Investigation of factors influencing employee performance

A case of sales forecasting

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Abstract

Purpose – The purpose of this paper is to investigate the effect of selected organizational factors on the performance of employees charged with sales forecasting, and to compare this across the different organizational environments of Central-Eastern European (CEE) retail chains.

Design/methodology/approach – The research involves seven major pan-European retail chain companies, with a total number of 201 respondents. Data were collected via a questionnaire [computer-aided personal interview (CAPI) and human-aided personal interview (HAPI) method] with a five-point scale evaluation of both dependent (organizational factors) and independent (performance indicator) variables. Cluster analysis was then used to derive the characteristics of average organizational environments, and correlation analysis was used to investigate the direction and size of the performance effect.

Findings – The results confirmed that different organizational environments have differing effects on the performance of forecasters. It also showed that the "hard core" factors (performance evaluation and information systems) do not have a dominant effect on employee performance in any of the environments regardless of their quality, and are aggregately outclassed by "soft" factors (communication lines and management support). Finally, the research indicated that among the personal attributes related to individual forecasters, domain and forecasting work experience have significant, beneficial effects on forecasting performance, whereas formal education level was detected to have a negative effect and can be, at best, considered as non-contributor.

Practical implications – The research results along with available literature enable us to define four management theses (focus on system, less on people; soft factors are equal to hard ones; higher formal education does not contribute to forecasting performance; and do not overestimate the social and morale situation on the working place) as well as four stages of organizational development, creating a practitioner's guide to necessary steps to improve an environment's key factors, i.e. performance evaluation, information systems and forecasting work experience.

Originality/value – Although there are regular studies examining the effect of organizational factors on employee performance, very few have explored this relationship in a forecasting context, i.e. in the case of employees charged with sales forecasting. Furthermore, the paper brings evidence on this topic from the CEE area, which is not covered in most prominent forecasting management studies.

Keywords Performance management, Organizational behaviour, Organizational analysis, Supply chain management, Sales forecasting

Paper type Research paper

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1. Introduction

Interactions between organizational environment and an employee's performance have become a prominent field of study over recent decades. The origins of the discipline, which evolved gradually into a branch of the wider system of organizational behaviour, can be traced back to the scientific management of Taylor and Hartness. After Child's (1972, 1975) progressive work in the early 1970s, the thesis of the effect of multiple organizational factors on subsequent performance came to the repeated attention of the management community (Steers, 1975) and was backed up in multiple functional areas by empirical studies such as Hansen and Wernerfelt (1989), Becker and Gerhart (1996) and, more recently, Liao and Chuang (2004). While the very general causal link has been firmly established, current literature proposes that although there are widely accepted patterns in an employee's sensitivity to some organizational factors (i.e. evaluation), there are also differences across different business functions as to how various factors affect employee behaviour and subsequent performance (Rhoades and Eisenberger, 2002).

Sales forecasting is one of the most distinct business functions. While critical in sales and supply chain structures (Merrilees and Fam, 2011; Ali and Boylan, 2010), it maintains its peculiarity, either in terms of its nature (Sanders, 1995), required know-how (Kahn and Adams, 2000) and often organizational anchorage (Mentzer and Kahn, 1997). Compared to other common business functions like logistics or production management, forecasting has greatly developed its procedural background, such as forecasting methods, but its interaction with the organizational environment remains largely unexplored (Fildes *et al.*, 2008; Winklhofer *et al.*, 1996; Fildes and Hastings, 1994). According to Wiklhofer *et al.* (1996) review, only about 17 per cent of papers from 1973 to 1996 investigated more than one forecasting aspect, including organizational factors. On the other hand, there is compelling evidence that forecasting performance has a direct and immediate effect on overall business profitability, as documented by Armstrong (1985), Catt (2007) or Kahn (2003). This makes it an even more interesting business function to study and creates a niche opportunity to enrich current management knowledge.

With respect to the above, this paper offers a theory-based, four-pillar business forecasting management (BFM) system designed to explore the effect of organizational factors on business sales forecasting performance. Coming out of the belief that different organizational environments have differing effects on employee performance, BFM factors are evaluated in four different business environments. A secondary effort is put into comparing the effect of organizational factors and the set of an individual forecaster's personal attributes, again in terms of performance contribution.

In the first section of the paper, available research on BFM components is gathered and reviewed, resulting in the main theory hypotheses of individual factors. Then, a two-stage primary research was conducted to evaluate their effect on sales forecasting performance. In the first stage, all BFM factors are assessed through an extensive questionnaire survey, obtaining quantitative data about both their values and relative forecasting performance. The research sample for this field survey comprises 201 forecasting professionals from seven pan-European retail chain companies. In the second stage, typical business working environments were modelled using cluster analysis, and, finally, the effect of various factors on forecasting performance is evaluated, using correlation and index statistics.

Work on this study is motivated mainly by the existing lack of empirical knowledge regarding management of the business forecasting function, compared to other business activities. It is also directed by the crucial importance of sales forecasting in distribution systems, particularly supply chains. Finally, it is related to and partly inspired by the system approach in Davis and Mentzer's (2007) paper, although the author decided to use a substantially different analytical method (Davis and Mentzer's paper uses content analysis based on individual interviews). It also needs to be stated that this paper does not deal with disseminating forecasting methods or descending deeper into forecasting know-how, which would qualify it for the *Journal of Forecasting or Operations Management*. Its main focus and perspective is purely managerial, and forecasting is taken merely as a functional agent in relation to which performance is measured, or more precisely, a dependent variable that provides a performance indicator for the evaluation of organizational environment effect.

2. Business forecasting management framework – literature review

2.1 Business forecasting management framework

For this paper, author proposed a simple BFM model of four components:

(1) communication and information;

(2) performance measurement and rewarding;

(3) climate and morale; and

(4) structure and organization (Figure 1).

Such functional taxonomy is not new, as exhibited by Pinto and Slevin (1988), Hoogervorst *et al.* (2004) or Bartel (2004). In the following literature overview, theoretical presumptions related to each of the components are discussed, based on the most relevant empirical findings.

2.2 Literature overview

According to numerous authors (Capon *et al*, 1990; Marcoulides and Heck, 1993; Keroack *et al.*, 2007), the organizational environment encompasses multiple factors with high potential impact on a firm and the performance of its employees. Rhoades and

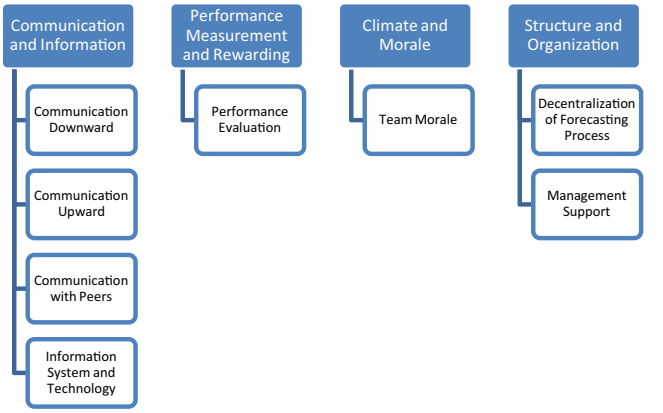

Figure 1.
BFM framework

Eisenberger, (2002) identified in her meta-analysis 73 studies operating with more than 177 assessments of associations between perceived organizational support and consequent employee behaviour. Management literature offers numerous empirical models operationalizing these associations and evaluating their effect on subsequent business or employee performance, such as Bamel *et al.* (2013), Rowland (2013) or Gill and Meyer (2011). Various papers putting forward empirical evidence regarding diverse working environments can also be found (Sanchez-Bueno and Suarez-Gonzales, 2010; Tsui *et al.*, 1997), although they are less common.

