16. Technology, Innovation and Supply Chain Management
Interactive Session

An Australia-China Joint Research Project: IT Gaps and Needs in Support of 'Green Tourism' Initiatives

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ABSTRACT: *More and more tourism destinations are adopting 'green' strategies in an attempt to alleviate problems or to gain competitive advantage. Information and communication technologies (ICT) can help here; an example being an intelligent transport system (ITS) that factors GHG emissions into its optimisation algorithm. This paper reports on a research (in progress) paper aimed at the identification of promising ICT solutions for green tourism requirements. The focus of the paper is on the specification and implementation of a requirements elicitation (RE) framework that allows convenient modification and extension.*

Keywords: green tourism, information systems, requirements elicitation

INTRODUCTION

According to Tourism Research Australia (TRA, 2013), the Australian tourism industry contributes $98.7 billion per year (around 6.8% of GDP) to the Australian economy. Driven primarily by the risks of climate change, the world is moving towards a new 'green economy', and tourism in a green economy context has been defined by the United Nations Environment Programme (UNEP, 2011: p.416) as: "--- tourism activities that can be maintained or sustained indefinitely in their social, economic, cultural and environmental contexts". An increasing number of tourism destinations have investigated the adoption of 'green' strategies as a means of addressing a variety of critical issues (Scott et al., 2008). These include: i) climate change; ii) severe environmental and social problems such as pollution, critical energy, water and land shortages, acute traffic congestion and rising unemployment and crime rates; iii) the need to rejuvenate destinations in decline; and iv) an apparent willingness on the part of visitors to pay a premium where sound environmental practices are employed (Hawkins and Bohdanowicz, 2011). Information and Communication Technology (ICT) can potentially address many of the challenges identified above. In this paper, we report on a research (in progress) project, conducted by research teams from Victoria University, Melbourne and Beihang University, Beijing, aimed primarily at the identification of promising ICT solutions for green and sustainable tourism requirements.

With a limited elapsed time (8 months) allowed for the project, it was necessary to adopt a pragmatic approach: specifically, since it was considered impracticable to realise all desired research objectives within time and budget constraints, the focus of much project activity was on the specification and implementation of a *requirements elicitation (RE) framework* that: i) could be easily modified and extended in future research stages; and ii) would allow for the convenient translation of identified requirements into formal system specifications for promising application areas. This necessitated that a formal approach (using recognized ICT analysis and design techniques) would have to be taken in the specification of requirements and, in particular, the requirements repository (database). Description of this repository, plus the rationale and background underpinning key design decisions, constitute the core of this paper.

The paper is organized as follows: background is provided in the following section and this is followed by a discussion of the research approach in Section 3. Details of the reference model that specifies the requirements repository are then presented in Section 4, together with an example of how a specific requirement is represented. The final section contains concluding remarks.

BACKGROUND

Green Tourism

Some care must be taken in defining the 'green tourism' concept, given that, in both the popular and academic literature, there has been a tendency to use terms such as 'sustainable development', 'green growth' and 'green economy' interchangeably.

The holistic (or systemic) view of the 'sustainable tourism system' is considered by some (e.g. Gammack et al., 2004: p.1) to have its roots in the work of Brundtland (1987) and its many manifestations include the Mill and Morrison (2002) model (focusing on a 'chicken-and-egg' like relationship between consumer travel decisions and destination marketing), the 'triple bottom line' concept (Adams et al., 2004) (encompassing the *natural, economic* and *cultural/social* environments), and the 'competitive destination' model of Ritchie and Crouch (2003).

Thus, essentially, a sustainable tourism destination is one where there is no short-term concentration on economic development at the expense of longer-term environmental and socio-cultural factors. More recently, with the focus on climate change, the UNWTO (United nations World Tourism Organisation) has extended its sustainable tourism definition to include a fourth dimension, referring to a "quadruple bottom line" encompassing "environmental, social, economic and climate responsiveness" (UNWTO, 2007: p.2).

