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**HOW DO FIRMS ORGANIZE FOR SUSTAINABLE ENERGY CONSUMPTION? AN
INVESTIGATION OF THE MALTESE HOTEL SECTOR**

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ABSTRACT: The aim of the paper is to investigate the capabilities of firms in a mature service sector to adopt innovative sustainable energy technologies and practices and the processes through which these firms obtain and exploit knowledge about energy management practices. The hotel sector in Malta is used as the empirical setting. Interviews were undertaken with 26 hotel managers and 14 engineering consulting firms in Malta. The interview data from the hotels were clustered to derive patterns of environmental action characterized by particular firm capabilities. The findings distinguish between hotels that adopt a narrow range of energy efficient measures and those with a higher innovative potential that modify routine maintenance activities and make deeper organizational changes to shift towards improved energy efficiency. Accounting for the range of innovative potential are different combinations of capabilities for problem-solving around energy efficiency and for collaborating with external actors (engineering consulting firms in this study). The paper concludes by providing some implications for policy.

Keywords: firm capabilities, energy efficiency, services innovation

1 INTRODUCTION

The increased volatility of oil prices and pressures to reduce carbon dioxide emissions are calling businesses to reduce the impact of their operations on the environment. However, businesses often face difficulties in meeting up to these environmental challenges and integrating sustainable energy technologies in their business operations. Amongst the most commonly cited barriers are the cost of technology implementation, limited technical knowledge, market penetration barriers, and consumer perception and willingness to adopt such measures [1]; [2]; [3]; [4]. Despite the extensive literature addressing barriers to adoption, there has been less research attention to those internal factors that characterize a firm's ability to take environmental action [5].

In this regard, there is a strong potential to integrate more sustainable energy consumption practices and concepts in the maintenance and operations of a business organisation [6]. Such practices may involve the adoption of innovative technologies that lead to improved efficiency in energy consumption as well as organisational measures such as new management practices, processes and techniques that may result in a

reduced impact on resource use. Therefore sustainable energy consumption encompasses the concept of 'efficiency' in relation to resource use, apart from ecological and social elements [7].

This paper discusses innovative processes taking place in the operations and maintenance activities of Maltese hotels and how these may lead to more sustainable energy consumption. In particular, it focusses on those capabilities that firms leverage in order to integrate energy efficiency measures and other innovative energy technologies in routine operations with the scope of improving the energy consumption profile of the firm. Amongst these, are capabilities to appropriate knowledge about energy efficient and renewable energy technologies from external sources. By connecting firm capabilities with particular strategies for innovation, the paper identifies different patterns of how firms reduce energy consumption and improve their operational effectiveness with one outcome being an improved environmental performance.

The paper is structured as follows. The next section gives an overview of energy efficiency performance in hotels; and then provides a review of the relevant literature on innovation and capabilities to adopt environmental practices. This is followed by a description of the methods used to

collect data about capabilities for innovation in Maltese hotels. The data is principally qualitative sourced through interviews with the operations managers and general managers of a sample of Maltese hotels and with engineering consulting firms. The conclusion provides some implications for managers and for policy-makers.

2 THEORETICAL UNDERPINNINGS

2.1 Energy Consumption in Hotel Establishments

After staff, energy consumption takes up the largest proportion of hotel running costs [8]. About 40% of this energy consumption is electricity, of which 45 % goes for lighting, 26 % for heating, ventilation and air-conditioning (HVAC), 6 % for water-heating, 5 % for food services and 18% for other activities, such as laundry, back office administration etc. [9]. These trends in energy consumption typically take into account the energy directly consumed to run the establishment and exclude other services such as airport shuttling services or transport of goods or waste to and from the hotel [10].

Mapping energy use by accommodation type is not an easy task; the available data is highly aggregated and its accuracy is debatable because of different methodologies employed to measure energy consumption and energy performance. Whichever methodology is used, a high variability in the data is inevitable because of the inherent variability in the characteristics of the establishments related to intrinsic factors such as size, occupancy level, facilities and extrinsic factors such as prevailing weather conditions [11]. Another consideration is the hotel star ratings. Generally 3-star hotels have the requirement to provide central heating and cooling in the lobby area only and in the guest bedrooms (with individual heat control in the bedrooms); whereas in 4- and 5-star hotels a controlled thermal environment is provided across the entire premises, including the guest bedrooms [12].