In forecasting-management literature, the situation is different. While there are many papers describing the role of organizational-factor effect within a forecasting system (Smith, 2009; Menzter *et al.*, 1999; Catt, 2012 or Moon, 2006), the majority of them are based only on the subjective insight of practitioners, and they lack reliable empirical evidence. Most of the empirical studies are focused on "hard factors", i.e. forecasting methods (Makridakis and Hibon, 2000; Armstrong, 2001; Fildes and Petropulous, 2013) and situational parameters, such as forecasting horizon (Armstrong, 2006; Granger and Jeon, 2007) or variable (Lapide, 2009; Catt, 2009). Although the focus of the forecasting community has shifted to management and organizational issues in recent years, papers presenting empirical evidence on organizational factors are still rather rare, as documented by Davis and Mentzer's (2007) review. With multifactorial studies examining multiple organizational factors, the closest example of an organizational environment model, the situation is even worse. To the best of the author's knowledge, there is to date no study directly evaluating the effect of different organizational environments and personal settings on subsequent forecaster performance. Only three studies in the past 10 years proposed and empirically tested a complex multifactorial model of employee/forecasting performance similar to a BFM framework: Moon *et al.* (2003) (preceded by Mentzer and Cox, 1984 and Moon and Mentzer, 1999; Durand, 2003 and Davis and Mentzer, 2007). Key aspects of all these studies, constituting the theoretical basis of the BFM concept are outlined in (Table I).

Moon *et al.*'s (2003) first paper used an unusual method of data collection – a forecasting audit. This in-depth and thorough on-site inspection of forecasting and organizational practices was conducted in 16 diverse global companies, with 22-64 interviewees per company, implying about 500 total participants. It surveyed performance associations in four management dimensions: functional integration, approach, systems and performance measurement. On the basis of the in-depth data collection, Moon and his colleagues revealed multiple issues, consisting of limited performance measurement (12 of 16 companies), blurred distinction between forecasting and planning (11 of 16 companies), limited commitment to forecasting (10 of 16 companies) and the presence of islands of analysis (9 of 16 companies). In their findings, they praised mainly the sophistication and decentralization of the forecasting process, individual training, development of business information systems (material requirements planning (MRP), enterprise resource planning (ERP)) and implementation of specific performance measurements. These were identified as the main drivers in the forecasting "way-forward" and the most performance-vital organizational assets; the authors argue that they represent the core of the process, training, system and performance-measurement improvements necessary to pave the way to the "should-be" system state. The paper presents numerous detailed findings in all areas, making it one of the most useful empirical sources so far.

Table I.
Key studies examining forecasting performance frameworks

Study	Method	Sample	Tested factor groups	Tested factors
Moon *et al.* (2003) Conducting a sales forecasting audit	Forecasting audit	16 global companies, ~500 interviewees	Functional integration, Approach, Systems, Performance measurement	Numerous, identified during research
Durand (2003) Predicting a firm's forecasting ability: The role of organizational illusion of control and organizational attention	Secondary survey	785 companies, 36 industries	Organizational illusion of control, Organizational attention	Ability to influence market environment, Perceived organizational strengths, Market intelligence, Employee education and training
Davis and Mentzer (2007) Organizational factors in sales forecasting management	Content analysis, Interviews	18 global companies, interviewees	Sales forecasting capability, Sales forecasting climate, Performance outcomes, Performance measurement feedback loops	Leadership, Credibility of forecasting, Reward alignment, Information technology, Information processes, Cross-functional communication, Cross-functional ownership, Performance measurement

Durand (2003) took a rather different approach in two aspects. First, instead of the qualitative insight of forecasting audits, he obtained quantitative, secondary macro-data from the Bank of France periodical survey, consisting of 785 firms from 36 industries. Second, he did not directly measure the relationship between forecasting performance and organizational factors, but he partly used indirect variables. A dependent variable was represented by the straight error of industry growth forecasts, while independent variables consisted of the organizational illusion of control (ability to influence the market environment), illusion of self-perception (perceived organizational strengths), attention to market information (market intelligence) and attention to employee capability (i.e. employee education and training). Using this unorthodox framework, Durand tested numerous hypotheses and came to the following conclusions: both higher illusion of control and self-perception encourage higher positive forecasting biases (over-forecasting) and forecasting error, attention to market information reduces the positive bias and forecasting error and, finally, a firm's attention to employee capability tends to increase negative forecasting bias (under-forecasting), but it may reduce forecasting error, although only for the highest values of the factor. Durand also presents a sophisticated mathematical apparatus to support these findings, along with numerous research implications and issues.

Finally, Davis and Mentzer (2007) paper arrived at what is perhaps the closest approximation to the proposed BFM framework. In this paper, the authors used a large sample of citations arising from interviews with forecasters and managers (516 from 18 global firms) and disseminated them using content analysis, highlighting important cross-functional linkages. Their study differs from the previous ones in two points: it has clear ambitions to cover the organizational environment as a whole, and it uses indirect quantitative rating to describe the importance of individual factors in the complex system. The surveyed factors consisted of five groups: sales forecasting climate, information logistics, shared interpretation, performance outcomes and feedback loops. In terms of results, it gave rise to several important findings. First, it strongly emphasized the predominant importance of information logistics and performance measurement with respect to all the other factors. The first group scored 2039 citations, almost half (45.17 per cent) of the total. The second, although containing a single factor, scored 673 citations (14.91 per cent), more than any other factor group. Second, it outlined the weak performance effect of psychological–social-related factors (sales forecasting climate; 14.16 per cent of the total) and communication, forecast-sharing procedures (14.33 per cent of the total). The third message indicates the inner conflict hidden in remuneration procedures: while performance measurement achieved the aforementioned significant score, reward alignment, related to post-measurement reward distribution, was found to be of much lesser importance.

Although quite different in their method and data sample, the presented studies provide important information regarding the relationship between forecasting performance and organizational factors. The Davis and Mentzer (2007) and Moon *et al.* (2003) papers provide empirical evidence suggesting that the centre of the performance generation lies in hard-system factors, particularly information infrastructure and performance evaluation. Other factors, such as quality of communication or organizational climate, constitute a residual edge around this core. The position of some variables (individual qualification and forecasting process decentralization) remains contested, with positive (Moon, 2009) and negative (Davis and Mentzer, 2007) results.

