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Feasibility study of installing artificial bathing platforms at the northeast coast of Malta

Darren Bianco

James Madison University

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Feasibility study of installing artificial bathing platforms at the

northeast coast of Malta

Darren Bianco

A dissertation submitted to the Graduate Faculty of

JAMES MADISON UNIVERSITY

In

Partial Fulfillment of the Requirements

for the degree of

Master of Science

Integrated Science and Technology

November 2013
Dedication

I would like to dedicate this dissertation to all those who participated in the public survey, my supervisor Dr. Anton Micallef for guiding me through the dissertation and last but not least my fiancée for assisting me during the long and arduous coastal survey from Sliema to Cirkewwa.
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Abbreviations

CAMP  Coastal Area Management Programme
CZM  Coastal Zone Management
EIA  Environmental Impact Assessment
FEE  Foundation for Environmental Education
FRC  Fiber-Reinforced Concrete
GIS  Geographic Information System
ICoD  Euro-Mediterranean Centre on Insular Coastal Dynamics
MEPA  Malta Environment and Planning Authority
MTA  Malta Tourism Authority
NGO  Non-Governmental Organization
NTM  Nature Trust Malta
ODZ  Outside Development Zone
PAP-RAC  Priority Actions Programme - Regional Activity Centre
SAC  Special Area of Conservation
SPSS  Statistical Software for the Social Sciences
UNEP  United Nations Environment Programme
WHO  World Health Organization
WTP  Willingness-to-pay
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Abstract

The need to create additional bathing areas at rugged karst rocky shores of the northeast coast of Malta could be met by installing temporary wooden decking platforms, since current sandy beaches are very crowded in the peak summer season. Wooden decking platforms are also an acceptable alternative to beach nourishment projects, where the latter can have permanent negative environmental impacts. The old and eroded concrete platforms which cover large areas of the northeast coast of Malta represent an eyesore to the public. The option of overlaying these concrete platforms with a permanent rock amalgam composed of fiber-reinforced concrete which mimics natural rock would improve their aesthetics and attract more people to make use of rocky shores. A public survey was conducted at six popular localities along Malta’s northeast coastline to assess the social acceptability of these two types of artificial bathing platforms. A field survey starting from Sliema and ending at Cirkewwa was also done to identify suitable sites for installing these artificial bathing platforms. The financial costs and the additional beach users who would be accommodated on these artificial bathing platforms were compared to two artificial sandy beaches; St. George’s Bay (St. Julian’s) and Bugibba Perched Beach. It resulted that wooden decking platforms cost more (€270/m²) while rock amalgam covered concrete platforms (€50/m²) cost less than local beach nourishment projects (€107/m²). Both wooden decking platforms and rock amalgam covered concrete platforms would be able to accommodate more beach users (909 and 4,138 beach users respectively) than St. George’s bay and Bugibba Perched beach can currently accommodate (815 and 559 beach users respectively).
1. Introduction

Preface

The Introduction chapter starts by giving a short discussion of how coastal uses are affecting the rate of coastal development, potentially leading to the degradation of this highly competitive resource. The situation in Malta is analyzed in terms of how past tourism policies have shaped coastal development and how unsustainable coastal development has led to considerable rocky shore areas being inaccessible to the public. The potential for additional bathing areas at rough karst rocky shore areas which would be created by wooden decking platforms and at smooth rocky shores by rock amalgam covered concrete platforms is discussed. The reasons for selecting the northeast coast of Malta to install these artificial bathing platforms are outlined. The objectives of this dissertation are presented at the end of the chapter.
1.1 Background to the study

Increasingly, in developed countries leisure time is becoming available to a wider range of people resulting to a growing demand for recreational facilities particularly those found at the coast (Herbert et al., 1989). The coastal zone ranks higher in importance than other recreational resources because of its diversity of landscape, aesthetic attributes and its potential for leisure and recreational activities. It is expected that if present trends continue, additional recreational pressure will be imposed on coastal environments potentially resulting to their rapid deterioration and to a reduction in beach user satisfaction (Sowman, 1987). These observations are also applicable to the Maltese Islands where tourism plays an important role in the country’s economic revenue. The encroachment of new commercial establishments and new infrastructural development to support existing facilities which the tourists depend on, degrade the quality of the recreational experience by the creation of pollution, such as beach litter, turbid bathing waters, noise and light pollution. This degradation results to decreased visits to and attractiveness of coastal areas (Reilly, 2011).

In Malta, socio-economic development at the coast is more rapid than further inland. Of the many coastal uses which are driving this accelerated coastal development are the production of food, the exploitation of mineral resources, the storage of petroleum and natural gas, agriculture, industrial development, housing, tourism and recreation (Cassar, 2003). The Maltese coastline is particularly vulnerable to the negative impacts of spreading urbanization i.e. people moving out from old and congested
urban centers to more rural and semi-urban areas. This has resulted to the concentration of human activities along the coastline and to the modification of the coastline for human uses such as ports, yacht marinas, hotels, restaurants, apartments, etc., all of which interfere with the natural coastal dynamics and cause erosion of natural sandy beaches. The intense development pressure at the coast is exacerbated by the fact that 50% of the coastline is inaccessible both because of development encroachments and natural factors such as boulder scree and cliffs (Cassar, 2003). This accelerated coastal urbanization is exerting “an escalating pressure on limited coastal resources” (Van Herwerden et al., 1989, p.170). Furthermore, in MEPA’s Coastal Topic Paper there is mentioned that 20% of the Maltese coast was developed within a five year period (MEPA, 2002a).

1.1.1 Malta’s tourism industry and current tourism policies

Tourism is one of the most important service industries in Malta. According to Cassar (2003) over 1.2 million tourists visited the Maltese Islands in the year 2000. In 2010, the Maltese government spent more than €1.1 billion on tourism development (Reilly, 2011). Tourism is estimated to contribute as much as 24% to Malta’s gross domestic product (GDP) and this figure is on the increase (Trumbic, 2005). Tourism growth in Malta is constrained by the limited space and resources available (Reilly, 2011). Hotels and resorts compete for coastal space with power stations, reverse osmosis plants and sewage treatment plants since these all require a coastal location (MEPA, 2002a). The construction industry is also an important competitor for coastal space since living close to the sea is becoming the norm. However,
The major legitimate coastal use which requires a coastal location, as identified in the Coastal Area Management Programme (CAMP), is recreation, i.e. the demand for free, equitable access and multiple use of coastal areas for recreation and leisure purposes. (UNEP, 2005, p. 61)

Policies which apply to the regulation of coastal development are the Environment Protection Act (2001), the Development Planning Act (1992) and the Tourism Policy for the Maltese Islands (2012-2016). The latter adopts an environmental focus for tourism development. In fact its regulations consist of ensuring that new development is not sited in sensitive coastal habitats, keeping local sandy beaches and rocky shores clean and creating new artificial sandy beaches to relieve pressures on existing ones (Ministry for Tourism, Culture and the Environment, 2012). However new artificial sandy beaches represent a variety of problems both to developers (due to high sediment losses when unsuitable sized sediment is used, for example the beach nourishment project at Pretty Bay, Birzebbugia in 1991) and to marine ecosystems, due to the smothering of Posidonia oceanica meadows with artificial sediment eroded during storm events. In spite of these potential negative impacts, the current tourism policy encourages the development of artificial sandy beaches in order to enlarge the area of sandy beaches available for beach users (Reilly, 2011). One of the deficiencies of the Tourism Policy for the Maltese Islands (2012-2016) is that it does not mention the recreational potential of karst rocky shores for improving Malta’s tourism industry, although this issue was addressed in earlier policy documents by concreting certain areas of the karst rocky shore with ‘normal’ (non-fibrous), cheap concrete (Borg, 1995 as cited in Cachia, 2002). These concrete platforms are now old and have
become eroded. Moreover they are unsightly and do not fit with the scenery of the natural rocky shore. Two new concepts are proposed in this study to increase recreational areas at the coast. One is overlaying these concrete platforms with a rock amalgam composed of coloured fiber reinforced concrete (FRC) which visually simulates natural rock to improve the aesthetics of the old concrete platforms. The other proposed option is the temporary installation of wooden decking platforms during summer on small sections of very rugged karst rocky shores to provide accessibility to the latter and as possible alternatives to beach nourishment projects.

1.2 Rationale

Tourism development at the coast grows within the carrying capacity of existing coastal resources (Reilly, 2011). The beach carrying capacity is a yardstick to sustainably manage visitor density at coastal environments (Mangion, 2001 as cited in Reilly, 2011). The beach space threshold for beach users is 3m$^2$ per person (Micallef, 2003). The Tourism Strategy Topic Paper states that on a typical August Sunday, sandy beaches have a density of 7 m$^2$ per person while Globigerina Limestone (smooth) rocky shores have a density of 10 m$^2$ per person (MEPA, 2001). In the 1990 Structure Plan report it was stated that the number of potential beach users (both foreigners and Maltese) on a peak summer day in the year 2000 would be circa 47,000 (Planning Services Division, 1990). Since the total area covered by sandy beaches could only accommodate circa 7,500 persons in the year 2000, the other 39,500 beach users could either pay to use private beaches or use the low-lying rocky shores, most of which are inaccessible due to their rugged surface. Therefore, by installing wooden
decking platforms at rough rocky shore areas at the northeast coast of Malta (i.e. the coastline from Sliema to Cirkewwa), these 39,500 beach users would have additional bathing areas thereby decreasing visitor pressure at smooth rocky shores (e.g. at Sliema) and more importantly at popular sandy beaches (e.g. Mellieha Bay and St. George’s Bay (St. Julian’s)). Although these beach user statistics are more than ten years old, possibly implying that nowadays existing sandy beaches can accommodate more than 7,500 beach users due to beach nourishment projects, updated statistics could not be found in the literature. The calculation of the number of potential beach users on a peak summer day in the year 2000 is shown in Table 1.1.

<table>
<thead>
<tr>
<th>Beach users</th>
<th>An estimation of the total number of beach users in the year 2000</th>
<th>Actual number of beach users on a peak summer day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maltese</td>
<td>377,145</td>
<td>20,000 (approx. 5% of Maltese beach users in the year 2000)</td>
</tr>
<tr>
<td>Overseas tourists</td>
<td>90,000 (60,000 plus 30,000 in unlicensed accommodation)</td>
<td>27,000 (30% of overseas tourists in the year 2000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total = 47,000</td>
</tr>
</tbody>
</table>

Table 1.1: A summary of the potential beach users on a peak summer day estimated for the year 2000.
Source: Planning Services Division, 1990
Despite the sensible calculation of the beach users supply on a typical summer day for the year 2000 (47,000 beach users), this is only an approximate figure because tourism draws from a large number of sources, products and services (Mangion, 2001 as cited in Reilly, 2011).

The reasons for choosing specifically the northeast coast of Malta for installing artificial bathing platforms are that the northeast coast is a naturally low-lying coastline due to the SW-NE tilt of the Maltese Islands which was created by the Maghlaq Fault rift system (Magri, 2006); this coastline is characterized by the highest beach user supply in Malta since most tourist accommodation is located here - this is emphasized by the ‘Tourism and Sustainable Development in the Mediterranean Region White Paper’ which states that:

Tourism development in the Maltese Islands is concentrated in four main localities – St. Paul’s Bay, Sliema, St. Julian’s and Mellieha. These localities account for over 78% of the total tourist accommodation supply.

(UNEP, 2002, p. 9)

In addition, six out of seven Blue Flag beaches in Malta (except Ghajn Tuffieha Bay) are located along the northeast coast of Malta, thus people prefer these beaches since they have better water quality and more facilities compared to non-Blue Flag beaches; and the most crowded sandy beaches in summer are found at the northeast coast (e.g. Bugibba Perched Beach, St. George’s Bay, Mellieha Bay and Armier Bay), hence wooden decking and new rock amalgam covered concrete platforms would provide alternative bathing areas at rocky shores.
1.3 Hypotheses

a) As a consequence of different beach user preferences and priorities for limited bathing areas in the Maltese Islands, the provision of wooden decking platforms and rock amalgam covered concrete platforms at karst and smooth rocky shores, respectively, would be an acceptable alternative. This hypothesis is answered via a public survey which will show whether the public prefers these artificial bathing platforms at rocky shore environments rather than natural and artificial sandy beaches and private beaches.

b) Artificial bathing platforms are more feasible than beach nourishment projects to increase Malta’s bathing areas. This hypothesis is partly answered in Section 4.1, Chapter 4, where the costs of two past beach nourishment schemes at Bugibba Perched Beach and at St. George’s Bay (St. Julian’s) are compared to the estimated costs of wooden decking platforms and coloured fiber reinforced concrete (rock amalgam) platforms as quoted from the Maltese suppliers of these materials. In Section 4.3 the potential additional beach users who would be accommodated on these artificial platforms are compared to those who can be accommodated at Bugibba Perched Beach and St. George’s Bay. Furthermore the negative environmental impacts of beach nourishment and of the two types of artificial bathing platforms are discussed in Chapters 2 and 5 respectively.
Below are some of the photographs taken during the field survey of the northeast coast of Malta showing existing concrete platforms upon which the rock amalgam could be overlaid and deeply pitted karst rocky shores where temporary wooden decking platforms could be installed.

Figure 1.1: Concrete platforms at Sliema

Figure 1.2: Old concrete platforms at Bahar ic-Caghaq
Figure 1.3: An unpleasant concrete platform at Qawra Point

Figure 1.4: Shoreline covered with concrete at St. Paul’s Bay
Figure 1.5: Shoreline covered with concrete at the east side of Mellieha bay

Figure 1.6: Eroded concrete platform at Armier
Figure 1.7: Concrete platforms at Cirkewwa

Figure 1.8: Karst rocky shore area at Sliema
Figure 1.9: Deeply pitted karst rocky shore behind Hilton hotel, St. Julian’s

Figure 1.10: Deeply pitted karst rocky shore behind Radisson hotel, St. Julian’s
Figure 1.11: Karst rocky shore at Pembroke

Figure 1.12: Karst rocky shore composed of Lower Coralline Limestone at Bahar ic-Caghaq
1.4 Research objectives

The first objective of this dissertation is to identify a number of beach user preferences regarding the two types of artificial bathing platforms by conducting a public survey to Maltese and foreigners during June/July 2013. This survey will determine whether the public generally accepts these two types of artificial bathing platforms.

The second objective is to identify suitable sites at the northeast coast of Malta where these two types of artificial bathing platforms could be installed based on the chosen localities by respondents in the public survey, the suggestions given by the stakeholders consulted, notably Nature Trust Malta (NTM), the Malta Tourism Authority (MTA) and the Malta Environment and Planning Authority (MEPA) (see ANNEX II in the Appendices for the interviews with these stakeholders) and based on the coastal configuration of the northeast coast of Malta as recorded during the field
survey. The legislative issues pertaining to the installation of these artificial bathing platforms at the rocky shore of northeast coast of Malta are discussed in Chapter 5.

The third objective is to establish whether both types of artificial bathing platforms or just one of them, are more feasible than beach nourishment projects, by considering St. George’s Bay and Bugibba Perched Beach case studies.
2. Literature Review

Preface

This chapter starts by giving a brief summary of the coastal geomorphology of Malta and of the state of the public accessibility to rocky shores. The past and present legislation controlling tourism development at the coast is discussed together with the projects currently underway by the Malta Tourism Authority (MTA) to improve the recreational value of the northeast coast. An introduction to beach nourishment is presented together with case studies of St. George’s bay and Bugibba Perched Beach and with a brief mentioning of the Blue Flag Campaign. A description of wooden decking platforms and rock amalgam covered concrete platforms is presented with reference to a Spanish case study concerning wooden decking platforms, however case studies of rock amalgam covered concrete platforms at rocky shores could not be found. Alternative materials which can be used for these artificial bathing platforms are discussed. A description of hand-delivered questionnaires is presented together with their advantages and disadvantages.
2.1 The Maltese coastline

Rocky shores comprise approximately 90.5% of the 272 km coastline of the Maltese Islands (Schembri et al., 2005). Of this 90.5%, around 40% is low-lying, composed of ‘smooth’ shores of Globigerina Limestone, karst pavements of Lower Coralline Limestone and boulder scree of Upper Coralline Limestone while the remaining 50.5% is made up of steep cliffs more than 50 meters high which characterize the southern and southwest coast of Malta and most of the coast of Gozo (Magri, 2006; Schembri et al., 2005). In contrast sandy beaches only comprise 2.4% of the Maltese coastline while the remaining 7% is developed (Schembri et al., 2005).

Paskoff and Sanlaville (1978) claim that the Maltese coastline has been determined by tectonics caused by the Pantelleria Rift System (Magri, 2006). Lithology and advanced karstification are major determinants of the coastal geomorphology of Malta (Magri, 2006). Bays in northern Malta correspond to downthrown blocks that were partially submerged. High cliffs at the southwest coast are associated with the Maghlaq Fault. Where cliffs are cut in the Globigerina Limestone they are fronted, in most cases, by flat or gently sloping shore platforms produced by the mechanical action of waves (Magri, 2006). Where cliffs are cut in the Lower Coralline Limestone they form vertical plunging cliffs (Magri, 2006).
2.2 Low-lying karst rocky shores

The northeast coast of Malta is characterized by long tracts of low, karst rocky shores (Paskoff, 1985 as cited in Magri, 2006). Pools and lapiés which form by solution (chemical weathering) give an extremely irregular topography to these karst pavements (Magri, 2006). Karst rocky shores display interesting examples of mechanical, chemical and biological processes such as hydraulic pressure (wave quarrying), corrosion, solution as well as bio-erosion (Magri, 2006; Micallef et al., 2009b). Chemical (corrosion of rock particles with the salt crystals in the surface pores of the rock), mechanical (wave quarrying) and to a lesser extent biological weathering are the prevailing processes in the formation of these karst pavements (Magri, 2006, Micallef et al., 2009b). Biological erosion occurs by algae, molluscs, marine worms, sponges and sea urchins (Bird, 2008). These marine fauna contribute
to erosion by drilling, scraping, plucking, grazing and solution by exuded fluids (Bird, 2008). On the other hand, mechanical erosion by abrasive sand and shingle is absent (Magri, 2006; Micallef et al., 2009b).

![Image: Karst rocky shore at St. Julian’s cut in the Lower Coralline Limestone](image)

Figure 2.2: Karst rocky shore at St. Julian’s cut in the Lower Coralline Limestone

### 2.3 Public accessibility of the northeast coast of Malta

Sliema - St. Julian’s and Bugibba - Qawra coastal areas mostly comprise of rocky shores with the exception of two artificial sandy beaches, St. George’s bay and the perched beach (literally an artificial beach above sea level) at Bugibba. Rocky shores are viewed by many as difficult to access, partly due to the uncomfortable and hazardous rugged karst topography at some localities such as at St. Julian’s, Bahar ic-Caghaq and Cirkewwa and partly due to private beach concessions (Cachia, 2002). With regards to beach concessions, in the North Harbours’ Local Plan there is stated that “a number of beach concessions and encroachments have been granted within the North Harbours’ Local Plan area, particularly at St. George’s Bay and Tigne’”
(MEPA, 2006, p. 73). Below are some photos taken during the field survey which show different localities along the northeast coast of Malta where private beach concessions block public accessibility to the rocky shore.

Figure 2.3: The lido behind Fortizza restaurant shown at the back of the photo blocks public accessibility to the rocky shore, l/o: Sliema

Figure 2.4: The Westin Dragonara Resort shown at the back of the photo has extended its premises right up to the shoreline thus blocking public access, l/o: St. Julian’s
Figure 2.5: A beach concession of a particular hotel at Qawra prevents public accessibility to the foreshore

Figure 2.6: An illegal encroachment by a private developer at Bugibba
Various options were proposed by respondents in a survey conducted by Cachia (2002) to increase accessibility to the rocky shore. These included cementing patches of the shore and temporary structures such as wooden platforms (Cachia, 2002). However, increased facilities do not suffice to make rocky shores fully accessible to the public, as proper planning legislation needs to be enforced by MEPA to prevent further privatization of this public resource.
2.4 Tourism development in Malta

The products of Malta’s tourism industry are closely linked to our sandy beaches (Cachia 2002). During the 1980s, government authorities gave up considerable stretches of the coast to private developers to incentivize tourism development (MEPA, 2002a). We can see the results of this policy today with the Sliema, Qawra, Bugibba and St. Paul’s Bay coastline characterized by lidos (private outdoor swimming pools), beach concessions and restaurants (Figures 2.3 – 2.8). Moreover, the lack of enforcement in the past with regards to the illegal boathouses and kiosks at rocky shores led to the privatization of significant stretches of publicly-owned rocky shores and to large areas covered with cheap and unpleasant concrete in an attempt to create safe entry points to the sea (Cachia, 2002). The problem, as stated by Pogue and Lee (1998) is that private coastal development is granted at a faster rate than public coastal areas can be secured.

The MTA has undertaken various coastal development and beach management projects as part of the European Regional Development Fund (ERDF) 2007 – 2013. The first project, which is still ongoing, is ‘Tourism zone upgrade with landscaped urban spaces and other facilities (St. Paul's Bay, Qawra and Pembroke)’. This project consists of coastal landscaping with natural vegetation, pavements and footpaths; a public aquarium at Qawra; tourist information centers, heritage parks, underground car parks and cycle tracks (MTA, n.d.). The second project, which is also still ongoing, consists of ‘Upgrading of two tourism coastal stretches in Qawra and
Sliema’. This project is being implemented in two phases. The first phase involves improving accessibility to the beach and to the sea for swimmers and divers, installation of ladders, planting trees and shrubs and upgrading of public toilets (MTA, n.d.). The second phase involves the creation of an artificial sandy beach at Qawra to “increase the popularity of these tourist areas in the summer months whilst reducing the pressure at other beaches in the north of Malta” (MTA, n.d.).

