ENVIRONMENTAL INITIATIVE ROI

ROI FROM ENVIRONMENTAL INITIATIVES IN TOURISM ACCOMMODATION ENTERPRISES: A ‘TRIPLE BOTTOM LINE’ APPROACH

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Preferred Stream: Stream 16
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ENGLISH INITIATIVE ROI

ABSTRACT
Owners, managers and operators of most businesses are now increasingly aware of their responsibility to the environment. Oftentimes, however, there are significant costs associated with environmental initiatives. Fortunately though, adopting sensible, effective and efficient energy, water and waste management practices may result in substantial savings. In this paper, we report on the development of a decision support system (DSS) designed to allow tourism enterprises to calculate ROI from the implementation of environmental management initiatives. The DSS is predicated on a ‘triple bottom line’ view, encompassing the economic, environmental and social perspectives.

Keywords: Sustainable enterprises; environmental initiatives; tourism; ROI.

INTRODUCTION
For any tourism accommodation enterprise, energy, water and waste management costs are a significant component of their total costs. Increasingly, as with society at large, the owners/operators of these businesses are becoming more aware that, in the interests of long-term sustainability, they have a responsibility to preserve and improve the environment. Naturally, this involves time, effort and some cost. The good news though is that it is not all one-way traffic: i.e. adopting sensible, effective and efficient energy, water and waste management practices can result in substantial savings.

In a recent paper, McGrath (2007) reported on the development of a ‘Tourism Enterprise Planning Simulator’ (TEPS). TEPS is a computerised business planning aid that allows existing or prospective tourism enterprise operators to factor tourism-specific variables into their strategic and operational-level planning. Specifically, it simulates projected ROI (over a 7-year period) for various combinations of economic, environmental and social investments (e.g. in staff development, local community initiatives, marketing and environment despoilment mitigation). A prototype has been implemented (as a Windows application) in stand-alone, fully self-contained CD-ROM form.

In this paper, we report on a follow-up research project, undertaken in partnership with the Green Globe (GG) organization. In this project, the initial version of TEPS was customized and extended to produce TEPS-V2.1; a commercial-standard, fully-functioning decision support system (DSS) designed to allow tourism businesses to project ROI from the specific environmental and social programs promoted by GG (in the areas of water, energy and waste management, and the impact of these programs on customers, the market and other key business stakeholders and partners). In addition, the DSS has been designed to act as a new business attractor for GG. At the time of writing this paper, an initial version has been implemented (as a Windows stand-alone prototype). The eventual plan is to m the system online through the GG website1.

The paper is organized as follows: in the following section, background to the project is presented and this precedes an outline of the research design. An overview of the DSS is then presented, followed by a discussion of some preliminary research results. The final section contains concluding remarks.

BACKGROUND
Sustainability and System Dynamics
Recently, there appears to have been an increasing awareness that responsibility for sustainability rests not just with governments and destination managers but with all – including individuals and organizations (large and small). In part, this motivated our recent attempts to develop the ‘Tourism Enterprise Planning Simulator’ (TEPS) detailed in McGrath (2007). The primary objective here was to provide prospective and existing tourism enterprise operators with a business planning tool, based on a total systems view and designed to complement traditional business planning tools and approaches (described briefly later in this

1 At: http://www.greenglobe21.com/
section). A further objective was to develop a tool that could be customized for different purposes and, from an information systems research perspective, a major aim of the specific project detailed in this paper was to test the extent to which this had been realized.

TEPS is based on methods, tools and techniques commonly employed in ‘system dynamics’ (SD) (or ‘systems thinking’) research and practice. SD has its origins in the work of Forrester (1961) and, more recently, has enjoyed something of a resurgence – largely due to Peter Senge’s (1990) very influential work on ‘the learning organization’ and the development and release of easy-to-use, powerful, SD-based software modelling and simulation tools (such as iThink, Vensim and Powersim). Recent examples of where SD has been used to good effect in tourism include the ‘Tourism Futures Simulator’ of Walker et al. (1999), the hotel value chain modeling work of Georgantzias (2003), the tourism multipliers model of Loutif et al. (2000), the ‘Sensitivity Model’ of Chan and Huang (2004) and the tourism information architecture modelling work of McGrath and More (2005).

