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Customer relationship management performance appraisal

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ABSTRACT

Customer relationship management (CRM) is a multi-perspective business paradigm which aims maximizing the benefits gained from relationships with customers. The aim of this paper is to compare the CRM performances of e-commerce firms using a multiple criteria decision making (MCDM) approach. Analytical network process (ANP) is a MCDM methodology which can take the inner and outer dependencies among multiple criteria into consideration. As there are dependencies among CRM performance evaluation criteria, ANP is used for comparing the CRM performances of the e-commerce firms under consideration. A sensitivity analysis also provided in order to monitor the robustness of the proposed ANP framework to changes in the weights of evaluation criteria. To the authors' knowledge, this will be the first study which evaluates CRM performance using ANP.

1. Introduction

Customer relationship management is a multi-perspective business paradigm that is composed of people, process and technology (Chen & Popovich, 2003). Keeping its roots in relationship marketing and information technologies, CRM aims at maximizing the benefits gained from relationships with customers. However, no single definition has been accepted in the literature. The researchers has investigated 48 different CRM definitions and concluded with five categories of definitions: strategy, process, philosophy, capability and technology (Zablah, Bellenger, & Johnston, 2004). In this study CRM is defined in a micro view which can be defined as a process that is concerned with managing customer interactions (Plakoyiannaki & Tzokas, 2002; Reinartz, Krafft, & Hoyer, 2004; Srivastava, Shervani, & Fahey, 1999).

As a result of its promises and benefit, CRM term has become popular and companies have been making investments on CRM projects. The most important expected outcomes of CRM can be listed as: improvements in efficiency, cost reduction, improved profitability, increase in sales, enhanced customer value, customer satisfaction and improved customer loyalty (Buttle, 2004; Eid, 2007; Jones, Brown, Zoltners, & Weitz, 2005; Ko, Kim, Kim, & Woo, 2008; Reinartz et al., 2004; Richard, Thirkell, & Huff, 2007a; Roh, Ahn, & Han, 2005; Rust, Zeithaml, & Lemon, 2001; Sheth & Sharma, 2001; Verhoef, 2003). Managing the performance of CRM is especially important because of the low success rates (Brewton, 2003; Krol, 2002; Richards & Jones, 2008). Many companies are still making investments in CRM projects (Richards & Jones, 2008).

Performance measurement can be defined as a part of a management process that is realized periodically in order to determine the success or quality of a particular process or activity (Oztaysi, 2009). Performance measurement is used to evaluate the overall results of the past and identify the future position of the company in the top level management, in the individual level, performance measurement provides information about the shortcomings and motivate for the upcoming activities (Meyer, 2002). PM is a combination of companies' characteristics that are numerically expressed (Folan, Browne, & Jagdev, 2007). In another perspective, performance measurement is process of choosing different attributes (and indicators about them) and generating a combined evaluation based on these attributes. The researchers define performance as a multi attribute decision making problem with the following requirements (Oztaysi & Ucal, 2009): (i) Ability to reflect meaningful numerical results that shows the overall performance of a period. (ii) Ability to reflect the performance of any sub-division or perspective. (iii) Ability to trace the performance improvements by time. (iv) Ability to be flexible to design according to companies preferences. (v) Ability to be dynamic so that firm can change the model when needed. (vi) Ability to give insight about future performance.

Current performance evaluation in CRM literature can be analyzed in four groups. (i) Indirect measures and operational indicators. (ii) Self assessment. (iii) Benchmarking with best practices. (iv) CRM Scorecards. Indirect measures aim at evaluating CRM performance by indicators such as customer equity and brand equity (Kellen, 2002; Richards & Jones, 2008). Operational

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indicators on the other hand identify information about the efficiency of the customer related operations. In the second group, there are tools/scales that are generated by statistical methods (Crosby, Evans, & Cowles, 1990; Dorsch, Swanson, & Kelley, 1998; Dwyer, Schurr, & Oh, 1987; Jain, Jain, & Dhar, 2003; Kumar, Scheer, & Steenkamp, 1995; Lagace, Dahlstrom, & Gassenheimer, 1991; Sin, Tse, & Yim, 2005). These studies aim at measuring relationship quality, behavioral dimensions or holistic CRM. Customer Measurement Assessment Tool (Woodcock, Stone, & Foss, 2003) is the only tool that takes place in the third group. The method has defined nine assessment areas which are; Information technology, people, process, customer management, analysis, proposition customer management, measurement, customer experience and competitors. Differently from others, the method is an assessment tool which is based on comparison of companies' performance with the best practices in the same performance assessment area. The last group is composed of the CRM scorecard studies. There are two studies in the literature that propose CRM scorecard (Kim & Kim, 2009; Kim, Suh, & Hwang, 2003). Also there are some studies that define the most important steps in CRM scorecard applications (Brewton, 2003; Wiedmann & Buxel, 2007) .

There are many studies in the literature which utilize ANP in performance evaluation. Sarkis (1999) proposed a methodological framework for evaluating environmentally conscious manufacturing programs. Yurdakul (2003) measured long-term performance of a manufacturing firm using ANP approach. Leung, Lam, and Cao (2006) used ANP to facilitate the implementation of the Balanced Scorecard (BSC) in order to incorporate a wider set of non-financial attributes into the measurement system of a firm. Sarkis (2003) showed how ANP approach could be used to enhance the manufacturing strategy performance evaluation models. Chen and Lee (2007) constructed a performance evaluation model for project managers on the basis of leadership behaviors that lead to managerial practices. Chen, Huang, and Cheng (2009) proposed an approach of measuring a technology university's knowledge management performance from competitive perspective. Chen and Chen (2010) interviewed Taiwanese higher education experts to integrate critical measurement criteria and develop an ANP based original performance appraisal system to present complex interdependent relationships and to construct a relation structure among measurement criteria for performance appraisal.

The purpose of this study is to compare the CRM performances of e-commerce firms using a multicriteria decision making method. ANP is a decision making methodology which can take the inner and outer dependencies among multiple criteria into account. Since there are dependencies among CRM performance evaluation criteria, ANP is used for comparing the CRM performances of the firms under consideration. To our knowledge, this will be the first study that evaluates CRM performance using ANP.

