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Mexican e-government ontologies: an adaptation

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Abstract
The Electronic Government is a new field of applications for the semantic web where ontologies are becoming an important research technology. The e-Government faces considerable challenges to achieve interoperability given the semantic differences of interpretation, complexity and width of scope. In this paper we present the results obtained in an ongoing project commissioned by the Mexican government that seeks strategies for the e-Government to reduce the problems encountered when delivering services to citizens. We also show an adaptation of e-Government ontology model; within this model a set of government ontologies are devoted to representing the Local Government processes.

Keywords
ontologies, e-government, knowledge engineering.

1. Introduction

The Electronic Government (e-Gov) is an important application field (Curtain et al, 2003) for the transformations that governments and public administrations will have to undergo in the next decades. Therefore, to transform the e-Gov into the e-Governance, the e-Gov research needs to be based on a robust theory, on modelling approaches, and on planning. In this scenario, a crucial issue is to manage in different ways the legal knowledge to improve the systems applications.
For more than two decades, the AI and Law community has been very active and productive. In the early 80´s, research was focused on logic programming, and all the efforts were centered on legislation and legal reasoning. Other approach adopted was the case-based reasoning, which was not as formal as logic programming was, that aimed at finding similarities in legal cases and allowed retrieving relevant cases for the judges. Knowledge Engineering was also of interest for the research community and the field most applied since it allowed developing and using the legal ontologies that underlie the growth of the Semantic Web.
The Semantic Web was proposed by Tim Berners-Lee (Berners-Lee et al, 2002) as a new field of research, and according to the World Wide Web Consortium[1] (W3C) the Semantic Web is defined as "an extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation. It is based on the idea of having data on the Web defined and linked such that it can Conference Proceedings will be produced directly from the camera-ready manuscripts received from authors. Therefore the authors should try to produce their paper, as closely as possible to this model paper.
be used for more effective discovery, automation, integration, and reuse across various applications".

[1] http://www.w3.org/2001/sw

The application of the Semantic Web to the e-Gov domain is completely new; it features knowledge representation, knowledge engineering, database design, information systems, database integration, natural language understanding, information retrieval and semantic portals, among others. The Semantic Web is considered to be the infrastructure upon which all intelligent e-Gov applications will be built in the near future. Within the objectives of the Semantic Web the ontologies play an important role.
In the field of the Artificial Intelligence, Neches (Neches et al, 1991) was the first to define an ontology, and he did it as follows: "Ontology defines the basic terms and the relations that include the vocabulary of a specific area, in addition to the rules to combine terms and relations to define extensions to the vocabulary". Gruber (Gruber, 1993) defines the ontology as: "An explicit specification of a conceptualization", being this definition the most referenced in the literature. Borst (Borst, 1997) slightly modify Gruber's definition saying that: "Ontologies are defined as a formal specification of a shared conceptualization". These last two definitions have been merged and explained by Studer and colleagues (Studer et al, 1998) as follows: "An ontology is a formal, explicit specification of a shared conceptualization. Conceptualization refers to an abstract model of some phenomenon. Explicit means that the type of concepts used, and the constraints on their use are explicitly defined. Formal refers to the fact that the ontology should be machine-readable. Shared reflects the notion that an ontology captures consensual knowledge, that is, it is not private of some individual, but accepted by a group".
The e-Gov has been strengthened with all these previous studies carried out by the research community and now its main concern is data representation and information management. By its nature, the e-Gov is supported by the legal domain. In Mexico, government ontologies for e-Gov applications have been scarce and to reverse this is the first goal of our paper. The second is to build ontologies that help reduce some important semantic problems presented when providing e-Gov services (EGOV, 2002).
This research is based on the needs stated in a Mexican Project that seeks strategies for e-Gov and aims to provide knowledge conceptualizations (given by legal experts).
This paper is organized as follows: section 2 deals with the related work carried out; section 3 presents the EGO model; section 4 describes the ontologies built; section 5 shows ontologies applications. And finally, section 6 is devoted to the conclusions.

2. Related Work

Nowadays the joint efforts put in by different research communities have made possible the birth of the semantic e-Gov. Since e-Gov ontologies are still in their initial state, only a few works carried out in this field are known; thus, in this section we provide a brief state of the art of those works performed in AI, in the law field and in the Semantic Web. The sum up of all these efforts will produce robust ontologies for the e-Gov domain in the near future.

