

Demonstrating GDPR Accountability with CSM-ROPA: Extensions to the Data Privacy Vocabulary

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Abstract: The creation and maintenance of a Register of Processing Activities (ROPA) are essential to meeting the Accountability Principle of the General Data Protection Regulation (GDPR). We evaluate a semantic model CSM-ROPA to establish the extent to which it can be used to express a regulator provided accountability tracker to facilitate GDPR/ROPA compliance. We show that the ROPA practices of organisations are largely based on manual paper-based templates or non-interoperable systems, leading to inadequate GDPR/ROPA compliance levels. We contrast these current approaches to GDPR/ROPA compliance with best practice for regulatory compliance and identify four critical features of systems to support accountability. We conduct a case study to analyse the extent that CSM-ROPA, can be used as an interoperable, machine-readable mediation layer to express a regulator supplied ROPA accountability tracker. We demonstrate that CSM-ROPA can successfully express 92% of ROPA accountability terms. The addition of connectable vocabularies brings the expressivity to 98%. We identify three terms for addition to the CSM-ROPA to enable full expressivity. The application of CSM-ROPA provides opportunities for demonstrable and validated GDPR compliance. This standardisation would enable the development of automation, and interoperable tools for supported accountability and the demonstration of GDPR compliance.

1 INTRODUCTION

Organisations are facing significant challenges in meeting the accountability principle of the GDPR. The GDPR prescribes that organisations create and maintain a Register of Processing Activities (ROPA), which is a comprehensive record of their personal data processing activities. Aside from being a legal obligation on organisations, a ROPA is an internal control tool and, is a way to demonstrate an organisation's compliance with the GDPR.

A review of the ROPA practices of organisations shows that they face challenges with maintaining their ROPA documents. We review these approaches and identify the inherent weaknesses and challenges that organisations face. We determine what best practice for GDPR compliance is. We provide a case study to demonstrate the expressiveness of our mediation layer CSM-ROPA. We semantically map the ROPA section of a regulator supplied accountability framework to support GDPR accountability.

In section 2, we discuss the accountability principle of the GDPR. We identify the internal bodies such as the board of the organisation, and external entities such as data subjects, business partners, data protection regulators and certification bodies to whom GDPR compliance is demonstrable. We discuss the benefits and sanctions that accrue dependant on the organisation's ability to demonstrate their GDPR compliance.

In section 3, we review the available literature to identify best practice for the demonstration of GDPR regulatory compliance and identify the key features that need to be present for a successful regulatory compliance framework. In section 4, we review the current approaches taken by organisations to create and maintain their ROPAs, and we discuss the challenges faced by organisations in meeting the accountability principle of the GDPR. In Section 5, we discuss the approach that organisations should be taking to go beyond a paper-based strategy for ROPA compliance. We discuss the steps that organisations

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should be taking to engage and apply the best practices to move to a machine-readable ROPA to support accountability.

In section 6, we introduce our Common Semantic Model of the Register of Processing Activities (CSM-ROPA), developed to map regulator supplied ROPA templates semantically. We describe the role of CSM-ROPA as a mediation layer between the processing activities layer of the organisation and the reporting and monitoring layer facilitating the automation of ROPA accountability compliance verification. Our research question asks to what extent can CSM-ROPA model the ROPA section of a regulator supplied accountability framework, to assist organisations in meeting the accountability principle of the GDPR. The remainder of the paper will introduce a case study where we deploy CSM-ROPA to facilitate the interoperable exchange of information to enable compliance verification as set-out in the accountability framework.

The contributions of this paper are the demonstration of the expressiveness of CSM-ROPA to facilitate GDPR supported accountability. We identify vocabularies that can be linked to the Data Privacy Vocabulary (DPV) to improve expressivity, and we identify several terms for inclusion in the DPV. The positive outcome of this research indicates that with a small number of additions to CSM-ROPA, it is possible to support machine to machine accountability compliance verification for the creation and maintenance of ROPAs.