UNEP has defined the *green economy* as:

> *"The concept of a 'green economy' does not replace sustainable development, but there is now a growing recognition that achieving sustainability rests almost entirely on getting the economy right. Decades of creating new wealth through a 'brown economy' model have not substantially addressed social marginalization and resource depletion, and we are still far from delivering*

> *the Millennium Development Goals. Sustainability is still a vital long-term goal, but we must work on greening the economy to get us there."*
>
> (UNEP, 2011: p.2)

On the other hand, the OECD talks about *green growth* and defines it as:

> *"Green growth means fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities."*
>
> (OECD, 2011: p.4)

Obviously, there is considerable overlap between these definitions. In an analysis of a substantial body of literature dealing with sustainability and green economy/growth, UN-DESA (2012) identified a number of concepts that were common to (or implicit in) all treatments, including: growth and economic development, environmental protection, low-carbon emissions, resilience, resource efficiency, ecological sustainability, human well-being, inclusiveness and equity. Within the IS world, a common means of dealing with concept overlap and ambiguity is through the use of 'information reference models'. Use of these within the tourism domain is discussed in the following section.

Tourism Information Reference Models

The tourism industry has long-recognized the importance of information integration and over the past 20 years or so has embarked upon a number of data standardization initiatives. One of the most ambitious of these was the *Harmonise* project (Missikoff et al., 2003). Harmonise is a major European Community (EC) initiative aimed at promoting tourism information systems interoperability through the adoption and use of a 'minimum tourism ontology'. As part of their work, the Harmonise team analysed existing tourism data standards and projects (Höpken, 2002) and discovered: i) more than 40 tourism-related data standards; ii) many different modelling approaches, languages and levels; and iii) while there is a fair amount of consistency between some of the major standards (e.g. the OTA and IFITT RMSIG reference models), there is also a very-high degree of semantic overlap and conflict.

It seems fairly safe to assume that no single tourism data standard will prevail in the near future. This assumption underpins the Harmonise project and their approach is based on facilitating and simplifying mappings between data models based on different standards (or none). In addition, the Harmonise team contend that most tourism IS standards are low-level and that "... harmonisation should be independent of the technical solution and should take place on a more abstract *conceptual* level" (Missikoff et al., 2003: p.60). We concur with this but go further in arguing that, where possible, the conceptual model itself should be abstracted. We have adopted this approach in recent tourism domain standardization work conducted within Australia.

Much of this work was sponsored by the Australian Government's Sustainable Tourism Cooperative Research Centre (STCRC) and culminated with the specification of the *National Information Architecture for the Australian Tourism Industry (NIAATI)* (McGrath and Meijerink, 2009), a project

led by the authors of this paper. This project built upon earlier STCRC work, in particular research aimed at developing an Australian *National Tourism Information Model* (Carson and Sharma, 2002) and development of the *Decipher*© national data warehouse for tourism business intelligence and research (Sharma, Carson and DeLacy, 2000; Carson and Richards, 2004). Outputs of related international initiatives in the public domain were also utilised; particularly the 'Minimal Domain Ontology' produced by the Harmonise team and the *IFITT*[1] *RM (Reference Model of an Electronic Tourism Market)* (Höpken, 2002a). Modelling work was broadly guided by the principles detailed by Martin (1982) and the results include (moderately abstracted) conceptual level process and data models and a set of matrices linking key information areas, processes, involved parties, information systems (existing and required) and locations. Development of the green tourism RE framework (described later in the paper) built upon and extended this earlier NIAATI work. In our work here, we have also drawn heavily upon work aimed at developing and specifying 'green tourism frameworks'. These are discussed briefly in the following section.

Green Tourism Frameworks

A number of organizations have specified conditions, prerequisites, requirements for green tourism. A good number of established strategic planning and policy development frameworks are proprietary but various United Nations bodies have been very active in this domain and have made a number of important contributions, including: the UNWTO's *Indicators of Sustainable Development for Tourism* guide (UNWTO, 2004); the UNEP and UNWTO (2005) *Making Tourism More Sustainable: A Guide for Policy Makers* framework; and the extension of these earlier works to incorporate the climate change dimension, resulting in the *Climate Change and Tourism: Responding to Global Challenges* report (Scott et al., 2008).

Among the many schemes developed to date, is the *Green Sustainable Tourism Council (GSTC)* proposal, which may be viewed at http://www.gstcouncil.org/. Other schemes (including those mentioned in the previous paragraph) are certainly more comprehensive but the GSTC criteria are readily-available and provide a wide-ranging list of requirements at the destination, operator (particularly hotel operator) and individual tourist levels. Their criteria also encompass all of the economic, environmental, social and cultural dimensions and, as such, this combination of relative simplicity and completeness, led the project team to the conclusion that this particular framework would be suitable for the early stages of the project (when there was an urgent need to rapidly come to grips with the problem domain).