The rest of the paper is organized as follows. Section 2 includes a literature review about the performance evaluation criteria used in CRM studies. In Section 3, a summary of ANP methodology and the CRM network structure used in this study are briefly given. In Section 4, the proposed ANP framework is applied to a case study in Turkish e-commerce market. In this section, a sensitivity analysis is also provided. Finally, in the fifth section concluding remarks and suggestions for further research are given.

2. CRM performance evaluation criteria

Performance is defined as the potential for future success of actions in order to reach the objectives and targets (Lebas, 1995). Wholey (1996) indicate that performance is not an objective reality; it is socially constructed reality and needs to be defined before getting measured. Meyer (2002) denotes that performance refers simultaneously to the action, the result of the action and to success of the result compared to some benchmark. By performance evaluation companies can 'look ahead', 'look back' and 'motivate' and 'compensate' people. While 'look ahead' and 'look back' aim at gauging the economic performance and past accomplishments of the firm as a whole, 'motivate' and 'compensate', at the individual level, motivate and drive the compensation of individual people.

Traditionally, accounting and financial indicators have dominated the performance measurement field. But these traditional systems were not often satisfactory as they are short term biased and do not address operational excellence and intangible assets (Kaplan, 1983; Kaplan & Norton, 1992). Balanced Scorecard (BSC) is a widely used corporate performance management system (Kaplan & Norton, 1992). In BSC, the performance of a company is proposed to be evaluated not only in financial perspective but also other perspectives that effect financial results. These four dimensions are defined as finance, customer, process and learning and development. Researchers propose that the companies should build a strategy map in order to identify the relationship between these dimensions and the criteria under each dimension (Kaplan & Norton, 2004).

In this study, the performance evaluation model is proposed in accordance with Balanced Scorecard and the performance of CRM is analyzed in four related dimensions, the relationships between the dimensions are identified and the criteria under each dimension are defined. The dimensions utilized in CRM performance evaluation can be listed as; outputs dimension, customer dimension, CRM processes, and organizational alignment (Fig. 1). With the considered dimensions, both the outputs and the factors that affect these outputs are taken into account which provides holistic and predictive performance evaluations.

The studies in the literature show that CRM has positive effects both in the companies' managerial ratios and indicators (Buttle, 2004; Ko, Lee, & Woo, 2004; Reinartz et al., 2004; Roh et al., 2005; Sheth & Sharma, 2001) and the customers' attitude towards the company (Eid, 2007; Jones et al., 2005; Mithas, Krishnan, & Fornell, 2005; Richard, Thirkell, & Huff, 2007b; Tanner, Ahrearne, Mason, & Moncrief, 2005). CRM outputs dimension implies the effect of CRM on the company financial and managerial indicators. In other words, CRM outputs are the main expectations of companies from CRM projects. CRM projects aim at reaching the CRM outputs by affecting the customers' perception and attitudes. Customer value, satisfaction and loyalty (Kim & Kim, 2009; Reinartz et al., 2004) are the key terms that CRM aims at improving. In the model, the results of CRM initiatives on customers are handled in the customer dimension.

The structure of CRM has been discussed in the CRM literature (Chen & Popovich, 2003; Reinartz et al., 2004; Roh et al., 2005; Sin et al., 2005; Zablah et al., 2004) and the absence of a single definition of the term has been shown as one of the major difficulty in CRM performance assessment (Richards & Jones, 2008). Zablah et al. (2004) has analyzed 48 CRM definitions and concluded with five different perspectives of CRM, strategy, process, technology, capability and philosophy. The proposed model is in accordance with process perspective and thus the primary dimension defining the structure of CRM is CRM process dimension. This dimension contains the key customer related procedures that are used in the company. The final dimension *organizational alignment* defines the accordance of the firm strategy, organizational culture and the technology with CRM processes. The organizational alignment dimension provides information about the environment and factors that improve the CRM processes.

In the proposed model, each performance dimension is represented by appropriate criteria. The performance dimensions and sample references using the related criteria are listed in Table 1.

Table 1
CRM evaluation criteria.

Dimension	Criteria	References
CRM outputs	Customer retention (CR)	Reinartz et al. (2004)
	Customer acquisition (CA)	Reinartz et al. (2004), Richards and Jones (2008)
	Share of Wallet (SoW)	Magi (2003)
Customer	Customer value (CV)	Jones et al. (2005), Chen and Popovich (2003)
	Customer satisfaction (CS)	Verhoef (2003), Winer (2001), Zikmund et al. (2003)
	Customer loyalty (CL)	Kim and Kim (2009), Buttle (2004), Tanner et al. (2005)
CRM process	Customer targeting (CT)	Reinartz et al. (2004), Woodcock et al. (2003)
	Enquiry management (EM)	Woodcock et al. (2003)
	Customer knowledge generation (CKG)	Stefanou et al. (2003), Sin et al. (2005)
	Campaign management (CM)	Bueren et al. (2005)
	Managing problems (MP)	Lowenstein (1995)
	Product logistics (PL)	Li and Hu (2008)
Organizational alignment	Intellectual alignment (IA)	Ocker and Mudambi (2003)
	Social alignment (SA)	Ocker and Mudambi (2003)
	Technological alignment (TA)	Ocker and Mudambi (2003)

2.1. Customer retention

Customer retention (CR) criteria represents the achievement of the company in keeping the existing customers. CRM aims to improve economic performance of companies by affecting customer retention, customer acquisition and development of customers with up sell and cross sell activities (Kim & Kim, 2009; Reinartz et al., 2004). With the emergence of relationship marketing, the focus of marketing has shifted from gaining new customers to keeping the existing customers (Sheth, 2002).

2.2. Customer acquisition

Customer acquisition (CA) indicates success of the company in acquiring profitable new customers. Besides the shift to retention of customers, getting new customers are still very important in the marketing activities. Targeting profitable customers, integration offerings across channels and improved pricing are most important drivers of CRM activities (Richards & Jones, 2008).

The term *Share of Wallet* (SoW) represents how the customers divide their purchases across the competing companies (Mägi, 2003). In order to improve the life time value of the existing customers, it is important to improve the salary from the existing customers by up-selling and cross-selling activities. As an indicator of how the change in customers' salaries over time, Share of Wallet criteria takes place under the CRM outputs dimension.