In their simplest form, SD models are represented as ‘causal-loop diagrams’ (CLDs). The reader looking for a more thorough introduction to CLDs is referred to Maani and Cavana (2000) but, essentially, only one modelling construct is employed; an arrow connecting two domain variables, indicating a causal connection between them. Arrows are generally annotated with either a ‘+’ or ‘-‘; a ‘+’ symbol meaning that both variables move in the same direction (i.e. increase or decrease together) and a ‘-‘ symbol meaning that the variables move in opposite directions. We employ a third annotation symbol, the question mark, ‘?’ – meaning that the connection is too complex to represent with the two basic annotations.

The usual approach in developing a SD model though, is to: i) specify the problem domain as a CLD and, then, ii) implement it in the slightly more complex stock-flow syntax employed by the types of software packages listed above. In this paper we restrict ourselves to CLDs and a high-level representation of the TEPS CLD is presented in Figure 1.

![Figure 1: System dynamics representation of some critical factors associated with tourism enterprise profitability within a regional context.](image-url)
ENVIRONMENTAL INITIATIVE ROI

Region attractiveness is at the heart of the model presented in Figure 1. An attractive region makes local enterprises more attractive themselves and, together, region and enterprise attractiveness lead to more tourists. More tourists result in healthier room occupancy rates and (with qualifications) this, in turn, improves enterprise profitability (or ‘return on investment’ – ROI). As enterprises become more profitable, more development takes place and, up to a point, developed regions and enterprises will draw even more tourists, resulting in a classic reinforcing loop. This, of course, holds true only to a point as, consistent with the ‘tourism life-cycle model’ (Butler, 1980), over-development eventually leads to a tourism decline. (This accounts for the ? annotation on the development → tourists link in Figure 1.)

Reinforcement is also moderated by the tendency of development to impact negatively on both enterprise profitability and occupancy rates.

In addition, development leads to environment despoilment and, in turn, this detracts from both region and enterprise attractiveness. Thus, with the addition of this balancing loop, we now have the essence of the classic sustainable tourism model (Ritchie and Crouch, 2003). Damage to the environment, however, may be limited by appropriate mitigation measures (e.g. through the construction and maintenance of barriers to protect sand dunes, and native vegetation and wildlife). There is a cost associated with effective and committed environment despoilment mitigation though and, ultimately, part of this must be borne by local tourism enterprises (as indicated by the despoilment mitigation → profitability link in our diagram).

The model presented in Figure 1 is specified at a very-high level (in the sense that each variable may be broken down further). Already though, a degree of complexity is apparent and this illustrates one of the benefits of SD modelling as claimed by its proponents: specifically, the approach can counter our tendency to over-simplify complex problems and issues into simple cause-effect relationships we can readily understand within the limits of our cognitive powers (Vennix, 1996). Of course, this is true of many conceptual modelling approaches and each of these have their own strengths and weaknesses. SD, however, is particularly well-suited to domains where feedback loops and time are significant (Richardson and Pugh, 1981) and both of these feature prominently in tourism models (see e.g. Ritchie and Crouch, 2003: 60-78).

Green Globe

The original version of TEPS was developed so that it could be easily customized for different purposes. Following the release of the original version (TEPS -V1.0), agreement was reached with the Green Globe (GG) organization to customize and extend this initial version to produce TEPS-V2.1; a commercial-standard, fully-functioning DSS designed to allow tourism businesses to project ROI from the specific environmental and social programs promoted by GG (e.g. in the areas of water, energy and waste management, and the impact of these on customers, the market and key business stakeholders and partners).

