Semantic Annotation for Assessing Website Communicative Efficacy

Nadzeya Kiyavitskaya
Dept. of Information Engineering and Computer Science, University of Trento, Italy
nadzeya@disi.unitn.it

Nicola Zeni, Luisa Mich
Dept. of Computer and Management Sciences, University of Trento, Italy
{nicola.zeni, luisa.mich}@unitn.it

Abstract. Modern organizations face the challenge of communicating their marketing strategies through the Web, besides the traditional means of communication, i.e., newspapers and television. In this context, evaluation of the communicative efficacy of websites becomes a 'must' for exploiting the power of such communication channels. In this paper, we propose a systematic method and a tool that supports communicative efficacy evaluation. We assume content coverage of the organization’s strategies as the main high-level content requirement for the organization website. The tool is based on a general-purpose semantic annotation framework that allows identifying concepts related to the detailed content requirements. The applicability and feasibility of our method is verified on a case study that compared the communicative efficacy of a set of tourist destination websites.

Keywords: method, communicative efficacy, content requirements, categories, concepts, tool support, Cerno.

1 Introduction

In order to identify a systematic approach to evaluate the communicative efficacy (CE) of a website, we first start from the fundamental principles of communication. In the classical rhetoric of Aristotle a discourse can be given to “docere, delectare, flectere”, that is to instruct the audience, arouse their emotions and gain their goodwill (Herrick, 2004). The modern communication theory identifies four similar fundamental objectives for a discourse or argument: control, motivation, information, emotional expression (Robbins, 2004), (Scott & Mitchell, 1972). Websites play a

DOI:10.3727/109830511X13049763021934.
relevant role to support all these objectives, which are strongly related to on-line corporate communication, and in particular to marketing communication strategy (Stuart, 1999). Content marketing explicitly assumes that high-quality content can help the users take actions profitable for the company (Pulizzi & Barrett, 2009), for example, fulfilling an online reservation of a hotel room, buying a product, paying to download market researches, or other actions.

CE is related to the business point of view and the question is if a given communication channel is efficaciously used to transmit content relevant to promote a given product or service. In general terms, websites are eminently communicative environments, and their content is critical to support business models fulfilling business’s objectives (Afuah & Tucci, 2003; Li, 2007; Rappa, 2009; Timmers, 1998). In this context, evaluating the CE of a website represents a valuable opportunity to obtain data for improving its content and in turn the success of the website. In this respect, the analysis focus is not on the effects or impact of the web content, but on the content’s suitability for satisfying a company’s goals as a necessary condition. Websites have to give the “right” information that is content adequate in respect of their strategies, in order to allow users to make a decision about products and services offered by the company.

In this paper we propose a method to evaluate a website CE in respect of how much of all the information necessary to accomplish the business model’s objectives in the context of the corporate communication the website contains. Thus, our primary goal is to methodologically define content requirements of the company or organization. According to the three levels that semiotics associates to a message (Chandler, 2002), syntax, semantics, and pragmatics, to evaluate CE we need to focus on the second level. In fact, in the first instance, the efficacy of a message depends on its correctness (syntax) and its meaning or content (semantics). Website syntax can be checked using a variety of tools (for example, links checker or HTML validators, www.w3c.org) and depends mainly on hardware, software and network technologies. As for pragmatics, to assess the success of a website as communicative channel, from the company’s point of view, web analytics are used. Other indices and feedback can be gathered from user generated content (UGC) adopting web reputation monitoring tools (Barbagallo et al., 2011; Beal, 2009).

Focusing on semantics as an issue to be addressed since the requirements elicitation step of a website development project, we propose a method for a systematic evaluation of websites CE adopting semantic annotation (SA) tools. These tools allow identifying relevant concepts in text, video or audio content. In our studies we used a SA tool for textual content based on a framework called Cerno. The architecture and the SA process of Cerno are described in (Kiyavitskaya et al., 2009). In (Kiyavitskaya et al., 2006) we investigated Cerno in terms of recall and precision, two measures that characterize the performances of SA tools. In contrast, the present work introduces the CE evaluation method that has been defined based on the experience matured since then regarding how semantic annotations can be interpreted with regard to CE-based content requirements. To illustrate our method, we describe its application to the evaluation of the CE of a set of 13 websites of local
Tourist Boards in the Italian province of Trentino: Aziende di Promozione Turistica (APT) di ambito.