The customers dimension is defined by three criteria; customer value, customer satisfaction and customer loyalty.

2.3. Customer value

Customer value (CV) is the evaluation of customers' perceived benefit from the product or service (Kotler, 2000). It is assumed that the customers give their purchase decisions based on the total value they gain from the purchase. CRM aims at improving customer value by pre-sell, product/service customization and after sales services (Chen & Popovich, 2003; Jones et al., 2005).

2.4. Customer satisfaction

Customer satisfaction (CS) is the customers general evaluation about his/her experience with the product or service. Customer satisfaction is the gap between customer's expectations and the observed performance of the product. As CRM activities aims at fulfilling the expectations of the customers (Verhoef, 2003; Winer, 2001; Zikmund, McLeod, & Gilbert, 2003), customer satisfaction is an important criteria for the performance of CRM.

2.5. Customer loyalty

Customer loyalty (CL) is a term that defines the customers' behavioral and attitudinal bond with the company. While altitudinal loyalty is determined with surveys and other qualitative studies, behavioral loyalty can be analyzed using companies salary records. In the customers dimension scope, customer loyalty is close to attitudinal loyalty. On the other hand, behavioral loyalty is parallel to customer retention criteria in CRM outputs dimension. Customer loyalty is a consequence of customer satisfaction and can be improved by CRM (Buttle, 2004; Kim & Kim, 2009; Tanner et al., 2005).

CRM process has been much investigated and various models have been proposed in the literature (Bueren, S. R., & Brenner, 2005; Leigh & Tanner, 2004; Parvatiyar & Sheth, 2001; Payne & Frow, 2005; Zablah et al., 2004). In this study, the processes are determined in a customer oriented perspective (Oztaysi, 2009; Reinartz et al., 2004; Woodcock et al., 2003) and modified according to e-commerce. The defined processes are customer targeting (CT), enquiry management (EM), customer knowledge generation (CKG), campaign management (CM), managing problems (MP) and product logistics (PL).

2.6. Customer targeting

Customer targeting (CT) emphasizes the ability of the company to define and target profitable customers (Reinartz et al., 2004; Woodcock et al., 2003). CT includes identifying potential customers and getting in interaction with the appropriate communication channels.

2.7. Enquiry management

Enquiry management (EM) indicates the processes that enable the value of enquiries to be maximized. EM covers the area from the time an individual expresses an interest on the products and continue through qualification, selection of the product (Woodcock et al., 2003).

2.8. Customer knowledge generation

Customer knowledge generation (CKG) is the process that company gathers information from multi channels, consolidate, store and analyze the customer data. Customer knowledge is vital for CRM activities (Stefanou, Sarmaniotis, & Stafyla, 2003), it can be used to improve the competitiveness of a firm (Sin et al., 2005).

2.9. Campaign management

Campaign management (CM) is a process that focuses on planning, application and control of all marketing efforts on current and potential customers (Bueren et al., 2005). The aim of the process is to generate new up-sell and cross-sell opportunities.

2.10. Managing problems

Managing problems (MP) includes procedures for identifying and solving customer complaints. Lowenstein defines that up to 90 percent of customer complaints are never registered and unregistered complaints have the greatest impact on customer retention (Lowenstein, 1995).

2.11. Product logistics

Product logistics (PL), the last criterion in the CRM process dimension, is a vital component of e-commerce. When the customers purchase the products online, the transfer of the product ownership is carried out but the transaction is not finished until the products reach the customers (Li & Hu, 2008).

Ocker and Mudambi (2003) defined organizational alignment in the CRM perspective in three groups, intellectual alignment, social alignment and technological alignment.

2.12. Intellectual alignment

Intellectual alignment (IA) contains the strategy, structure and management of the company. The criterion defines the alignment of company's strategy and management with the CRM initiatives.

2.13. Social alignment

Social alignment (SI) is an other group that defines organizations alignment with CRM. SI is composed of organizational culture, interaction with shareholders and domain knowledge.

Finally in the *Technological Alignment* (TA), the alignment of CRM software with the current business needs and IT capabilities of the firm takes place. Technology is a vital part of CRM and sometimes CRM is confused with the technology itself. TA criterion defines the alignment of technological capabilities with CRM initiatives.

Table 2
Random index.

Order	1	2	3	4	5	6	7	8	9	10
R.I.	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

3. Analytical network process and CRM

The analytic network process (ANP) is a generalization of the analytic hierarchy process (AHP). The basic structure of the methodology is an influence network of clusters and nodes. A source node is an origin of paths of importance and never a destination of such paths. A sink node can be a destination of paths of influence but cannot be an origin. A full network can include source nodes; intermediate nodes, and sink nodes (Saaty, 1996). The challenge of ANP is to determine the priorities of the elements in the network and in particular the alternatives of the decision. ANP approach allows modeling complex and dynamic environments which are influenced by ever changing external forces (Meade & Sarkis, 1998).

In order to make tradeoffs between objectives and criteria, the qualitative judgments are expressed numerically. To do this, rather than simply assigning a score out of a person's memory that appears reasonable, one must make reciprocal pairwise comparisons in a carefully designed scientific way (Saaty, 1996). A priority vector may be determined by asking the decision maker for a numerical weight directly, but there may be less consistency, since part of the process of decomposing the hierarchy is to provide better definitions of higher level attributes (Meade & Presley, 2002). Then consistency index (*CI*) of an evaluation matrix is calculated as:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{1}$$

The consistency index of a randomly generated reciprocal matrix shall be called to the random index (*RI*), with reciprocals forced. Table 2 gives average random consistency index computed for $n < 10$ for large samples. The last ratio that has to be calculated is CR (consistency ratio). Generally, if *CR* is less than 0.1, the judgments are consistent, so the derived weights can be used. The formulation of *CR* is $CR = CI/RI$ (Önüt & Soner, 2008).

Inconsistency may be thought of as an adjustment needed to improve the consistency of the comparisons. But inconsistency itself is important because without it, new knowledge that changes preference cannot be admitted (Saaty & Ozdemir, 2005).

The priorities derived from pairwise comparison matrices are entered as parts of the columns of a supermatrix. The supermatrix represents the influence priority of an element on the left of the matrix on an element at the top of the matrix with respect to a particular control criterion. A supermatrix along with an example of one of its general entry matrices is shown in Eqs. (2), (3).

