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## ICT – AN INNOVATIVE APPROACH TO SUSTAINABLE TOURISM DEVELOPMENT

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### ABSTRACT

*This research develops the proposition that Information and Communication Technology (ICT) can offer an innovative approach to sustainable tourism development. ICT applications can play a critical role in managing the impacts of tourism and destination managers, amongst other key stakeholders, will find this research useful in helping to translate the theory of sustainable tourism into a workable reality for their destinations. This paper discusses and presents a conceptual version of the modified the Abernathy & Clark (1985) model in exploring and developing a new research domain of ICT and sustainable tourism development. A wide-ranging collection of ICT-based tools/applications is identified which can be used for the diverse aspects of the sustainable development of tourism.*

**Keywords:** *Computer-based sustainability, eTourism; Information and Communication Technology (ICT); Innovation; Sustainable Tourism Development.*

### Introduction

Engaging in innovative behaviours is critical to any industry seeking to achieve its potential and tourism is no exception to this. Hall & Williams (2008) commented that tourism can be a commanding force for driving and transmitting innovation, yet the tourism industry is noted for paying insufficient attention to innovation (Liburd, 2005; Hjalager, 2002). Moreover, research in tourism innovation is limited, sparse and fragmented (Hjalager, 2005) but with a growing body of knowledge (see Hall & Williams, 2008; Hjalager, 2005; 2002; 1997; Ritchie & Crouch, 2003). However, a research gap still exists in demonstrating the significance of how tourism innovation can be carried out in practice (Hjalager, 2002).

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In recent years, a very significant driver of tourism innovation has been information and communication technology (ICT). Technology is already regarded as being critical for tourism (Buhalis, 2003), since it not only drives economic growth but it can also ensure the long-term prosperity of the industry (Liburd, 2005). Moreover, there is indeed a link between ICT and innovation facilitation where, for instance, seventy-eight percent (78%) of European tourism companies identified the critical link between ICT and innovation (European Commission, 2006). Using ICT to innovate may not only be beneficial but is in fact essential to the long-run prosperity of the tourism industry.

The exploitation of ICT in tourism has focused mainly on consumer and demand dimensions, technological innovations and industry functions (Buhalis & Law, 2008). There are still other areas in tourism where ICT can be used, with sustainable tourism development (STD) being such an avenue. The application of ICT to STD will not only expand the eTourism research domain beyond, for example, the heavily researched areas of web based marketing and distribution (Frew, 2000), but it may further stimulate innovation in the tourism industry. Miller & Twining-Ward (2005) identified innovation as being important and appealing to organisations engaged in sustainable activities with Stamboulis & Skayannis (2003) agreeing that the impacts caused by tourism can be a major motivating force for innovation in the tourism industry. Tourism researchers have, however, placed little emphasis on the application of ICT as an innovative approach to STD for destinations.

The economic gains attributed to tourism have led the debate on its growth as an industry (Page & Connell, 2006), however this development has produced detrimental environmental and socio-cultural impacts, some of which are irreversible. In seeking to address these issues, the tourism industry has applied the concept of sustainable development to tourism policy and planning i.e. STD (Choi & Sirakaya, 2006). For the purpose of this paper, STD will be viewed as a positive, comprehensive and integrated approach to tourism development, which involves resource management and working together with stakeholders for the long-term viability and quality of the social, economic and environmental resources (Miller & Twining-Ward, 2005). It is a moving goal which changes as the tourism system changes and which all destinations must aspire to achieve (Lee, 2001; Swarbrooke, 1999).

Striking a balance between economic growth and protection of the natural and socio-cultural environments has proven to be difficult, and to date there is no agreed approach as to how destinations should develop their tourism industry in a sustainable manner (Ali & Frew, 2008). Numerous destinations are still struggling to achieve sustainability (Sheldon, Knox, & Lowry, 2005) and many of the efforts to realise the benefits of STD have been identified as having a “lack of quality, technical content, reliability, maturity, equity and effectiveness” (van der Duim & van Marwijk, 2006, p. 449). Even the alternative forms of tourism (green tourism, soft tourism, responsible tourism, niche tourism, and eco-tourism) have not yet proven successful in this respect (Liu, 2003). The increasing pressures of climate change for the tourism industry (Becken & Hay, 2007) will no doubt intensify these already present problems. The preparedness of destinations for these environmental threats will be a critical factor for the continued prosperity of the industry. Therefore, the industry has to develop more innovative and beneficial solutions to limit the levels of environmental degradation to destinations and to reap the positive rewards of tourism. The most radical solution that can be proposed is to reduce the future growth of tourism by decreasing the amount of travel (air, rail, bus, coach) that occurs. However, this solution is neither feasible nor beneficial to anyone.

Dearing (2000) argued that sustainable development must be treated as a framework for innovation, and management principles must be used and extended for this framework to be operational and effective. He also discussed that the use of better technologies will make sustainable development a reality. The same can be said for STD which must be viewed in light of its relationship with sustainable development (Sheldon et al., 2005). STD can be seen as a framework for innovating in tourism and using ICT as a new and innovative approach will extend the theories of innovation in order to make STD a more workable reality for destinations.

Researchers in different fields of tourism must occasionally question the current ways of thinking and doing things and seek out more radical concepts, methods and practical solutions to revitalise the industry. Innovations in STD would require changes being made to the existing tools and mechanisms that are used for managing the sustainability of destinations. For tourism to be sustainable in the long-run, significant re-evaluation of the current STD practices, new approaches and management techniques are required (Saarinen, 2006; Gezici, 2005; Swarbrooke,

1999). It is time for new and innovative methods to be introduced for tackling the problems of STD and ICT may be the practical mechanism that assists in translating the theory of STD into action.