Prior to the project's initial workshop, the team conducted an exercise designed to trial the broad RE approach adopted in a tightly-constrained area of the problem domain; specifically, energy usage and conservation. A selection of relevant GSTC criteria were selected, broad information systems (IS) requirements were then derived from these and were then mapped against known, existing ICT

[1] International Federation for Information Technology in Travel and Tourism.

systems that address these needs and the underlying technical IS requirements. All of the criteria identified may be broken down much further (and were to some extent in the actual exercise) but a representation at this level of detail was deemed to be probably about right for an initial analysis of green tourism ICT gaps and opportunities.

The IS requirements associated with each of the criteria were then analysed and it was noted that there was a certain degree of commonality through the three levels. This gave rise to a group of higher-level IS requirements, these were mapped against the party types associated with levels and an assessment was made of the extent to which current systems met these broad requirements. The results (partial) are presented in Figure 1 below.

	GSTC Level / Party Type		
IS Requirement	**Destination**	**Operator**	**Tourist**
Monitor energy usage data			
Calculate and monitor GHG emissions data			
Transport planning: environmental modelling, simulation and forecasting			
Intelligent route planning (environmental focus)			

Figure 1: *Current IS coverage: IS requirements by party type - partial view (darker shading represents greater coverage).*

The results of this exercise (as displayed in Figure 1) clearly indicate that, while current IS offerings provide some coverage at the destination level, the situation is much worse at the tourism operator and individual tourist levels and that this applies particularly to the more advanced offerings (such as an intelligent route planner that factors in environmental considerations and optimises along the economic and environmental dimensions). This is discussed further later in the paper.

RESEARCH DESIGN

The broad research question driving this project was: *What are the most urgent needs for IS application support of green tourism initiatives and what are the most promising areas for early development?*

Markus et al. (2002) have argued that IS development may be considered a knowledge-creating activity and a legitimate research method and that the development process itself is an *emergent knowledge process (EKP),* with significant parallels to the way that new research addresses gaps in – and builds upon – previous research. Hasan (2003: p.6) claims that IS development, concerned with EKPs, can be considered original research in the following two ways: i) where the artefacts of design, development and implementation (including functional and technical specifications, data and process models, databases and code) add to the body of knowledge concerning a system domain; and ii) "--- where the requirements [elicitation process], design and even implementation ---- contain new

knowledge towards a general understanding of how to proactively manage data and information in complex situations."

Hasan (2003: p.6) goes on to say that "Many of these systems evolve through a series of prototypes, which are constantly evaluated with the results fed back into the systems requirements and design [processes]" and highlights parallels between this and the classical research cycle (e.g. as illustrated by Leedy, 1997: p.10). Our interpretation of this equivalence is presented in Figure 2.