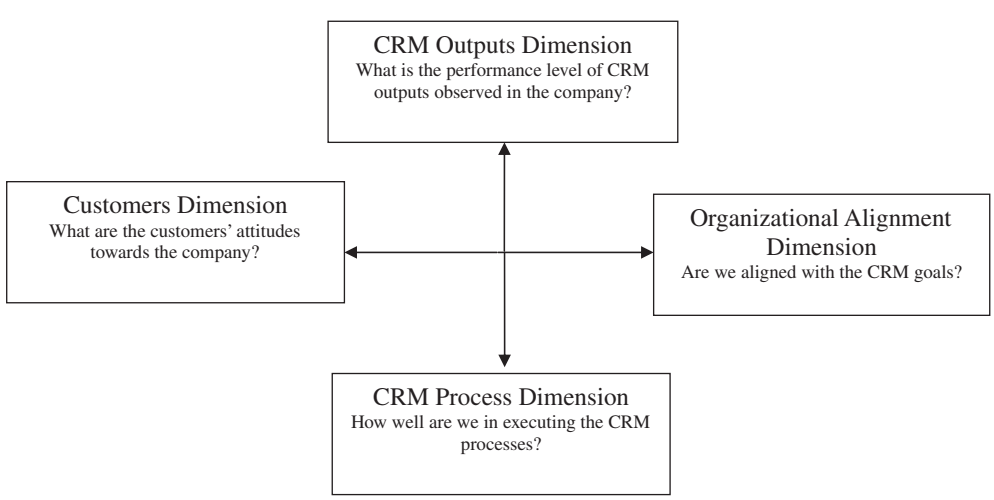

Fig. 1. Dimensions of CRM performance evaluation.

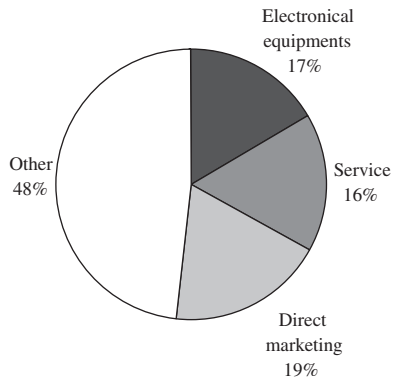

Fig. 2. Sectoral distribution of e-stores in Turkey.

$$W = \begin{array}{c|c} & \begin{array}{cccc} C_1 & C_2 & \cdots & C_N \\ e_{11}e_{12}\cdots e_{1n_1} & e_{21}e_{22}\cdots e_{2n_2} & \cdots & e_{N1}e_{N2}\cdots e_{Nn_N} \end{array} \\ \begin{array}{c} C_1 \\ \\ C_2 \\ \\ \vdots \\ \\ C_N \\ \\ \end{array} & \begin{array}{c} e_{11} \\ \vdots \\ e_{1n_1} \\ e_{21} \\ \vdots \\ e_{2n_2} \\ \vdots \\ e_{N1} \\ \vdots \\ e_{Nn_N} \end{array} \begin{bmatrix} W_{11} & W_{12} & \cdots & W_{1N} \\ W_{21} & W_{22} & \cdots & W_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ W_{N1} & W_{N2} & \cdots & W_{NN} \end{bmatrix} \end{array} \tag{2}$$

$$W_{ij} = \begin{bmatrix} W_{i1}^{(j1)} & W_{i1}^{(j2)} & \cdots & W_{i1}^{(jn_j)} \\ W_{i2}^{(j1)} & W_{i2}^{(j2)} & \cdots & W_{i2}^{(jn_j)} \\ \vdots & \vdots & \cdots & \vdots \\ W_{in_i}^{(j1)} & W_{in_i}^{(j2)} & \cdots & W_{in_i}^{(jn_j)} \end{bmatrix} \tag{3}$$

The component C_1 in the supermatrix includes all the priority vectors derived for nodes that are parent nodes in the C_1 cluster. In the ANP steady state priorities is looked for from a limit super matrix. In order to obtain the limit the matrix is raised to powers. Each power of the matrix captures all transitivities of an order that is equal to that power (Saaty, 1996). To summarize, ANP comprises four main steps (Cheng & Li, 2004; Sarkis, 1999):

Step 1: Conducting pair-wise comparisons on the elements at the cluster and sub-cluster levels.
Step 2: Placing the resulting relative importance weights in submatrices within the supermatrix.

Table 3
The scale for pairwise comparisons.

Intensity of importance	Definition
1	Equal
2	Equally to moderately more important
3	Moderately to strongly more important
4	Moderately more important
5	Strongly more important
6	Strongly to very strongly more important
7	Very strongly more important
8	Very strongly to extremely more important
9	Extremely more important
Reciprocals	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.

