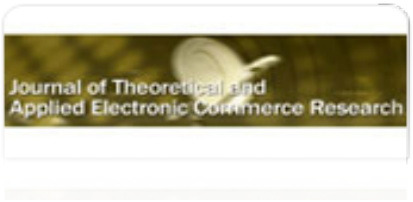

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Applying a Multicriteria Satisfaction Analysis Approach Based on User Preferences to Rank Usability Attributes in E-tourism Websites

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Abstract

A user-centered approach in the development lifecycle of e- commerce websites is nowadays a crucial factor in the success of any on-line business. The purpose of this paper is twofold: a) to identify the factors that affect e-commerce website usability and b) to analyze the role of those factors in increasing the effectiveness of e-commerce web sites. Furthermore, it presents the application of a Multicriteria Satisfaction Analysis (MUSA) method to rank usability attributes in websites based on their competitiveness importance. A case study in eight e-tourism web-sites is presented as a demonstration of this work, the outcome of which will help usability specialists and e-commerce website developers to determine specific usability attributes that are more crucial to the overall usability and user satisfaction of a website. The results of the proposed approach suggest that for each e-commerce website certain usability attributes are likely to be more crucial to the success of the e-commerce website than others. Therefore, identifying the relevant usability attributes in advance through customers' feedback can be a great advantage to website developers if they want to have an edge over other competitors.

Keywords: Web usability, E-commerce, E-tourism, Multicriteria analysis, Customer satisfaction analysis

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1 Introduction

Electronic commerce refers to a wide range of online business activities for products and services [50]. Electronic commerce reduces costs and extends existing distribution channels, extending existing business models. Web usability is one of the important factors that determine the success of e-commerce websites [23]. A website which is not user friendly will drive users away [2]. Moreover, others will also be advised to avoid it. It is difficult to convince dissatisfied visitors to revisit your website even if you launched a new site.

In e-business, the website is the firm's interface with the customer, and its usability is crucial to the success of the venture. E-business success is determined in part by trust [49], and research shows a strong relationship between website usability and trust.

In his book, *Usability Engineering*, Nielsen [40] defines usability in terms of a number of users' oriented attributes. According to Nielsen [40], usability refers to:

- The ease of learning how to use the interface
- The efficiency of the interface design
- The ease of memorizing how to use the interface
- The reduction of errors
- General satisfaction with the interface

Usability in ISO 9241-11 is defined as "The extent to which a product can be used by specified users to achieve specified goals with effectiveness (fit for purpose), efficiency (taking less time to achieve a particular task) and satisfaction in a specified context of use". According to Jakob Nielsen [39] usability is a quality attribute that assesses how easy user interfaces are to use. The word *usability* also refers to methods for improving the ease-of-use during the design process.

Human-computer interaction (HCI) is the study of interaction between humans and computers [8]. The objectives of human computer interaction design are to produce usable, secure and functional systems. People's concern has been of utmost importance in HCI, since they will use these systems in their everyday life. The usability and design of websites have received much attention in the human computer interaction (HCI) literature as well as in web-specific usability research. Usability and its determinants pose a considerable challenge to usability interaction designers and electronic commerce website developers.

The term *user experience* (most often abbreviated *UX*, but sometimes *UE*) refers to a concept that places the end-user at the focal point of design and development efforts, as opposed to the system, its applications or its aesthetic value alone. It's based on the general concept of user-centered design. It is used to describe the overarching experience a person has as a result of their interactions with a particular product or service, its delivery, and related artifacts, according to their design. In the web world, user experience is sometimes conflated with usability, and user interface (UI), both of which are components of it [13].

People are increasingly talking in terms of *experience*. Research has shown that efficient interaction features positively influence customer loyalty [12]. Pine & Gilmore suggest that we have moved from a service economy to an experience economy [41]. A good user experience is one where a user achieves his/her goals and is highly satisfied with the process.

The user experience is primarily made up of four factors:

- Branding
- Functionality
- Usability
- Content

Branding includes all the aesthetic and design-related items within a website [3]; *functionality* includes all the technical and *behind the scenes* processes and applications [42], *Usability* entails the general ease of use of all site

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components and features - it can also include navigation and accessibility. *Content* refers to the actual content of the site (text, multimedia, images) as well as its structure, or information architecture.

There are evidences of the existence of a direct relationship between usability and user experiences. According to Zviran et al., measuring usability is based on evaluating the experience of the user interacting with the system, which involves a focus on the interface [53].

We advocate in this paper, that by identifying and analyzing usability attributes by recording user experience, more effective web sites can be designed and developed with increased customer loyalty and improved buying behavior and conversion rate.

MUSA, a Multicriteria Satisfaction analysis method has been applied in this work to study the usability domain for the purpose of identifying and evaluating the usability attributes of a number of e-commerce websites via user experience.

This paper attempts to study some aspects that affect usability and motivate customers to visit and buy from the electronic commerce website increasing thus customer loyalty and leading to successful electronic commerce websites. The key questions that are addressed herein are: 1) Are there specific usability attributes that determine the success of electronic commerce websites? and 2) If so, can we rank those attributes based on their importance?

2 Theoretical Framework

The usability and design of websites have received much attention in the human computer interaction (HCI) literature as well as in web-specific usability research [5], [6], [21], [33]. The information stored across the World Wide Web is enormous and growing daily. Millions of new web pages are published daily, designed and developed by people who give little thought to how the information will be used and by whom. In such an environment, providing guidelines and frameworks for creating pleasing user experiences would be valuable [22].

The conversion rate for an e-commerce business is the number of visitors making a purchase directly from the website expressed as a percentage of the total number of visitors. In other words, the conversion rate is simply the percentage of customers who do what you want them to do as a result of using your site: this might be purchasing a product, but it could also be joining your mailing list or visiting one of your 'bricks and mortar' stores with a voucher obtained on-line [48].

The domain of electronic commerce introduces a new concept: trust in machines. This extension introduces a shift from assessing motives and intentions to assessing reliability. In electronic commerce both human intentions and system reliability can affect consumer trust. When users start navigating the website, they start to develop some confidence that the system will perform as predicted. Through this confidence, the user will build trust in the system, learning more about its behavior, its reliability and the risks involved in using it. The user develops an attribution of dependability, taken as evidence that the system can be relied on [21], [42], [44].

The success of a web site design can be measured by a) how frequently the user uses it, b) how often users return to a website, c) how often they recommend it to friends, and d) how often they buy similar products from the same company in the future. Specifically, loyalty may be defined as a customer's intention or predisposition to purchase from the same organization again [20]. That result comes from the conviction that the value received from one seller is greater than the value available from other alternatives [26]. In general, loyalty development has been an objective traditionally aimed at by managers [4], [9], [17] since it enables higher future purchase intention.

Loyalty is also enhanced if the site becomes more valuable to the user at each visit. Choi and Kim found that "efficient interaction features positively influence customer loyalty" [13]. According to Reid Smith [46], e-marketers should develop e-loyalty design standards to ensure that all web designs stimulate customer retention. These standards are the strategy behind the website design and cover the navigation strategy, the basic usability, and the degree of interactivity. These strategies need to be developed before the website is created by the web designer. "Integrating e-loyalty into all areas of your website should be your ultimate design goal".

