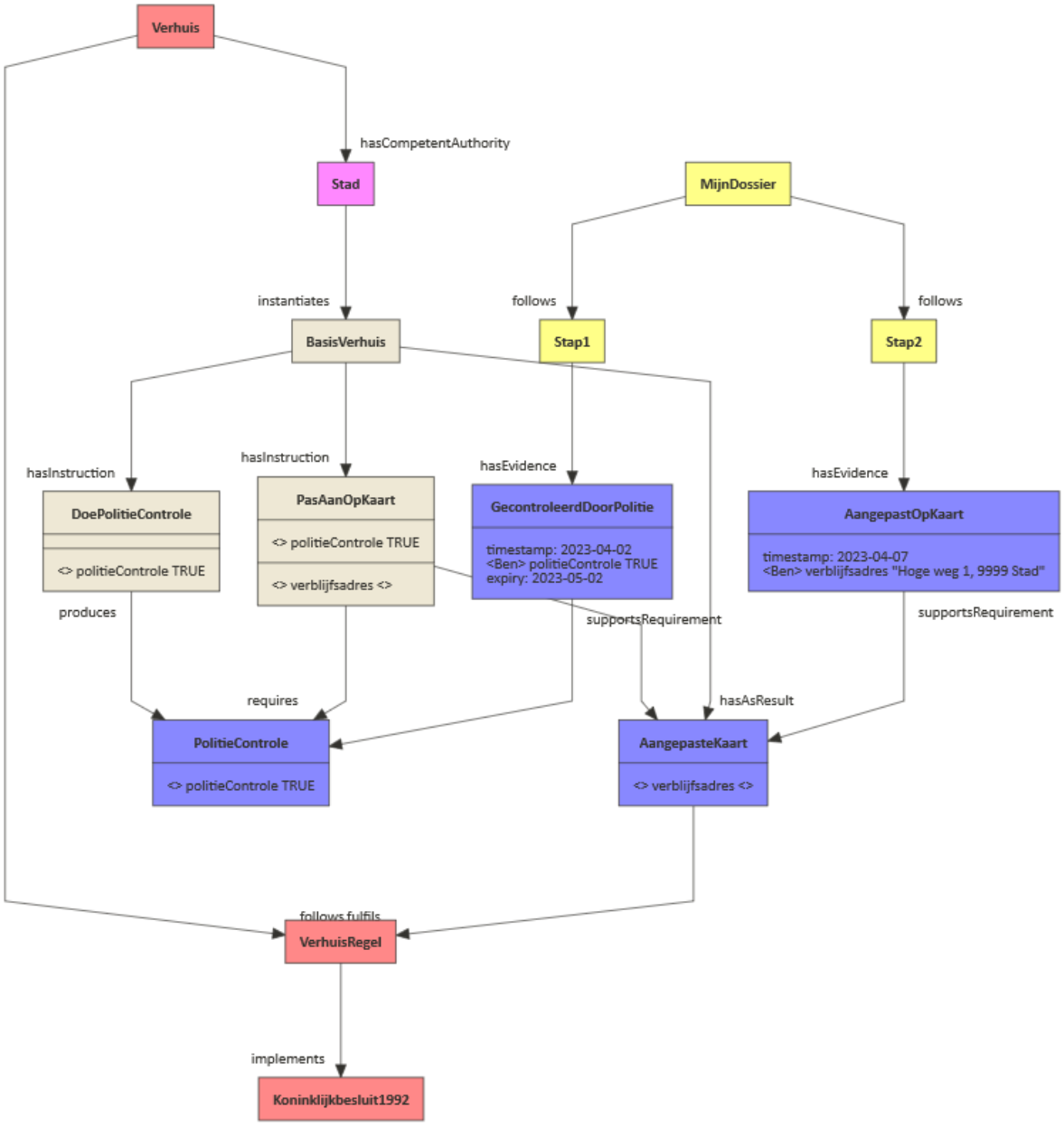
Alignment with OSLO-STEPS

Since the inception of OSLO-STEPS, CCCEV 2.0 was released. We can see following mappings

- ***oslo-steps:Step*** → ***ex:Instruction*** A choice was made to rename this concept to clarify the difference between an instruction (i.e., describing what to do) and a step (i.e., describing what you have done). The concepts ***oslo-steps:JourneyLevelStep***, ***oslo-steps:ContainerLevelStep***, and ***oslo-steps:ComponentLevelStep*** remain to clarify the hierarchy between ***ex:Instructions***.
- ***oslo-steps:State*** → ***cccev:Requirement*** CCCEV's Requirement covers the same definition as OSLO-STEPS' State.
- ***oslo-steps:StateShape*** → ***sh:NodeShape*** SHACL's NodeShape covers the same definition as OSLO-STEPS' StateShape.

End-to-end Examples

Example 1: Adjusting your address first requires a police check



We will go through the example in steps, the compliant JSON-LD snippet is available as Technical Annex.

A Public Service “Verhuis” follows a specific Rule “VerhuisRegel” that implements Legal Resource “Koninglijkbesluit1992”. This Public Service needs to be put in place by its competent authority Public Organization ‘Stad’. This Public Organization instantiates a Business Process “BasisVerhuis” that has two instructions: Instruction “DoePolitieControle” and Instruction “PasAanOpKaart”. Each instruction requires and produces Requirements. Instruction “DoePolitieControle” produces the Requirement “PolitieControle” and Instruction “PasAanOpKaart” requires the Requirement “PolitieControle” and produces the Requirements”AangepasteKaart”. The shape of the data is described for each Requirement. Fulfilling the Requirement AangepastKaart fulfils the Rule VerhuisRegel and thus concludes the Business Process.

When the Case MijnDossier is started, multiple steps are followed. The Evidence GecontroleerdDoorPolitie of Stap 1 supports the Requirement “PolitieControle” and similar for Evidence AangepastOpKaart. Being able to provide evidence allows us to validate that each required step is followed.

Conclusions

The proposed model nicely aligns with existing mature vocabularies, and only introduces complementary terms. The concept of a Business Process was missing in existing standards and OSLO-Steps, and is hereby introduced. Next to that, combining OSLO-steps concepts and CCCEV concepts allowed us to glue these existing vocabularies together.

Two things are not strictly specified within this proposal:

- The order between steps is only implicitly defined when looking at how the requirements depend on each other
- The semantic description of business rules is out of scope

Business rules

For describing business rules, there are typically the following alternative solutions.

- Predefining a fixed set of available operators to build business rules upon. Although the most simple choice, one must be aware that this fixed set will constantly evolve to cope with changing requirements.
- Defining an extension mechanism to define business rules as externally defined functions that can be maintained and developed in parallel. The Function Ontology is a potential solution to allow declarative business rules without limiting the scope, complexity, or implementation.
- A hybrid solution.

Smaller recommendations

- Evaluating the current CPSV application profiles (Dienstencataloog and Public Service) in light of the latest CPSV v3 release, to see whether these can be reconciled and updated.
- Extend the **Public Service** class to a more general **Service**. At the moment: it is not possible to describe services that are not performed by or on behalf of a public agency.

Future work

A new architecture for delivering and managing e-government applications, built on existing interoperability standards, could be rolled out. It should separate:

- Logic / Regulations: regulations are documented in a linked data format based on existing vocabularies such as OSLO and CCCEV.
- Data: personalised data is fetched from and stored in different decentralised data sources, such as SOLID or data registers.
- Applications: the application creates a personalised digital user experience based on up-to-date regulations and the personal context of the user.