There is significant potential for hotels to decrease operational costs through energy savings [13]. Estimates indicate that energy saving measures can accrue a saving of between 10-15% of the total energy consumption in hotels, depending on the age and size of the hotel, as well as the type of equipment installed and the maintenance and operating procedures in use.

A hotel may improve its energy consumption profile by making interventions at different levels. Technological solutions help reduce the energy needs of the hotel or improve the energy consumption profile; they may be geared at improving insulation and the building envelope or enhancing efficiency of operations e.g. through

occupancy and daylight controls or by replacing equipment [9]. Energy management solutions deal with staff and guest involvement in energy conservation measures.

Operations and maintenance managers can integrate sustainable energy consumption practices in the management of the physical properties of the hotel [6]. This can be achieved through regular monitoring of energy consumption across the hotel establishment such as through the manual inspection of electricity and water meters and sub-meters at distinct monitoring areas (including high energy consuming areas such as the kitchen, restaurant, back of the house) and monitoring the performance of plant room equipment [9]. Alternatively, monitoring can be done remotely through installation of a building management system that records utility consumption and can regulate heating and cooling delivered to each room. Continuous monitoring is fundamental in providing a detailed picture of demand patterns and energy saving opportunities [9]. In addition, an energy audit undertaken by an assessor can serve to identify hot spots of consumption.

2.2 Innovation in Service Firms

This paper focuses on how energy technologies and organisational practices are realized in the firm and become integrated into the firm's operations in order to enhance energy efficiency at the operational level. Firms need to redirect their resources and competencies in order to innovate in a context which is new to the business and that relates to adopting environmental activities and environmental management processes. Innovation may take the form of environmental technologies that are new to the firm as well as changes in organizational structures and processes that result from implementing new management techniques and working concepts and practices [14].

The case of service firms is interesting since innovation can be studied along several points of the innovation value chain [15]. A distinction is often made between innovations in the 'front-office', that occur through direct interaction with the customer, from those in the 'back-office' that are 'hidden' to the customer yet precede the front stage in order to make the service encounter possible. Back-office activities typically involve non-visible interaction with a customer, such as a customer telephoning the hotel reception and activities where there is no contact with the customer but that need to be carried out in order for the service to be delivered ('support processes') – [16]. In their example of a 'hotel check-in experience', Glushko and Lindsay [15] discuss how activities collected in the back-office, about for example the hotel room preferences of a particular guest, may empower the guest's experience if this

information is transmitted successfully to the front-office. Bridging front and back-office aspects of a service experience means finding linkages and inter-relations between the two aspects of service delivery [15]. The risk with focusing on front-office innovations alone is that back-office changes may go un-noticed. This is a problem with traditional service sectors, including hospitality, that are often considered non-innovative because the service remains unchanged; whilst innovative activity may be taking place in the supporting processes [17].

In mature service firms, including hotels, individuals and departments are rarely dedicated to innovative activity alone; therefore in addition to handling day to day jobs, employees and managers may spend an unspecified amount of time and effort on innovation activity, but this may vary and is rarely managed in a formalized setting [18]. The attention devoted to innovative activity becomes dependent on the different goals, interests or focus that employees may harbour.

A firm's innovative activity can be measured in terms of its capabilities to take environmental action and improve energy efficiency. The next section discusses firm capabilities for innovation.

2.3 Capabilities to Adopt Environmental Innovations

A firm's potential to innovate and implement environmental action depends on its capabilities to adopt advanced technology, to collaborate with other firms and to participate in networks of different types of actors [7];[19]. The literature suggests that these capabilities often overlap with those needed to innovate for competitiveness [7];[20].

In order to build capabilities for sustainable innovation, firms need to identify new ways of recombining their resources and knowledge in order to identify novel solutions to existing problems such as those related to energy and water consumption and enact a response. The capability to discover new options and new solutions requires employees to think inventively in order to solve problems. Employees' skills, obtained through formal training or on-the-job experience may enhance their capability to implement innovative ideas and champion innovative environmental practices [21];[22]. One aspect of innovation is the ability of managers and employees to ask untraditional questions in order to challenge the status quo [20]. This triggers a learning process in the firm through which new knowledge developed through internal problem solving or acquired from external sources is combined into novel solutions to a problem.

The allocation by the firm of time and resources for problem-solving and innovative activity has been identified as a determinant of the adoption of environmental strategies [23]. An environment that

is supportive of experimentation and innovation activity whether this occurs in a formal R&D department or in a more 'informal' setting is also indicative of how much time and resources are re-directed for innovation activity; whereas a focus on operational issues tends to stall the innovative process [18].