Research has showed that the intention to purchase has a strong relation with website usability while poor usability lowers purchase intent. Customer loyalty favors greater future purchase intention [20]. It was suggested by Kwon and Kim that future research was needed to determine whether there was a similar relationship between sales and website design factors [32]. Their research into e-commerce sites showed how *design elements on an e-commerce website carry out the rhetorical function of persuasion.*

According to Winn & Beck [51], "Knowing that the way in which the salient factors are presented on the site can affect their persuasive power puts designers firmly in command of the persuasive process. As a result, designers who understand the theoretical nature of the interfaces they create will be better equipped to make educated design choices." These tools could also be useful for business managers who want to ensure their e-commerce website is functioning as well as it could be.

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3 Factors Influencing Websites Usability

Gathering from various literatures on web design and usability, a number of usability attributes have been identified and classified into 10 major categories (see Table 1).

The first category (also referred as criterion later on), *accessibility* is defined by World Wide Web Consortium (W3C) as "Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging" [28]. Websites should be designed to ensure that everyone, including users who have difficulty seeing, hearing, and making precise movements, can use them.

The major accessibility issues to be dealt with include [32]:
Provide text equivalents for non-text elements.

- Ensure that scripts allow accessibility.
- Provide frame titles.
- Enable users to skip repetitive navigation links.
- Ensure that plug-ins and applets meet the requirements for accessibility.
- Synchronize all multimedia elements.

Interactivity also refers to the ability and ease at which users can supply content as a co-creator by adding, modifying, or manipulating information, and the potential for controlling content personalization – for example, think about blogs' feedback comments, personalized news outlets, and retailers that capture buyer patterns and suggest similar products. The main goal of online interactivity is to facilitate the feeling of interpersonal human communication and increase user autonomy by shifting control away from the media and to the audience [36].

Ghose and Dou [22] found that interactivity in a website can take many forms, including customer support activities (such as order status tracking, feedback options), market research activities (such as taking product surveys), personal choice helpers (such as key word searches, dealer locators), advertising/promotion/publicity activities (such as sweepstakes, multimedia shows, and user groups), and even entertainment activities (such as playing games).
Interactivity is divided into five sub-categories: Machine-mediated communication, Real-time communication, Dialogues, Interactive Decision Aids, and Transaction-related vs. non-transaction related interactivity.

Personalization is the process of tailoring pages to individual users' characteristics or preferences. Personalization is sometimes referred to as one-to-one marketing; because the enterprise's web page is tailored to specifically target each individual consumer. It helps screen out unwanted information or product options, reduces user effort by eliminating the need to provide personal information or preferences multiple times, improves the accuracy of searches, and speeds up the completion of transactions.

Customizable e-commerce means the system can automatically identify, judge, search and match information according to the different demands of individuals, companies, organizations or institutions, and submit corresponding functions and services. What's more, this kind of e-commerce system has the ability to adopt itself; that is, it can adjust to the changes of the environment, such as users demand and technology [42].

Personalization is divided into five sub-categories: Recognizing Visitors, Customization of Content, Tailoring, Explicit and Implicit Personalization and Collaborative Filtering.

Privacy and Security: An important contributor for e-business in general and trust in particular is the privacy and security aspect. In the early days of e-business, many people shied away from online purchases simply because of security concerns. Security issues are centered on transmission and storage of transactional information by a website. As in the case of privacy, consumers experience a lack of control over the payment information provided to a website. Security issues are shared by the websites and consumers. This has led many websites to resolve the technical issues related to security. In spite of these measures, visitors may still perceive the website to be unsafe [47].

Privacy and security are divided into five sub-categories: Personally Identifiable Information, Transmission of Transactional Information, Lack of Control, Trust and Assurance Seals.

Content relates to the informational and transactional capabilities of a web site. A well-organized website will be perceived as being less complex and more user-friendly, and will increase the quality of a visitor's experience.

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Most website designers agree that having a lot of information may be of little value, unless visitors find the arrangement of information logical and easy to understand. We view organization as the ability of a website to arrange content, information, images, graphics, etc. in a manner that increases clarity of presentation and makes it easy for a visitor to find the needed information. Most people don't read online, they skim [18].

Content has six sub-categories: Organization, Layout, Readability, Current and Timely Information, Complexity, Informative Product Pages.

Learnability relates to the features of the interactive system that allow users to understand how to use it initially and then how to attain a maximum level of performance. A well-designed interface should be easy to learn quickly and effectively. According to Nielsen [40] the system should be easy to learn so that the user can rapidly start getting some work done with the system. Learnability is most likely the fundamental usability attribute as most systems need to be easy to learn, since the first experience of users is to learn and understand the system.

Learnability is divided into five sub-categories: Familiarity, Consistency, Generalizability, Predictability, and Simplicity [34].

Design-Structure: It is important for the web designers to design the website in such a way that it makes it easier, not harder, for the mind to see the pattern. It must be clear to a visitor if he is still at the same site. Consistency refers to the likeness in behavior arising from similar situations. Generally, a user relies on a consistent interface; however, the difficulty of dealing with consistency is that it can be of many kinds. The design and structure of information should be standardized to support understandability and easy maintenance.

Consistency has been a widely discussed field of user interface design. Consistency refers to the likeness in behavior arising from similar situations. Generally, a user relies on a consistent interface; however, the difficulty of dealing with consistency is that it can be of many kinds. Consistency is not just a single property of an interactive system that is either satisfied or dissatisfied. Consistency can also be demonstrated in terms of the form of input expression or output responses with respect to the meaning of actions in some conceptual model of the system [15]. Design-Structure is divided into seven sub-categories: Website Design, Homepage, Graphical Interface, Page Background, Color Consistency, Information Structure and Organization and Text Consistency.

Navigation: The e-commerce website navigation should be easy to understand and use, providing clear labels that explain what a user will find when he or she clicks. Website navigation needs to provide adequate navigational choices so that users can find what they want, while at the same time not presenting the user with so many options that they become overloaded. Menus would help the user to browse through the website and make it easier to retrieve information. It will also enhance the learnability and predictability levels of the user interface [43].

Navigation has three sub-categories: Know Where They Are, Easily Return and Search.

Performance: In order to ensure a high level of performance, the websites should be efficient to use. Website efficiency refers to the stable performance stage of an expert user.

Product differentiation and comparison tools can also help users to choose and thus overcome decision paralysis and facilitate sales. User fears must be soothed about buying the wrong product, or they will postpone their purchases and probably never buy from this website [40].

Performance has only two criteria: Efficiency and Product Differentiation and Comparisons.

The last category, *Memorability*, refers to the ability of the casual user to use the interface effectively after sometime. According to Nielsen [44] memorability refers to how easy a system is to remember, so that a formal user can return to the system after some period without having to relearn everything over again. Memorability has one sub-category: Interface Memorability.

In Table 1 the main criteria and subcriteria that are crucial to the success of e-commerce websites are summarized.