Figure 2.9: Tabloid at the Sliema promenade showing one of the projects undertaken to increase facilities and improve accessibility to the rocky shore

Figure 2.10: Concrete footpaths to provide easier public access to rocky shores. Location: Sliema
Successful beach nourishment schemes have been carried out at St. George’s bay and at Bugibba Perched Beach. Both beaches have been awarded the Blue Flag Beach status (see section 2.7.3 for the Blue Flag Programme). With regards to rocky shores, a project under the regulations of the Blue Flag Management Programme has been carried out at Sliema and consisted of the paving of the promenade, the provision of sun shades, the installation of street lighting, shower and toilet facilities and the facilitation of access to the rocky shore by the installation of wooden footpaths (Cachia, 2002).

2.5 Beach nourishment

Beach nourishment allows for increased recreational usage of eroding beaches (Hanson et al., 2002). However it is only a partial solution to the insufficient and eroding sandy beaches (ICoD, 2001). Beach nourishment projects involve the addition
of sediments from an offshore dredge site or a terrestrial site onto the beach to enlarge its surface area (Peterson et al., 2005). Beach nourishment in Malta is justified by the high demand for sandy beaches and by the fact that most urban beaches cannot be replenished naturally due to inland development blocking sediment transport to the beach (Borg, 2013; Adi Associates Environmental Consultants Ltd., 2011). Many sandy beaches in urban areas (e.g. Xlendi, Marsalforn, Xemxija, St. Julian’s, Balluta, St. Thomas Bay, St. George’s Bay and Mellieha Bay) are being eroded by the modification of the shoreline such as the construction of pontoons, quays, promenades, jetties and slipways (Borg, 2013).

The design of a beach nourishment scheme starts with the examination of beaches having similar sediments to determine the cross-sectional area of a stable beach (Hanson et al., 2002). This enables the calculation of the volume of material needed for the beach fill, the type of beach material to use, the potential suppliers and the estimation of the cost using knowledge from past schemes (Hanson et al., 2002). Beach material for Maltese sandy beaches is usually not brought from offshore dredging but is imported from overseas such as the Jordanian quarry used for St. George’s Bay nourishment project in 2004. Avoiding offshore dredging implies mitigating ecological impacts on benthic and pelagic organisms. The height and width of the replenished beach profile is determined using numerical and empirical models for sand and shingle material respectively (Hanson et al., 2002). This modeling is carried out to determine the far-reaching effects of the fill material under storm events, for example the possible smothering of *Posidonia oceanica* meadows and reduction in water quality, the formation of algal blooms and the long-shore drift of excess sediments along the coastline, such as the deposition of crushed granite from
Bugibba Perched Beach in coves downdrift of the beach (Hanson et al., 2002). According to Cipriani et al. (1999), 66% of the volume of sand added to a typical Italian beach is lost within a year. Aerial photogrammetry is used to determine the volume of beach lost over the years and thus is used to calculate the longevity of the scheme and the time for re-nourishment (Hanson et al., 2002).

![Bugibba Perched Beach](image)

Figure 2.12: Accumulation of eroded beach material downdrift from Bugibba Perched Beach

The recreational benefits of a replenished beach include a reduction in travel time for a more attractive beach and a higher number of beach users who are willing to pay to use a larger beach area (Dean, 2002). The upgrading of existing sandy beaches enhances visitor satisfaction and leads to more repeat visits and to the promotion of the sandy beach through positive visitor feedback (ICoD, 2001). The success of a beach nourishment project depends on the local site characteristics and has to be considered on a case-by-case basis (Finkl et al., 2005). Beach nourishment is likely to become costlier in the future both because of relative sea level rise and because more stretches of the coast are being developed (Finkl et al., 2005).
2.5.1 St. George’s bay nourishment project

St George’s Bay has been awarded the Blue Flag Pilot Beach Award in 2007 (FEE, n.d., a). This beach is a man-made beach which had been replenished with sand during 2005 after having eroded over time (FEE, n.d., a). The beach is in a high priority touristic area, with accommodation ranging from three to five star hotels and other commercial establishments (FEE, n.d., a). After the beach was re-nourished, it was instantly used by foreigners and Maltese. Furthermore, the beach saw again the return of its natural sand, and the deposition of *Posidonia oceanica* banquets after subsequent winters, making the nourishment project a total success environmentally, economically and socially (FEE, n.d., a).

![Figure 2.13: St. George’s bay after being replenished. Source: http://www.blueflag.org/Menu/Awarded/sites/2012/Northern+Hemisphere/Malta/Malta/St+Georges+Beach. Accessed on 09/08/2013](image)

2.5.2 Bugibba Perched Beach
Bugibba Perched Beach was a joint project between the MTA and the Dolmen hotel. Before the intervention, the beach was a linear rocky shore with a sharp rock surface (FEE, n.d., b). When sand was being considered, the beach was planned to be totally reversible and should the need arise, this rocky shore would return to its original natural state (FEE, n.d., b). The nourishment project transformed approximately 2,000 square meters of this rocky shore into a sandy beach, perched above sea level. Wooden bridges and ladders were constructed to facilitate access from the sandy beach over the rocky shoreline and into the sea. In 2011, Bugibba Perched Beach was awarded the Blue Flag Beach Award (FEE, n.d., b).

![Figure 2.14: Bugibba Perched Beach after the nourishment project. Source: http://www.blueflag.org/Menu/Awarded+sites/2012/Northern+Hemisphere/Malta/Malta/Bugibba+Perched+Beach. Accessed on 09/08/2013](image)

2.6 The Blue Flag Eco Label

The Blue Flag is a voluntary eco-label administered by the Foundation for Environmental Education (FEE) and is awarded to beaches, marinas and boats all over
The Blue Flag programme was initiated in Malta in 2006 and is administered by Nature Trust Malta (NTM). Beaches must meet 26 regulations related to environmental education and information, water quality, environmental management, safety and services (FEE, 2002 as cited in Micallef et al., 2004). These 26 regulations are grouped into four major criteria which consist of the following: excellent bathing water quality; environmental education and information such as a beach code of conduct and information about the Blue Flag Campaign; beach management principles such as beach/shore cleanliness, adequate sanitary facilities, waste separation bins, waste recycling facilities, prohibition of camping, barbeques and pets, provision of facilities for disabled persons and regular public transport; and health and safety criteria such as lifeguards, first aid facilities, facilities which improve accessibility to the beach/shore, safe entry points to the sea, warning systems for water pollution and jellyfish, as well as maps displaying the beach facilities (FEE, 2006).

2.7 Wooden decking platforms

2.7.1 Microcostas Project Case Study - Vinaros, Spain

The Microcostas project was a series of man-made wooden decks located at Vinarós, Spain. The project was completed in 2007 and it cost €600,000 (Bordas, n.d.). It was carried out in order to mitigate coastal erosion caused indirectly by the modification of the shoreline for urban development (Bordas, n.d.). The idea behind this project was that of preserving the rocky promontories of the Vinaros coast while also making
them accessible (Bordas, n.d.). The project consisted of a series of hexagonal wooden decks of varying shapes and sizes. These wooden platforms are assembled on the shore and are built in such a way that they can be removed anytime, without having any irreversible negative impacts on the natural rocky shore environment (Bordas, n.d.). They are situated in the vicinity of the sea which allows beach users to experience a part of the coast which otherwise would not be accessible due to the rugged shore surface (Bordas, n.d.). In addition, these wooden decking platforms provide additional space for recreational and leisure activities such as reading, relaxing and sunbathing (Bordas, n.d.).


**Figure 2.15:** Hexagonal-shaped wooden decking platforms at Vinaros, Spain. Source: http://www.landezine.com/index.php/2009/07/microcostas-spain/. Accessed on 25/08/2013


**Figure 2.16:** A photomontage of the rocky promontory of Vinaros with wooden decking platforms. Source: http://publicuseofprivatespace.files.wordpress.com/2012/10/microcostas-19.jpg. Accessed on 25/08/2013
2.7.2 Wooden decking materials

Gillespie (n.d.) provides an excellent review of potential wooden decking materials. Timber treated with chemical preservatives, known as pressure treated timber, is the most popular material used for outdoor wooden decks. Pressure treated timber is much more durable and more resistant to the elements, rot and insects than untreated wood (Gillespie, n.d.). Pressure-treated timber is generally sourced from tree species that are naturally resistant to weathering and decay such as cedar, redwood and teak. These hardwoods hold up well to exposure to the weather, but in most cases waterproof sealing is required to maximize their lifespan (Gillespie, n.d.). Alternative and more sustainable decking materials consist of wood-plastic composites (WPCs) made up of wood residues and thermoplastics such as polythene, polypropylene and PVC (polyvinyl chloride) (Gillespie, n.d.). The advantages of WPCs are that they do not corrode, they are highly resistant to rot and decay, do not expand much when wet,
have substantially longer lifespans and are lighter than hardwoods. Thus WPCs require significantly less maintenance than pressure-treated timber (Streetlife, n.d.; Stark, 2001). Furthermore, the manufacturing and transport of WPCs have less environmental impact compared to hardwoods since the latter are bulkier and require more trees to be cut (Streetlife, n.d.). The only disadvantage of PVC is that it is nearly three times more expensive than pressure-treated timber (Marsh, 2002).

2.8 Rock amalgam covered concrete platforms

Concrete is a mixture of Portland cement, water, crushed stone aggregate, sand and in some cases admixtures (El-Sherbiny, 2011; Wafa, 1990). It “provides the perfect canvas for creating an economical replica of more expensive materials, yet still maintaining a very natural, authentic look” (El-Sherbiny, 2011, p. 264). Concrete can be molded into virtually any shape, reproduce any surface texture and can be coloured with pigments or painted (True, 2004; Suprenant, 2007 as cited in El-Sherbiny, 2011). Pigments and acid stains can either be mixed in the concrete admixture or applied to the concrete surface (Marie, 2007). Fiber reinforcement of concrete improves its mechanical properties (tendency of breakage). The fiber content is typically 1.5% (Wafa, 1990). There are different types of fibers which can be used such as glass, steel, organic, mineral, polypropylene, kevlar, nylon and polyester (Wafa, 1990). Fiber reinforcement reduces the number and size of cracks formed in concrete and improves the post-cracking load carrying capacity such that the rate of damage is less than in normal concrete (Wafa, 1990). Moreover fibers decrease moisture permeability in concrete (Banthia et al., 2007 as cited in Kurtis, 2007). In a coastal
environment, fibrous concrete is 25 times more resistant to damage by wave impact compared to normal concrete (Wafa, 1990). When fiber reinforced concrete (FRC) is used for seaside locations, anti-corrosion chemicals and fibers which increase resistance to sea waves are normally added to the concrete mixture (personal communication with a structural engineer). Cellulose and polypropylene fibers are particularly effective to decrease the ‘free’ chloride ions which penetrate through the small cracks and which are the main cause of corrosion (Banthia et al., 2012). The suggested mix design for a metal-based FRC for a coastal environment is presented in Figure 2.18 below:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Quantity kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement—Type II</td>
<td>519</td>
</tr>
<tr>
<td>Water</td>
<td>234</td>
</tr>
<tr>
<td>Fine aggregate</td>
<td>761</td>
</tr>
<tr>
<td>Coarse aggregate—max ¾ in.</td>
<td>607</td>
</tr>
<tr>
<td>Fibers—2 volume %, carbon steel/stainless steel 0.016 ø × 1 in.</td>
<td>148</td>
</tr>
</tbody>
</table>

Admixtures
- air entraining agent
- water reducing agent

Mix Properties
- slump: 7.6 to 12.7 cm
- air content

Precautions
- avoid segregation, excessive bleeding, and over-vibration,
- cure sufficiently

Other Possible Considerations
- surface coatings (water proofers/damp proofers)
- polymer impregnation
- interval sealants

Figure 2.18: Recommended FRC mix design for seawater applications. Source: Rider et al., 1980. Note: Type II cement has moderate sulfate resistance (<8% tricalcium aluminate) making it ideal for a coastal environment (Thomas et al., 2008)
2.8.1 Overlaying procedure of the rock amalgam on existing concrete platforms

Before the overlay procedure it is very important to correctly prepare the old concrete surface so that the FRC, the material used for the rock amalgam, attaches immediately (Marie, 2007). The old concrete surface is first given an acid bath that loosens the top layer (Marie, 2007). This is neutralized and washed away. Once a clean, fresh surface is created the FRC admixture is overlaid in a ‘plastic’ state by a transit mixer inside a rectangular wooden box which prevents the admixture to spill on the natural rocky shore surface. The admixture is flattened out and made to a thickness of 15 cm by workers before it solidifies where it becomes permanently attached to the old concrete platform underneath. A colour hardener which mimics natural rock is sprayed or painted on the surface of the FRC platform once it has solidified. This latter procedure is also known as a texture finish (Ellis, 2013).

2.9 Public survey

Surveys are commonly divided into interview and self-administered surveys (NOAA, 2007). Examples of interview surveys include face-to-face interviews and telephone interviews. Examples of self-administered surveys include posted mail questionnaires, hand-delivered questionnaires (also known as ‘paper-and-pencil’ questionnaires) and internet surveys. In this study, hand-delivered questionnaires were used for the public survey. These questionnaires are provided to respondents face-to-face, where the researcher briefly describes the questionnaire purpose. The questionnaire is completed
by the respondents themselves and returned to a collection box provided by the researcher. Before conducting a questionnaire it is important to identify the research goals and what information one needs to obtain from respondents to meet these goals (Loughborough University, n.d.).

2.9.1 Advantages and disadvantages of hand-delivered questionnaires

The advantages of hand-delivered questionnaires are that they are cheap to conduct and can be conducted anywhere; respondents have the freedom to complete the questionnaire at their own pace; respondents’ anonymity is maintained; provide useful data for testing out research hypotheses; and interviewer bias is avoided since answers are given by the respondents themselves (Gilham, 2008; Milne, 1995; Saifuddin, 2009).

The disadvantages of hand-delivered questionnaires are problems with accuracy and completeness in the data gathered; the very low response rate can skew the data collected; must be short in length; generally people prefer to give their own opinions by word of mouth rather than writing them; honesty of answers given can be an issue; no benefits to respondents and concerns about their confidentiality (Gilham, 2008; NOAA, 2007; Reilly, 2011).
3. **Methodology**

**Preface**

This chapter starts with a brief description of the field survey along the northeast coast of Malta. The objectives of the public survey are outlined. The choice of the sample size and the sampling methodology for the public survey are explained. The justifications for using hand-delivered questionnaires rather than other surveying methods are given. The questionnaire design is discussed with reference to the questionnaire objectives. Examples of open and closed questions from the questionnaire are presented. Various factors which can affect the respondents’ ability to answer are mentioned. Step-by-step instructions to create a number of maps for the proposed locations of the two artificial bathing platforms using GIS software (ESRI ArcGIS) and to create photomontages of field survey photos onto satellite images showing the northeast coast of Malta, using the graphics software GIMP, are presented. Instructions to enter questionnaire data, graphically present it and analyze it using standard tests in IBM SPSS Statistics are also given.
3.1 Survey along the northeast coast of Malta

A coastal survey starting from Sliema and ending at Cirkewwa was conducted to identify suitable areas where wooden decking platforms and rock amalgam covered concrete platforms could be installed. This survey was divided into four fieldtrips: a) Sliema and St. Julians’s, b) Pembroke and Bahar ic-Caghaq, c) Qawra, Bugibba, St. Paul’s Bay and Xemxija and d) Mellieha, Armier and Cirkewwa.

3.2 Public survey

The main objectives of the public survey are to assess:

a) Whether the public would make more use of the northeast rocky coast should wooden decking platforms and/or rock amalgam covered concrete platforms be installed.

b) Whether public preference for sandy and private beaches would change if wooden decking and rock amalgam covered concrete platforms at rocky shores are also available.

c) Whether the two types of artificial bathing platforms are more feasible than beach nourishment projects.
d) Whether artificial bathing platforms are more acceptable amongst Maltese or foreigners.

e) Where the respondents propose that artificial bathing platforms should be installed along the rocky coast of northeast Malta.

f) Whether the respondents are prepared to pay for the use of the two types of artificial bathing platforms.

g) How the public perceives the present usage of Malta’s rugged karst rocky shores.

According to Krejcie et al. (1970), a sample size of 384 is the maximum required sample size for any population > 250,000 people (see Table 3.1). For this study, choosing a sample size of 400 questionnaires did not represent a problem since any sample greater than 384 questionnaires would be acceptable (at the expense of time wasted conducting additional questionnaires) to give a margin of error of +/- 5% at the 95% confidence level. Therefore the “results of the survey are 95 percent accurate, +/-5% of people surveyed” (NOAA, 2007, p.5). A 95% confidence level means that if one questionnaire is conducted 100 times, 95 of the times there would be no more and no less than 5% chance that the questionnaire results differ from the results of a random person surveyed from the whole Maltese population and from all foreigners currently residing in Malta, thus producing a statistically significant result.
Table 3.1: Table showing the required sample size for a specific population size, a specific margin of error and a specific confidence level. Source: http://www.research-advisors.com/tools/SampleSize.htm. Accessed on 02/08/2013

The required sample size (384) for a population > 250,000, a margin of error of +/-5% and a confidence level of 95% shown in Table 3.1 was calculated using the following formula created by Krejcie et al., 1970:

\[ s = \frac{X^2NP(1-P)}{d^2(N-1)} + X^2P(1-P) \]

Where,
\( s = \text{required sample size}. \)

\( X^2 = \text{the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841)}. \)

\( N = \text{the population size}. \)

\( P = \text{the population proportion (assumed to be .50 since this would provide the maximum sample size)}. \)

\( d = \text{the degree of accuracy expressed as a proportion (.05)}. \)

Figure 3.1: Graph showing the relationship between sample size and total population assuming a margin of error of +/- 5%. Source: Krejie et al., 1970

Figure 3.1 shows that as the population increases, the required sample size increases at a diminishing rate and then remains constant at 384 cases.

The questionnaire survey was conducted once over a period of two weeks, i.e. from the beginning of the last week of June 2013 to the end of the first week of July 2013.
Since the respondents were sampled once, this study is called a cross-sectional study. A cross-sectional study is different from a longitudinal study because in the latter the same sample is surveyed more than once in order to see any trends over time in the behaviour or opinion of respondents.

*Sampling is the process of selecting a subset of observations from an entire population of interest so that characteristics of the subset (sample) can be used to draw conclusions or make inferences about the entire population.*

(Saifuddin, 2009, p. 14)

A systematic random sampling methodology was used in this study since it involved sampling a large population (Singh, 2003 as cited in Portelli, 2010). Systematic random sampling is a type of probability sampling where all respondents from the whole population have the chance of being selected and thus the mathematical probability that one person is selected can be calculated (Chaturvedi, n.d.). In contrast, non-probability sampling selects respondents based on how available they are to the researcher such as family members and friends. Non-probability sampling also results in an unknown percentage of the whole population being excluded from the survey due to selection bias of the researcher (Chaturvedi, n.d.). The selection of survey participants in this study involved asking every other person who passed by the author if he/she would like to participate in a survey for his Master’s dissertation. If the person rejected to participate, the next other person who passed by was asked again. Respondents were approached with a short description of what the questionnaire was about and for what purpose it was being conducted. In addition, pictures of wooden decking platforms installed at a karst rocky shore (Figure 3.3); a photomontage of an
aesthetically pleasing rock amalgam overlaid on an old concrete platform (Figure 3.5); a natural karst rocky shore (Figure 3.2); and of an old and eroded concrete platform (Figure 3.4) were shown to the respondents.

Figure 3.2: Deeply pitted karst rocky shore at St. Julian’s, Malta

Figure 3.3: A wooden decking platform installed at a rugged rocky shore at Lanzarote Island, Spain. Source: http://www.lanzaroteinformation.com/files/Decking%20at%20Los%20Cocoteros.jpg. Accessed on 25/08/2013
Figure 3.4: An old and eroded concrete platform at Armier bay, Malta

Figure 3.5: A photomontage of a rock amalgam overlaid on the concrete platform shown in Figure 3.4

The 400 questionnaires were conducted at these six localities: Valletta, Sliema, St. Julian’s, Bugibba, St. Paul’s Bay and Mellieha Bay, with the reason being that most tourist accommodation and Malta’s major commercial areas are found here. Moreover these localities are evenly distributed along the northeast coast of Malta, thus sampling bias is avoided. The author did not conduct questionnaires at sandy beaches or rocky shores but stayed on promenades and pavements because conducting
questionnaires at coastal environments creates an inconvenience to beach users by disturbing them during their leisure time. In addition, the systematic sampling methodology described previously would not be possible at coastal environments since most people at the latter would be stationary. Thus, respondents did not necessarily make use of Malta’s coastal environments for their recreational activities even if all survey locations, except Valletta, were located at the coast. The survey was conducted at the peak holiday season (June/July 2013) during daytime so that maximum population numbers would be present (Sowman, 1987).

Interview surveys were not chosen for this study due to the short time frame of the dissertation and the need to obtain a wide public opinion as possible. Telephone surveys were not applicable because the respondents needed to be shown photos of how these proposed artificial platforms would look like in reality (Figures 3.2 to 3.5). Mail interviews were not selected because questionnaire counts would presumably be low plus assistance to respondents would not be possible. Online surveys were not chosen due to their low turnout rate and the possibility of sampling bias (NOAA, 2007).

3.2.1 Questionnaire design (adapted from Micallef, 2002)

The number of questions asked in the questionnaire was kept as low as possible so not to discourage respondents. Initial questions were interesting and general in nature (e.g. what type of beach people prefer) (Micallef, 2002). Difficult, controversial (e.g. how much to pay to use these artificial bathing platforms) and specific questions (e.g.
where these artificial bathing platforms should be installed) appear later in the questionnaire so that respondents build confidence and their ability to answer increases (Micallef, 2002). Before the questionnaire was ready to conduct to the public, a small pilot study was done which involved questioning family members and friends. After this ‘trial’, the necessary changes were made for the questionnaire to be ready to conduct to the general public.