2 WHAT IS ACCOUNTABILITY UNDER THE GDPR?

Accountability is an expression of how an organisation must display "a sense of responsibility and a willingness to act in a transparent, fair and equitable way" (Bovens, 2007), moreover, "the obligation to explain and justify conduct" (Bovens, 2007). The GDPR places accountability as one of the seven fundamental principles of the regulation and requires that an organisation is responsible for and must demonstrate compliance with all principles of the GDPR (Ryan, 2020a). Organisations must put in place "appropriate and effective measures to put into effect the principles and obligations of the GDPR and demonstrate on request" (GDPR, Art 5). This regulation places an obligation on organisations, to demonstrate proof related to whether, how and how well the organisation protects personal data. Considering such a significant obligation,

organisations must fundamentally rethink the way they store and process personal data on an enterprise-wide level (Labadie, 2019).

The purpose of accountability is not just the evaluation of compliance with statutory obligations. An accountable organisation can demonstrate how they respect the privacy of their data subjects, i.e. the subjects of the processing of personal data. Hence the organisation has several audiences for the demonstration of compliance. Internally, the organisation must demonstrate that it is operating in an accountable manner to its corporate board and employees; they need to put internal organisational privacy and information management programs in place. The provision would include the implementation of internal measures and procedures, putting into effect existing data protection principles, ensuring their effectiveness and the obligation to prove this should data protection authorities request it.

Similarly, the organisation has obligations to demonstrate compliance to external stakeholders such as individuals, business partners, shareholders and civil society bodies representing individuals and, to Data Protection Authorities. The organisation may also need to demonstrate compliance with a certification body as part of a code of conduct or a standardised certification accountability framework (GDPR Art 42). The role of such external certifications, seals and codes of conduct have the benefit to support accountability when accompanied by some form of external validation, which ensures both verification and demonstration (CIPL,2018).

The benefits of organisational accountability cannot be overstated (CIPL2018). Accountability gives organisations a solid framework for compliance with applicable legal requirements, for protecting data subjects from privacy harms and for building trust in the organisations' ability to engage in the responsible use of data. Importantly, accountability provides an approach to data protection that is transparent, risk-based, technology-neutral and future-proof (CIPL, 2018). Implementation of accountability increases trust in the operations of the organisation. It ensures that the organisation is equipped to handle new challenges to data protection law and practice, regardless of advances in technology or changes in the behaviours or expectations of individuals and provides them with the necessary flexibility and agility to customise their data privacy management programs. Successfully embedding accountability will enhance the reputation of the business that it can be trusted with personal data (CIPL,2018).

The alternative to the implementation of a robust accountability framework is that the organisation may face the consequences for non-compliance with the accountability principle of the GDPR. Such non-compliance can result in an organisation facing fines up to €20 million, or up to 4% of the annual worldwide turnover of the preceding financial year, whichever is greater. Hence the accountability principle is a double-edged sword, with one side containing the reputational trust and confidence gained from acting in an accountable manner when organisations are meeting its obligations versus compliance failures resulting in reputational damages and financial sanctions.

3 BEST PRACTICE FOR THE DEMONSTRATION OF GDPR ACCOUNTABILITY

We conducted a review of the literature to establish best practice for the demonstration of regulatory compliance. The review yielded very little direct research of GDPR compliance; however, we identified a body of relevant research in the area of RegTech. The catalyst for the emergence of this approach to regulatory compliance was the Global Financial Crisis of 2007. The introduction of many financial regulations, increasing operational costs and significant regulatory fines, created significant

challenges for the Financial Industry. The response of the industry was RegTech to meet the increasing compliance challenges they faced (Butler, 2019). We identified the four critical features of RegTech systems to enable organisations successfully demonstrate compliance with regulations. These are, the enabling of a well-defined data governance capability, applying ICT advances to regulatory compliance, the agreement on common standards/agreed semantics to enable the interoperability of systems, and the role of regulators as facilitators for the automation of regulation (Ryan, 2021). We will discuss these in detail in the next sub-section.

3.1 Enabling a Well-defined Data Governance Capability

Organisations need a dedicated data governance capability to build common ground between the legal and data management domains, to facilitate the digital transformation of organisations and to enable effective control and monitoring of data processing for compliance purposes. Despite embracing the productivity and agility gains of digitisation, many organisations struggle with the basic principles of data governance (Butler, 2019). Organisations need to have clearly defined data principles and treat data as an asset. (Khatri, 2010). The agreed uses of that data must be clearly defined, and the organisation must ensure that the use of data relates positively to the

