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December 2005

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Using Composite Act Frame Technique to Model the Rule of Origin Knowledge Representations in E-Government Services

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Abstract

The rule of origin, globally applied to determine the eligibility for trade preference, is a vital instrument for an international trade, as it defines the country origin of products. The unified rule of origin ontology and knowledge representations is a vital key to promote interoperability and effective rule of origin verification services that could bring about trust amongst stakeholders and trading partners. This paper aims to lay down a rule of origin knowledge representations model using the composite act frame technique extended from the frame-based ontology of law proposed by van Kralingen and Visser. To prove the generic and extendibility aspect of the model, an assessment test with different criteria for the rule of origin is conducted. The implementation of the rule of origin knowledge representations to support the web-based e-government services is accomplished through the system called "Rule of Origin VERification Systems: ROVERs". The rule of origin knowledge representation in this paper represents a generic model that may be applied and extended to other rule of origin agreement for modeling purposes.

Keywords: Composite act frame technique, Rule of origin knowledge representations, Human intervention, E-government services, Free Trade Agreements

1. Introduction

World Trade Organization (WTO) describes "rule of origin" as criteria used to define where a product was made (World Trade Organization 2005). Therefore, the rule of origin is a vital instrument for international trades as it affects the determination of trade preferences, i.e. preferential tariffs, anti-dumping actions, countervailing duty, etc. In recent years, several countries have signed bilateral Free Trade Agreements (FTA), e.g. United States of America (U.S. Free Trade Agreements 2005), Australia (Australian Government 2004), India (Federation of Indian Chambers of Commerce and Industry 2004), and Thailand (Thai Free Trade Agreement 2005). These are major market opening agreements, which resulted in the reduction or elimination of tariffs on virtually all exported products. Substantial improvements in trade and investment environment amongst agreement countries are expected. However, whereas each agreement country must ensure that their rule of origin is transparent and administered in a consistent, uniform, impartial, and reasonable manner, the complication lies in the complexity, diverse, and lack of uniform knowledge formulation of the rule of origin criteria itself. This causes difficulty for the government and businesses to determine and verify whether their products have satisfied the rule of origin criteria for trade preference purpose.

In the light of interoperability e-government (Klischewski 2003), the unified rule of origin ontology and knowledge representations is a vital key to the development of a interoperable web-based rule of origin verification services. As such, this paper aims to lay down a rule of origin knowledge representation model using the legal frame based ontology and the

composite act frame technique. The outline of this article is as follows. In section 2, we begin with a short description of the background of the rule of origin criteria. Next, an overview of the frame based ontology of law and the proposed composite act frame technique are introduced in Section 3. In Section 4, we present the rule of origin knowledge representations modeling based on the Thailand-Australia Free Trade Agreement. In Section 5, an assessment test with other rule of origin agreements is conducted and results are reported accordingly. In Section 6, the implementation of the knowledge representation, called the Rule of origin VERification Systems: ROVERs, is illustrated. Finally, the conclusions and discussions of our findings are presented in Section 7.

2. The Rule of Origin Criteria

In this paper, the rule of origin is a set parameter for determining whether products exported to another countries are eligible for reduced duty rates under the FTA or other agreements. The basic notions, problems, and implications in e-government services are discussed as follows:

2.1 The Basic Notions about the Rule of Origin Criteria

There are two primary notions of the rule of origin criteria (see figure 1).

2.1.1 *General rule:* General rule is a set of rules that are enforced upon products either in its entirety or in parts of the list of products under an agreement, i.e. the scope of applications, the determination origin, the Harmonized System (H.S.), neutral elements, packing and packaging materials and containers, and accessories and spare parts and tools.

2.1.2 *Specific rule:* Specific rule is a rule that is applied exclusively to a specific product under the Harmonized System. There are basically two types of specific rules:

- a) *Wholly obtained product rule* confers to a product that is extracted, harvested, or produced in the territory of an originate country.
- b) *Substantial transformation rule* confers to a product that two or more countries are involved in the production of goods. It includes process criteria and regional content value criteria. *Process criteria* consist of a *change in tariff classification criteria* which confers an eligibility to a product when the classification of the non-originating materials and components of the product changes to a classification of the finishing product, and a *minimal operations or processes criterion* which is a rule that does not by itself or in combination with other rules confer the origin to a product. *Regional content value criteria* confer the eligibility when a product contains at least a minimum percentage of regional content value.

2.2 Problems Related to the Rule Of Origin Criteria

The rule of origin raise a set of problems, for instance:

2.2.1 Rule of origin criteria are voluminous which is difficult and time consuming for a human verification process. For example, the rule of origin of Thai-Australia FTA, Thai-India FTA, and Thai-Asian together contains more than 9,900 rules.