## **Purpose**

The motivation for this research grew from the realisation that undertaking work in the domain of ICT and STD can be invaluable for destination managers, amongst other key stakeholders, in tourism, as they strive to ensure their destinations are sustainable. On a daily basis, destination managers encounter numerous challenges, problems and decisions related to sustainability concerns in developing their destinations and need to be equipped with practical tools/mechanisms. Most of the research on STD has focused on theorising and policy formulation with challenges still existing on finding viable ways of translating this emergent theory into practical actions for tourism professionals. Therefore the aims of this paper are:

- to conceptualise ICT as innovative approach to sustainable tourism development
- to propose a modified version of the Abernathy and Clarke (1985) model in understanding and developing ICT as an innovative approach to sustainable tourism
- to demonstrate the ICT-based tools/applications which can be used for managing the sustainable tourism developments of destinations
- to identify new areas of research in progressing this body of research

There are some specific benefits of undertaking research in this domain. It recognises the immense potential of the usefulness of ICT-based tools/applications as a new and innovative approach for lessening some of tourism's negative impacts. A wide-ranging collection of ICT-based tools/applications which can be used to manage different aspects of sustainable tourism is identified and ICT is now added to range of options destination managers can avail themselves of when dealing with different aspects of sustainable tourism development. Moreover, it facilitates better decision making and enhances the communication between the different tourism stakeholders by bringing together different views and perspectives, all with the aim of making tourism more sustainable.

Ali & Frew (2008) proposed an emergent framework for the application of ICT to STD by discussing the following four stages: tourism as a complex, adaptive system, current approaches to managing STD, existing opportunities for using ICT-based tools/applications and ICT as an innovative approach to STD. This paper will be focusing on the last step of this emergent framework by exploring it in greater detail. Hjalager (2002) observed that classical innovation theories have much to offer tourism and to date there has been little research on their applications. This research therefore considers the use of the Abernathy & Clark (1985) model and its usefulness in the application of ICT as being innovative in managing STD. Innovation is the first step in the diffusion process (Agarwal, 1983) and the discussion will focus on this, and not on ICT usage and adoption and diffusion by tourism organisations for STD and their behaviour. The paper therefore examines some promising perspectives driven by both an ambitious and creative research agenda to combine STD and ICT.

This research will be developed from the perspective of DMOs and destination managers but it can benefit other stakeholders who have an interest in seeing destinations develop in a sustainable fashion. Destination managers are identified as the person(s) responsible for the overall management of a destination management organisation (DMO) where a DMO is defined as the organisation in charge of the holistic management of the tourism destination and can fall under one of the following categories:

- Continental DMO responsible for the management of tourism in a continent defined for that purpose.
- Regional DMO also known as Regional Tourism Organisations, responsible for the management of tourism in a geographic region defined for that purpose.
- National DMO also known as National Tourism Organisations, responsible for management of tourism of a country.
- Local DMO, responsible for the management of tourism based on a smaller geographic area or city/town.
- Local attraction DMO responsible for the management of tourism based on an attraction or local feature of a geographic area or city/town.

More specifically, DMOs were selected for this investigation since they are established with the main purpose of managing tourism development of

a particular destination and are the primary body responsible for sustainable tourism development in the area. Additionally, they adopt an integrated and holistic approach in managing the destination and represent the interests of all the major stakeholders in tourism development of that destination.

The researcher does understand that destinations exist which are not managed by a DMO as identified above. These destinations may be managed by a government Ministry, part of this Ministry, a local body, a private entity, a public-private partnership or some other type of management arrangement. The person(s) charged with the responsibility of managing these entities can indeed be identified as destination managers. Therefore, different classifications of destination managers do exist outside of the sphere of a DMO. Additionally, other agencies besides the DMO such as environmental agencies may be responsible for managing the sustainable tourism development of a destination. It may well be that local businesses at the destinations are responsible for managing their aspects of STD. However, to progress the research in both eTourism and sustainable tourism and to develop practical solutions setting boundaries are necessary. Those which are set too large can result in problems due to the diversity and complexity of issues involved whereas narrow boundaries do not permit all the necessary elements to be included; for a sound analysis to occur (Lee 2001). For this research to be realistic and meaningful, investigating ICT and its innovative application to sustainable tourism will be considered from the viewpoint of destination managers.

### **Opportunities for using ICT as an Innovative Approach to Sustainable Tourism**

In researching ICT as an innovative approach for STD, the authors were unable to locate in the literature any such existing approach to innovation, any sort of classification or any comprehensive research covering this topic. Moreover, they could not locate any examples of destinations using ICT for STD in previously published work. Table 1 presents a wide array of ICT-based tools/applications and the opportunities for using these applications in STD. These opportunities are information management, tourist satisfaction; interpretation, enabling partnerships, community participation and energy consumption and each will be discussed subsequently.

At the heart of STD lies the process of decision-making which is focused on the best allocation of resources in a limited period of time

that satisfies all stakeholders involved. If a destination manager has sound methods of monitoring and analysing environmental data (El-Gayar & Fritz, 2006), the routes tourists use, the frequency of use and timings and how tourists account for time, space and place (Lew & McKercher, 2005), they can better support planning to ensure tourism is more sustainable for destinations. ICT can help in this process by facilitating better information management to support operational, tactical and strategic decision making to assist in the various aspects of tourism planning such as identifying suitable areas for development, monitoring economic impacts and obtaining views of the host community in the tourism development process.