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Table 1: Criteria and subcriteria

Category	Sub-category	Relevant Literature
Accessibility	Design Satisfies Accessibility Needs	[27], [28], [31], [52];
Interactivity	Computer-mediated Communication Real-time Communication Dialogue Interactive Decision Aids Transaction-related vs. non-transaction related interactivity	[14], [15], [22], [36], [52];
Personalization	Recognizing Visitors Customization of Content Tailoring Explicit and Implicit Personalization	[1], [8], [11], [29], [31];
Privacy and Security	Personally Identifiable Information Transmission of Transactional Information Lack of Control Trust Assurance Seals	[5], [31], [47];
Content	Organization Layout, Headings and Styles Readability Current and Timely Information Complexity Informative Product Pages	[5], [8], [10], [18], [31], [52];
Learnability	Familiarity Consistency Generalizability Predictability Simplicity	[5], [15], [18], [34], [40];
Design - Structure	Website Design Homepage Graphical Interface Page Background Color Consistency Information Structure Text Consistency	[5], [8], [15], [39], [40], [52];
Navigation	Know Where They Are Easily Return Search	[8], [37], [38], [42], [52];
Performance	Efficiency Product Differentiation and Comparisons	[5], [15], [19], [39], [40], [52];
Memorability	Interface Memorability	[5], [39], [40];

4 Research Methodology

Customer satisfaction is a measure of how products and services supplied by a company meet or surpass customer expectations. In marketing literature, it has been traditionally considered that a greater degree of customer satisfaction leads to a greater degree of individual loyalty [9], [12]. When customers perceive that an organization fulfills the agreed conditions, they will feel satisfied and believe that these behaviors will come back in the future. To reinforce customer orientation on a day-to-day basis, a growing number of companies choose customer satisfaction as their main performance indicator [37]. The best way to find out whether your customers are satisfied is to ask them. Measuring customer satisfaction provides an indication of how successful the organization is, at providing products and/or services to the marketplace. By analyzing answers from different customers, trends can be observed, differences by region can be realized, and suggestions from customers can be presented [45].

The research work is accomplished through establishing a questionnaire evaluating different users' perspectives about the existence of usability attributes that affect the success of electronic commerce websites and to what extent usability activities are considered in Greek e-tourism websites. The questionnaire involved satisfaction questions: i.e. the participants were asked to give a score corresponding to how much they believe a particular usability attribute is

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present in an e-tourism website, or the extent to which they think an attribute is crucial to the usability of an e-tourism website. Multicriteria Satisfaction Analysis (MUSA) model aims to aggregate the individual judgments of the surveyed population into a collective value function, assuming that the population's global satisfaction depends on a set of satisfaction criteria or variables characterizing specific dimensions of programme management [30]. This tool evaluates the respondent's satisfaction level, both globally and partially, for each of the satisfaction criteria, and it supplies a complete set of results that explains their satisfaction level and analyzes in depth the respondent's behavior and expectations.

To apply multicriteria analysis, the criteria set must satisfy three fundamental properties: monotonicity, exhaustiveness and non-redundancy [24]. Moreover, the MUSA method infers an additive collective value function Y^*, and a set of partial satisfaction functions X_i^* from customers' judgments. The main objective of the method is to achieve the maximum consistency between the value function Y^* and the customers' judgments Y. To this end, customers should be able to provide their satisfaction levels for the entire set of criteria. According to the two aforementioned theoretical constraints, six of the above categories (criteria) were chosen which satisfy those requirements: Accessibility, Interactivity, Personalization, Content, Navigation and Design-Structure. The selected attributes were easier to be evaluated by customers after a few minutes of navigation, every attribute has multiple sub attributes, this can add more consistency to customer judgments and highly applicable to the web environment, specifically in E-tourism. This will provide deeper understanding of the importance of the existence of usability attributes. To demonstrate the utility of the MUSA approach in the usability domain, a quantitative approach was used; satisfaction data was collected through a questionnaire that targeted the master student population that uses e-tourism services. Participants were asked to fill in the questionnaire electronically using a customized windows application that was developed for that purpose.

4.1 Measurement

As already stated, questionnaires have been developed to evaluate the extent to which the usability attributes affect the success of e-tourism websites. Users were asked to give a score for the extent each usability attribute is present in each website. Accordingly, the e-tourism website that received the highest total score was ranked as the best site. The design of the questionnaire involved a literature search to consider the best possible types of questions and scales to be included [25], [35].

The final questionnaire included four parts: personal data, a usability questionnaire, a general evaluation section and a comparative evaluation section. Each questionnaire was revised to incorporate suggestions and clarify ambiguous questions. Each questionnaire was then filled out by 80 users. The questionnaire included 37 close-ended questions designed to evaluate users' attitudes towards usability attributes and can be found in the appendix.

For consistency, this study only focuses on e-tourism websites which present some services including flight tickets, boat tickets, and car rental and hotels reservation. Airline websites are not included in the survey. They are all companies which developed their websites to facilitate the reservation process. In order to obtain unbiased evaluations, we selected websites which offered similar services and transactions. Eight Greek e-tourism websites took part in the study and for privacy issues we refer to them as WS_1, WS_2, WS_3, WS_4, WS_5, WS_6, WS_7 and WS_8.

4.2 Subjects and Procedure

The online questionnaire targeted the Master student population who used e-tourism services. The evaluators were Master students majoring in Business Economics and Management, Geoinformation in Environmental Management, Horticultural Genetics and Biotechnology, Food Quality Management and Chemistry of Natural Products. The respondents were asked to evaluate the e-tourism websites. They self-administered the questionnaire and for each question, they were asked to check the response which best described their level of agreement with the statements.

Respondents were linked to an online application specifically developed for the purposes of this paper, where they could answer the questionnaire and obtained all the information about the research subject. When the respondent starts the application, the main screen appears. Questions are not viewed until the respondent clicks the *New Respondent* button. A new dialog will ask the respondent to enter the respondent number; this number is given to the respondent to help retrieve data. After that another screen is shown that contains demographic questions about the respondent and questions about the respondent experience in e-commerce transactions.

The total number of Master students who participated in the usability evaluation was 80. Among them 34 were male and 46 female. All evaluations were carried out in a period of two weeks, taking into consideration the possibility that the website may have changed over time. An email was sent to the volunteers one day before the evaluation process; this email contained the list of websites, and respondents were asked to perform three tasks: find a predefined flight, then make a reservation to that flight, then try to make a reservation for a hotel, car or buy a boat ticket, and simulate the order process up to the payment operation without submitting the order, so that all the necessary information for the study could be gathered.

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5 Data Analysis

The questionnaire contained 37 items representing six usability parameters, which participants were asked to rate on a 5-point scale (0-4), where 0 represents *very dissatisfied* and 4 represents *very satisfied*, the respondents evaluating the web site rated the extent to which they agree with each existence of the criterion. This questionnaire was computer-based, and it was delivered in the English language.

5.1 Demographic Characteristics of the Respondents

Our sample was composed of 80 respondents distributed as 43% males and 57% females. Of the respondents 92% were between 24 to 28 years old, 7% were over 30 and 1% was less than 24 years old, while the average age is 26 years.

5.2 Usability Evaluation for the Websites

In the next step, users provide ratings for eight Greek e-tourism websites on various categories and subcategories according to their beliefs. The results from each website evaluated are summarized in the results section.

Generally, all of the websites attach great importance to *Content*; they try to show a lot of respect to their customers by providing up to date and detailed information. None of the websites provide a sitemap for the browsers; also none of the websites provide accessibility options for the disabled. Some websites have a user-friendly design, such as WS1 and WS6, while some websites use an old, standard design such as WS8 and WS5. Moreover, some websites provide navigation tools while others do not. WS6 and WS8 are the only websites that provide multilingual options; this might increase the level of internationalization. The information on all the websites is reasonably organized and clearly structured. The WS6 is the only one that provides a feedback forum, where customers can exchange experiences and obtain relevant information by subscribing to the website's forum.

5.3 Satisfaction Analysis Method

The first objective is to identify the attributes that affect customer satisfaction and verify the existence of those attributes in the eight e-tourism websites.