2.1 Law and e-Gov within the Semantic Web

Currently, the Semantic Web is a new area of research and applications within the legal system and e-Gov domains and is a promise for the Web of the next generation; this new area, which is now used mainly to communicate with people but not with machines, will transform the current web since the capability of communication with machines is one of the main objectives of the Semantic Web. If the Web were equipped with more meaning, every citizen would extract answers in a new, easy and simple way and this action could be carried out by web powered semantics, what would enable citizens and businesses to obtain better information from the government. Web powered semantics could help the e-Gov in two ways: first, by allowing the government to delegate more intelligent tasks to computers and second, by solving daily problems with logic deductions and reasoning. But at present, the web is merely a common framework that allows data to be shared and reused.
Currently the legal and e-Gov Semantic Web applications are still in an experimental phase, but their potential impact on social, economical and political issues is extremely significant.

The main goals of e-Gov are to develop user-friendly and efficient services for the public and the business community, though semantic interoperability is also seen as an important issue to solve within this domain. Some of the works aimed at covering the semantic e-Gov domain are the following: the DIP project[2], the Reimdoc project[3], The IFIP Working Group 8.5[4], the Ontogov project[5], the Egov project[6], and the WEBOCRAT project[7].

2.2 Ontologies: Domain Considerations

The e-Gov scenario is a promising application field for the ontologies underlying the legal engineered knowledge. Many ontologies have been built in the legal domain but not all of them are available or modelled just for a specific domain. The research efforts made in the legal domain by the AI community have contributed to the making of ontologies such as: LLD (McCarty, 1989), NORMA (Stamper, 1980, 1991), FOL (Valente, 1995), FBO (Kralingen, 1995) (Visser, 1995) and LRI-Core Legal Ontology (Breuker, 2004).
The emergence of legal ontologies as part of the Semantic Web initiative has provided a new opportunity for the research community and has brought about a solution to retrieve legal documents within the e-Gov domain. We can mention some of the efforts carried out by AI community on building e-Gov ontologies:
● The Government R&D[8] describes organizations and individuals participating in a government R&D program.
● The Government type[9] describes government concepts used in the CIA World Fact Book 2002.
● The E-Government Ontology[10] describes a seamless UK taxonomy.

3. EGO Model

We use a reference model to focus on and build a common understanding of the problem stated; Figure 1 shows the different actors within the e-Gov.

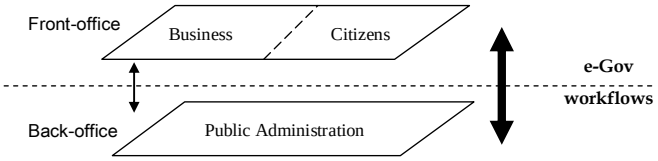

Figure 1. The e-Government Reference Model

At the Back-office, the main actor is the Public Administration; it has many processes inside which should work properly to provide efficient services. The dynamics of the Public Administration provides a huge amount of information to be processed and these data should be managed in a transparent and efficient way.
Within the Public Administration many processes take place and these must be carried out properly to provide efficient services; since the Public Administration functions in a decentralized way and the dynamics of this field generates a huge amount of information to be processed, it is necessary to manage this vast amount of information in a transparent and efficient way. Therefore, the implementation of e-Gov ontologies and applications is crucial.

[2] [2] http://dip.semanticweb.org
[3] http://reimdoc.atosorigin.es
[4] http://falcon.ifs.uni-linz.ac.at/research/ifip85.html#aim
[5] http://www.ontogov.com/
[6] http://www.egov-project.org
[7] http://www.webocrat.org/
[8] http://www.daml.org/projects/integration/projects-20010811
[9] http://reliant.teknowledge.com/DAML/Government.owl
[10] http://dip.semanticweb.org/documents/D9.3e-Governmentontology.doc

The main objective of designing this initial model in the e-Government domain is aiming to represent the legal issues behind the governments. This model should work as a framework to deploy semantic e-Government systems given the law and regulations approach.