The paper is structured as follows: section 2 describes our method of evaluating the CE of websites; section 3 illustrates the application of the proposed method on the case study analyzing the CE of tourist destination websites; and the conclusion, in section 4, summarizes main results and indicates open problems and future works.

2 The Method

2.1 Related Work

Communication has been investigated in different disciplines: rhetoric, psychology, mathematics, sociology, anthropology, and many others. Information theory (Shannon & Weaver, 1949) and communication theory as specific disciplines have drawn a widespread interest since the inception of new communication channels and devices. Thus, we have a large variety of areas and contributions related to communication principles and theories. In particular, computer science has been investigating communication issues in the context of such disciplines as artificial intelligence, natural language processing, human computer interface, knowledge management, addressing also human-side aspects apart from those considered first, that included, for example, coding. Among them, an important role is given to the communication efficacy (CE) that is the capacity of communicating to accomplish a desired goal. CE has been investigated, for instance, for communication in the context of collaborative interaction tools, where “the CE of the environment is determined based on how quickly participants are able to accomplish the task at hand” (Doerry, 1995). Other studies focused on the analysis of the pragmatics of communication (Lefons, 1977), (Winograd & Flores, 1987), more specifically, on the effect of messages in terms of actions following an utterance or linguistic act (Austin, 1962).

In marketing, however, given the difficulty in measuring the impact of a given communication strategy, a strong emphasis is placed on the evaluation ex-ante of the content necessary to fulfill a company’s communicative goals. The assumption, often implicit, is that if content is inadequate, such objectives cannot be achieved (Pulizzi & Barrett, 2009). In this vision, website CE evaluation is a part of the quality evaluation of a website. In fact, quality evaluation models always include content or information quality as a dimension to be analysed. Content is added to the characteristics of the ISO 9126-1 quality software model (ISO/IEC 9126-1, 2001) in (Olsina, Mich, & Sassano, 2008) to extend it to Web applications. There are many other models to evaluate the quality of a website; among them, WebQME (Olsina & Rossi, 2002), MiLe (Triacca et al., 2004), 7Loci (Mich & Franch, 2005). The method we propose in this paper specifically addresses website CE and can be perceived as a detailed analysis of the content coverage characteristic of a quality model. Also, the fundamental difference from the business point of view is that web analytics and other parameters (e.g., the conversion rate) are used to measure the success of a web site, while our goal is to address CE as an ex-ante issue at the website (re)design phase.
2.2 Our approach

Our starting assumption for evaluating the CE of a website is that the efficacy of communication depends on the content coverage. This characteristic implies the need in identification of the pieces of information pertinent to the website goals in its content. This task can be addressed by SA of the website content. A SA tool can be used to explicitly assign semantics to text fragments relevant to a particular annotation goal.

Based on these assumptions, we suggest an evaluation process that consists of the following steps:

1. Analyze the business model of the company by identifying its mission and its management strategies.
2. Identify the role of the website in the business model.
3. Based on the identified objectives of the website, understand how the website should support this role in terms of its content.
4. Derive the conceptual model for SA using the list of content categories and concepts.
5. Fulfill the SA using a SA tool in order to find all content fragments related to the entities of the conceptual model.
6. Use the results of the SA to calculate some indices to evaluate the CE of the websites.

The first four steps are necessary to define which content are relevant and have to be given in a given website (content requirements). Step 5 is the one for which we suggest to apply a SA tool. Elaborating data obtained in this step we can finally evaluate the website CE. In particular, we define a set of CE measures that can be used to take into account structural and layout characteristics of websites.

The following paragraphs discuss each step of the process in general terms, while the study case presented in the next section illustrates the CE evaluation method’s application and describes the tool we adopted to support it.