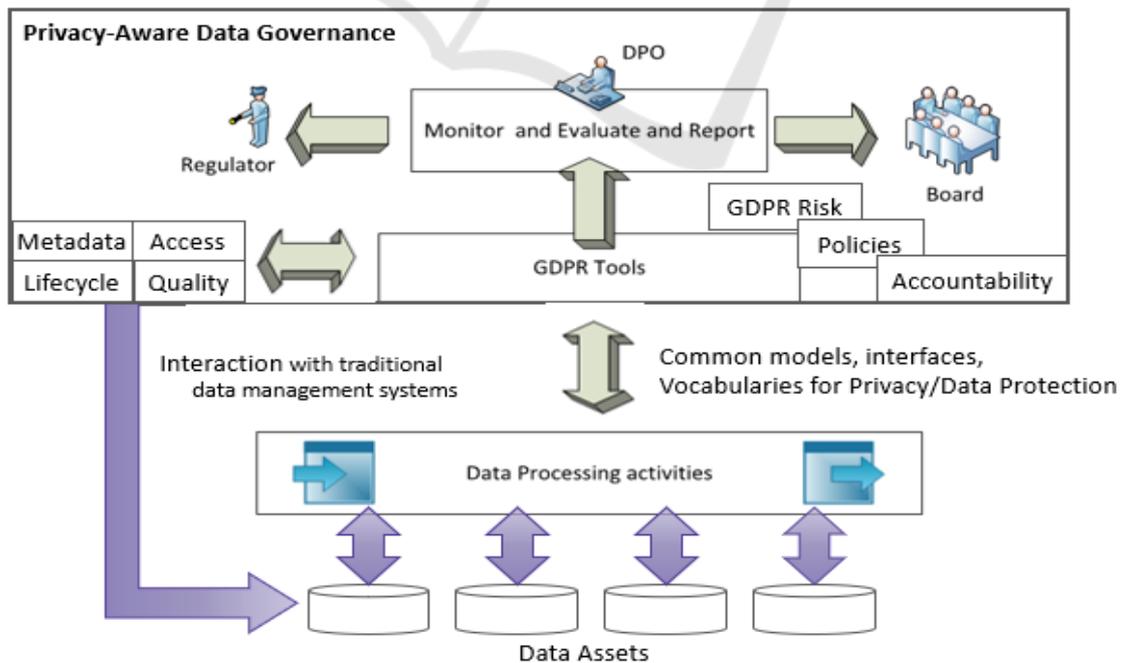


Figure 1: Privacy-Aware Data Governance to Support GDPR RegTech.

regulatory environment. They need to set out as to what are the organisational behaviours for data quality, who will access the data, how data is interpreted and what is the data retention period. The application of structured data governance to organisational data, coupled with agreed semantics, can enable the smooth and efficient flow of data between parties, thus bringing efficiencies to the organisation (see figure 1). The challenge that organisations are facing regarding personal data is locating, classifying and cataloguing this data, i.e. creation of appropriate metadata to enable management of the personal data, and then deploying a policy monitoring and enforcement infrastructure leveraging that metadata to assure legal data processing and generate appropriate compliance records.

3.2 Applying ICT Advances to GDPR Compliance

The adaption of new technologies has been at the forefront of the successes of RegTech. A GDPR RegTech solution will require the same approach to new technology to facilitate efficient and effective compliance. The Fintech revolution (Arner, 2015) brought about the implementation of Big Data collection and analytics techniques, machine learning, Natural Language Processing (NLP), Artificial Intelligence (AI), cloud technology, DevOps (continuous development), Distributed Ledger tech, software integration tools and many other technologies in the financial industry. The cost of compliance and the need for agile solutions brought about the speedy and effective implementation of such new technologies. A RegTech approach to GDPR would require organisations to implement such technologies in a GDPR environment. The transformative nature of technology (Arner, 2016) enjoyed by RegTech is achievable in the GDPR environment through a new approach to technology at the nexus of data and regulation.