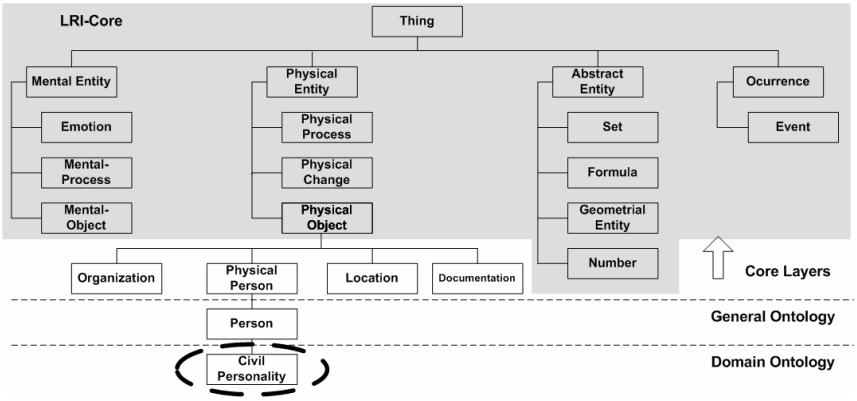

Figure 2. Excerpt of the EGO Ontology Model

The EGO Ontology Model reuses parts of the first two layers of LRI-Core model and is being adapted to the legal system of the Spanish government. The EGO Ontology Model is one of the first efforts not intended for legal domain but for e-Gov domain instead, which is a domain that needs to consider the law, regulations, citizen services, administrative processes, best-practices, and also the different languages spoken within the nation.

3.1 Spanish Case

A particular case was (Gómez-Pérez et al, 2005) developed within the Reimdoc[11] Project. This project aims to develop tools that allow the legal document to be modelled in electronic support and be semantically retrieved to facilitate the government-citizen document transaction. The domain selected is related to the Real-estate transaction market and offers sufficient juridical guarantees.
This project will permit verifying the Real-estate processes gathered in digital support. These processes consist of procedures that occur in three areas: the Property Title, the Tributary Administration of the Autonomous Communities and the Justice Administration. In Spain these procedures are meticulously regulated in a coherent form by the context, which is marked by the legal knowledgeable community.
Reimdoc Project is currently developing an application based on the proposed Legal Ontologies described in section 5: EgoIR, an Information Retrieval system.

3.2 Mexican Case

This project aims to develop the knowledge models necessaries to develop systems that improve the actual services in local governments. This ongoing project is reusing actual work done in Spain. The ontologies to be adapted are shown in the next section of the paper.

4. Local Government Ontologies

The Ontologies described in this section were developed on the Spanish project and being adapted to the ongoing Mexican Project, These are used to illustrate this section.

These ontologies (Gómez-Pérez et al, 2005) were built to represent the Real-estate transactions within the Spanish Government domain. These Ontologies were developed with knowledge acquired by experts

11 http://reimdoc.atosorigin.es/

from academic and private sectors and built with the methodology METHONTOLOGY (Gómez-Pérez et al, 2003) and the workbench WebODE (Gómez-Pérez et al, 2003)
The Legal Ontologies provide support to the EgoIR aforementioned in three important ways: by concept-based indexing, by querying by inference and by improving the navigation. The EgoIR based on these Legal Ontologies bring much focused information, well-defined queries, well-organized information and a sophisticated navigation.
The Legal Ontologies presented here are part of an EGO Ontology Model (Figure 2) being develop on this project, this model aims to represent a part of the legal processes carried out within the government.

4.1 EGO Ontology Model Roles

In (Valente, 2005) (Metz et al, 2004) the five main roles of ontologies are identified: organizing and structuring information; reasoning and problem solving; semantic indexing and searching; semantics integrating and interoperating; and understanding the domain. Before building the EGO Ontology Model, we think it should be useful to settle the proper role(s) that the ontology will play.
The EGO Ontology Model (Figure 2) will perform three of the five roles mentioned above: the first role is that of organizing and structuring information in the e-Gov domain, mainly by defining the terms used. The second role is that of reasoning and problem solving; this role basically represents the knowledge of the domain so that an automated reasoner can represent problems and generate solutions for these problems, what implies the use of an inference engine to achieve specific goals. The third role is that of semantic indexing and searching (where the ontology will represent the contents of documents) that will enable semantic search for content.