2.2.2 Rule of origin criteria are defined in each FTA and often contain different knowledge formulations, producing varied outcomes on the same product. For example, a product with tariff item number 732690 (other articles of iron or steel) has three different rules of origin as follows:

Thai-India FTA: “Change at 4-digit H.S. level (change to subheading 732690 from any other headings), provided that there is a Local Value Added Content not less than 40%”.

Thai-Australia FTA: “Change to subheading 732619 from any other heading”.

Thai-ASEAN FTA: “There is an ASEAN content value not less than 40 percent”.

2.2.3 Not all rules of origin criteria can be automated whereby human intervention becomes necessary in the verification processes. For instance, for a product tariff item 6303 (curtains and interior blinds: curtain or bed valances) has a specific rule of “change to heading 6303 from any other chapter, provided that, where the starting material is fabric, the fabric is pre-bleached or unbleached and there is a regional value content of not less than 55 percent”. Only the change of tariff number and the regional value content percentage can be logically automated while the processes (i.e. starting material of fabric and bleached) need human judgments as to whether the actual production processes (i.e. a production diagram) comply with the rule of origin criteria.

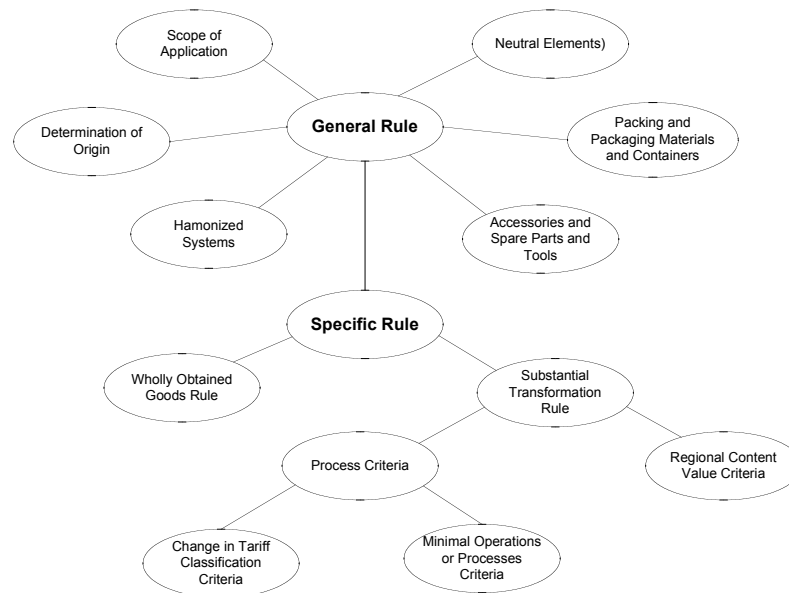


Figure 1: The typology of the rule of origin criteria

2.3 The Rule of Origin Verification Service Model

In order to appreciate the contribution of the rule of origin knowledge representations, it is useful to understand its implication in the e-government services. Figure 2 presents a conceptual model of the rule of origin verification service. It consists of five major components as follows:

- *E-government website* is where business accesses e-government services, submits data, and interacts with a government agency. The verify linkage between e-government website and the rule of origin knowledge-based systems is the most important function of the model where applicant’s data input through the website will be processed to determine facts of the case. With relevant facts, the verify function will search applicable rules contained in the rule of origin knowledge-based systems and match facts against rule’s criteria in order to draw the verification results.

- *Rule of origin knowledge-based systems* works as a repository for the rule of origin knowledge capturing, storing, and reasoning purpose. The correctness and completeness of rules is vital to the citizen's confidence of government services therefore an authority has the responsibility of managing and verifying the accuracy of the rule of origin knowledge representations contained in the knowledge base.
- *Human intervention facility* is used mainly by an authority who needs to exercise judgment and discretion if specified by the rule of origin criteria.
- *Explanation facility* is where e-government services provide explanations and reasons as to why service's outcomes are accepted or rejected to businesses.
- *XML Rule of Origin* aims to support the interoperability e-government by disseminating rules to other e-government computing systems or business back office systems using XML web services technology.