3.3 Agreement on Common Standards/Agreed Semantics for Personal Data Processing

The third requirement for GDPR RegTech is the need to make personal data interoperable between systems. Whilst the digital transformation of financial data in RegTech has facilitated the application of technology to this data; this may be more challenging in a GDPR

environment. The semantic modelling of GDPR business processes would be a great benefit to an organisation and provide for machine-readable and interoperable representations of information allowing queries to be run and verified based on open standards such as RDF, OWL, SPARQL, and SHACL (Pandit, 2020). The combination of legal knowledge bases with these models become beneficial for compliance evaluation and monitoring, which can help to harmonise and facilitate a joint approach between legal departments and other stakeholders to the identification of feasible and compliant solutions around data protection and privacy regulations (Labadie, 2019). There has been progress in developing 'Core Vocabularies', maintained by the Semantic Interoperability Community (SEMIC), that provides a simplified, reusable and extensible data model for capturing fundamental characteristics of an entity in a non-domain specific context (Pandit, 2020) in this area to foster interoperability. This work continues to be built on through the development of the W3C Data Privacy Vocabulary (DPV) and the PROV-O Ontology (Pandit, 2020).

3.4 Data Protection Supervisory Authorities as an Enabler

The fourth requirement for GDPR RegTech is the need for proactivity by regulators, who will work with organisations to automate regulation and make compliance easier to achieve. GDPR Regulators have lacked the proactivity of financial regulators in the facilitation of automated digital compliance. This lack of leadership has resulted in organisations facing the "pitfalls of a fragmented Tower of Babel approach" (Butler, 2019). The role of the supervisory authority is a critical enabler and facilitator, for RegTech. However, GDPR Regulators have been relatively slow to take a similar role in comparison to financial regulators. Our analysis of RegTech (Ryan, 2020a) (Butler, 2019) has shown that compliance monitoring and reporting to improve compliance monitoring is achievable using technology when flexible, agile, cost-effective, extensible and informative tools are combined. When regulators enable and facilitate digital compliance, and actively promote digital regulatory compliance standards, and act as facilitators for the automation of regulation, they create an environment for digital compliance. For GDPR RegTech to be successful GDPR regulators, need to move towards a symbiotic relationship with technology innovators and organisations processing personal data to develop open-source compliance tools, digital regulations,

sandboxes (Arner,2017) and tech sprints (Arner,2017). This relationship would significantly accelerate the successes of GDPR RegTech solutions.

4 CURRENT CHALLENGES TO ROPA COMPLIANCE

A study conducted mid-2019 among more than 1100 executives across ten countries, and eight sectors reported that only 28% of the responding organisations were compliant with the GDPR at that time (Cap Gemini, 2020). This low level of GDPR compliance is a significant risk for organisations, so why are they failing to be compliant? Jakobi et al. describe the three approaches that organisations are taking for dealing with the GDPR in day-to-day business (Jakobi,2020). These strategies stretch from "burying the head in the sand" to compliance to the minimum level against a "first-time fine", to the few organisations that see compliance as a quality feature for their business customers or end-users and seek to generate competitive advantage from GDPR compliance.

The GDPR requires an organisation explicitly to build and implement comprehensive internal data privacy and governance programs (including policies and procedures) that implement and operationalise data privacy protections. Many Data Protection Authorities agree that in order to have a good overview of what is going on in an organisation, the Register of Processing Activities is a vital element (Nymity, 2018). Aside from being a legal obligation on organisations, the record is an internal control tool and, is a way to demonstrate an organisation's compliance with GDPR³. It is a comprehensive record of the personal data processing activities of an organisation. It is integral to meeting the principle of accountability as set out in Article 30 of the GDPR. It not only provides an overview of the ongoing data processing operations but also helps organisations to decide which are the appropriate technical and organisational measures that need implementation. Furthermore, the ROPA supports the drafting and updating of privacy notices, which will need to include much information already included in the register. Finally, the information included in the ROPA allows assessing if processing activities are "high risk" and thus need to be part of a Data Protection Impact Assessment (DPIA).

Considering the importance of ROPA regarding GDPR compliance, we analyse the approaches that

organisations are taking to the creation and ongoing maintenance of ROPAs. Several data protection supervisory authorities have provided ROPA templates to assist organisations to complete their ROPA. These documents are spreadsheet-based templates which can vary significantly between regulators (Ryan,2020). These solutions are mainly spreadsheet-based, they rely on qualitative input of users, and they lack input or output interoperability with other solutions.

The United Kingdom Data Protection Regulator (ICO) recommends that organisations start by doing an information audit or data-mapping exercise to clarify what personal data the organisation holds and where they hold it. The process requires a cross-organisation approach to ensure that the organisation is fully engaged in the process. This approach ensures that that the organisation is not missing anything when mapping the data processed by the organisation. The ICO adds that "It is equally important to obtain senior management buy-in so that your documentation exercise is supported and well resourced."