1. **Identification of the business model.** The CE can only be estimated within a specific communication strategy, because it requires understanding the goals of the communication. In other words, our first concern must be to identify the objectives that an organization is trying to achieve and its business model.

2. **Identification of the website role in the business model.** Having derived the organization’s strategies and business model, we need to understand the role of the website within this model, i.e., which business goals the website must contribute to.

3. **Identification of relevant content categories.** To realize the goals derived from the business model of the organization, the website has to provide appropriate content, persuading the user take an action that the organization is interested in. Thus, in this step the goals of the website have to be analysed and described in terms of a list of key content categories that must be present on it to contribute to its CE.

4. **Derivation of the conceptual model.** When the key categories are provided, the next step is to specify them by more specific concepts. The result is a domain
conceptual model specific for the content categories identified according to the company’s and its website goals. For example, the concept of Geography is a generic category and can be extended with a lot of related terms based on a dictionary or a thesaurus like WordNet (WordNet, 2010), see Fig. 1. In order to limit the scope of related terms, we suggest asking the domain experts to filter candidate concepts by selecting only those relevant to the website strategy.

![WordNet search results for Geography term (with hyponyms also shown)](image)

Fig. 1. WordNet search results for Geography term (with hyponyms also shown)

5. **Semantic annotation based on the derived model.** The conceptual model built on the previous step should guide the SA process. There are many SA approaches and tools available (a detailed classification of such tools can be found in (Siorpaes & Simperl, 2010)). However, some tools cannot be applied for the evaluation of websites. For example, machine-learning methods require essential amount of training data in order to provide reliable results, whereas it is not feasible to expect much training data provided from a single site. Wrapper induction methods are not applicable since they rely on the regularity of HTML format, on which the annotation rules are based. Therefore, we suggest using one of the rule-based approaches. In the perspective of this work, i.e., tourist destination websites, the domain knowledge corresponds to the business strategies materialized in the website. Starting from these strategies, a domain conceptual model must be derived. Such a model representing domain expertise is usually indispensable for semantic annotation methods which do not rely on HTML formatting to generate meaningful annotations, as one should naturally define what pieces of knowledge she is interested to identify. One of such model-driven annotation tools based on a comprehensive SA framework is Cerno (Kiyavitskaya et al., 2009). In Cerno, the conceptual model obtained from domain experts must be then converted into an
annotation schema, i.e., the list of semantic categories with their annotation rules. After that, the annotation process can be executed. Cerno automatically annotates texts with the concepts in the conceptual model. It is able to annotate general concepts and not only named entities (Organization, Person, Location) as several SA tools do. The output is saved in a table containing texts at the specified level of granularity (single words, sentences, paragraphs, documents). Non textual content are annotated analyzing information available in their meta-tag descriptions (e.g., the description of an image in HTML).

6. Analysis of the annotation results based on the efficacy measures. The results of the SA can be used as an input for calculation of quantitative measures of CE. The most basic index is to calculate the total number of annotations identified for each category and check which categories are well-covered and which are under-represented. This index can be then elaborated into more complicated metrics (Coulleri, 2006):

- **The evaluation according to a hierarchy inside of the conceptual model.** Every concept can be assigned a weight \( w \) based on its hierarchical level of the conceptual model. The idea is to assign smaller weights to the deeper levels, while weight higher top level concepts. In this way we can take into account the contribution a given annotated text gives to satisfy specific requirements content. The final result is the sum of the number of annotations \( (N_i) \) for each \( i \)-th concept multiplied by its corresponding weight.

- **The evaluation based on the website structure hierarchy.** This metric takes into account the hierarchy structure of the website. For example, the information found on its Home page can be given a greater weight compared to the information that is provided on the internal pages, assigning a weight according to the hierarchy level of the annotations.

- **The evaluation based on the number of keywords found for a given concept in the annotated pieces of text.** We weight each annotated text according to the number of concepts that correspond to a given category. This measure can be applied when the granularity of the annotation is longer than single words.

- **The evaluation based on the relevance of HTML tags.** When fulfilling the SA, one can take into account the information about HTML tags where the annotations were found. For instance, the heading like \(<h1>, <title>\), can be given a higher score than the text found in \(<p>\) tags.