3.2.1.1 Individual question content

The questions were structured with the following considerations: they had to meet at least one of the questionnaire objectives outlined at the beginning of Section 3.2, they had to be concise and understandable by the public in general, they did not have to contain negative wording which can influence the respondent’s opinion and they did not have to be double-barreled (University of Leeds, n.d.).

The first objective which is to assess ‘whether the public would make more use of the northeast rocky coastline of Malta if wooden decking platforms and/or rock amalgam covered concrete platforms are installed’ was met by asking the public whether they would make more use of rocky shores with these artificial bathing platforms installed (Questions 5 and 6 of the Questionnaire – see ANNEX I in the Appendices). The second objective which is to assess ‘whether public preference for sandy and private beaches would change if wooden decking and rock amalgam covered concrete platforms are also available’ was met by asking the public whether they would still go to their preferred beach or would change preference for these artificial bathing
platforms (Question 4); the third objective which is to assess ‘whether the two types of artificial bathing platforms are more feasible than beach nourishment projects’ was met by asking the public which of these two recreational enhancement options they would prefer (Question 11). The fourth objective which is to assess ‘whether artificial bathing platforms are more acceptable amongst Maltese or foreigners’ was met by asking the public to rate the level of acceptability of these artificial bathing platforms on a 5-point Likert scale (Questions 7a and 7c) and by asking respondents their nationality (Question 1). The fifth objective which is to assess ‘where respondents propose that artificial bathing platforms should be installed at the northeast coast of Malta’ was met by providing a list of localities found along the northeast coast of Malta (Question 14). The sixth objective which is to assess ‘whether the respondents are prepared to pay for the use of artificial bathing platforms’ was met by providing an ordinal scale of fee options ranging from nothing to 5 euros (Question 13). The seventh objective which is to assess ‘how the public perceives the current usage of Malta’s rough karst rocky shores’ was met by providing an ordinal scale for the level of use of deeply pitted karst rocky shore areas (Question 8).

The use of open-ended questions was limited to Question 15, where respondents had the opportunity to make any comments regarding the questionnaire topic or about any other issues. Open-ended questions allow for a broad spectrum of opinions to be explored and certain opinions help the researcher improve his knowledge on the topic (Bremer, 2011). The comments made in Question 15 are later mentioned in the Recommendations section of Chapter 6. Close-ended questions were mostly used in the questionnaire. Answer options were mainly of a qualitative nature except for Question 7 which had a Likert rating scale (Markham, 2012). Examples of qualitative
answers included dichotomous answers, such as the nationality of respondents (Maltese or foreigner), non-dichotomous answers having the format of ‘no, yes or not sure’ and multiple choice answers such as Question 3: “Which of these coastal environments do you prefer for your recreational activities? Rocky shores, Sandy beaches or Private beaches”. The advantages of close-ended questions are that they are simple and quick to answer, easy to code, record and analyze using SPSS and thus comparisons with similar studies can be made (Bremer, 2011). The disadvantages of these type of questions are the limited answer possibilities, hence the limited exploration of different opinions on particular issues.

The inability of respondents to answer was accounted for. Technical terms such as ‘karst’ were defined in simpler terms such as a rough natural rocky shore which is difficult to walk on. A ‘not sure’ option was always included in the answer options for people who were not knowledgeable on the subject matter and for those who did not have the time to complete the questionnaire. Articulation problems were addressed by showing pictures of how the proposed artificial bathing platforms would look like in reality (Figures 3.2 – 3.5). Another issue which affected the completeness of responses was the individuals’ interests. For example people who do not go swimming were not able to fill the questionnaire since most of the questions were about coastal recreational environments.

3.3 Application of GIS software
GIS is an ideal spatial planning tool for coastal development projects where land use, demographic, geomorphic, and infrastructural data all come into play (Reilly, 2011). ArcMap 10 was used to create a series of maps showing possible rocky shore areas at the northeast coast of Malta where artificial bathing platforms could be installed. ArcCatalog 10 was used to create the shapefiles for the wooden decking platforms, rock amalgam covered concrete platforms and sandy beaches. The methodology used to produce these maps is described below:

1. A satellite image of the Earth with the name ‘World Imagery’ was uploaded on ArcMap by clicking File, ArcGIS Online and searching for ‘Satellite imagery’ in the text box provided. The satellite image ‘World Imagery’ was zoomed on the northeast coast of Malta. The coordinate system for ‘World Imagery’ is the WGS 1984 Web Mercator (Auxiliary Sphere).

2. For the ‘wooden decking platforms’, ‘rock amalgam covered concrete platforms’ and ‘sandy beaches’ shapefiles, two separate folders were created using ArcCatalog; one for sandy beaches and the other for the two types of artificial bathing platforms. These shapefiles were created by clicking File, New and Shapefile. The name of each shapefile was entered and the Polygon feature type was selected. The coordinate system for each shapefile was set to match that of ‘World Imagery’. This was done as follows: under Spatial Reference click Edit, Select, double-click Projected Coordinate System, double-click World, select WGS 1984 Web Mercator (Auxiliary Sphere).prj and click Add.
3. In ArcMap, the three shapefiles were added by clicking *Add Data*. With the map editor turned on (click *Editor* and *Start editing*), wooden decking platforms were drawn as rectangular brown polygons on karst rocky shore areas at Sliema and Bahar ic-Caghaq (the two most frequently chosen localities by respondents - refer to Figure 4.30, Section 4.5.1.5, Chapter 4). The length and width of each rectangular polygon was specified to have the following dimensions: 5.04 meters by 4.4 meters, as stated by the Maltese supplier of wooden decking platforms (see Section 4.1.3, Chapter 4). This was done by drawing the first vertex, then the second vertex (which determines the angle of the rectangle), then pressing *W* to set the width (in meters) and *L* to set the length of the rectangle (in meters). Rock amalgam platforms were drawn as peach-coloured polygons on existing concrete platforms at Sliema, Bahar ic-Caghaq and Bugibba (the three most frequently chosen localities by respondents - refer to Figure 4.31, Section 4.5.1.5, Chapter 4). The total surface area covered by these new rock amalgam platforms was calculated as follows: open the *attribute table* of the ‘rock-amalgam covered concrete platforms’ layer and add a new field. Name it *Surface Area*. Set the field type to *Long Integer*. With the map editor turned on, right click on the *Surface Area* field and select *Calculate geometry*. For *Property* select *Area*. Make sure that the coordinate system is ‘WGS 1984 Web Mercator Auxiliary Sphere’. For the *Units* select *Square meters* and select *Ok*. To display the surface area in m² covered by each rock amalgam platform on the map, right click the layer name in the table of contents, select *Properties*, click *Labels* and for the Label Field select *Surface area*. The individual surface areas of each rock amalgam platform on the map were added to determine the total surface area covered by them. This was done to calculate their actual cost and the beach users which could be accommodated on them. Sandy
beaches were drawn as yellow-coloured polygons using the polygon construction tool of the Map Editor.

4. Reference to the photos taken during the field survey was made to help pinpoint the exact location where these artificial bathing platforms would be installed.

5. Three satellite images of the proposed localities for installing these artificial bathing platforms, i.e. Sliema, Bahar ic-Caghaq and Bugibba, were exported in JPEG format. These three images are shown in Figures 4.32, 4.33 and 4.34, Section 4.5.2, Chapter 4.

A similar methodology to the one described above was used to create four maps representing the field survey which was divided into four fieldtrips (Figures 4.4, 4.6, 4.8 and 4.10, Sections 4.4.1 to 4.4.4, Chapter 4). The red lines (representing the route taken by the author) and the green lines (representing cliffs/boulder scree at the coastline) were drawn as polylines using the Map Editor while buildings which prohibited access to the rocky shore were drawn as polygons using a line fill symbology.

3.4 Application of GIMP to create photomontages

GIMP, a graphics editing software, was used to create photomontages showing the exact location of some of the photos taken during the field survey onto a satellite
image of the northeast coast of Malta. Below are step-by-step instructions to create these photomontages, based on GIMP version 2.8.6:

Open GIMP. Go to File and click Open. Choose the image file to set as the background picture, in this case, the satellite image showing Malta’s northeast coast, and click Open. Do the same to open the field photo that needs to be superimposed onto the background picture. Go to the window which contains the field photo and click Edit and Copy. Go back to the window which contains the satellite image and click Edit, Paste as and select New Layer. Scale down the pasted layer (field photo) by clicking Tools, Transform Tools and select Scale. Make sure that the scale is in percentage and not in pixels and that both the width and the height of the pasted layer are reduced simultaneously. The pasted layer can be moved around by clicking Tools, Transform Tools and select Move. To paste another photo on the satellite image follow the same procedure just described. To switch between the pasted layers (field photos), click Layer, Stack and choose either Select Next Layer or Select Previous Layer. To draw a line from the field photos to their exact location on the satellite image, the photomontage was exported by clicking File and choosing Export. The file extension type was set to ‘.bmp’ to be able to open the image in Paint. Click Export again in the dialogue box which appears. The image file was opened in Paint, and connecting lines were drawn from the field photos to their actual location on the satellite image. When finished, the whole image was selected and copied and pasted it in Word.
3.5 Use of SPSS to present and analyze questionnaire results

SPSS is a software for statistical analysis commonly used in the social sciences. The advantage of using SPSS is that it enables the researcher to analyze quantitative and qualitative data quickly and in many different ways (Cachia, 2002). “SPSS is particularly well adapted for gathering and processing data related to beach and rocky shore user preferences and priorities” (Micallef et al., 2009a, p.80). The procedure used to enter the questionnaire data into SPSS is described below:

1. A total of 22 variables were inputted in the ‘Variable view’ of SPSS as shown in Table 3.2.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Width</th>
<th>Decimals</th>
<th>Label</th>
<th>Values</th>
<th>Missing</th>
<th>Columns</th>
<th>Align</th>
<th>Measure</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location_1</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Location of survey</td>
<td>[1] Voltaic</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_1</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Nationality</td>
<td>[1] Maltese</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_2</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Age group</td>
<td>[1] Under 20</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_3</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Which of these coastal environments do you prefer for your recrea...</td>
<td>[1] Rocky +</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_4</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>If your preference in Question 3 is not 'Rocky shores', in the case...</td>
<td>[1] Retain</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_5</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>If your preference in Question 3 is not 'Rocky shores', in the case...</td>
<td>[1] Retain</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_6</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Would you make more use of rough rocky shores if they have temp...</td>
<td>[1] Not</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_7</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Would you make more use of rough rocky shores if they have temp...</td>
<td>[1] Not</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_8</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Acceptability of temporary wooden deck platform overlaid on you...</td>
<td>[1] Strongly</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_9</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Acceptability of permanent artificial rock armour on rocky shore...</td>
<td>[1] Strongly</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_10</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>How would you rate the present level of use of Mellieha's rough horizo...</td>
<td>[1] Low</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_11</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Do you think that wooden deck platform would have a negative...</td>
<td>[1] Not</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_12</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Do you think that artificial rock armour on rocky shores would have a negative...</td>
<td>[1] Not</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_13</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Do you think that artificial rock armour on rocky shores would have a negative...</td>
<td>[1] Not</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_14</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Do you think that artificial rock armour on rocky shores would have a negative...</td>
<td>[1] Not</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_15</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>How much are you prepared to pay for using wooden deck platforms...</td>
<td>[1] Nothing</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_16</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>How much are you prepared to pay for using artificial rock armour on rocky shores...</td>
<td>[1] Nothing</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_17</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Where do you think is the most appropriate kind rocky shore local...</td>
<td>[1] Where</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
<tr>
<td>Question_18</td>
<td>Numic</td>
<td>0</td>
<td>0</td>
<td>Where do you think is the most appropriate rocky shore locality for...</td>
<td>[1] Where</td>
<td>None</td>
<td>Right</td>
<td>Nominal</td>
<td>Input</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.2: Table showing all the variables from the questionnaire inputted in the variable view

2. Answers to each variable were coded into different values. For example for the answer labels ‘no’, ‘yes’ and ‘not sure’, the values of ‘1’, ‘2’ and ‘3’ were given respectively.
3. Data from the 400 questionnaires was entered in the ‘Data view’. 22 variables had to be inputted for each of the 400 cases. Where respondents left empty answers, the respective variable cell was also left empty.

To present graphically the questionnaire results, pie charts and bar charts were used. These graphic presentations are also known as descriptive statistics. Below are the instructions to create these two charts in SPSS, written with the help of Dr. Liberato Camilleri.

To create a pie chart, go in the Data View. Click Graphs, Legacy Dialogs, and select Pie. In the new window which appears click Define. In the Slices Represent section click % of cases. In the Define Slices by text box enter the variable which is to be presented. Click OK. To create a bar chart, click Graphs, Legacy Dialogs, and select Bar. In the new window which appears click Define. In the Bars Represent section click % of cases. In the Category Axis text box enter the variable which is to be presented. Click OK.

The seven objectives of the questionnaire outlined at the beginning of Section 3.2 were analyzed using two non-parametric tests; Chi-square and Friedman Test. The reason for choosing the non-parametric test category was because the questionnaire data is not normally distributed (i.e. categorical) and is skewed (Camilleri, n.d.).

3.5.1 Cross tabulations (contingency tables) and Chi-square
In a cross tabulation the values of the two variables are displayed in columns and rows. Values of one variable are displayed in columns and values from the other variable are displayed in rows. The cells are formed by the intersection of the columns and rows and these cells display the number of cases where the value from the respective column and the respective row intersect (Camilleri, n.d.).

The Chi-square test is used to determine whether there exists a significant association between two related categorical variables. The null hypothesis specifies that there is no association between the two categorical variables (row or column percentages in the cross tabulation are comparable) and is accepted if the \( p \)-value exceeds the 0.05 level of significance (Camilleri, n.d.). The alternative hypothesis specifies that there is a significant association between the two categorical variables and is accepted if the \( p \)-value is smaller than the 0.05 criterion (Camilleri, n.d.). “Generally, a significance level less than 0.05 is required for a statistical relationship to be significant or accepted as not occurring by chance” (NOAA, 2007, p.13). A significance level of 0.05 thus means that there is a 5 percent probability that the association between the two categorical variables occurs by chance.

To perform the Chi-square test, the following steps have to be followed (based on IBM SPSS Statistics version 21) (Note: these instructions were written with the help of Dr Liberato Camilleri):

From the Menu bar, choose Analyze, Descriptive Statistics and click Crosstabs. Generally the variable which has the most categories is entered into the Row(s) text box and the variable with least categories is entered in the Column(s) text box. To
perform the Chi-square test, first click *Statistics* and tick *Chi-square* in the new dialogue box that appears. Press *Continue*. To calculate the Fisher’s exact test (more accurate than the Pearson Correlation coefficient and is recommended to use when there is more than one cell in the cross tabulation with an expected value less than 5), click *Exact* and select *Exact*. Press *Continue*. Click *Cells* and select *Observed* counts and tick either *Row* or *Column* percentages as necessary.

To create a clustered bar graph to display graphically the association between the two variables, click *Graphs, Legacy Dialogs, Bar, Clustered, Define* and tick *% of cases*. In the *Category axis* text box enter the variable which has to be displayed on the x-axis and in the *Define clusters by* text box enter the variable which differentiates the responses for that variable (e.g. nationality).

### 3.5.2 Friedman test

This test is used to compare the mean rating scores provided for a number of related statements. The null hypothesis specifies that the mean rating scores of all related statements are comparable and is accepted if the $p$ ($\alpha$) value exceeds the 0.05 level of significance. The alternative hypothesis specifies that the mean rating scores provided for the related statements differ significantly and is accepted if the $p$-value is less than the 0.05 criterion. Each statement is measured on a 5-point Likert scale (Camilleri, n.d.). For example, in Question 7 of the Questionnaire where respondents had to rate the level of acceptability of these artificial bathing platforms, 1 corresponds to ‘Strongly unacceptable’ and 5 corresponds to ‘Strongly acceptable’. To conduct the
Friedman test, these steps have to be followed (Note: these instructions were written with the help of Dr Liberato Camilleri):

Go to Analyze, Nonparametric Tests, Legacy Dialogs and click K Related Samples. Move the variables that are to be analyzed into the Test Variables text box. Click Statistics and select Descriptives, press Continue and click OK.

To produce an error bar chart to be able to compare the ranges of the mean rating scores between the related statements, go to Graphs, Legacy Dialogs, Bar, Simple, Summaries of separate variables and click Define. Enter the variables that are to be analyzed in the Bars Represent text box. Click Options, tick Display Error Bars, Continue and OK. The error bars show the population mean with 95% level of confidence.
4. Results and Data Analysis

Preface

This chapter starts by comparing the costs and the beach users who can be accommodated at St. George’s Bay and Bugibba Perched Beach with those of wooden decking platforms and rock amalgam covered concrete platforms. An account of inaccessible coastal areas, karst rocky shore areas and smooth rocky shores found along the northeast coast of Malta is given in section 4.4. This is accompanied by maps showing the four different fieldtrips and photomontages of the field survey photos on Malta’s northeast coast. Descriptive statistics were used to present the questionnaire results. Maps showing potential sites for the installing these artificial bathing platforms at Sliema, Bahar ic-Caghaq and Bugibba are presented in Section 4.5.2. Various hypotheses were analyzed using Chi-square and Friedman tests. Descriptions for each hypothesis result are presented. The problems encountered with hand-delivered questionnaires are summarized at the end.
4.1 Quantifying the costs of past beach nourishment projects and potential future artificial bathing platforms in Malta

4.1.1 St. George’s bay

Ebejer (2004) stated that €85,860 were spent by the Maltese government to source, transport and place the sand at St. George’s Bay as part of the gross sum of €236,115 for other complementary beach replenishment works such as a storm water system, the upgrading of the sewerage system and the building of the promenade. In addition, an annual charge of €4,300 is incurred by the MTA on beach maintenance “in order to compensate for any losses of sediment from the replenished beach during severe storm events” (ICoD, 2001, p.4).

The total surface area of St. George’s Bay is 2,445 m². This figure was calculated using Google Maps Area Calculator Tool as shown in Figure 4.1. Therefore, using the gross sum stated earlier by Ebejer (2004) for the overall cost of St. George’s bay nourishment project (€236,115), the cost per square meter would be €96.57/m² (€236,115/2,445 m²).
4.1.2 Bugibba Perched Beach

The creation of this artificial beach cost €195,982 (Times of Malta, 2006). This gross sum is divided as follows: €50,657 were spent for the procurement and spreading of the beach fill, €84,143 for marine and civil engineering and road works, €10,303 on finishing, €13,781 on electrical, mechanical, plumbing and lighting, €2,576 on landscaping, €4,722 on the metal railings, life guard post and the timber boardwalk (Times of Malta, 2006).

The total surface area of Bugibba Perched Beach is 1,676 m². This figure was calculated using Google Maps Area Calculator Tool as shown in Figure 4.2. Therefore, using the gross sum mentioned earlier in the Times of Malta (2006) for the overall cost of Bugibba Perched Beach project (€195,982), the cost per square meter would be €116.93/m² (€195,982/1,676 m²).
4.1.3 Wooden decking platforms

The cost of one teak deck, 5.04 meters in length, 4.4 meters in width (a surface area of 22.176 m²) and 4.4 cm thick, as quoted from a Maltese company, is €523.92. This figure excludes the stainless steel metal base under the wooden deck. Other information pertaining to the teak deck includes maintenance, which is typically once every year and the average use life span which is approximately 10 years (Bolin et al., 2011). The cost of a stainless steel ladder for access to and from the sea is €175.64¹.

A stainless steel metal frame of 4.04 meters in length and 3.4 meters in width would support the teak deck. This metal frame has ten 15 cm legs welded to its underside, as shown in Figure 4.3. Altogether, the metal base (including the ten legs) costs around €1,517 (Azzopardi, 2013). This sum includes a hollow section (10 cm*10 cm) which

costs €1,050, a flat bar (10 cm*12 cm) which costs €267, forty holding-down bolts (1 cm*10.5 cm) which cost €120 and forty fisher screws (0.8 cm*6 cm) which cost €80 (Azzopardi, 2013).

Figure 4.3: Annotated diagram of the complete wooden decking platform (with metal frame) seen from the underside

Therefore the total cost of one wooden decking platform or one ‘unit’ which includes the teak deck, the stainless steel base and a ladder for access to and from the sea would be around €2,216.56 (excluding VAT). However this sum can be significantly reduced if a bulk order of these wooden decking platforms is made.

Other costs which have to be considered include manufacturing, transportation, installation and uninstallation of these wooden decking platforms. The manufacturing cost of the metal frame with ten legs includes welding, electricity, argon gas, acid for cleaning, etc. and can be assumed to be twice as much as the cost of the whole metal base i.e. €3,034 (€1,517*2) (Azzopardi, 2013). The installation and uninstallation of
these wooden decking platforms at the site would require renting a crane at a cost of approximately €100. Assuming the crane charges €25 per hour and the whole operation takes eight hours, this would amount to €300 (€100 + (€25 * 8)) (Azzopardi, 2013). In addition, an extended crane jib to transport the wooden decking platforms from the road to their location on the rocky shore would cost around €80. The installation of these units onto the rocky shore also requires recruiting about four persons. Assuming that each person is paid an average hourly wage of €6/hour and that the operation takes eight hours to complete, the labor cost would be €192 (€6*8hrs.*4) (Azzopardi, 2013). There is also the cost of hiring two wardens to close the road so that the crane can maneuver while handling these wooden decking platforms. Given that it costs €2.33 for road closure (quoted from Kalkara Local Council), that each warden is paid €4.50/hour (personal communication with a Transport Malta officer) and that the whole procedure takes eight hours, the total cost would be €74.33. Storage costs would involve renting a large warehouse of 520 m² (i.e. accommodating circa 23 ‘units’) for a cost of €2,000 per month. It is assumed that the 123 units installed at Sliema and Bahar ic-Caghaq would fit into one warehouse, piled over each other. Therefore, to store these wooden decking platforms during the eight months of the year (excluding the four months of summer that these platforms would be in operation) would cost €16,000 (€2,000*8). There is also the cost of hiring basic facilities such as portable toilets (€54/portable toilet per week2), umbrellas and sunloungers (€10/day for a set of an umbrella and two sunloungers3).