One of the most important determining elements of satisfaction is receiving accurate and comprehensive tourist information (Buhalis & O'Connor, 2006). ICT can assist by providing accurate and timely information to the tourists, when and where they need it, through the use of ICT. Interpretation too plays an important role in STD (Moscardo, 1998). ICT can play a role in informing tourists about the importance of a destination. This will facilitate so they have better enjoyment of it, with the ultimate aim of creating a positive tourist attitude towards conservation, preservation, history, culture and landscape (Mason, 2005). Involving different stakeholders in tourism planning is now being seen as an essential (Bramwell & Lane, 2000). ICT enables stakeholders at the destination to become more efficient in their communication strategies and it supports greater cooperation in the delivery of the tourism products and services (Buhalis & O'Connor, 2006). Community involvement in tourism planning and decision making can be important for allowing the host population more control in tourism development decisions (Mowforth & Munt, 1998). ICT can be used to facilitate communities becoming more involved in the tourism decision making process through the use of such tools such as community informatics and geographical information systems. Energy usage has become a major concern for tourism especially with increasing attention being given to the climate change agenda. The tourism industry requires large amounts of energy for transportation to, from and at the destination, as well as providing the facilities and services required at the destination (Becken, 2002). Managing the uses and impacts of energy is beyond a destination manager's control (Kelly & Williams, 2007), however, there are still some ICT-based tools that they can adopt to enhance their destinations such as Virtual Tourism, Intelligent Transport System and Carbon Calculators.

## **Defining Innovation**

The concept of innovation is broad in scope since it can be classified in numerous ways (Hall & Williams, 2008). Much of the research on innovation stemmed from Schumpeter's (1939; 1942) research which is grounded in economic theory and emphasised that innovations were at the heart of competition (Hall & Williams, 2008). Following in Schumpeter's "creative destruction" footsteps, innovation is frequently placed on a continuum between invention and adoption with the existing literature categorising innovations based on a firm's capabilities (Volo, 2005; Singh, Chhatwal, Yahyabhoy, & Heng, 2002). Inventions are however different from innovations. The first happening of an idea is an invention whereas an innovation is the foremost effort to carry out this invention in practice i.e. invention is the new breakthrough whilst innovation is the new value. The core understanding behind an innovation is that the idea has to be developed and merged into a product, process or service for particular industry uses. Therefore innovation is not a one off happening but rather a long and cumulative process (Singh et al., 2002). Moreover, one of the problem areas in defining innovation is the understanding of the term "newness" (Hjalager, 2002). Sundbo (1998) observed that an innovation does not have to be new, but rather only new to the market segment or industry. This thinking will be adopted for this research since the application of ICT is not new to tourism but it will be new for its uses for STD.

According to Kanter (1983) innovations changes a problem-solving idea into an application. Innovation can exist in a variety of forms but share three main elements – creativity, a problem solving approach and a new way of thinking (Moscardo, 2008). De Bono (1998) the leading scholar on creative thinking observed that all thinking techniques are connected by challenging the existing assumptions and looking at the situation from a different perspective. Based on this, Moscardo (2008) argued that being innovative involves varying degrees of creativity. It must be noted that being creative is a necessary but not sufficient factor for facilitating innovation (Carayannis & Gonzalez, 2003). Rather it is the ability to develop novel ideas that are useful for solving problems and satisfying needs and is therefore "a goal-oriented process that generates innovations" (Hall & Williams, 2008, p. 83). This is at the core of this paper which looks at the solutions to tourism's negative impacts by approaching STD from an alternative viewpoint. In looking at ICT

applicability to STD, this approach will be seen as a new and innovative one for the tourism industry i.e. a problem solving idea that transforms STD into a practical concept.

Perdomo-Ortiz, González-Benito, & Galende (2006, p. 1172) provides an analysis of innovation and defined innovation as a “dynamic capability” which is a pattern of collective activity whereby an organisation changes how it operates in order to improve its effectiveness. This definition will be used for this research since it demonstrates that all forms of innovation are based on new ways of thinking associated with creative thinking techniques (Moscardo, 2008). This definition is also relevant since the application of ICT for STD will come from the organisations responsible for the management and development of tourism at the destination – the DMO. Being innovative in STD requires management which supports strategy formulation, dissemination of new techniques and implementation. The DMOs can also bring together the creativity and problem solving expertise to generate the innovations and monitor changes at the destination (Krozer & Redzepovic, 2006). Therefore DMOs will change their current operations in how STD is managed and display their dynamic capability by bringing forth a process of change which is innovative for the STD of the destination through the use of ICT.

### **Classification and Innovation Theories**

Innovation is a process to classify and the output of this process results in a classification, which serves as a framework for ordering and representing (Coccia, 2006). There are two main approaches to constructing such a classification: empirical and theoretical (Coccia, 2006). The former approach involves using collected data that is analysed to produce the classification. The latter approach involves using existing theory to develop a classification where the topic under investigation is placed in this classification. This paper will adopt a theoretical approach but will discuss empirical work to be undertaken to support this theoretical approach.

Various classifications of innovation exist in the literature from different disciplines. In Schumpeter’s (1939) term, innovation is aligned to new goods, new quality products, new methods of production, new markets or marketing and new organisation or management. Most of the classifications of innovation are modelled after Schumpeter’s research and Table 2 provides a listing of some of the more common classifications in

the literature. The classification of innovations identified emerged from the theories of innovation which are depicted in Table 3. With regards to STD, Hjalager (1997) developed an analytical typology for innovation by providing classifying it as product innovation, classical process innovation, process innovations in information handling, management innovation and institutional innovation.

Product innovation consists of changing, combining or introducing a new tourism product or service, where the novelty of this is more attractive to the tourists. Examples of product innovation in tourism are nature tourism, organic farming and volunteering tourism. With regards to ICT for STD, a product innovation would be the development of different types of ICT for use by various individuals and groups. One such example is Location Based Services (LBS) defined in Table 1. LBS can lead to STD by promoting greater tourist satisfaction. This offers the DMO an opportunity to become more customer focused and flexible in their information and service delivery, which is essential in tourism becoming more responsive to the tourists' needs (Buhalis & O'Connor, 2006). LBS can be used to provide real-time and correct information to the tourists whilst they are on their trip, facilitate in reducing potential risks by providing easy and quick access to information on services such as hospitals and policing and alert the tourist of any activity whilst on their vacation, and be used for transactions and tele-banking (Flouri & Buhalis, 2004). The environmental quality of a destination can also be improved by using LBS since this leads to more sustainable production with less paper and energy being used to produce maps and brochures. Liburd (2005) discussed these devices can also lead to sustainable consumption by allowing the tourist to make better decisions on what products to purchase and which companies to support whilst they are at the destination.