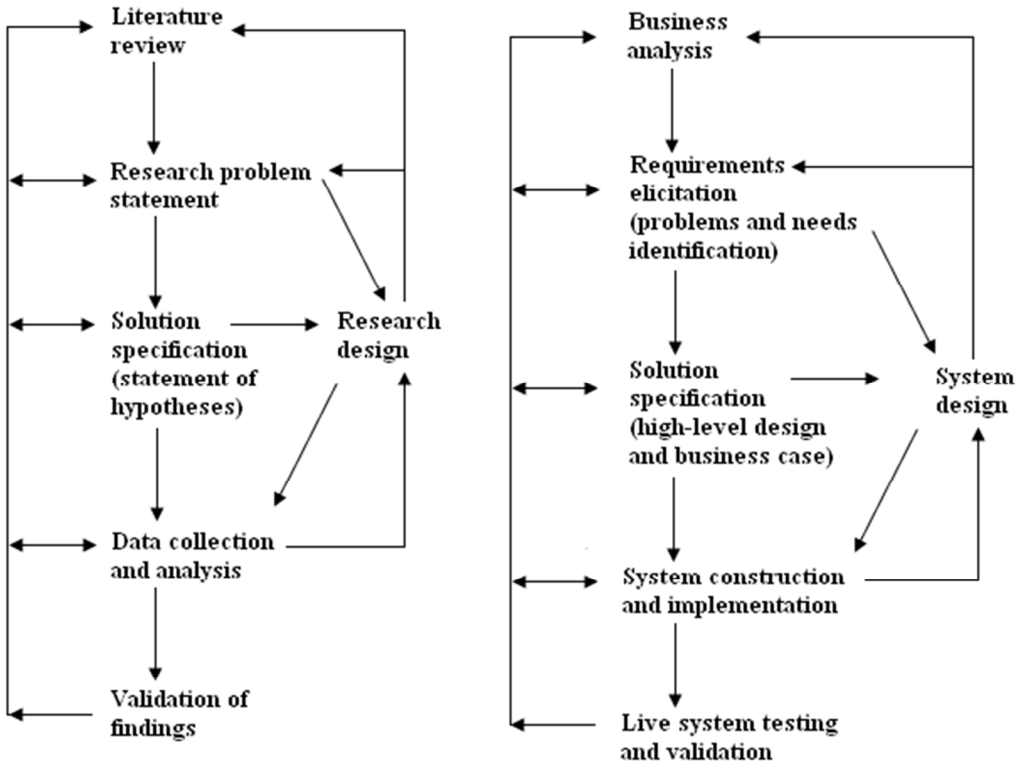

Figure 2: *The research and IS development processes compared (using research cycle material from Leedy, 1997: p.10).*

Space does not permit a detailed description of these two cycles and their equivalences but, to date, the focus of this particular project has been on the early part of the IS development cycle: specifically, requirements elicitation. Business analysis and literature reviews are similar in that both are primarily concerned with domain familiarization and identification of gaps and needs at a high level. Also, while the emphasis is certainly different, both activities involve reviews of articles detailing the most up-to-date domain knowledge, analysis of more-routine archival and procedural material and interviews and discussions with experts and other involved parties. The major outputs of these early phases are also somewhat similar: i.e. in research, the aim is to come up with a clear statement of the research problem to be addressed, followed by a subdivision into sub-problems, each of which has associated with it a specific research question and/or appropriate hypotheses. As Leedy (1997) notes, this may be viewed as a solution specification and, in IS development, the parallel is a high-level design (generally

based around data and process models and independent of implementation platform) specifying a logical solution to the business problem and, again, broken down into sub-problems (components or modules).

The project team consisted of researchers from Beihang University, Beijing and Victoria University, Melbourne. Workshops were held in Beijing (September, 2013) and Melbourne (January and March, 2014), in concert with substantial work conducted outside formal sessions. The broad aim was to specify a preliminary version of a green tourism information architecture and to identify promising application niches. Research outputs were to be specified formally, with a view to follow-up R&D projects, and a pragmatic approach was adopted, whereby the RE process would be driven to some extent by the particular skills of the research team[2].

Finally, it is important to emphasize that, where IS development is used as the research foundation (as with this project), much of the 'emergent knowledge' generated with each new research phase and prototype is actually contained within the system itself; specifically, the schemas used to specify data (and database) structures and contents, the data itself and the code that is employed to manipulate system data. It is contended that: i) together, these components constitute what is commonly referred to as a *conceptual model/framework* for informing and guiding research studies (see e.g. Braithwaite, 2003); and ii) conceptual models produced where the principal research method is IS development are more precise, specified more rigorously and, oftentimes, are much richer than such models and frameworks typically employed with other research approaches. With such an approach, the database (repository) and its meta-models (reference model) are particularly important insofar as the specification and presentation of the elicited system requirements are concerned. As such, in the following section, we turn our attention to this particular aspect of our research project.