2 http://www.approvedindex.co.uk/a/portabletoilets/portable-toilet-hire-prices/
3 http://www.tripadvisor.com/ShowTopic-g190311-i348-k5676810-How_much_for_umbrella_deckChair_hire-Malta.html
Furthermore, 18% VAT must be added to the total cost of these wooden decking platforms (Azzopardi, 2013).

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teak deck</td>
<td>€523.92</td>
</tr>
<tr>
<td>Stainless steel base</td>
<td>€1,517</td>
</tr>
<tr>
<td>Manufacturing costs of the whole metal base</td>
<td>€3,034</td>
</tr>
<tr>
<td>Stainless steel swim ladder</td>
<td>€175.64</td>
</tr>
<tr>
<td>Installation &amp; removal costs</td>
<td>€572 (€380 + €192)</td>
</tr>
<tr>
<td>Storage costs</td>
<td>€16,000/year⁴</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>€380/year⁵</td>
</tr>
<tr>
<td>Wardens &amp; road closure</td>
<td>€74.33</td>
</tr>
<tr>
<td>Value added tax (VAT)</td>
<td>€0.18</td>
</tr>
<tr>
<td>Recycling/Disposal costs</td>
<td>/</td>
</tr>
</tbody>
</table>

Table 4.1: Table summarizing the whole life cycle and other costs associated with wooden decking platforms.

4.1.4 Rock amalgam covered concrete platforms

The cost of ready-mixed, coloured fiber-reinforced concrete (FRC) which is the material for the new rock amalgam platforms, was quoted by a Maltese company as costing €50/m² (Ellis, 2013). The thickness of the FRC slab is typically 15 cm, the lifespan is 10 years (minimum) and the compressive strength is classified as C30.

⁴ http://www.remax-malta.com/commercial_malta.aspx#pr5
⁵ http://www.redbeacon.com/hg/5-tips-maintain-wooden-deck/
meaning that once completely solidified, this FRC has a compression resistance of 30 N/mm² (measured on the 28th day since overlaying on the old surface) (Alilou et al., 2010). There is also the finishing cost which involves spraying the FRC slab surface with a colour hardener which mimics natural rock (Ellis, 2013).

### 4.1.5 Cost of beach nourishment projects vs. artificial bathing platforms

**Beach nourishment in Malta**

The overall cost of a typical Maltese beach nourishment project is €106.75/m² (this figure is the average cost of St. George’s Bay and Bugibba Perched Beach nourishment projects quoted in Sections 4.1.1 and 4.1.2 respectively).

<table>
<thead>
<tr>
<th>Wooden decking platforms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teak deck (22.2 m²)</td>
<td>€523.92</td>
</tr>
<tr>
<td>Stainless steel base</td>
<td>€1,517</td>
</tr>
<tr>
<td>Manufacturing costs of the whole metal base</td>
<td>€3,034</td>
</tr>
<tr>
<td>VAT</td>
<td>€0.18</td>
</tr>
<tr>
<td>Total cost of one ‘unit’</td>
<td>€5,988.41</td>
</tr>
</tbody>
</table>

*Table 4.2: Table showing the individual costs for producing one ‘unit’*
The cost of wooden decking per square meter is €270/m² (€5,988.41/22.176 m² (surface area of one ‘unit’)). At the coastline of Sliema and Bahar ic-Caghaq a total of 123 units are being proposed. Therefore, the total cost of these 123 wooden decking platforms would be €736,465 (€270*(123*22.176 m²)).

Rock amalgam covered concrete platforms

The cost of producing coloured FRC as the rock amalgam material is €50/m² (Ellis, 2013). The total surface area of these rock amalgam covered concrete platforms at Sliema, Bahar ic-Caghaq and Bugibba is 12,415 m². This figure was calculated using ArcMap 10 (see Point 3, Section 3.3, Chapter 3). Therefore, the total cost of these rock amalgam covered concrete platforms would be €620,750 (€50*12,415 m²).

4.2 Additional beach users

4.2.1 Wooden decking platforms

Assuming a minimum beach space of 3 m²/beach user as stated by Micallef (2003), the 123 wooden decking platforms installed at Sliema and Bahar ic-Caghaq, would accommodate 909 additional beach users \( \left( \frac{22.176 \text{ m}^2 \times 123}{3 \text{ m}^2} \right) \).

4.2.2 Rock amalgam covered concrete platforms
Assuming the same 3 m²/beach user figure, the 12,415 m² of new rock amalgam covered concrete platforms installed at Sliema, Bahar ic-Caghaq and Bugibba would accommodate around 4,138 additional beach users (12,415 m²/3 m²).

4.2.3 St. George’s Bay

Assuming the same 3 m²/beach user, St. George’s Bay which has a surface area of 2,445 m² can accommodate approximately 815 beach users (2,445 m²/3 m²). A similar figure is quoted by ICoD (2001) for the additional beach users St. George’s bay could accommodate after being replenished, i.e. 660 additional beach users.

4.2.4 Bugibba Perched Beach

Assuming the same 3 m²/beach user, Bugibba Perched Beach which has a surface area of 1,676 m² can accommodate approximately 559 beach users (1,676 m²/3 m²).

4.3 Socio-economic feasibility summary

<table>
<thead>
<tr>
<th>Recreational option</th>
<th>Surface area (m²)</th>
<th>Actual cost (£)</th>
<th>Cost (£/m²)</th>
<th>Additional beach users</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. George’s Bay</td>
<td>2,445</td>
<td>236,115</td>
<td>97</td>
<td>815</td>
</tr>
<tr>
<td>Bugibba Perched Beach</td>
<td>1,676</td>
<td>195,982</td>
<td>117</td>
<td>559</td>
</tr>
</tbody>
</table>
| Wooden decking platforms | 2,727.6  
|                          | (22.176*123)  
| Rock amalgam covered concrete platforms | 12,415  
|                                         | 620,750  
|                                         | 50  
|                                         | 4,138  

Table 4.3: A socio-economic account of the four options considered in this study to increase bathing areas at the northeast coast of Malta

4.4 Results from the field survey

Inaccessible areas along the northeast coast of Malta were the result of human factors such as private beach concessions and encroachments which extended up to the shoreline and physical factors such as high rugged cliffs (“rdum”) and boulder scree. “Rdum” and boulder scree comprised the coastline from Xemxija to Cirkewwa. Rough karst rocky shore areas extended from St. Julian’s to Salini (Pembroke and Bahar ic-Caghaq included) and were also found at Cirkewwa. Existing concrete platforms were densest at Sliema - St. Julian’s, Qawra - Bugibba - St. Paul’s Bay and less dense at the two bays of Armier.

4.4.1 Sliema and St. Julian’s
Figure 4.4: Satellite image showing the route of Fieldtrip 1 which comprised of the coastline of Sliema and St. Julian’s

Figure 4.4 shows the route the author took along the coastline. Buildings which prohibited rocky shore access consisted of lidos, restaurants, illegal boathouses and hotels. St. Julian’s area is heavily restricted in public shore access mainly due to the
numerous hotels at the coastline, particularly Cavalieri hotel, Westin Dragonara Resort & Casino and Corinthia San Gorg but also the Portomaso yacht marina which blocks shore access with large concrete boulders placed at its boundaries. Sliema coastline mainly consists of smooth rocky shores and concrete platforms. St. Julian’s area on the other hand, has more karst rocky shore areas, particularly behind Hilton and Radisson hotels (see Figures 6.1 and 6.2, Section 6.4, Chapter 6). The total length of the coastline of Fieldtrip 1 was about 9.1 km. This distance was calculated using Google Maps Distance Calculator Tool. Smooth rocky shores (including the developed coastline) comprised approximately 62% of the coastline, karst rocky shores comprised 11%, while inaccessible rocky shores comprised 24%.
Figure 4.5: Satellite image showing the field survey photos taken during fieldtrip 1 pinpointed to their exact location. Photomontage made using GIMP

4.4.2 Pembroke and Bahar ic-Caghaq
Figure 4.6: Satellite image showing the route of Fieldtrip 2 which started from Pembroke and ended at Salini.

Fieldtrip 2 started at Pembroke recreational park and ended at the Coastline hotel at Salini. This stretch of coastline mostly consists of karst rocky shores with floral assemblages of *Agave americana* amongst others. Human development is absent except for a few boathouses, the Splash & Fun water park and the Mediterraneo marine park at Bahar ic-Caghaq. Starting at Qalet Marku, there were notices at regular distances which prohibited swimming in this area. In fact this whole stretch of coast starting from Bahar ic-Caghaq until St. Paul’s Bay (including Qalet Marku area) is an
official non-bathing area according to the Malta Environmental Health Directorate\textsuperscript{6}. This whole stretch of coast was publicly accessible at the time of the survey, i.e. in December 2012. The total length of Fieldtrip 2 was about 10.05 km. This distance was calculated using Google Maps Distance Calculator Tool. Smooth rocky shore areas comprised approximately 33\% of the coastline while karst rocky shore areas comprised the remaining 67\%. There were no inaccessible shore areas along this coastline.

Figure 4.7: Satellite image showing the field survey photos taken during Fieldtrip 2 pinpointed to their exact location. Photomontage made using GIMP

4.4.3 Qawra, Bugibba, St. Paul’s Bay and Xemxija

Fieldtrip 3 started from Qawra and ended at Xemxija. The east side of Qawra was characterized by boathouses, concrete platforms and hotels. The hotels present restricted public access to the rocky shore (the hatched black areas in Figure 4.8). The north and northeast sides of Qawra comprised of karst rocky shore areas. The coastline of Qawra, Bugibba and St. Paul’s Bay was similar to that of Sliema due to the high density of concrete platforms. Inaccessible rocky shore areas at Bugibba, St. Paul’s Bay and Xemxija were both due to human factors such as resorts, beach clubs and restaurants and natural factors, such as the boulder scree found at St. Paul’s Bay (marked as a green line in Figure 4.8). The total length of the coastline of Fieldtrip 3
was about 9.64 km. Smooth rocky shores (including the developed coastline) comprised approximately 73% of the coastline, karst rocky shores comprised 6% while inaccessible rocky shores comprised 21%.

Figure 4.9: Satellite image showing the field survey photos taken during Fieldtrip 3 pinpointed to their exact location. Photomontage made using GIMP

4.4.4 Mellieha, Armier and Cirkewwa
Fieldtrip 4 consisted of long tracts of very rugged karst rocky shores particularly at Cirkewwa. Boulder scree characterized the east side of Mellieha Bay and was also found at “l-Ahrax tal-Mellieha”. Steep, vertical cliffs characterized the east side of Marfa ridge. Concrete platforms at the two bays of Armier were probably made illegally by the residents of boathouses to have improved sea access. There are also numerous kiosks at this area and a lido pertaining to the Ramla Bay Resort which blocks public accessibility to the foreshore (the large hatched black area in Figure 4.10). The total length of the coastline of Fieldtrip 4 was about 4.7 km. Smooth rocky shores (including the developed coastline) comprised approximately 41% of the coastline, karst rocky shores comprised 45%, while inaccessible rocky shores due to natural and human factors comprised 14%.
4.5 Questionnaire results

4.5.1 Descriptive statistics

The sample size for a population greater than 250,000 individuals was decided to be 400 since this produces a margin of error of +/- 5% at the 95% confidence level (see Table 3.1, Section 3.2, Chapter 3).
4.5.1.1 Characteristics of the respondents

Figure 4.12: Pie chart showing the percentages of Maltese and foreign respondents

Figure 4.12 shows that 88% of respondents were Maltese while only 13% were foreigners. This created a bias towards Maltese respondents in the questionnaire results as foreigners are an unrepresentative sample of the total foreigners’ population who visit or reside in Malta.
Figure 4.13: Pie chart showing the age distribution of respondents in percentages

Figure 4.13 shows that 42% of respondents were in the 50+ age group. 36% were in the ‘under 30’ category while 23% were between 30 and 49 years old.

4.5.1.2 Coastal recreational environments

Figure 4.14: Pie chart showing the preferred beach type of respondents
Figure 4.14 shows that 44% of respondents preferred rocky shores while 47% preferred sandy beaches for their recreational activities. In contrast, only 9% preferred private beaches. With regards to nationality, although a higher percentage of Maltese (46%) than foreigners (35%) preferred rocky shores and a higher percentage of foreigners (55%) than Maltese (46%) preferred sandy beaches, these results cannot be inferred to the whole Maltese and foreigners’ population since the Chi-square test showed a 33% probability that this result occurred by chance (i.e. greater than the 5% margin of error) (see Section 4.5.3.1, Chapter 4).

Respondents were asked to rate the present level of use of Malta’s rough, karst rocky shore areas. Figure 4.15 illustrates the survey results.
Figure 4.15 shows that 49% of respondents considered Malta’s rough karst rocky shores as being sparsely used by people, 35% considered them as moderately used while 15% thought they are highly used for leisure and recreational activities.

Respondents were also asked whether they have enough space when they go to their preferred sandy beach for bathing purposes. Figure 4.16 illustrates the survey results.

Figure 4.16 shows that 62% of respondents thought that there is not enough space at Maltese sandy beaches for leisure activities. In contrast, 24% thought the opposite. 15% were not sure since beach space depends on the time, the day and on the individual preferences. In addition, respondents who were not sure were those who do not go to sandy beaches or who do not like swimming. With regards to differences between Maltese and foreigners in beach crowdedness perception, there was not a
significant difference between the two since the Chi-square test showed a 21% probability that the result occurred by chance (see Section 4.5.3.6).

4.5.1.3 Artificial bathing platforms compared to conventional coastal recreational environments

![Figure 4.17: Bar chart showing the respondents preference for wooden decking platforms compared to sandy beaches](image)

Figure 4.17 shows that 34% of respondents would still prefer sandy beaches, 42% would make use of both options and 24% would prefer karst rocky shores with wooden decking platforms. With regards to differences between Maltese and foreigners in their preference for wooden decking platforms vs. sandy beaches, there was not a significant difference in nationality since there was 12% probability that the Chi-square test result occurred by chance (see Section 4.5.3.2).
Figure 4.18 shows that 31% of respondents would still prefer private beaches, 22% of respondents would not have any preference while 47% would change their preference for wooden decking platforms. With regards to differences between Maltese and foreigners in their preference for wooden decking platforms with respect to private beaches, there was not a significant difference in nationality since there was 33% probability that the Chi-square test result occurred by chance (see Section 4.5.3.3).
Figure 4.19 shows that 38% of respondents would still prefer sandy beaches, 47% would not have any preference while 15% would change their preference for rock amalgam covered concrete platforms. With regards to differences between Maltese and foreigners in their preference for rock amalgam covered concrete platforms with respect to sandy beaches, there was not a significant difference in nationality since there was 30% probability that the Chi-square test result occurred by chance (see Section 4.5.3.2).
Figure 4.20: Bar chart showing the respondents’ preference for rock amalgam covered concrete platforms compared to private beaches.

Figure 4.20 shows that 28% of respondents would still prefer private beaches, 33% would have equal preference for the two options while 39% would prefer rock amalgam covered concrete platforms. With regards to differences between Maltese and foreigners in their preference for rock amalgam covered concrete platforms with respect to private beaches, there was not a significant difference in nationality since there was 84% probability that the Chi-square test result occurred by chance (see Section 4.5.3.3).

Figures 4.21 and 4.22 below show whether these artificial bathing platforms would increase the number of people making use of rocky shores.
Figures 4.21 and 4.22 show that 81% of respondents for wooden decking platforms and 71% for rock amalgam covered concrete platforms would make more use of rocky shores with these platforms installed. In contrast, only 10% of respondents for wooden decking platforms and 14% for rock amalgam covered concrete platforms...
would not make increased use of rocky shores. Similarly, 9% of respondents for wooden decking platforms and 15% for rock amalgam covered concrete platforms were unsure. With regards to differences in nationality for the increased use of karst rocky shores with wooden decking platforms, there was not a significant difference between Maltese and foreigners since the Chi-square test gave an 88% probability that the result occurred by chance (see Section 4.5.3.4). With regards to differences in nationality for the increased use of rocky shores with rock amalgam covered concrete platforms, there was also not a significant difference between the two nationalities since the Chi-square test gave a 7.5% probability that the result occurred by chance (see Section 4.5.3.4).

Respondents were then asked whether the potential economic and social benefits of these artificial bathing platforms would outweigh the negative environmental impacts they might have on the rocky shore/marine ecology, such as toxic chemicals from these artificial bathing platforms dissolving in seawater.
Figure 4.23: Pie chart showing the public opinion for the negative environmental impacts wooden decking platforms could have on the karst rocky shore

Figure 4.23 shows that 72% of respondents thought that wooden decking platforms would not have negative environmental impacts, 15% thought otherwise while 13% were unsure.

Figure 4.24: Pie chart showing the public opinion of whether the social and economic benefits of wooden decking would outweigh their potential negative environmental impacts
Figure 4.24 shows that 75% of respondents thought that the social and economic benefits of wooden decking platforms would outweigh their negative environmental impacts. In contrast, only 13% did not agree with this statement while another 13% were unsure.

Figure 4.25: Pie chart showing the public perception for the negative environmental impacts rock amalgam covered concrete platforms could have on the rocky shore

Figure 4.25 shows that 57% of respondents thought that new rock amalgam covered concrete platforms would not have negative environmental impacts on the rocky shore, 20% thought otherwise, while 24% were unsure.
Figure 4.26: Pie chart showing the public opinion as to whether the socio-economic benefits of rock amalgam covered concrete platforms would outweigh their negative environmental impacts

Figure 4.26 shows that 66% of respondents thought that the socio-economic benefits of rock amalgam covered concrete platforms would outweigh their negative environmental impacts, 17% did not agree with this statement while another 17% were unsure.

Respondents were also asked whether they prefer the two types of artificial bathing platforms rather than artificial sandy beaches (beach nourishment schemes). Figure 4.27 illustrates the survey results.
Figure 4.27: Pie chart showing the results for the public preference of artificial bathing platforms at rocky shores compared to artificial sandy beaches

Figure 4.27 shows that 71% of respondents preferred artificial bathing platforms while only 14% preferred artificial sandy beaches. 16% were unsure or did not have any preference for either of the two options. With regards to differences between Maltese and foreigners in their preference for either artificial bathing platforms or artificial sandy beaches, there was not a significant difference in nationality since there was a 19% probability that the Chi-square test result occurred by chance (see Section 4.5.3.5).

### 4.5.1.4 Willingness-To-Pay for artificial bathing platforms

Figures 4.28 and 4.29 show the survey results for the public’s willingness-to-pay (WTP) for artificial bathing platforms.
Figures 4.28 and 4.29 show that 51% of respondents for wooden decking platforms compared to 63% for rock amalgam covered concrete platforms would not be willing to pay for the use of these platforms. Respondents were also prepared to pay more for the use of wooden decking platforms than rock amalgam covered concrete platforms.
This relationship is shown by comparing the ‘€3 to €4’ and ‘€5’ categories of Figures 4.28 and 4.29. With regards to differences between Maltese and foreigners in their WTP for wooden decking platforms, Maltese respondents were willing to pay more than foreigners for the use of wooden decking platforms (see Section 4.5.3.7). With regards to differences between Maltese and foreigners in their WTP for rock amalgam covered concrete platforms, Maltese respondents were also willing to pay more than foreigners for the use of rock amalgam covered concrete platforms (see Section 4.5.3.7).

4.5.1.5 Proposed localities for installing artificial bathing platforms

Respondents were asked to suggest localities along the northeast coast of Malta where they would want wooden decking platforms and rock amalgam covered concrete platforms to be installed. Figures 4.30 and 4.31 show these results.
Figure 4.30 shows that 22% of respondents chose Bahar ic-Caghaq and 20% chose Sliema for installing wooden decking platforms. Other localities were chosen by less than 10% of respondents. With regards to differences between Maltese and foreigners, 38% of foreigners compared to 18% of Maltese chose Sliema. On the other hand, a much higher percentage of Maltese (24%) compared to foreigners (7%) chose Bahar ic-Caghaq (see Section 4.5.3.8).
Figure 4.3 shows that 16% of respondents did not want rock amalgam covered concrete platforms to be installed anywhere, despite the fact that 13% suggested Sliema, 11% suggested Bahar ic-Caghaq and 10% suggested Bugibba. With regards to differences between Maltese and foreigners, 16% of foreigners compared to 4% of Maltese chose St. Julian’s. On the contrary, more Maltese (11%) rather than foreigners (2%) chose Bugibba. Other localities were chosen by comparable proportions of Maltese and foreigners (see Section 4.5.3.8).

4.5.2 Maps showing possible sites for installing artificial bathing platforms
Figure 4.32a: Map showing possible sites for installing artificial bathing platforms at ‘Exiles’, Sliema
Figure 4.32b: Map showing possible sites for installing artificial bathing platforms at ‘Font Ghadir’, Sliema
Figure 4.32c: Map showing possible sites for overlaying the rock amalgam on existing concrete platforms at ‘Chalet’, Sliema
Figure 4.33a: Map showing possible sites for installing artificial bathing platforms at Salini/Bahar ic-Caghaq
Figure 4.33b: Map showing possible sites for installing artificial bathing platforms at Qalet Marku/Bahar ic-Caghaq
4.5.3 Hypothesis testing

Since the variables of the questionnaire were not normally distributed, two non-parametric tests were used to analyze the following hypotheses; Chi-square test and Friedman test.

4.5.3.1 Hypothesis 1: To test whether there is an association between nationality of respondents and the preferred beach type for recreational activities.
\( H_0: \) There is no association between the nationality of respondents and the preferred beach type.

\( H_1: \) There is a significant association between the nationality of respondents and the preferred beach type.