Process innovation refers to raising the performance level through the redesign of the production and delivery systems with the aim of achieving savings in production inputs such as labour (Hjalager, 1997). Examples of these in tourism are computerised management and monitoring systems and self check-in/check-out machines. With regards to the application of ICT to STD, an example of a process innovation would be a Destination Management System (DMS) as identified in Table 1). By serving as an "information diffusion mechanism" (Buhalis, 1997, p. 84), a DMS can contribute to the STD by fostering new tools for managing the valued

resources (natural, economic and social-cultural) of a destination (Buhalis, 1999). A DMS can lead to economic benefits by efficiently managing the resource inventory of a destination, providing managerial aid for small business and supporting the tourist experience before, during and after the visit. The socio-cultural benefits can be improved by disseminating information to the tourists on culture, customs, history and other needed elements that fosters an understanding between the tourist and the host community. This DMS can also highlight the fragile eco-systems and resources of a destination. Process innovation is therefore achieved through improvements of the DMS which leads to savings in the production inputs required to monitor, market and promote the destination.

Process innovation for information handling refers to using ICT for managing information. ICT will play an invaluable role in STD through the efficient management and monitoring of environmental information and issues for better performance and a higher quality destination. An example of such an application is an Environmental Management Information System (EMIS) (please see Table 1 for a definition). An EMIS coordinates information about environmental issues such as tracking waste, monitoring emissions, scheduling tasks, coordinating permits and documentation, conducting cost/benefit analysis, and choosing among alternative materials (Moore & Bordeleau, 2001). This allows the decision maker to analyse the information in a more appropriate fashion since it is focused on the effective and efficient collection of performance data to sustain performance measurement and process improvement as well as providing cross-organisation integration of environmental data (El-Gayar & Fritz, 2006). DMOs can use an EMIS to obtain the answers to many questions which would have been difficult before due to the incompatibility, diversity and volume of information available. An example of an EMIS in action for tourism is Xanterra Parks & Resorts Ecometrix System (Xanterra Parks & Resorts, 2008). This computerised system monitors consumption of electricity, natural gas, gasoline, diesel, propane, fuel, oil water, generation of solid waste recycled materials, hazardous materials, recycled hazardous materials, sustainable cuisine and green house gas emissions.

Management innovation refers to new management procedures which change the existing authority systems, creating new jobs and collaborative structures and staff empowerment (Liburd, 2005). By using ICT for STD, new roles in DMOs will need to be defined since these tools/mechanisms

will assist them in better management of the destination, using information more appropriately, and having greater stakeholder involvement. Lastly, institutional innovation lies beyond the individual enterprises as collaborative processes or regulatory structures that transect the public and private sectors. This type of innovation is more wide-ranging than those discussed prior since institutions not only exist in a physical state, but are also habits and customs and provide some type of framework within which people can interact (Hjalager, 1997). The tourism system will have to be managed by an institution that is located beyond the scope of individual businesses and organizations (Hjalager, 1997). The use of ICT for STD can stimulate this type of innovation by fostering better partnerships with stakeholders by use of the Internet and engaging in dialogue with the community by using community informatics (CI) as identified in Table 1. By using e-mail, bulletin boards and community networks based on the Internet, community participation and development will be strengthened (Milne, Speidel, Goodman, & Clark, 2005).

**Table 1**

Illustrative Uses of ICT-based Tools/Applications for Sustainable Tourism

<b>ICT tools/ applications</b>	<b>Definition</b>	<b>Opportunity</b>
Carbon Calculator	Used to determine carbon emissions based on the type and amount of energy consumed. The result of this calculation is known as the carbon footprint	Energy Consumption
Community Informatics	An ICT-based tool/application focused on the design and delivery of technological applications for enhancing community participation and development through the use of e-mail, bulleting boards and networks all based on the Internet.	Community participation
Computer Simulation	A simulation of real world settings where models are designed to depict how a system operates over time	Information management Community participation
Destination Management System	A system that consolidates and distributes a comprehensive range of tourism products through a variety of channels and platforms	Information management Tourist satisfaction Enabling partnerships

Economic Impact Analysis Software	Software used to monitor the economic impacts of tourism by providing information on the type and amount of spending	Information management
Environment Management Information Systems	A combination of computer hardware, software, and professional services that integrates disparate information about environmental issues in order to manage the environmental function within an organisation. EMIS systematically gathers, analyses and reports business information related to environmental management such as waste tracking and emissions monitoring. This allows a company to track, refine, and improve its environmental management practice.	Information management
Energy consumption Geographical Information Systems	An information system that can capture, store, manage, manipulate, analyse, integrate and display large amounts of geographical data	Information management Community participation
Global Positioning System	Satellite-based navigation system that provides positioning, navigation and timing services to users in any weather conditions around the world 24 hours a day	Information management
Intelligent Transport System	Telematic systems which provide detailed information on traffic, information from independent locations, traffic guidance and dynamic routing	Tourist satisfaction Energy consumption
Location Based Services	An ICT- based tool/application that can collect and deliver information to and from a mobile device depending on the automatic location of the user. The aim of a LBS is to provide targeted information to the user based on his/her geographic location. Such information include but is not limited to places to visit, eat and stay as well as emergency and health services	Tourist satisfaction Interpretation

