The current issue and full text archive of this journal is available at
www.emeraldinsight.com/0368-492X.htm

Received 13 August 2012
Revised 5 May 2013
Accepted 29 May 2013

Instruments and methods for the integration of company's strategic goals and key performance indicators

Aleksander Janeš and Armand Faganel
University of Primorska, Koper, Slovenia

Abstract

Purpose – The purpose of this paper is to explore and clarify the cause and effect relations between key performance indicators (KPIs) which significantly contribute to the benefits of the business processes exploitation in the Luka Koper, d.d. Company.

Design/methodology/approach – The paper developed a single equation microeconomic error correction model (ECM) with the Engle and Granger two-step method. With the ECM approach, the paper performed application on the KPIs and estimated short- and long-term effects between them.

Findings – From the final ECM model, it can be recognized that the total turnover has been increased, by increased maritime throughput. Increasing the maritime throughput means a reduction in electricity consumption per tonne reloaded and increasing consumption of fossil fuels and water. Revenue per unit of maritime throughput has a negative regression coefficient, which may lead to an increase in income or increased amount of maritime throughput and simultaneously reducing the cost per tonne reloaded. Results are reflecting the impact of sharp declining in maritime throughput with the greatest added value in the years 2007 and 2008. All these results and observations suggest that an error correction mechanism exists and that the paper set up a stable model, which describes the dynamics of short-term determinants of the long-term service performance.

Research limitations/implications – The following limitations exist to this study: sample size and quality of the data that were available and the quantitative analysis in the four perspectives of the Kaplan and Norton's balanced scorecard (BSC). Since this is the case study that investigates the impact of the KPIs' on the results and causalities between them, the paper also encountered the data, which are treated as a business secret. Further research into the impact of introducing the four perspectives of the BSC to monitor the implementation of strategies and strategic projects is recommended.

Practical implications – The presented quantitative approach is useful in combination with a qualitative approach, which is a common practice in determining the causal relations resulting in the strategic map of BSC. Simulations of the developed model are possible on all levels of management, by combining the KPIs, and consecutively acquire new knowledge about their relations. Developed quantitative approach supports improving the monitoring of operational efficiency of an organization, improving business processes, project efficiency and achievement of the strategic goals.

Originality/value – Developed approach supports identification and classification of strategic goals and their KPIs that are best suited for inclusion in the BSC strategic map, improvements to the monitoring of implemented strategic initiatives and achievement of strategic goals.

Keywords Balanced scorecard, Cybernetics, Business processes, Diagnostics, Performance measurement systems, Strategic goals, Key performance indicators

Paper type Case study

Kybernetes
Vol. 42 No. 6, 2013
pp. 928-942

0368-492X
DOI 10.1108/K-08-2012-0022

1. Introduction

Purpose of this paper is the identification and analysis of the key performance indicators (KPIs) which significantly contribute to the benefits of the business processes exploitation in the Luka Koper, d.d. Company. With this case study we attempted to gain a deeper understanding, and to clarify and evaluate the causalities between strategic goals and their respective KPIs. For this purpose we developed a single equation error correction model (ECM) with the two-step method. With the ECM approach, an application on the KPIs and estimation of short and long-term effects between them was performed. In practice KPIs are used for the monitoring of fulfilment of the company's strategy. In that context KPIs are excellent managerial tool for identification and monitoring of the key initiatives and projects for the strategy fulfilment. Long-term framed qualitative and quantitative analyses indicate the benefit of the identified KPIs and their influence on the implementation of the strategic directions.

The Luka Koper, d.d. Company alias Port of Koper, is recognized as a significant port and logistic system in the Adriatic maritime market. The company introduced their first balanced scorecard (BSC) system in 2006. Beside that the company entered the competition for the most prestigious European Business Excellence Award, and becomes an Excellence Award Finalist in 2006. Maritime throughput port has an excellent location at the head of the Adriatic, the northernmost reach of the Mediterranean, which ensures the company with a leading position in servicing central and south-eastern Europe, and in particular those EU markets with the highest growth potential. Port is strategically oriented towards vehicles, containers and other high value-added cargos. It has great potential to further increase handling and storage capacities, which will allow the company to further strengthen market share in Austria, Croatia, Czech Republic, Hungary and Italy (i.e. Eurozone) as well as the domestic-Slovenian market (Port of Koper, 2013).

If a company develops and applies a model to identify those KPIs that are most important for the effective performance of the company, diagnostic activities will support improvements of the business processes. Many authors, such as Kaplan and Norton (1992), Bititci (1994), Bititci *et al.* (2006), Olve *et al.* (1999) and Robson (2004), argue that the establishment of a system of performance measurement must begin with the review of the strategy and not the actual outcome of business processes. Therefore, measures must be directly related to the strategies of the organization and should be selected on the basis of the strategic goals of the organization. Knowledge about the relations and causality between the KPIs in the selection and composition of BSC is essential for efficient and effective management of the organizations. Namely, implementing and measuring effective strategies for future success represent continuous challenges for managers, professionals and researchers.

The main goal, of this single case study, was to develop a quantitative approach that is complementary with a qualitative method. Namely, a qualitative[1] and verbal method is a common practice in determining the causal relations resulting in the strategic map of BSC (Abernethy *et al.*, 2005; Fritz and Fritz, 1985). Causal knowledge for the strategic map can be gathered from employees that:

> [. . .] through their experience and training have encoded causal knowledge about complex systems; that is, they understand how things fit and work together, although they might not have articulated that knowledge (Abernethy *et al.*, 2005).

