

# Judgmental Forecasting of Operational Capabilities: Exploring a New Indicator to Predict Financial Performance

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The authors thank Einar Marnburg for his contributions to an earlier version of the paper.

**August 30, 2012**

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### **Abstract**

This paper explores a new judgmental forecasting indicator, the *Employee Sensed Operational Capabilities* (ESOC). The purpose of the ESOC is to establish a practical prediction tool that can provide early signals about changes in financial performance by gauging frontline employees' sensing of changes in the firm's operational capabilities. We present the first stage of the development of ESOC by applying a formative measurement approach to test the index in relation to financial performance and against an organizational commitment scale. We use distributed lag models to test whether the ESOC can predict financial performance. Monthly data were collected from frontline employees in three different companies during an 18-month period, and the initial results indicate that the ESOC has predictive power.

**Keywords:** financial performance, intuitive judgments, operational capabilities, sensing

## **Introduction**

The majority of research on predicting changes in the financial performance of the firm has concentrated on revenue and cost budgeting combined with statistical techniques using time series data derived from historical data and current business activity (Cross 1997; Ghalia and Wang 2000; Kimes 1989). Over the last 25 years, several authors (Hogarth and Makridakis 1981; Lawrence, Edmundson and O'Connor, 1986; Lawrence, Goodwin, O'Connor and Onkal 2006) have pointed out the limitations of such statistical techniques, namely that some untypical events cannot be predicted using historical data. Most of the studies (e.g., Lawrence et al. 1986, 2006) emphasize the importance of judgmental and intuitive forecasting based on human knowledge that is not employed in statistical models, and recognize that in some cases more accurate predictions can be made by combining historical and quantitative data with judgmental methods (Wright and Ayton 1987). Yet despite the increasing emphasis on judgmental forecasting, a method of continuously systematizing collective employee knowledge and judgmental predictions of firm performance is still lacking (Ghalia and Wang 2000; Schwartz and Cohen 2004).

Businesses are confronted with increasing complexity from the internal and external environment in their daily decision-making processes. This complexity manifests itself in many forms, such as coping with economic upturns and downturns, promotional activities, pricing strategies, innovation activities to stimulate customers' changing interests, control of capacity constraints, loans, and fixed costs. Consequently, managers digest vast quantities of information in order to deal with day-to-day operations and to come up with the best and most effective course of action in their strategic decisions.

In a changing environment, however, there can be important developments in operational capabilities that may not be fully communicated to or understood by management. In the strategic management literature, operational capabilities are defined as “how you earn a living” and are critical for the enterprise’s “bottom line” (Helfat and Peteraf 2003; Winter 2003). Operational capabilities include coordination capabilities that can affect motivation and productivity (i.e., how teams work across the organization); any slow deterioration in service quality that eventually influences customer satisfaction in a non-trivial manner; and how management is able to address issues at the operational level (e.g., Helfat and Raubitschek 2000; Protogerou, Caloghirou and Lioukas 2011). Of course, there can also be positive changes at the operational level that initially go unnoticed by management. This puts frontline employees in a position to sense and accumulate distinct knowledge about operational aspects of the hospitality business that will eventually influence its financial performance. Teece (2007: 1323) refers to the importance of employee environmental sensing for financial performance when he states:

While certain individuals in the enterprise may have the necessary cognitive and creative skills, the more desirable approach is to embed scanning, interpretative, and creative processes inside the enterprise itself. The enterprise will be vulnerable if the sensing, creative, and learning functions are left to the cognitive traits of a few individuals.

Employees develop these perceptions about various aspects of the firm’s operational capabilities based on their daily tasks and interactions with, for example, customers, managers, colleagues, agents, and employees from competing businesses and other stakeholder groups.

Introducing frontline employees as a resource in strategic decision-making enhances the knowledge base on which firm predictions and decisions are made. In this sense, this

study is in line with Mintzberg's (1990) view of strategy as a learning process in which management has only partial information about the organization; in this view, there can be serious loss or distortion of information when processed and transmitted vertically within the hierarchy. Thus our study sets out to increase the information flow from the bottom to the top, but in a distilled (aggregate) manner, so that the information is useful for management and is not overwhelmed by the specificities of operational tasks and routines. This approach allows a broad range of agents in the organization to provide information that we believe can be of strategic importance.

