COMPUTER-BASED CARTOGRAPHY: A MARKETING INFORMATION SYSTEM TOOL FOR THE EU CONSTRUCTION INDUSTRY

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Trans-national construction companies (TNCCs) would need information when venturing overseas to increase their share of the global construction market and to achieve a higher level of global performance. A good marketing information system is thus important to develop strategic marketing plans. Against this setting, the importance of a marketing information system is becoming more apparent today; however its application remained limited in the construction field. For this purpose, the aim of this study is to develop an iterative computer system using cartograms for TNCCs to gain information relating to the which, where, why and when of global construction. A cartogram is a representation of a map which shows quantitative information, thereby rendering spatial comparison between countries/regions possible. The use of computer-based cartography can therefore effectively yield a clearer representation of geographical attributes in the global construction market. This study develops, for the first time, a computer-based cartography approach to analyzing and presenting the EU construction market. The research design comprises of several stages that produce an appropriate computer-based cartography that can clearly reflect the relative positions/potentials of all the countries/regions in the world which can be used to analyze the global construction market for TNCCs. Following the development of the global cartogram, further studies can be undertaken to analyze the correlations which the construction industry may have with other economic variables such as GDP and population, and with other economic sectors such as manufacturing and agriculture. A proto-type computer-based cartogram for the EU construction market will be presented in the paper.

Keywords: cartography, construction market, EU, GDP growth, marketing information systems.

INTRODUCTION

Trans-national construction companies (TNCCs) would need information when venturing overseas to increase their share of the global construction market and to achieve a higher level of global performance. To gain a competitive edge over others, the key lies in how fast the organization can convert the vast knowledge of information into customer value and relationships under reduced time and at lower costs. In order to survive, the organizations must be prepared to brace themselves in the area such as customer relationship management, marketing decision support systems, market research and marketing communications. These elements form the crux to a successful marketing strategy.

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Marketing information systems is often seen as a critical element in effective decision making and are increasingly being adopted to support the marketing activities in many organizations. The notion of a computerized marketing information system (MKIS) dated back as early as in the 1960s. Since then, there have been an increasing number of literatures in this field. There is mounting evidence that the importance of a computerized marketing information system is catching with the companies.

Computer- based cartography took off around the same time as that of the MKIS. Its ability to provide for strong visual aids and efficient communication channels for the users made this software stand out from the rest of the tools available in the market. Till now, the use of cartography has been mostly limited in the discipline of computer sciences and geography. There has been no attempt to bridge a connection between the computer based cartography and MKIS.

This paper introduces the notion that computer-based cartography can indeed be used in MKIS by discussing the full potential of using a computerized information system to graphically display data and to provide for more effective decision marketing. A proto-type computer-based cartography for the EU construction market will be presented in the paper.

Background

Bell (1981) is one of the pioneers who undertook studies to examine the marketing attitudes of the construction firms in UK. It is concluded that the marketing strategy could perhaps be developed based on the service nature of the construction industry. Hardy and Davies (1983), when investigating the perception of the marketing concept in the UK construction industry, discovered that many firms exhibit an indifferent attitude towards marketing. Morgan and Morgan (1990) concluded that the marketing concept is still viewed with scepticism among the companies in the UK construction industry. And Morgan and Burnicle (1991) pointed out that the UK construction industry has been slow in adopting marketing principles.

Low (1991) also observed that the marketing has only attracted little attention from the construction contractors and professionals. Dikmen et al (2005) made a strikingly similar conclusion when examining the marketing attitude in the Turkish construction industry; that is the marketing concept in the industry is still in its early stages. There seems to lack a strategic marketing information system that could add value to the overall marketing strategies in the construction industry.