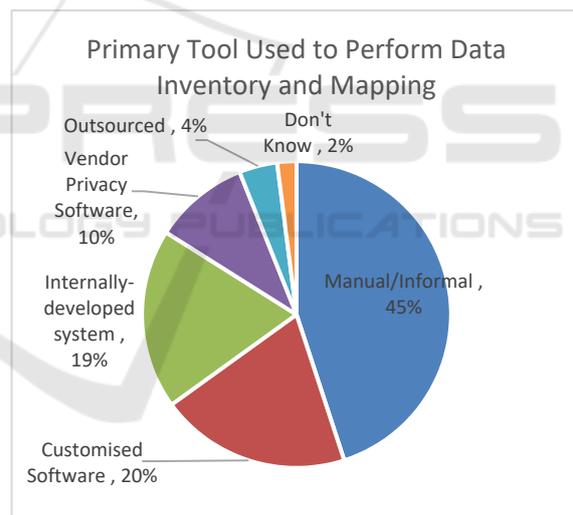


Figure 2: Primary Tool Used by Organisations for Data Inventory and Mapping.

In practice, we find that almost half (45%) of organisations complete their data mapping and inventory operations using manual/informal tools, such as email, spreadsheets, and in-person communication (Figure 2). A further 10% of organisations are using off the shelf vendor-supplied software (IAPP/Trust Arc, 2019).

There has been significant investment by organisations in privacy software over the last

³ <https://www.cnil.fr/en/record-processing-activities>

number of years. Whilst there are a variety of privacy software solutions offered by vendors, "there is no single vendor that will automatically make an organisation GDPR compliant" (IAPP,2020). One hundred forty-two vendors supply data mapping, data inventory and ROPA software (IAPP,2020). The key challenges with vendor supplied ROPA software are as follows:

- they are stand-alone and lack interoperability
- they focus on manual or semi-automated approaches that are labour intensive, rely on domain experts
- these software solutions have been completed enterprise without the input of the regulator.
- they lack standards-based approaches to compliance

A recent survey of the ROPA practices of 30 public bodies found that only 7 (23%) of the organisations met the threshold of having ROPA's that were "sufficiently detailed for purpose" (Castlebridge,2020). Among the failing identified in this report are:

- Many ROPAs appear to generalised and vague
- Failing to integrate maintenance into the day to day operations, resulting in ROPA not being kept up to date
- Defaulting ownership to the Data Protection Officer (DPO)
- Recording an inventory of records, not of processing activities
- Insufficient details for technical and organisational security measures
- Inaccurate or no retention periods declared
- Inconsistent approaches to ROPA maintenance
- Fragmentation of ROPAs across sub-divisions leading to inconsistency.

Organisations are very much putting their head in the sand regarding ROPA compliance. They are failing to clearly, consistently and comprehensively document their processing activities ROPA. They are devolving responsibility to the DPO when it is the organisation that is responsible for the demonstration of compliance and not the DPO. They are exposing themselves to significant risk in this area. They need to adopt best practice for ROPA regulatory compliance.

5 REQUIREMENTS FOR A MACHINE-READABLE ROPA

In section 3, we identify the best practice for supporting the demonstration of regulatory

compliance. In section 4, we show that organisations are facing significant compliance challenges with ROPA compliance (Castlebridge,2020). Organisations continue to create and maintain ROPAs through informal tools and spreadsheets (IAPP-Trust Arc 2019). They need to go beyond a paper-based strategy for compliance verification and reap the benefits of ICT-based automation and move to machine-readable ROPA accountability compliance systems to support ROPA compliance. These systems will require organisations to employ systems with the following capabilities:

- Record accountability data
- Interoperable with platforms and tools
- Facilitate the digital exchange of data
- Standards-based
- Apply ICT advances to facilitate automation
- Industry agnostic
- Agile and flexible for expansion

In practice, this will require an organisation to have an active data governance strategy and deployed data governance tools or platforms. The organisation needs to know what data they are holding, why they are collecting it and what they do with it. This knowledge must be captured in a machine-readable format and be easily maintained and exchanged. Organisations are facing significant difficulties when implementing GDPR best practice due to a lack of common ground between the legal and data management domains (Labadie, 2019). Legal professionals have led the data protection context with limited insight into native digital methods to define, enforce and track privacy-centric data processing, for example only 3% of data subject access requests are automated, and 57% are entirely manual (IAPP 2020). This approach has resulted in ad hoc or semi-automated organisational processes and tools for data protection that are not fit for purpose and block innovation and organisational change (Ryan 2021).