Multicriteria Satisfaction Analysis (MUSA) approach is introduced in this work as a research methodology applied in the usability domain to analyze customers' satisfaction of the 8 different Greek e-tourism websites. The MUSA model was initially developed to measure and analyze customer's satisfaction from a specific product or service, but the same principles can be used to measure global satisfaction of a group of individuals regarding a specific service or operation they interact with [30].

The MUSA method was designed and used in the consumer satisfaction area of marketing discipline. According to Grigoroudis and Siskos [24], the main objectives of the MUSA method are:

1. The evaluation of customers' satisfaction level, both globally and partially, for each of the characteristics of the provided service.

2. The supply of a complete set of results that analyzes in depth customers' preferences and expectations, and explains their satisfaction level.

3. The development of a decision tool with emphasis on the understanding and the applicability of the provided results.

Satisfaction analysis results consist of the following [37]:

1. Overall Satisfaction Index: this average index shows, in the range 0-100%, the level of global satisfaction of the users.

2. Criteria value functions: These curves show the real value (0-100) that users give for each level of the criteria ordinal satisfaction scale. The form of these functions indicates the customers' degree of demanding as follows:

3. Neutral customers: the value function has a linear form; the more satisfied these customers express they are, the higher the percentage of their fulfilled expectations is.

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4. Demanding customers: this refers to the case of a convex value function; customers are not really satisfied, unless they receive the best quality level.

5. Non-demanding customers: this refers to the case of a concave value function; customers express that they are satisfied, although only a small portion of their expectations is fulfilled.

6. Criteria & sub-criteria satisfaction indices: These indices demonstrate the level of partial satisfaction of the users to every criterion and sub-criterion, similarly to the overall satisfaction index.

7. Weights of criteria and sub-criteria: They show the relative importance within a set of criteria.

8. Action diagrams: These *performance/importance* diagrams are developed through the combinations of criteria weights and satisfaction indices. The action diagrams, similar to SWOT analysis, indicate the strong and the weak points of responder satisfaction, and define the required improvement efforts. Each of these maps is divided into quadrants, according to relative importance (high/low), as expressed by the satisfaction index, and performance (high/low) as measured by the relative weight of each criterion [30]. A grid can be used in order to identify priorities for improvement by classifying actions.

9. Improvement diagrams: The action diagrams indicate which satisfaction dimensions should be improved, but they cannot determine the output or the extent of the improvement efforts. A solution to this problem is given by the improvement diagrams which combine the average improvement and demanding indices for the criteria of each dimension [30].

We have suggested an indicative set of 37 sub-criteria that refer to the six main criteria. The surveyed responders were asked to express on a five-point ordinal scale their total satisfaction, as well as their partial satisfaction judgments. The method considers the qualitative form of the respondent's judgments, and it estimates a qualitative scale that represents the collective satisfaction value of the surveyed population.

6 Results

In this section, results of the data collection are presented and analyzed. Furthermore, users' evaluation of the importance of usability attributes is presented and satisfaction analysis results for the eight websites are explained.

6.1 Ranking of the Categories

By asking the question "*Which are the most significant reasons that make you decide to buy or not from an e-tourism website over the internet?"*, the respondents selected which attributes can affect their decision to buy or not. This selection reflects their evaluation of the importance of those attributes.

Content is the most important of the 6 major categories (60%). It suggests that information is the primary reason when the customer visits an e-tourism website. *Personalization* ranks second in importance in the e-tourism website's usability (57.5%). Customers care about being recognized by the website and being treated as an individual. The third important category is *Interactivity* (53.75%). This suggests that customers need to be able to communicate and collaborate with other customers. *Navigation* and *Interactivity* have approximately the same importance (52.5%) of the customers selected navigation as an important factor that affects their decision to buy or not from an e-tourism website. The fifth important category is Design-Structure (43.75%). It is important for the users when they visit the website for the first time to find a professional homepage describing the purpose of this website and containing suitable elements. *Accessibility* has the least importance among the six major categories of usability evaluation, about 39%. This makes us aware of the fact that customers who have difficulty seeing or hearing, can appreciate more this property; our sample does not include customers who have such difficulties, however they still identified some importance of accessibility in the design of web sites.

6.2 Satisfaction Analysis Results

This section presents and discusses satisfaction analysis results for the eight websites resulting from the analysis of the data by exploiting the MUSA model. For this reason, we present herein the satisfaction indices, criteria weights, demand indices and impact values for the six criteria and the eight websites.

6.2.1 Satisfaction Indices

Satisfaction indices show, in the range 0–100%, the level of partial satisfaction of the responders for the specific criterion, similarly to the global satisfaction index. Figure 1 represents the satisfaction indices of all criteria for the eight websites with different colors starting from left (WS1) to the right (WS8). From this graph, we notice that WS5 and WS7 achieve relatively very low satisfaction indices, compared to the other websites. It is also apparent that for

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the same website different levels of satisfaction indices appear in the six criteria. This confirms our initial hypothesis that the overall satisfaction depends on multiple criteria.

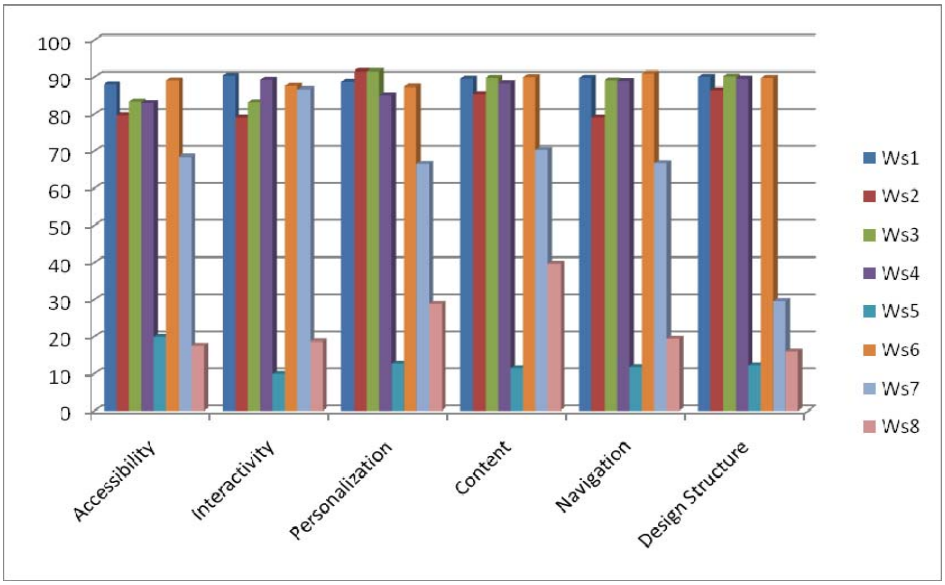

Figure 1: Satisfaction indices of the six criteria

6.2.2 Criteria Weights

To further analyze the significance of each criterion in the overall satisfaction MUSA calculates the weights of the criteria which represent the relative importance of each criterion within a satisfaction dimension. Figure 2 displays the weights for the six criteria and the eight websites in concordance with the colors of figure 1. We notice that WS7 achieves a high interactivity weight in comparison to the other websites; also, WS2 achieves a high weight for the criterion *personalization*.