We propose to operationalize this knowledge by using it to predict the firm's financial performance. More specifically, we explore whether it is possible to build forecasts of financial performance based on frontline employees' sensing and predictions about the future of the company. In this paper, we present the first stage of the construction of the *Employee Sensed Operational Capabilities* (ESOC) and apply a formative measurement approach (e.g., Bagozzi 1994; Diamantopoulos and Sigauw 2006; MacCallum and Browne 1993) to test the method's validity in relation to predicting hotels' financial performance relative to the market's performance. By providing indications of a number of possible latent variables of the construct for further study, we perform a principal component analysis (PCA) and test the predictability of components against firm financial performance in a prediction contest. The ESOC is based on 13 survey indicators that address frontline employees' intuitive judgments about changes in relevant operational capabilities on a monthly basis. The knowledge, which we seek to aggregate from the survey observations, is (to our knowledge) information that has been thus far overlooked for the purpose of forecasting performance. We hypothesize that this kind of employee

information can complement the knowledge of the top management, and that ESOC is therefore a novel strategic tool for management. This study's initial empirical results indicate that ESOC has predictive power. That is, frontline employees accumulate knowledge that is of strategic value to the company. However, we also emphasize in our paper that these findings must be further validated with a larger sample in the future to assess the exact value of the index as a strategic tool.

The structure of the paper is as follows: First, we focus on the definitions of judgmental forecasting. Then we turn to a review of employee sensing of operational capabilities within the strategic management literature and present a theoretical derivation of our prediction model. Next we discuss the choice of measurement approach in the construction of indices in terms of reflective versus formative measures. We then present the method and indicators of the ESOC and the empirical results of applying the ESOC to hotels. The paper concludes with a discussion of the results and implications.

### **Definitions of Judgmental Forecasting**

Unlike statistical forecasting techniques, judgmental forecasting is not a clearly defined method. Rather, it encompasses all approaches that involve some degree of human judgment in predictions. The field involves methods in which intuitive judgments, opinions, or subjective probability are incorporated into or combined with statistical models, or separately applied as subjective components into econometrics models (Wright and Ayton 1987). Thus, the ESOC qualifies as an instrument within the field of judgmental forecasting. It taps into employee predictions that are derived from their environmental

sensing of operational capabilities and incorporated into a statistical forecasting model (Helfat and Winter 2011; Teece 2007). As Brehmer (1987: 199) states, “the term judgmental forecasting is used to denote anything from probability judgments obtained under highly controlled conditions to rather loose statements about what may, or may not happen in the future.”

A review of published research in the field of judgmental forecasting reveals that there is no consensus among scholars about how statistical and judgmental approaches should be combined (Ghalia and Wang 2000). Since there is a variety of approaches to human judgments in forecasting, it is more useful to discuss specific approaches to judgmental forecasting (Brehmer 1987). For the development of a method for judgmental forecasting of financial firm performance, consumer confidence/sentiment indices can be a useful point of departure (Curtin 2006; Katona 1951). Such indices typically supplement model-based forecasting with information from other, more qualitative, indicators gathered from surveys (e.g., Batchelor and Dua 1998).

Construction of confidence/sentiment indices is based on data collected from regularly conducted surveys. Research on consumer confidence has mainly sought to evaluate the ability of consumer confidence data to predict economic outcomes (Dominitz and Manski 2004). For example, confidence variables can be tested by estimating forecasting models, such as autoregressive distributed lag and vector autoregressive models, in relation to target performance variables, such as consumer spending or gross domestic product. Current and lagged values of the confidence index are then tested for these target variables (Batchelor and Dua 1998).

In many judgmental forecasting approaches, experts' judgments are not necessarily included in an econometric model, but rather are applied to adjust the model (Lawrence et al. 2006; Wright and Ayton 1987). Yet when applying survey results as a separate statistical forecasting model, information captured from the survey results can substitute for traditional judgmental and qualitative adjustments, because confidence indices tend to have incorporated the adjustment information (Batchelor and Dua 1998).

### **Employee Sensing of Operational Capabilities**

In the strategic management literature, a central debate has focused on the operationalization of dynamic capabilities (Teece 2007). Several scholars have suggested distinguishing between operational capabilities ("how you earn your living") (Zollo and Winter 2002) and dynamic capabilities ("how you change your operational routines") (Helfat and Peteraf 2003; Winter 2003). Teece (2007) similarly recognizes the importance of operational capabilities in ensuring day-to-day operational efficiency.

Operational capabilities improve the coordination and integration of tacit and codified knowledge in ways that permit firms to more effectively deliver their products (e.g., technology, services) and acquire more information on customers' needs (Helfat and Raubitschek 2000). For instance, in service companies this relates to how customers express their feelings about their service experiences and how suppliers and service providers deal with the firm. More specifically, operational capabilities are related to the learning processes (e.g., technologies, services, etc.) that promote, enhance, and renew knowledge within a firm (Helfat 1997). Simply possessing some excellent operational capabilities does not imply that firms are able to cope with the renewal challenges



associated with a dynamic environment (Teece 2007). Employees' sensing of managerial abilities to deal with problems effectively, and to foster innovativeness and competitiveness, are thus assumed to be an important knowledge depository of a firm's operational capabilities (Danneels 2008; Dosi, Nelson and Winter 2002; Protogerou et al. 2011; Schreyoegg and Kliesch-Eberl 2007; Teece 2007).