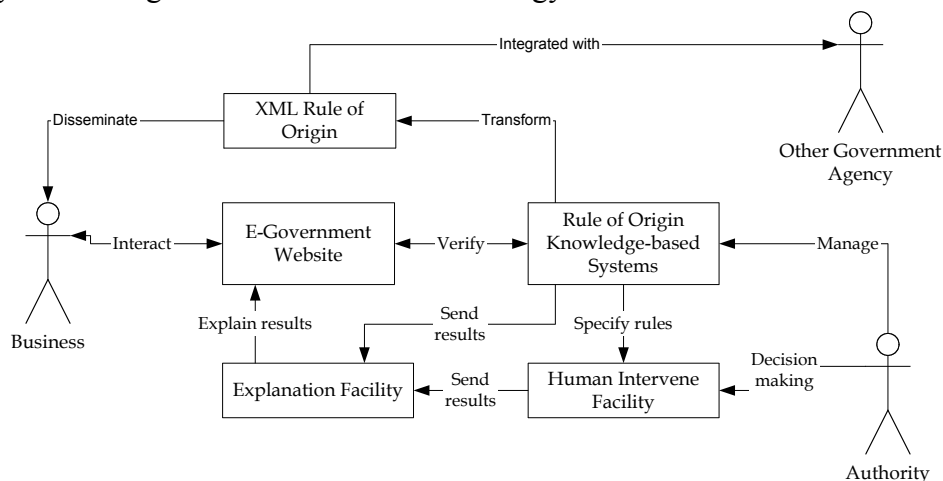


Figure 2: The conceptual model of the rule of origin verification service

3. The Frame-Based Ontology of Law and the Composite Act Frame Technique

We apply the frame-based ontology of law to conceptualize and define elements and its relationship pertaining to the rule of origin criteria domain. The composite act frame is proposed to construct the norm frame knowledge representations from a complex rule of origin argument. The concept of the frame-based ontology and the composite act frame technique are given as follows:

3.1 Frame-based Ontology of Law and the Rule Of Origin Domain

The ontology-based conceptualizing of knowledge representation from knowledge formulation in the legal domain has been performed in several research works, i.e. McCarty's language for legal discourse (McCarty 1989), Stamper's norma formalism (Stamper 1996), Valente's functional ontology of law (Valente et al 1999), and the ontology of Van Kralingen and Visser (van Kraligen et al. 1999; 1997; 1993). As Louve et al. (2003) points out, there is no reason to consider any of these ontology better or worse than the others, as the adequacy of ontology depends on the purposes of a particular application.

Because of the generic aspect and the incorporation of the first-order formulation into the element of knowledge representations of the van Kralingen's frame-based ontology, we choose the ontology to conceptualize and define elements contained in the rule of origin domain. The van Kralingen's frame-based ontology is constituted by three frame structures: a norm frame, an act frame, and a concept-description frame. Each frames comprises a vocabulary or an element necessary to instantiate the frame structures. Descriptions of each frame in the context of the rule of origin criteria are as follows:

- *The norm frame* is general rules, standards, and principles of behavior that subjects of laws are bound to comply with. This is the most important element of the legal systems. Under the rule of origin context, we designate the elements of norm as shown in table 1.

Table 1: Norm frame in the context of the rule of origin domain

Element	Descriptions
Norm Identifier	The tariff number of product under the Harmonized System is assigned as a point of reference, which could be chapters, headings, or subheadings.
Promulgation	The source of the norm which is a name of an agreement
Scope	The range of applications is divided into general rules and specific rules
Conditions	The rule of origin verification result is assigned to ‘true’
Act identifier	The reference to separate a single or a composite act frames

- *The concept frame* deals with the meaning of concepts found in the domain. The definition of concepts or factors pertaining to the FTA must be clearly specified in the element “Condition” which could be in the format of descriptive text or mathematic formulae. The norm frame and concept frame link through the element “Promulgation”. Table 2 shows the concept frame in relation to the rule of origin description.

Table 2: Concept from in the context of the rule of origin domain

Element	Descriptions
Concept	Concept pertaining to the rule of origin agreement
Type	Term or Mathematic
Promulgation	A name of an agreement
Scope	General rules or specific rules
Conditions	Text descriptions or mathematic formulae

- *The act frame* represents the dynamic functional aspects, which affect changes in the state of the world. We assign the “Act identifier element” name as “function” that describes behavior of rules and encapsulates operation details under the “Circumstances” element. Each act frame must contain only a single function. “Means” element describes knowledge formulations of “function”. “Agent” element describes input variables into functions while the “Final state” or output must be “True”. Norm frame and act frame link with each other through the element “Act identifier”. Table 3 shows a completed act frame element descriptions.

It should be highlighted that we categorize the “Act type” element of act frame into two separate decision-making actions: logic and human intervention.

- Logic* is used for routine decision-making that can be made by verifying structured data against applicable rules.
- Human intervention* is applied to decisions involved with unstructured data or vague rules that requires human judgments. With this act frame, knowledge base can indicate whether the rule of origin verification process needs human to decide. If yes, the knowledge base will trigger the human intervene facility interface for authority to make decisions.

Table 3: Act frame in the context of the rule of origin domain

Element	Descriptions
Act identifier	Function ()
Agent	Input variables
Scope	General rule or Specific rules
Act Type	Logic or Human intervention
Means	Description of functions
Circumstances	First order logic formulae
Final state	Output *True*

3.2 The Composite Act Frame Technique

The Kralingen’s frame-based approach keeps the elements “Act identifier” as a reference link between norm frame and act frame. However, in order to deal with a complex semantic unit of rules, we propose the composite act frame technique similar to a concept of a composition of functions in discrete mathematic concept (Munro 1992) to relate one or more act frames using a connective relationship from the language of first-order logic, i.e. conjunction (\wedge) and disjunction (\vee).