Durand's (2003) study offered a different approach and may therefore serve as a kind of control sample. Its conclusions partly confirm the concept of a "hard performance core", mainly in the area of information infrastructure, and deliver additional evidence in terms of the positive effect of individual qualification. The concept of a performance core and residual edge, although not explicitly defined, is also supported by other studies – Armstrong (2005), Mentzer and Cox (1984) and Moon and Mentzer (1999), and it forms the backbone of this paper's theoretical expectations. Next present are hypotheses arising from this premise.

2.3 Research hypotheses

The first research hypothesis presumes a higher performance effect from factors explicitly included in the "core" than those expected to reside in the "edge" zone, across all organizational environments:

H1. The summed performance effect of information system and technology and performance evaluation factors will be higher than the summed performance effect of communication downward, communication upward, communication with peers and management support factors.

This hypothesis is supported by all of the surveyed studies, and particularly by Moon *et al.* (2003) or Davis and Mentzer (2007). It is also supported by older studies by Armstrong (1987) and Moon and Mentzer (1999) as well as many partial studies (Smith, 2009; Fildes and Hastings, 1994; Goodwin, 2007). While there are examples of differing evidence on some factors (Watson and Oliva, 2012; Mello, 2005; Jain and Malehorn, 2006), available literature findings make this hypothesis a robust one:

H2. Formal education, domain work experience and forecasting work experience will have higher summed performance effect in a higher-quality organizational environment than in the lower-quality ones.

Arising from Durand's (2003) research, among scarce evidence regarding the effect of individual qualifications on forecasting, this presumption is rather confirmed. An opposite stance is taken mainly by papers not dealing with its effect across different environments, but rather contradicting its beneficial effect at all (Cho and Hersch, 1998). Because of this discrepancy, we can consider this expectation to be of medium strength:

H3. A higher-quality organizational environment (in terms of aggregate factor rating) will have higher positive effect on forecasting performance (supplemented by the z-index) than the lower-quality ones.

Finally, the third hypothesis reflects the main presumption of the whole research. Confirmed by numerous papers indicating that organizational factors do have significant effect on forecasting performance (in addition to those already mentioned, and also Winklhofer *et al.*, 1996; Sanders, 1995; Deschamps, 2004 and others) and by evidence suggesting that this effect varies with respect to different levels of a factor's quality (Durand, 2003; Mentzer *et al.*, 1999), we can consider this hypothesis to be very robust.

3. Method and data

3.1 Dependent variable

Analysing forecasting performance identifies one unique advantage: there is a consistent and clear set of quantitative performance indicators available. Of these, the non-financial indicator of "pure" sales forecast accuracy was selected, measured by mean average percentage error (MAPE). Selection of the primary, non-financial indicator ensures compatibility of data between different companies and respondents, without the need for their re-calculation, as in the case of financial indicators (Kahn, 2003; Jain, 2009). As explained later, the respondents evidenced their performance through the evaluation of four forecasting methods[1] in three forecasting horizons[2]. They also marked which method of the set was the main one in their forecasting work and which time horizon they considered the most important. These indications set the data-line (method/horizon) to be used as the performance indicator.

3.2 Method

The research strategy of the paper is based on a combination of quantitative survey (questionnaire) and subsequent statistical analysis, similarly to the methodology employed by Bartel (2004). Its main components and successive steps are described by the following figure (Figure 2).

3.2.1 Research instrument preparation. In the first step, significant effort was dedicated to the development of the main survey instrument: the questionnaire. The first draft of the questionnaire was proposed as early as 2010 and came out of the experience gathered in a previous qualitative research project (interview survey)[3]. After that, three separate consultations were carried out: internal, with university department senior experts; professional, with representatives of the surveyed industry and research sample; and external, with a market research agency contracted for the data collection phase. Through this process, the questionnaire was gradually modified from the first draft (A) into a quasi-final version (C). From the conceptual perspective, it was decided to divide the questionnaire into two principal parts (Appendix 1):

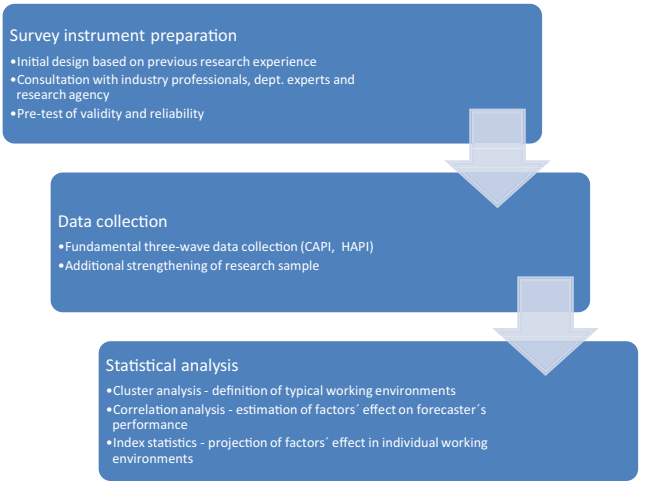

Figure 2.
Main components of study method

(1) Organizational factor evaluation, based on direct assessment of BFM model components. For this part, Likert scales were used and set to 5 points from extremely poor (−2) to extremely good (2). In most cases[4], however, individual rating definitions were developed, partly reflecting the previous research project and partly Mentzer's *et al.* (1999) work.

(2) Performance (accuracy) evaluation, based on assessment of four forecasting methods performance, in different time horizons. The scale of this accuracy evaluation was based on MAPE metrics and calibrated with 5 points from very inaccurate (−2) to very accurate (+2).

3.2.2 Validity and reliability concerns. Putting an evaluation of performance and factor into a single instrument simplified data collection, yet on the other hand increased the tangible risk of subjective distortion. This was tackled by placing proxy assessment of forecasting methods in the front place, diverting the attention of respondents towards evaluation of FM instead of evaluation of their own performance. We presume that, with these measures, risk of subjective self-evaluation has been principally avoided, while the causal link between factors and accuracy has been preserved. While this presumption was backed in the literature (Fox *et al.*, 1994), it inevitably put the validity of the instrument under increased scrutiny. Following Litwin (1995) and Crocker and Algina's (2008) framework, the validity itself was assessed in three main dimensions:

(1) *Face validity and content validity*: The quasi-final version of the questionnaire was reviewed and rated by a group of 15 respondents of the pre-research sample (randomly selected from the main research sample). This assessment ended with positive results, with a strong majority of the reviewers finding the questionnaire items understandable and relevant (average Lawshe's (1975) content validity ratio of 0.62[5]). On the other hand, the review also produced minor revisions, mainly regarding the wording and formal layout of the questionnaire. This phase was important mainly for the evaluation of organizational factors.

