Assessing Legislative Alignment – An Ontological Approach

Work in progress

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***Abstract*—An ontology provides the agreed definitions and describes how the terms in a subject area or domain, are related. It is a model that can be read by humans and coded for use by computers. Across the globe, governments are using ontologies in innovative ways to solve long-standing government problems. The problem is that there is no single approach used by government agencies to assess whether their systems are aligned to the legislation. In a social welfare setting, if there is any misalignment between the legislation and the systems, then, it may result in an unintentional disadvantage to those most in need. This paper outlines the research design using a case study to detect and to compare the ontological patterns existing in legislation and an online claim form relating to a family tax benefit in Australia.**

Keywords-Ontology; Ontology alignment; Legislation; Government claim forms; Online claim forms.

I. INTRODUCTION

Around the globe, different governments are using ontologies in innovative ways to solve long-standing government problems. An ontology is an artefact that provides a community with the agreed definitions and describes how the terms in a subject area or domain, are related. As a model, it can be read by humans, and coded for computers. Besides being useful as an agreed dictionary, its strength lies in the way that technology can consume it. Ontologies allow sophisticated machine manipulation, aggregation of information, pattern analysis and inferences from vast quantities of data that ordinary humans would not be able to handle [1]. It is for this capability that governments are using ontologies to contribute to the development of e-government. E-government is a way for government to use new technologies to provide people with more convenient access to government information and services, to improve the quality of services and to provide greater opportunities to participate in the democratic institutions and processes [2].

In Australia, e-government is supporting the move away from traditional service delivery. Historically, a single agency would have sole responsibility to deliver all components of a service to consumers. Connected government, and increased partnership with the private sector, now requires the responsibility for the delivery of services to be shared, and new ways of using technology to manage the complexity need to be found.

The literature has reported many different ways that governments are using ontologies to solve long-standing government problems. For example, in Greece, Italy, Denmark and Germany, ontologies have been used to enhance public participation in the development of legislation [3]. In the Netherlands, ontologies have been used to compare legislation across jurisdictions [4], while in Spain, ontologies have been used to improve the retrieval of legal documents for citizens [5], and in the UK, the government has used ontology to model the notification of multiple agencies of a change of circumstance and replace it with a single local authority [6].

This paper reports on research-in-progress to address another long-standing problem for government responding to frequent and complex legislative change. In Australia, ministers must establish audit committees and provide an annual compliance report that the effectiveness of review for monitoring compliance with laws, regulations and associated government policies [7]. This requires processes to ensure that information systems evolve in line with the law. An information system is the application of people, technologies and procedures to solve a business problem and government information systems are used to solve government problems [8].

Many government information systems involve decision making. Decision making is big business for many government agencies [9]. For the recipients of welfare, any misalignment between the legislation and the systems may result in unintentional disadvantage. There is no single approach used by government agencies to assess whether the government information systems and legislation are conceptually aligned. This paper outlines the design of novel research using the ontology patterns existing in legislation to assess the alignment between legislation and government information systems.

There has been work to explore how administrative organisations can use ontologies to manage the complex policy change management [10]. This research-in-progress explores the comparison of ontological patterns existing in different artefacts within a single domain to assure ministers and service consumers that systems and legislation are aligned. The artefacts being compared are the legislation and

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the claim form for an Australian Government Family Tax Benefit (FTB) payment. These artefacts are key components of the government information systems used to administer the law.

The FTB claim form is completed by service consumers and used as evidence by the service providing agencies that are responsible for the administration of the payment. It is a record of the claimant's application for the payment. The evidence being collected in the form should be aligned to the regulatory requirements [10]. For the FTB payment in Australia, the legislation supports two consecutive legislative processes: (1) assess the eligibility of the applicant, and (2) if the applicant is eligible, then, assess the payment value.

The FTB claim form should therefore be designed to collect the data that is necessary for the government information systems to assess (1) the eligibility in accordance with the '*A New Tax System (Family Assistance) Act 1999*', and (2) to determine the value of the payment in accordance with *A New Tax System (Family Assistance) (Administration) Act 1999*. No more, and no less. If the claim form seeks more data, or less data, then this may indicate misalignment.

The online claim form for a FTB payment is very complex. An applicant seeking the payment must provide no less than 946 data items about themselves, 145 about their partner, and 52 items about each of their children. Perhaps the complex legislation requires all this data. In that case, we would expect that the investigation will determine that alignment exists.

Government information systems are developed by experts who have a deep understanding of the legislation and the government information systems that enact it. Rather than relying on a few key experts perhaps there is a way to model the information so that the knowledge can be shared by government agencies and service consumers alike. Meeting the greater expectation from citizens is made possible with modern information technologies [12]. With a model of the knowledge that is currently hidden behind complex legislation, more opportunities to streamline payments and processes, reduce duplication and enhance the online experience are expected to emerge.