A MKIS can perhaps be best defined by Kotler (1966) as a structure consisting of people, equipment, and procedures to gather, sort, analyze and evaluate to provide for timely and accurate information for management decisions in marketing. This notion of a continuous flow of decision making via information is precisely the gist of MKIS. Being designed to be flexible and comprehensive in nature, MKIS addresses the collaborative and analytical needs of an organization. Firstly, in the collaborative approach, MKIS allows information to be shared virtually among the marketing managers. Secondly, in the analytical mode, the decision support nature of a MKIS enables marketers the ability to carry out an analysis of the market data on customers, competitors, technologies and general market conditions (Harmon,2003).

Given that decision-making in marketing is becoming more complex, the need for a systematic approach to managing information is becoming more essential (Brien and Stafford, 1968). The development of a computer based MKIS then becomes crucial.

Despite the increasing need for a computerized MKIS, the industry has not been catching on with the ideal situation of a MKIS which the literature reviews have captured. Of interest to this study is a survey done by Li, McLeod and Rogers (2001) in a 20-year longitudinal study, revealing that only 67% of the managers indicated that their firms have MKIS, a level considerably down from the 75 to 77% of 1980 to 1990, although they claimed that computer usage by marketing decision makers overall has gone up.

The above studies suggest that the benefits of employing a computer based MKIS have not been fully realized by the companies.

In response, this paper introduces cartography, in the light of its capabilities, to see how it can be utilized in enhancing MKIS. This will be the first attempt ever to bridge the connection between a computer- based cartography and MKIS. The strongest selling point of computer based cartography is its ability to display information graphically for the decision makers.

Computer- based cartography, apart from being able to provide a visualizable object to the end-user, can help in managing the massive data in a database. The computer-based cartography has the ability to transform this data through the visualization process into an object that can help the users in stimulating their thinking and ultimately aid in their decision making.

The next section will provide an introduction on how the development of the cartogram tends towards the production of maps. The function of the computer-based cartography will be discussed in greater details and place emphasis on visual aids and communication channels. This will be followed by an insight into the capabilities of a computer-based cartography, stressing on the advantages of using the computer-based cartography and also providing technical explanations on how the cartogram is generated.

Cartography

Maps have been regarded as a form of scientific visualization and cartography is seen to be able to provide this visualization process more effectively. Visualization through cartography is refereed to as the cartographic visualization process. This process takes place when a given geospatial database is converted into map-like objects through the visualization process as can be seen in figure 1. The end product is of value to the users because cartographers are able to transform the data into useful information (Kraak,2001).

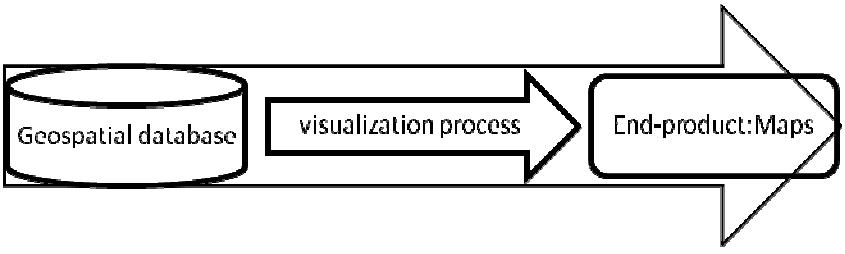

Figure 1: The cartographic visualization process (Source: Kraak, 2001)

The application of scientific visualization on cartography also has the ability of instantaneously changing the appearance of the maps. This interaction with the map can help stimulate the user's thinking and can add on a new dimension to the functions of a map. Besides being able to prompt thinking, cartography can be used to foster communication and decision making which is a crucial factor in MKIS.

Communication Process

Communication within the cartographic process starts with the notion of "How do I say what to whom, and is it effective" (Kraak, 2001). Figure 2 demonstrates this process. Cartographers start off by having to study the data or information, which are usually collected by third parties such as geographers, statisticians and so on. The cartographers must make sure that the information is properly represented in the map form. Quite frequently, the map does not contain every particular information that the cartographers are supplied with and more often than not, some generalization have to be applied to present a clearer picture. The map reader will then be able to derive some information from these maps.