(2) *Criterion validity*: To judge this, a control variable was inserted into the research: forecasting horizon. This was expected to retain a negative correlation with forecasting accuracy by a substantial empirical standard (Mentzer and Cox, 1984; Granger and Jeon, 2007). This presumption was fully confirmed, with the control variable exhibiting a significant negative correlation (Goodman and Kruskal's Gamma of -0.56, $p = 0.000$).

(3) *Construct validity*: It was put under the most intense scrutiny. In the last wave of data collection (2014, $n = 53$), two methods of performance evaluation were conducted: one by the questionnaire itself and one by the respondents' superiors, who were separately asked to evaluate the forecasting performance of their (participating) subordinates using the same scale. By this procedure, two different measurements were obtained, gaining material for the construction of a monotrait–heteromethod matrix (Campbell and Fiske, 1959; Crocker and Algina, 2008). After correlating the two data lines with Goodman and Kruskal's Gamma ($p = 0.000$), we achieved the following results (Table II).

The level of correlation achieved shows strong correspondence with both methods of measurement (Crocker and Algina, 2008 recommend 0.50 to be the minimum), providing proof of the (convergent) construct validity of the survey instrument and, specifically, its performance/accuracy evaluation part.

Overall, all of the aspects of validity combined provided sufficient arguments to consider the survey instrument valid *per se* (Litwin, 1995; Crocker and Algina, 2008). Moreover, according to feedback provided by the pre-test sample, the whole process improved the understandability and "user friendliness" of the questionnaire, potentially reducing time costs associated with the submission. This might be one of the reasons, along with segment delimitation, behind the very good return rate, as described later.

Finally, the reliability of the instrument was assessed, through a frequent test-retest method. The questionnaire was submitted and after an appropriate delay, resubmitted to the pre-test sample members. Comparison of these two measurements revealed 0.89 average correlation (Goodman and Kruskal's Gamma, $p = 0.000$), indicating a good level of reliability according to Litwin (1995). Following this procedure, the final version of the instrument (D) was deemed suitable for the research and the next phase begun.

3.3 Data collection

In the second step, data collection was undertaken in four consecutive waves: in 2010, 2011, 2012 and an additional one in 2014. Majority of the data were obtained through computer-aided personal interview (CAPI) method, while the rest of the respondents were serviced using the human-aided (HAPI) variant. The data collection itself took place in seven companies, consisting of crucial pan European as well as local players on the Central-Eastern European (CEE) market (Table III).

In every company, a contact person (liaison) was appointed, usually the department manager or director, and asked to provide a list of potential respondents, in terms of their work qualification (must have been based on sales forecasting). No other criteria were enforced. After that and with the help of the liaison person, they were all approached and asked to take part in the research. While the majority of the sample was carried out by the author himself and his direct associates, for a minor part (company C), an external market research agency was contracted.

Of the 324 potential respondents, a total number of 201 ($n = 201$) actually took part in the research[6] and completed the questionnaire, marking the rate of return at 62.03 per cent. The structure of the survey sample is outlined in Table IV. It shows that the working affiliation of the respondents varied from managers and supply chain planners to almost pure forecasters, complying with the "broad" and "deep" principle[7] recommended by Moon *et al.* (2003).

Taking into account that the study deals with highly specialized personnel (forecasters) and incorporated all of the major retail chains in the surveyed area (Czech Republic), we can assume that the total population would not dramatically exceed the number of potential respondents addressed here. According to the guide published by

Table II. Key studies examining forecasting performance frameworks

Measurement	M1	M2
M1: Main instrument measurement	0.89	0.72
M2: Control measurement (superior)	0.72	1.0

Table III.
Key studies examining forecasting performance frameworks

Company	Position	Area of operations	No. of markets (Czech Rep., 2012)[a]	Yearly turnover/market share (Czech Republic, 2012)[a]	Potential respondents	Respondents in final sample
Comp. A	Major retailer	Pan-European	226	1.63 bn. € 13.92%	57	32
Comp. B	Major retailer	Pan-European	296	1.5 bn. € 12.81%	61	48
Comp. C	Major retailer	Pan-European	115	1.68 bn. € 14.36%	52	42
Comp. D	Major retailer	Pan-European	70	0.49 bn. € 4.17%	33	21
Comp. E	Major retailer	Czech Rep	159	1.01 bn. € 8.67%	48	13
Comp. F	Major retailer	Pan-European	205	0.76 bn. € 6.48%	42	17
Comp. G	Major supplier of consumer goods	Worldwide	–	0.16 bn. € –	31	28
Total			1,071	7.23 bn. € 60.40%	324	201

Note: [a]Not taking into account company G, which acts in a different market role

Bartlett *et al.* (2001), a number of 201 respondents is appropriate for a population of 400 (for common $p = 0.05$), when using categorical data. Both these facts support the adequacy of the survey sample. With respect to Bartlett *et al.* (2001) methodology, a sub-limit for the number of respondents in an individual cluster was also be set, this time to $n = 50$ (minimal n for population of about 100 forecasters). This should ensure the representativeness of individual clusters to the relevant population share; clusters having fewer respondents would not be taken into account.

3.4 Statistical analysis

The final step was aimed at a quantitative evaluation of the relationship between the set of factors and accuracy indicator of forecasting performance. The strength of the relationship was examined by correlation analysis. For this purpose, Goodman and Kruskal's Gamma was adopted, based on a Gonzalez and Nelson (1996) analysis. The significance of the correlation coefficient was also tested, resulting in elimination of factors found insignificant.

Simultaneously, typical organizational working environments (configurations) were consolidated on a factor basis, using a cluster analysis method. After the necessary preparatory procedures (survey analysis – elimination of outliers, analysis of factor inter-correlation), hierarchical clustering, based on the Ward method and Euclid distances, was carried out to set the number of future clusters. Finally, through non-hierarchical clustering (k-means method, constant intervals), individual clusters, i.e. typical organizational environments, were derived.

In the final step, the total supportive effect of the derived environments on forecasting performance was evaluated. To achieve this, index analysis was used, and an indicator of *Organizational support index* (OSI) was constructed. The OSI was computed as a summed product of average correlation coefficients (of the three used) and the rating of the given factor in the current environment. As evinced by the computation modus, the index serves only an aggregative purpose and does not produce new inputs. Reflecting a correlated effect of all factors on performance (accuracy) indicator, the OSI-index expresses the supportive effect that environment has and therefore serves as a main parameter in the aggregate comparison of working environments.

The application of cluster analysis to determine groupings of similar organizational design is common, as documented by considerable number of studies (Desarbo *et al.*, 2005; Ferguson *et al.*, 2000; Lim *et al.*, 2006). In most of these, cluster analysis would be accompanied by correlation (regression) analysis to examine the effect of clusters/factors on the dependent performance indicator (Fiss, 2007). To this end, methodology of the paper represents no deviation and follows established rules. The addition of index method (OSI) is a partial extension, inspired mainly by the similar

Table IV. Key studies examining forecasting performance frameworks

Item	Executive forecasters[b] (Inventory planner, demand planner, supply chain planner, etc.)	Forecasting managers[b] (Sales manager, team leader, inventory manager, etc.)	Total
Respondents in final sample	162	39	201

constructs of McKnight (2007 – Training Support index) and Datta (1991 – Acquisition Performance index). This enables us to aggregate and simply compare derived clusters; yet, it still only reformulates outputs of the fundamental correlation and cluster analyses.