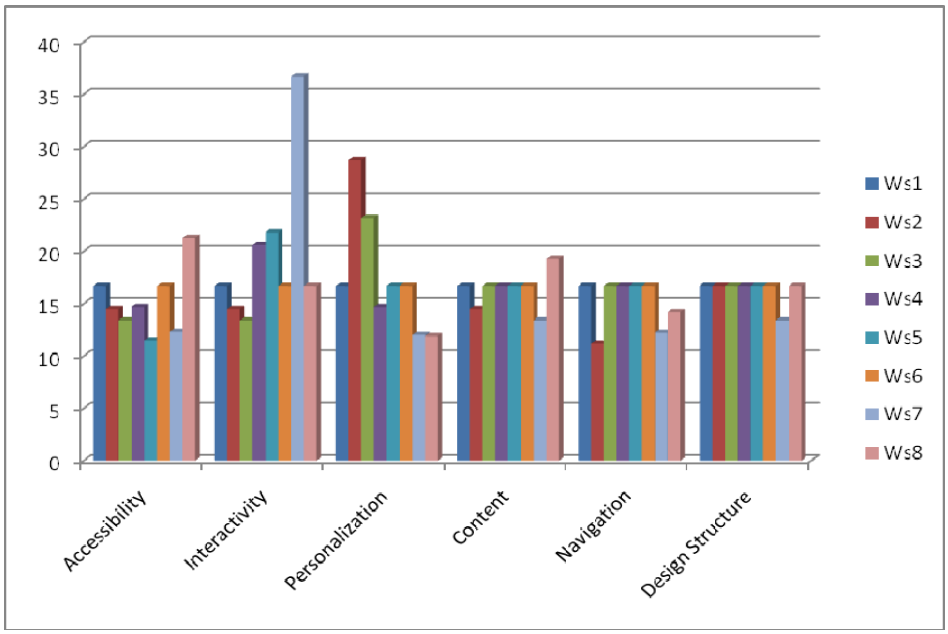

Figure 2: Weights for the six criteria

6.2.3 Demanding Index

Demanding indices are normalized in the interval [100%, 100%], and they correspond to the average deviation of the estimated satisfaction value curve from a *normal* (linear) function.

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Figure 3 represents the demanding index for the six usability criteria; we can see that two websites have a positive demanding index and the others are in the negative. In general, the higher the demanding index, the more the satisfaction level should be improved in order to fulfill responders' expectations.

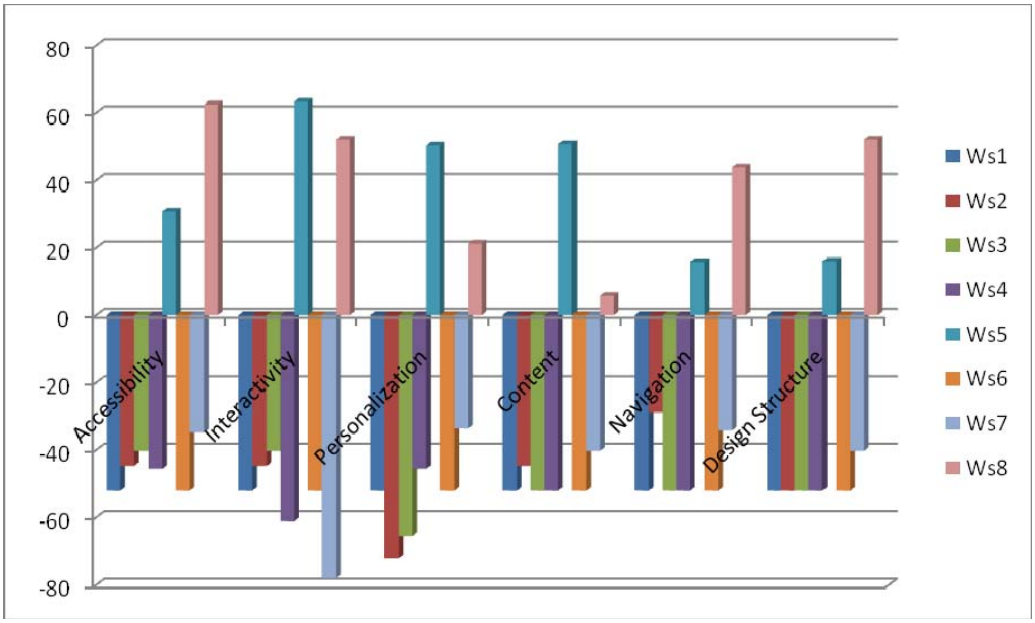

Figure 3: Demanding index for the six criteria

6.2.4 Impact Values

Figure 4 shows the impact values for the six usability criteria; clearly the websites WS5 and WS8 both achieve very high impact values, which means that those companies need to increase improvement efforts, and any improvement effort by the two web companies is expected to create relatively large improvements in overall satisfaction, so they will increase their competitiveness.

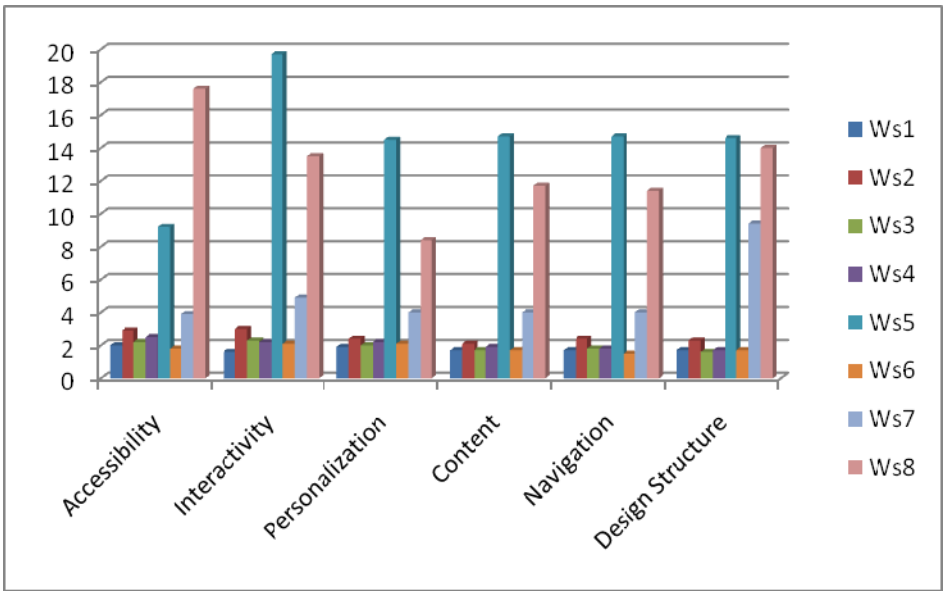

Figure 4: Impact values for the six criteria

In Figures 5 and 6 the action and improvement diagrams are presented in a collective way accordingly. These diagrams indicate the strong and the weak points of customer satisfaction, and define the required improvement efforts. Each of these maps is divided into quadrants, according to performance (high/low) and importance (high/low) that may be used to classify actions:

- Status quo (low performance and low importance): Generally, no action is required.

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- Leverage opportunity (high performance/high importance): These areas can be used as advantage against competition.
- Transfer resources (high performance/low importance): Resources may be better used elsewhere.
- Action opportunity (low performance/high importance): These are the criteria that need attention.