The organisation needs to employ standard models that can facilitate the digital exchange of information between stakeholders. The need for organisations and regulators alike to work together to agree on common standards and agreed semantics for personal data processing has never been greater. There has been significant investment in governance and privacy software to date by organisations (IAPP-EY,2019). The investment would be best directed to the development of platforms and tools using interoperable protocols, APIs and data formats, like RDF-based vocabularies. This investment would support the creation of privacy-aware, accountability-centric data processing ecosystems based on

toolchains, open standards, automated metadata creation, ingestion and maintenance. These platforms and tools can use the same standards to connect with regulators, certification bodies and third parties to verify compliance, build trust and automate accountability. The role of supervisory authority has been a major driving force in the success of RegTech; however, Data Protection regulators are lagging their financial counterparts (Ryan et al., 2021). There has been some effort by data protection regulators to provide templates self-assessment checklists and guidance documents to make the business of compliance easier through the guidance documents, and templates, however this remains far removed from the success of RegTech. Whilst each GDPR regulator must apply the GDPR consistently (GDPR recital 135), there have been very little in the form of a unified approach to technical solutions to facilitate GDPR ROPA compliance.

Table 1: Samples of Expectations taken from ICO Accountability Framework.

Section	Ways to meet ICO expectations
6.2.1	You record processing activities in electronic form so you can add, remove or amend information easily.
6.3.1	The ROPA includes (as a minimum): <ul style="list-style-type: none"> •Your organisation's name and contact details, whether it is a controller or a processor (and where applicable, the joint controller, their representative and the DPO); •the purposes of the processing; •a description of the categories of individuals and personal data; •the categories of recipients of personal data; •details of transfers to third countries, including a record of the transfer mechanism safeguards in place; •retention schedules; and •a description of the technical and organisational security measures in place.

There have been progressive initiatives by some regulators such as the UK regulator (ICO) who published their accountability framework⁴ in 2020. The ICO describes the framework as an opportunity for organisations large or small to meet their GDPR accountability obligations. The ICO accountability framework contains ten categories. Each category contains a set of expectations (of how an organisation can demonstrate accountability), and each expectation contains many detailed statements (see table 1 and table 2). An organisation must evaluate

their level of compliance relative to each statement based upon a four-level scale ranging from not meeting/ partially/ fully meeting this expectation, or not applicable.

The ICO Framework contains a specific section for ROPA, which is particularly beneficial for the organisations as this details the regulator's expectation that an organisation must reach for ROPA compliance. What is interesting though about the ICO's framework is that for the first time, a regulator has provided a comprehensive oversight of accountability looks like, and what they will be looking for when they investigate organisations. As part of the accountability framework, the ICO has provided a detailed accountability tracker which has several uses for organisations, such as to record, track and report on compliance progress. It can check the organisations existing practices against the ICO's expectations to identify where they could improve existing practices and to clearly understand how to demonstrate compliance and to increase senior management engagement and privacy awareness across an organisation.

Table 2: Breakdown of ICO Accountability Framework.

Category	No. of Expectations	No of Questions
Leadership and Oversight	6	33
Policies and procedures	4	17
Training and awareness	5	17
Individuals' rights	11	42
Transparency	7	31
Records of processing and the lawful basis	10	33
Contracts and data sharing	9	31
Risks and Data Protection Impact Assessments.	5	29
Records management and security	12	63
Breach response and monitoring	8	38
	77	334

The provision of the accountability tracker is a progressive step by a regulator as it is a description of what GDPR accountability is. The critical challenge for organisations is to evolve from the existing ROPA compliance solutions where ROPA are created and maintained through informal tools and spreadsheets (IAPP-Trust Arc 2019). The current approach is resulting in a lack of interoperability and a lack of interoperability with stakeholders.

⁴ <https://ico.org.uk/for-organisations/accountability-framework/>

6 CSM-ROPA OVERVIEW

In section 3, we identified best practice for the demonstration of compliance. In section 4, we have shown how organisations are struggling to maintain ROPA's, which is a crucial element to demonstrate their GDPR compliance. We show that they are resorting to manual solutions for completion and that they are failing to take cognisance of best practice. In section 5, we identify the requirements for a machine-readable ROPA for accountability compliance. The development of CSM-ROPA is motivated to take these best practices, and semantically express regulator supplied ROPA's.