To instantiate the norm frame of each rule of origin of each product, the act identifier element of a norm frame could be represented in a single act frame or a composite act frame, depending on the complexity of knowledge formulation of each rule. Figure 3 depicts the relationship model between a norm frame, a concept frame, and composite act frames.

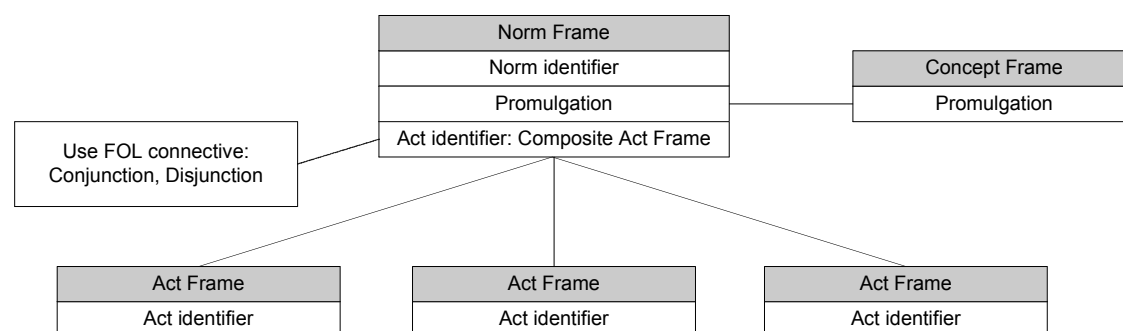


Figure 3: Relationship between a norm frame, a concept frame, and composite act frames.

4. Modeling the Rule of Origin Knowledge Representations

We select the Thailand-Australia Free Trade Agreement, which was entered into force on January 1, 2005, as a point of departure (Australia Government 2004). The reason is the voluminous and complexity of rules contained in the agreement. We expect the model gleaned from the agreement should be generic enough to be applied or extended to others rule of origin criteria in the future.

We define our modeling methodology into three steps as follows:

Step 1: Designate a fundamental structure of the rule of origin descriptions.

Step 2: Instantiate the concept frame and act frame.

Step 3: Using a composite act frame to instantiate a norm frame.

Step 1: Designate a fundamental structure of the rule of origin descriptions

The knowledge formulations of the rule of origin criteria are similar to legal arguments as they express rule statements stipulating that a product under consideration ought to or ought not to originate in the country of origin. In order to enclose the first-order formulation to the frame-based ontology, we have designated object's name, predicate symbols, and function symbols pertaining to the rule of origin's domain as follows.

- Object Names
 - t = Tariff number under the Harmonized System
- Predicate symbols
 - $p()$ = Exported product
 - $m()$ = Imported material
 - Chapter () = Classified in chapter: the first two digits of the Harmonized System
 - Heading () = Classified in heading: the first four digits of the Harmonized System
 - SubHeading () = Classified in subheading: the first six digits of the Harmonized System
 - Rvc () = Regional Value Content in percentage
 - Arvc () = Agreement Regional Value Content in percentage
 - Ivc () = Imported Value Content in percentage
- Function symbols
 - InRangeOf (t_i, t_j) = Range of <tariff number lower limit> and < tariff number upper limit> under the Harmonized System

Step 2: Instantiate the concept frame and act frame

Instantiate a concept frame

A concept frame is constructed to describe rule of origin terms or concept pertaining to the rule of origin agreement, such as the De Minimis content rule, the regional value content, the agreement regional value content, etc. Excerpted samples of concept frames instantiated from the Thai-Australia FTA documents are shown in table 4 and 5.

Table 4: The sample of a “regional value content” concept frame

Element	Descriptions
Concept	Regional Value Content
Type	Mathematic
Promulgation	Thai-Australia FTA Rule of Origin
Scope	General rule or Specific rule
Conditions	Regional Value Content (%) = $(\text{FOB} - \text{VNM} / \text{FOB}) * 100$

* FOB = Free on Board; VNM = Value of all Non-originating Materials

Table 5: The sample of an “agreement regional value content” concept frame

Element	Descriptions
Concept	De Minimis content rule
Type	Mathematic
Promulgation	Thai-Australia FTA Rule of Origin
Scope	General rule
Conditions	The value of all non-originating materials used in the production of the goods that do not undergo the required change in tariff classification does not exceed *###* percent of the FOB value of the goods.

Instantiate an act frame

Act frame is used as a separate function for the representation of rule behavior. The excerpted sample of act frame is shown in table 6. The functions contained in each act frame are very important in the instantiate act identifier of norm frame for each product. In order to instantiate an act frame from a voluminous rule of origin criteria, we use the common rule approach to analyze and assemble similar knowledge formulation patterns. We designate an act identifier’s name and construct a circumstance element in the language of first-order logic as shown in table 7.