By comparing a conceptual model of the legislation to the conceptual model of the claim form, it should be possible to identify any misalignment between them. A conceptual model is an abstract and simplified description of the reality that is being represented [2].

The conceptual structure in the legislation and the online claim form will each be modelled as ontologies. An ontology is defined as "an explicit specification of a conceptualisation" [13]. An ontology specifies and organises the concepts in a domain [14] in a model as an abstract and simplified view of the domain [15]. It is a shared understanding accomplished by agreeing on an appropriate way to conceptualize the domain, and then to make it explicit in some language [16]. An ontology can be used by humans and formalised for computers.

Like an ontology, legislation provides definitions of terms in a domain and describes the relations between these terms. It is a primary source for government agencies to harvest terms to build an ontology. While it is a rich source, legislation is difficult to understand because: not all terms are defined; the relations between terms are not always clear; and the context can sometimes only be understood by accessing all cross-referenced sections or legislation.

This paper describes the research design that will be used to develop a conceptual model of the legislation and the claim form related to the FTB payment domain. The research in progress will contribute a strategy and method of conducting ontological analysis, and a novel means of using ontology to determine alignment. It will apply an instrumental case study to gain a broader appreciation of how legislation is being translated in the claim form. It is expected that the processes used to detect, extract and analyse the concepts from legislation will be generalizable.

The remainder of the paper is organised as follows: in Section II, the research setting is described. In Section III, the research strategy is outlined. In Section IV, the research limitations and risks are presented. Finally the research contributions are discussed in Section V.

II. RESEARCH SETTING

In Australia, the government has the powers to pass laws. There are three arms of government: the parliament, the executive and the judiciary (see Figure 1). The *parliament* makes the law; the *executive* operationalises the law, and the the *judiciary* interprets the law. The interpretation of the law is not a focus of this paper. In Figure 1 the research setting, overview and scope are modelled. This research in progress will apply a case study using the FTB payment to demonstrate how the conceptual structure of the legislation drafted by the *parliament*, i.e., the government agency making the law, has been operationalised in the claim form by the executive, i.e., the service delivery agency Department of Human Services, on behalf of the APS policy agency, the Department of Social Services. While the minister for the policy department is responsible for the legislation, (2) the minister for the service delivery department is responsible for delivering the services i.e., to determine the eligibility for the payment, and to assess the value of the payment.

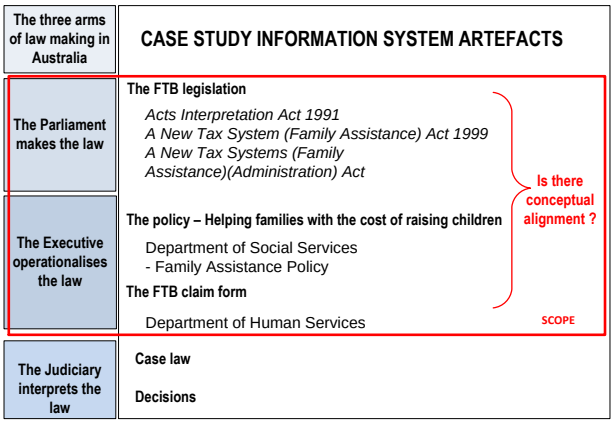

Figure 1. Research setting, overview and scope.

III. RESEARCH STRATEGY

This section outlines the proposed research strategy in three sections. Section A identifies the research methodology to be used. Section B provides an overview of case study methodology, and Section C describes the research methods that will be used to undertake the data collection and analysis.

A. *Research methodology*

This research will use a case study methodology. The case study has two phases the build and the appraisal (see Figure 2). This work-in-progress paper describes the research design for the first build phase only. In the build phase, an ontological investigation will be undertaken to identify the concepts as they exist in the two pieces of legislation and the claim form. Then, in the appraisal phase, the domain ontology developed by the researcher will be reviewed by key informants to appraise its appropriateness to confirm whether it as an objective representation of the FTB domain. The assessors will include representatives from candidate legal, ICT, Business and policy departmental groups.

B. *Case study methodology*

Case study is a research strategy that has been used in both policy and public administration research [17]. The research in progress will apply an instrumental case study that is defined as a study that uses a particular case to gain a broader appreciation of an issue or phenomenon [17]. The research will use the legislation and the claim form relating to the payment of FTB in normal circumstances to gain a broader and deeper appreciation of alignment issues that may exist. The reason for concentrating on the normal circumstances is to constrain the study, and ensure it is completed within a reasonable timeframe.