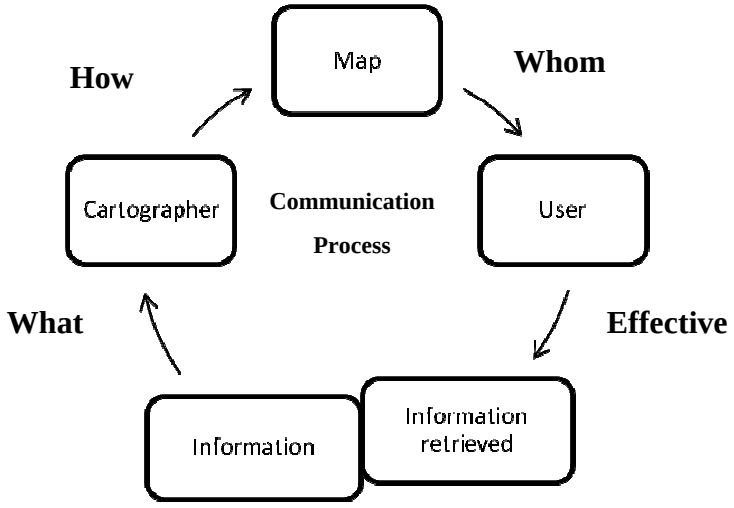

Figure 2 The Cartographic communication process (Source: Kraak, 2001)

After the brief introduction to cartography and explanation of the functions (both visual aid and effective communication tools for end-users) within the cartographic process, the next section will make a comparison between computer- based cartography capabilities and ordinary maps and how the former can be used for effective decision making.

Computer-based Cartography

The use of computer-based cartography, as explained above, in analyzing global spatial properties is not a new phenomenon in the discipline of computer sciences and geography. The use of Geographical Information Systems (GIS) to analyze spatial representation in two economic groupings has been explored by Low, Raphael and Lim (2008) but was unable to produce the desirable visual effects when compared to that of cartography. Computer-based cartography has what it takes to enable for more effective decision making for marketing.

Cartogram Application for European Union (EU)

The European Union (EU), established in 1993 by the Treaty of European Union, has an objective to develop a political an economic union. With 500 million people, the EU combined generates a nominal gross domestic product (GDP) of US$18.5 trillion (2008), an estimated 30% share of the world's GDP (IMF, 2008). Of importance commercial sense to all the member states in the EU lies in the prospect of an enlarged single market, through a standardised system of laws, serving a large population.

A cartographic-based analysis of the construction value-added in the EU construction industry for the period 1970-2006 is developed based on officially published national

account statistics of the EU member states. The 27 member states of EU, at the time of writing, are Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

Similar studies have been carried out firstly, through global construction opinion survey by Bon and Crosthwaite (2001) and secondly, through the internet that relied on uncertain opinionated responses from time to time by Crosthwaite (2006). It was felt that such internet based opinion surveys, for all their good intents and purposes, suffered from the following weakness: poor response rates, idiosyncrasies of respondents, inaccurate reporting, biased reporting, prejudices and so on. An analysis of the EU construction industry based on officially published national accounts statistics would offer a more reliable alternative that can likewise be disseminated on an annual basis for corporate planning.

Two cartograms are presented below to provide an illustration of possible comparison between different cartograms. Figure 6 shows a cartogram that illustrates the GDP (in billions of US$) for the 27 member states of EU in 2006, whereas figure 7 shows a cartogram that illustrates the construction value added measured at US dollars at current prices in millions for the 27 member states of EU in 2006. These two cartograms can be used to compare and contrast the proportion of the construction value added in the GDP. The two cartograms show that in 2006 for example, the construction value added both in Spain (ES) constitute a large proportion of the GDP.