Studies of many authors in the field of performance measurement systems show the actuality of this scientific field and the selected methodology provides support to organizations' decision-making process in real time. Simulations of the developed model are possible on all levels of management, by combining the KPIs and consecutively acquire new knowledge about their relations. Developed model also supports improvements to the monitoring of implemented sustainable strategy and achievement of strategic goals. In that context the contribution of effective performance measurement system to the sustainability integration has been discussed (Assiri *et al.*, 2006; Bukh and Malmi, 2005; Ittner *et al.*, 2003; Janeš, 2013; Janeš and Dolinšek, 2010; Kaplan and Norton, 2000, 2004; Modell, 2009; Poister, 1982; Vanita *et al.*, 2010; Wang, 2005; Wisniewski and Dickson, 2001).

2. Background

The origins of the BSC date back to the time when the management of organizations generally relied on a short-term perspective and only considered the historical data, which mainly represented the financial performance indicators (Johnson and Kaplan, 1987; Modell, 2009).

Since the mid-1980s accounting has attempted to turn strategic (Bukh and Malmi, 2005; Kaplan and Norton, 1992, 2004). Gradually, the need has arisen to take into account new business perspectives, such as the customer satisfaction, the internal process perspective and the perspective of learning and growth. In the 1990s, the role of various business-related perspectives and the associated financial and non-financial performance indicators have become an important topic for practitioners, experts and researchers. Achterberg *et al.* (2003) have assessed the BSC whether the BSC supports the necessary functions for organizational viability and found out that it: "focuses on controlling the synergy and cohesion of primary activities given the organization's identity and mission".

The cause and effect relations among the different BSC perspectives are underlying for accomplishing the long-term strategic goals of the organization. This can be achieved by a decomposition of the vision and strategic goals of an organization into a set of causally related KPIs, which represent the financial perspective, the customers and internal processes perspectives, and the learning and growth perspective. Such a set of indicators should be cascaded across all levels of management so as to promote the understanding of the organization's goals from the perspective of managers and all employees (Assiri *et al.*, 2006; Bukh and Malmi, 2005; Kaplan and Norton, 2000; Modell, 2009; Poister, 1982; Wisniewski and Dickson, 2001).

As a rule, the KPIs are determined based on the past experience and by regular reviewing. Where appropriate, an expanded range of KPIs may be confirmed or some of them may also be phased out.

It is necessary to clarify why, what and how often we need to measure before we actually decide how to measure (Jones, 2009). Managers should be first asked the questions about what they want to achieve, what their business strategic goals are and how they can describe them. Therefore, it is mandatory to set up the system of performance indicators with consensus of managers regarding the description of strategic goals in the four BSC perspectives. This kind of action can substantially facilitate the determination of measurement, as well as definition and changeability of the KPIs and the sources of data (Kaplan and Norton, 2004; Ittner *et al.*, 2003; Poister, 1982).

Historically, the business processes in the organizations were investigated mainly as qualitative and verbal (Bukh and Malmi, 2005; Kaplan and Norton, 2000, 2004). Previous research in the field of business processes and performance measurement systems was predominantly performed with the data within a short period of time (Nörreklit, 2000; Thakkar *et al.*, 2007).

Meanwhile, the longitudinal and dynamic researches for developing theories in this area are very rare. An example for updating the research methodology could be the theoretical physicists, who think in the context of mathematical equations. Thus, the mathematical tools are appropriate to increase the exactness of the conceptual and empirical research. A completion of qualitative research of business processes with statistical tools holds great potential in this area. Namely, the inclusion of a process-based approach and the methodology of longitudinal treatment of business processes make a very important addition to the conceptual thinking of researchers (Biloslavo and Grebenc, 2012; Brock and Durlauf, 2001; Fritz and Fritz, 1985; Monge, 1990).

Given the framework of the strategy map, which consists of four perspectives, and within them a large number of related strategic goals, it is considered that the added value to business processes is increased by direct and indirect mutual relations. The added value in business processes is manifested in the form of chains of cause and effect relations ranging from non-financial and quantifiable KPIs in the learning and growth perspective to the results in the customers' perspective (Ittner and Larcker, 1998) and in the financial perspective. Kaplan and Norton's BSC provides a comprehensive framework that translates the strategic goals of the organization into a coherent set of measures. The biggest advantage of the BSC, as compared to other approaches or models, is its ability to integrate the capabilities of the various perspectives of the company – financial and non-financial, as well as internal and external (Kaplan and Norton, 2006).

Management seldom operates in an environment where the KPIs relations are known, or can be established before setting up a strategy and integrated management system. What follows then is that, if these relations are not known with certain reliability, defining strategy relies only on assumptions. It becomes a hypothesis of what management believes is the best thing to do. Often many applications of the BSC are only composed of a collection of KPIs sorted in four dimensions without any attempts to map the relations between the indicators. Cause-effect relations can be understood as a set of hypotheses that are taken to meet the strategic goals (Laitinen, 2004). In this context, the KPIs causal relations are providing better relations model between the four BSC perspectives (Bukh and Malmi, 2005, p. 96).

Since we do not know the exact principles between the observed variables[2], which were taken into account in addition to the available literature, researches, documents and records, we especially applied the information contained in the time series of observed variables (i.e. KPIs).