Regulation includes any laws or other rules that govern the conduct of people or businesses (service consumers) and affect them either directly or indirectly, sometimes in ways that are more apparent than others [11]. For example, it is apparent that the payment of FTB is covered by Division 1 'Family tax benefit', of Part 3 'Payment of family assistance', in the '*A New Tax System (Family Assistance)*

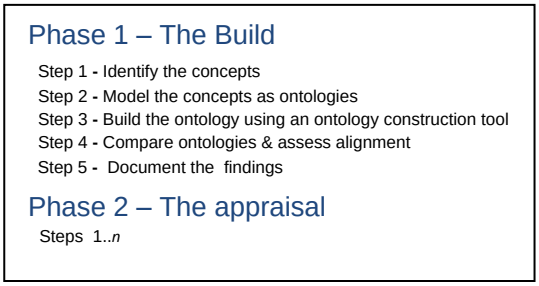

Figure 2. Research setting, overview and scope.

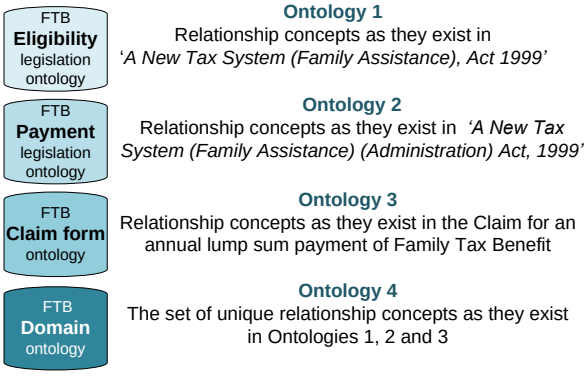

Figure 3. The ontology outputs from Phase 1 – The Build.

(Administration) Act, 1999'. In Australia, the *Acts Interpretation Act, 1901* is a reference for reading any Commonwealth Act. It provides a dictionary to make Commonwealth legislation shorter, less complex and more consistent in operation and should be referred to for common definitions of such terms as person, individual, and Minister.

A reader must be more attuned, to less-apparent connections existing in legislation. These legislative connections are only possible to identify by tracing all cross-referencing in the legislation. For FTB, the two core pieces of legislation cross-reference another 13 pieces of legislation. These include the *Migration Act, 1958*; *Income Tax Assessment Act, 1997*; *Military Rehabilitation and Compensation Act, 2004*; and the *Social Security Act, 1991*. The connections are not intuitive, but exist nevertheless.

C. *Research method*

The case study uses two different methods to generate the data for the research. The first method requires the researcher to undertake a manual exercise to identify the terms in the two pieces of legislation and the claim form, and to develop three separate models as ontologies as well as a single view, or domain model (see Figure 3). The process used to build the ontologies and any observations from the build phase will presented for appraisal to key informants from Business, ICT, and legal areas of the policy and service delivery departments.

The research will develop a set of assumptions to indicate where misalignment may exist, and if found to exist, will require some correction. Although the researcher will suggest the possible implication of any misalignment identified, it is only by appraisal by key informants that the action to correct the misalignment will be made to the department responsible for the information system.

So far, the research in progress has identified the following three patterns indicating possible misalignment, (1) the legislative terms, or synonyms for these terms in Ontologies 1 or 2, are not present in the Claim form Ontology 3, (2) the Claim form ontology 3 introduces terms that are not present in the legislation ontologies 2 or 3, and (3) relations between terms in the Claim form ontology do not maintain the structure used in the legislation ontologies 1 and 2.

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Where any of these patterns are identified then a closer investigation will be undertaken. Figure 4 is an example where the legislative term 'Adopted child' is not used in the Claim form. Further investigation shows that the Claim form is using a related term 'adoptive parent'. That is, the Claim form has introduced a term that is not present in the legislation. If a synonym term is being used, it will be necessary to conduct an ontological assessment to confirm whether it is a synonym or another term. A synonymy is a relation between terms in a given language representing the same concept [19]. For example, in the legislation providing for payment of the FTB, two forms of FTB Child 'of' are used. (1) FTB Child of the individual, and (2) FTB Child of the adult. By analyzing the legislation, the individual and the adult are synonyms, therefore, when building the domain ontology only one relationship will be modelled, and one synonym will be recorded. This is an example of how logic based reasoning is being used to understand the differences between similar terms. The power of ontology is that it can return inferences and aggregations provided the information has been declared (coded) in a software-processable format.

These examples demonstrate how a manual process can be used to identify misalignment between the legislation and the Claim form in the FTB domain. Rather than supporting two views, government can agree to harmonize and use only one term in the future. Alternatively it may be agreed that more than one term will be maintained, and this may require the development of further guidance material for service providers and service consumers. Whatever the decision, an agreed and explicit understanding can be captured in an ontology, and this would remove the reliance on a few highly skilled legal interpreters. It is likely that the research in progress will detect ambiguities existing in the legislation, or the claim form. By removing the ambiguities, a closer legislative alignment will be possible.