- **The evaluation based on the user profile.** This measure combines two things: the information on the profile of the user as well as the information on the needs of the user. One solution to obtain the profile data is to use socio-demographic reports, as for instance in (Stanca, 2004).

Formulas for the first four metrics are represented by the sum of annotations which are multiplied by weights assigned according to the suggested evaluation aspect, i.e., position in the hierarchy of the conceptual model, position in the hierarchy of the website, relevance of the keywords, or relevance of the HTML tags:
To express the last metric we can use the following function:

\[ CE = \sum_{i=1}^{n} \sum_{j=1}^{m} N\alpha_{ij}w_{j} \]

where a user profile could be for example defined in the set \{student, manager, teacher, employed, unemployed, elderly, family\}; user needs could be defined as \text{Accommodation} = \{hotel, camping, B&B, residence, apartment\}. In this case, weight distribution depends on the profile and needs of the users.

All these measures require a preliminary selection of weights. This selection must be realized by domain experts together with web engineers and is not trivial.

2.3 The Semantic Annotation Method: Cerno

For investigating the validity of the CE evaluation method, in our studies we have been interested in a general-purpose semantic annotation method which could be easily customized to a new document domain with a limited amount of training data available. One of such approaches is Cerno (Kiyavitskaya et al., 2009). The annotation phase of Cerno uses a domain-dependent annotation schema which contains a list of concepts to be identified and a vocabulary of \textit{syntactic indicators}, i.e., keyword-based annotation rules, related to each concept. Thus, the domain model plays an important role in guiding the document analysis. Cerno assumes that the annotation schema is provided either automatically using some learning methods or manually in collaboration with domain experts. Syntactic indicators lists may include literal words, e.g., “Euro” or “tel.”, phrases, e.g., “is not required to”, or names of parsed entities, for instance, “e-mail” or “money”. They also can be positive, i.e., pointing to the presence of the given concept, or negative, i.e., excluding the presence of this concept. The final products of Cerno can be both XML-like marked up text, i.e., in-line annotation, and the populated database, i.e., standoff annotation. Because Cerno factors out domain-specific knowledge, such as syntactic indicators and the domain schema, the process can easily be adapted to different semantic domains (Kiyavitskaya et al., 2008).

3 Case Study

This case study was run within a larger project of the eTourism group of University of Trento (eTourism research group, 2010) which aim was to investigate the tourism models of Trentino (http://www.provincia.tn.it) as an alpine destination. The economy of Trentino – which is part of the Italian autonomous region Trentino Alto-Adige Suedtirol – is mainly based on tourism, and the territory is organized in fifteen agencies responsible for local administration and promotion (Local tourist boards,
2010). We choose the Local Tourist Boards in Trentino because they are highly uniform as regards their mission and goals unlike agencies of promotion at higher level (national and regional). Moreover, we found a reasonable number of them, i.e. 15 (this number refers to the situation until year 2008), which allows carrying out an accurate analysis of the sites. The following subsections illustrate the application of the CE evaluation method.

1. **Business model identification.** Tourism is a principal source of income in many areas of the Trentino Dolomites, and therefore, the mission of the Tourist Boards in this area is marketing and promotion of local tourist destinations. In particular, the eTourism group was interested in evaluating the efficacy of the Tourist Boards in promoting these alpine destinations among international visitors. To address this task, we need to assess the quality of the communication realized by the Tourist Boards to accomplish this goal.

2. **Identification of the website role in the business model.** The communication for promoting the alpine destinations abroad is largely realized through the official B2C (Business to Consumer) websites of the 15 Tourist Boards (local APTs). Considering the international target of tourism offer, one of the main requirements of our investigation was the presence of English versions of the websites. Only 13 websites satisfy such a requirement. Thus, we have to extract the English-language content of the websites and then we have to analyze how comprehensively the strategic goals of the Tourist Boards are represented there.

