Rapport 2 pages + Publications

Action 4: Utiliser les systèmes d'information pour fluidifier le trafic et contribuer à l'intégration d'acteurs hétérogènes.

In this action two main axes are highlighted: (1) knowledge communication assistants for traceability in logistic network and (2) ontology-based system for traceability during transport of goods by sea.

1 Knowledge communication assistants for traceability in logistic network

It is well-known that the quality of logistic corridors depends on the quality of collaborations in supply networks. Many tools and techniques that help companies to collaborate have been developed for the last years. However, we are still witnessing prevailing person-to-person communication.

Let us consider a typical business case, which is often lack of automated support. There are two producers in Hamburg, who needs to transfer their goods to Paris *as soon as possible* under *suitable conditions* (price, temperature, delivery time, humidity, vehicle capacity, etc.). These producers fill many web-forms on transporter's web-sites to find a suitable partner. However, choices made on the basis of such information exchange often constitute only the preliminary phase of service agreement. Later on the service agreement, transportation companies may discover many additional requirements. Thus, the first producer A of refrigerators is looking for transportation *with minimum transshipments*. Cheese maker B is looking for a possibility to transport his products in a way that cheese *is kept inside* of the transport *for a minimal time*. So, he is ready to wait for a suitable transport means while keeping cheese under his own supervision. Both producers might have a plenty of other non-standard requirements towards logistics operations and objects like container's quality or minimal greenhouse-gas estimations. While standard transportation requests can be processed automatically through a web-form, additional requirements are often discovered in a person-to-person communication.

In our research, we focus on ***automated and meaningful information sharing***. Where 'automated' assumes involvement of information systems, and 'meaningful' information sharing minimizes a meaning loss of information elements on information exchange. We are developing artificial (or virtual) ***knowledge communication assistants*** able to support network participants in obtaining and providing the information required in their business interactions. Our artificial assistants must (partially) simulate a human ability to understand data, i.e. to extract information from the context.

In application to the aforementioned business case, our communication assistants are able to help producers to find the most suitable transporters and to communicate producers' requirements in details. For this purpose, each network participant can install a simple application named a *knowledge communication assistant*. This application keeps the details about service requirements, service provision, and production domain in the form of ***ontology***, implemented by means of Semantic Web technologies. One can understand ontology as a calculus of concepts that forms a way of thinking about particular system. Implementation of ontology in a machine-readable language allows programmed agents to reason about the target system. The way and the result of reasoning depends on the quality of the underlying ontology. In our research we propose some core elements of the ontology of services.

Being a part of one distributed information system, knowledge communication assistants should be able to communicate knowledge of the network participants they represent with each other. The problem of information exchange among autonomous information storages keeps scientists and practitioners busy for the last decade. In our research we use some deterministic and non-deterministic approaches in the process of information exchange by means of communication assistants.

2 Ontology-based system for traceability during transport of goods by sea

In the domain of carriage of goods by sea, several events (accidents and incidents) might happen during transport of goods between ports. Examples of such events are identified in The Hague and Hamburg conventions:

unseaworthiness (e.g. impurities of goods, not cooled sufficiently), act, fault, neglect or omission of agents (carrier, shipper or master), inappropriate stowage of goods (temperature, ventilation), loading/unloading faults (e.g. drops, contact), fire on vessels, act of war, act of public enemies, strikes, insufficiency of packing (e.g. vent problems), etc. When these events occur, several results arise but mainly the damage or loss of goods. Therefore, a liability might be defined and the responsible will be charged with amendment.

In order to track the events occurring during transport of goods by sea and the arising results, we are developing an **ontology-based semi-automatic system**. This system will store all the **knowledge** related to the occurred events in the domain of carriage of goods by sea (such as agents, goods, ports, situations, moments, etc.) in the form of a *well-founded* **domain ontology** called **Cargo**. An ontology is defined as a model for describing the world that consists of concepts, relationships and axioms. An ontology is well-founded when it is *grounded* on a validated well-known foundational ontology. In other words, the concepts and relations of the ontology are defined in the light of a foundational ontology. Therefore, a well-founded domain ontology can closely resemble to the real domain of discourse.

For building Cargo, we relied on a well-known foundational ontology called UFO (Unified Foundational Ontology) and an ontologically well-founded modeling language (OntoUML). Furthermore, the ontology is implemented in a machine readable form (OWL, RDF) in order to be understandable by machines. This ontology will permit the users of the system to perform a **semantic search** over the given knowledge of the domain and the events occurred.

Moreover, we aim to reason over Cargo for a **prediction functionality** of the system. For example, an event has occurred in a given situation and we need to define the reliable agent(s) according to the rules of The Hague and Hamburg conventions. For this purpose, we proposed to build a **rule-base** grounded on the integration of the developed domain ontology (Cargo) and a logic rule language.

Publications

Theses

1. **Poletaeva**, T., « Ontological foundations of multi-agent framework for operational data processing », Date de soutenance: Janvier 27, **2017**
2. **El Ghosh**, M., « Automation of Legal Reasoning and Decision based on Ontologies » Date de soutenance: Septembre 24, **2018**

Papers

1. **Poletaeva**, T., Guizzardi, G., Almeida, J.P.A., **Abdulrab**, H.: Revisiting the DEMO transaction pattern with the Unified Foundational Ontology (UFO). In: Advances in Enterprise Engineering XI. LNBIP, Vol. 284, pp.181-195. Springer, **2017**.

2. **Poletaeva**, T., **Abdulrab**, H., Babkin, E.: From the Essence of an Enterprise towards Enterprise Ontology Patterns. In: Aveiro, D., Pergl, R., Gouveia, D. (eds.) Advances in Enterprise Engineering X (EEWC **2016**). LNBIP, Vol. 252, pp. 118-131. Springer, Switzerland, **2016**.

3. **El Ghosh**, M., **Abdulrab**, H.: The application of ODCM for Building Well-founded Legal Domain Ontologies: A Case Study in the Domain of Carriage of Goods by Sea Conventions. In: ICAIL Conference, Montreal, June **2019**.

4. **El Ghosh**, M., **Abdulrab** H., Naja, H., Khalil, M.: Application of Ontology Modularization for Building a Criminal Domain Ontology. In: AICOL **2018**, AI Approaches to the Complexity of Legal Systems, LNCS, vol. 10791, pp. 394-409, Springer, Cham.

5. **El Ghosh,** M.**,** Research in progress: report on the ICAIL 2017 doctoral consortium, Automation of Legal Reasoning and Decision based on Ontologies, Artificial Intelligence and Law, vol. 26(1), 49-97, **2018**.

6. **El Ghosh**, M., **Abdulrab** H., Naja, H., Khalil, M.: Using the Unified Foundational Ontology for Grounding Legal Domain Ontologies. In: KEOD **2017**, vol2, pp. 219-225, **2017**.

7. **El Ghosh**, M., **Abdulrab** H., Naja, H., Khalil, M.: Towards a Legal Rule-based System Grounded on the Integration of Criminal Domain Ontology and Rules. Procedia Computer Science, vol. 112, pp.632-642, Elsevier, Netherlands, September **2017**.

8. **El Ghosh**, M., Naja, H., **Abdulrab**, H. and Khalil, M.: Ontology learning process as a bottom-up strategy for building domain-specific ontology from legal texts. In: Proceedings of the 9th International Conference on Agents and Artificial Intelligence – vol 2- ICAART, ISBN978-989-758-220-2, 473-480, **2017**.