4. Results

4.1 Operationalized forecasting method and decisive horizon

Before we proceed to the actual results, it needs to be clarified, which forecasting method/horizon data were chosen as the performance indicator. The preferences of the responding forecasters are outlined in Table V.

The survey clearly indicates that more than 71 per cent of respondents marked Method no. 2 (time series method adjusted by individual judgment) as their primary working tool, while more than 65 per cent marked the medium horizon (6-12 months) as the most important. As for method, this result is not surprising – the dominant position of time series adjusted by individual judgment in supply chain forecasting has already been confirmed in Mentzer and Kahn's (1997) study. Choosing a medium horizon as the decisive one has also substantial logic – in this horizon, the bulk of inventory/demand planning and strategic supply chain decisions are carried out (Stadtler and Kilger, 2007). It should also be noted that omission of the subdivision of performance using these two variables and using only some kind of general variable of "performance" is not possible, as both methods (Fildes and Petropulous, 2013; Makridakis and Hibon, 2000) and horizon (Mentzer and Cox, 1984; Granger and Jeon, 2007) are reported to have a crucial potential effect on resulting accuracy. As a result of this, a data set related to the individually adjusted time series method in the medium horizon was used as a performance indicator in the following analysis. All results are, subsequently, tied to this forecasting method and forecasting horizon.

4.2 Factor mutual correlation and control variable

First, the potential mutual correlation of independent variables, performance factors, needed to be investigated. An overall correlation matrix was calculated for this purpose, again using all of the three non-parametric correlation coefficients. It revealed that just a few of the dependencies narrowly exceeded the 0.5 level of correlation (communication downward × communication upward, management support × communication downward and management support × performance evaluation); in fact, the majority of them were placed as low as between the values of 0.2 and 0.3. This confirms the mutual independence of all involved factors, dispelling concerns of their imperfect or overlapping definition. Additionally, as already mentioned, the control variable (forecasting horizon) maintained its expected position and with strong negative association (−0.56) supporting the criterion validity of the results.

Table V. Key studies examining forecasting performance frameworks

Forecasting method	Main working method (%)	Forecasting horizon	Most important horizon (%)
Forecasting method nr. 1	9.45	Short horizon	18.41
Forecasting method nr. 2	71.14	Medium horizon	65.17
Forecasting method nr. 3	16.91	Long horizon	16.42
Forecasting method nr. 4	2.49		

4.3 Core results

Next, on the basis of a dendrogram of results produced by hierarchical clustering, the final number of clusters was set at four (Figure 3).

Of the four final clusters, three were admitted to the results with respect to the minimal population limit ($n = 50$), covering a relatively even number of respondents ($n_1 = 62$, $n_2 = 51$ and $n_3 = 64$). Single cluster ($n_4 = 24$) had to be eliminated because of the insufficient population. All of the surveyed factors were found to be vital by the cluster analysis ANOVA test. From the correlation coefficient significance perspective, two factors exceeded $p = 0.01$ (team morale and formal education), while a single factor also exceeded $p = 0.05$ (team morale). Following Fisher (1956) rule of thumb, correlation coefficients with $p > 0.05$ were considered insignificant, resulting in elimination of the team morale factor from further considerations. A detailed description of the resulting clusters/organizational environments is outlined in Table VI.

Overall, the correlation coefficients present a rather conservative picture. None of the significant factors were detected as prevalent or dominant, with coefficients ranging from 0.20 to 0.35, and most of the field concentrated around a value of 0.3. Perceived hard-system factors, information system and technology and performance evaluation, offered above-average correlation ratings, yet were equalled by most of the remaining factors and even surpassed by some. Others offered rather homogeneous results, with communication upward being the most effective factor, followed by quality communication with peers, forecasting work experience and communication from superiors and leaving domain work experience to be the least influential. In total, self-standing correlation measurement did not confirm the concept of hard core and soft