Table 4.4: Cross tabulation showing the relationship between preferred beach type and nationality of respondents

<table>
<thead>
<tr>
<th></th>
<th>Nationality</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltese</td>
<td>Foreigners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocky shores</td>
<td>Count</td>
<td>157</td>
<td>17</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>45.5%</td>
<td>34.7%</td>
<td>44.2%</td>
</tr>
<tr>
<td>Sandy beaches</td>
<td>Count</td>
<td>157</td>
<td>27</td>
<td>184</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>45.5%</td>
<td>55.1%</td>
<td>46.7%</td>
</tr>
<tr>
<td>Private beaches</td>
<td>Count</td>
<td>31</td>
<td>5</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>9.0%</td>
<td>10.2%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>345</td>
<td>49</td>
<td>394</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher’s Exact value = 2.157, \( p = 0.331 \)

Table 4.4 displays a high proportion of Maltese (45.5\%) rather than foreigners (34.7\%) who prefer rocky shores. On the other hand, it also shows a high proportion of foreigners (55.1\%) rather than Maltese (45.5\%) who prefer sandy beaches for their recreational activities. With regards to the preference for private beaches, there is only a difference of 1.2\% between Maltese (9\%) and foreigners (10.2\%). Since the \( p\)-value (0.331) of the Fisher’s Exact test exceeds the 0.05 level of significance (i.e. more than 5\% probability that the stated association occurred by chance), we accept \( H_0 \). Therefore there is no significant difference in preferred beach type between Maltese and foreigners.
4.5.3.2 Hypothesis 2: To test whether there is an association between nationality of respondents and preference for artificial bathing platforms with respect to sandy beaches

\(H_0\): There is no association between the nationality of respondents and preference for wooden decking platforms with respect to sandy beaches.

\(H_1\): There is a significant association between the nationality of respondents and preference for wooden decking platforms with respect to sandy beaches.

Table 4.5: Cross tabulation displaying the association between nationality of respondents and preference for wooden decking platforms with respect to sandy beaches

<table>
<thead>
<tr>
<th>If you prefer sandy beaches, in the case of a rough, karst rocky shore having wooden decking platforms would you:</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retain your preference</td>
<td>Maltese</td>
<td>49</td>
</tr>
<tr>
<td>Have equal preference</td>
<td></td>
<td>69</td>
</tr>
<tr>
<td>Change your preference</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>157</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Foreigners</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>14</td>
<td>63</td>
</tr>
<tr>
<td>Percentage</td>
<td>51.9%</td>
<td>31.2%</td>
</tr>
<tr>
<td>Count</td>
<td>8</td>
<td>77</td>
</tr>
<tr>
<td>Percentage</td>
<td>29.6%</td>
<td>43.9%</td>
</tr>
<tr>
<td>Count</td>
<td>5</td>
<td>44</td>
</tr>
<tr>
<td>Percentage</td>
<td>18.5%</td>
<td>24.8%</td>
</tr>
<tr>
<td>Count</td>
<td>27</td>
<td>184</td>
</tr>
<tr>
<td>Percentage</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher’s Exact value = 4.062, p = 0.123

Table 4.5 shows that a higher proportion of foreigners (51.9%) rather than Maltese (31.2%) would still prefer sandy beaches. On the contrary, a higher proportion of Maltese (43.9%) rather than foreigners (29.6%) would not have preference for either option. In addition, 24.8% of Maltese and 18.5% of foreigners would change their
preference for wooden decking platforms. Since the $p$-value (0.123) of the Fisher’s Exact test $> 0.05$ level of significance, we accept $H_0$. Therefore there is no significant difference between Maltese and foreigners in their preference for wooden decking platforms with respect to sandy beaches.

$H_0$: There is no association between the nationality of respondents and preference for rock amalgam covered concrete platforms with respect to sandy beaches.

$H_1$: There is a significant association between the nationality of respondents and preference for rock amalgam covered concrete platforms with respect to sandy beaches.

Table 4.6: Cross tabulation displaying the association between nationality of respondents and preference for rock amalgam covered concrete platforms with respect to sandy beaches

<table>
<thead>
<tr>
<th>If you prefer sandy beaches, in the case of a rocky shore having rock amalgam covered concrete platforms, would you:</th>
<th>Retain your preference</th>
<th>Have equal preference</th>
<th>Change your preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>57</td>
<td>13</td>
<td>70</td>
</tr>
<tr>
<td>Percentage</td>
<td>36.3%</td>
<td>48.1%</td>
<td>38.0%</td>
</tr>
<tr>
<td>Count</td>
<td>77</td>
<td>9</td>
<td>86</td>
</tr>
<tr>
<td>Percentage</td>
<td>49.0%</td>
<td>33.3%</td>
<td>46.7%</td>
</tr>
<tr>
<td>Count</td>
<td>23</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Percentage</td>
<td>14.6%</td>
<td>18.5%</td>
<td>15.2%</td>
</tr>
<tr>
<td>Total Count</td>
<td>157</td>
<td>27</td>
<td>184</td>
</tr>
<tr>
<td>Percentage</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher’s Exact value = 2.457, $p = 0.298$

Table 4.6 shows that 36.3% of Maltese and 48.1% of foreigners would still prefer sandy beaches. On the other hand, 49% of Maltese and 33.3% of foreigners would have no preference for either of the two options. The difference between Maltese
(14.6%) and foreigners (18.5%) diminishes when changing preference for rock amalgam covered concrete platforms. Since the $p$-value (0.298) of the Fisher’s Exact test exceeds the 0.05 level of significance, we accept $H_0$. Therefore there is no significant difference between Maltese and foreigners for the preference of rock amalgam covered concrete platforms with respect to sandy beaches.

4.5.3.3 **Hypothesis 3: To test whether there is an association between nationality of respondents and preference for artificial bathing platforms with respect to private beaches**

$H_0$: There is no association between the nationality of respondents and preference for wooden decking platforms with respect to private beaches.

$H_1$: There is a significant association between the nationality of respondents and preference for wooden decking platforms with respect to private beaches.
Table 4.7: Cross tabulation displaying the association between nationality of respondents and preference for wooden decking platforms with respect to private beaches

<table>
<thead>
<tr>
<th>If you prefer private beaches, in the case of a karst rocky shore having wooden decking platforms would you:</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltese</td>
<td>Foreigners</td>
</tr>
<tr>
<td>Retain your preference</td>
<td>Count</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>25.8%</td>
</tr>
<tr>
<td>Have equal preference</td>
<td>Count</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>25.8%</td>
</tr>
<tr>
<td>Change your preference</td>
<td>Count</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>48.4%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher’s Exact value = 2.487, p = 0.333

Table 4.7 shows that a higher proportion of foreigners (60%) compared to Maltese (25.8%) would retain their preference for private beaches. In contrast, 25.8% of Maltese and no foreigners would have equal preference for both options. Meanwhile, 48.4% of Maltese and 40% of foreigners would change their preference for wooden decking platforms. Since the p-value (0.333) of the Fisher’s Exact test exceeds the 0.05 level of significance, we accept $H_0$. Therefore there is no significant difference between Maltese and foreigners in their preference for wooden decking platforms with respect to private beaches.

$H_0$: There is no association between the nationality of respondents and preference for rock amalgam covered concrete platforms with respect to private beaches.

$H_1$: There is a significant association between the nationality of respondents and preference for rock amalgam covered concrete platforms with respect to private beaches.
Table 4.8: Cross tabulation showing the association between the nationality of respondents and preference for rock amalgam covered concrete platforms with respect to private beaches

<table>
<thead>
<tr>
<th>If you prefer private beaches, in the case of a rocky shore having rock amalgam covered concrete platforms would you:</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retain your preference</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Maltese</td>
<td>8</td>
<td>25.8%</td>
</tr>
<tr>
<td>Foreigners</td>
<td>2</td>
<td>40.0%</td>
</tr>
<tr>
<td>Have equal preference</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Maltese</td>
<td>11</td>
<td>35.5%</td>
</tr>
<tr>
<td>Foreigners</td>
<td>1</td>
<td>20.0%</td>
</tr>
<tr>
<td>Change your preference</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Maltese</td>
<td>12</td>
<td>38.7%</td>
</tr>
<tr>
<td>Foreigners</td>
<td>2</td>
<td>40.0%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher’s Exact value = 0.804, p = 0.841

Table 4.8 shows that a higher percentage of foreigners (40%) compared to Maltese (25.8%) would retain preference for private beaches. On the other hand, more Maltese (35.5%) than foreigners (20%) would have equal preference for both options. There is only a small difference between foreigners (40%) and Maltese (38.7%) who would change their preference for rock amalgam covered concrete platforms. Since the $p$-value (0.841) of the Fisher’s Exact test exceeds the 0.05 level of significance, we accept $H_0$. Therefore there is no significant difference between Maltese and foreigners for the preference of rock amalgam covered concrete platforms with respect to private beaches.

4.5.3.4 Hypothesis 4: To test whether there is an association between nationality of respondents and increased rocky shore usage from installing artificial bathing platforms.
\(H_0\): There is no association between nationality of respondents and increased karst rocky shore usage from installing wooden decking platforms.

\(H_1\): There is a statistically significant association between nationality of respondents and increased karst rocky shore usage from installing wooden decking platforms.

Table 4.9: Cross tabulation showing the association between nationality of respondents and increased use of karst rocky shores from installing wooden decking platforms

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Would you make more use of rough rocky shores if they have temporary wooden decking platforms?</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Maltese</td>
<td>33</td>
<td>285</td>
</tr>
<tr>
<td>Percentage</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>325</td>
</tr>
</tbody>
</table>

Fisher's Exact value = 0.225, \(p = 0.880\)

Table 4.9 shows that there is not a significant difference between Maltese and foreigners with regards to the increased use of karst rocky shores with wooden decking platforms due to similar column percentages between Maltese and foreigners. In fact the \(p\)-value (0.880) is much larger than the 0.05 level of significance, thus we accept \(H_0\). Therefore there is no significant difference between Maltese and foreigners for the increased use of karst rocky shores with wooden decking platforms.

\(H_0\): There is no association between nationality of respondents and increased use of rocky shores with rock amalgam covered concrete platforms.
$H_1$: There is a statistically significant association between nationality of respondents and increased use of rocky shores with rock amalgam covered concrete platforms.

Table 4.10: Cross tabulation showing the association between nationality of respondents and increased use of rocky shores with rock amalgam covered concrete platforms

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Count</th>
<th>Yes</th>
<th>Not sure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maltese</td>
<td>43</td>
<td>254</td>
<td>53</td>
<td>350</td>
</tr>
<tr>
<td>Percentage</td>
<td>12.3%</td>
<td>72.6%</td>
<td>15.1%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Foreigners</td>
<td>12</td>
<td>30</td>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>Percentage</td>
<td>24.0%</td>
<td>60.0%</td>
<td>16.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>284</td>
<td>61</td>
<td>400</td>
</tr>
<tr>
<td>Percentage</td>
<td>13.8%</td>
<td>71.0%</td>
<td>15.3%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher's Exact value = 5.103, p = 0.075

Table 4.10 shows that 12.3% of Maltese and 24% of foreigners would not make increased use of rocky shores with rock amalgam covered concrete platforms while 72.6% of Maltese and 60% of foreigners would. Maltese and foreigners who were not sure were comparable (15.1% and 16% respectively). Since the $p$-value (0.075) > 0.05 criterion, we accept $H_0$. Therefore there is no significant difference between Maltese and foreigners for the increased use of rocky shores with rock amalgam covered concrete platforms.
4.5.3.5  Hypothesis 5: To test if there is an association between nationality of respondents and preference for either artificial bathing platforms or artificial sandy beaches.

\[ H_0: \] There is no association between nationality and preference for either artificial bathing platforms or artificial sandy beaches.

\[ H_1: \] There is a significant association between nationality and preference for either artificial bathing platforms or artificial sandy beaches.

Table 4.11: Cross tabulation showing the association between nationality of respondents and preference for artificial bathing platforms with respect to artificial sandy beaches

<table>
<thead>
<tr>
<th>Would you prefer installing these artificial bathing platforms on the rocky shore rather than creating new artificial sandy beaches?</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltese</td>
<td>Foreigners</td>
</tr>
<tr>
<td>No Count</td>
<td>44</td>
<td>11</td>
</tr>
<tr>
<td>Percentage</td>
<td>12.6%</td>
<td>22.0%</td>
</tr>
<tr>
<td>Yes Count</td>
<td>249</td>
<td>33</td>
</tr>
<tr>
<td>Percentage</td>
<td>71.1%</td>
<td>66.0%</td>
</tr>
<tr>
<td>Not sure Count</td>
<td>57</td>
<td>6</td>
</tr>
<tr>
<td>Percentage</td>
<td>16.3%</td>
<td>12.0%</td>
</tr>
<tr>
<td>Total Count</td>
<td>350</td>
<td>50</td>
</tr>
<tr>
<td>Percentage</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher's Exact value = 3.302, \( p = 0.187 \)

Table 4.11 shows that a higher proportion of foreigners (22%) compared to 12.6% of Maltese would prefer artificial sandy beaches rather than artificial bathing platforms. Conversely, 71.1% of Maltese compared to 66% of foreigners would prefer artificial bathing platforms rather than artificial sandy beaches. In addition, 16.3% of Maltese compared to 12% of foreigners were unsure or would prefer both. Since the \( p \)-value...
(0.187) exceeds the 0.05 criterion, this implies that there is not a statistically significant difference between Maltese and foreigners with regards to their preference for either artificial bathing platforms or artificial sandy beaches.

4.5.3.6 Hypothesis 6: To test whether there is an association between nationality of respondents and the perception of crowdedness at Maltese sandy beaches.

Table 4.12: Cross tabulation showing the association between nationality of respondents and beach crowdedness perception at Maltese sandy beaches

<table>
<thead>
<tr>
<th>Do you feel you have enough space when you go to a local sandy beach for bathing purposes?</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltese</td>
<td>Foreigners</td>
</tr>
<tr>
<td>No</td>
<td>220</td>
<td>26</td>
</tr>
<tr>
<td>Yes</td>
<td>83</td>
<td>13</td>
</tr>
<tr>
<td>Not sure</td>
<td>47</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>350</td>
<td>50</td>
</tr>
</tbody>
</table>

Fisher's Exact value = 3.222, p = 0.209

$H_0$: There is no association between the nationality of respondents and the perception of beach crowdedness at Maltese sandy beaches.

$H_1$: There is a significant association between the nationality of respondents and the perception of beach crowdedness at Maltese sandy beaches.
Table 4.12 displays a higher proportion of Maltese (62.9%) compared to foreigners (52%) who thought that there is not enough space at local sandy beaches. On the contrary, a slightly higher percentage of foreigners (26%) than Maltese (23.7%) thought otherwise. Furthermore, 22% of foreigners and 13.4% of Maltese were not sure. Since the $p$-value (0.209) of the Fisher’s Exact test exceeds the 0.05 level of significance, this implies that there is no significant difference between Maltese and foreigners in beach crowdedness perception at local sandy beaches.

**4.5.3.7 Hypothesis 7: To test if there is an association between nationality of respondents and WTP for artificial bathing platforms.**

$H_0$: There is no association between nationality of respondents and WTP for wooden decking platforms.

$H_1$: There is a statistically significant association between nationality of respondents and WTP for wooden decking platforms.
<table>
<thead>
<tr>
<th>How much are you prepared to pay for using wooden decking platforms?</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltese</td>
<td>Foreigners</td>
</tr>
<tr>
<td>Nothing</td>
<td>Count</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>25.1%</td>
</tr>
<tr>
<td>1 to 2 euros</td>
<td>Count</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>13.1%</td>
</tr>
<tr>
<td>3 to 4 euros</td>
<td>Count</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>7.7%</td>
</tr>
<tr>
<td>5 euros</td>
<td>Count</td>
<td>189</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>54.9%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher’s Exact value = 19.217, \( p < 0.001 \)

Table 4.13 shows there is not much of a difference between Maltese (25.1%) and foreigners (24%) who would not be prepared to pay for the use of wooden decking platforms. However, 36% of foreigners would be willing to pay 1 to 2 euros compared to 13.1% of Maltese. There is only a small difference of 4.3% between Maltese and foreigners who would be willing to pay 3 to 4 euros. However, a considerably higher percentage of Maltese (54%) than foreigners (28%) would be willing to pay 5 euros. Since the p-value (0.001) is less than the 0.05 level of significance, we accept \( H_1 \), i.e. there is a significant association between nationality of respondents and WTP for wooden decking platforms.

\( H_0 \): There is no association between nationality and WTP for rock amalgam covered concrete platforms.
**H1**: There is a statistically significant association between nationality and WTP for rock amalgam covered concrete platforms.

<table>
<thead>
<tr>
<th>How much are you prepared to pay for using rock amalgam covered concrete platforms?</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltese</td>
<td>Foreigners</td>
</tr>
<tr>
<td>Nothing</td>
<td>Count</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>19.4%</td>
</tr>
<tr>
<td>1 to 2 euros</td>
<td>Count</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>8.6%</td>
</tr>
<tr>
<td>3 to 4 euros</td>
<td>Count</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>6.9%</td>
</tr>
<tr>
<td>5 euros</td>
<td>Count</td>
<td>228</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>65.1%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Fisher's Exact value = 8.253, p = 0.038

Table 4.14 shows that 19.4% of Maltese compared to 26% of foreigners would not want to pay for the use of rock amalgam covered concrete platforms. In contrast, 18% of foreigners would be willing to pay 1 to 2 euros compared to 8.6% of Maltese. There is only a difference of 3.1% between Maltese and foreigners who would be willing to pay 3 to 4 euros. On the contrary, 65.1% of Maltese compared to 46% of foreigners would be willing to pay 5 euros. Since the $p$-value (0.038) is less than the 0.05 level of significance, we accept H1. Thus there is a significant difference between Maltese and foreigners in their WTP for rock amalgam covered concrete platforms.
4.5.3.8 Hypothesis 8: To test if there is an association between nationality of respondents and locality for installing artificial bathing platforms

\( H_0 \): There is no association between nationality of respondents and locality for installing wooden decking platforms.

\( H_1 \): There is a significant association between nationality of respondents and locality for installing wooden decking platforms.

<table>
<thead>
<tr>
<th>Where do you think is the most appropriate karst rocky shore locality for installing wooden decking platforms?</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where needed</td>
<td>Maltese</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>8.3%</td>
</tr>
<tr>
<td>Everywhere</td>
<td>Count</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>4.0%</td>
</tr>
<tr>
<td>Nowhere</td>
<td>Count</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>8.9%</td>
</tr>
<tr>
<td>Sliema</td>
<td>Count</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>18.1%</td>
</tr>
<tr>
<td>St.Julian’s</td>
<td>Count</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>4.3%</td>
</tr>
<tr>
<td>Pembroke</td>
<td>Count</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>6.0%</td>
</tr>
<tr>
<td>Bahar ic-Caghaq</td>
<td>Count</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>24.1%</td>
</tr>
<tr>
<td>Qawra</td>
<td>Count</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>6.6%</td>
</tr>
<tr>
<td>Bugibba</td>
<td>Count</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>5.5%</td>
</tr>
</tbody>
</table>
Table 4.15 shows a significantly higher proportion of foreigners (37.8%) compared to Maltese (18.1%) who chose Sliema. On the other hand, a much higher percentage of Maltese (24.1%) compared to foreigners (6.7%) chose Bahar ic-Caghaq. Since the $p$-value (0.043) is less than the 0.05 margin of error, we accept $H_1$. Thus, there is a significant difference between Maltese and foreigners for the locality for installing wooden decking platforms.

$H_0$: There is no association between nationality of respondents and locality for installing rock amalgam covered concrete platforms.

$H_1$: There is a significant association between nationality of respondents and locality for installing rock amalgam covered concrete platforms.
Table 4.16: Cross tabulation showing the association between nationality of respondents and locality for installing rock amalgam covered concrete platforms

<table>
<thead>
<tr>
<th>Locality</th>
<th>Nationality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltese</td>
<td>Foreigners</td>
</tr>
<tr>
<td>Where needed</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td>Percentage</td>
<td>10.1%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Everywhere</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Percentage</td>
<td>4.0%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Nowhere</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>51</td>
<td>10</td>
</tr>
<tr>
<td>Percentage</td>
<td>14.7%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Sliema</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>42</td>
<td>8</td>
</tr>
<tr>
<td>Percentage</td>
<td>12.1%</td>
<td>17.8%</td>
</tr>
<tr>
<td>St.Julian's</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Percentage</td>
<td>3.7%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Pembroke</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Percentage</td>
<td>2.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Bahar ic-Caghaq</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>41</td>
<td>2</td>
</tr>
<tr>
<td>Percentage</td>
<td>11.8%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Qawra</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Percentage</td>
<td>5.2%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Bugibba</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>37</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>10.6%</td>
<td>2.2%</td>
</tr>
<tr>
<td>St.Paul's Bay</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Percentage</td>
<td>6.9%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Xemxija Bay</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Percentage</td>
<td>3.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Mellieha Bay</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>6.3%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Armier Bay</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Percentage</td>
<td>6.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Cirkewwa</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>2.6%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>Count</td>
<td>348</td>
<td>45</td>
</tr>
<tr>
<td>Percentage</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Pearson Chi-square test value = 29.67, p = 0.05
Table 4.16 shows that 15.6% of foreigners compared to 3.5% of Maltese chose St. Julian’s. The situation is different for Bugibba since 10.6% of Maltese and 2.2% of foreigners chose this locality. Since the p-value (0.05) is just at the 0.05 level of significance, we accept H$_1$. Therefore these differences between Maltese and foreigners with regards to the locality for installing rock amalgam covered concrete platforms are only marginally statistically significant.

### 4.5.3.9 Hypothesis 9: To test whether there is an association between age of respondents and the preferred beach type for recreational activities.