4.2 Reimdoc Case

These ontologies are being adapted to the Mexican Government context. These ontologies are highly reusable.
Figure 3 shows the relationships between the Real-estate Transaction Ontologies aforementioned (each ontology is represented by a triangle). The aim of this figure is to show all the ad-hoc relations between the Real-estate Transaction Ontologies.
For the Reimdoc Project eleven ontologies have been developed: person, civil personality, organization, location, tax, contract model, jurisprudence, Real-estate transaction verifications, Real-estate, legislation, and Real-estate transaction. Individually, they play the specific goals and model knowledge used in the Reimdoc Project. We describe next the relationships between the main ontologies.
The Civil Personality Ontology has as main concept the civil person, which is split into two subclasses: natural person (representing citizens), juridical person (representing enterprises, public administrations, etc.). The ad-hoc relations specified for each concept are those relations whose domain is the concept. For example, the concept civil person has six binary relations: ‘has data from juridical person’, ‘has residence’, ‘is buyer’, ‘is seller’, ‘realizes’ and ‘has data from Natural Person’.
The Real-estate Transaction Ontology has as main concept the Real-estate transaction, which is split into two subclasses: buy (representing the action of buying), sell (representing the action of selling.). The concept Real-estate transaction has eight binary relations: ‘is bought’, ‘is sold’, ‘based on’ (tax, legislation, jurisprudence), ‘acquires ’, ‘verifies’ and ‘uses’.
The Location Ontology has as main concept the location, which is split into three subclasses: geographic division, town and country. The concept location has two binary relations: ‘is residence’ and ‘is associated’.
The Person Ontology has as main concept the person. The concept person has one binary relation: ‘is associated’.
The Organization Ontology has as main concept the organization. The concept organization has one binary relation: ‘is associated’.
The Real-estate Ontology has as main concept the Real-estate. The concept Real-estate has one binary relation: ‘is associated’.