Table 6: The sample of a “change in tariff classification criteria” act frame

Element	Descriptions
Act identifier	@CTOC (*Chapter (t)*)
Agent	{Heading (p(t)) ∨ SubHeading (p(t))}, {Chapter (m(t))}
Scope	Specific rule
Act Type	Logic
Means	Change to (heading '#####', subheading '#####') from any other chapter.
Circumstances	{Chapter (m(t)) ≠ Chapter (t)}
Final state	*True*

Step3: *Using a composite act frame to instantiate a norm frame*

A norm frame in the context of the rule of origin conveys information to fulfill its function for the verification of a product in questions. Therefore, a rule of origin norm frame serves as a scheme of rule interpretation classified under the product Harmonized System. As a norm frame may consist of a complex rule of origin argument, a composite act frame is very useful to instantiate norm frame. To articulate general application of a composite act frame in the instantiate of a norm frame from the rule of origin criteria, two examples of specific rule can be illustrated where example I contains a single rule argument while example II has two rule arguments with a connective relation ‘OR’.

Example I: Product tariff number: 620500 (men’s or boy shirts)

Rule of Origin: "Change to heading 6205 from any other chapter, provided that the goods is both cut and sewn or otherwise assembled in the territory of one or both of the parties and there is a regional value content of not less than 55 percent."

Explanation: For all products classified in H.S. headings 6205, all non-Thai and non-Australia material inputs must be classified in an H.S. chapter other than H.S. chapter 62, and need human intervention to verify the process’s criteria, and a regional value content must not less than 55 percent in order for the product to obtain tariff preference.

Table 8: Norm frame knowledge representation of H.S. 620500

Element	Value
Norm Identifier	620500
Promulgation	Thai-Australia FTA Rule of Origin
Scope	Specific rule
Conditions	*True*
Act identifier	{@CTOC(*62*) ∧ HITV(*6205*) ∧ @RGVC(*≥ *,*55*)}

Table 7: The rule of origin act frame knowledge representations model

<i>The rule of origin knowledge formulation patterns</i>	<i>The rule of origin act frame knowledge representations</i>	
	<i>Act identifier element</i>	<i>Circumstance elements in the language of first-order logic</i>
1) Wholly obtained	@WHOL(*0*)	{Ivc(*##%*) = '0'}
2) Change to (Chapter, Heading, Subheading) from any other (Chapter, Heading, Subheading).	@CTOC (*Chapter (t)*) @CTOH (*Heading (t)*) @CTOS (*SubHeading (t)*)	{Chapter (m(t)) ≠ Chapter (t)} {Heading (m(t)) ≠ Heading (t)} {SubHeading (m(t)) ≠ SubHeading (t)}
3) Change to (Heading, Subheading) from (Heading, Subheading).	@CFTH (*Heading (t)*) @CFTS (*SubHeading (t)*)	{Heading (m(t)) = Heading (t)} {SubHeading (m(t)) = SubHeading (t)}
4) Change to (Heading, Subheading) from range of (Heading, Subheading).	@CFHR (*Heading (t) _i , Heading (t) _j *) @CFSR (*SubHeading (t) _i , SubHeading (t) _j *)	{Heading (m(t)) ∈ InRangeOf (Heading (t) _i , Heading (t) _j)} {SubHeading (m(t)) ∈ InRangeOf (SubHeading (t) _i , SubHeading (t) _j)}
5) Change to (Chapter, heading, subheading) except range of (Chapter, Heading, Subheading).	@CTHR (*Heading (t) _i , Heading (t) _j *) @CTSR (*SubHeading (t) _i , SubHeading (t) _j *)	{(Chapter (m(t)) ∨ Heading (m(t)) ∨ SubHeading (m(t))) ∉ InRangeOf (Heading (t) _i , Heading (t) _j)} {(Chapter (m(t)) ∨ Heading (m(t)) ∨ SubHeading (m(t))) ∉ InRangeOf (SubHeading (t) _i , SubHeading (t) _j)}
6) Regional content value not less than '##' % of FOB value of the good.	@RGVC (*≥ *, *Arvc(*##*)*)	{Rvc(*##%*) ≥ Arvc(*##%*)}
7) Human intervention	@HITV (*Chapter (t) ∨ Heading (t) ∨ SubHeading (t)*)	{Chapter (t) ∨ Heading (t) ∨ SubHeading (t)}