Tourism Information System	Data warehouses that manage business critical information in order to provide quality information on hand to assist in decision making by serving as a decision support system for destination managers	Information management
Virtual Tourism	An ICT-based tool/application based on the Internet where anyone can experience the culture, history and other points of tourist interests in a visual and interactive manner without actually visiting the destination. An example of this include on-line guided tours of museums and heritage sites where the visitor can experience the destination without actually visiting the destination	Energy consumption
Weather, Climate and Ocean Change Forecasting Software	Software used to monitor changes in the weather, climate and ocean	Information management

### ICT, Sustainable Tourism Development, Innovation and the Abernathy & Clark (1985) Model

The Abernathy & Clark (1985) model analysed innovation and the various roles this plays in competition. According to this model, innovation was classified according to two dimensions, market knowledge and technological capabilities of the firm, by distinguishing between the preservation and destruction of this knowledge after an innovation has occurred and the capability of the firm needed for producing the product or service as a result of this innovation. Based on this model, the technological capabilities of a firm can become archaic, but the firm can still maintain its market capabilities and use this to its advantage to deal with competing, newer firms in the market. Combining market knowledge and technological capabilities leads to four kinds of innovation: regular, niche, revolutionary and architectural as seen in Figure 1.

From the model, architectural innovation defines the architecture of the industry. It is broad based and involves changes not only to the industry but also the community in which it would be used (Hjalager, 2002). It is both a radical technological and market innovation (Singh

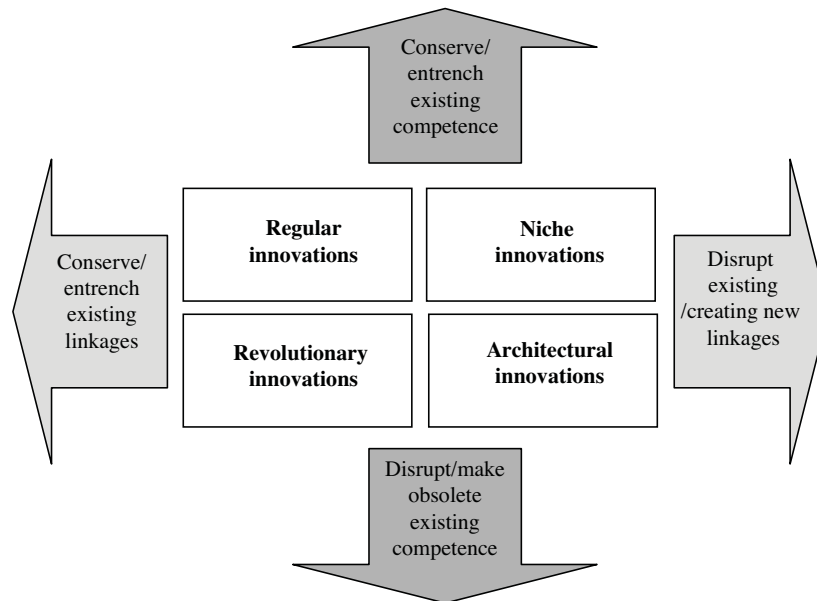


Figure 1. Abernathy and Clark Model (1985)

et al., 2002). Regular innovations are those that appear almost invisible but whose cumulative impact over time can be substantial i.e. conserves the manufacturer's existing technological and market capabilities (Abernathy & Clark, 1985; Hjalager, 2002; Singh et al., 2002). This type of innovation strengthens the existing competence. Niche innovations are those which are focused on strengthening the established structures but not the existing competences i.e. it enhances technological capabilities but obsolesces market capabilities (Hjalager, 2002; Singh et al., 2002; Abernathy & Clark, 1985). Lastly, revolutionary innovations are those which can have a disruptive effect on competences and causes radical consequences with structures remaining unchanged (Hjalager, 2002; Abernathy & Clark, 1985).

The benefit of this model is that it demonstrates the importance of the market capabilities of a firm since businesses having well established markets and/or technological capabilities will tend to take advantage of regular, revolutionary and niche innovations. New market entrants will tend to exploit architectural innovations and niche innovations to a lesser extent. It also shows that innovation is not a unified phenomenon but rather they disrupt, destroy and make obsolete an existing firm's competences while others refine and improve. The model also identified

that different kinds of innovation require different kinds of organisational environments and managerial skills.

In discussing tourism innovation in the realm of several conceptual frameworks Hjalager (2002) used the Abernathy & Clark (1985) approach to provide examples of innovation of the types of innovation discussed above for the tourism industry. For this research the model will not only demonstrate how ICT will be innovative for STD but it will also seek to identify some of the ICT-based tools/applications which can be used to accomplish this innovation.

**Table 2**  
Innovation Classification

Categorisations	Existing Models
Octa	Reformulated, new parts, re-merchandising, new improvements, new products, new users, new market, new customers (Johnson and Jones, 1957)
Penta	Systematic, major, minor, incremental, unrecorded (Freeman, 1994)
Tetra	Incremental, modular, architectural, radical (Henderson and Clark, 1990)
	Niche creation, architectural, regular, revolutionary (Abernathy and Clark, 1985)
	Incremental, evolutionary market, evolutionary technical, radical (Moriarty and Kosnik, 1990)
	Incremental, market breakthrough, technological breakthrough, radical (Chandy and Tellis, 2000)
	Incremental, architectural, fusion, breakthrough (Tidd, 1995; Tidd et al, 2001)
Triadic	Low, moderate, high innovativeness (Kleinschmidt and Cooper, 1991)
	Incremental, new generation, radically new (Wheelwright and Clark, 1992)
Dichotomous	Discontinuous, continuous (Anderson and Tushman, 1990; Robertson, 1967)
	Instrumental, ultimate (Grossman, 1970)
	Variations, reorientation (Norman, 1971)
	True, adoption (Maidique and Zirger, 1984)

Dichotomous	Original, reformulated (Yoon and Lilien, 1985)
	Innovations, reinnovations (Rothwell and Gardiner, 1988)
	Radical, routine (Meyers and Tucker, 1989)
	Evolutionary, revolutionary (Utterback, 1996)
	Sustaining, disruptive (Christensen, 1997)
	Really new, incremental (Schmidt and Calantone, 1998; Song and Montoya-Weisse, 1998)
	Breakthrough, incremental (Rice et al, 1998)
	Radical, incremental (Balachandra and Friar, 1997; Freeman, 1994).