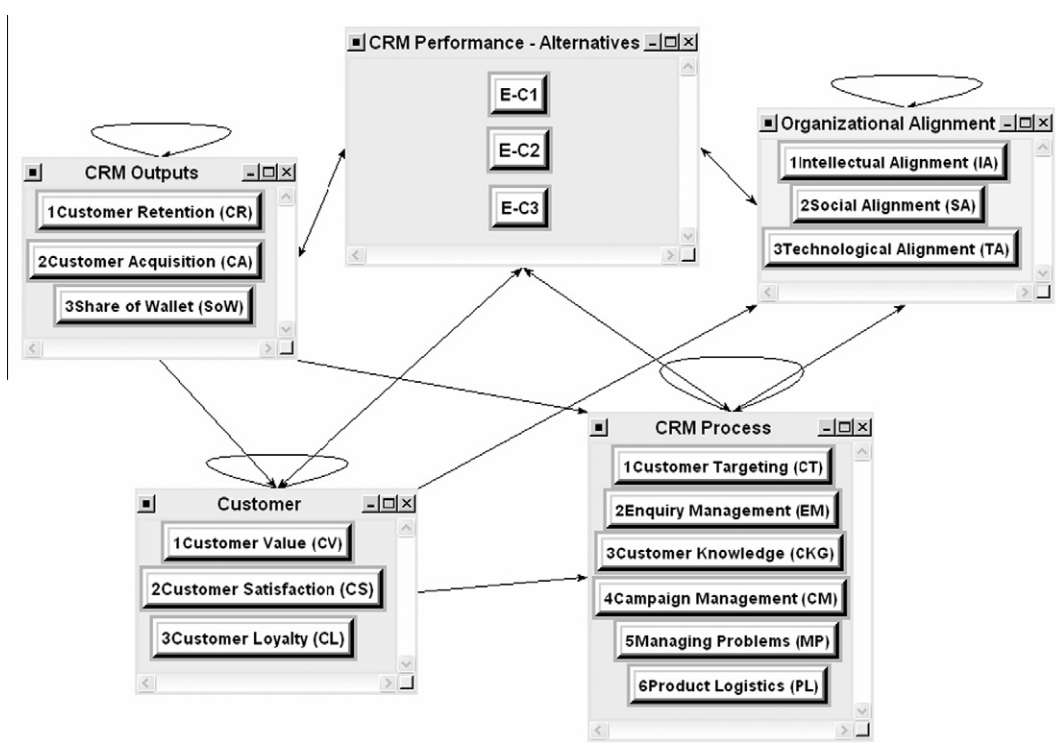

Fig. 3. Network structure of the CRM performance evaluation problem.

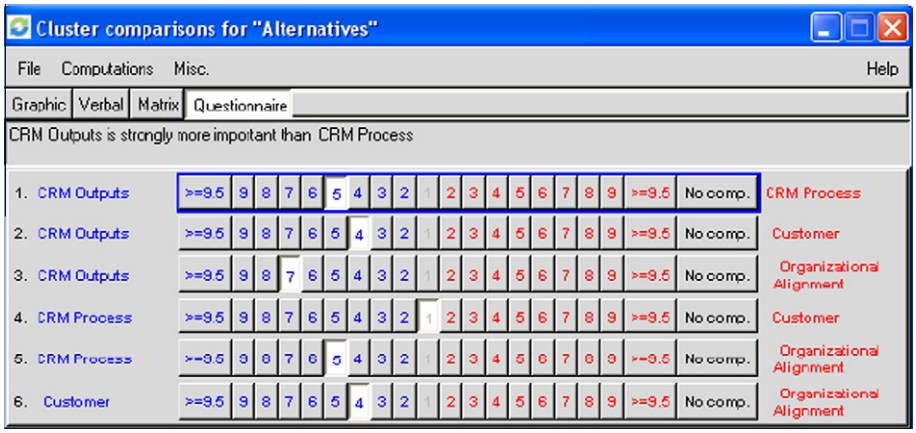

Fig. 4. The questionnaire of pairwise cluster comparisons.

Table 4
Pairwise comparison results with respect to each cluster.

	CRM outputs	CRM process	Customer	Org. alignm.	Weights
With respect to CRM performance					
CRM outputs	1	5	4	7	0.600
CRM process	1/5	1	1	5	0.175
Customer	¼	1	1	4	0.175
Org. alignm.	1/7	1/5	1/4	1	0.051
Inconsistency index = 0.057 (desirable value to be less than 0.10)					
	CRM outputs	CRM perf. alt.	CRM process	Customer	Weights
With respect to CRM outputs					
CRM outputs	1	7	2	3	0.465
CRM perf. alt.	1/7	1	1/7	1/9	0.040
CRM process	½	7	1	1/2	0.210
Customer	1/3	9	2	1	0.286
Inconsistency index = 0.089 (desirable value to be less than 0.10)					
	CRM perf. alt.	CRM process	Org. alignm.	Customer	Weights
With respect to customers					
CRM perf. alt.	1	1/5	1/4	1/7	0.053
CRM process	5	1	3	1/4	0.252
Org. alignm.	4	1/3	1	1/3	0.148
Customer	7	4	3	1	0.548
Inconsistency index = 0.098 (desirable value to be less than 0.10)					
	CRM perf. alt.	CRM process	Org. alignm.		Weights
With respect to CRM process					
CRM perf. alt.	1	1/9	1/7		0.057
CRM process	9	1	2		0.597
Org. alignm.	1/2	7	1		0.346
Inconsistency index = 0.02 (desirable value to be less than 0.10)					
	CRM perf. alt.	Org. alignm.			Weights
With respect to organizational alignment					
CRM perf. alt.	1	1/9			0.100
Org. alignm.	9	1			0.900
Inconsistency index = 0.00 (desirable value to be less than 0.10)					

Step 3: Adjusting the values in the supermatrix so that the supermatrix can achieve column stochastic.
Step 4: Raising the supermatrix to limiting powers until the weights have converged and remain stable.

4. Evaluation of CRM in Turkish e-commerce market using ANP

4.1. CRM performance evaluation based on ANP

Since 1993, Internet access is available in Turkey. Cable internet and asymmetric digital subscriber line (ADSL) was launched in 1998 and 2003, respectively. Turkey occupies the seventh position among Internet top 10 European countries, having 26.5 million subscribers as of March 2009. As for the Internet penetration it marks significant growth of 1,225%, rising from 2,000,000 (or 2.9%) in 2000 to 26,500,000 (34.5%) in 2009. However, Turkey still has just 6.6% of European total market share.

E-business in Turkey has been growing fast, though it has not been fully established. Most medium-sized and large companies have their own websites, however they are used mainly for promotion purposes rather than commercial transactions. The most active companies offering online services are airlines, supermarket chains, and retailers of books and electrical goods. According to August 2009 figures there are 20,153 online stores operating in Turkey. These e-stores realized 77.9 million transactions (total amount of which is around 3.5 billion USD) in the first eight

Super Decisions Main Window: CRM Perform...

Cluster Node Labels	CRM Outputs	CRM Perf.	CRM Process	Customer	Org. Align.
CRM Outputs	0.473845	0.605165	0.000000	0.000000	0.000000
CRM Perf.	0.039588	0.000000	0.057240	0.050752	0.500000
CRM Process	0.202603	0.174094	0.596941	0.252931	0.000000
Custom er	0.283964	0.168899	0.000000	0.551854	0.000000
Org. Align.	0.000000	0.051841	0.345819	0.144463	0.500000

Done

Fig. 5. Cluster priority weights matrix.

months of 2009. This amount indicates a 5% growth when the first eight months of the previous year is considered. Fig. 2 gives the distribution of online stores by sectors in Turkey in 2009:

In this section, CRM performances of three Turkish e-commerce firms are compared using the network structure formulated in Section 3.