**H$_0$:** There is no association between age of respondents and the preferred beach type.

**H$_1$:** There is a significant association between age of respondents and the preferred beach type.

Table 4.17: Cross tabulation showing the relationship between age of respondents and preferred beach type

<table>
<thead>
<tr>
<th>Age</th>
<th>Under 30</th>
<th>30 - 49</th>
<th>50+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Count</td>
<td>Count</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td>Rocky shores</td>
<td>Sandy beaches</td>
<td>Private beaches</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>41</td>
<td>85</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>43</td>
<td>61</td>
<td>184</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>7</td>
<td>17</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>91</td>
<td>163</td>
<td>394</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Count</th>
<th>Percentage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 30</td>
<td>34.3%</td>
<td>57.1%</td>
<td>100.0%</td>
</tr>
<tr>
<td>30 - 49</td>
<td>45.1%</td>
<td>47.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>50+</td>
<td>52.1%</td>
<td>37.4%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>52.1%</td>
<td>37.4%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Table 4.17 shows that people under 30 tend to prefer more sandy beaches (57.1%) rather than rocky shores (34.3%). Middle aged people (30 - 49 years) have approximately equal preference for rocky shores (45.1%) and sandy beaches (47.3%). On the other hand, elderly people (50+ years) tend to prefer more rocky shores (52.1%) rather than sandy beaches (37.4%). With regards to private beaches, elderly people have the most liking for the latter (10.4%) when compared to middle-aged (7.7%) and young people (8.6%). Since the p-value (0.015) is less than the 0.05 level of significance, we accept $H_1$. Therefore there is a statistically significant association between the age of respondents and preferred beach type.

4.5.3.10 Hypothesis 10: To test if the mean rating scores for the public acceptability of wooden decking platforms, concrete platforms and rock amalgam covered concrete platforms are the same.

$H_0$: The mean rating scores for the acceptability of wooden decking platforms, concrete platforms and rock amalgam covered concrete platforms have equal rating.

$H_1$: The mean rating scores for the acceptability of wooden decking platforms, concrete platforms and rock amalgam covered concrete platforms are different.
Table 4.18: Table showing descriptive statistics for the three rating scores given for these coastal development scenarios

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptability of wooden decking platforms</td>
<td>4.20</td>
<td>.853</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Acceptability of current concrete platforms</td>
<td>2.84</td>
<td>1.234</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Acceptability of rock amalgam covered concrete platforms</td>
<td>3.92</td>
<td>.967</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

\[ X^2(\text{df } 2) = 292.022, \ p < 0.001 \]

Table 4.18 shows that the mean rating score for the acceptability of wooden decking platforms (4.20) is significantly larger than the mean rating score for the acceptability of rock amalgam covered concrete platforms (3.92) which in turn is significantly larger than the mean rating score for the acceptability of current concrete platforms (2.84). The mean rating scores provided for these statements differ significantly since the \( p \)-value (approximately 0) is less than the 0.05 level of significance, hence \( H_0 \) is rejected. Therefore the mean rating scores of the three options considered are different.

![Figure 4.35: Error bar graph showing the 95% confidence intervals if all Maltese and foreigners had to be included in the study](image-url)
Figure 4.35 shows the 95% confidence intervals for the range of values for the actual mean rating score for a statement if the whole Maltese population and all possible foreigners had to be included in the survey. As the confidence intervals of the two types of artificial bathing platforms overlap slightly this indicates that their mean rating scores do not differ significantly. On the other hand, since the confidence intervals of the two types of artificial bathing platforms do not overlap with that of current concrete platforms, this indicates that the corresponding mean rating scores differ significantly.

### 4.5.4 Problems encountered during the public survey

The survey had a very low turnover rate because the time spent at the six survey sites was much higher compared to the actual number of completed questionnaires during the same amount of time. The main reason for this was because the elderly and adults with a low standard of education took more than the standard five minutes to complete the questionnaire as continuous assistance had to be provided by the author and some questions had to be translated in Maltese otherwise these respondents were not able to answer. Foreigners generally rejected the questionnaire due to their insufficient knowledge about Malta’s coastal environments. Some respondents were unwilling to complete the questionnaire due to their lack of interest on the questionnaire topic. Other problems included persuading the public to participate in the survey while some respondents were in a hurry and filled in the questionnaire carelessly.
5. Discussion

Preface

This chapter starts by reviewing the past and current Maltese legislation on coastal development. A discussion of the feasibility of installing wooden decking platforms and rock amalgam on existing concrete platforms is presented by integrating the social, economic, technical and environmental considerations. The justifications for installing these artificial bathing platforms at the northeast coast of Malta are outlined with reference to current coastal development policies and the coastal configuration of the northeast coast of Malta. An account of the pros and cons of wooden decking and rock amalgam covered concrete platforms is given. The most significant results from the public survey are discussed at the end.
5.1 Coastal development legislation in Malta

“The Structure Plan policies together with the zoning given by the Temporary Provision Schemes are the main strategic instruments through which development on the coast is controlled” (UNEP, 2005, p.47). The Temporary Provision Schemes indicate the type of development likely to be acceptable in specific areas (MEPA, 2002a). For instance, the classification of ‘white area’, which is mainly low-lying rocky coastline, promotes land as an opportunity area for development however it does not define what type of development could be permitted (MEPA, 2002a). The scheduling process of the Temporary Provisions Schemes has protected most of the natural coast from being developed and therefore explains why most of the approved development occurs within existing urban areas (MEPA, 2002a).

![Figure 5.1: Map showing the Temporary Provisions Schemes applicable to the northeast coast of Malta in 2001. Source: MEPA, 2002a](image-url)
The urban waterfronts of Sliema and Bugibba have had the largest percentage of development applications granted (MEPA, 2002a). With regards to the North Harbours Local Plan, the amount of applications submitted for development from 1994 to 1998 amounted to more than 40% of the coastal area (MEPA, 2002a). Large areas of the northeast coastline have been taken by private developers due to inadequate enforcement and regulatory measures to limit coastal development. Despite the creation of the Coastal Strategy Topic Paper and the Leisure and Recreation Topic Paper, current policies are not sufficient to ensure public accessibility to rocky shores (UNEP, 2005). “If no policy changes are made, coastal areas available for informal recreation will continue to decrease and there will be losses of cultural heritage” (UNEP, 2005, p.61).

Figure 5.2: Map showing granted development applications between 1994 and 1998 within the northeast coast of Malta. Source: MEPA, 2002a
Furthermore, the 1990 Structure Plan Policy CZM 3 states that the coast should be freely accessible to and owned by the public, however it does not mention any specific areas where this applies (MEPA, 2002a). This has led to the present situation where the low-lying coast is scattered by both legal and illegal development and to numerous private beaches with the result of the exclusion of certain segments of society who are reluctant to pay and in denying the right of people to use public resources (MEPA, 2002a). With the recent change of the Maltese government, the current planning framework for coastal development is being addressed in a Strategic Plan for Environment and Development (SPED). This plan has been initiated by the previous government in February 2012 and is still under progress. The SPED is set to replace the Structure Plan for the Maltese Islands of 1990 (MaltaToday, 2013).

5.2 The feasibility of installing artificial bathing platforms at the northeast rocky shore of Malta

5.2.1 Wooden decking platforms

Since the surface of a rugged karst rocky shore is not flat but with large hollows and sharp protrusions, the stainless steel legs of the wooden decking platforms would need to have screws which let adjust their height according to the rock surface. Moreover shallow holes need to be drilled into the rock so that the platforms remain stable and do not move by breaking waves, by the wind or people trying to displace them. These holes would have the diameter of the stainless steel legs and would be capped when the wooden decking platforms are removed at the end of summer. Stainless steel, the
material making up the metal base of the wooden decking platforms, contains at least 12% chromium (BOC, 2007). If chromium dissolves in seawater it accumulates on the gills of fish resulting to increased fish mortality (Sneddon, 2012). However, Berggren et al. (2004) state that the actual concentrations of chromium, nickel and iron in seawater dissolved from stainless steel are far below reported ecotoxic concentrations for marine flora and other organisms.

The use of teak as the decking material is ideal for coastal environments due to its resistance to weathering and rot. Teak (*Tectona grandis*) is a tropical hardwood tree species which occurs in deciduous forests but is also grown in plantations throughout the tropics (Kew Royal Botanical Gardens, n.d.). Teak's high oil content, high tensile strength and tight grain structure make it particularly suitable for outdoor recreational applications such as coastal environments (Robertson, 2002). Moreover, teak is resistant to ‘shipworm’, a wood-boring sea mollusc (*Teredo teredinidae*) (Robertson, 2002). Quinones in teak also inhibit the growth of several species of fungi which cause the wood to rot (Robertson, 2002). Teak has a relatively low shrinkage ratio, which makes it excellent for coastal environments, where it undergoes periodic changes in moisture (Williams et al., 2001). Saltwater actually helps teak absorb and retain some moisture which in turn prevents the growth of mildew and algal growth which could make the platform slippery (Williams et al., 2001). Morrell et al. (2006) have described various methods to prevent photodegradation of wooden decking. For changes in colour, surface composition and mechanical properties, ultraviolet absorbers (UVAs), hindered amine light stabilizers and pigments are typically used. On the other hand, to prevent degradation by marine organisms, zinc borates are usually added to the surface layers of the wooden deck. To prevent deck fracturing by
repeated swelling and shrinking, a plastic rich surface layer is used to inhibit moisture penetration (Morrell et al., 2006).

Anti-corrosion and anti-fouling chemicals painted on the decking surface and the harvesting of teak (when not harvested from plantations) could potentially have negative impacts on marine and forest ecosystems respectively (Gillespie, n.d.). Two chemicals in particular, creosote and chromated copper arsenate (CCA), contain polycyclic aromatic hydrocarbons (PAHs) that are persistent in the natural environment (San Francisco Bay Sub-tidal Habitat Goals Project, n.d.; Marsh, 2002). In addition, there has to be a sustainable demand for teak otherwise new forest areas would need to be cut to create additional teak plantations (Marsh, 2002). Wooden decking platforms would also partly cover rock pools close to the shoreline thereby creating partial shade potentially reducing the biodiversity present in these rock pools (UNEP, 2005).

Besides the known costs of wooden decking platforms such as the teak deck, the metal base and its manufacturing cost, one also has to consider the infrastructural costs to provide facilities and accessibility to these wooden decking platforms such as wooden footpaths, parking areas, mobile toilets, lighting, rubbish bins, sunshades and sunloungers, etc. The maintenance (repair) costs of these wooden decking platforms would presumably be more than once a year as stated by the Maltese manufacturer in Section 4.1.3 (Chapter 4) as they would be placed close to the shoreline for easy sea access. They would also be very crowded since they would be free for the public. This issue can be handled by possibly having to pay for the use of these wooden decking platforms, since 49% of respondents were willing to pay €1 to €5 (see Figure 4.28,
Section 4.5.1.4, Chapter 4). Beach litter would be managed by placing waste separation bins at frequent intervals and close enough to these wooden decking platforms. There is also the charge for disposing/recycling these wooden decking platforms when they get broken down from heavy human use as well as by weathering and decay from marine organisms.

Wooden decking platforms are the most expensive coastal recreation enhancement option (€270/m²) compared to beach nourishment projects in Malta (€107/m²) and rock amalgam covered concrete platforms (€50/m²). Thus installing wooden decking platforms on a large-scale, e.g. at every karst rocky shore of the northeast coast of Malta, would certainly not be economically feasible. On the other hand, a meso-scale project such as at the coastline of Sliema would be socially and economically feasible due to the dense tourist accommodation and apartments at this locality. However, wooden decking platforms installed on rough rocky shore areas at Sliema and Bahar ic-Caghaq would accommodate a higher number of beach users (909) compared to those who can be accommodated at St. George’s Bay and Bugibba Perched Beach, i.e. 815 and 559 beach users respectively. Thus these wooden decking platforms would significantly decrease crowdedness at popular sandy beaches and would significantly increase the number of beach users at rugged karst rocky shores thereby opening a new tourism niche.

5.2.2 Rock amalgam covered concrete platforms
Fiber-reinforced concrete (FRC), the rock amalgam material, might not be very suitable for a rocky shore environment due to possible corrosion in the presence of seawater (Rider et al., 1980). For example, sulfates present in seawater react with tricalcium aluminate in the cement paste to form ettringite, and since the latter is more voluminous than the former it causes swelling and cracking of the fibrous concrete slab (Rider et al., 1980). Another problem is the formation of gypsum (calcium sulfate) from calcium hydroxide present in the cement paste. Since gypsum is soft, it can be easily broken off by wave impact resulting to a newly exposed surface to wave attack. In addition, unless closely monitored and regularly maintained, broken FRC fragments from the rock amalgam platform could collect in rock pools and at the swash zone (where waves break), with potential adverse effects on the marine ecology from the possible dissolution of the colour hardener/paint in seawater (Gillespie, n.d.; Marsh, 2002). Possible solutions to limit corrosion of FRC include: limiting the content of tricalcium aluminate in the concrete mix, using a low water-high cement ratio mix design, using non-reactive aggregates and lithium-based admixtures to inhibit the alkali-silica reaction which causes cracking in concrete (Rider et al., 1980). Painted (coloured) carbon-steel reinforced concrete also has a lower corrosion rate than non-painted FRC (Rider et al., 1980).

Coloured FRC, the material used for the rock amalgam platforms, would cost €50/m² (Ellis, 2013). Besides being considerably cheaper and has a much longer lifespan than wooden decking platforms, it also costs about half as much as local beach nourishment projects (€107/m²). In addition, beach nourishment projects could potentially cause much greater damage to the marine ecology (e.g. death of infauna at the dredge site and destruction of *Posidonia oceanica* meadows via direct smothering
and subsequent re-adjustment of the beach footprint following initial placement of the new sand) than rock amalgam covered concrete platforms. Furthermore, rock amalgam covered concrete platforms installed at Sliema, Bahar ic-Caghaq and Bugibba would accommodate about six times more beach users (4,138) than those who can be accommodated at St. George’s Bay and Bugibba Perched Beach (815 and 559 beach users respectively). There is also the added revenue from ancillary facilities associated with these rock amalgam covered concrete platforms such as deckchairs and sunshades, car parks and mobile toilets. Therefore, rock amalgam covered concrete options are the most socio-economically feasible when compared to the other two recreational options considered in this study.

5.3 Justifications for installing artificial bathing platforms at the northeast coast of Malta

5.3.1 Wooden decking platforms

“In order to improve accessibility along the foreshore, the use of temporary/reversible structures such as wooden/timber platforms (as opposed to concrete pathways) should be viewed positively” (MEPA, 2002b). Moreover “new development at rural coastlines should be minimal and directed towards improving degraded areas and enhancing informal recreation. Access provision should preferably be reversible and respects the environmental characteristics of the area” (MEPA, 2007, p. 11; MEPA 2002a, pp. 119-120).
Therefore there is no reason why wooden decking platforms would not be granted a development permit, since they are temporary structures which grant public accessibility to deeply pitted/rugged rocky shores and thereby create new areas for recreation other than the crowded sandy beaches. It is suggested that within rural areas no additional facilities are provided in association with wooden decking platforms.

Figure 5.3 below shows the extent of protected areas as well as rural and urban land uses at the northeast coast of Malta. Wooden decking platforms installed at the rocky coast of Sliema and Bahar ic-Caghaq would be acceptable since these two locations are unprotected areas according to Figure 5.3.

Figure 5.3: Map showing the planning strategy for the northeast coast of Malta in 2001. Source: MEPA, 2002a
Micallef et al. (2009a) encourages the installation of temporary wooden decking platforms by the Maltese government to improve shore comfort, shore accessibility and safe entry points to and from the sea. Wooden decking should be preferred to large-scale commercial development of coastal areas, as in landscaping and embellishment works where large areas of natural rocky shore are permanently covered with concrete, mainly because wooden decking platforms are temporary structures. This is emphasized by a study carried out by Micallef (2002) where beach users generally were against large-scale commercial development such as kiosks, restaurants, resorts, apartments and shops at or near rocky shores since these create increased crowdedness which in turn leads to higher levels of pollution. Furthermore, in a beach survey conducted by Cachia (2002), respondents thought that accessibility at the rocky shore at Qawra, amongst other issues, needs to be improved. Thus by installing temporary wooden decking platforms, these beach users would have access to these rough rock shore areas and also prevent accidents from people falling on the sharp rock surface of these karst rocky shores.

5.3.2 Rock amalgam covered concrete platforms

Coastal development in urban settings “is restricted to that which enhances public use and coastal facilities provided that it is small-scale, preferably of a temporary and reversible nature” (MEPA, 2002a, p.121). If rock amalgam covered concrete platforms would be installed at Bugibba, they must comply with the NWTO 3 policy of the Northwest Local Plan. This policy states that these artificial platforms must first be approved by the MTA; must not create inconveniences to the residents of the area
in the form of noise, visual pollution and traffic congestion; must be consistent with the character of the site and surrounding areas; must have high design qualities fully explained in a work method statement; existing infrastructure should be adequate and not adversely affected and that accessibility to the foreshore is not hindered (MEPA, 2007). Although rock amalgam platforms are not reversible structures, they would enhance the coastal characteristic by covering existing old and eroding concrete platforms, thus improving their aesthetics while also make them less prone to erosion. The natural rocky shore ecology would not be harmed since the rock amalgam would only be overlaid on existing concrete. Moreover with the correct concrete mix design as suggested by Rider et al. (1980) in Figure 2.18, Section 2.8, Chapter 2, corrosion of FRC would be minimized as well as the possible dissolution of toxic chemicals sprayed on the surface. It is suggested that few facilities would be provided alongside these platforms. These would be limited to mobile toilets, bins, sunbeds and umbrellas, so as not to cause overcrowding, produce excessive beach litter, or create inconvenience to the residents living in the area such as food & beverage outlets would create. Hence the natural characteristics of the rocky shore would be retained.

5.4 Advantages and disadvantages of wooden decking platforms

The advantages of wooden decking platforms are their design flexibility, they provide access to rough rocky shore areas, they make possible recreational activities at previously unoccupied karst rocky shores; they provide a comfortable surface to lie on; and they would not be slippery since teak hinders the growth of algae and mosses on the decking surface. The disadvantages include frequent maintenance especially
with high beach user densities and due to weathering by natural and biological agents; their low return on investment (one wooden decking platform costs €5,988 - see Section 4.1.5, Chapter 4); crowding and beach litter.

5.5 Advantages and disadvantages of rock amalgam covered concrete platforms

Among the advantages of rock amalgam covered concrete platforms are that FRC is widely available, it requires low maintenance, it is cheap to manufacture; and it is unaffected by heat or humidity particularly if the FRC admixture is custom-made for a coastal environment (Marie, 2007; El-Sherbiny, 2011). The disadvantages are the hardness of the platform which could be an issue for some beach users; the lack of long-term performance data and lack of industry-wide standards with regards to composite materials used in FRC which are possibly more environmentally friendly and more cost effective; the rock amalgam platform can be slippery particularly if it is situated close to the shoreline due to the growth of algae and mosses; and the present old and eroded concrete platforms would not provide much structural support to the rock amalgam slab, potentially resulting to crack development in the latter over time.

5.6 Protected areas along the northeast coast of Malta

Pembroke coastline is a special area of conservation (SAC) due to the presence of an ecological community of sea lavender (*Limonium melitensis*). Wooden decking platforms placed about 15 cm above the karst shore surface would create shade which
could stunt the growth of this species growing underneath the platforms. Rock amalgam overlaid on existing concrete platforms on the other hand would be harmless to the endemic *Limonium melitensis*.

Figure 5.4: Pembroke coastline is a special area of conservation (SAC) and a Natura 2000 site. Source: MEPA, n.d

With regards to the conservation value of the different geological strata making up the Maltese rocky coastline, karst rocky shores have a higher number of floral species when compared to ‘smooth’ rocky shores (Schembri et al., 2005). Furthermore, karst rocky shores are more likely to be exploited by people as they constitute the largest fraction of the low-lying rocky coast of Malta. This necessitates that karst rocky shores have a higher conservation value than Globigerina Limestone (‘smooth’) rocky shores (Schembri et al., 2005).
5.7 Public Survey

5.7.1 Artificial bathing platforms compared to conventional coastal recreational environments

Private beach users (47% of respondents) are more willing to change their preference for wooden decking platforms than sandy beach users (24% of respondents). This shows that people generally prefer public beaches rather than lidos and resorts. Moreover, the public would generally prefer sandy beaches than wooden decking platforms (34% of respondents) or use both options (42% of respondents) rather than change their preference for wooden decking platforms (24%). This is because sandy beaches are considered more comfortable, safer, more accessible and have more facilities than karst rocky shores. With regards to private beach users, 47% of the latter would change their preference for wooden decking platforms since these platforms would supposedly be free of charge. A similar relationship was noticed for rock amalgam covered concrete platforms, with private beach users generally being more willing to change their preference than sandy (public) beach users. This shows that the public generally prefers free beaches/beach facilities rather than having to pay. Furthermore, 47% of sandy beach users would make use of both sandy beaches and rock amalgam covered concrete platforms compared to 33% of private beach users. With regards to the nationality of respondents, there was not a significant difference between Maltese and foreigners in their preference for the two types of artificial bathing platforms with respect to sandy or private beaches.
Regarding public perception of beach crowdedness at local sandy beaches, 62% of respondents thought they are too crowded while only 24% thought the opposite. This highlights the need for additional bathing areas such as at the currently unused karst rocky shores. Increased recreational use of karst rocky shores would diversify Malta’s tourism product and result to a more sustainable use of Malta’s coastal resources for recreation. Ideally, wooden decking platforms would be installed not far from crowded sandy beaches (e.g. Armier Bay, Mellieha Bay, Bugibba Perched Beach and St. George’s bay) so as to be within walking distance of these popular sandy beaches, thus attracting beach users who feel that they do not have enough space at the latter.

With regards to public preference for both types of artificial bathing platforms compared to artificial sandy beaches, 71% of respondents would prefer the former and only 14% would prefer artificial sandy beaches. This suggests that there would be high usage of these artificial bathing platforms which are a new concept in Malta and reflects the need for additional bathing areas at rocky shores. There was no significant difference between Maltese and foreigners in their preference for either artificial bathing platforms or artificial sandy beaches.