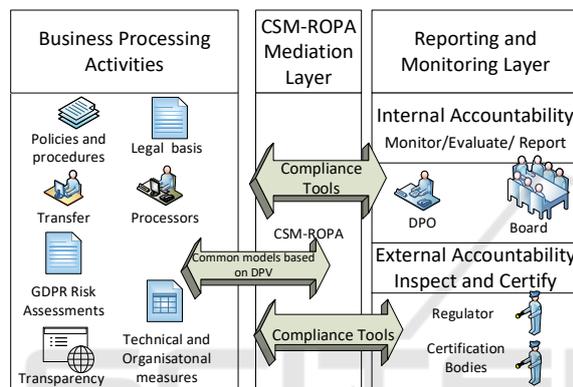


Figure 3: CSM-ROPA as a Mediation Layer.

CSM-ROPA is a semantic model designed to model six English language ROPA templates provided by EU Data Protection Regulators and is a profile of the data privacy vocabulary (DPV). A profile is "a named set of constraints on one or more identified base specifications, including the identification of any implementing subclasses of datatypes, semantic interpretations, vocabularies, options and parameters of those base specifications necessary to accomplish a particular function"⁵. The creation of the DPV ontology follows guidelines and methodologies deemed 'best practice' by the semantic web community (Pandit, 2020). It follows a combination of NeOn methodology (Suarez-Figueroa, 2012) and UPON Lite methodology (DeNicola, 2016). The methodology used for ontology engineering and development lies on the reuse and possible subsequent reengineering of knowledge resources, on the collaborative and argumentative ontology development, and the building of ontology networks.

CSM-ROPA will be deployed as a mediation layer (see figure 3) between the business processing

layer and the reporting and monitoring layer of the organisation. In section 2 we detailed the obligations that the organisation had to demonstrate compliance to both internal stakeholders such as the board of the organisation, and external stakeholders such as individuals, business partners, shareholders and to Data Protection Authorities. Organisations can be complex entities, performing heterogeneous processing on large volumes of diverse personal data, potentially using outsourced partners or subsidiaries in distributed geographical locations and jurisdiction (Ryan,2021). We developed CSM-ROPA to act as a mediation layer between such complex business processing activities and the reporting monitoring layer of the organisation. CSM-ROPA has evolved to support machine to machine accountability compliance verification. CSM-ROPA is the application of RegTech best practice. CSM-ROPA is a basis for the development of platforms and tools that allow for the smooth interoperation of systems. The use of CSM-ROPA for the creation and maintenance of the organisations ROPA will enable automated ROPA accountability compliance verification and interoperability with regulators and certification bodies alike. (Ryan, 2020b).

7 CASE STUDY

In this section, we examine the potential deployment of our existing CSM-ROPA interoperable data model. We select the ROPA section of the ICO accountability tracker, where the regulator has set the reporting requirements. We evaluate the extent that an organisation can use CSM-ROPA as a mediation layer to demonstrate ROPA compliance, and as a basis for the development of compliance tools.

The ICO accountability tracker is an excel based spreadsheet. The maintenance method for the document is manual data entry by a user. The ICO document is a static, stand-alone entity, and it does not facilitate interoperability with any system, thus significantly increasing the likelihood that it will not be managed or maintained. This analysis will also provide a use case for the DPV and help to identify additional requirements for vocabulary, thus providing valuable insight into the standard requirements from industry and stakeholders to identify areas where interoperability is a requirement for the handling of personal data (Pandit, 2019).

⁵ <https://www.w3.org/2017/dxwg/wiki/ProfileDescriptors>

7.1 Methodology

We evaluate to what extent that CSM-ROPA can express ROPA compliance in its role as the mediation layer between the business processing layer and the reporting and monitoring layer of an organisation. Our methodology for this case study involves the following steps:

- Identify the ROPA category within the Accountability Tracker for analysis
- Identify the unique terms stated in each accountability expectation (see table 3)
- Compare the unique terms to CSM-ROPA terms to establish if they were is a corresponding exact pattern match of each other or a narrower match, or no match (Scharffe,2009)
- For terms that have no match with CSM-ROPA, evaluate if they exist in another known vocabulary and use the additional vocabulary to model the unique term
- For the remaining terms, make a recommendation for inclusion in CSM-ROPA

7.2 Analysis

For this case study, we select the category "Records of processing and lawful basis" for analysis, which contains all relevant expectations for ROPA compliance demonstration. The process we used to analyse the category was that we identified 139 unique terms under "Records of processing and lawful basis" category. We evaluated these terms to establish if it was possible to map the terms using existing terms in CSM-ROPA (see table 3 for examples of outcomes).