Firm 1 (E-C1) is a Turkish e-business company which mainly focuses on the trade of real estates and vehicles. Firm 1's product line contains computers, electronic equipment, construction equipment, and pets as well. Firm 1 also provides repair and maintenance services.

Firm 2 (E-C2) mainly focuses on the trade of health and cosmetics products, clothing products, antiques, electronic equipment and musical instruments. Firm 2 also trades DVD's, films and video game products.

Firm 3's (E-C3) product line is very similar to that of Firm 2. The company positions itself as a facilitator of trade among people. Computers, mobile phones, personal care, clothing, electronics, music and video games are among the most frequently purchased categories.

The websites of the firms which subject to evaluation in this study are among the most frequently visited 50 Turkish websites. They are also among the most frequently visited five Turkish e-commerce websites. The companies evaluated in this study (E-C1, E-C2, and E-C3) are among the ten e-business firms with the highest sales value.

Table 5
Unweighted super matrix.

	E-C1	E-C2	E-C3	CR	CA	SOW	CT	EM	CKG	CM	MP	PL	CV	CS	CL	IA	SA	TA
E-C1	0	0	0	0.857	0.789	0.809	0.211	0.111	0.088	0.111	0.6	0.095	0.111	0.144	0.111	0.25	0.55	0.311
E-C2	0	0	0	0.095	0.103	0.097	0.705	0.667	0.243	0.222	0.2	0.655	0.111	0.096	0.111	0.5	0.24	0.196
E-C3	0	0	0	0.048	0.108	0.094	0.084	0.222	0.669	0.667	0.2	0.25	0.778	0.76	0.778	0.25	0.21	0.493
CR	0.637	0.637	0.637	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
CA	0.105	0.105	0.105	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOW	0.258	0.258	0.258	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CT	0.104	0.116	0.088	0.167	0.644	0	0	0	0	0.2	0	0	0.129	0.084	0	0	0	0
EM	0.048	0.041	0.086	0	0.085	0	0	0	0	0	0	0	0.114	0.141	0	0	0	0
CKG	0.132	0.147	0.186	0	0	0	1	1	0	0.8	0	0	0	0	0	0	0	0
CM	0.212	0.159	0.129	0	0.271	1	0	0	0	0	0	0	0	0.079	0	0	0	0
MP	0.392	0.351	0.403	0.833	0	0	0	0	0	0	0	0	0.302	0.399	1	0	0	0
PL	0.112	0.186	0.109	0	0	0	0	0	0	0	0	0	0.454	0.296	0	0	0	0
CV	0.105	0.105	0.105	0.125	0	0	0	0	0	0	0	0	0	1	0	0	0	0
CS	0.258	0.258	0.258	0	0	0.125	0	0	0	0	0	0	0	0	1	0	0	0
CL	0.637	0.637	0.637	0.875	0	0.875	0	0	0	0	0	0	0	0	0	0	0	0
IA	0.614	0.614	0.614	0	0	0	1	0	0.113	0	0	0.8	0	0	0	0	1	1
SA	0.117	0.117	0.117	0	0	0	0	0	0.179	0.2	0.8	0.2	0	0	0	0	0	0
TA	0.268	0.268	0.268	0	0	0	0	1	0.709	0.8	0.2	0	1	0	0	0	0	0

Table 6
Weighted super matrix.

	E-C1	E-C2	E-C3	CR	CA	SOW	CT	EM	CKG	CM	MP	PL	CV	CS	CL	IA	SA	TA
E-C1	0	0	0	0.034	0.129	0.032	0.012	0.006	0.012	0.006	0.085	0.014	0.013	0.009	0.007	0.25	0.275	0.155
E-C2	0	0	0	0.004	0.017	0.004	0.04	0.038	0.034	0.013	0.028	0.093	0.013	0.006	0.007	0.5	0.12	0.098
E-C3	0	0	0	0.002	0.018	0.004	0.005	0.013	0.095	0.038	0.028	0.035	0.088	0.045	0.046	0.25	0.105	0.247
CR	0.385	0.385	0.385	0	0	0.474	0	0	0	0	0	0	0	0	0	0	0	0
CA	0.063	0.063	0.063	0.237	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOW	0.156	0.156	0.156	0.237	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CT	0.018	0.02	0.015	0.034	0.539	0	0	0	0	0.119	0	0	0.073	0.025	0	0	0	0
EM	0.008	0.007	0.015	0	0.071	0	0	0	0	0	0	0	0.064	0.042	0	0	0	0
CKG	0.023	0.026	0.032	0	0	0	0.597	0.597	0	0.478	0	0	0	0	0	0	0	0
CM	0.037	0.028	0.022	0	0.226	0.203	0	0	0	0	0	0	0	0.024	0	0	0	0
MP	0.068	0.061	0.07	0.169	0	0	0	0	0	0	0	0	0.17	0.118	0.296	0	0	0
PL	0.02	0.032	0.019	0	0	0	0	0	0	0	0	0	0.256	0.087	0	0	0	0
CV	0.018	0.018	0.018	0.036	0	0	0	0	0	0	0	0	0	0.645	0	0	0	0
CS	0.044	0.044	0.044	0	0	0.036	0	0	0	0	0	0	0	0	0.645	0	0	0
CL	0.108	0.108	0.108	0.248	0	0.248	0	0	0	0	0	0	0	0	0	0	0	0
IA	0.032	0.032	0.032	0	0	0	0.346	0	0.097	0	0	0.686	0	0	0	0	0.5	0.5
SA	0.006	0.006	0.006	0	0	0	0	0	0.153	0.069	0.686	0.172	0	0	0	0	0	0
TA	0.014	0.014	0.014	0	0	0	0	0.346	0.608	0.277	0.172	0	0.322	0	0	0	0	0

Table 7
Limit matrix.

	E-C1	E-C2	E-C3	CR	CA	SOW	CT	EM	CKG	CM	MP	PL	CV	CS	CL	IA	SA	TA
E-C1	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
E-C2	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
E-C3	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
CR	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108
CA	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
SOW	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
CT	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
EM	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CKG	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
CM	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
MP	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
PL	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CV	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
CS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
CL	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
IA	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SA	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
TA	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066

Table 8
ANP results.