Already through the observation of linear regression between pairs of variables or KPIs, we can presume the causality which is then confirmed by the Granger causality test (Smith, 1993). It should be noted that from available literature review to date, we have not found any similar single case study of maritime throughput with the use of econometric tools (i.e. ECM). In the field of econometrics, causality is one of the most studied concepts. This concept, which is relevant to this study, embraces time-scale causality, which means that the cause occurs before the effect and contains unique

information about the latter. From this idea, it follows that knowledge about the causes supported by forecasts enables several aspects of the consequences (Bukh and Malmi, 2005; Granger, 2004).

The knowledge about the correlations and causalities between the KPIs in the selection and composition of BSC is essential for efficient and effective management of organizations. BSC focuses attention of management on only a few KPIs and it links different functional areas, key business processes and strategic projects as it includes both financial and non-financial indicators. Studies of many authors in the field of performance management system show how topical this scientific field is and the selected methodology provides the support to organizations' decision-making process in real time (Bukh and Malmi, 2005; Janeš and Dolinšek, 2010, 2013).

3. Empirical findings

System of performance measures or BSC, when used in practice, shows that is difficult to determine transparent relations between perspectives. It is true that the implemented BSC model usually does not enable the identification of all information on the relations (i.e. correlations, causalities) between process KPIs. And this is why the company cannot provide a clear evaluation of resource inputs in efficiency of the implemented model in the management system (Janeš and Dolinšek, 2010). Very often it can be found that diagnostic activities, in this context, represent an excessive cost to the company and additional workload to its employees. Due to the latter's outlook, diagnostic is regarded as being time-consuming activity. With the development and application of a model for identification of the influential KPIs' which gives important contribution to the business results, company can perform its own diagnostic activities and focus on improvements of the key processes and strategic projects in a short and long-time period. This is very important, as Kavčič and Bertoncelj (2010) state: "companies in Slovenia, a transition economy within the European Union, often enter contractual relationships without sufficient strategic long-term assessments and are thus faced with high risks".

3.1 Purpose of the research

The purpose of research is to explore and clarify the cause and effect relations between KPIs. This will give us a basis for understanding these relations and understanding about the relations between business strategy and operations at all managerial levels. This quantitative-oriented research deals with the influence of the measured process KPI's on the company's strategy fulfilment. As a research method we have chosen the case study (Yin, 1994) of the Luka Koper, d.d. Company, based on the following criteria:

- First BSC system has been introduced in 2006.
- Luka Koper, d.d. entered the competition for the most prestigious European Business Excellence Award, and has become an Excellence Award Finalist in 2006.
- The project of identification of the KPI in collaboration with the University of Primorska, Faculty of Management has formally started in 2009 and finished in 2011.

3.2 Methodology

From the purpose originates our main goal that aimed at developing a quantitative approach that would be complementary with a qualitative approach, which is

a common practice in determining the causal relations resulting in the strategic map of BSC (Abernethy *et al.*, 2005; Janeš, 2012).

For this purpose and goal we developed a single equation microeconomic ECM with the Engle and Granger (1987) two-step method. In the first step, we evaluated the cointegration according to the Engle-Granger procedure. The linear combination of observed KPIs represents a co-integration vector that could be stationary. If the cointegrating vector is unique, then we can apply the ordinary least squares (LS) method to estimate the relation among KPIs. In this case, the residuals from LS regression equation can be used in place of the error correction term (u_{t-i}) to proceed with the estimation of the short-term dynamic model. To this end, we set the initial model of KPIs; we calculated the regression by the LS method and saved the residual values of the potential co-integrating vector. The residual values were tested for stationarity, which we confirmed with the Phillips-Peron test. The stationarity of the residuals is needed for the stability of the final model but it also confirms co-integration relations between the KPIs.

In the second step, we set up the ECM using the seasonal differences and different time lags of KPIs and residuals. According to Engle and Granger (1987), when the variables are cointegrated, there must be an error correction mechanism that describes the short-run dynamics of the cointegrated variables towards their long-run equilibrium values. In the presentation of the ECMs (Table I), RESID(−11) or u_{t-i}

Variables, i.e. KPIs	Operating revenue D11OR[a] Coefficient	SE	*t*-stat.	Sig.
Maritime throughput D11MT	16.91501	0.529441	31.94880	0.0000
Electricity consumption D11EC	−11.54019	1.222652	−9.438652	0.0000
Fossil fuel consumption D11FC	6.149600	1.430026	4.300341	0.0001
Water consumption D11WACN	14.08760	2.065849	6.819277	0.0000
Revenue per unit of maritime throughput D11RU	897.9722	101.5168	8.845557	0.0000
Error correction term RESID(−11)	−0.925361	0.030894	−29.95276	0.0000
Operating revenue OR	0.836054	0.029701	28.14920	0.0000
Maritime throughput MT	−13.10256	1.049950	−12.47923	0.0000
Electricity consumption EC(−1)	9.172357	1.517075	6.046082	0.0000
Fossil fuel consumption FC(−1)	−5.883652	1.374530	−4.280482	0.0001
Revenue per unit of maritime throughput RU	−732.4894	142.9989	−5.122343	0.0000
C	−500,897.6	55,176.52	−9.078093	0.0000
R^2	0.990579	Schwarz criter.	26.34720	
Adj. R^2	0.989098	Hannan-Quinn criter.	26.13640	
Akaike criterion	25.99499	Durbin-Watson stat.	2.074189	
SE of regression	99,840.46	Mean dependent var.	−48,929.45	
Prob. (*F*-statistic)	0.000000	SD dependent var.	956,228.3	

Notes: [a]On the right side of the equation is a dependent KPI; dependent variable is operating revenue denoted as D11OR; D11 means 11th seasonal difference; method: least squares; sample (adjusted): 2003M12 2010M09; included observations: 82 after adjustments

Table I.
Final ECM for operating revenue of general cargo terminal

is a lagged error correction term that measures the speed of adjustment to long-run equilibrium. In order to restore equilibrium, the sign of the coefficient of the, RESID(−11) or u_{t-i} is expected to be negative (Denbaly and Vroomen, 1993; Engle and Granger, 1987; Hylleberg and Mizon, 1989; Gujarati, 1995; Janeš, 2012, 2013).