5.7.2 Preferred beach type

With regards to the preferred beach type according to the age of respondents, young people under 30 tend to prefer sandy beaches while people aged 50 years and above generally prefer rocky shores (see section 4.5.3.9, Chapter 4). This can be explained
by the fact that young couples go to sandy beaches because they are safer for their children and more comfortable than rocky shores whereas elderly people might prefer uncrowded beach environments where they can relax and enjoy nature. With regards to the nationality of respondents, there was not a significant difference between Maltese and foreigners in their preference for a particular beach environment.

5.7.3 Potential increase in the use of rocky shores by these artificial bathing platforms

81% of respondents would make more use of karst rocky shores with wooden decking platforms and 71% would make more use of ‘smooth’ rocky shores with rock amalgam covered concrete platforms. This is because wooden decking platforms improve accessibility to previously unused karst rocky shores and provide safe entry points to and from the sea. In fact, 49% of respondents considered Malta’s karst rocky shores as being sparsely used by the public while 35% considered them as moderately used. This reflects the need to improve public accessibility to these karst rocky shores so the public is more satisfied from having multiple recreational options. On the other hand, rock amalgam covered concrete platforms would potentially lead to increased rocky shore usage. However they would not improve accessibility to karst, rugged rocky shores whilst popular sandy beaches would probably remain crowded. Regarding differences between Maltese and foreigners, there was not a significant difference in nationality for the potential increased use of rocky shores with the two types of artificial bathing platforms installed.
5.7.4 Public acceptability of artificial bathing platforms

Wooden decking platforms are the most acceptable recreational option (given a rating score of 4.2 out of a maximum of 5) when compared to new rock amalgam covered concrete platforms (given a rating score of 3.92 out of 5) and existing concrete platforms (given a rating score of 2.84 out of 5). These mean rating scores suggest that recreational projects aimed to enhance accessibility and comfort of natural rocky shores and the upgrading of present facilities/infrastructure are acceptable by the public in general.

5.7.5 Negative environmental impacts and socio-economic benefits of artificial bathing platforms

72% of respondents for wooden decking platforms and 57% for rock amalgam covered concrete platforms thought that these platforms would not have negative environmental impacts on the rocky shore/marine ecology (see Figures 4.23 and 4.25, Section 4.5.1.3, Chapter 4). The possible negative environmental impacts of these artificial platforms (see Sections 5.2.1 and 5.2.2) are negligible compared to the large-scale and permanent negative environmental impacts of beach nourishment projects. These negative environmental impacts are substantiated in the MEPA Environment Report 2008, Sub-report 6, which deals with Malta’s coastal and marine environment, where there is stated that:
The addition of sand to an area can impact negatively the species found within it since the habitat is altered in the process. Such impact is exacerbated when, as happened in St. George’s Bay [Birzebugia], a sand type not typical of the area [was] used. Questions also arise with respect to long-term impacts, as the sand is likely to be displaced since it is not replenished naturally.

(MEPA, 2010, p. 25)

13% of respondents for wooden decking platforms and 24% for rock amalgam covered concrete platforms were unsure about the negative environmental impacts of these artificial platforms. This is attributed to a possible lack of understanding about their material composition (the possibility for toxic chemicals dissolving in seawater over time) and long-term performance data of these platforms. With regards to the socio-economic benefits of these platforms, 75% of respondents for wooden decking platforms and 66% of respondents for rock amalgam covered concrete platforms thought that their socio-economic benefits would outweigh their potential negative environmental impacts. This is because wooden decking platforms would improve access to karst rocky shores thereby resulting to increased beach user satisfaction and in the enhancement of the tourism industry while new rock amalgam platforms would increase rocky shore usage since they are safer (would erode at slower rate) than the current non-fibrous concrete platforms and by the improved aesthetics of the rock amalgam compared to the old concrete platforms.

5.7.6 Willingness-To-Pay for artificial bathing platforms
51% of respondents for wooden decking platforms and 63% for rock amalgam covered concrete platforms would want the use of these artificial bathing platforms for free since they expect that they are subsidized by the Maltese government through EU funding. With regards to wooden decking platforms, 49% of respondents would pay between 1 to 5 euros so that they are kept clean and well maintained, by for instance replacing broken planks, applying anti-fouling and anti-corrosion coatings and removing splinters. 37% of respondents would be willing to pay between 1 to 5 euros in order to maintain rock amalgam covered concrete platforms by for example removing slippery algae from the surface, re-spraying the surface with a natural-looking colour hardener and sealing surface cracks with special coatings to limit corrosion of the internal fibers. As noted by Blakemore et al. (2002), WTP for beach facilities is higher when the need for improvement and accessibility is greater. This could explain why more people are willing to pay for wooden decking platforms than for rock amalgam covered concrete platforms. The issue of paying for the use of these artificial platforms could have been elaborated further in the questionnaire since one cannot pay to use these platforms without there being some sort of fence surrounding them or someone in charge to collect the fees. Moreover, it was not clear whether the charge would be for the sole use of these bathing platforms or whether it included other facilities as well such as portable toilets, sunbeds and umbrellas. In addition, respondents were unsure on how the fee works, such as per day, per hour or per person and to whom it would go; i.e. to government entities (e.g. the MTA) or to private contractors who would be commissioned with the project. Regarding nationality, a higher proportion of Maltese would be willing to pay more (€5) than foreigners, while foreigners would only be willing to pay €1 - €2 for using both types of artificial bathing platforms. This suggests that these platforms would be used more
by Maltese than by foreigners hence decreasing the potential tourism revenue accrued from the use of these platforms and/or from the adjunct facilities provided (see Section 4.5.3.7, Chapter 4). On a different note, a beach user survey conducted by Cachia (2002) showed that the majority of respondents were ready to pay (an unspecified amount) for using beach facilities because otherwise they can get misused (Cachia, 2002). Furthermore, a beach user survey conducted at St. George’s bay before it was replenished indicated that 50% of beach users were willing to pay around €0.24 per visit for improved beach facilities (ICoD, 2001).

5.7.7 Preferred locality(s) for installing artificial bathing platforms

The two most frequently chosen localities for installing wooden decking platforms were Bahar ic-Caghaq (22% of respondents) and Sliema (20%) because the coastline at Bahar ic-Caghaq is very rough and has high recreational potential such as wind surfing, as claimed by Mr Vincent Attard in the interview with the author (see the first interview in Annex II, Appendices section). At Sliema, wooden decking platforms would provide additional bathing areas at rough rocky shore areas and contribute to a larger tourist product coming from rocky shores. The least preferred localities were Xemxija bay (1%) since this coastal area is all covered with concrete platforms and Cirkewwa and Armier Bay (2% respectively) because these areas are too distant from major tourist accommodation and urban areas; as there has to be a large beach user supply for these wooden decking platforms to be economically feasible. With regards to rock amalgam covered concrete platforms, 16% of respondents did not want them to be installed anywhere, thus suggesting that these rock amalgam platforms are
unnecessary to these respondents. Instead, some respondents suggested removing existing old concrete platforms and replacing them with this new rock amalgam. However this option could cause much greater damage to the rocky shore than the overlay option since heavy machinery would be required to remove the current concrete platforms. The most frequently chosen localities for the rock amalgam covered concrete platforms were Sliema (13% of respondents), Bahar ic-Caghaq (11%) and Bugibba (10%). With regards to Sliema, this locality would be ideal since it is heavily frequented by beach users. As for Bahar ic-Caghaq, although it is sparsely used by people due to the lack of facilities and rough shore surface, there are significant areas covered with concrete which contrast greatly with the natural appearance of the karst rocky shore. Bugibba is also a very suitable locality as there are considerable areas covered with eroding concrete platforms. On the other hand, the least preferred localities were Xemxija Bay (3% of respondents), since current concrete platforms look very neat and do not require maintenance, Pembroke (3%), since there are no concrete platforms and Cirkewwa (3%), since there are very few if any concrete platforms plus the area is not frequented much by beach users. With regards to differences between Maltese and foreigners in the chosen localities for installing wooden decking platforms, touristic areas such as Sliema were chosen more by foreigners than by Maltese (37.8% vs. 13.1% respectively). On the other hand, areas distant from tourist accommodation areas such as Bahar ic-Caghaq were chosen more by Maltese than by foreigners (24.1% vs. 6.7% respectively). With regards to rock amalgam covered concrete platforms, the association was less clear due to similar percentages between Maltese and foreigners (see Section 4.5.3.8, Chapter 4). Nonetheless, foreigners generally preferred localities which are close to their place of
residence, such as St. Julian’s (15.6% of foreigners vs. 3.7% of Maltese), rather than those which are further away.
6. Conclusion and Recommendations

Preface

This chapter outlines the main reasons for the proposed installation of the two artificial bathing platforms as determined by the field survey, the public survey results, the costs as quoted from the literature and Maltese suppliers and the potential beach users who could be accommodated on these platforms. A list of recommendations associated with the proposed installation of artificial bathing platforms is also presented at the end, some of which reflect the comments respondents made in the questionnaire.
6.1 The case for installing wooden decking platforms at the karst rocky shore of northeast Malta

Wooden decking platforms are the most expensive option when compared to the cost of local beach nourishment projects and rock amalgam covered concrete platforms, as one ‘unit’ costs €5,988 or €270 per one square meter of wooden decking. However, the 123 ‘units’ which would be temporarily installed on karst rocky shores at Sliema and Bahar ic-Caghaq would be able to accommodate 909 beach users, which is about 100 more than St. George’s Bay and 350 more than Bugibba Perched Beach can currently accommodate.

From the public survey it resulted that 49% of respondents considered Malta’s rough karst rocky shores as sparsely used by beach users; therefore by installing temporary wooden decking platforms we would be creating new bathing areas at otherwise inaccessible coastal areas. Moreover 62% of respondents thought that there is not enough space at local sandy beaches. 81% of respondents indicated that they would make more use of karst rocky shores with wooden decking platforms installed. 72% of respondents thought that wooden decking platforms would not have negative environmental impacts on the rocky shore/marine ecology and 75% thought that their socio-economic benefits would be greater than their potential negative environmental impacts. With regards to the public preference for wooden decking platforms compared to private beaches, 47% of private beach users would change their preference for wooden decking platforms. 49% of respondents would be willing to pay between €1 and €5 for the use of wooden decking platforms. Respondents gave a
rating score of 4.2 out of 5 for the acceptability of wooden decking platforms, which translates to an acceptable recreational enhancement option by the public. 22% of respondents chose Bahar ic-Caghaq for installing wooden decking platforms, with a much higher proportion of Maltese (24%) compared to foreigners (6.7%) choosing this locality. 20% of respondents chose Sliema, with a much higher proportion of foreigners (38%) compared to Maltese (18.1%) choosing this locality.

Added advantages of wooden decking platforms are that teak is resistant to ‘shipworm’, a wood boring sea mollusk; teak has high tensile strength; it does not rot by fungi due to the presence of quinones; teak has a low shrinkage ratio thus making it ideal for coastal environments; the salt-absorbing qualities of teak discourages the growth of algae and mosses which could make the deck slippery; and wooden decking platforms provide public access to rugged karst rocky shores. The disadvantages of wooden decking platforms are that anti-fouling and anti-corrosion coatings typically applied to the surface of wooden decking potentially have negative environmental impacts on the rocky shore/marine ecology; chromium possibly dissolved from the stainless steel metal frame can potentially increase fish mortality; shade created by these wooden decking platforms especially if they cover a large area could affect biodiversity of small rock pools and stunt the growth of rocky shore vegetation; and these wooden decking platforms would require frequent maintenance considering that they would be placed close to the shoreline.
6.2 The case for overlaying an aesthetically pleasing rock amalgam on existing concrete platforms at the northeast coast of Malta

Compared to the cost of wooden decking platforms (€270/m²) and local beach nourishment projects (€107/m²), rock amalgam covered concrete platforms are the cheapest recreational option (€50/m²). In addition, the proposed new rock amalgam covered concrete platforms at Sliema, Bahar ic-Caghaq and Bugibba would accommodate the highest number of beach users (4,138) compared to the proposed wooden decking platforms installed at Sliema and Bahar ic-Caghaq (909 beach users) and St. George’s Bay and Bugibba Perched Beach (815 and 559 beach users respectively). Therefore rock-amalgam covered concrete platforms are the most feasible recreational option, both economically (in terms of cost) and socially (in terms of additional beach users).

From the public survey, 62% of respondents thought that there is not enough space at local sandy beaches. With regards to the preference for private beaches compared to rock amalgam covered concrete platforms, more (39%) respondents would prefer private beaches than those who would prefer private beaches (28%). A large percentage of respondents (71%) would make more use of rocky shores with rock amalgam covered concrete platforms. 57% of respondents thought that these rock amalgam covered concrete platforms would not have negative environmental impacts; less than half this group (24%) were unsure due to the insufficient information provided regarding the material composition of the rock amalgam, amongst other factors. 66% of respondents thought that the socio-economic benefits of rock
amalgam covered concrete platforms would outweigh their potential negative environmental impacts. 63% of respondents would want the use of rock amalgam covered concrete platforms for free compared to 37% who would be prepared to pay 1 to 5 euros. With regards to nationality, a higher proportion of Maltese would be willing to pay more (€5) than foreigners while foreigners would not be willing to pay or pay 1 to 2 euros. Respondents gave a rating score of 3.92 out of 5 for the acceptability of rock amalgam covered concrete platforms, indicating a general acceptability amongst the general public. 16% of respondents did not want these rock amalgam platforms to be installed anywhere, despite the fact that 13% suggested Sliema, 11% suggested Bahar ic-Caghaq and 10% suggested Bugibba.

The pros of rock amalgam covered concrete platforms are that fiber-reinforced concrete (FRC) is 25 times more resistant to damage by sea waves than ‘normal’ concrete, thus making FRC much less maintenance demanding compared to existing concrete platforms; FRC requires the least maintenance and is the most long lasting when compared to wooden decking platforms and beach nourishment projects; it is widely available and cheap to manufacture; and FRC does not rot by marine microorganisms. The cons of FRC (the rock amalgam material) are its tendency to crack due to the weak structural support of the eroded concrete platforms and to corrode due to the presence of sodium chloride in sea spray and sulfate in seawater; potential negative environmental impacts on the rocky shore/marine ecology due to the dissolution of toxic chemicals such as the surface paint/colour hardener in seawater; the hardness of the platform could be an issue to some beach users; and the surface of these rock amalgam platforms would be slippery when wet especially with the presence of algae and mosses.
6.3 The need for more research

More research needs to be conducted on the environmental impacts, socio-economic benefits, design, performance, costs and other alternatives to these artificial bathing platforms so that the return on investment from these platforms would be high and the negative environmental impacts on the rocky shore and the marine environment are as few as possible. The wooden decking material would need to be very durable to resist decay and weathering but on the other hand does not need to be too expensive. The rock amalgam would need to be very resistant to wave action, weathering and corrosion by seawater. The whole life-cycle costs of the two types of artificial bathing platforms would also need to be taken into consideration and the hidden costs accounted for. Studies on the hydrodynamics (wave action) and wind strength of the chosen coastal areas for installing these artificial bathing platforms need to be conducted to minimize the potential damage done to these platforms during rough seas (this applies mostly to rock amalgam covered concrete platforms since they are permanent) and to assess the safety of these coastal areas for beach users, particularly beach users engaging in water-based activities. Further in-depth socio-economic assessments need to be conducted in the project development stage so that these artificial bathing platforms are installed where there is maximum beach user supply (i.e. as close as possible to residential and tourist areas) and close to popular sandy beaches to decrease visitor pressure at the latter. The economic feasibility to install these artificial bathing platforms at coastal areas not frequented by people due to the
lack of services/infrastructure and rough seas, such as at Bahar ic-Caghaq, would need to be evaluated.

6.4 Recommendations

- At the northeast of Malta, the coastline characterized by karst rocky shores extends from St. Julian’s to Salini and also at Cirkewwa. When considering the popularity of these sites by beach users, St. Julian’s is the most frequented locality both amongst Maltese and foreigners in particular. Karst rocky shore areas at St. Julian’s where temporary wooden decking platforms could be installed are located behind the Hilton and Radisson hotels.

Figure 6.1: Publicly accessible karst rocky shore behind Hilton hotel, St. Julian’s
Figure 6.2: Publicly accessible karst rocky shore behind Radisson hotel, St. Julian’s

- Possible locations for overlaying the rock amalgam would be where existing concrete platforms are old, eroding and do not fit with the scenery of the natural rocky shore. Suitable sites would be the east side of Qawra, Bahar ic-Caghaq and Armier Bay.

Figure 6.3: An unpleasant concrete platform at Qawra Point
Figure 6.4: Concrete footpaths at Bahar ic-Caghaq which would look more aesthetically pleasing if they are overlaid with a rock amalgam which simulates natural rock

Figure 6.5: An unsightly concrete platform acting as a jetty for small fishing vessels which would look more aesthetically pleasing if overlaid with the proposed rock amalgam, l/o Armier Bay

- Other potential sites for installing these artificial bathing platforms would be at the southeast coast of Malta, such as at Marsascala, St. Peter’s Pool and the Delimara peninsula due to the high beach user demand and large rocky shore areas at the southeast coast of Malta. In Gozo, potential sites include Dwejra, since wooden decking platforms would facilitate access to this popular dive site without harming the natural rocky shore with concrete footpaths, Hondoq
ir-Rummien and Marsalforn (see the first interview of Annex II in the Appendices).

- A common suggestion by the respondents who participated in this study was to preserve the natural rocky shore and to install these artificial bathing platforms where there is already coastal development.

- The public perception that the area in front of lidos and resorts is private has to be changed since with the establishment of the Temporary Provision Schemes in 2005, private owners have to leave at least 10 meters landwards from the shoreline accessible to the public. Furthermore, new proposals from private developers for the extension or the creation of new private establishments have to be critically evaluated by MEPA to ensure that the natural rocky shore remains a public resource. Hotels should not block access to the rocky shore (e.g. the Dolmen hotel at Bugibba and the Ramla Bay resort at Cirkewwa). Instead private owners could provide facilities for improved comfort and accessibility to rocky shores such as the proposed wooden decking platforms against a small fee which goes directly to these owners to maintain these artificial platforms and the rocky shore itself. However public access to the rocky shore should remain free to the public.

- Barbeques would not be allowed on wooden decking platforms since teak can burn plus the charcoal would make the deck surface gritty. The same applies for rock amalgam covered concrete platforms, as charcoal would ruin the aesthetically pleasing surface of the rock amalgam.
A site specific environmental impact assessment (EIA) of the potential sites for installing these artificial bathing platforms would be required which takes into consideration both land (e.g. existing road network, proximity to urban development and sandy beaches, protected coastal areas, etc.) and marine factors (e.g. hydrodynamics of the coastal area, wind exposure index, bathing water quality, etc.) and would assess the feasibility of artificial bathing platforms under technical, environmental, economic and social criteria.

Floating wooden decking platforms connected to the shoreline by piers are another alternative to land-based wooden decking platforms.

Teak not harvested from plantations decreases biodiversity and increases soil erosion risk in tropical teak forests. Thus when considering wooden decking platforms made from teak, one has to ensure that teak is sourced from certified plantations such as those managed by the Forest Stewardship Council.

Wooden decking platforms could also be installed at sandy beaches to provide accessibility to people in wheelchairs and to avoid walking on the hot sand during summer afternoons. Wooden footpaths are already present at “Ramla l-Hamra” Bay in Gozo.

It is also possible to combine both types of artificial bathing platforms, for example at the rocky shore of Sliema which was chosen by 20% of
respondents for wooden decking platforms and 13% of respondents for rock amalgam covered concrete platforms.

I would like to end this dissertation with this eye-catching comment a foreigner made in a survey conducted by Cachia (2002) at the coast of Qawra:

*It is nice to keep it [the rocky shore] natural – however, one can only see it but not enjoy it ... therefore there is the need to strike a balance between development and [the] natural environment.*

(Anon)
APPENDICES

ANNEX I: Questionnaire

The Acceptability of Artificial Bathing Platforms

This questionnaire is being conducted as part of an ongoing Dual Master of Science Degree in Sustainable Environmental Resources Management from the University of Malta and in Integrated Science and Technology from James Madison University, Virginia, USA. The aim of this questionnaire is to assess the public acceptability of installing artificial bathing platforms on the rocky shore of northeast Malta. The goal of this questionnaire is to see whether these artificial bathing platforms are accepted by the general public or otherwise.

These artificial bathing platforms would comprise of:

a) Wooden decking platforms (installed in summer and removed in winter) placed on deeply pitted (karst) rocky shore to make better use of our rough rocky coast thus relieving the pressure on sandy beaches during the peak summer months.

b) Rock amalgam covered concrete platforms (made up of decorative fiber-reinforced concrete which mimics natural rock) to improve the aesthetics of the existing concrete platforms.
Hereunder are photos of how these artificial bathing platforms would look like on the natural rocky shore:

i. *Natural deeply pitted (karst) rocky shore*

![Image of deeply pitted karst rocky shore]

*Figure A: Deeply pitted karst rocky shore at St. Julian’s, Malta*

ii. *Karst rocky shore overlaid with wood/timber decking*

![Image of wooden decking platforms]

*Figure B: Wooden decking platforms at the coast of Lanzarote Island, Spain. Source: http://www.lanzaroteinformation.com/files/Decking%20at%20Los%20Cocoteros.jpg*
iii. *Rocky shore currently with concrete platforms*

![Figure C: A concrete platform at Armier bay, Malta](image)

iv. *Fiber-reinforced concrete overlaid on an existing concrete platform*

![Figure D: A photomontage of a rock amalgam (coloured fiber-reinforced concrete) overlaid on the concrete platform shown in Figure C](image)
Kindly answer honestly the questions below. Feel free to leave empty answers where you may not have enough knowledge about. The questionnaire should only take five to ten minutes to answer. All information provided will remain anonymous and will be used solely for research. By agreeing to fill this questionnaire you confirm that you are at least 18 years of age.

Date: ………………
Location: ………………..