This grid can be used in order to identify priorities for improvement. The bottom right quadrant is obviously the first priority, for the attributes are important to customers but company's performance is rated moderately low. The second priority may be given to the satisfaction criteria in the top right quadrant, especially if there is room for improvement. The third priority issues are indicated in the bottom left quadrant; although these issues are not terribly pertinent at the time of the analysis, they may be more important in the future, and company's performance is certainly not good. Finally, last priority for improvement should be given to the criteria in the top left quadrant because this category is the least important and company's performance is relatively good. Apparently, priorities for improvement may vary among different companies, depending on the potential capabilities of improving the particular category.

The action diagrams can indicate which satisfaction dimensions should be improved, but they cannot determine the output or the extent of the improvement efforts. For this reason, combining the average improvement and demanding indices, the so called improvement diagrams can be created.

As shown in figure 6, each of these maps is also divided into quadrants according to demanding (high/low) and effectiveness (high/low) that may be used to rank improvement priorities:

- First priority: this area indicates direct improvement actions since these dimensions are highly effective and customers are not demanding.
- Second priority: it includes satisfaction dimensions that have either a low demanding index or a high improvement index.
- Third priority: it refers to satisfaction dimensions that have a small improvement margin and need substantial effort.

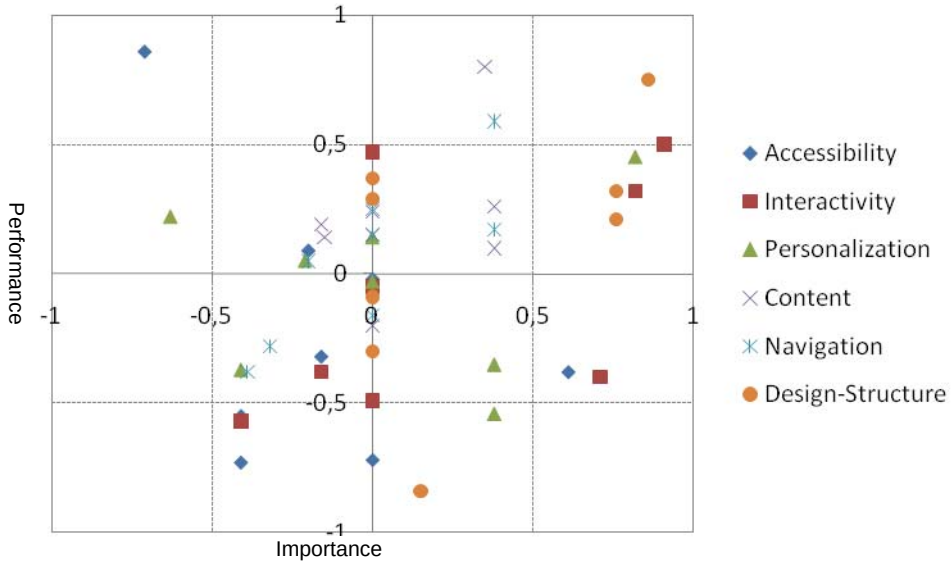

Figure 5: Action diagram

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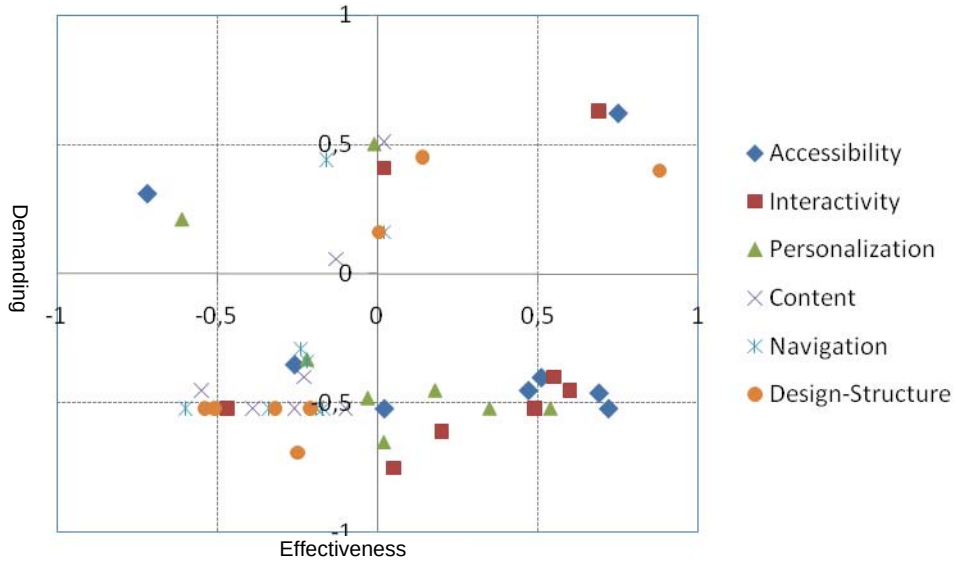

Figure 6: Improvement diagram

From Figures 5 and 6 it is obvious that six different usability attributes lie most times in different parts of the quartiles, meaning thus that different competitiveness policies should be adapted from each web site. To this end, a detailed satisfaction analysis method is considered crucial and cannot be performed in a collective manner; on the contrary, every web site should be studied individually.

To explain how every website should be analyzed individually, the following 2 graphs demonstrate action and improvement diagrams for WS4. From the action diagram (Figure 7) the Interactivity criterion seems to be the most important; it also achieves good performance in this website according to customers' evaluation. Additionally, the criteria *Accessibility* and *Personalization* both have low importance and low performance in comparison to the other criteria, which all achieve an acceptable performance.

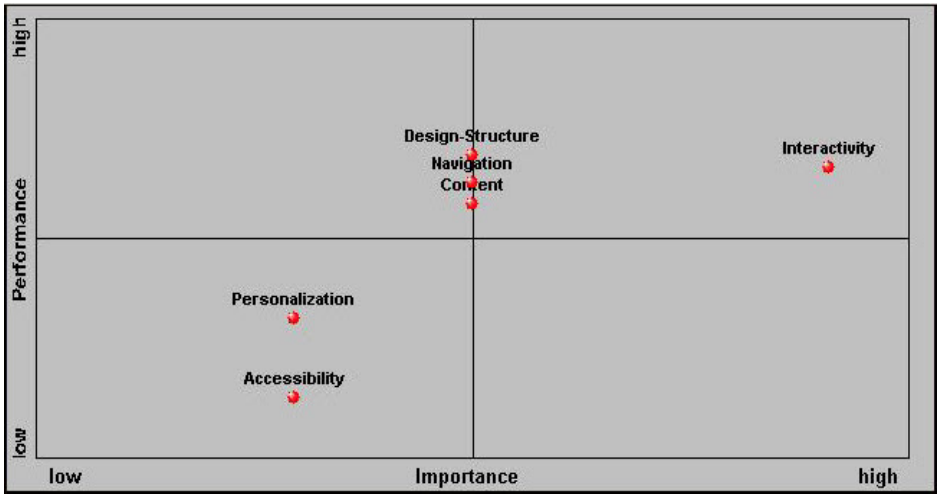

Figure 7: Action diagrams for the six criteria for WS4

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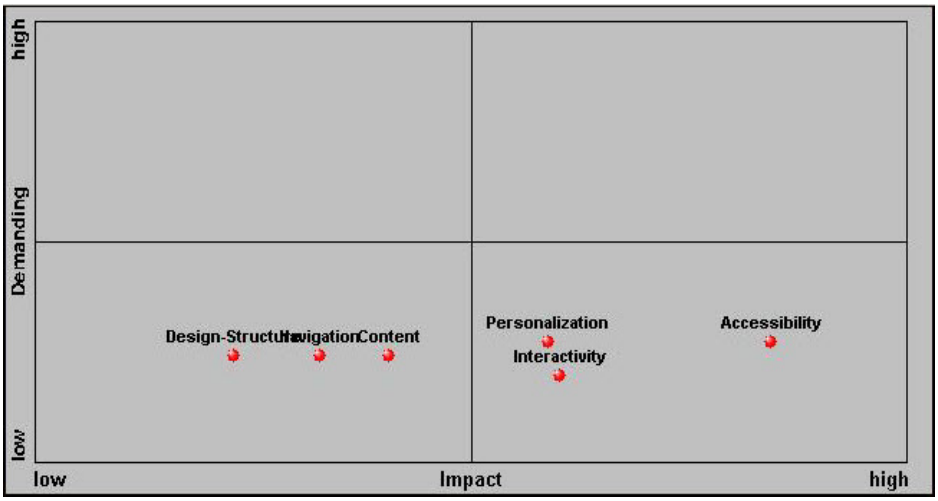