GG runs the global ‘Affiliation, Benchmarking and Certification’ program for sustainable travel and tourism. It works with travel and tourism companies and communities to achieve and maintain good environmental and social practice, deliver maximum benefit to all interested parties and provide choice for concerned consumers. The GG brand signifies better environmental performance, improved community interactions, savings through using fewer resources, and greater yields from increased consumer demand. It provides recognition and promotional support to a global consumer market. Obviously, with increased general levels of concern over issues such as climate change and pollution, many companies believe that being GG-accredited is simply good business practice.

Companies wishing to achieve this accreditation must undergo the GG benchmarking process. Sector Benchmarking Indicators itemise the measures of key environmental and social impacts for travel and tourism sectors. The measures are used by Green Globe to produce a Green Globe Benchmarking Assessment Report. The GG benchmarking assessment benchmarks the performance of an organisation’s operations, and provides advice where appropriate and where worthwhile improvements may be made. Organisations satisfying all of the requirements of the ‘Green Globe Company Standard’, whose
indicators have been benchmarked above the ‘Green Globe Baseline’ and who are successfully certified following an on-site visit by an accredited third-party auditor, are entitled to use the Green Globe logo.

TEPS-V2.1 has been designed primarily to act as a GG new business attractor and to assist tourism and hospitality companies to understand the complex interactions within and between the economic, environmental and social sub-systems. Development is being undertaken in partnership with GG (Asia-Pacific) and Decipher (an Australian company specializing in data warehousing for the tourism and hospitality (T&H) industry). Both GG (Asia-Pacific) and Decipher are subsidiary companies of the Australian Sustainable Tourism Cooperative Research Centre (STCRC). Following a brief overview of our research approach in the following section, the essential details of the design and operation of the TEPS-V2.1 DSS will then be introduced.

RESEARCH DESIGN

The research questions explored in this applied research were:

Q1: To what extent may a DSS, built primarily upon system dynamics principles, tools and techniques, be used to formally model the operations of T&H enterprises within the wider tourism system and, in particular, to model the application and impacts of the types of environmental initiatives advocated by GG (and others)?

Q2: To what extent is a DSS of the type referred to in H1 above useful to both: i) enterprise owners and operators; and ii) organizations with a primary mission of promoting environmental initiatives (such as GG)?

Q1 was explored largely by desk checking, which involved comparing outputs from DSS simulation runs with actual data – e.g. accommodation sector occupancy and revenue data retrieved from (ABS, 2002). In contrast, Q2 was evaluated mostly in the field. Specifically, website hits and analysis of new GG business (before and after implementation of the various phases of the DSS) were employed as surrogate measures for system ‘usefulness’. We return to the issue of validation in the penultimate section but the reader should note that, at the time of writing this paper, system implementation (and, consequently, data analysis) is incomplete.

DSS OVERVIEW

Development Stages

As noted previously, the DSS (designated as TEPS-V2.1) has been designed as a commercial-standard, fully-functioning DSS designed primarily to allow tourism businesses to project ROI from the specific environmental and social programs promoted by GG. Development was broken down into three stages as follows:

i) Stage 1 - Basic Calculator: The focus here was on calculating costs and savings relative to established GG baselines and best-practice levels for water, energy and waste management initiatives.

ii) Stage 2 - Investment DSS: This involved extension of the Stage 1 software product to include ROI and ‘what if’ functionality.

iii) Stage 3 - The Social Dimension: Extension of Stage 2 to incorporate social factors into the DSS (e.g. business benefits from social capital generated by environmental programs and associated community engagement).

We now provide overviews of the functionality produced out of each of these three stages in turn.