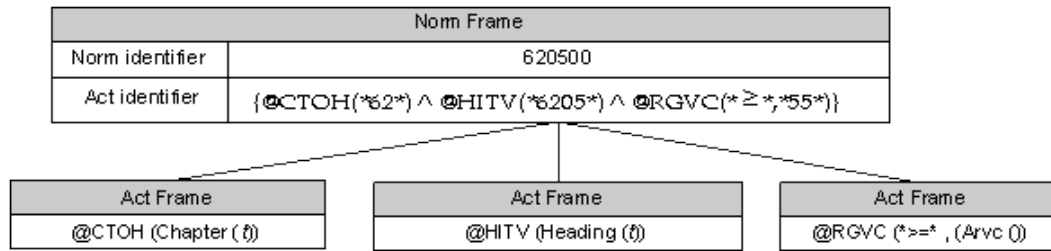


Figure 4: Norm frame and act frame relationship diagram of H.S.620500

Example II: Product tariff number: 848220 (tapered roller bearings, including cone and tapered roller assemblies)

Rule of Origin: "A change to subheading 848220 from any subheading except from subheadings 848210 through 848280 and inner or outer rings or races of subheading 848299; OR

A change to subheading from inner or outer rings or races of subheading 848299, whether or not there is also a change from any subheading outside that group provided there is a regional value content of 45 percent."

Explanation: For all products classified in H.S. subheadings 848220, all non-Thai or Australia inputs must be classified in an H.S. chapter other than H.S. subheading 848220 and other than from H.S. subheading 848210 to 848280 and need human intervention to verify inner or outer rings or races of subheading 848299 in order for the product to obtain preferential duty treatment OR

Need human intervention to verify a change to subheading from inner or outer rings or races of subheading 848299 and a regional value content not less than 45% in order for the product to obtain preferential duty treatment.

Table 9: Norm frame knowledge representation of H.S. 848220

Element	Value
Norm Identifier	848220
Promulgation	Thai-Australia FTA Rule of Origin
Scope	Specific rule
Conditions	True
Act identifier	{(@CTOS(*848220*) ^ @CTSR(*848210*,*848280*) ^ HITV(*848299*)) v (HITV(*848299*) ^ @RGVC(*≥*,*45*))}

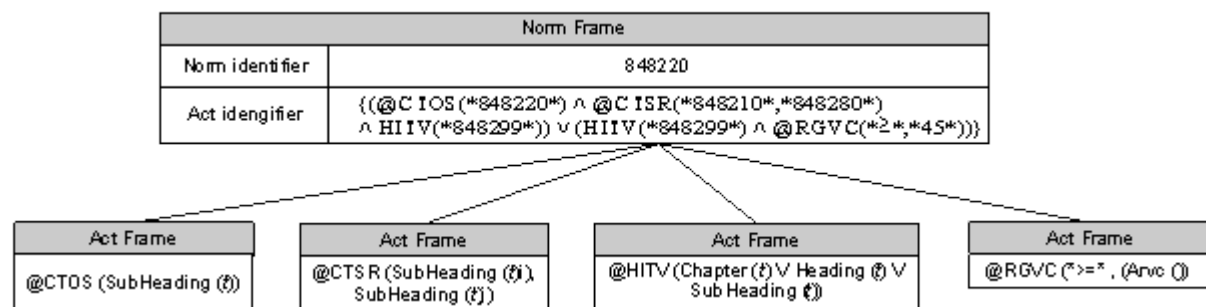


Figure 5: Norm frame and act frame relationship diagram of H.S. 848220

5. Assessment Test

To prove the generic and extendibility aspects of the rule of origin knowledge representation, we conduct an assessment test with other rule of origin criteria beside the Thai-Australia FTA (Australia government 2004), namely Thai-India FTA (India-Thai Chamber of Commerce 2004), Thai-ASEAN FTA (ASEAN 2005), and Thai European Union GSP (European Union 2004).

On the generic modeling aspect, after applying the rule of origin knowledge representations to instantiate norm frames pertaining to the three other rule of origin agreements, we found that India and ASEAN rule of origin knowledge formulations can completely be instantiated without a need to create a new act frame. However, for EU rule of origin criteria, we found that there were some variances of knowledge formulations that could not be instantiated from existing knowledge representations (see Table 10).

Table 10: Number of single act frame (SAF) and a composite act frame (CAF) from different agreements

<i>Act Identifier</i>	<i>Australia</i>		<i>India</i>		<i>ASEAN</i>		<i>EU</i>	
	SAF	CAF	SAF	CAF	SAF	CAF	SAF	CAF
@WHOL ()	-	-	12	-	-	-	100	-
@CTOC ()	196	185	-	-	-	-	1	14
@CTOH ()	623	455	-	51	-	-	323	361
@CTOS ()	1,158	367	-	17	-	-	-	-
@CFTH ()	-	18	-	-	-	-	8	5
@CFTS ()	-	100	-	-	-	-	-	-
@CFHR ()	-	1	-	-	-	-	-	1
@CFSR ()	-	14	-	-	-	-	-	-
@CTHR ()	-	50	-	-	-	-	3	1
@CTSR ()	-	121	-	-	-	-	-	-
@RGVC ()	1	442	4	68	6,523	-	128	381
@HITV ()	38	151	-	-	-	-	322	85
<i>N/A</i>		-		-		-		190

To test the extendibility aspect, after analyzing the distinctive rule of origin criteria in the EU agreement, we encounter two new knowledge formulation patterns which are different from existing act frame knowledge representations. As such, we have extended additional act frames as shown in table 11. The number of new act frames used in the instantiation of norm frame results in 5 single act frames of @EXEP, 185 composite act frames of @EXEP, and 9 composite act frames of @NOGO.