3. **Identification of relevant content categories.** In order to derive a list of key categories that must be covered by an alpine Tourist Board website to be effective, we referred to the notion of tourist destination, which is defined as a place of travel that tourists wish to visit due to its natural or artificial attractions. A tourist destination is characterized by the following factors (Mich & Franch, 2005):

   - a well-defined geographic area with specific borders and a territorial identity;
   - presence of a variety of operators with different visions and objectives which requires a shared strategy in promoting a local offer;
   - understanding of the nature of a potential demand for the tourist products offered;
   - awareness of the need to balance tourist use of local resources according to ecological, environmental and community regulations.

Among the operators involved in generation of the tourist product are: Hosting structures, Restaurants, Commerce, Handicrafts, Agriculture, Entertainment, Cultural institutions, Sports activities, Free-time, Public boards, Transportation, Public services.

All these factors and operators embrace a list of key categories important for promoting a tourist destination. The nature of the destination is another issue to take into account. There exist many various types of destinations, and concepts relevant for each type differ or need to be defined at different level of details (Mich, Franch & Martini, 2005). In the context of our case study, alpine destinations are characterized
by specific sport activities (skiing, snowboarding, hiking, mountain biking) and lodging facilities (hotel, B&B, garni, Gasthaus) that visitors are interested in. Whereas for a religious destination, for instance, sports do not play an important role and an accommodation could be arranged in a convent. Therefore, in the next step we elaborate the key categories based on our destination type and tourism offer.

4. Derivation of the conceptual model. In order to develop a conceptual model for CE of an alpine destination, we asked the tourist experts to select a subset of high-level categories and more specific concepts relevant for its strategies. The resulting list includes the following concepts: accommodation (hotels, campings, apartments for rent), catering places (restaurants, local food), sports (possibility to do various sport activities, competitions, courses, facilities), transportation (how to reach a destination by any transportation means, timetables, terminals), culture and history (artistic heritage, places to visit, cultural events, local traditions, holidays, costumes), and medicine (medical services and treatments of the resort). See the extended description of these categories in Table 1.

Table 1. Topics related to the CE of Tourist Board Websites for an alpine destination.

<table>
<thead>
<tr>
<th>Category</th>
<th>Key concepts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geography</td>
<td>Climate, Weather predictions, Land Formation, Lakes and Rivers, Landscape</td>
<td>Comprises characteristics of the landscape (mountain, lakes, plateaus), or geologic features (type of the rocks), characteristics of the environment (natural resources, parks, protected zones, biotopes) and climate (temperature, number of sunny days, precipitations, quality of the air, altitude).</td>
</tr>
<tr>
<td>Local products</td>
<td>Local handcrafting, Agricultural products, Gastronomy</td>
<td>Concerns all aspects that differentiate the production of one destination from the others: typical products of local agriculture, farming, and gastronomy (wine, cheese, sausage), or products related to forest – (wood, mushrooms, flowers). Local handicraft products are also important (sculptures, weaving, embroidery, etc.). Includes also markets and fairs.</td>
</tr>
<tr>
<td>Culture</td>
<td>Traditions and customs, Local history Festivals, Population, Cultural institutions and associations, Libraries, Cinemas, Local literature, Local prominent people</td>
<td>Description of historical aspects related to the origins of the local population, ancient institutions of local governing (laws, municipal government, etc.) Other characteristics are folklore manifestations, customs and traditions related to particular periods of the year (e.g., carnival, Christmas). It includes also cultural associations (choruses, bands, etc.), libraries, reading-rooms, cinemas. Historical and contemporary personalities of the area, such as writers, photographers, mountain climbers.</td>
</tr>
</tbody>
</table>
Artistic Heritage | Places to visit: museums, castles, Tickets, fees, guides | Artistic heritage involves all that a tourist can visit or see in a destination; among these are: churches, castles, museums, ruins, castles, etc.

Sport | Sporting events, Sport infrastructure, Sport disciplines | Usually, it is distinguished between winter and summer sports. Among winter sports there are all types of snow activities (e.g. downhill, cross country skiing, snowboarding, etc.). Summer activities include excursions, climbing, Nordic walking, jogging, mountain bike, paragliding, etc. Other sports relate to this category, such as those practicable using special infrastructure (swimming pools, gold fields from golf, etc.). Relevant information is rental stations of sport equipment, training possibilities, enrollment to specific initiatives (alpine guides). Includes sport manifestations as well (e.g., marathon races).