Stage 1 – The Basic Calculator

For any one T&H company, savings that might result from implementation of a GG environmental initiative depend on a number of factors; including the company’s location, the utility companies and contractors it uses, and its current level of environmental commitment.
A company participating in GG’s benchmarking program must supply substantial detail: e.g. annual energy usage details must be submitted for all of grid electricity, solar power, gasoline, diesel fuel and LPG in terms of (respectively) kilowatt-hours (kWh), kWh, volume (gallons or litres), volume and weight (lbs or KG). This input is then converted into a single energy usage figure, expressed in megajoules/guest-night (MJ/GN) and this is then compared to the GG baseline and best-practice levels. To be entitled to use the GG logo, the company must perform at better than baseline level for pretty-much all indicators.

Figure 2: Energy Savings Calculator – user interface.

Our calculator, however, was designed only to provide an indication of the savings that might be realized by performing at GG baseline and best-practice levels – rather than a precise figure. Moreover, for this project, a user requirement was that the calculator be very simple to use and that too much data input should not be expected of the user. Consequently, a decision was made to use approximations and averages where possible and to only request data input where the user might be expected to have the required information at his or her fingertips. For example, with the energy savings calculator user interface (see Figure 2), we only ask that the user enter approximate monthly expenditures for each energy type –

2 Currently, for energy consumption, these are 240MJ/GN (baseline) and 168MJ/GN (best-practice).

3 Some exceptions are permitted to allow for factors such as climate, local prices, availability of different energy sources etc. For details see: http://www.greenglobe.org/docs/pdf/Company%20Standard%20June%202006.pdf.
our assumption here being that the average user should be readily able to supply this data without reference to records. Then, knowing the user’s region and ballpark energy costs for the region, we can easily calculate energy usage and compare this to GG benchmarks. If the user’s consumption is worse than one or both of these (i.e. baseline or best-practice), then the difference(s) are calculated, these are re-converted to dollars and the estimated potential savings are displayed in graphical format (see the right-hand side of Figure 2).

The code and logic underpinning the savings calculator are fairly simple. Nevertheless, the system is very easy to use and does the required job (in terms of providing an indication of where the user is placed in relation to GG benchmarks and of the order of savings that might result from the adoption of sound environmental management initiatives). There are, however, costs associated with many of these initiatives and we now turn our attention to this side of the equation.

Stage 2 – The Investment DSS

The database for the investment DSS is was modelled in entity-relationship form. High-level activities are energy, water and waste management and these may be broken down to further levels of detail. There may be a number of environmental management initiatives associated with each activity and the converse also applies. This relationship is represented by an IAI (Initiative-Activity Involvement) intersecting entity, instances of which are:

- passive solar heating addresses energy management;
- plastic covers on pools addresses water management; and
- fluorescent globes address energy management.

Initiatives were identified through an analysis of recommendations found at the Twinshare website[^4]. These may be involved with each other in a multi-level in an III (Initiative-Initiative Involvement) intersecting entity. Examples are:

- appliance management improvement is-a-kind-of energy management improvement;
- induction cooktops are-part-of appliance management improvement;
- introduction of high energy rating appliances is-a-kind-of appliance management improvement;
- introduction of high energy rating washing machines is-part-of introduction of high energy rating appliances; and
- introduction of high energy rating dishwashers is-part-of introduction of high energy rating appliances.

Is-a-kind-of, is-part-of, isa etc. are all examples of III Roles (Initiative-Initiative Involvement Roles). There is one (and only one) III role associated with each III.

There is an ROI Profile associated with each initiative and this is composed of the set of quarterly expenditure and savings figures[^5] for an initiative. Expenditure for each quarter is the ‘do nothing’ option, while savings are the difference between expenditure and costs incurred in implementing an initiative. Multiplying all values by 100/expenditure allows us to ‘normalise’ each profile and, finally, summing


[^5]: Currently, profiles are established on a 28 quarter (7 year) basis.
normalised quarterly savings figures produces a ‘normalised cumulative savings’ sequence\textsuperscript{6}. This is, essentially, a view (or representation) of the ROI profile for an initiative\textsuperscript{7}.