Node name	Limiting	Normalized by cluster
E-C1	0.070	0.335
E-C2	0.073	0.350
E-C3	0.066	0.314
Sum of alternatives cluster	0.209	1.000
Customer retention (CR)	0.108	0.527
Customer acquisition (CA)	0.039	0.189
Share of Wallet (SoW)	0.058	0.284
Sum of CRM outputs cluster	0.205	1.000
Customer targeting (CT)	0.036	0.176
Enquiry management (EM)	0.010	0.048
Customer knowledge (CKG)	0.046	0.226
Campaign management (CM)	0.028	0.137
Managing problems (MP)	0.064	0.314
Product logistics (PL)	0.020	0.099
Sum of CRM process cluster	0.204	1.000
Customer value (CV)	0.041	0.262
Customer satisfaction (CS)	0.052	0.332
Customer loyalty (CL)	0.064	0.405
Sum of customer cluster	0.158	1.000
Intellectual alignment (IA)	0.100	0.445
Social alignment (SA)	0.058	0.258
Technological alignment (TA)	0.066	0.297
Sum of org. alignment cluster	0.224	1.000

Super Decisions 1.6.0 software package has been used for the ANP computations. Fig. 3 gives the network structure of the model built by using Super Decisions software.

A decision group of three experts were employed in the study. In the first step the experts defined the inner and outer dependencies between the nodes and clusters. In the second step the group evaluated the criteria and the alternatives according to the scale given in Table 3.

The compromising evaluation scores are entered into the ANP model using the interface provided by Super Decisions package. An example of these comparison questionnaires is given in Fig. 4.

Experts' compromising evaluation scores are given in Table 4: The inconsistencies of the pairwise comparison matrices have been checked using Super Decisions Software and as it is seen in Table 4, all the CR values are less than 0.1.

Normalized weights for the components of the main clusters are derived as paired comparisons of intensities, based on the nine-point scale. The development of the main cluster priority weights is obtained as in Fig. 5:

Finally, using Super Decisions, unweighted super matrix, weighted super matrix, and limit matrix are obtained as in Tables 5–7.

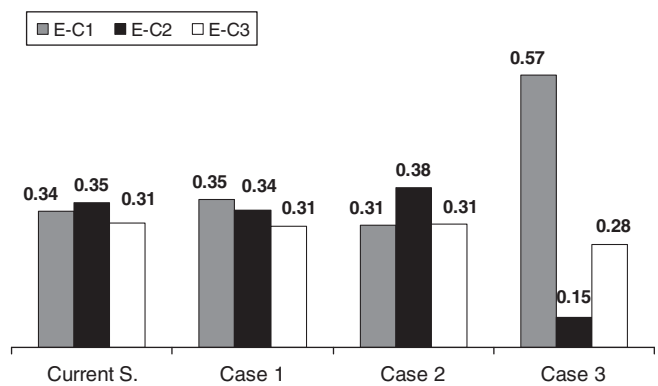

Fig. 6. Sensitivity analysis.

According to the results of the ANP analysis, E-C2 is the alternative with the highest CRM performance. As it is seen in Table 8, normalized limiting matrix values for E-C1, E-C2, and E-C3 are obtained as 0.335, 0.35, and 0.314, respectively. Thus, the ranking among the e-commerce companies is obtained as E-C2, E-C1, and E-C3.

4.2. Sensitivity analysis

A sensitivity analysis is conducted to monitor the robustness of the ranking among the alternative websites to changes in the criteria weights and different interdependency situations. Fig. 7 shows the order of the alternatives based on limiting matrix values normalized by clusters with respect to different weight configurations.

As it is seen in Fig. 6, E-C2 is the e-commerce company with the best CRM performance in the current situation. In Case 1, the relative importance of *customer retention* (CR), *customer acquisition* (CA), and *Share of Wallet* (SoW) criteria slightly increases with respect to current situation. This makes *CRM Outputs* (CRMO) cluster the prevailing cluster (total weight: 0.296) and *customer retention* (CR) most important node (weight: 0.16) in the network. (see Fig. 7). Consequently, as it is seen in Fig. 6, E-C2 becomes the best alternative in Case 1.

In Case 2, it is assumed that all the experts, ceteris paribus, have decided to give equal evaluation scores to all four clusters. In this situation, due to the interdependencies between nodes from different clusters, the equilibrium weights are realized as in

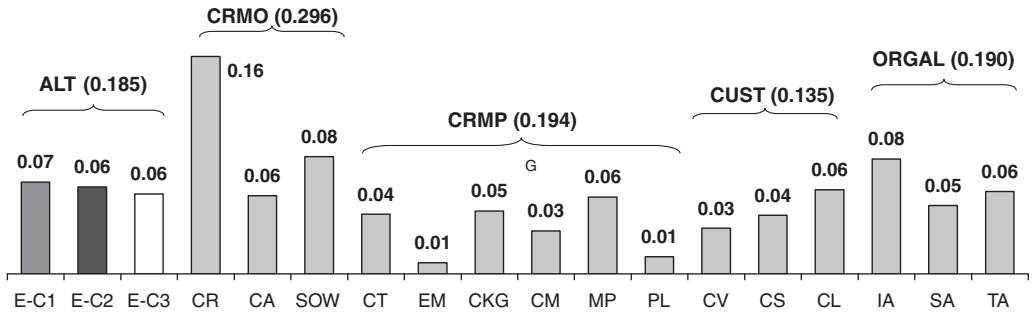

Fig. 7. Sensitivity analysis: limiting weights in Case 1.