With the ECM approach we performed application on the KPIs and estimated short and long-term effects between them. Final ECM indicates that that there is a lot of nonlinearity at the microeconomic level between KPIs and that a two-step method should be used for the time series (i.e. KPIs) analyses at the microeconomic level. From the literature review it is evident that this kind of approach is not used very often with exception for the macroeconomic level.

Data for the model testing, application and analyses were gathered in the period between September and November 2010. From the collected data we constructed time series of KPIs' for one of the terminals for maritime throughput in the period from January 2003 to September 2010. For the purpose of research we obtained and used KPIs that were already monitored by the company on a monthly basis and were available. In 2010 of the research project we already ascertained correlations between KPIs that were the basis for ECM modelling selection (Janeš and Dolinšek, 2010). But the research question about causality relations still remained:

RQ1. Which KPIs should be monitored and what are their causal relations that are enabling fulfilment of the strategy?

3.3 Solutions, discussion and recommendations

For the quantitative analysis we have chosen KPIs by which the company executes monitoring of its business performance in the four perspectives of the BSC. Among the indicators that were available, we were opting for those who are monitored in general cargo terminal (GT). All variables represent indicators which are monitored in the company's BSC system, on a monthly basis, and were available for the research. We used six indicators which are: operating revenue (OR), revenue per unit of maritime throughput (RU), maritime throughput (MT), electricity consumption (EC), fossil fuel consumption (FC), and water consumption (WACN).

From the previous analyses in 2010 and 2011 we ascertained that selected KPIs are stationary, cointegrated between pairs and causally related (Janeš and Dolinšek, 2010; Janeš and Dolinšek, 2011).

3.4 Error correction model

In the first step, we estimated cointegration in accordance with the Engle and Granger (1987) two-step procedure. To this end, we set the initial model of performance indicators, calculated regression by the LS method and saved the residual value of the potential cointegration vector. Residual values were tested for stationarity which was ascertained by the Phillips-Peron test.

In the second step, we built an ECM model by using the seasonal differences and different time lags of KPIs' and residuals. In the following ECM (Table I and equation (1)) the value of RESID(−11) represents the error correction term u_{t-i}. The latter represents the residuals from the cointegration regression equation, which measures the speed of adjustment to long-term equilibrium (Engle and Granger, 1987; Gujarati, 1995; Alkhathlan, 2011).

Since we had monthly data available we included 12th time lag for the initial model (Gujarati, 1995). We evaluated the structure of the lags with the criteria for determining the order of lags and correlograms. In our case, 11th order of lags proved to be suitable. This was approved on the basis of five criteria, at the 5 per cent level of statistical significance (i.e. sequential modified LR test statistic, FPE – final prediction error, AIC – Akaike information criterion, SC – Schwarz information criterion and HQ – Hannan-Quinn information criterion):

$$\Delta OR_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta OR_{t-i} + \sum_{i=1}^{n} \alpha_2 \Delta MT_t + \sum_{i=1}^{n} \alpha_3 \Delta EC_t + \sum_{i=1}^{n} \alpha_4 \Delta FC_t + \sum_{i=1}^{n} \alpha_5 \Delta WACN_t + \sum_{i=1}^{n} \alpha_6 \Delta RU_t + \alpha_7 u_{t-i} + \varepsilon_t \quad (1)$$

In activity of excluding lags we performed the visual analysis of time series and residuals with correlograms (Gujarati, 1995). The number of lags was then gradually reduced on the basis of Wald test for exclusion of lags (excluding lags 2, 4, 7, 8, 10 and 12). By testing different KPIs time lags on the right side of the equation and decreasing of autocorrelation and serial correlation we have come to the final ECM model (Table I).

The results of the final ECM model show that the operating revenue (OR) is dependent on several indicators. First and foremost, the causal indicators of the OR are maritime throughput (MT) and revenue per unit of maritime throughput (RU).

The statistically significant causal relationship is contributed also by electricity consumption (EC), fossil fuel consumption (FC) and water consumption (WACN), which are exploited for the handling of all types of maritime throughput.

The final model has a high adjusted determination coefficient which is Adj. $R^2 = 0.9890$. For the cointegration regressions is generally recommended to choose the solutions that have the highest coefficient of determination R^2, because the latter reduces bias in the estimated cointegration parameters (Banerjee *et al.*, 1986; Hall, 1986 as cited in Jiha and Orphee, 1995).

In addition, the Durbin-Watson's statistic, which is 2.0741, indicates that we significantly reduced the impact of autocorrelation and serial correlation. All regression coefficients and constants of the KPIs' are statistically significant, the error correction term, is negative and also statistically significant, i.e. $\text{RESID}(-11) = -0.9253$. Error correction term shows how fast the model returns to stability at any disturbance or shock. The result in Table I can be interpreted as follows: total turnover is increased, by increased maritime throughput. Increasing the maritime throughput means a reduction in electricity consumption per tonne reloaded and increasing consumption of fossil fuels and water.