*Source: Coccia, 2006, p.13*

### ***Selection of this Model***

This model was chosen in comparison to the other models of innovation for this research for several reasons. Firstly, Coccia (2006) stated that in the management of technology, this model provided the most useful classification since it presents a clearer understanding of the nature of particular and well-defined innovations. Moreover, there are numerous ICT-based tools/applications that can be used for STD and this model serves in providing a useful classification for the tourism industry in differing aspects both on a micro and macro level.

Secondly, many of the innovation theories looked at the behaviour of firms, the types of firms that innovate, the firms that generate innovation and the stages they go through in adopting these innovations. This research is focused on the types of innovation rather than the behaviour of firms in the innovating process. The intent is therefore to develop concepts that may prove useful in incorporating ICT in the struggle to make STD more achievable. The reason for this is that there is little knowledge on the use of ICT for STD, the types of ICT based tools/applications that are being used, how they are being used and how they are selected by DMOs for their destinations.

Thirdly, Hjalager (2002) in her analysis of the Abernathy & Clark (1985) model used core competence as the unit of analysis. This measurement of core competencies is more suitable since innovation in tourism is often based on core competencies (Weiermair, 2003). Since all destinations are striving to be competent in managing their sustainability, this model is most appropriate.

Lastly, the use of ICT for STD can be classified under this taxonomy because the dimensions identified by Abernathy & Clark (1985) are appropriate. Regular innovations will exist with ICT-based tools/applications in that their impacts will seem insignificant but over a considerable period of time this impact builds up and play a huge role in sustaining the tourism industry. Regular innovation include new investments in existing technology for STD such as investments in DMS as discussed earlier. Another example include adding a technology aspect to the current methods for managing STD. This can be achieved by using an EMIS (see earlier discussion) to assist with monitoring, if this is a method currently being used for managing STD.

Niche type innovations will be created with the use of ICT for STD by strengthening the existing structures. New opportunities will be realised by using what the destination managers already possess. The same ICT that DMOs are using for other purposes can be used for STD with this ICT being refined, improved or changed in some way to support the new use. One such example is extending the uses of the Internet. DMOs can improve the environmental quality of their destination by placing promotion materials and maps on their websites. This leads to sustainable production with less paper being used to produce promotional materials, and sustainable consumption by the tourists using these websites. Additionally, the Internet can be used as a tool for interpretation by encouraging interaction amongst tourists whereby they can share their experiences on a DMO's website. This is critical to a destination image since it might be these very comments that influences the tourists' destination choice (Staab & Werthner, 2002). DMOs can also use the Internet creatively by providing the tourists with information on ground transport, directions, safety and security, events, eating places, and background information on the destination so that they are aware of the local culture, dress, behaviour, history and geography and how best to experience and learn about the destination prior to their visit. The Internet for STD can also be used for enabling partnership by fostering stakeholder consultation and information transfer. It can be a strategic tool for building and strengthening relationships, networks and communities which can transform the tourism planning process and enhance economic development at the destination level. An example of this is DestiNet (<http://destinet.ewindows.eu.org>), an initiative of the European Environment Agency. The information resource and communications

**Table 3**  
Theories of Innovation

Model	Key Features
Abernathy and Utterback (1978)	Introduced dynamism into the innovation process and the concept of a dominant design. This model examined the processes that occur with firms in an industry during the evolution of technology (Singh et al., 2002) and described three phases in an innovation's life cycle from a firm's perspective – the fluid, transitional and specific phases.
Appropriability and Complementary Assets	Discussed more than technological capabilities were required to make use of an innovation. This model argued that the appropriate innovation and the complementary assets were needed by the firm, both of which were important. It therefore demonstrated that inventors are not always the ones to profit from an innovation.
Chandy and Tellis (1998)	Discussed the extent to which technology involved in a product is new or different from previous technologies and the extent to which the new product satisfies important customer needs better than the existing product.
Disruptive Innovation Theory	Discussed why new entrants to the market have a better chance of succeeding in the market. The reasoning behind this is that established firms in the marketplace have a greater likelihood of winning over the new entrants when the innovation is incremental or radical, whilst the newcomers tend to be more successful if the innovations are disruptive. Disruptive innovations are those which are simple, convenient and low-cost.
Foster "S" Curve (1986)	Foster argued that the rate of technology advancement is a function of the amount of effort put into the technology and this follows the shape of a "S" curve. This model contributes to predicting the end of an existing technology and the introduction of a new one.
Henderson and Clark (1990)	This model defined innovation based on its impact on the components and its impacts on the linkages between components. It argued that categorising innovation as either incremental or radical was incomplete and confusing since the large effects that minor improvements in technological products can have on an industry were not considered. Based on this, innovation was examined from a product development perspective especially the development of a new product by building product demand which resulted in two types of knowledge: architectural and component knowledge. The combination of component and architectural knowledge leads to four kinds of innovation: incremental, radical, architectural and modular. This model provides insights into why established firms have trouble adapting to architectural innovations and why they fail at such types of innovations.