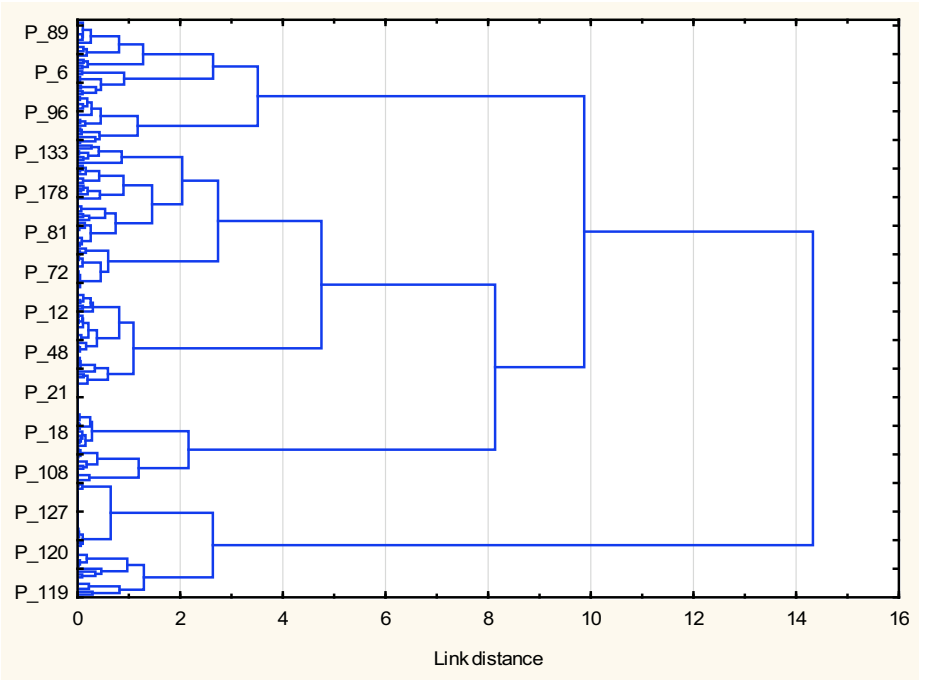

Figure 3.
Hierarchical clustering dendrogram

Table VI.
Study results–correlation and clusters

Factor	Kruskal's Gamma	Cluster 1 Factor values	Cluster 1 Given size of effect	Cluster 2 Factor values	Cluster 2 Given size of effect	Cluster 3 Factor values	Cluster 3 Given size of effect	*p*-test ANOVA	*p*-test Correlation coeff. significance
Forecasting horizon	−0.56	–	–	–	–	–	–	–	0.000
Communication downwards	0.312948	−0.68627	−0.21477	−0.187500	−0.05868	0.612903	0.191807	0.000	0.000001
Communication upwards	0.354020	−0.01961	−0.00694	−0.078125	−0.02766	0.741936	0.26266	0.000	0.000000
Communication with peers	0.335401	0.33333	0.1118	0.437500	0.146738	0.806452	0.270485	0.000	0.000010
Information system and technology	0.317474	−1.17647	−0.3735	−0.156250	−0.04961	0.258065	0.081929	0.000	0.000002
Decentralization of forecasting process	0.289124	−0.70588	−0.20409	0.031250	0.009035	0.919355	0.265808	0.000	0.000008
Team morale	0.052186	−0.27451	–	0.484375	–	0.822581	–	0.000	0.406698
Management support	0.291774	−0.66667	−0.19452	−0.031250	−0.00912	0.806452	0.235301	0.000	0.000003
Performance evaluation	0.280716	−1.39216	−0.3908	−0.046875	−0.01316	0.870968	0.244495	0.000	0.000003
Formal education	−0.172422	2.86275	−0.4936	1.203125	−0.20745	1.306452	−0.22526	0.000	0.017983
Domain work experience	0.203409	2.43137	0.494563	1.859375	0.378214	2.838710	0.577419	0.000	0.001161
Forecasting work experience	0.330053	1.70588	0.563031	1.218750	0.402252	2.451613	0.809162	0.000	0.000000
OSI index		−0.708818		0.5705762		2.713804			

edge, yet rather brought up a set of equal, similarly effective factors. Finally, formal education exhibited the only negative value, indicating a non-positive effect on performance outcome. The final outcome would be produced in the context of individual clusters.

The first cluster is characterized by poor quality of almost all the surveyed factors. The absolute value of the average factor quality is not dramatic, yet almost completely negative. The only positive deviation was found in communication with peers, indicating that team and social climate were the only functional element of this organizational environment. The level of forecasting work experience is also significantly low, in fact second lowest of the clusters, suggesting sub-average professional qualification of forecasting personnel. Interestingly enough, formal education level is rather high, actually the highest of all surveyed clusters (further hurting performance support). With regard to this, it is not surprising that the overall aggregate OSI value is very low and actually bellow zero. This means that the effect of organizational factors on forecasting performance in this cluster is, in fact, negative. This is a severely dissatisfying outcome. From a frequency perspective, it is the least populous (admitted) cluster, with a total of 51 adjacent respondents.

The second cluster can be labelled an average quality working environment. Most of the factors achieved a rating around zero value, with the communication with peers and decentralization of forecasting process representing the positive incursions. On the other hand, the set of remaining factors is lagging behind, implying that while horizontal communication and social climate are positive, see insignificant team morale, the remaining environment's components are inferior. Staff are professionally junior, with lowest domain and forecasting work experience as well as formal education of all of the clusters This mediocre setting contributes to the positive, yet limited organizational support expressed by the OSI index, implying a positive, mildly supportive effect, of about the same size as with the first cluster, yet with the opposite sign. With 64 respondents linked to it, it is also the most frequent cluster set.

The third cluster represents a clearly superior working organizational environment. All of the factors remain positive, some even close to a +1 value, which indicates a high perceived quality, in aspects such as decentralization of forecasting process, management support, communication with peers or performance evaluation. Surprisingly, information system and technology achieved a lower, although still positive evaluation, indicating a potential organizational weakness. The work experience (both domain and forecasting) of personnel is also high, attacking the highest value possible. Level of formal education, on the other hand, is rather limited and resembles more the second than the first cluster. Hence, it is not surprising that the overall OSI value is universally the highest, nearly double the value of the second cluster and many times higher than the first one. Frequency values imply rather the same coverage as with the previous builds, as the environment comprises 62 respondents – the mean value of all three.

5. Discussion

The study results have provided numerous interesting findings regarding the effect of different organizational environments on forecasting performance. With respect to the established hypotheses, the first one (*H1*) was not confirmed in any of the surveyed environments. All of the surveyed clusters exhibit a different proportion, with factors

perceived to form the soft performance edge "out-effecting" the hard-system ones. This suggests that the presumption set implicitly by the Davis and Mentzer (2007) and Moon *et al.* (2003) studies might not be valid, but in fact, the results indicate pretty much the opposite conclusion. As there is no obvious rule (i.e. low versus high quality environment) in the proportion, the outcome of the first hypothesis puts up substantial scepticism on the theory-preferred role of hard-core factors.

The second hypothesis (*H2*) was, on the other hand, partially confirmed. Forecasting work experience was found to be among the most influential factors and, complemented with domain work experience, it overpowered the negative effect of formal education in every cluster. Nevertheless, the hypothesis of the increasing effect of the three factors was confirmed only between the second and third clusters, but not between the first and second one (albeit narrowly). This implies that the higher supportive effect of staff experience/low education might be naturally linked to a higher quality environment; yet, this outcome requires further verification. Finally, the case of formal education raises serious doubts about the already sparse positive empirical evidence (Davidson, 1987; Sanders, 1995).

The importance of the third hypothesis (*H3*) in the overall research construction was self-evident. Plausible evidence was presented during the introductory chapter in favour of the effect of organizational environment on forecasting performance, which was the *de facto* concept behind the last hypothesis. The study results did confirm this expectation, as overall quality of the working environment led to higher performance support, represented by the aggregate OSI index. However, because of the different weights, i.e. correlation coefficients achieved by individual factors, different scenarios within this postulate are possible. These are mainly represented by the difference between personal and system components where, although the work experience and education of staff provided nearly the same level of performance support, the decisive difference was provided by the organizational factors. This division in turn supports the validity of Davis and Mentzer's (2007) framework in medium and low-end systems (i.e. emphasis only on system factors, omitting personal attributes). Practical implications would follow.

Overall, as evident from discussion of the hypotheses, the results confirmed literature outcomes only to a moderate degree. The survey mostly disagreed with the findings of Moon *et al.* (2003) and Davis and Mentzer (2007), disproving the dominant effect of information systems and performance measurement on forecaster employee performance. On the other hand, it confirmed the significant role of decentralization of forecasting process, which supports the findings of Moon and others (White, 1986; Sanders and Martrodt, 1994). From a broader theoretical perspective, represented by the management sections of Winklhofer *et al.* (1996) and Fildes *et al.* (2008) meta studies, such outcome is innovative. In particular, Winklhofer *et al*'s (1996) work puts forward a broad range of evidence in support of the two named factors, and some others from the set (individual qualification, management support, communication downwards), while effectively omitting the rest. The study, on the other hand, implies the balanced importance of all included system factors. Although there is generally only partial agreement among the studies, limited mainly to the implicit concept of a hard performance core, the observed deviations require further investigation and set fundamentals for future research directions. From the author's point of view, they can be explained either by regional-industrial differences (see Jain, 2009 study for further

evidence) or by functional variance, i.e. a partially different forecasting or information processing model. Both of the arguments seem reasonable, as the survey took place in a different region than the usual mainstream (UK, USA), and some minor differences in forecasting process, although within a fully compatible higher scheme, were detected in previous qualitative steps (Šindelář and Hudcová, 2008).