GREEN TOURISM REFERENCE MODEL

Overview of the Reference Model and Repository

The reference model is represented in Entity-Relationship (ER) form (Chen, 1976) and, more specifically the higher-levels of the model are an adaptation of the 'Public Value Framework' (PVF) of Cresswell et al. (2006). The PVF was developed because its designers believed that most methods of assessing return on investment (ROI) from government IT initiatives are far too narrow, with a very limited view of what can be considered returns to the public (generally restricted to the economic dimension alone). Similarly, within our green tourism study, we saw the following very strong

[2] This was deemed necessary as, with only 8 months to complete the research project, the team was working to very-tight deadlines. Broadly speaking, the Beihang University researchers were expert in GIS and satellite navigation technology and systems and the Victoria University team had expertise in tourism research generally and ICT in tourism research in particular.

parallels between IT investments in the public sector and the tourism industry: i) both have very large and complex domains; ii) both are concerned with a huge variety of and number of stakeholders; iii) both take a holistic view of ROI (in particular, one that encompasses all of the economic, environmental and social dimensions); and iv) both have the public value of investments as their respective focus.

Our reference model is illustrated in Figure 3. We shall now provide a brief overview of the model's major constructs and elaborate on these through an example presented in the following sub-section.

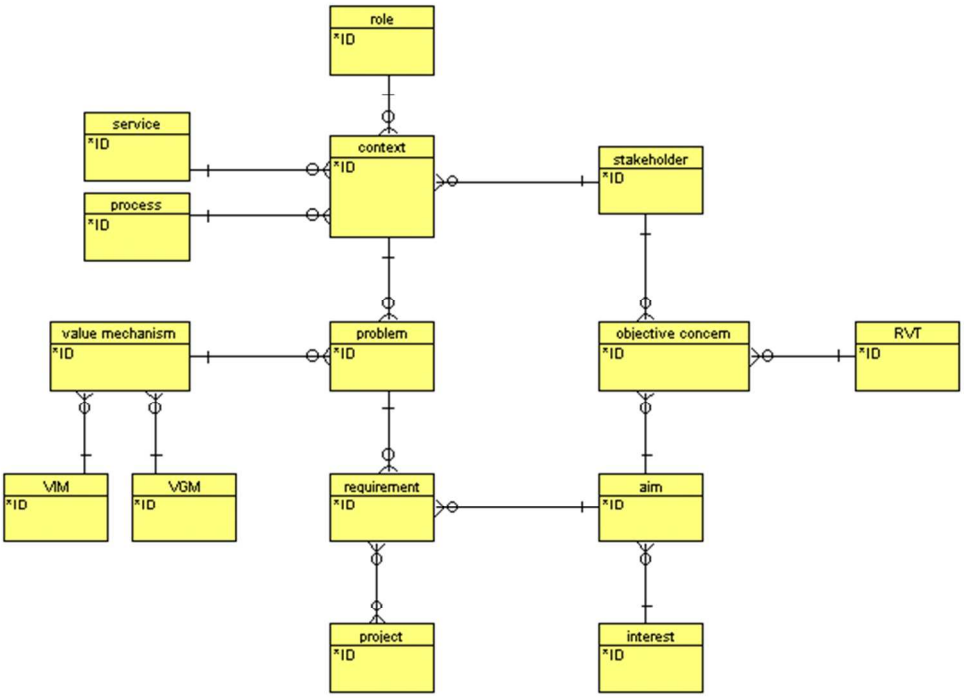

Figure 3: *Repository schema in ER form – adapted from the 'Public Value Framework' of Cresswell et al. (2006).*

An *interest* is an entity, generally an abstracted entity that may be sub-typed (perhaps in many different ways). Examples are *parties* (e.g. *destinations, communities, households, people, customers, workplaces* and *providers), locations* (e.g. *interesting places* and *WiFi hotspots), activities* (e.g. *ancillary services, adventure experiences, dining* and *travel), attractions* (e.g. *heritage sites, local geography* and *museums)* and *broad aspirations* (e.g. *environmental, conservation, climate, accessibility* and *satisfaction). Aspects* (not shown in the ER diagram) are, basically, attributes of interests. For example, *ghg emissions, water usage, energy usage* and *waste* are all aspects of *climate, attractiveness* is an aspect of *interesting places* and *availability* is an aspect of *service.* One interest may (optionally) have many aspects and an aspect may be related to 0, 1 or many interests.