Revenue per unit of maritime throughput (RU) has a negative regression coefficient, which may lead to an increase in income or increased amount of maritime throughput and simultaneously reducing the cost per tonne reloaded. Results are reflecting the impact of sharp declining in maritime throughput with greatest added value in the years 2007 and 2008. All these results and observations suggest that an error correction mechanism exists and that we set up a stable model, which describes the dynamics of short-term determinants of the long-term service performance.

The final model with an ECM reflect Granger's causality caused by maritime throughput and energy consumption on the total sales revenue. Results of the analysis are also consistent with the developed procedure and the results of several authors on which we can tie our findings about cointegration between KPIs (Engle and Granger, 1987; Granger, 1983; Janeš, 2012; Jiha and Orphee, 1995).

From the methodological point of view it would be interesting to analyse the existence of cointegration and ECM with time series data sample divided into two parts. However, because of the relatively small number of measurements over the entire sample, which is $n = 93$, statistical analysis of the halved measurements indicates no cointegration between time series. Such a procedure is problematic due to the low number of available measurements and the error correction term that could be misleading. This was identified by the authors of the several studies (Engle and Granger, 1987; Stock and Watson, 1988 as cited in Jiha and Orphee, 1995; Macunovich and Easterlin, 1988; Miller, 1991).

3.5 Diagnostics of the ECM

KPI of maritime throughput (MT), which in this model appears on the right side of the equation, is substantively and statistically (Wald's test of independence) recognized as an independent indicator. Maritime throughput cannot be dependent on other KPIs such as consumption of energy and consequently the revenue of maritime throughput. This happens because of the maritime throughput that is shipped into and through the Port of Koper. A share of throughput is also achieved due to the land transhipment of cargo, which was not addressed in this study. The maritime throughput (MT) also includes seasonal component and random errors (Table I).

Correlogram of residuals showed that residuals did not induce serial correlation as the Q statistic is not significant (from 0 to 36 lags). Breusch-Godfrey LM serial correlation test showed that between the residuals of the KPIs' there is no serial correlation, since we could not reject the null hypothesis that there is no serial correlation (up to 12th lag).

With the Breusch-Pagan-Godfrey, Glejser and White test we rejected the hypothesis of residuals heteroskedasticity. Examination of the stability of the model in breaking year 2006, with the Chow's test showed that we cannot reject the null hypothesis of no breaks at specified breakpoint. In the case of rejection of the null hypothesis, the Chow's test would indicate structural changes. This means that the coefficients of the model equation are stable. Using different tests we confirmed the relative stability of the final ECM. Performed test can be tied to procedures for testing models in studies of various authors (Engle and Granger, 1987; Stock and Watson, 1988; Jiha and Orphee, 1995; Macunovich and Easterlin, 1988, Miller, 1991).

4. Future research directions

Strategic goals and their KPIs that are best suited for inclusion in the BSC strategic map can be identified and classified with the use of semi-structured interviews with employees at various managerial levels (Bukh and Malmi, 2005, pp. 95-96). In determining the cause-effect relations between KPIs, causal relations that are interesting to analyze in terms of adding value for customers and, ultimately, for the financial results of the company can be identified. The qualitatively identified causal relations are then suitable for quantitative ECM modelling and analysis. In addition,

it is recommendable to consider the appropriateness of the selection of KPIs based on the review of available literature and research on the use of the BSC in the business sector of interest (Bititci, 1994; Bititci *et al.*, 2006; Bukh and Malmi, 2005; Cobbold *et al.*, 2004; Ittner and Larcker, 1998; Ittner *et al.*, 2003; Janeš, 2012, 2013; Kaplan and Norton, 1992, 2000, 2004, 2006).

From the results of the final ECM model in Table I we can also assume the existence of certain nonlinearities which are reflecting their influence at the observed microeconomic level. Granger (1997) believed that there is a lot of nonlinearity in economics at the micro level. But there is not much left of that at the macro level, after temporal and cross-sectional aggregation. Granger was also of the opinion that more attention should be given to the nonlinearities (Phillips and Granger, 1997). In addition the ECM modelling approach should be used more often at the microeconomic level on various business areas (e.g. BSC, project management, operations management, etc.).

Of course, it is appropriate to test and evaluate the final ECM model with the latest actual data and recalculate the ECM model and error correction term, which could further improve our model. It is also of our further research interest that the ECM approach should be deployed, first of all, on the BSCs on the strategic level of the company. In the next step BSC of the strategic level should be harmonized with the BSCs of all other terminals for the maritime throughput.

With the continuation of the research on other case studies, our preliminary learned lessons can be expanded to other organizations (for further details see Janeš, 2012). The results of the analyses are also consistent with the developed procedure and the research results of several authors to which we can tie our findings about the cointegration between KPIs with the error correction mechanism (Engle and Granger, 1987, Granger, 1983; Miller, 1991; Janeš, 2013; Jiha and Orphee, 1995).

5. Conclusion

The Luka Koper, d.d. Company has faced sharp decline in maritime throughput in 2007 as a result of the global financial crisis which is reflected through the KPIs in the period from 2008 to 2010. During the years 2011 and 2012, Luka Koper, d.d. established effective and efficient performance as it was before the crises (Port of Koper, 2013). The cause-effect relations in the strategic map of BSC are specific to the organization and actual business conditions. Beside that the cause-effect relations can be understood as a set of hypotheses that are taken to meet the strategic goals (Laitinen, 2004). By following cause-effect logic, management can come up with KPIs that reflect a chosen strategy, and will lead to planned outcomes. In this context, the KPIs causal relations are providing better relations model between the four BSC perspectives (Bukh and Malmi, 2005; Ittner and Larcker, 1998; Ittner *et al.*, 2003).