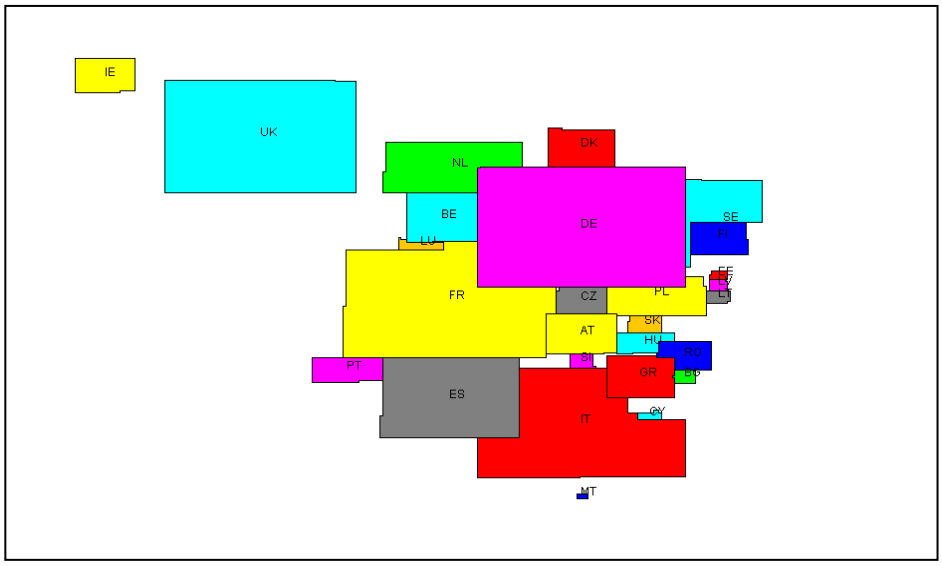

Figure 3 Cartogram illustrating GDP (in billions of US$) for the 27 member states of EU in 2006

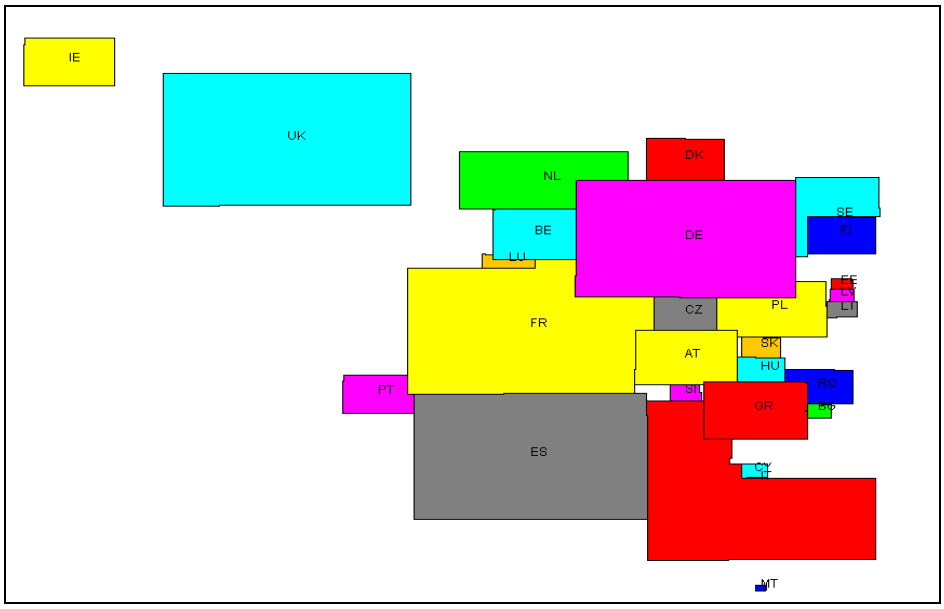

Figure 4 Construction value added measured at US dollars at current prices in millions for the 27 member states of EU in 2006