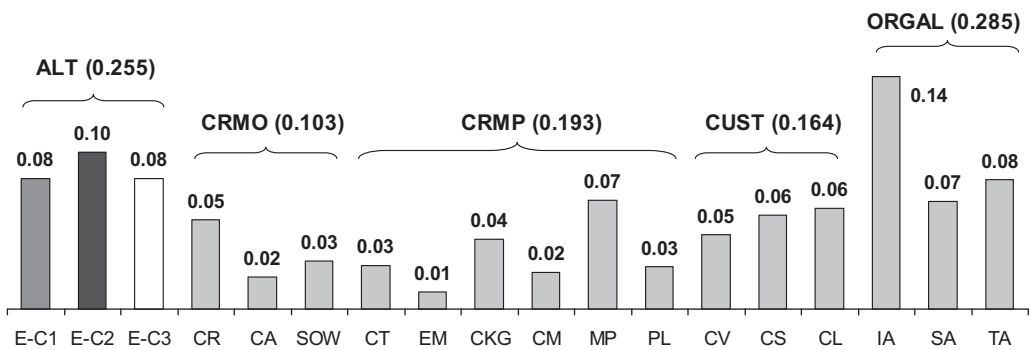

Fig. 8. Sensitivity analysis: limiting weights in Case 2.

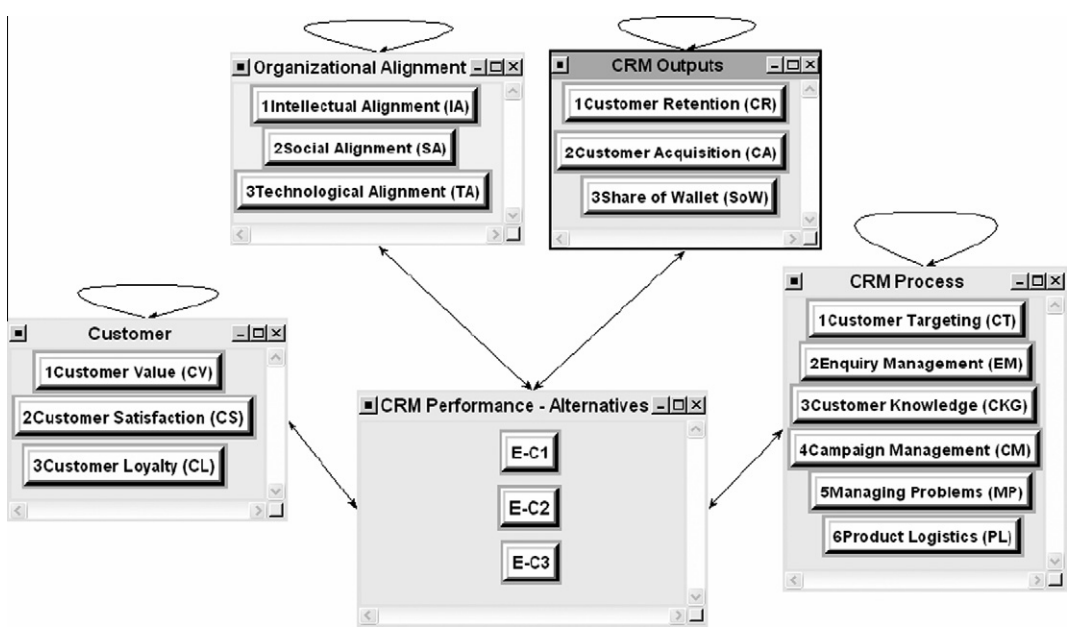

Fig. 9. Network structure in Case 3.

Fig. 8. In Case 2, *organizational alignment* (ORGAL) is the most effective cluster (total weight: 0.285). This makes E-C2 the best alternative, while E-C1 and E-C3 share the second place.

In the final case, to show the significant effects of interdependencies among the clusters we removed the interdependency connections as in Fig. 9.

Keeping all the evaluation scores same with the current situation, the interdependencies between the clusters other than alternatives have been dropped. This change in the network structure has affected the distribution of the weights as in Fig. 10. As it is clearly seen, the weights of the nodes in the clusters *CRM Process* (CRMP) and *organizational alignment* (ORGAL) have become almost zero. Fig. 6 shows that, in case 3, E-C1 has become the best alternative with a superior CRM performance.

The sensitivity analysis shows that the preference ranking among the alternatives is quite sensitive to changes in the interdependency relations and the weights of the clusters and nodes.

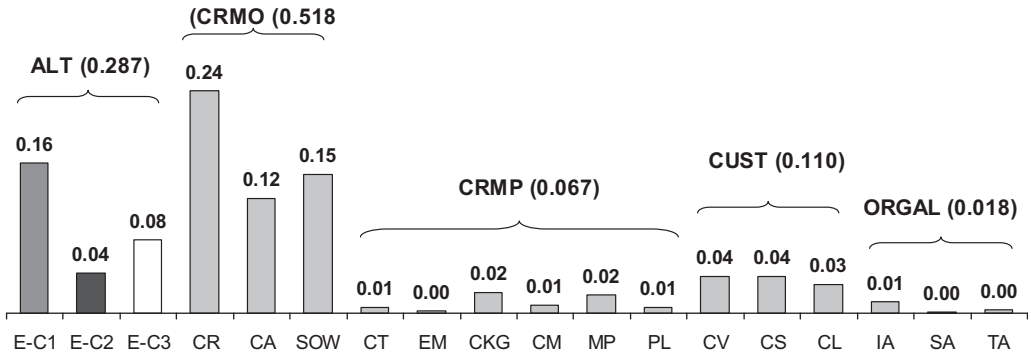

Fig. 10. Sensitivity analysis: limiting weights in Case 3.

5. Conclusion

CRM is a multidimensional business paradigm which aims at enhancing the benefits gained from relationships with customers. Assessing CRM performance of a company requires considering interdependent factors. Therefore CRM performance evaluation is a MCDM problem which has to take inner and outer dependencies into account. ANP is an excellent methodology which can deal with such issues by considering dependencies between nodes and clusters of criteria.

In this paper, CRM performances of three e-commerce companies operating in Turkey have been compared using ANP approach. For this purpose, based on an extensive literature review, a network structure has been built. The model has been established and ran in Super Decisions package. Sensitivity analyses have also been conducted. The results showed that the ranking among the alternatives are sensitive to changes in the parameters. To the knowledge of the authors, this paper is the first study which evaluates CRM performance of firms using ANP MCDM methodology.

In the future research, the framework established in this study can be applied to different sectors like fast moving consumer goods, airlines, and banking. Moreover, to monitor the dynamics in CRM performances of the considered firms, this model can be re-used periodically. Finally, the results obtained in this paper can be compared with that of alternative approaches like Choquet integral or multi-attribute utility models which can also take the interactions and dependencies among evaluation criteria into consideration.

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