![ROI Profile - Fluorescent Globes](image)

**Figure 3:** Example of a view of an ROI profile.

As an example, consider the ROI profile for the fluorescent globes initiative presented in Figure 3. The assumption is made here that existing incandescent globes will be replaced progressively (e.g. over a 1-2 year period and/or as they burn out) and the initial negative cash flow reflects the fact that the purchase cost of fluorescent globes is currently much more expensive than that for the traditional variety. They are, however, much more energy-efficient (resulting in lower grid electricity costs) and they last a lot longer than incandescent globes (meaning lower replacement costs). Thus, we gradually recoup the initial capital outlay and break even around Quarter 14. Actual cumulative savings can easily be calculated by simply reversing the normalisation process.

ROI profiles allow us to conveniently calculate a simple, overall ROI measure by averaging the final cumulative normalised savings value over all initiatives implemented (or under consideration for adoption). They are also a key element of the model that underpins Stage 3 of our DSS and this is addressed in the following section.

**Stage 3 – The Social Dimension**

There is an increasing recognition that, consistent with more general trends in tourism research and industry practice, tourism enterprise planning must move beyond its traditional focus on economic issues only to encompass the social and environmental dimensions. Essentially, this is in recognition of the fact that, while tourism may result in significant economic benefits for the host region, it may also have other, negative consequences: e.g. increased traffic noise, crime, waste, spikes in energy and water usage, and more general environment despoilment. Thus, any serious attempt to specify a holistic tourism enterprise DSS framework must include both: i) factors within each of the economic, social and environmental systems; and ii) interactions within and between each of these three systems.

One of the more significant, recent attempts at specifying such a framework is that of Fredline et al. (2005). While their focus is on tourism events, their approach is grounded squarely in the ‘triple bottom

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\textsuperscript{6} Perhaps more familiar as a ‘time to break-even’ graph.

\textsuperscript{7} Note that one ROI profile can apply to many initiatives (see Figure 4). Without normalisation, this highly useful system feature would not be possible.
line’ (TBL) concept (Elkington, 1999; Adams et al., 2004) and one of their key objectives is to represent the outcomes of an event evaluation in a form that is comprehensive but sufficiently non-complicated that it affords an overall view without the need for complicated interpretation and analysis. To accomplish this, they employ a ‘synthesis diagram’ an example of which is presented in Figure 6. Here, the TBL impact of an event can “be expressed by the ratio between the area of the plotted triangle and the theoretical maximum defined by the outer limits of the diagram” (Fredline et al, 2005: 12). Thus, Figure 4 might represent a moderately successful event overall, an extremely successful event from an economic viewpoint but something of a worry when viewed from an environmental perspective (e.g. some sort of motorsport event might fit this profile).

Figure 4: A view of a TBL evaluation (Source: Fredline et al., 2005).

Thus, the social dimension component of our DSS is not treated in isolation but as part of an integrated economic-environmental-social tourism system. Moreover, as noted earlier, system dynamics (SD) techniques and tools were employed here\(^8\) and the Stage 3 SD model and simulator is, effectively a customised version of TEPS-V1.0\(^9\) (McGrath, 2007). The Stage 3 SD model, in CLD form, is presented in Figure 5. Note that, while there are a great many social factors that need to be taken into account (e.g. noise, crowding, crime, anger and stress etc.), we have restricted our initial version to issues associated with goodwill resulting from the level of demonstrated commitment to the environment. This decision was made because increasing the level of T&H enterprise integration and involvement with local communities (and their environments) is a fundamental GG objective (STCRC, 2007: 10).

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\(^8\) More conventional database and software development approaches were used in Stages 1 and 2 but the Stage 3 SD component receives essential input from the software components produced out of these earlier stages.

\(^9\) Designated as TEPS-V2.1.
Figure 5: Stage 3 SD Model – CLD representation.