Local Environment Model	Stated that the ability of a firm to innovate is based on the environment in which it operates.
Moore's Chasm Concept (1991)	Based on the Technology Adoption Life Cycle, Moore explained why firms encounter difficulties in "crossing the chasm" from being early adopters to early majority with their products.
Resources, Processes, and Values Theory	Based on the above theory, this model explained why existing companies have difficulties grappling with disruptive innovations whilst newcomers fail at incremental or radical innovations.
Strategic Choice Model	Demonstrated that the strategic choices of a firm are what determined whether the firm exploited an innovation.
Strategic Incentive to Invest	Examined the type of firm that will invest or be the first to take advantage of an innovation based on whether this innovation is incremental or radical.
Strategic Leadership Model	Examined the role of top management in innovation and resolved that a firm's failure or success at adopting innovation is based on its management.
Teece Model (1986)	This model of innovation looked at why innovating firms tend to derive less returns compared to later market entries and innovators. It provided a framework which identified the factors that determined the firms which won from innovation. These were the firms which were first to market, follower firms, or firms that have related capabilities that the innovator needed.
Tushman and Rosenkopf (1992)	Discuss the extent a firm can influence the evolution of an innovation and the dominant design (Mustonen-Ollila & Lyytinen, 2003). This model considered that for a firm, the greater the complexity of an innovation, the greater the chances of it being affected by non-technical factors. Technological progress depends on factors other than those internal to the firm and the more it is under-determined by factors internal to it. It considered innovation from the perspective of the impact on market knowledge and technology. These researchers described market knowledge as being either new or existing technology and was classified as either incremental or radical. Using these two dimensions, innovation was classified into four categories: architectural, incremental, major product or service and major process.
Value-Added Chain Model	Investigated innovation according to the value added chain of suppliers and other innovators in the value chain. The significance of this model is that it explained why some firms tend to fail with incremental innovations but succeed with radical ones.

platform contains quality information on the ways in which tourism is being made more sustainable. It acts as a single European-level gateway to environmental sustainability for the tourism sector, allowing users to understand and report on sector impacts on the environment, learn how to improve tourism sector sustainability, and coordinate information exchange between tourism stakeholders (World Bank, 2006).

Revolutionary innovations will occur when the types of ICT-based tools/applications used for STD have a disruptive effect on the competence of how STD is managed. This is accomplished by transforming the current methods to managing STD, making some of these approaches obsolete and in the long term changing how tourism is overall managed at the destination. An example of a disruptive ICT-based tool/application could be the use of Geographical Information Systems (GIS) as identified in Table 4. GIS development is a full spectrum approach to retrieving information, developing new and existing products, ensuring quality and managing the environment (Raghuvanshi, Belwal, & Solomon, 2007) and if supported, GIS can be a fundamental tool for STD. Bahaire and Elliott-White (1999) and McAdam (1999) concur that GIS will be extremely useful for tourism planning and management because it will be able to assist managers with the decision making process. There have been several studies conducted where GIS has been used for tourism planning and decision making (see Feick and Hall 2000; Boers and Cottrell 2006; Connell and Page 2008). GIS can be applied to a variety of settings such as testing different scenarios to determine what the outcomes might be based on varying variables, auditing of tourism resources and conditions, identification of locations for potential development and modelling outcomes. It can also be used for measurement of geographic, environmental, and socio-economic characteristics of an area which can be used to depict the socio-demographic attributes and identify possible market segments, examine spatial relationship between resource use and distance travelled, find alternative travel routes and identify hidden areas of damage (Lee and Graefe 2004). Tourism is a spatial phenomenon and therefore is aligned to the uses of GIS (Avdimiotis et al. 2006; Boers and Cottrell 2006). It has the capability to bring the necessary information needed by destination managers for decision making on a common stage. If supported, GIS can be a fundamental tool for managing sustainability. This can be a critical decision-support making mechanism to improve the quality and quantity of information that destination managers require to

make decisions regarding the sustainability of their destinations. Chancellor and Cole (2008) commented that GIS will become more widely used in tourism as a decision making tool due to increasing awareness of the benefits for planning and management. According to Lee & Graefe (2004), being GIS illiterate in the next decade would be like someone who does not know how to use e-mail and the Internet today.

Architectural innovation will occur through the use of ICT for STD since it will change the existing ways in which STD is managed. This will open up new market linkages and users and is characteristic of the creation of new industries as well as the reformation of old ones. The use of certain types of ICT-based tools/applications can change the framework of how STD is managed and in effect make the destination more competitive.

No discussion of this approach would be complete without addressing some of the existing criticisms of the Abernathy & Clark (1985) model. The model has been criticised for being too static (Hjalager, 2002). For this approach, this static is overcome by applying it to a dynamic system such as tourism and changing the dimensions from its previous applications to see how it works in a tourism setting. Another criticism is that the model underestimated the extent to which innovation builds on existing technologies. This adapted model will consider this aspect since as mentioned earlier this approach is not looking at developing new technologies but rather seeing what already exists and how these ICT-based tools/applications can be used for STD. No model is flawless and despite the criticisms, this model aids in providing insight in forming a useful framework for addressing ICT as being an innovative approach to STD.

## **Conclusions and Future Work**

Organisations generally and in our context destination-based organisations are being alerted to the fact that if they do not innovate they may cease to exist. No change issue is more vital than sustainability and arguably no economic sector is as sensitive to this as tourism. The authors' premise is that through ICT destination-based organisations may adopt an innovative approach to sustainable development issues. This paper has introduced ICT as a new, innovative approach to managing STD and demonstrated that the Abernathy & Clark (1985) model in progressing research in this domain. Adapted from Ali & Frew (2008),