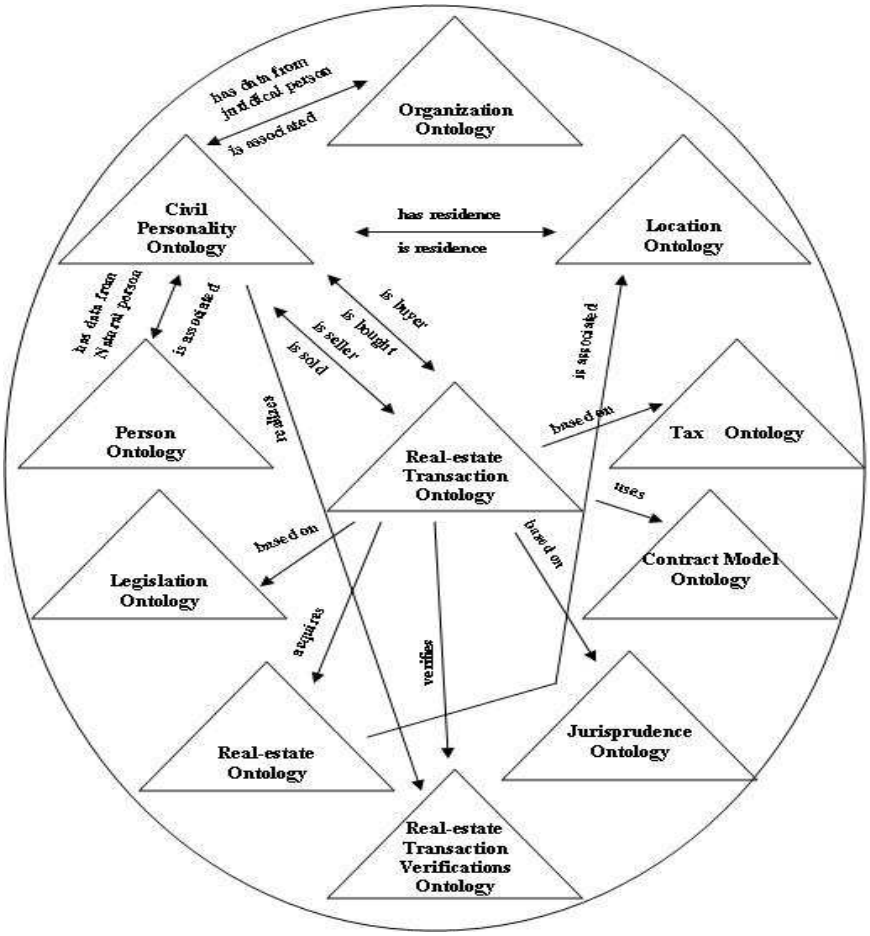

Figure 3. Main ad-hoc relationships for the Real-estate Transaction Ontologies

5. Reusable Applications for Mexican Government Ontologies

We now present two applications that are being developed that employ the proposed EGO Ontology Model and the adapted government ontologies derived from the model. In detail, we present two complementary applications, the P2P system Egoster and the Information Retrieval EgoIR. In general, the two tools differ in their usage perspective and are appropriate for different tasks. However, only the combined application of both tools will offer users the full potential of document management across government.

5.1 EgoIR –Ontology-Based Legal Information Retrieval to Improve the Information Access in e-Government

EgoIR (Gómez-Pérez et al, 2006) is a java-based system that offers an ontology-based approach to Information Retrieval, and its main goal is to retrieve e-Gov documentation. The system deals government documents, and gives citizens, business and governments the opportunity to integrate and recover documents. For this purpose EgoIR provides facilities that manage, search, and share e-Gov documentation. EgoIR also offers an ontology browsing capability using the ontologies described in section 4. These ontologies are stored in WebODE (workbench for ontological engineering). Besides, EgoIR allows the construction of a query from the ontology concepts; the query obtained is composed of a set of concepts extracted from the ontologies. EgoIR connects to WebODE throughout WebODE's ODE service to obtain ontology concepts and it employs Lucene (search engine library) to retrieve the

documents that match the given query. The possibly main users of EgoIR are: a) end users, who require consulting juridical documentation; b) agencies, which need to know the current legislation; and c) lawyers, who have to consult concrete aspects.

5.2 Egoster– A Peer-to-Peer System for Sharing Government Documentation

Egoster is a java-based system that exploits semantic web techniques in order to provide an innovative and useful solution for exchanging and retrieving Government Documentation. For this purpose, Egoster provides facilities for managing, searching and sharing Government Documentation in a P2P network, thereby implementing the Model Ontology as a proposal for a standard base to manage Official and Non Official documents across Governments.
Egoster offers a user driven approach where each peer has its own local repository of documents and also has access to the information of others repositories, thus creating a virtual decentralized document repository. The Egoster client on its own (e.g. disconnected from the P2P network) will already provide added value to its users as it will give developers an overview and search facilities of his/her own government documentation stored in its local repository. The goal is: to provide a decentralized Government documentation sharing and retrieving environment using Semantic Web technologies that allows the Back-office (Public Administration) and the Front-office (citizen and business) to interact easily to share documents.
The Egoster is at present time under developing as an instance of the Swapster system architecture . It uses ontologies extensively in order to provide some of its main functions importing Government Documentation, formulating queries, routing queries and processing answers.

6. Conclusions

In this paper we have presented a set of ontologies being adapted to Mexican Government domain as a part of the EGO Ontology model, which in turn is part of an ongoing project aiming, on the one hand, at supporting semantic applications to retrieve legal documents and, on the other, at delivering services from the public administration (within the government) to citizens. These ontologies are built following the methodology METHONTOLOGY and the workbench WebODE and are application independent.
The e-Gov domain does still have many needs: knowledge, for instance, has not been modeled at all. These needs represent real challenges for researchers. One problem to be solved in the near future is that of knowledge acquisition by legal experts. We must add here that the legal domain is very complex and evolving and its complexity provides a different situation than that provided by domains such as physics or mathematics, and this fact will bring about the deployment of future e-Gov ontologies.
In our future work, we will be focused on further enhancement and evaluation of these Local Government Ontologies; we will be centred on the reasoning capabilities of these ontologies; we will continue integrating the legal knowledge captured on the EGO Ontology Model and we will compare the model with other ontology models.

References

Borst, W.N.(1997) Construction of Engineering Ontologies. University of Tweenty. Enschede, NL-Centre for Telematica and Information Technology.

Breuker, J.(2004). Constructing a Legal Core Ontology: LRI-Core.University of Amsterdam, Leibniz Center for Law, Amsterdam, the Netherlands.

Curtain, G., Sommer, M., Vis-Sommer, V.(2003) *The World of E-Government.* The Haworth Press.