Figure 8: Improvement diagrams for the six criteria for WS4

From the grid (Figure 8), first priority is given to the bottom right quadrant; this area indicates direct improvement actions. The improvement diagram suggests that improvement efforts should focus on the *Accessibility* criterion. Additionally, other improvement efforts may concern the criterion of *Interactivity* and *Personalization*, mostly due to the observed high impact of improvement and low demand level. By improving those attributes this company can increase its competitiveness and gain more customer satisfaction due to the observed low demand level.

7 Discussion

Usability is often mentioned as an important determinant of harmonious and productive online transactions [16], [15]. The definition of usability has evolved over time, and usability researchers have varying opinions on how to define and measure usability [7]. Based upon the background and the research problem in the introduction, the purpose of this research study is to identify some e-commerce websites' usability attributes, evaluate the existence of six attributes in eight Greek e-tourism websites and evaluate the importance of each attribute by studying the effect of existence or nonexistence of those attributes on the users' evaluation of the e-tourism websites. Furthermore, this paper aims to study the significance of these attributes in the overall satisfaction of website users.

The main output of this study is a list of web usability criteria that can be used for evaluation purposes. Also, this study classifies them into suitable categories. The idea behind this is to allow web designers to properly evaluate the effect of each category on customers' satisfaction. By evaluating the importance of six categories and the existence of those categories in Greek e-tourism websites, website designers can observe the important issues that they have to pay extra attention to because it is critical for the success of the e-tourism websites.

The results demonstrate that some websites should put extra improvement efforts on some criteria to increase competitiveness, some additional features were missed appearing in this study, and the importance of the attributes varies from one website to another. It was observed that some criteria have a high impact and low demanding level, which means that a small effort by the web company to improve those criteria is expected to create a relatively large improvement in overall customers' satisfaction, which will help the web company to increase its competitiveness. From our results, we concluded that interactivity had the highest improvement priority in several websites; accessibility is ranked second, followed by personalization and design-structure.

The results of this study also show that all six measured factors are important and affect users' confidence and satisfaction.

Content suggests that information is the primary aspect involved when the customer visits an e-tourism website. It also indicates that the customers are concerned that the website they visit provides fresh, abundant, correct, pertinent and timely information content and clear topics that are easy to understand. In six out of the eight websites content falls in the region with low demanding index, the second priority region, meaning that the specific websites must pay attention in order to improve customer satisfaction for the website content.

Personalization of a user's preferences can also be successful in encouraging frequent visits. Moreover, customers care about being recognized by the website and being treated as an individual. In six of the selected websites, personalization is found to be at the first or the second priority region, indicating that immediate action should be taken to improve personalization features.

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Interactivity suggests that customers have the need not only for appropriate content and a personalized website, but also for communicating with other customers to make progress together. Furthermore, this is an important approach that keeps customers' loyalty and enhances their satisfaction. The customer also hopes to add, modify and manipulate the information flow by themselves; in contrast, they hope to have the ability to interact with other customers, and have the ability to compare competitors' product features. In our study, interactivity in most cases lies in the bottom right quadrant of improvement diagram, in the first priority region, meaning that interactivity although is important to customers, most website performance is rated moderately low.

We also found that *navigation* within a website is a significant factor in the success of e-tourism websites since navigation in most websites lies in the bottom left corner of improvement diagrams. One of the vital needs for the site users is to know where they are and where they are going, by adding navigation tools such as links to a sitemap and search features. These tools are there to help out those visitors who can't find what they are looking for using the ordinary approach. Designing effective navigation requires some understanding of what makes a good navigation system in general and what will appeal to your e-tourism customers in particular. Also high in terms of the number of criteria is the *Design-Structure* factor highlights the need for consideration by the websites' designers. In five out of the eight examined websites the design-structure criterion lie in the bottom left quartile, indicating that it may be an important feature for those websites in the future, and website's performance is certainly not good at this point, since it exhibits both low effectiveness and demanding.

Accessibility in the action diagram appears on the *Status quo* (low performance and low importance) quartile, meaning that no action is necessary for this criterion. It is important to mention at this point that customers who have difficulty seeing or hearing can appreciate this property; our sample does not include customers who have such difficulties, which could be a reason for having accessibility in the status quo of the action diagrams. Although accessibility is important for general usability purposes, it is possible that non-disabled users are not highly sensitive to this issue; mostly they want to have access to the website's information quickly and efficiently.

Based on our study we inferred that some e-tourism websites apply usability testing for their websites while others do not give it enough attention. Maybe one of the main obstructions is that they need to redesign the website, which would be a difficult and time-consuming process. This result is alarming because this urges designers to think about solutions to such problems before they happen, and to start to think that when they design new websites, they should make the upgrading process of the website easier in the future.

Overall, it was found that some factors of usability are more important than others in e-tourism transactions. Furthermore, applying a multicriteria satisfaction analysis approach can help website designers, usability specialists and marketers to evaluate customers' satisfaction about usability attributes in prototyped e-commerce websites. On-line vendors should pay particular attention to the issues of ease of navigation, ease of learning, perception and support when designing their websites, or when they observe some difficulties related to trust by their potential clients.

8 Conclusions

Potential factors affecting the usability of e-commerce websites were identified in this work together with consumer preferences and attitudes towards different factors affecting the usability of eight e-tourism websites. Based on the results of our empirical study, we have drawn below some specific conclusions regarding best practices for website design:

1. The specific nature of e-tourism transactions makes it vital for designers to consider certain usability attributes, namely the navigation, personalization and design-structure of a website, as early as possible in the development process. Usability plays a key role in attracting and retaining customers. Hence, companies should have websites that are user friendly and rich in content, which give the customers a sense of trust and satisfaction.

2. Integrating usability activities in the development lifecycle is crucial to the success of e-commerce applications which are designed to attract customers and generate revenue.

3. The application of the MUSA methodology is an effective method for measuring customers' satisfaction from e-tourism websites. The analysis of collected user data can also provide a deeper understanding of user attitude towards certain aspects of website designs. To build a successful e-commerce website, usability testing should be considered as early as possible throughout the website development lifecycle.

4. The MUSA system is a powerful approach to identify crucial aspects that would eventually increase usability, when used by designers and usability specialists at the early stages of a development lifecycle, in particular at the prototyping stage, which is an integral component of any user-centered design approach. However the MUSA method is domain specific and is applied to every web site separately. This means that in order to establish a consistent family of criteria according to MUSA's constraints, the satisfaction analysis should be planed carefully for every domain and product.