An *aim* is a measurable aspect of an interest: consequently, an aim may be represented by an <*interest, aspect*> tuple. An example is <*climate, ghg emissions*>, with the aim being to improve the

climate by reducing ghg emissions. A *stakeholder* is actually a *stakeholder type,* the full set of which constitutes all party types relevant to the green tourism domain, including *DMO, tourism operator, traveller, local community, government authority* etc. A *stakeholder* may (or may not) have one or more aims and an *aim* can apply to several stakeholders Thus, an *objective concern* is an intersecting entity linking an aim with a single stakeholder. Objective concerns may also be thought of as valued aims. This value must be one of a limited number of *returned value types (RVTs),* the allowable set being *{financial, ideological, political, quality of life, social, stewardship, strategic}*. Consequently, the 4-tuple, <*climate, ghg emissions, stewardship, traveller*>, is an example of an objective concern. *DMOs, tourism operators* and *transport operators* are examples of other stakeholders with the same concern.

A *process* is an activity (which may often be broken down into sub-activities), undertaken in support of a goal (or goals) and which, almost invariably, results in state changes in involved stakeholders and services. Examples are *dining, purchasing, travelling,* and *accommodation booking.* A *service* is something (often involving an action or activity), provided by one or more stakeholders and consumed by other stakeholders, in support of a process. Examples are *restaurant, hotel, location-based system (LBS), intelligent transport system (ITS)* and *property management system (PMS).* A *context* links a process, supported by a service, with a stakeholder involved in a specific *role* and may, therefore, be represented as a 4-tuple. Related examples are <*local transport, ITS, traveller, consumer*> and <*local transport, ITS, IT service provider, provider*>.

A *value mechanism (VM)* is a *value impact mechanism (VIM)* combined with a *value generating mechanism (VGM).* A VGM is drawn from a limited set, *{efficiency, effectiveness, enablement, ----},* which may be viewed as broad aspirations or aims applying to processes and services. Thus, for the local transport process, efficiency and effectiveness both apply as VGMs. A VIM is drawn from the set, *{direct, indirect, mixed},* and indicate the type of impact that an improvement initiative or investment may have on a process or service. Thus, an ITS might have both a direct and indirect impact: the direct impact being that it enables end-users (travellers) to use local transport more efficiently and the indirect impact being that it may provide the ITS providers with information that may enable them to develop a more-effective system. The ITS may also have a mixed impact, which occurs where value flows beyond users (consumers) and providers to others. Again, an ITS may also have a mixed impact because the local community may reap benefits resulting from lower GHG emissions and a cleaner environment.

A *problem* links a context with a VM. Extending our local transport example, the <*local transport, ITS, traveller, consumer*> context may be linked with the VM, <*efficiency, direct*>. A *requirement* is an intersecting entity linking a *problem* with an *aim* and has the attributes, *extent met* and *priority.* Thus, our example problem of employing an ITS to improve efficiency from the perspective of travellers can be linked to aims concerned with customer satisfaction, local travel itinerary and

customer expenditure. Consequently, the one problem may generate many requirements and the one requirement may be assigned for implementation in many *projects*.

In the following sub-section, we present an instance of a requirement specification within the repository (based on the local transport and GHG emissions examples used above) in an attempt to clarify the purpose and usage of the various reference model entities and relationships.

Transport and GHG Emissions

Ali and Frew (2010: p.486) have highlighted the importance of tourism-related transport and its impact on energy usage and GHG emissions. Thus, in order to provide a somewhat less-abstract view of our repository, we shall focus on this particular issue and its repository specification in some detail.

The relevant repository view (partial) is presented in Figure 4. From the top, the broad interest is the climate and the aim indicates a desire to improve the climate by reducing GHG emissions. As noted, one purpose of the objective concern relationship is to link aims with stakeholders and the four tuples listed here indicate that all of travellers, hotel operators, tourism operators and destinations have involvements with the GHG emissions aim (specifically, stewardship, which denotes that all nominated party types have responsibilities insofar as climate improvement and protection is concerned).