Table 11: Extended act frame knowledge representations

<i>Knowledge formulation Patterns</i>	<i>Act identifier element</i>	<i>Circumstance elements</i>
1) Regional content value of material '#####' not less than '##' % of the ex-works price of the product.	@EXEP ()	{Ivc (m(t)() ≥ Aexp ())}
2) The value of all the non-originating materials used does not exceed the value of all the originating materials used.	@NOGO ()	{Rvc () ≥ Ivc ()}

*Aexp () = Agreement ex-works price of the product in percentage.

6. Implementation

We have implemented the rule of origin knowledge representation model in the actual e-government services named the Rule of Origin VERification Systems: ROVERs operated by Ministry of Commerce, Thailand (The rule of origin verification services 2005). ROVERs has started providing on-line rule of verification services to Thai businesses since January 2005. The basic goal of ROVERs is to answer whether a product under consideration originated in Thailand in connection with applicable rule of origin criteria under specific trade agreement. The knowledge editor, the e-government website, and the explanation facility are completed but the XML rule of origin and the human intervene facility are left out for further development.

6.1 Knowledge Editor

The specific rule knowledge editor interface is designed for domain experts to manage rules by viewing existing rule of origin knowledge formulation and construct or edit a specific rule knowledge representation for each product using a single or composite act frame technique (see figure 6). To ensure the correctness of the composite act frame, the simulate feature is provided for domain experts to enter essential bill of material data and verify results accordingly.

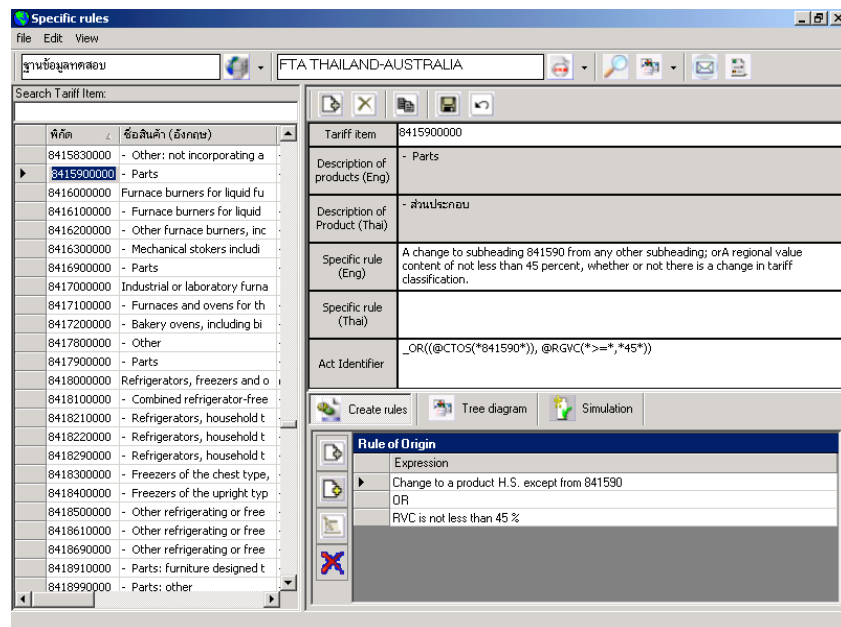


Figure 6: Specific rules knowledge editor user interface

6.2 Verification Processes

In order to verify the rule of origin of a product in questions, businesses must input the bill of material data into the systems. The program will search for a norm frame of a specific product by a harmonized system number and specify the act identification expression for verification purpose. The imported material will be recursively verified against the act identifier expression element of the norm frame knowledge representations using the template *if <conditions> then <consequent>*. The left-hand side of the template consists of the act identifier expressions contained in a norm frame, while the right-hand side is a result of verification “true” or “fault”. Single “fault” verification output caused by an imported material item or others will produce “rejected” result of the verification services. Based on the Thai-Australia FTA, the process flow of the rule of origin verification can be summarized as follows:

1. Search for the rule of origin knowledge representation by the agreement code and tariff number.
2. Verify facts against the rule of origin knowledge representations.
 - If found '@WHOL', verify import value content in percentage, and generates final state: 'true' or 'false'.
 - If found '@HITV', final state always be 'true', and triggers the human intervene facility.
 - If found '@CTXX' or '@CFXX', verify tariff number of imported material and verify the De Minimis content rule in percentage, and generates final state: 'true' or 'false'.
 - If found '@RGVC', verify regional value content in percentage, and generates final state: 'true' or 'false'.
3. Verify other general rules if necessary.
4. Check number of arguments, if it has more than one argument, verify final state through the connective of conjunction (\wedge) or disjunction (\vee), and generates final state: 'true' or 'false'.