From the practitioner's perspective, the study outcomes largely correspond with Smith (2009) system decomposition into people, process and tools, indicating an important pillar of management validity. Regarding the implementation priorities, i.e. components that require the foremost improvement attention, the results are varied. Smith's (2009) original approach of "first people, then processes and tools" can be most probably be associated with the third surveyed environment, but the "people" part is still outweighed by "process" and "tools". Watson-Jones (2009) emphasis on primary process melioration is most suitable for the first, low-end environment. Morlidge's (2011) more balanced approach, stressing an equal implementation priority for all of the system components, is most relevant for the second, well-rounded environment. All of the findings and the corresponding management literature are reflected in the practice-oriented conclusions chapter.

6. Conclusions

The study presents several interesting findings and also raises further questions for future research. As regard its most interesting implications, the study confirmed the first thesis stating that quality of working environment has a substantial positive effect on forecaster performance. It also refuted the concept of the "hard performance core", a group of organizational-system factors that have a decisive influence on subsequent performance. It was not found sufficiently prevalent only in any of the surveyed systems, with improvement in the overall working environment quality, the difference between "hard core" and "soft" factors is even broadening. The third point is related to the role of individual factors. Contrary to formal education, (both domain and forecasting) work experience was found to be vital and produced a comparatively significant positive effect.

6.1 Implications for practitioners

With respect to the above, we can draw four management recommendations for the administration of forecasting bodies in retail chains. These capitalize mainly on the factors' proportion and are outlined in Table VII.

The results along with the available literature (mainly Mentzer *et al.*, 1999) also pave the way for projected system improvement. Using the set scales, we can define four stages of core organizational development, illustrating also a method of possible progress between clusters four stages of core organizational development:

(1) The first stage (generally improvement from -2 to -1 scale value) resembles imminent crisis management. Basic forecasting features in information system should be enabled (not necessarily by obtaining new software, but rather through plug-ins for common office SW) and a forecasting performance (non-financial accuracy) record needs to be started. In the second step, a basic tool of interconnection between performance and evaluation should be implemented, i.e. in the form of periodical meetings where achieved accuracy is discussed. Finally, the search for new forecasting software (common statistics

General thesis	Commentary
Focus on system, less on people	The survey proved that in all types of environments, system factors contribute to forecasting performance more than personal ones and have higher growth potential. This fact is further amplified by the negative effect of formal education and much higher aggregate correlation of system factors, albeit diffused. With respect to this, the primary object of care for forecasting managers should be the system itself, while the cultivation of people ought to be given a lower priority
Soft factors equal the hard ones	No system factor, or group of factors, was shown to notably outperform any other in performance support. The concept of "hard core" and "soft edge" was not confirmed. Therefore, all of the system's components should be given equal development priority (i.e. communication, ICT, management processes and remuneration). Furthermore, the development of factors presumed to be organizationally less challenging (i.e. performance evaluation, process foundation, according to Smith, 2009) would produce a similar effect to the more demanding ones (i.e. personal attributes, information technology, according to Smith, 2009)
Higher formal education does not contribute to forecasting performance	Formal education level does not positively contribute to forecasting performance. In fact, the analysis indicates its effect is negative. With respect to this, firms might want to consider its position and weight in the recruiting process and personal development model. Instead, attention should be diverted to relevant work experience in the business domain and primarily in forecasting itself. Our study indicates that this is the main performance-driver related to the personality of individual forecasters
Do not overestimated the social and morale situation on the working place	As the team morale factor was found to be completely insignificant, quality of social climate on the working place should not be given exaggerated attention. On the other hand, it should not be omitted either, as some related factors (communication with peers, management support) suggest horizontal/vertical cooperation is a vital part of performance moulding. Therefore, managers should strive to build a reasonably friendly and motivating environment, but not rely on team spirit as the main motivation force, as is common in, for example, some sales teams

Table VII.
Main management recommendations

forecasting procedures – i.e. time series methods) should be launched, along with a recruitment campaign for senior (experienced) forecasters – at least several of whom should be acquired and inserted into the system as soon as possible.

(2) In the second stage (−1 to 0 values), the system should have been largely stabilized. As a next step, senior forecasters should have been recruited and sensitively inserted among the current crew, creating mixed teams of junior workers under their mentorship. Then, a basic forecasting information system should be implemented (starting with trial operation in parallel with previous IS), and, finally, a basic indicator of accuracy (i.e. mean absolute error (MAE), MAPE, mean absolute scaled error (MASE) or similar natural metrics) should be tied to the remuneration system. This might be the most difficult step and hence, a conservative and cautious approach is recommended; interconnection between remuneration and accuracy should at least be differentiated between different horizons and variables (stock – goods), according to past track-record. Finally, basic financial indicators of forecasting performance (i.e. inventory cost, lost profit cost) ought to be developed and their track record started.

(3) The third stage (0 to +1 values) is about progressive improvement. The current forecasting system should be interconnected with other corporate information assets, contributing to a comprehensive MIS system (i.e. system providing full-scale decision support). The level of interconnection between performance and remuneration should be broadened, using also financial indicators developed earlier, and deepened, gradually tying a higher proportion of forecaster salary to achieved performance.

(4) The fourth and final stage (+1 to +2 values) covers the shift from an above-average system to a best practice environment. An advanced forecasting system (advanced statistics procedures, incorporation of subjective adjustments, multiexpert forecasting with track recording) should be implemented and connected to other corporate IS and to other parts of the supply chain (EDI). In addition to the current performance evaluation scheme, a multidimensional remuneration system should be elaborated and launched, incorporating indicators of non-financial, financial accuracy (inventory costs, stock-outs, lost sales, etc.) as well as performance indicators of the whole replenishment/inventory/supply chain system (timeliness, flexibility, distribution costs, etc.). By this time, a comprehensive scheme for the acquisition, adaptation and retention of experienced personnel should also be implemented, along with internal personal professional growth lines, resulting in steadily increasing organizational experience. Gradual improvement in other significant performance factors (communication and management support) is assumed.

Further comparing the four different environments, the study came across diverse findings. The three included represented a gradually improving line of organizational systems, with overall increase in the quality of significant factors. The distribution of respondents across the four clusters also paints a picture of overall working environment quality for CEE forecasters. The picture is not entirely positive, as it indicates that a majority of forecasters (57.21 per cent) still reside in environments with

low or medium perceived standard, and only a limited proportion (30.85 per cent) rate their organizational system as superior, reflected by the third (most supportive) cluster. Because of this, we can state that while the centre of the forecasting working environment in CEE lies in the lower-medium quality bracket, there is still substantial room for improvement, due to the significant proportion of the clearly low-end environments. Although the total results are not entirely negative, significant investments are still needed for the CEE organizational systems to catch up with their (presumably) better developed Western counterparts. This may also serve as a warning message for all of the involved forecasting managers.