Accommodation | Places to stay, How to book, How to arrive, Prices, Availability | Comprises all types of accommodation (hotel, pension, residence, bed and breakfast, rooms, campings, hostels, garni, hospitality in family). Apart from this, relevant information is modalities to make a reservation, offers, discount packages, prices must be indicated.

Food and refreshment | Places to eat, Dishes, Degustation, Time tables, How to book | Concerns various eating structures (restaurant, pizzeria, bar, malga), typical dishes, initiatives related to tasting of local products. Relevant information includes restaurants’ opening hours, how to reach the place, how to make a reservation of a lunch, how to get to a restaurant.

Wellness | Wellness centers, Wellness services | Often, the wellness structures are present in hotels or thermal centers. Those include Turkish bath, sauna, massages, diets, gymnastics, beauty treatments.

Services | Transport, schedules, Information offices, Terminals, stations, airports, Travel agencies | Means of transports available in the region: buses, shuttles from the airport, ski-buses, trains; routes, timetables, parking areas, the distances from highways, railway and coach stations. Tourist information offices, Tourist boards and travel agencies.

5. Semantic annotation based on the derived model. Having derived a list of concepts of interest, we fulfilled the SA of the English-language content. In order to populate the components of Cerno with annotation rules, the initial schema provided by the domain experts was expanded semi-automatically using definitions and synonyms provided by WordNet (WordNet, 2010) database and the on-line Thesaurus (On-line Thesaurus, 2005). The total number of annotation rules
collected was 507. To download and save the website content, we used an automatic tool called WebExtractor (WebExtractor, 2010). After that, we converted the websites from their format (HTML, PHP, or others) into textual form using Detagger (Detagger, 2004), a tool which removes markups and scripts from the documents. As a result, we obtained a set of 11,742 paragraphs of plain text and performed the SA of these paragraphs using Cerno. That is the granularity of the annotated texts was set to the paragraph level, an adequate level given this domain where grammatical sentence structure can not be recognized by linguistic tools which use punctuation symbols as sentence separators. See, for instance, extracted pieces in the fragment below (Fig. 2).

![Fig. 2. Sample fragment of the text extracted from an APT website](image)

By “paragraph level” here we mean a text fragment between HTML tags like `<p>`, `<h1>…<h6>`, `<title>`, and other tags denoting meaningful textual contractions. Given that obtained paragraphs can highly differ in their length, located on a separate sub-page with a lot of repeated navigation-related text or in a single main page, it is also difficult to statistically compare the sizes of websites. See an example of the annotated content fragment in Fig. 3. The technical details of the annotation process setup and evaluation can be found in (Kiyavitskaya et al., 2006).

![Fig. 3. Example of the annotated content of the website](image)
6. Analysis of the annotation results. When the annotation process was completed, we calculated the total number of all the identified phrases relevant to varied categories, shown in Table 2, corresponding to the basic index described in section 2.2. To provide a qualitative diagram of these results, Fig. 4 displays the coverage of different categories by all websites. From the both figure and table, we observe that the best total score was estimated for the website of APT Altopiano di Pinè e valle di Cembra. Moreover, this website also covers all the categories with at least one text fragment, which means that the CE was high both in terms of overall breadth and depth of relevant information provided. As regards the application of the other metrics (section 2.2), in our case study we found out that measures (2) and (4) are not applicable in a comparative evaluation, because the websites we considered do not possess a homogeneous structure, both in terms of the website layout, as well as in HTML usage. Measure (5) assumes existence of several user profiles for evaluation, what was not the case in our study where only one type of user (i.e., a tourist from abroad) was considered. Measure (3) relies on the on the percentage of keywords found for a given concept in a text fragment, whereas in our work we use a similar method of identification of relevant information based on semantic annotation rules. Finally, formula (1) could be applied in our study, but the weights would be all equal, given that the conceptual model in this case consisted of a plain list of 9 categories, which makes this measure identical to a simple count of the annotations.