7. Conclusions and Discussions

The main contribution of this paper is to lay down a rule of origin knowledge representations model using the composite act frame technique. The composite act frame technique has several merits in the knowledge representation modeling; first, the composite act frame which extends from the frame-based ontology approach has been designed to provide a set of reusable building blocks which is suitable to model normative semantics from the rule of origin documents. Second, domain experts can easily use the technique and apply it as a modeling tool to communicate with knowledge engineers in order to extract, instantiate, and verify the rule of origin knowledge representation from the documents. Third, the composite act frame makes the modeling method flexible enough to handle complex rules or extend a new function to accommodate a new rule without a need to create a new act frame for each different product. Finally, the frames are enclosed with the first-order formulation of which it fits very well on the rule of origin's knowledge formulation.

Comparing the composite act frame technique based on the van Kralingen's frame-based ontology with other technique, namely the semantic network technique, the composite act frame technique has a significant advantage in two aspects. First, the composite act frame technique is well suited for the representation of the rule of origin formulation where the schematic knowledge and stereotypical cognitive patterns mainly use logic rather than concept and relationship. Second, the composite act frame technique are more object-centers than semantic networks therefore all the rules can be located in one place and there is no need for costly search processes in the database.

The model as presented in this paper incorporates the human intervention as an essential act identifier element of the knowledge representation. This demonstrates the limitation of a rule-based reasoning technique in dealing with vague or ambiguous concepts. As such, a design of e-government service based on the assumption that every legal and business rule can be automated needs to be carefully thought out. Particular services still need only human decisions to interpret ambiguous rules and unstructured type of inputs to determine outcomes. This could impede a seamless interaction between citizens and the government. Nevertheless, the use of discretion by authorities is inevitable, as the law cannot foresee every circumstance that may arise in future situation (Gardner 1987). Therefore, the legal reasoning theory of clear cases (clear cases deal with clearly stated and published rules for resolving easy

questions) and hard cases (hard cases involve the property of open textures, which are vague and need human interpretations) (Gardner 1987; Hart 1961; Dworkin 1977) should be taken seriously in the design of e-government services in order to promote good governance principles (SIGMA 1999).

In the context of e-government services, the rule of origin knowledge representation introduced in this paper may be applied to other rule of origin agreement for modeling purposes and support different kind of government to business (G2B) applications (Aichholzer 2001); for instance:

- *Intelligence e-government services*: The rule of origin knowledge representation may be processed in real time using deductive or inductive rule-based reasoning to verify the product's origin with minimum needs to contact authorities.
- *One stop services e-government*: With the e-government portal, citizens may request rules from the rule of origin knowledge base in XML in order to verify product's origin criteria and integrate the results with multiple data, sources and crosses various departmental boundaries to achieve efficient services.
- *Interoperability e-government*: Businesses or cross-border government agencies with an automated back office computerized systems, such as ERP or logistic systems can link data to the rule of origin verification XML web service or retrieve rules and store within their systems for trading supported purposes. This could bring about trust and accountability amongst trading partners and the government, e.g. post rule of origin verification if any doubt should occur and is raised by the relevant parties. With the generic and extendable rule of origin ontology and knowledge representations, stakeholders could "see through" the rule of origin criteria exercised by trading partners for the purpose of scrutiny and supervision.
- *E-government knowledge management*: The collection of rule of origin criteria in the knowledge base is valuable to business; therefore, authorities must constantly garner, retain, update, and realize its knowledge to the full worth in the realm of trade.

Finally, this paper demonstrates the implication of a legal knowledge based technology in the design of effective e-government services. As Lenk et al. (2002) points out, one of the government characteristics is a high degree of legal structuring; therefore, e-government services are inevitably operated under complex functions, and multifarious legal rules. As such, the legal knowledge based system technology can offer opportunities for serious electronic service delivery, e.g. a legal expert system, an interactive citizens assistant, etc. (Leenes 2003). Nevertheless, a successful implementation of a legal expert system in the public sector also depends on the explicit and well-structured formulation of laws and regulations (Svensson 2002). Furthermore, the basic users of legal knowledge-based should not be limited to lawyers who are obligated to find a legal decision abiding by rules of the legal system in order to cure the legal pathology but also users who is a "person entitled" (Yannopoulos 1998), such as a public authority and citizens.

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