A firm's ability to restructure its asset base also relies on mechanisms and processes that sense the changes taking place in the environment in relation to the movements of close competitors. Benchmarking activities are an important way to appraise, develop, and transform organizational capabilities by comparing an organization with its competitors (Protogerou et al. 2011). In particular, the employees' sense of prestige resulting from their perceived performance of the firm in relation to how other colleagues (agents) perceive their job in competing businesses can be important benchmarking information. Operational capabilities can, moreover, be explained by how departmental and cross-functional teams work and interact with each other; these relationships tend to affect the transformation and combination of, for example, service product capabilities or marketing and technological capabilities (Protogerou et al. 2011). Therefore, employees' sensing of how the teams work is critical for effective product and service delivery. Some scholars suggest that job rotation (also in consideration of job advancement) will increase the effectiveness of knowledge absorption, since it enhances the complementarities of experiences inside the firm (Cohen and Levinthal 1990). There are good reasons to believe that employees' job commitment – i.e., their sensing of advancement opportunities, their experience of interesting job tasks, whether they look for another employer, and whether they expect higher bonuses in their present job situation – indicates whether they stay with the firm (e.g., Meyer, Paunonen and

Gellatly 1989). As such, these variables can signify the absorptive capacity of knowledge in the organization, which suggests that management techniques such as job rotation and enhanced knowledge sharing will promote innovation (Cohen and Levinthal 1990).

In sum, dynamic capabilities can be considered tools that allow firms to continually build and renovate their operational capabilities. Organizations thus need to have systematic processes in place to recognize, understand, and monitor their internal resource and capability base (Danneels 2010; Teece 2007; Schreyoegg and Kliesch-Eberl 2007). By adopting a micro-foundations perspective (Teece 2007), we suggest that employee sensing (their perceptual and emotional processes), which is influenced by both internal and external firm factors, can help organizations identify gaps in their operational capabilities. However, so far we have little empirical insight about the value of such sensing activities and their possible effects on firm performance.

### **Theoretical Derivation of the Prediction Model**

Teece (2007, 2009) argues that locally held knowledge is important for strategic decisions in a dynamic business environment, which supports the notion that frontline employees possess strategically important knowledge. This line of reasoning also bolsters Mintzberg's (1990) arguments that management has incomplete information about the organization and, in fact, that employees have superior knowledge about conditions that are of strategic importance to the firm. These arguments form the basic premise that underlies the forecasting model developed in this study.

To see more clearly the relevance of employees' knowledge about changes in operational capabilities, we outline a schematic mathematical model of firm performance.

Operational tasks and routines related to sales, marketing, finance, operations, maintenance, etc. influence overall performance, even if in a minor way. The way that these tasks and routines influence performance may be nonlinear (Anderson 1999). With this in view, the overall financial performance of a firm can be modeled as a result of external and internal factors. Specifically, the model is written as:

$$Firm\ Performance_t = F_t(OC_{1,t}, \dots, OC_{1,t-k}, \dots, OC_{N,t}, \dots, OC_{N,t-K}, z) \quad (1)$$

where firm performance at time period  $t$  depends on the current and lagged operational capabilities of the firm's different sections (e.g., departments)  $OC_{i,t}$ ,  $i = 1, \dots, N$ . In addition, a vector  $z$  represents the effect of external factors on performance (e.g., expanding production capacity, level of business activity, macroeconomic climate, seasonality, etc.). In addition to stating that all parts of the organization influence overall performance, we basically treat the "how" as a black box. However, we also assume that the departmental performance variables  $OC_{i,t}$  are interdependent (e.g., the level of coordination of teams across the firm) and on factors external to the firm,  $z$ .

The main purpose of this theoretical exercise is to illustrate that overall firm performance depends on its operational capabilities and forms a complex system. The degree of complexity increases with the scale and scope of the organization. We assume the cost for management of attaining all relevant information for decision-making in a complex system is prohibitively high.

Furthermore, we assume that employees have superior knowledge on specific operations in the firm, as represented by  $OC_{i,t}$  in Equation (1). This can be viewed as

codified or tacit knowledge (Nonaka and Takeuchi 1995). This tacit knowledge is based on learning from their work experience in the organization, and may also be related to their prior knowledge and experience. Knowledge of operational capabilities is strategically important information because it is instrumental to the overall performance of the firm. Consequently, if it is possible to elicit employees' intuitive judgments about changes in operational capabilities, then it should be possible to predict changes in firm performance. Note that this does not imply that employees necessarily possess complete information about  $OC_{i,t}$  in Equation 1. For example, management may have exclusive knowledge that influences operational capabilities, e.g., ownership structure, organizational restructuring, investment decisions, etc. In addition, employees' knowledge about the functioning of their departments and the interrelations between departments can be partial.