Inter-firm relations are increasingly being leveraged in order to address environmental challenges [20]. By drawing on established relations and by establishing new ones, firms may draw on the knowledge and capabilities of external actors in order to solve environmental problems and adopt innovative environmental technologies. This is important since knowledge about environmental practices may not always lie at the core of the business function or activity; and is often new to the firm. Alternatively inter-firm relations may serve to sensitize firms to new opportunities for sustainable innovation and contribute to building problem-solving capabilities in firms [20]. By exploring the exchanges occurring at the interface between firms, the study set out to investigate how these may be a source of knowledge on sustainable energy practices.

3 METHODOLOGY

3.1 Qualitative Case-Study Approach

The research used a qualitative approach in order to investigate how Maltese hotels build internal capabilities to innovate and adopt sustainable technologies and practices leading towards more sustainable energy consumption. Since innovation requires firms to obtain knowledge about sustainable energy consumption practices from external actors, the study explored the relation of hotels with engineering consulting firms that represent one such source.

3.2 Sampling Maltese hotels

A sample of 25 hotels was selected from the Malta Tourism Authority Hotel Directory; this represents 69% of the 5-star hotels, 24% of the 4-star and 7% of the 3-star hotels in Malta. Specific criteria were used in the selection of the hotels to reflect pro-environment action. Most of the hotels had adopted an environment label or 'eco-certificate' at the time of investigation and were actively implementing environment measures that included actions towards more sustainable energy and water consumption. The hotels were also beneficiaries of a government grant, through the 'Energy Grant Scheme', that supported investments in energy saving measures and alternative energy sources; and the 'Sustainable Tourism Projects Grant Scheme' that supported the implementation of environmental practices amongst hotels.

Twenty-six interviews were undertaken with top managers and with the maintenance department of the sampled hotels in order to investigate the capabilities to undertake environmental activity. Ten interviewees were in top management (owners, directors at corporate level or general/hotel managers). These provided information on the strategic orientation of the hotel and its vision on environment and energy issues. Twelve interviews were undertaken with the technicians or maintenance managers in the maintenance department. These are involved in the maintenance of all machinery and equipment including the HVAC system and other aspects of general upkeep including carpentry, upholstery, plumbing; landscaping and upkeep of the grounds; and renovations. Part of the responsibilities of the maintenance/engineering department include controlling the costs of heating, lighting and power as well as the design and implementation of environmental programmes and measures. Four interviews were with human resource managers responsible for the implementation of environment measures in the hotel.

3.3 Sampling the Engineering Consulting Firms

Engineering consulting firms may play one of two roles in hotels. They either act as 'company engineers' assisting in the implementation of the preventive maintenance programme. In this context, they are typically contracted to oversee the operations of the hotel facilities (heating, ventilation and air conditioning systems, HVAC), and peripheral needs including energy and environmental management. Alternatively, they may be contracted to design building services (electricity and water plumbing systems, lift installations, air-conditioning systems, etc.) in new construction developments such as hotel extensions. An emergent group of consultancy firms is specializing in the provision of energy management services. Fourteen interviews were conducted with either senior partners or directors/owners of the business who could provide insight on the types of environmental and energy management services provided.

3.4 Data Analysis

The interview data with Maltese hotels and with engineering consulting firms were coded and this enabled to group the data into three main themes: 1) types of innovative technologies and practices adopted in Maltese hotels (innovation pattern/strategy); 2) capabilities for problem-solving for energy efficiency and for identifying innovative solutions to improve energy consumption; 3) capability to exploit the relation with engineering consulting firms to implement sustainable energy technologies and practices.

Based on this analysis, the hotels were clustered

into different groups based on the types of capabilities and the innovative patterns adopted. The aim was to link the firm capabilities with the innovation strategies for environmental action.

4 FINDINGS

4.1 Patterns of Innovation Adoption

The study identifies a range of capabilities amongst Maltese hotels to adopt environmental practices that is also reflected in the patterns of adoption of innovative environmental technologies and measures. Although the size of the hotel property and the firm size (in terms of number of employees) are factors that do influence environmental action, this study rather focusses on how these firms organize their resources in order to develop competencies for environmental action.

First it is interesting to map the patterns of adoption across the hotels investigated. A vast majority of hotels adopt a technology-replacement strategy where energy efficient technologies are implemented in order to replace inefficient equipment. These firms rely on suppliers as a source of information on innovative energy efficient technologies. Their innovative activity is minimal as they are focussed on routine operations and maintenance tasks.