BSC is an effective managerial tool for identification of a wide range of initiatives related to strategy implementation (Bryde, 2003; Kaplan and Norton, 2000, 2004), i.e. new products/services development, processes improvements and adaptation of the business model towards achievement of the vision. Thus, a represented quantitative approach is useful in combination with a qualitative approach, which is common practice in determining the causal relations resulting in the strategic map of BSC.

Using the ECM modelling in order to identify KPIs is suitable for classification and assessment of the causality and integration between the performance indicators under the four perspectives of BSC. Simulations of the presented approach are possible on all

levels of management, by combining the KPIs and consecutively acquire new knowledge about their relations. Developed quantitative approach supports improving the monitoring of operational efficiency of an organization, quality improvements, project efficiency and achievement of the strategic directions and goals (Janeš, 2013). Some specific factors that affect the unexplained part of the variables, analyzed in the case study, are certainly random, but some may arise from circumstances in the period of observation of the company, and are not included in the ECM model or we did not have available data (Bukh and Malmi, 2005, pp. 95-96).

A case study of the port and logistic system Luka Koper, d.d. has also some limitations. The first relates to sample size and quality of the data which were available. A second limitation is a quantitative analysis in the four perspectives of the BSC. Since this is the case study which investigates the impact of the KPIs' on the business results and causalities between them, we also encountered the data, which are treated as a business secret.

Anyway, it must be stressed that the generalization of case study research findings is limited to only one Service Company. Further research on other case studies is definitely recommended, because the key issue about the KPIs causal relations is, whether they really contribute to the benefits of the business processes exploitation and strategy fulfilment (Bukh and Malmi, 2005; Ittner *et al.*, 2003; Janeš, 2012, 2013).

Notes

1. The method of semi-structured interviews in the form of workshops enables qualitative analysis and modelling the layout of the BSC.
2. In this paper the terms variables, time series and KPIs are treated synonymously.

References

Abernethy, M.A., Horne, M., Lillis, A.M., Malina, M.A. and Selto, F.H. (2005), "A multi-method approach to building causal performance maps from expert knowledge", *Management Accounting Research*, Vol. 16 No. 2, pp. 135-155.

Achterberg, J., Beeres, R. and Vriens, D. (2003), "Does the balanced scorecard support organizational viability?", *Kybernetes*, Vol. 32 Nos 9/10, pp. 1387-1404.

Alkhathlan, K.A. (2011), "Foreign direct investment and export growth in Saudi Arabia: a cointegration analysis", *China-USA Business Review*, Vol. 10 No. 2, pp. 137-149.

Assiri, A., Zairi, M. and Eid, R. (2006), "How to profit from the balanced scorecard: an implementation roadmap", *Industrial Management & Data Systems*, Vol. 106 No. 7, pp. 937-952.

Banerjee, A., Dolado, J.J., Hendry, D.F. and Smith, G.W. (1986), "Exploring equilibrium relationships in econometrics through static models: some Monte Carlo evidence", *Oxford Bulletin of Economics and Statistics*, Vol. 48 No. 3, pp. 253-277.

Biloslavo, R. and Grebenc, A. (2012), "Integrating group Delphi, analytic hierarchy process and dynamic fuzzy cognitive maps for a climate warning scenario", *Kybernetes*, Vol. 41 Nos 3/4, pp. 414-428.

Bititci, U.S. (1994), "Measuring your way to profit", *Management Decision*, Vol. 32 No. 6, pp. 16-24.

Bititci, U.S., Mendibil, K., Nudurupati, S., Garengo, P. and Turner, T. (2006), "Dynamics of performance measurement and organisational culture", *International Journal of Operations & Production Management*, Vol. 26 No. 12, pp. 1325-1350.

Brock, W.A. and Durlauf, S.N. (2001), "Growth empirics and reality", *The World Bank Economic Review*, Vol. 15 No. 2, pp. 229-272.

Bryde, D.J. (2003), "Project management concepts, methods and application", *International Journal of Operations & Production Management*, Vol. 23 No. 7, pp. 775-793.

Bukh, P.N. and Malmi, T. (2005), "Re-examining the cause-and-effect principle of the balanced scorecard", in Jönsson, S. and Mouritsen, J. (Eds), *Accounting in Scandinavia: The Northern Lights*, Liber, Malmö.

Cobbold, I., Lawrie, G. and Issa, K. (2004), "Designing a strategic management system using the third-generation balanced scorecard: a case study", *International Journal of Productivity and Performance Management*, Vol. 53 No. 7, pp. 624-633.

Denbaly, M. and Vroomen, H. (1993), "Dynamic fertilizer nutrient demands for corn: a cointegrated and error-correcting system", *American Journal of Agricultural Economics*, Vol. 75 No. 1, pp. 203-209.

Engle, R.F. and Granger, C.W.J. (1987), "Co-integration and error correction: representation, estimation, and testing", *Econometrica*, Vol. 55 No. 2, pp. 251-276.

Fritz, R.G. and Fritz, J.M. (1985), "Linguistic structure and economic method", *Journal of Economic Issues*, Vol. 19 No. 1, pp. 75-101.

Granger, C.W.J. (1983), "Co-integrated variables and error-correcting models", Working Paper 83-13, University of California, San Diego, CA.

Granger, C.W.J. (1997), "On modelling the long run in applied economics", *The Economic Journal*, Vol. 107 No. 440, pp. 169-177.