1. Nationality: ……………

2. Age group of respondent:  
   - Under 30  □
   - 30 - 49  □
   - 50+  □

3. Which of these coastal environments do you prefer for your recreational activities? (please choose one)
   - Rocky shores  □
   - Sandy beaches  □
   - Private beaches (including swimming pools)  □

4. If your preference in Question 3 is not ‘Rocky shores’ in the case of a rocky shore having:
a) Wooden decking platforms, would you:

- retain your preference of Question 3  □
- have equal preference for rocky shore and your choice of Question 3  □
- change your preference for rocky shore  □

b) Rock amalgam covered concrete platforms, would you:

- retain your preference of Question 3  □
- have equal preference for rocky shore and your choice of Question 3  □
- change your preference for rocky shore  □

5. Would you make more use of rough rocky shores if they have wooden decking platforms?

No ….  Yes ….  Not sure ….

6. Would you make more use of rocky shores if they have rock amalgam covered concrete platforms?

No ….  Yes ….  Not sure ….

7. Please rate how acceptable are the following coastal development scenarios:

a. Rough rocky shore overlaid with wooden decking platforms:
Strongly acceptable □
Acceptable □
Neutral □
Unacceptable □
Strongly unacceptable □

b. Rocky shore currently with concrete platforms:

Strongly acceptable □
Acceptable □
Neutral □
Unacceptable □
Strongly unacceptable □

c. Rocky shore with new rock amalgam covered concrete platforms:

Strongly acceptable □
Acceptable □
Neutral □
Unacceptable □
Strongly unacceptable □

8. How would you rate the present level of use of Malta’s rough rocky coast:
9. Do you think that these artificial bathing platforms would have a negative environmental impact?

Wooden decking platforms: No ..., Yes ..., Not sure ....
Rock amalgam covered concrete platforms: No ..., Yes ..., Not sure ....

10. Do you think that the social and economic benefits of these artificial bathing platforms would outweigh their negative environmental impacts?

Wooden decking platforms: No ..., Yes ..., Not sure ....
Rock amalgam covered concrete platforms: No ..., Yes ..., Not sure ....

11. Would you prefer installing artificial bathing platforms on the rocky shore rather than creating new artificial sandy beaches?

No .... Yes .... Not sure ....

12. Do you feel you have enough space when you go to a local sandy beach for bathing purposes?

No .... Yes .... Not sure ....
13. How much are you prepared to pay for using:

a) Wooden decking platforms?

Nothing  □
€1 to €2  □
€3 to €4  □
€5        □

b) Rock amalgam covered concrete platforms?

Nothing  □
€1 to €2  □
€3 to €4  □
€5        □

14. Where do you think is the most appropriate rocky shore locality for installing:

(Please choose from the following: Sliema, St. Julian’s, Pembroke, Bahar ic-Caghaq, Qawra, Bugibba, St. Paul’s Bay, Xemxija Bay, Mellieha Bay, Armier Bay, Cirkewwa, Where needed, Everywhere, Nowhere)

Wooden decking platforms: ..........................
Rock amalgam covered concrete platforms: ..........................

15. Any other comments?

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........................................................................................................
........................................................................................................
........................................................................................................
........................................................................................................

Thank You!
ANNEX II: Stakeholder Interviews

Interview with Nature Trust Malta (NTM) President: Mr. Vincent Attard (Date: 14/06/13)

Q. 1. What is the position of NTM for installing:

a) Wooden decking platforms on currently inaccessible rocky coastal areas due to their rough surfaces

Wooden decking platforms are acceptable as long as they are removable however it depends on the ecological importance of the site. From a Blue Flag point of view, there has to be environmental education to the public about the importance of wooden platforms to protect sea urchin assemblages at sandy beaches. This is because sea urchins are being removed at sandy beaches since beach users complain about stinging their feet. Moreover, wooden platforms provide alternative swimming areas where there are no sea urchins.

b) Rock amalgam covered concrete platforms to improve the aesthetics of present concrete platforms

I would suggest stopping concreting areas of the natural rocky shore and instead opting for temporary structures such as wooden decking. However, considering the state of existing concrete platforms, an aesthetically pleasing rock amalgam is a good
option for improving the aesthetics of existing concrete platforms, particularly at popular areas, for example at Bugibba. There should be studies on whether to replace existing concrete platforms or to overlay them to see which of the two options has the least ecological impacts on the rocky shore. In my opinion, covering (overlaying) existing concrete platforms would be the better option since replacing them would require the intervention of heavy machinery (e.g. jackhammers) which would have substantial environmental impacts on the ecological communities of small rock pools which characterize these rocky shores.

**Q.2. Are you against such a coastal project? Why?**

It depends on the characteristics of the site being considered. Necessary environmental impact assessments need to be carried out before installing these platforms. However, the fact that wooden decking platforms are temporary structures would not make me against such a project. With regards to the litter generated by the additional beach users, rocky beaches are more difficult to clean up however specially designed vacuum cleaners would clean up litter from these difficult environments.

**Q.3. What do you think are the pros and cons of these artificial bathing platforms?**

**Wooden decking platforms**

The pros of wooden decking platforms are that they provide rocky shore access to persons with disability; provide access to dive sites such as at Dwejra (Gozo) without concreting parts of the rocky shore and without trampling on shore vegetation thus
they would enhance Malta’s tourism product via the diving industry; reduce human impacts on sandy beaches by controlling visitor flows; save sea urchins from being removed from sandy beaches (sea urchins are ecological indicators of water quality); a better option than concreting areas of the natural rocky shore as it was done in the 1980s; and reduce trampling on sand dunes (e.g. the wooden footpaths at Ramla l-Hamra Bay, Gozo). The cons of wooden decking platforms are that they increase crowding thereby creating litter at the installation sites; require ongoing maintenance due to the exposure to the elements (wind, rain and seawater) and the anticipated heavy use by the public.

**Rock amalgam covered concrete platforms**

The pros of rock amalgam covered concrete platforms are that they improve the aesthetics of existing concrete platforms which are an eyesore to tourists and they make concrete platforms look more natural. The cons of rock amalgam covered concrete platforms are that they would be expensive.

**Q.4. Do you think that these artificial bathing platforms are a better option than beach replenishment projects?**

Yes. Artificial beaches such as Bugibba Perched Beach cause great environmental damage due to the exposure of these sites which results to beach erosion and the smothering of *Posidonia oceanica* meadows in coastal waters. Artificial bathing platforms are a good choice to increase Malta’s bathing areas in the long-term and are
preferable to beach nourishment projects, especially when one considers the ecological impacts of the latter.

**Q.5. Where do you propose to install:**

Proposed locations for these artificial bathing platforms have to be evaluated against trade-offs between the potential environmental degradation and the popularity of the site by beach users.

**i) wooden decking platforms**

Wooden decking platforms are feasible to install near the shoreline since they would not have significant environmental impacts on ecological communities, but preferably a shore with low ecological value would be chosen. Popular areas to install these wooden platforms include: Pembroke; Dwejra (Gozo); Qawra (since the rocky shore found here does not have high ecological importance); Mistra bay; Xrobb l-Ghagin, St. Peter’s pool and Kalanka (Delimara) (the south/southeastern coast of Malta is heavily frequented by the locals; thus providing wooden decking platforms as part of a larger Blue Flag beach project on rough rocky shore areas would greatly improve public satisfaction); behind Radisson hotel at St. Julian’s however this area is highly exposed to strong winds and rough seas; and Bahar ic-Caghaq since this area is already popular with wind surfers.

**ii) rock amalgam covered concrete platforms**
Rock amalgam covered concrete platforms preferably should be installed at the backshore zone of rocky shores since closer to the shoreline there are more diverse ecological communities which merit protection. Suggested sites for overlaying this rock amalgam on existing concrete shore platforms include Qui-Si-Sana (Sliema) and Bahar ic-Caghaq.

**Q.6. Do you agree that these artificial bathing platforms are not free?**

No. One of the Blue Flag beach criteria is to maintain public accessibility to both rocky and sandy beaches. If there is going to be a charge for using these artificial bathing platforms, the rocky shore should still be publicly accessible. If these artificial bathing platforms are installed at private beaches the fee has to be reasonable. The current coastal development policy states that the coast is a public resource and has to remain that way.

**Q.7. Do you envisage there will be public opposition for this project or any conflicts between coastal users?**

If these artificial bathing platforms are free the public would welcome this project.

**Q.8. Any additional comments?**

There should be no barbeque activities allowed on these platforms so as to keep their maintenance low and to maintain the environmental quality of the site; since barbeques are one of the major sources of litter at beaches. With the presence of litter,
there would be rat outbreaks which could have substantial negative ecological impacts on rocky shore ecology. As part of the Blue Flag Program, smoking should also be prohibited at rocky shores because it is very difficult to remove cigarettes from a rocky shore, especially when it has crevices and sharp protrusions which make cleanup operations very difficult.

It is important to provide first aid and lifeguards at rocky shores due to the rougher seas present compared to sheltered sandy beaches. In addition, the roughness of the shore surface can easily cause accidents particularly to children and the elderly. Ladders are also important to improve public safety and accessibility to the sea.

The rocky shore area close to the old Maghtab landfill is not suitable for installing these bathing platforms since the long-term impacts of hazardous substances which contaminated the coastal waters would still be present. Moreover, toxic fumes are still present in this area.

There needs to be more public education through Blue Flag events and information meetings on making better use of our rocky shores, on protecting them from illegal coastal development and on their high ecological value.
Interview with Mr. Raymond Azzopardi: Senior Manager - Product Development Unit at the Malta Tourism Authority (MTA) (Date: 18/06/13)

Q. 1. What is the position of the MTA for installing:

a) Wooden decking platforms on currently inaccessible rocky coastal areas due to their rough surfaces

Studies need to be conducted before installing these platforms. The northeast coast of Malta is very exposed to the northeast wind which creates very rough seas in winter. This makes the northeast coast unsuitable for bathing. In addition, large sea waves would corrode these wooden decking platforms. Financially and operationally these wooden decking platforms are not feasible since they are expensive and would require regular maintenance.

b) Rock amalgam covered concrete platforms to improve the aesthetics of present concrete platforms

From an aesthetics point of view it is a good idea however MEPA would need to be consulted about this project. Not a cheap option plus the project needs to be financed by someone. Wind studies need to be conducted to minimize wave damage to these rock amalgam covered concrete platforms especially during storms. A cost-benefit analysis also needs to be conducted to determine their economic feasibility.
Q.2. What do you think are the pros and cons of these artificial bathing platforms?

Wooden decking platforms

The pros of wooden decking platforms are that they create additional bathing space and they make rugged shore areas more accessible. The cons are that an insignificant number of beach users could be accommodated on these wooden platforms thus they would not help to reduce crowdedness at popular sandy beaches; teak is expensive; charges to store, transport and manufacture these wooden decking platforms; a low return of investment due to their high initial costs and high maintenance; one would need to provide additional facilities alongside these platforms which all require extra costs; rough rocky shores are not used by the common beach user but by more specialized users such as divers and snorkelers; swimming zones cannot be created at the rocky coastline of northeast Malta since it is very exposed to strong winds and there need to be inlets (small embayments) to create swimming zones.

Rock amalgam covered concrete platforms

The pros of rock amalgam platforms are that they are more aesthetically pleasing than the current concrete platforms. The cons are that they are more expensive than the existing concrete platforms thus this rock amalgam would not be economically feasible to overlay over large areas; these rock amalgam platforms would be heavily damaged by storm waves and by abrasion of large boulders which would be brought up to the shore by storm waves - “A ton and a half of concrete benches had been
destroyed during past storm events”; and these rock amalgam platforms would require frequent maintenance.

Q.3. Do you think that these artificial bathing platforms are a better option than beach nourishment projects?

Artificial beaches worked very well in the past and they are very aesthetically pleasing. However, beach replenishment is still an expensive option. Artificial beaches are a better long-term solution than artificial bathing platforms to provide additional bathing areas. Like artificial bathing platforms, replenished beaches require frequent maintenance (regular additions of fill material). Crushed granite (the material used for Bugibba Perched Beach) is much heavier and denser than normal sand hence gets eroded less easily. Eroded granite from Bugibba Perched Beach created new artificial beaches at small inlets downdrift and is not negatively affecting Posidonia oceanica meadows; studies done by MEPA did not mention any adverse impacts from the nourishment project on the marine ecology of the area.

Q.4. Where do you propose to install:

i) wooden decking platforms

Unless physical studies of potential areas are made, no propositions can be made yet.

i) rock amalgam covered concrete platforms
Nowhere since they are not financially or operationally feasible.

Q.5. Do you agree that these artificial bathing platforms are not free?

The public would want these bathing platforms free of charge. If they are not free people would not make use of them. To use deckchairs and umbrellas one has to pay, so this cost also has to apply to use wooden decking platforms. In spite of the costs involved throughout the whole life cycle of wooden decking platforms (to manufacture, to treat the wood against corrosion and rot, to install/uninstall the wooden platforms on site, to store them, etc.), the public would take these costs for granted and would not be willing to pay to use these platforms.

Q.6. Do you envisage there will be public opposition for this project or any conflicts between coastal users?

There would not be any conflicts between coastal users at rough, inaccessible rocky shores since they are not safe for beach users and not frequented very much by people. Regarding rock amalgam platforms, there would be no conflicts between coastal users since they would have the same uses as the current concrete platforms.

Q.7. Any additional comments?

Concrete wave breakers placed close to the shoreline would partially protect these artificial bathing platforms from powerful sea waves, thereby reducing their maintenance costs.
A wood-plastic composite for the wooden decking material is better from an environmental point of view than teak decking. It is also maintenance free. However, wood-plastic composites are about four times more expensive than teak.

Wooden decking platforms on rocky shores are more feasible (less expensive) than floating wooden platforms.

In-depth studies need to be made about alternative designs and materials for these artificial bathing platforms.

Services and facilities provided alongside these artificial bathing platforms would require permission from MEPA and funding as part of a large project to enhance coastal accessibility and recreational facilities.
Interview with Ms. Christine Tanti representing the Environmental Protection Directorate within the Malta Environment and Planning Authority (Date: 04/07/13)

Q. 1. What is the position of the Environmental Protection Directorate for installing:

a) Wooden decking platforms on currently inaccessible rocky coastal areas due to their rough surfaces

This project has to be assessed based on the design, location and amount of decking to be used. There would be possible impacts on species and habitats of rock pools due to the shade created by these wooden decking platforms which would prevent photosynthesis of the vegetation growing under them. More research needs to be done on the impacts of these wooden platforms. Wooden decking platforms would need to be frequently maintained. These platforms would cause visual impacts. This project will cause pressure for further coastal development and facilities such as kiosks. Issues of land uptake need to be properly controlled once these wooden decking platforms are installed. The provision of infrastructure also needs to be taken into consideration such as road access, parking areas, lighting, etc.

b) Rock amalgam to improve the aesthetics of present concrete platforms
These are less of a concern, environmentally, provided that the concrete is already there and that it is legal. However any chemical leakages from these rock amalgam platforms to the sea have to be studied. Conditions for these rock amalgam covered concrete platforms will have to be presented in a work method statement. The work method statement would mention that the current legal uses of concrete shore platforms would be retained; the method for overlaying the rock amalgam, etc.

**Q.2. What do you think are the pros and cons of these artificial bathing platforms?**

**Wooden decking platforms**

The pros of wooden decking platforms are that they would help to increase recreational activities and to decrease anthropogenic pressure at popular sandy beaches. The only con would be inadequate parking areas at karst rocky shores.

**Rock amalgam covered concrete platforms**

The advantage of new rock amalgam platforms is that they would reduce the negative visual impact of old concrete platforms. The cons include increased maintenance costs of the rock amalgam as the old concrete platforms get eroded; and the continuous monitoring of these rock amalgam covered concrete platforms to assess their environmental impacts.

**Q.3. Do you think that these artificial bathing platforms are a better option than beach nourishment projects?**
Yes because the environmental impacts of artificial bathing platforms are less drastic and of a temporary nature since they are land-based structures compared to artificial beaches, where the impacts of the latter are more diffuse and permanent. With artificial sandy beaches, beach material gets transported everywhere especially during storm events. On the other hand, if these artificial bathing platforms are not successful there would be no damage done since they have few negative environmental impacts.

Q.4. Where does the Environmental Protection Directorate would permit the installation of:

i) wooden decking platforms

Development applications are assessed according to the habitats, site designations (e.g. the present status of site accessibility) and characteristics of the proposed rocky shore area (whether impacts arising from wooden decking platforms would be significant or not with regards to the conservation status of the site in consideration).

ii) rock amalgam covered concrete platforms

No specific areas.

Q.5. Do you agree that these artificial bathing platforms are not free?
Access to the beach has to be free of charge. If paying for these artificial bathing platforms, expectations of the public would be high and more services would need to be provided alongside these artificial bathing platforms which would increase the project costs considerably and would create pollution.

**Q.6. Do you envisage there will be public opposition for this project and any conflicts between coastal users?**

There would be different opinions from various stakeholders who make use of the rocky shore (e.g. fishermen, divers, swimmers, sunbathers, owners of private establishments, etc.). Beach users would welcome this project since they would have more bathing areas. However residents would complain about fewer parking spaces and increased noise amongst other impacts. Conflicts between boaters and swimmers at rocky shore areas would be anticipated. There would need to be public meetings between the MTA, Transport Malta, residents, owners of private establishments, etc. to settle disputes.

**Q.7. Any additional comments?**

The ancillary interventions that are required to regularly maintain litter bins, mobile toilets, sunbeds and umbrellas and these artificial bathing platforms would be of concern and would need to be financed by someone.

There could be possible modification of the project proposal by relocating these platforms to more suitable rocky shore areas and by using alternative materials and
alternative designs for these bathing platforms. There is also the option of replacing current concrete platforms with these rock amalgam platforms. As for wooden decking platforms, they could be washed away by sea waves and the decking surface would be slippery due to the growth of algae, which would discourage people to use them. Also these wooden decking platforms would need to be protected from rot by marine organisms.
Interview with Mr. Raphael Axiaq representing the Planning Directorate within the Malta Environment and Planning Authority

(Date: 17/07/13)

Q. 1. What is the position of the Planning Directorate for installing:

a) Wooden decking platforms on currently inaccessible rocky shore areas due to their rough surfaces

Any intervention on rocky shores has to be evaluated against the scheduling of the site regarding ecological habitats and species, geomorphology, archeological remains and areas of high landscape value. Parking areas would also need to be provided at rural areas and areas outside development zones (ODZ).

b) Rock amalgam covered concrete platforms to improve the aesthetics of present concrete platforms

Acceptable as long as existing concrete platforms are legal. This rock amalgam can be viewed as maintenance of existing concrete so it is acceptable. However it also depends on whether any of this material would spill into the sea thus releasing toxic substances which would affect the marine and rocky shore ecology.

Q.2. What do you think are the pros and cons of these artificial bathing platforms?
Wooden decking platforms

The pros of wooden decking platforms are that they facilitate easier access to the foreshore; greatly improve surface comfort of rugged rocky shores; easily reversible method of creating alternative bathing areas other than crowded sandy beaches; and damage to the rocky shore would be very limited since wood is a natural material. The cons are increased crowding at rocky shores; facilities provided would have to be limited so as not to create excessive pollution as more people to the site would cause negative impacts on the infrastructure, commercial establishments and residents of the area.

Rock amalgam covered concrete platforms

The pros are that they would require less maintenance than present concrete platforms since their durability would be higher; and they would be safer than present concrete platforms since they would be more comfortable and would erode at a much slower rate. The cons are that any toxins leached from broken rock fragments of the coloured FRC would possibly harm the marine ecology; and that these platforms could be slippery.

Q.3. Do you think that artificial bathing platforms are a better option than beach nourishment projects?

Artificial bathing platforms are definitely cheaper options and have fewer negative environmental impacts than beach nourishment projects since these artificial
platforms are a land-based project rather than a marine-based project. Therefore these platforms would not require an EIA if there are no significant impacts on the rocky shore and the surrounding area.

**Q.4. Where does the Planning Directorate within MEPA would permit the installation of:**

i)  **wooden decking platforms**

Near the Coastline hotel at Bahar ic-Caghaq and at the karst rocky shore along the Coast Road since there is already a road and a parking area. However the location for installing these platforms must be determined on a case by case basis. For example, one must consider the distance from the site to existing infrastructure, the amount of traffic which would be generated in the area and on the scheduling of the site for any ecological, geomorphological or cultural heritage.

ii)  **rock amalgam covered concrete platforms**

Since these are regarded as maintenance of existing concrete platforms, they do not represent a problem. Thus they can be overlaid where needed on legal concrete platforms.

**Q.5. Do you agree that these artificial bathing platforms are not free?**
They should be free since public access to the foreshore must be retained. This is stated in the policy CZM 3 of the Structure Plan of 1990.

**Q.6. Do you envisage there will be public opposition for this project and any conflicts between coastal users?**

No, the public would welcome this project. However, residents, hotel owners and restaurant owners would potentially object because of the increased noise and litter generated. In the case of wooden decking platforms there could be conflicts between coastal users. Ecologists and NGOs might protest against such project since the shade created beneath these platforms could stunt the growth of the flora present on the rocky shore.

In the case of rock amalgam covered concrete platforms, the conflicts would be similar to those of existing concrete platforms, i.e. would fisherman and boaters accept this aesthetically pleasing material when considering the increased number of people who would make use of it? Conflicts between users also depend on the location in consideration. A case in point is Marsaxlokk; where the shore is heavily contested by fishermen, hawkers and restaurant owners.

**Q.7. Any additional comments?**

Facilities alongside wooden decking platforms should be as few as possible since their purpose is ultimately to increase accessibility to rough, karst shore areas and to
increase shore comfort. Moreover, they would only be suitable for people who prefer peaceful and natural/undeveloped coastal environments.

Private beach concessions should be restricted and given back to the public. At the Bugibba coastline there is a serious issue of private land uptake, characterized by long tracts of concrete platforms most of which are private beach concessions.
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