A separate group of 'problem-solver' hotels adopt more advanced technologies for energy management and typically make regular investments in sustainable energy technologies as opposed to one-off investments. The hotels adopt a larger spread of technological innovations including energy efficiency and renewable energy systems and source information about sustainable energy technologies from a wider range of actors including suppliers, energy services companies and engineering consulting firms.

Apart from adopting advanced technologies, the third category of 'collaboration-specialists' implement organizational innovations for energy management. These include setting-up a green committee and an environmental management strategy or the provision of staff training on environmental aspects such as waste management. Eight of these hotels also implement new environmental initiatives that fall outside the routine tasks of monitoring operations; one such initiative includes regular meetings of an eco-team or committee to discuss and coordinate environmental policies and projects with other departments in the hotel. In more than half of the cases where new environmental measures are introduced, the hotel maintenance managers are spearheading these initiatives, being responsible for the staff training and strategies related to waste separation and energy efficiency and taking up additional tasks

over and above maintenance duties. These innovative initiatives drive the firms along trajectories that may result in greening aspects of the service so that the hotels are more likely to introduce environmental innovations in the front office through interaction with the hotel guest (e.g. through the introduction of a laundry re-use policy and other measures aimed at water and energy conservation).

4.2 Capabilities for Adopting Sustainable Energy Practices

The ‘leaders’ in the adoption of advanced technologies are the problem-solving firms and those that engage in collaboration activity with external actors (engineering consulting firms were investigated in this study). The latter group adopt the broadest spread of innovation types in terms of technological and organisational measures.

Problem-solving is about combining knowledge about energy consumption trends and about the performance of the plant rooms that is accumulated ‘on the job’ in order to find solutions to energy consumption problems; these solutions may lead to modifying current maintenance practices and implementing new ones. The findings show that hotels apply a problem-solving approach when choosing amongst various available sustainable energy technologies and evaluating the best available option; and when assessing how these technologies may affect the standard of the service. As data on energy consumption are collected and organized by month and year, the maintenance managers are thinking of how to exploit these data to propose and implement new investments in energy efficient systems as part of the preventive maintenance programme or during refurbishments on the hotel property.

The information and knowledge obtained through managing different aspects of the hotel property gives the ‘bigger’ picture on the hotel operations; this means that the firm is able to use this information to solve problems and adjust maintenance routines where these are functioning sub-optimally or where improvements can be made. The findings demonstrate that hotels nurture a problem-solving approach when the maintenance department is involved in varied tasks in terms of attention focus dedicated to different aspects of engineering and management other than simply being involved in monitoring routine operations. Hotels with capabilities for problem-solving are more likely to initiate new environment-related projects compared to those focused on routine activities.

‘Collaborative-specialist’ hotels show an enhanced propensity towards taking initiative beyond day-to-day tasks compared to ‘problem-solver’ firms, and develop capabilities to engage in

collaboration with engineering consulting firms on research projects and when undertaking trials on novel environmental technologies.

4.3 Capabilities to Source Knowledge from Engineering Consulting Firms

Inter-firm relations can represent an important source of information and knowledge about sustainable energy consumption. This study investigated the relation of hotels with engineering consulting firms and the hotels’ capabilities to exploit this relation and introduce sustainable energy practices.

Hotels with limited problem-solving capabilities tend to rely on established relations with trusted engineering consultants when it comes to taking decisions on the adoption of novel technologies that occurs during preventive maintenance programme. The role of the engineering consultant or ‘company’ engineer is that of providing information on novel sustainable energy technologies that are purchased as “off-the-shelf” solutions typically to solve hot-spots of energy consumption. This type of relation however may not always provide the ideal conditions for the adoption of energy efficient technologies as it may lead to “lock-in” to particular technological solutions.

In relations that are established over the long-term, such as is the case for preventive maintenance contracts of service, the engineering consulting firm is likely to be focused on routine tasks and may not seek to make improvements beyond maintaining existing operations. In turn, the hotel maintenance manager or technician is typically focused on the many components of routine maintenance, and is marginally involved in searching for and assessing novel environmental solutions therefore lacking the capability to identify potential solutions that accrue significant energy savings.