Another related method is ontology matching. The focus of matching is to discover the differences between two ontology versions. The challenges for ontology matching process, have received recent attention, and include: discovering missing background knowledge, selection, user involvement, explanation of matching results, and alignment management [18]. Once a domain ontology has been created it will be important to undertake matching on a regular basis to manage the continued alignment. This is another requirement for legislative change management that will be considered in future research.

The representation of the knowledge will be captured in Resource Description Framework (RDF), a standardized syntax for encoding RDF statements to make them software processable [20]. All RDF triples can be developed as a distributed graph, and captured as a Uniform Resource Identifier (URI) address for location by other resources. The relationships between the service providers and service subject/predicate/object form statements. Two examples of triples are shown in Figure 5. The triples describe that (1) an applicant must be responsible for a child, and that (2) an applicant must apply for the payment to the Secretary.

In the eligibility legislation	In the payment legislation	In the Claim form
Adopted child	Adopted child	N/A

Figure 4. Adopted child example.

The ontological representations will be entered in an ontology builder to provide a model of the relationships. The output will include a model of the FTB domain and, an ontology for each of the separate pieces of legislation, and the claim form.

In the development of the domain ontology, government is interested in the relationship of the parent and the child. For the FTB, the agencies connected to this payment through the legislation are interested in the way the FTB legislation describes these terms. For service consumers who are parents with children, they too would enjoy a model that described the relationship for FTB, as opposed to any other payment. Government as a whole would also be interested in understanding the 'parent picture' in its entirety. All these views can be accommodated using ontologies.

This section has outlined the proposed research strategy for the first phase of this research. It has described the case study methodology and the methods that will be used to build the research artefacts and to gather the necessary data to conduct the research.

IV. RESEARCH LIMITATIONS AND RISKS

This section will describe the limitations and risks of undertaking this research using the methods outlined in Section III. Two limitations of the research arise because the selection of the legislation is restricted to the FTB payment in normal circumstances. The first limitation is that only some of the legislation relating to the FTB payment will be modelled as an ontology. The second limitation is that only system end-points will be compared i.e., the current legislation and claim form. The changes to the legislation and the form that have occurred since the legislation's commencement date cannot and will not be individually analysed. This point-in time analysis will be useful to identify the alignment issues, but it will not be possible to understand the reasons for the alignment issues.

V. CONTRIBUTION

The manual process used to detect and compare the ontological patterns existing in the legislation and the claim form are expected to be transferable to other information system artefacts used to operationalise the legislation. If the terms and relationships existing in the family tax benefit domain can be modeled as an ontology, then, it should be possible to model all legislation being administered by Government. The contribution is a novel strategy and method of conducting ontological analysis, and a novel means of conducting alignment assessment. The power of

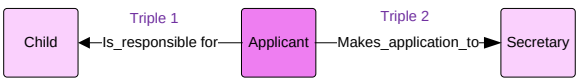

Figure 5. Two examples of relationships captured as RDF triples.

ontologies in e-government would mean that a new use of technologies will result in more convenient access to government information and services, and provide service consumers greater opportunities to participate in the democratic institutions and processes [2].

If a domain ontology exists, and a legislation change occurs, the ontology could be used by government to identify the owners of: systems, processes, activities, guidelines, forms, etc., that may be impacted. Evidence-based assessments would improve the quality of such assessments for policy makers, service providers, and service consumers. Policy makers exploring changes to legislation would be better informed as an evidence-based estimate of a whole of government impact would be possible. Service Delivery departments could schedule programs of work anticipating the changes to the systems and processes to comply with the legislation, and with this knowledge, they will be able to improve their engagement through clear messaging to service consumers.

VI. CONCLUSION

This research develops a new way to reveal important aspects of the relationship between legislation and its implementation in government information systems, using ontologies. This work-in-progress paper has described the research approach that will be used to assure ministers and service consumers that systems and legislation are aligned. A strategy has been outlined describing the method of conducting ontological analysis as a novel way to use ontology to determine alignment. An instrumental case study has been described using the FTB legislation applying to the payment in normal circumstances. The reasons for the selection of the FTB payment in normal circumstances have been outlined. The limitations and the risks of this research design and the contributions of the proposed research have been discussed. The research offers a new approach using technology for all government agencies to assure their ministers that information systems are aligned to the legislation. This research attempts to develop a method to detect the underlying ontologies existing in legislation that can be used more broadly across all legislation being used in Australian government service delivery. Future work will explore automatic and semi-automatic ways to identify relationships existing in legislation.

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