Referring to Figure 5, the more guest nights an accommodation enterprise has, the greater the energy, water and waste (eww) produced. As we have seen though, an enterprise with effective environmental management (em) policies and practices may reduce eww and this, in turn, may lead to substantial em savings. These savings, together with costs incurred in implementing em initiatives, may be used to calculate an em ROI. The foregoing is, essentially, an SD specification of the functionality covered in Stages 1 and 2 of our DSS.

A commitment to em may generate some degree of visitor goodwill\(^{10}\), resulting in an increase in business. While this will certainly increase eww levels, it may also spawn additional employment opportunities for locals. This, by itself, may lead to an increase in local goodwill but a perceived commitment to sound em among the community may also result in a further boost to goodwill at the local level. In turn, an increase in local goodwill may lead to additional local business\(^{11}\), thus further improving em ROI.

Insofar as instantiating model variables is concerned, we may well be able to locate (or derive) reasonably accurate data for some social dimension variables (e.g. traffic congestion, accidents, community health and crime). However, the likes of local and visitor goodwill pose more problems. As noted in Fredline et al. (2005), some form of survey is often required to estimate values for these softer variables and detailed examples of how this might be accomplished are presented in their paper.

Oftentimes though, we might need to rely on the ‘best guess’ of relevant experts and those closest to the problem domain. So, for example, in our initial implementation we have assumed that the variable, IofEMonVG (impact of em on visitor goodwill), is as represented in Figure 6. That is, after discussions without GG users, it was presumed that variations in the level of em commitment will have the most significant impacts (positive and negative) around the mean (100) but will tail off towards both extremes.

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\(^{10}\) Hence, the potential value of formal GG accreditation.

\(^{11}\) e.g. through use of restaurants, golf courses and other amenities open to the public.
The accuracy of assumptions such as this can only be validated by comparing simulation outputs with actual values for model variables that can be measured with some degree of accuracy. This is addressed in the following section.

![Impact of Environmental Management on Visitor Goodwill](image)

**Figure 6.** Relationship between environmental management commitment and visitor goodwill.

### RESEARCH OUTCOMES AND MODEL VALIDATION

Referring back to our ‘Research Design’ section, in summary, the intention was that research outcomes were to be evaluated by assessing: i) the extent to which intended users found the system useful; and ii) the degree of correspondence between simulation outputs and ‘reality’.

Insofar as usefulness is concerned, at the time of writing this paper only the Stage 1 component (the Basic Calculator) had been implemented – and then only in stand-alone mode. This software was demonstrated to an audience of hotel general managers and chief engineers at a workshop held in late-May 2007. Having been given the opportunity to trial the software, participants were two questions. First, they were asked to rank its usefulness on a 1-5 scale. Results are presented in Table 1.

**Table 1:** Perceived usefulness of the Basic Calculator.

<table>
<thead>
<tr>
<th>Rating (1-5)</th>
<th>Perceived Usefulness</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Very useful</td>
<td>24</td>
<td>54.6</td>
</tr>
<tr>
<td>4</td>
<td>Somewhat useful</td>
<td>12</td>
<td>27.3</td>
</tr>
<tr>
<td>3</td>
<td>Unsure</td>
<td>6</td>
<td>13.6</td>
</tr>
<tr>
<td>2</td>
<td>Not much use</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>1</td>
<td>Forget it!</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Having been given the opportunity to trial the software, participants were two questions. First, they were asked to rank its usefulness on a 1-5 scale. Results are presented in Table 1.

**Question:** How useful do you think that this calculator might be in convincing key decision makers in hotels to adopt best-practice environmental management initiatives?

ENVIRONMENTAL INITIATIVE ROI

Participants were then asked whether they personally would be prepared to use the software. Results are presented in Table 2 below.