Table 3: Sample of Mapping Outcomes.

Unique term taken from Accountability Tracker	The matching concept found in CSM-ROPA	Mapping/ proposed action
"The official authority."	No match in CSM-ROPA	Recommend addition to DPV
"An individual."	Categories of data subjects	Narrower Match
"Contact details."	Nil - use other vocabularies	Use alternative vocabulary ⁶
"Information required for privacy notices."	Privacy notice	Exact Match
"The purposes of the processing."	Purposes of processing	Exact Match

⁶ <http://www.w3.org/TR/vcard-rdf/>

⁷ <http://www.w3.org/TR/owl-time/>

⁸ <http://www.w3.org/TR/vcard-rdf/>

Our mapping (see Table 4) showed that CSM-ROPA could express 41% of the unique terms precisely, while another 51% could be expressed, as a narrower match. CSM-ROPA did not have the expressiveness to model 8% of the unique terms. This equated to 11 terms. We have identified other vocabulary's that could map 8 of these terms⁷⁸, as they are date/time and age-related terms.

Table 4: Summary of Mapping Results.

Outcome of Mapping	No. of terms	% of terms
Exact mapping one to one	57	41%
Narrower mapping	71	51%
Mapped using other vocabularies	8	6%
No mapping, add the term to CSM- ROPA	3	2%

We have engaged with the Data Privacy Vocabularies and Controls Community Group (DPVCG)⁹ for the addition of three additional terms that could not be mapped for inclusion in the DPV and CSM-ROPA. These terms are "Data Protection Regulator" "Data Map "and "Legislation" (see RDF listing below). We have shown that CSM-ROPA can map up to 92% of them with additional vocabularies bringing the mapping to 98%. The addition of three identified terms to CSM-ROPA will enable the full mapping of the ICO Accountability Tracker ROPA category.

Listing 1: New Terms for DPV in RDF format.¹⁰

```

dpv:DataProtectionAuthority a
  rdfs:Class ;
  rdfs:label "Data Protection
  Authority"@en ;
  dct:description "Public body tasked
  with data protection and privacy"@en.

dpv:DataFlowMap a rdfs:Class ;
  rdfs:label "Data Flow Map"@en ;
  dct:description "A data flow map to
  support register of processing
  activities"@en ;
  rdfs:subClassOf
  dpv:DataProcessingActivitySpecification

dpv:Legislation a rdfs:Class ;
  rdfs:label "Legislation"@en ;
  dct:description "A collective of
  laws "@en .
    
```

⁹ <https://www.w3.org/community/dpvcg/>

¹⁰ <https://github.com/Paul-Ryan76/ICO2CSM-ROPA>

8 CONCLUSIONS

Our research question asks, to what extent can CSM-ROPA model the ROPA section of the ICO Accountability Tracker to facilitate ROPA compliance, and therefore assist organisations in meeting the accountability principle of the GDPR? Our case study identified that CSM-ROPA could express 92% of the 139 identified unique terms contained in this section of a regulator supplied accountability tracker. When we consider other vocabularies, it is possible to express another eight terms bringing the mapping to 98%. We find that CSM-ROPA did not contain the expressiveness to model 3 terms. These terms are "Data Protection Authority" "Data Flow Map" and "Legislation". We have recommended these terms for inclusion in the DPV. The contributions of this paper are that we have demonstrated that the expressiveness required in a semantic vocabulary to facilitate the demonstration of ROPA compliance with the accountability principle of the GDPR is achievable. We have identified several vocabularies that can be linked to DPV to improve expressivity. We have communicated several terms to the DPVCG vocabulary for inclusion. The outcome of this analysis is positive as it indicates that with a small number of additions to CSM-ROPA, it is possible to use a standardised approach to the demonstration of ROPA compliance using CSM-ROPA to meet the ROPA obligations as set out by a regulator.

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