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5. Rapid prototype techniques should be used as early as possible to elicit users' feedback about the usability attributes which are most crucial to the success of the website under development. In addition, it can help designers identify the best prototype or implementation if more than one is proposed.

Below are some general conclusions resulted from this study:

1. Interactive content, i.e specialized communities, might be a very useful marketing tool in e-tourism websites. For example, a chat room or a forum could be used to discuss recommended places and topics of interest.

2. According to the results of our study, to increase the usability of the websites, designers should focus on the following design features :

   i. Users should be allowed to customize and personalize the websites.

   ii. Sites should be reasonably organized, and interaction techniques should be consistent throughout the website.

   iii. Navigation should be smooth and information should be easily accessible in a timely manner.

This study is limited to a narrow group (Master Students). The research can be further generalized if other diverse user groups were to be selected and also users with accessibility issues. Nonetheless, the outcome of this study provides some basics for further investigation in this area.

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Appendix A: Questionnaire

Ranking:

Rating	Value	Description
Very satisfied	4	You found exactly what you want related to this criterion.
Satisfied	3	You are satisfied about the existence of this criterion.
Neither satisfied nor dissatisfied	2	You are not able to evaluate the existence of this criterion in this website. (Neutral attitude)
Dissatisfied	1	You are not satisfied from the performance of this criterion on this website.
Very Dissatisfied	0	Your expectations were not fulfilled from the performance of this website to this criterion.

Section 1: General Questions

(Question 1) How old are you?
……..
(Question 2) Gender?
(A) Male
(B) Female
(Question 3) How frequently do you buy online?
(C) Once a month or more frequently
(D) Once every six months
(E) Once a year
(F) I have never bought online
(Question 4) How long have you been making online purchases? (Please tick one)
(A) Less than 1 year
(B) 2 – 4 years
(C) 5 – 8 years
(D) More than 8 years
(Question 5) How much have you spent in electronic purchases the last year?
(E) EUR 1- 99
(F) EUR 100-499
(G) EUR 500-999
(H) EUR 1,000-5,000
(I) Above EUR 5,000
(Question 6) Which are the most significant reasons that make you decide to buy or not from an E-Tourism website over the internet? (Tick all that apply)
(A) Access to information is quick and efficient.
(B) Convenience, have a sense of control while using this website.
(C) Feel recognized by the website; get more relevant and targeted news, information.
(D) The information content of each page is consistent, timely, correct, and complete.
(E) Always know where you are in the website, find what you want easily good site navigation and long download times.
(F) Professional visual design, good quality of graphics, suitable structure of information and text consistency.

Section 2: Rating for the existence of the usability attributes in website.

Please make a virtual buying process on the following websites and answer the following:
(Please provide your level of satisfaction for each criterion and sub criterion on a five level scale ranging from very dissatisfied to very satisfied. Please check the corresponding box.)

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Rating **Criteria**	Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very Dissatisfied
1-Accessibility					
The page capable of being understood and navigated even if users do not have the ability to identify specific colors or differentiate between colors.	☐	☐	☐	☐	☐
Access to information is quick and efficient.	☐	☐	☐	☐	☐
The time it takes for each Web page to load is acceptable. (the overall site speed is acceptable)	☐	☐	☐	☐	☐
The website is free from technical problems (hyperlink errors, programming errors etc.) (i.e. you did not face any technical problems while browsing this website)	☐	☐	☐	☐	☐
How satisfied are you from the accessibility of this web site?	☐	☐	☐	☐	☐
2-Interactivity					
This website provides popular forms of computer-mediated communication such as e-mail, video, audio or text chat with customers.	☐	☐	☐	☐	☐
You feel the this website is Interactive (clear animations, hints, examples and messages)	☐	☐	☐	☐	☐
You have the sense of control while using this website.	☐	☐	☐	☐	☐
It is easy to find links on each webpage such as links back to the homepage, hyperlinks on key words, and hyperlinks suggesting additional information.	☐	☐	☐	☐	☐
You found customer support activities while using the website (such as status tracking, feedback options), market research activities (such as taking product surveys), personal choice helpers (such as key word searches, dealer locators).(i.e. it was easy for you to complete virtual buying process)	☐	☐	☐	☐	☐
How satisfied are you from the interactivity of this web site?	☐	☐	☐	☐	☐
3-Personalization					
This website gives a high recognition to the customers and visitors (treating each visitor as an individual). (i.e. you feel that this website recognize you and welcome you when you visit for the first time)	☐	☐	☐	☐	☐
You get more relevant and targeted news, information, and even advertisements.	☐	☐	☐	☐	☐
Information can be changed on the fly to meet your interests and activities.	☐	☐	☐	☐	☐
Information may be changed on the fly based on the past behavior of a visitor along with business rules. (i.e. information can be changed according to your selections).	☐	☐	☐	☐	☐
You don't feel annoyed by unwanted information or product options; you don't need to provide personal information or preferences multiple times.	☐	☐	☐	☐	☐
How satisfied are you from the personalization of this web site?	☐	☐	☐	☐	☐

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Appendix A: continuation

4-Content					
This site is organized in logical way (The arrangement of information is logical and easy to understand).	☐	☐	☐	☐	☐
The website contains usability elements related to layout and styles include color, white space, scrolling, separators, text, frames, links, and data entry labels.(i.e. you found it easy to fill the data and to find what you were looking for)	☐	☐	☐	☐	☐
The website contains easy-reading text; font text color and the background color are in high contrast.	☐	☐	☐	☐	☐
The information content of each page is consistent, timely, correct, and complete.	☐	☐	☐	☐	☐
The information is presented clearly and that make it easy for visitors to find the needed information	☐	☐	☐	☐	☐
This company seems to have a lot of respect to its customers; Ads are clear and integrated nicely into the website.	☐	☐	☐	☐	☐
How satisfied are you from the content of this web site?	☐	☐	☐	☐	☐
5-Navigation					
While moving in the purchase process you know where you are and where you are going, it is clear for you the number of steps before making the purchase.	☐	☐	☐	☐	☐
Navigation is predictable and consistent. (i.e. the naming of menus is clear and help you to reach your destination easily)	☐	☐	☐	☐	☐
The 'Search' functionality is clear and useful. (you find what they want easily, also it is easy to find the information you are looking for)	☐	☐	☐	☐	☐
How satisfied are you from the navigation of this web site?	☐	☐	☐	☐	☐
6. Design-Structure					
The site's visual design is clear and professional.	☐	☐	☐	☐	☐
Purpose of site made clear on homepage and suitable use of links in the homepage (e.g. text, graphical, underlined)	☐	☐	☐	☐	☐
The quality of graphics is high, icons are easy to understand.	☐	☐	☐	☐	☐
This website uses negative contrast between background color and text color, that makes text easy to read (e.g. black text on white background)	☐	☐	☐	☐	☐
Suitable and consistent use of colors in this website.	☐	☐	☐	☐	☐
Suitable structure of information (e.g. organized categorically, i.e. the selection of categories is easy, you could easily find what you are looking for)	☐	☐	☐	☐	☐
Consistent fonts used, font size is readable and appropriate use of bold for important text.	☐	☐	☐	☐	☐
How satisfied are you from the design/ structure of this web site?	☐	☐	☐	☐	☐
Website General Evaluation					
Considering all the above, please provide an overall satisfaction level for this website?	☐	☐	☐	☐	☐