Electronic Government: First International Conference, EGOV 2002, Aix-en-Provence, France, September 2-5,. Proceedings (Lecture Notes in Computer Science) by Roland Traunmüller (Editor), Klaus Lenk (Editor) (2002)

Gómez-Pérez, A.; Fernández-López, M.; Corcho, O. (2003).Ontological Engineering. Springer Verlag.
Gómez-Pérez, A., Ortiz-Rodríguez, F., Villazón-Terrazas, B.(2005). Legal Ontologies for the Spanish e-Government. In Proceedings of the 11th Conference of the Spanish Association for Artificial Intelligence. Santiago de Compostela, Spain.
Gómez-Pérez, A., Ortiz-Rodríguez, F., Villazón-Terrazas, B. (2006). Ontology-Based Legal Information Retrieval to Improve the Information Access in e-Government. To appear in *WWW2006*, Edinburgh, Scotland.
Gruber, T.R.: A Translation Approach to Portable Ontologies. *Knowledge Acquisition*. 5(2) (1993) 199-220
Gruber, T.R. (1993).Toward Principles for the Design of Ontologies Used for Knowledge Sharing. *Presented at the Padua workshop on Formal Ontology*, to appear in an edited collection by Nicola Guarino
Hendler, J., Berners-Lee, T., and Miller, E. (2002). Integrating Applications on the Semantic Web, http://www.w3.org/2002/07/swint.html
Kralingen, R.W. (1995). Frame-based Conceptual Models of Statute Law, *Computer/Law Series*. No.16, Kluwer Law International. The Hague, the Netherlands.
McCarty, L.T.(1989). A Language for Legal Discourse, I. Basic Features, *Proceedings of the Second International Conference on Artificial Intelligence and Law*, Vancouver, Canada 180-189.
Melz, E., Valente, A. (2004). Modelling the Tax Code. *The Second International Workshop on Regulatory Ontologies*.
Neches, R., Fikes, R.E., Finin, T., Gruber, T.R., Senator, T., Swartout, W.R. (1991). Enabling Technology for Knowledge Sharing. *AI Magazine*. 12(3) 36-56.
Stamper, R.K. (1980). LEGOL: Modelling Legal Rules by Computer. *Computer Science and Law*. Bryan Niblett. Cambridge University Press. Cambridge, United Kingdom.
Stamper, R.K. (1991). The Role of Semantics in Legal Expert Systems and Legal Reasoning. *Ratio Juris*, Vol. 4, No. 2 219-244.
Studer, R., Benjamins, V.R., Fensel, D. (1998). Knowledge Engineering: Principles and Methods. *Data and Knowledge Engineering*. 25: 161-197.
Valente, A. (1995). Legal Knowledge Engineering; A Modelling Approach. University of Amsterdam, The Netherlands, *IOS Press*, Amsterdam, The Netherlands.
Valente, A. (2005). Types and Roles of Legal Ontologies. V.R. Benjamins et al. (Eds.): *Law and the Semantic Web*, 65-76.
Visser, P.R.S. (1995). Knowledge Specification for Multiple Legal Tasks; A Case Study of the Interaction Problem in the Legal Domain, Computer / *Law Series. No. 17, Kluwer Law International*. The Hague, The Netherlands.

Duan, L., Loh, J.T., and Chen, W.F. (1990). “M-P-F based analysis of dented tubular members”. *Journal of Structural Engineering*, Vol. 21, No. 8, pp 34-44.
Fang, T.C. (1987). “Network resource allocation using an expert system with fuzzy logic reasoning”, Ph.D. thesis, University of California at Berkeley, California, USA.
Hong Kong MTR Corporation. (2001). Passenger Data for 1990-2000, http://www.mtr.com.hk, mm/dd/yy. (date accessed)
Paulson, B.C., and Barrie, D.S. (1992). *Professional Construction Management*, 3rd edition, Mcgraw-Hill International, Singapore.
Peter, J. (1998). “Development of a risk management model for international joint ventures”, *Proceedings of Second International Conference on Project Management*, Editors: L.R.K. Tiong, National University of Singapore, Singapore, pp. 55-67.
Truman, H. (1990). Private Communications.
Van Hoover, M. (2002). Interview, 7 August 2002.

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