**Table 4**  
Uses of Geographical Information System for Sustainable Tourism  
Development

GIS Uses	Applications for Sustainable Tourism Development
Data Integration	Produces more informed arguments, compromise and resolution for decision-making by managing, integrating and co-ordinating data from a variety of sources. The Lake District National Park Authority used a GIS to integrate accommodation data from the Cumbria Tourist Board, Population Census and Ordnance Survey to examine how the types of accommodation vary within the quieter and busier central valleys areas of the Lake District (Bahaire & Elliott-White, 1999).
Indicator Identification	Updating of old data as new data becomes available and taking account of changing demand over time (Avdimiotis, Mavrodontis, Dermetzopoulos, & Riavoglou, 2006).
Resource Inventory	Used to map and report about an area selected for development (Lee & Graefe, 2004). It assists in determining problematic areas and provides stakeholders with the types of information required to assert their point of view (Bahaire & Elliott-White, 1999). A landscape and resource inventory was developed in the Badenoch and Strathspey District in Scotland (Bahaire & Elliott-White, 1999).
Suitability Analysis	Provides guidance in identifying suitable locations for tourism development, location of surrounding communities, right to the land in the area, accessibility to the proposed site, areas that require protection, identify utilities and highlight how the land is changing over time.
Visual Impact Analysis	Three-dimensional visualisations of areas can be produced before and after proposed developments which aids in the evaluation of proposals, alternatives and the degree of virtual intrusiveness (Bahaire & Elliott-White, 1999).
Community Participation	Serves as a structured framework to assist the socio-cultural aspects of STD by enhancing public consultation and community participation process by use of different types of data such as video, sound, three dimensional images and large scale maps to give the community more information and hence foster better decision making. (Bahaire & Elliott-White, 1999; Hasse and Milne, 2005; Avdimiotis et al., 2006).

future research efforts in the ICT-STD domain should focus on investigating the particular uses of these identified tools in Table 1 as well as identifying other potential ICT-based tools/applications for STD. The results of these findings will lead to refinement of the model presented in Figure 2 and will describe, categorise, and show how this wide-ranging list can be used for different perspectives of the industry and how it will be an innovative approach. Developing from this, another area of research could focus on tracing the history of these ICT-based tools/and and documenting their uses in the tourism industry. There has been a lot of research on GIS in the tourism literature but researchers need to start focusing on the other tools and their benefits for destination management such as Carbon Calculators, Community Informatics, Computer Simulation and Environment Management Information System.

More research is required in looking at the opportunities for using ICT for sustainable tourism. Climate change and transport are currently “hot” topics and areas where ICT can have a valuable contribution to lessening tourism’s negative impacts and research efforts can be concentrated in these areas. Other potential areas of research for the application of ICT to sustainable tourism are sustainable production, energy management, water availability and consumption, and wastewater management. No mention was made of these in the analysed literature. This research sought to look at the uses and applications of ICT from the perspective of DMOs. A further area of research would be to look at the application of ICT from the perspective of the individual tourism businesses at the destination. Different categorisation of tourism businesses can be identified such as accommodation, airlines and cruise lines. The accommodation sector can be further broken down into different classifications. The consumer perspective and their motivations to visit a destination engaging with technology for assisting the destination to become more sustainable can be considered. It might also be worthwhile to explore how consumers make use of the Internet in promotion of the principles for sustainable tourism development.

Moreover, for this approach to be innovative, decision makers not only need to know the ICT-based tools/applications which can be used for STD, but also need to know what ICT-based tools/applications are available and how best to make use of them for their particular needs (Fache, 2000). Decision-makers would be offered no practical benefit if they were only to be made aware of these tools and rather a systematic

framework is essential in helping destinations select the best ICT-based tools/applications for them based on their particular needs relating to tourism development. Therefore, further exploration is warranted in taking forward this avenue and ultimately perhaps providing an expert-system to aid decision-making. The authors hope that the research presented here painted a representative landscape of the current research of ICT and STD, and has helped to lay the foundation for future research efforts to enhance this body of knowledge and the theoretical and practical progression of ICT and STD.

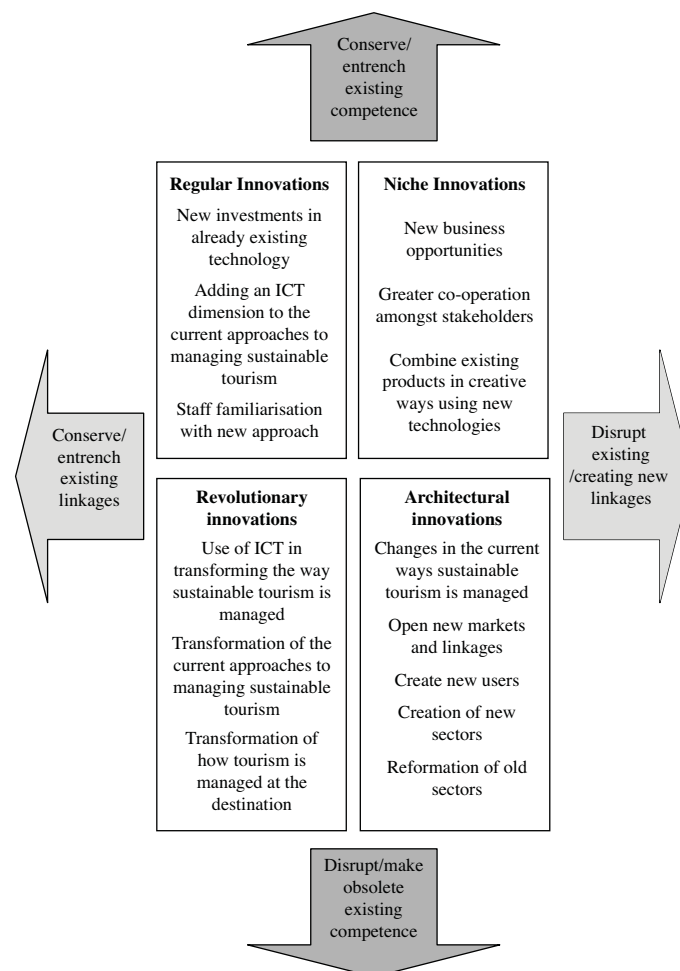


Figure 2. Innovation, ICT and Sustainable Tourism Development – A Modified Abernathy and Clark (1985) Model

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