The results revealed that the best-covered category among all others was Geography (see Fig. 5). The total sum of Geography-related annotation was 185. In fact, all of the considered websites include a page presenting the destination, which normally contains many geography-related terms, like “mountain”, “valley”, “alpine” and others. The highest scores were demonstrated by APT dell'Altopiano di Pinè e valle di Cembra (26) and APT San Martino di Castrozza, Primiero e Vanoi (24). Another well-represented category was Sport, whose total sum of annotations was 78. This result is also not surprising, given that the major focus of promotion of Alpine destinations is different kinds of mountain sport activities. The least covered category was Wellness. Its total count of annotations was 9. In fact, only few websites provided the information about wellness facilities, like beauty centers, fitness courses, or massages. The site that contained most information about this category was APT Terme di Comano-Dolomiti di Brenta (4), which tourism offer is based on thermal waters. Other under-represented category was Food and Refreshment, where the total count was 31 and only 10 of 13 websites provided related information. As the matter of fact, the information about places to eat was not covered by those versions of the website.
The results showed that the site of APT dell’ Altopiano di Pinè e valle di Cembra had the best CE; it not only has the greatest total count of annotations, but also represented all of the categories. The lowest CE in terms of both breadth of knowledge coverage and extent to which this knowledge is elaborated (see section 2) was shown by the following sites: (a) APT delle Valli di Sole, Pejo e Rabbi with ...
total count equal to 23 and three categories are not represented at all; (b) APT degli Altipiani di Folgaria, Lavarone e Lucerna with a total count equal to 27 and three categories that are not represented. One website also demonstrated a low total score equal to 23 (Madonna di Campiglio – Pinzolo – Val Rendena Azienda per il Turismo Spa); however, all the categories are represented by this site at least once. Consequently, this website demonstrated good breadth coverage of related information, but poor elaboration of this information.

The obtained results can be used to provide some recommendations to the Tourist Boards regarding the ways to improve their website content in order to achieve a better CE. For example, the importance of several categories, especially Wellness, Food and Refreshment, and Accommodation, was underestimated by the website developers. Therefore, more information related to these categories must be provided. The overall representation of relevant information was not balanced. We found out that the majority of websites contained too much information related to Geography category compared to other categories (see the extreme left-hand bars of the diagram in Fig. 3). The best coverage in terms of both breadth and depth of detail was demonstrated by APT dell’Altopiano di Piné e valle di Cembra. Moreover, this website also largely outnumbered all other sites obtaining a total count of 95 annotations. In comparison, the second best result demonstrated by two websites – of APT Valle di Fiemme and Ingarda Trentino Spa – was only 49 annotation counts. Therefore, other Tourist Boards could take this result as a best practice example in order to improve their CE.

### Table 2. Evaluation summary for the Tourist Board Websites

<table>
<thead>
<tr>
<th>Agency (A.P.T.)</th>
<th>Geography</th>
<th>Identity</th>
<th>Culture</th>
<th>Artistic heritage</th>
<th>Sport</th>
<th>Accommodation</th>
<th>Food &amp; Refresh.</th>
<th>Wellness</th>
<th>Service</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trento e Monte Bondone</td>
<td>11</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td>San Martino di Castrozza</td>
<td>24</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td>Valle di Fiemme</td>
<td>17</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>13</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>49</td>
</tr>
<tr>
<td>Altipiani di Folgaria</td>
<td>14</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>Terme di Comano, Brenta</td>
<td>19</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>Vals del Sole, Pejo e Rabbi</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>Dolomiti di Brenta, Pagan</td>
<td>17</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>34</td>
</tr>
<tr>
<td>Rovereto e Vallagarina</td>
<td>9</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>3</td>
<td>44</td>
</tr>
<tr>
<td>Val di Fassa</td>
<td>10</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>39</td>
</tr>
<tr>
<td>Altopiano di Piné, Cembra</td>
<td>26</td>
<td>17</td>
<td>8</td>
<td>15</td>
<td>11</td>
<td>12</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>95</td>
</tr>
<tr>
<td>Ingarda Trentino s.p.a.</td>
<td>15</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>10</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>49</td>
</tr>
<tr>
<td>Madonna di Campiglio</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Valle di Non</td>
<td>13</td>
<td>11</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>37</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>185</strong></td>
<td><strong>63</strong></td>
<td><strong>46</strong></td>
<td><strong>44</strong></td>
<td><strong>78</strong></td>
<td><strong>36</strong></td>
<td><strong>31</strong></td>
<td><strong>9</strong></td>
<td><strong>41</strong></td>
<td></td>
</tr>
</tbody>
</table>