**Table 2: Willingness to use the Basic Calculator.**

<table>
<thead>
<tr>
<th>Rating (1-5)</th>
<th>Intent to Use</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Definitely</td>
<td>20</td>
<td>45.5</td>
</tr>
<tr>
<td>4</td>
<td>Probably</td>
<td>15</td>
<td>34.1</td>
</tr>
<tr>
<td>3</td>
<td>Perhaps</td>
<td>6</td>
<td>13.6</td>
</tr>
<tr>
<td>2</td>
<td>Probably not</td>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>1</td>
<td>No</td>
<td>1</td>
<td>2.3</td>
</tr>
</tbody>
</table>

At first glance, with almost 80% of the survey sample indicating they would use the calculator if given a chance, these results appear to be fairly impressive. However, it is possible that all participants at the workshop might already have had a fairly-high degree of commitment to best-practice environmental management. Consequently, caution should be exercised in generalizing these results to the target user base of all Australian accommodation sector owners/managers. It is anticipated that a follow-up survey, to be conducted concurrently with the implementation of the online version of the calculator, might provide a better indication of perceived usefulness.

The second part of model validation (establishing that systems outputs are accurate) was accomplished mostly through desk-checking.

For Stages 1 and 2, this was a fairly trivial exercise. i.e. calculating potential savings and ROI is largely a deterministic process and outputs are primarily a function of energy, water and waste costs and usage, plus the costs involved in implementing the environmental management initiatives targeted in Stage 2. It was easy enough to determine all of these¹³, so accuracy was established simply by independently replicating system calculations within Excel and comparing results. Consequently, we are reasonably confident that the functionality of our Stage 1 and 2 components is correct – at least, in a ‘partial system correctness’ sense¹⁴ (Boehm, 1981).

With regard to Stage 3, SD models are notoriously difficult to validate (Richardson and Pugh, 1981). As noted by Forrester and Senge (1980: 209-210), there is no single test which might be employed to validate an SD model but, rather, confidence in the model accumulates gradually as it passes more tests and as new points of correspondence between the model and empirical reality are identified.

Essentially, the aim of validation is to “show that there is nothing in the model that is not in the real system and nothing significant in the real system that is not in the model” (Maani and Cavana, 2000: 69). An excellent example of how much of this can be accomplished through desk checking has been provided by Georgantzas (2003) where statistical measures, such as coefficient of determination and Theil’s inequality statistics (TIS) (Theil, 1966), were employed to compare the predictive results of an SD model focused on various key measures of the performance of Cyprus hotels against actual data (over a 40 year period). Similarly, it is our intention to subject our model to similar tests, concentrating on measures for

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¹³ For the three climatic zones into which GG divides the Australian continent.

¹⁴ Briefly, in software engineering, an algorithm is considered to be ‘partially correct’ if it produces correct outputs for all inputs and execution paths. It is ‘totally correct’ if it is partially correct and does the job for which it is intended.
ENVIRONMENTAL INITIATIVE ROI

which data is readily available (such as guest nights and local employment). At the time of writing this paper, however, this phase of our research was still outstanding.

CONCLUSION

The essential aim of this research project was to construct a DSS that can be used to allow tourism accommodation enterprises to calculate economic ROI from environmental and social initiatives they might consider undertaking. Secondary aims were to use the DSS as a business attractor for the project’s sponsor (GG) and to promote that organization’s programs. The system was to be evaluated against: i) its usefulness; and ii) the extent to which it correctly models the tourism accommodation enterprise within the wider tourism system.

With regard to the second of these evaluation criteria, standard software engineering system testing techniques (Boehm, 1981) were employed to establish that, for parameters where data was readily available, simulation outputs matched this real-world ‘model’ – at least inssofar as economic and (some) environmental variables are concerned. Establishing that social dimension parameters (e.g. goodwill) are simulated accurately is more difficult and this will require a survey of the type suggested by Fredline at al. (2005).

Determining the system’s usefulness is also a fairly problematic exercise but a survey was used to confirm that, within limits, intended users do indeed consider that the system will be of benefit to them. Again, additional surveys will be required to clarify the extent to which this holds and this research will be undertaken as additional components (and versions) are deployed.

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