Granger, C.W.J. (2004), "Time series analysis, cointegration, and applications", *The American Economic Review*, Vol. 94 No. 3, pp. 421-425.

Gujarati, D.N. (1995), *Basic Econometrics*, McGraw-Hill, New York, NY.

Hall, S.G. (1986), "An application of the Granger and Engle two-step estimation procedure to United Kingdom aggregate wage data", *Oxford Bulletin of Economics and Statistics*, Vol. 48 No. 3, pp. 229-239.

Hylleberg, S. and Mizon, G.E. (1989), "Cointegration and error correction mechanisms", *The Economic Journal*, Vol. 99 No. 395, pp. 113-125.

Ittner, C.D. and Larcker, D.F. (1998), "Indicators of financial performance? An analysis of customer satisfaction", *Journal of Accounting Research*, Vol. 36, pp. 1-35.

Ittner, C.D., Larcker, D.F. and Meyer, M.W. (2003), "Subjectivity and the weighting of performance measures: evidence from a balanced scorecard", *The Accounting Review*, Vol. 78 No. 3, pp. 725-758.

Janeš, A. (2012), "Development and empirical verification of the balanced scorecard model", doctoral dissertation, Faculty of Management, University of Primorska, Koper.

Janeš, A. (2013), "Managing sustainability with the error correction model", *International Journal of Sustainable Economy*, Vol. 5 No. 2, pp. 125-139.

Janeš, A. and Dolinšek, S. (2010), "Do we need a new compass for the journey through the global crisis?", *Journal of Industrial Engineering and Management*, Vol. 3 No. 2, pp. 255-293.

Janeš, A. and Dolinšek, S. (2011), "Can we use the statistical causality with the sufficient reliability?", *Conference Proceedings Knowledge and Learning International Conference 2011, Celje, June*, pp. 259-266.

Jiha, J. and Orphee, G. (1995), "A note on inflation in Haiti: evidence from cointegration analysis", *Social and Economic Studies*, Vol. 44 No. 1, pp. 95-115.

Johnson, H.T. and Kaplan, R.S. (1987), *Relevance Lost: The Rise and Fall of Management Accounting*, Harvard Business School Press, Boston, MA.

Jones, P. (2009), "Avoiding problems and predicting recovery during the economic crisis", available at: www.excitant.co.uk (accessed 20 April 2012).

Kaplan, R. and Norton, D. (1992), "The balanced scorecard – measures that drive performance", *Harvard Business Review*, Vol. 70 No. 1, pp. 71-79.

Kaplan, R. and Norton, D. (2000), "Having trouble with your strategy? Then map it", *Harvard Business Review*, Vol. 78 No. 5, pp. 167-176.

Kaplan, R.S. and Norton, D.P. (2004), *Strategy Maps: Converting Intangible Assets into Tangible Outcomes*, Harvard Business School Publishing, Boston, MA.

Kaplan, R.S. and Norton, D.P. (2006), *Alignment: Using the Balanced Scorecard to Create Corporate Synergies*, Harvard Business School Publishing, Boston, MA.

Kavčič, K. and Bertoncelj, A. (2010), "Strategic orientation of organizations: risk management perspective", *Kybernetes*, Vol. 39 No. 5, pp. 735-749.

Laitinen, E.K. (2004), "Towards a microeconomic approach of the balanced scorecard", *Managerial Finance*, Vol. 30 No. 6, pp. 1-27.

Macunovich, D.J. and Easterlin, R.A. (1988), "Application of Granger-Sims causality tests to monthly fertility data, 1958-1984", *Journal of Population Economics*, Vol. 1 No. 1, pp. 71-88.

Miller, S.M. (1991), "Monetary dynamics: an application of cointegration and error-correction modeling", *Journal of Money, Credit and Banking*, Vol. 23 No. 2, pp. 139-154.

Modell, S. (2009), "Bundling management control innovations", *Accounting, Auditing & Accountability Journal*, Vol. 22 No. 1, pp. 59-90.

Monge, P.R. (1990), "Theoretical and analytical issues in studying organizational processes", *Organization Science*, Vol. 1 No. 4, pp. 406-430.

Nörreklit, H. (2000), "The balance on the balanced scorecard a critical analysis of some of its assumptions", *Management Accounting Research*, Vol. 11 No. 1, pp. 65-88.

Olve, N., Roy, J. and Wetter, M. (1999), *Performance Drivers: A Practical Guide to Using the Balanced Scorecard*, Wiley, Chichester.

Phillips, P.C.B. and Granger, C. (1997), "The ET interview: professor Clive Granger", *Econometric Theory*, Vol. 13 No. 2, pp. 253-303.

Poister, T.H. (1982), "Developing performance indicators for the Pennsylvania Department of Transportation", *Public Productivity Review*, Vol. 6 Nos 1/2, pp. 51-77.

Port of Koper (2013), *Annual Report 2012*, Port of Koper, Koper.

Robson, I. (2004), "From process measurement to performance improvement", *Business Process Management Journal*, Vol. 10 No. 5, pp. 510-521.

Smith, P.K. (1993), "Welfare as a cause of poverty: a time series analysis", *Public Choice*, Vol. 75 No. 2, pp. 157-170.

Stock, J.H. and Watson, M.W. (1988), "Variable trends in economic time series", *The Journal of Economic Perspectives*, Vol. 2 No. 3, pp. 147-174.