Hotels with capabilities for problem-solving and evaluation utilize the ‘practice-based’ knowledge arising from modifying maintenance operations and adopting novel environmental measures in their relation with the engineering consultants to obtain information and expert knowledge about energy efficiency and exploit this in the firm. The interview findings demonstrate that the engineering consulting firm plays a more active role in searching and scanning for environmental solutions and designing environmental systems. The relation involves a high degree of collaboration and is characterized by the co-production or co-development of solutions. This pattern of collaboration is observed in small and large hotels that develop collaborative and problem-solving capabilities. The relation is characterized by high ‘compatibility’ between the engineering consultant and the hotel which means that information and knowledge exchange occurs in both directions

between the two entities.

4.4 Linking Hotel Capabilities and Patterns of Innovation

Environmental action is being spearheaded by a cluster of hotels that are taking initiatives to implement new environmental projects. These include the subsidiaries of multinational hotels as well as medium four-star independent hotels. A common feature amongst these hotels is their enhanced capacity to tap specialist knowledge about energy efficiency and environmental technologies through interaction with external actors (engineering consulting firms) and also through informal exchanges amongst hotels that are adopting energy efficiency measures. The capability for problem-solving, that develops through hotel managers making active searches for information about sustainable energy technologies and measures, contributes to building a practical knowledge-base about feasible solutions and ways of adapting maintenance tasks.

The 'collaborative-specialist' hotels evidence adjustments in the way of managing and distributing maintenance practices as well as implementing new organisational structures. This could represent deeper structural change occurring in these hotels compared to those firms that go back to doing things the 'old' way and adopt energy efficiency measures on an *ad hoc* basis, in response to identified hot spots of consumption. Hotels that have a pro-environment strategy are more likely to introduce organizational innovations other than merely technological innovations; these include principally multinational subsidiaries and also a small group of independent 4-star hotels.

The findings provide insight on how hotels can better exploit their relation with the engineering consulting firms in order to adopt environmental measures during routine preventive maintenance tasks and also in short-term projects such as hotel renovations. Hotels that build internal capabilities to solve problems around energy efficiency are better able to collaborate with engineers not because they rely on these engineers to obtain relevant knowledge about energy efficiency; rather they exploit this relation to create 'innovative' spaces where to discuss novel sustainable energy solutions and energy management measures in the maintenance and running of the hotel property.

Hotels with a limited problem-solving capability tend to outsource energy efficiency to engineering consultants or 'company' engineers since they have limited internal capabilities to do this themselves. The findings show that their relation with company engineers is focused on routine tasks and maintaining operational efficiency, with little opportunity to look beyond the preventive maintenance programme.

5 CONCLUSION & IMPLICATIONS FOR POLICY AND PRACTICE

The study provides insights on how Maltese hotels implement environmental action and shift towards adopting environmental technologies and practices. It demonstrates a link between the presence of capabilities for problem-solving and for engaging in collaboration and the potential of hotels to innovate and adopt sustainable energy practices. These capabilities develop 'on the job' through the hotel managers' exposure to diverse situations that require problem solving for energy efficiency and that generate practice-based knowledge about environmental solutions. The study also demonstrates that a range of capabilities are present that account for the observed patterns of innovative behaviour in Maltese hotels.

There are some practical lessons to be learnt about how to nurture an environment where the hotel staff is motivated to take environmental initiatives that go beyond their day-to-day tasks. One practical recommendation is for the hotels to invest in a training programme for the technical staff that addresses novel aspects of engineering in such a way that the maintenance staff are kept abreast with developments in technologies that could significantly improve the performance of the hotel's operations (e.g. heating and ventilation systems). This knowledge could contribute to building a problem-solving capability and facilitate the implementation of environmental technologies.

There could be scope for enhanced sharing of information and knowledge about environmental practices amongst hotels. Often the hotels in the study claimed to have insufficient time to attend meetings and exchange ideas and best practices with engineers and maintenance staff from other hotels.

Policies promoting access to specialist knowledge e.g. to undertake an energy audit, are more likely to have an impact on hotels that are already active in implementing environmental action; whilst firms with limited problem-solving capabilities are more likely to benefit from policies aimed at building internal capabilities for energy management. A suggestion is for policy to shift from a focus on subsidizing environmental technologies to those that promote building capabilities for energy management in firms. This is especially relevant for the hotels with limited capabilities for problem-solving and with a low capacity to access specialist knowledge about energy efficiency measures. This approach is believed to favour responses that are high impact that is that result in a significant reduction in energy consumption over low impact measures.

Energy efficiency programmes would benefit

from funding channelled towards developing protocols that evaluate a range of environmental innovations, in terms of the energy savings they accrue, and establish a list of validated technologies that firms, including hotels could implement. This means providing low-tech services with a guide of the best available technologies, validated and tested.

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