Table 1: Countries in the EC ranked in regressional trends of VA by construction

Countries	**Rate**	**Rank**	**r**
Lithuania (LV)	12.369	1	0.91
Latvia (LV)	11.839	2	0.87
Estonia (EE)	10.314	3	0.84
Slovakia (SK)	10.088	4	0.82
Ireland (IE)	9.227	5	0.92
Cyprus (CY)	8.504	6	0.89
Slovenia (SI)	8.468	7	0.86
Portugal (PT)	8.464	8	0.94
Spain (ES)	8.198	9	0.91
Austria (AT)	6.901	10	0.91
United Kingdom (UK)	6.890	11	0.93
Czech Republic (CZ)	6.873	12	0.71
Malta (MT)	6.439	13	0.90
Greece (GR)	6.009	14	0.91
Netherlands (NL)	5.832	15	0.90
Italy (IT)	5.720	16	0.88
Denmark (DK)	5.370	17	0.91
France (FR)	5.137	18	0.87
Belgium (BE)	4.902	19	0.77
Finland (FI)	4.883	20	0.75
Germany (DE)	4.744	21	0.76
Hungary (HU)	4.548	22	0.78
Poland (PL)	3.915	23	0.87
Sweden (SE)	3.847	24	0.70
Romania (RO)	2.044	25	0.22
Luxembourg (LU)	0.897	26	0.02
Bulgaria (BG)	-1.234	27	0.07

(Note: 1. Rate of growth in %. 2. R= coefficient of correlation)

Table 1 shows the ranked order of countries in regressional trends over 37 years from 1970 to 2006. At the top of the table is Lithuania, indicating that the Lithuanian construction is the fastest growing market in the EC. This table is a good indicator to illustrate the growth of the construction industry in a particular country. Analysis such

as those in table 1 and coupled with the aid of the visual capability of the cartogram can provide a direction to the marketing managers in identifying the potential construction market.

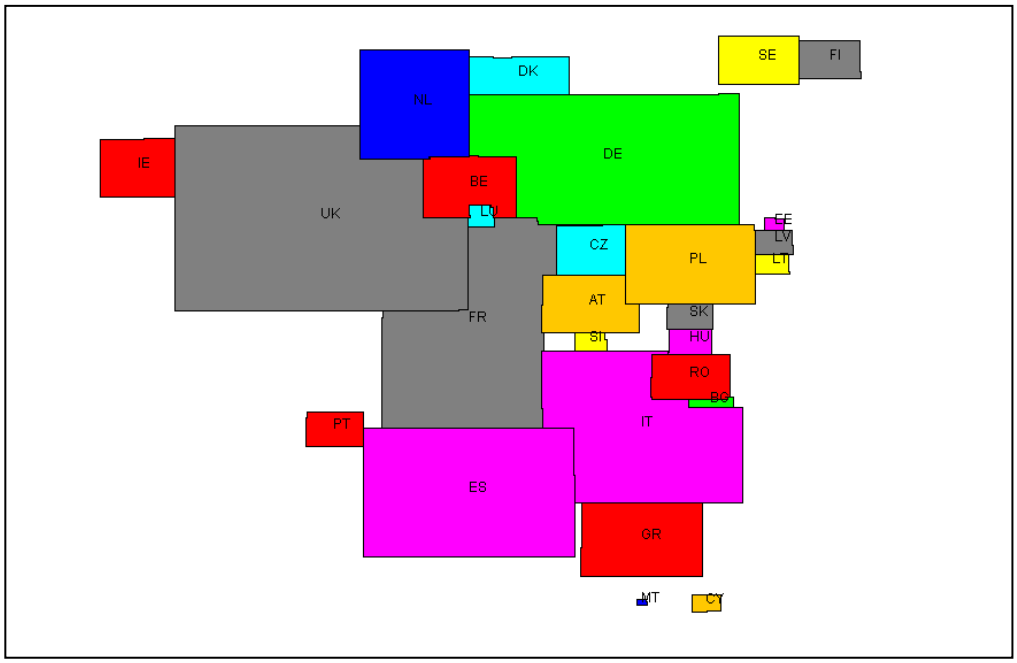

Figure 5 Projected Construction VA for countries in the EU in 2015

A time series analysis has been carried out to project the construction VA for countries in the EU. Figure 5 shows a cartogram that illustrates the projected construction VA in the EU in 2015. United Kingdom is forecasted to lead the whole construction industry in being the biggest construction market. This is followed by Germany, Spain, France and Italy. The upcoming Olympic game to be held in London, UK will create a boost to the construction output in UK.