Thakkar, J., Deshmukh, S.G., Gupta, A.D. and Shankar, R. (2007), "Development of a balanced scorecard: an integrated approach of interpretive structural modeling (ISM) and analytic network process (ANP)", *International Journal of Productivity and Performance Management*, Vol. 56 No. 1, pp. 25-59.

Vanita, A., Yang, J., Skitmore, M. and Shankar, R. (2010), "An empirical test of causal relationships of factors affecting ICT adoption for building project management: an Indian SME case study", *Construction Innovation: Information, Process, Management*, Vol. 10 No. 2, pp. 164-180.

Wang, W. (2005), "An evaluation of the balanced scorecard in equity valuation: the case of exchange ratio in the M&As of Taiwan's financial industry", *Journal of Intellectual Capital*, Vol. 6 No. 2, pp. 206-221.

Wisniewski, M. and Dickson, A. (2001), "Measuring performance in Dumfries and Galloway constabulary with the balanced scorecard", *The Journal of the Operational Research Society*, Vol. 52 No. 10, pp. 1057-1066.

Yin, R.K. (1994), *Case Study Research: Design and Methods*, Sage, Thousand Oaks, CA.

Further reading

Aaltonen, P. and Ikavalko, H. (2002), "Implementing strategies successfully", *Integrated Manufacturing Systems*, Vol. 13 No. 6, pp. 415-418.

Abernathy, W. (1997), "Balanced scorecards make teamwork a reality", *Journal for Quality and Participation*, Vol. 20 No. 5, pp. 58-59.

Agostino, D. and Arnaboldi, M. (2011), "How the BSC implementation process shapes its outcome", *International Journal of Productivity and Performance Management*, Vol. 60 No. 2, pp. 99-114.

Atkinson, H. (2006), "Strategy implementation: a role for the balanced scorecard?", *Management Decision*, Vol. 44 No. 10, pp. 1441-1460.

Basu, R., Little, C. and Millard, C. (2009), "Case study: a fresh approach of the balanced scorecard in the Heathrow Terminal 5 project", *Measuring Business Excellence*, Vol. 13 No. 4, pp. 22-33.

Camacho, M. and Perez-Quiros, G. (2002), "This is what the leading indicators lead", *Journal of Applied Econometrics*, Vol. 17 No. 1, pp. 61-80.

Caporale, G.M., Katsimi, M. and Pittis, N. (2002), "Causality links between consumer and producer prices: some empirical evidence", *Southern Economic Journal*, Vol. 68 No. 3, pp. 703-711.

Geweke, J., Meese, R. and Dent, W. (1983), "Comparing alternative tests of causality in temporal systems", *Journal of Econometrics*, Vol. 21, pp. 161-194.

Goold, M. (1991), "Strategic control in the decentralised firm", *Sloan Management Review*, Vol. 32 No. 2, pp. 69-81.

Granger, C. (1986), "Statistics and causal inference: comment source", *Journal of the American Statistical Association*, Vol. 81 No. 396, pp. 967-968.

Guilkey, D.K. and Salemi, M.K. (1982), "Small sample properties of three tests for Granger-causal ordering in a bivariate stochastic system", *The Review of Economics and Statistics*, Vol. 64 No. 4, pp. 668-680.

Holland, P.W. (1986), "Statistics and causal inference", *Journal of the American Statistical Association*, Vol. 81 No. 396, pp. 945-960.

Hylleberg, S., Engle, R.F., Granger, C.W.J. and Yoo, B.S. (1990), "Seasonal integration and cointegration", *Journal of Econometrics*, Vol. 44, pp. 215-238.

Murray, M.P. (1994), "A drunk and her dog: an illustration of cointegration and error correction", *The American Statistician*, Vol. 48 No. 1, pp. 37-39.

Neely, A. (2008), "Does the balanced scorecard work: an empirical investigation", RP 1/08, available at: www.som.cranfield.ac.uk/som/research/researchpapers.asp (accessed 23 April 2012).

Neely, A., Bourne, M., Mills, J., Platts, K. and Richards, H. (2002), *Strategy and Performance: Getting the Measure of Your Business*, Cambridge University, Cambridge.

Neely, A., Mills, J., Platts, K., Richards, H., Gregory, M., Bourne, M. and Kennerley, M. (2000), "Performance measurement system design: developing and testing a process-based approach", *International Journal of Operations & Production Management*, Vol. 20 No. 10, pp. 1119-1145.

Young, J.Z. (1978), *Programs of the Brain*, Oxford University Press, Oxford.

About the authors

Aleksander Janeš holds a PhD received from the University of Primorska, Faculty of Management Koper. From diversity of experiences in economy, with emphasis on project work, he continues upgrading his professional experiences and skills in a tertiary education with lecturing, as a researcher in projects with economy, and as a licensed external evaluator in HE and EFQM assessor. He received the Breakthrough certificate for Leadership Initiative for Excellence from Consortium Institute of Management and Business Analysis (CIMBA). His research fields are leadership, management of technology, management of quality and business excellence. Aleksander Janeš is the corresponding author and can be contacted at: aleksander.janes@gmail.com

Armand Faganel gained his Master's degree in the area of marketing from the Faculty of Economics and Business in Maribor. He is a PhD student at the Faculty of Management, where he teaches as a Senior Lecturer in marketing. Before taking up teaching at the faculty, he had gained working experience in the field of commerce, and he was a marketing director, sales director and a business unit manager in different international companies. He is the Head of Marketing Institute at the Faculty of Management. His research areas include marketing, communication, intercultural competences, quality and evaluation of tertiary education.