### 3.1 Lessons Learned

The case study represents a first validation of our CE evaluation method. It has been applied to a set of 13 websites, allowing to highlight that relevant content for the promotional strategies are missed, even applying the simplest of the metrics we introduced. The entire process required a large effort, especially to define the conceptual model in terms of indicators that represents content requirements for the
companies’ strategies. However, the result is that the detailed output of SA process (the annotated texts are saved in a database) can be used by a Tourist Board to improve the content of its website addressing specific issues in a systematic and automatic way, also supporting the maintenance activities of the website. Most importantly, our method allows yielding the CE-focused models in the first third steps that help building more robust information and recommendations in the remaining steps, where eventually a different semantic annotation approach can be applied.

The limitations of the method are related to the following issues: recall and precision performances for Cerno have been assumed equal for all the concepts, but it could not be the case. In fact this assumption does not fit for named entities, vs. general concepts (in our case none of the concepts correspond to named entities) given that annotation results are better for the second ones. Multimedia content is only partially evaluated (where textual tags were attached) and needed the application of specific annotation tools as those used in (Saathoff et al., 2010). Also, to distinguish if “Museum Nights programme the 3, 10, 17 and 24 of August.” gives more information on than “Museo del Pianoforte Antico” as an item in an enumeration (both of which would have generated the ArtisticHeritage annotation), a more detailed analysis would be required. The first is the description of a single event, the second could be the item of a menu related to the museum as part of the cultural offer of the destination; even as single sentence in the enumeration it could be more important than the longer description in the first sentence.

4 Conclusion

In this work, we investigated the application of SA in evaluating CE of websites. To address this issue, we proposed a systematic approach for estimating a website’s CE where the key role is played by its content. An important contribution of this approach is the process that allows building models for well-communicating websites, starting from high-level business strategies. These models can be further applied either manually by an expert to estimate CE of a website in question, or automatically by an annotation tool as a domain knowledge base for identifying CE-related concepts. In this work, we applied a tool to automate this evaluation, i.e., a SA framework Cerno, and showcased our method on a realistic case study. The study was fulfilled for 13 websites of Tourist Boards of the Italian autonomous province Trentino. The results of the study, though carried out using the basic metric for CE, allowed us to identify strong and weak points for each site and derive a number of useful recommendations for improving the communication between providers of tourist services and their target sectors of consumers. These problems were also confirmed after a manual check of the site content.

From an application viewpoint, this case study demonstrates how advances in modern information technologies and, in particular, SA and domain models can yield benefits to both providers and users of tourist services (Maedche & Staab, 2002), (Spohrer & Riecken, 2006), (Walchhofer et al., 2009).

Our future work will address the limitations of the first applications of the method in order to:
include a deeper investigation of the CE testing the metrics introduced in section 2 applying other modules of Cerno (Zeni et al., 2007), so that to analyze the structural information of a document and XML tags (Zeni, 2008) (step 6),
• take into account information contained in multimedia content of websites (Saathoff et al., 2010) (step 5),
• validate the method with different CE metrics on different types of websites.
Furthermore, we are interested in developing a toolset to support the construction of a conceptual model starting from the description of the website communication strategies (steps 3 and 4),
• investigate how the method can be integrated with CE indexes, so-called success measures.

From the research viewpoint, we aim to investigate what types of problems can be identified by applying different CE metrics. This will allow for a fine-tuning of our CE evaluation method to the conditions or expectations of a particular case study.

Acknowledgments. This work was partially sponsored by the PAPYRUS project (ICT-215874).

References