Apart from the possible comparisons, the cartograms can also reflect the changes in the construction value added on a yearly basis. Any gradual or acute trend in the construction value added for each country can be effectively captured by means of an animation. It can then be seen from the animation of the cartogram whether the country is growing or shrinking in their construction value added figures.

All the above application of the computer-based cartography indicates that it can be a useful tool for the MKIS. This computer-based cartography can store massive statistical data into databases. This is illustrated in Figure 6. This could then be generated into cartograms, which is shown in Figure 3 and 4, to graphically display information for the decision makers. Through the visualization process, the cartogram can help the users in correctly identifying the various countries with their respective construction value added. An added bonus to the computer-based cartography is that it can effectively yield a clearer representation of geographical attributes in the EU construction market. This means that the computer-based cartogram has great potential in construction marketing especially in assessing new markets.

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32
1       GR      23794
2       BG      1332.4
3       RO      7370.7
4       LT      1930.2
5       LV      1211.3
6       HU      4555.2
7       SK      3150.3
8       PL      18903.2
9       SI      1855.4
10      AT      22099.4
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Figure 6 Database for storing statistical data

Advantages of computer based cartography

Computer based cartography has the capabilities of storing, processing and displaying more information to the user. The numerous advantages that computer based cartography can provide to the construction industry are as follows:

1. Statistical analysis can be performed on the data to project the construction value added in the EU.
2. Different cartograms can be generated for different analysis. For instance, the construction value added of ASEAN, APEC, NAFTA could be generated into cartogram to provide for a similar analysis as the EU.
3. It is possible to analyze the relationship between construction and: (a) manufacturing (b) agriculture (c) finance and banking through cartograms.
4. Computer based cartography can produce maps whose content is related solely to the user's needs. For instance, the user can specify attribute criteria like plotting regional contribution to increase of world value added by construction between specific periods of time. For the cartogram generated in this paper, the time period is from 1970 to 2006.
5. Up-dating of maps are made possible when data are available in digital forms. For example, the recent independence of Kosovo in 2008 can be updated in the digitalized data that can be readily displayed on the screen for the user. One has to be careful, however, in selecting the relevant data. For instance, in the case of Kosovo, the researcher may find it difficult to collate the statistical data for Kosovo, instead of lumping it with Serbia or the former Yugoslavia.
6. Different types of color coding can be made possible. For instance, the third world countries, developing countries and developed countries can all be differentiated from each other using different colors for each category. In this instance, red, yellow or green can be used to illustrate the economic status of a particular country on the map.

All the above advantages contribute towards the notion that computer based cartography can indeed serve as decision tool for the user.

CONCLUSIONS

This paper sheds new light on the application of computer based cartography in management systems, specifically with reference to MKIS. The ability to provide a visualization process and communication channel forms the crux of benefits accrued from the cartogram. These two functions can help in stimulating the user's thinking and aid in decision making. Apart from these two notable functions, the cartogram can also provide a graphical user interface whereby the spatial information can easily be

stored and manipulated. All these can aid companies in finding the potential customer base or in analyzing the world's market trends.

The trend towards computerized MKIS provides the potential for applying computer-based cartography. The benefits of using a computerized MKIS have not yet been fully realized, although the importance of having good computer software support is well known. The benefits of applying computer- based cartography are vast and therein lay the possibility in bridging the gap between the MKIS and the cartography.

Following the development of the EU cartogram, further studies can be undertaken to analyze the correlations which the construction industry may have with other economic variables such as GDP and population, and with other economic sectors such as manufacturing and agriculture.

Good rectangular cartograms may be difficult to generate. The area specifications for each rectangle may hamper its relative positioning in the region and thus disrupt the intuitive understanding of the maps generated.

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