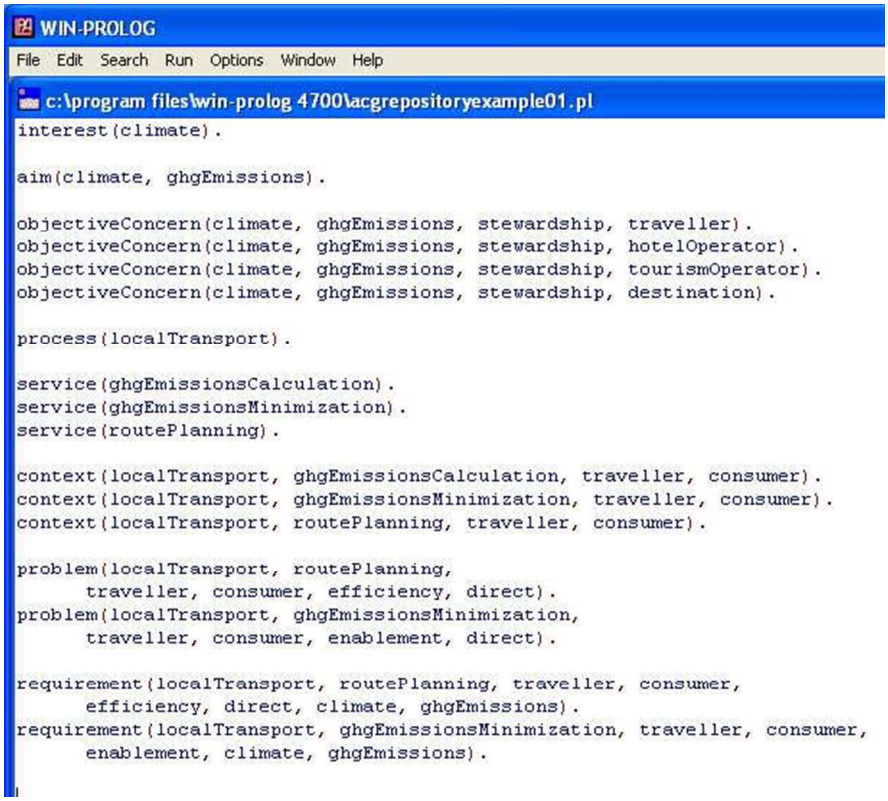

Figure 4: *A partial view of the repository (extracted into an LPA-WinProlog4700 external database environment).*

Next, the process we are concerned with is local transport and the support services of interest are GHG emissions calculation and minimization, plus route planning. Focusing on the individual tourist (traveller) only, this generates three context tuples in which the traveller is linked with the local transport process, supported by the three nominated services, in the role of consumer.

A single context may optionally be related to many problems and, in this example, local transport route planning and GHG emissions minimization are linked to problems concerned with both efficiency and enablement. In turn, these each give rise to requirements linked back to our original aim of climate improvement through a reduction in GHG emissions. Finally, these could be packaged together in a project involving the development and implementation of a 'Personalized Electronic Tourist' (PET) guide similar to that described by Garcia et al. (2009). Such a system would typically be required to provide intelligent route planning between attractions, service sites and other places of interest based on customer profiles and preferences, with an emphasis on the use of public transport where possible. The core of the application would be determination of optimum routes based on time, cost and GHG emissions (with start and end points specified).

The above is one example of how an identified requirement is represented in the repository. Currently, as a result of project workshops and follow-up, consolidation activity, the repository contains a great many more requirements and, as noted earlier (and, probably, not surprisingly), many of these focus on niches and needs at the individual traveller level. Certainly, the RE exercise is not complete but work has reached a stage where requirements have now been specified to a point where this could for the basis for detailed development work; particularly in areas, also recently identified as green tourism priorities by Buhalis and Amaranggana (2014), such as joint destination/tourist dynamic co-production of products and services, environmental management and protection through tourist tracking and pattern analysis, and travel recommender systems (TRS) that 'inspire' and challenge the tourist (rather than precisely match his or her preferences). In parallel with this, RE work is continuing. As noted, the design of the requirements repository and its reference model is expected to allow this to not impact significantly on the current requirements specification and, indeed, development work based on this.

SUMMARY

Increasingly, tourism destinations are developing and implementing green tourism strategies in an effort to address deep-seated problems that appear to be impervious to solutions underpinned by a continuing, BAU (business-as-usual) brown economy model. ICT can assist here and, in this paper, we have reported progress on a joint Australia-China research project aimed at identifying requirements for promising application gaps and niches within the green tourism domain. A significant number of these requirements have been identified and many of these focus on the individual tourist and smart local transportation. Much of the focus of the paper has been on the repository used to hold

requirement specifications and its reference model. A key feature of these is that they have been designed in a way that permits convenient extension and modification (i.e. this can be done with minimal impact on existing requirements and applications based on these).

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