6.2 Directions for future research

Directions for future research are concentrated mainly on the confirmation of result validity, both from the methodological, factual and regional perspectives. The first and obvious direction is to verify the study results on a larger sample of respondents, which might require regional enlargement, considering the limited number of target forecasters in the Czech Republic. This should be followed by a confirmation study, aimed at the same segment and same research problem, but with a different resolution methodology and, preferably, survey instrument. Confrontation of current, enlarged and alternative studies should enable the final assessment of the results' (construct) validity, in terms of both causal linkages and clusters. Special attention should be paid to potential criterion validity deviations, such as formal education or team morale. From a longevity point of view, verification of results after a certain time delay is also viable, possibly on a periodical basis (index), covering the development dynamics of the research problem.

The second implication derives from the regional focus of the presented survey. While most of the findings in reviewed literature result from the USA/UK area (Winklhofer *et al.*, 1996), evidence from continental Europe is exceptionally rare. This puts pressure on the cross-regional validity of the assumptions and conclusions and creates the first opportunity for further analysis. This study, along with some other papers – Moon *et al.* (2003) and Davis and Mentzer (2007) are particularly useful, offers a robust BFM framework for repeated usage and enhancement. This should be the second natural step in extending this research, potentially also in other geographic environments.

The concept of "backbone" factors places strong emphasis on the limited number of system components with highest long-term performance contribution. While this conclusion partially overlaps the hard system core concept, it is vital to test its validity in different distribution systems and channels (i.e. financial distribution, pharmaceutical industry). The results of this re-validation and analysis of possible deviances would be the vital first step in achieving comparative familiarity of different distribution channels and enable, or potentially disprove, knowledge transfer from one to another. The proposed BFM framework can easily be replicated in such research, reducing the necessary effort to mainly data collection and making this research implication the most feasible one.

The final point reflects the increasing role of financial indicators of forecasting performance. While the selected metric of natural (non-financial) accuracy was very practical and suitable for this survey, future research should concentrate on development and use of self-standing financial indicators. This would enable us to see

things from a totally different perspective, as financial indicators tend to put business weight onto technical accuracy performance. Plenty of clues regarding the construction of financial indicators can be found in current literature (Kahn, 2003; Catt, 2007; Armstrong, 1985); nevertheless, the context and peculiarities of the surveyed supply chain structure should always be taken into account, possibly at least with a pre-survey analytical instrument.

Notes

1. The four surveyed methods were: time series method, time series method adjusted by individual judgment, time series method adjusted by group judgment and pure individual judgment.
2. Three common horizons were examined: Short (<6 months), Medium (6-12 months) and Long (>12 months).
3. See Šindelár and Hudcová (2008) for details.
4. Information system and technology, decentralization of forecasting process, management support, performance evaluation, formal education, domain work experience and forecasting work experience.
5. Lawshe (1975) recommended 0.49 as the minimal value for 15 judges.
6. The paper was part of bigger research project, and the gathered data would serve numerous analytical purposes.
7. Moon *et al.* (2003) recommended adding people from different levels of organizational structure as well as from different business entities.

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Table AI.
Overview of research variables (performance factors)

Variable	Working definition	Key words	Measurement scale
Forecast accuracy	Performance indicator	MAPE accuracy metric	5 point MAPE-based scale Very accurate (0-5% MAPE) Accurate (5-10% MAPE) Rather accurate (10-15% MAPE) Inaccurate (15-20% MAPE) Very inaccurate (20%+ MAPE)
Communication downward (from superiors) quality	Quality of information flow from superior to subordinate	Bilateral communication, Team meetings, Workflow systems	5-point Likert scale Extremely poor (−2) Poor (−1) Average (0) Good (+1) Extremely good (+2)
Communication upward quality	Quality of information flow from subordinate to superior		5-point Likert scale Extremely poor (−2)–Extremely good (+2)
Communication with Peers quality	Quality of information flow between peers		5-point Likert scale Extremely poor (−2)–Extremely good (+2)
Information system and technology quality	Quality of company information system (IS) from forecasting perspective	Forecasting SW, Data assets, Interconnection with other corporate IS	5-point Likert scale No distinct forecasting software, only common office SW Basic forecasting SW (examples of typical features were provided) not connected to MIS and other corporate IS Basic forecasting SW connected to MIS and other corporate IS Advanced forecasting SW (examples of typical features were provided) connected to MIS and other corporate IS Advanced forecasting SW connected to MIS/ other corporate IS and incorporated into whole supply chain EDI structure, enabling multi-level forecasting and planning

(*continued*)

Variable	Working definition	Key words	Measurement scale
Team morale level	Level of morale and social climate inside forecasting team	Team motivation, Collaborative forecasting, Outcome orientation	5-point Likert scale Extremely poor (−2)–Extremely good (+2)
Decentralization of forecasting process	Composition and competence division in the forecast preparation process	Forecast preparation process, Collaborative forecasting, Workflow system	5-point scale Solo forecast preparation (−2) Is recommended and used to consult with other forecasters (−1) Is obliged to consult other forecasters, but retains decision about final forecast (0) Installed formal mechanism to involve other departments, forecaster retains strong influence on final forecast (+1) Installed formal mechanism to involve other departments, final forecast developed jointly (+2)
Management support	Level of overall support, distinction and independence of forecasting function in the management system	Functional independence, Distinctive management regime, Executive sponsorship	5-point Likert scale Very low level of support, no recognition of forecasting among other business procedures (−2) Low level of support, but forecasting is recognized as self-standing special business procedure (−1) Mediocre level of support, forecasting is recognized and managed as a separate function, but within common management system (0) Good level of support, forecasting is managed as a separate function and within common management system, but with distinctive deviations (+1) Very good level of support, forecasting enjoys attention of top-management and is managed via special designed management system (+2)

(*continued*)

Table AI.

Table AI.

Variable	Working definition	Key words	Measurement scale
Performance evaluation	Level of performance–reward interconnection within the forecasting function	Forecasting accuracy measurement, Key performance indicator (KPI), Reward scheme	5-point scale Forecasting accuracy not measured, evaluation based on non-accuracy criteria (−2) (this option would exclude respondent from research) Forecasting accuracy measured, yet evaluation based primarily on non-accuracy criteria (−1) Forecasting accuracy measured, evaluation based on accuracy without further implications (0) Forecasting accuracy measured, evaluation based on accuracy with recognition of further implications (inventory level, financial and marketing plans) (+1) Evaluation based on multidimensional metrics of performance, i.e. impact of accuracy on business goals (+ 2)
Formal education level	Evaluation of forecaster's formal education	Formal education, Academic training	Four options (undergraduate, professional college, university and postgraduate)
Domain work experience	Evaluation of previous work experience in the same domain as surveyed (retail chains)	Supply chain management, Sales and operations planning (S&OP)	Four options: 0-4 years 5-9 years 10-14 years 15-19 years 20+ years
Forecasting work experience	Evaluation of previous work experience in the sales forecasting	Sales forecasting, Demand forecasting, Demand planning	Four options: 0-4 years 5-9 years 10-14 years 15-19 years 20+ years