Based on this reasoning, we argue that it is possible to substitute the left-hand side of Equation 1 with an index that aggregates employees' knowledge about factors that relate to organizational performance. This index can be thought of as a proxy measurement that takes into account departmental performance. This can be shown as:

$$Firm\ Performance_t = H(Operational\ Capabilities\ Index_t) + error \quad (2)$$

where,  $Operational\ Capabilities\ Index = \sum w_i \cdot Employee\ Judgment_i$ .  $H(\cdot)$  is a linear function that relates the index to the performance measurement. The construction of this index is shown in Equations 3 and 4 below. The operational capabilities index construct implies that it is possible to elicit the tacit knowledge of employees by exploring their

predictions about the performance of various aspects of the hotel based on their environmental sensing, or intuitive judgment of the firm's operational capabilities.

### **The Use of Formative versus Reflective Measures in Constructing Employee-based Indices**

When developing new or supplementary theories, one of the most fundamental considerations concerns the direction of the relationship between constructs and measures (Edwards 2011). One method is to view the constructs as causes of measures (independent variables) in such a way that the survey variables are reflective manifestations of underlying constructs. A reflective measurement approach to theory development is performed with the classical factor model (Harman 1976; Kim and Mueller 1978) and structural equation modeling (Jöreskog 1979; Jöreskog et al. 2000). Consequently, with reflective measurement models, causality flows from the latent construct to the independent variables. Reflective measures have typically been used in social science studies such as psychology (Borsboom, Mellenbergh and Van Heerden 2003, 2004) and by organizational researchers in studies of intra- and interorganizational relationships (e.g., James and James 1989; Scandura and Williams 2000; Stone-Romero, Weaver and Glenar 1995).

However, not all latent constructs are entities that are measurable with a series of positively correlated items (Bollen and Lennox 1991; Edwards and Bagozzi 2000; Fornell and Brookstein 1982). An equally reliable approach is to combine a number of indicators (independent variables) to form a construct (index) without making any assumptions about the patterns of inter-correlation between the items. Formative, or causal, index results flow in the opposite direction from the indicator to the construct (Blalock 1964; Diamantopoulos

and Winklhofer 2001; Edwards and Bagozzi 2000). This approach is typically applied in the economics literature, when one is interested in testing the causality of the index indicators of a financial measure and the aim is to capture as much of the variance of the (economic) performance measure as possible, rather than to explain the underlying psychological constructs of the indicators. A formative measurement approach is usually applied in various country and market potential indexes (e.g., Dichtl, Köglmayr and Müller 1986); the index of customer sentiment (Katona 1951, 1960), or the quality-of-life index (Johnston 1988). Constructing prediction indices based on employee-based measures calls for a further discussion of reflective versus formative measures. This is because employee-based indices are a new methodological approach in the strategic management literature where employee-based instruments traditionally are based on reflective measures.

In recent years, there has been an increasing debate on the use of reflective versus formative measures in theory development. Formative measures are gaining interest in management research as a viable alternative to reflective measurement in diverse areas such as organization research (e.g., Podsakoff et al. 2003), strategy (Podsakoff et al. 2006), and marketing (e.g. Jarvis et al. 2003). This surge of interest has resulted in discussions of formative measures (e.g. Bollen and Lennox 1991; MacCallum and Brown 1993; Diamontopoulos and Winklhofer 2001). Some of the recent critiques are presented by Edwards (2011), who argues that the growing enthusiasm about formative measurements is mistaken. He critically compares reflective measures and formative measurement on the basis of six core themes (dimensionality, internal consistency, identification, measurement error, construct validity, and causality) and concludes that formative measurement is a fallacy. However, Bagozzi (1994) contends that formative measures are particularly

relevant for dealing with organizational and social constructs, when the unit of analysis is the firm or the group. In line with this argument, Bollen (1989) asserts that the choice of a formative versus a reflective specification depends on the causal priority between the indicator and the latent variable. Edwards and Bagozzi (2000) and Diamantopoulos and Siguaw (2006) also acknowledge that the choice between reflective and formative indicators should be theoretically driven and specified according to the nature and direction of the relationship between constructs and measures. In many cases, this choice will be straightforward, as the causal priority between the construct and the indicators is very clear. In a recent paper by Diamantopoulos (2011: 336), he concludes that “constructs themselves are not *inherently* formative or reflective.” The choice of formative versus reflective measures relates to the auxiliary theory (Bagozzi 1982; Blalock 1968; Costner 1969) and the way in which the latent variable should represent the construct of interest. In another recent paper on formative versus reflective measurement models, Coltman and colleagues (2008) assert that while reflective models should be considered in the design of theoretical considerations and the development of constructs, formative measurement models speak more to the empirical considerations of constructs. As such, they are in agreement with Bollen and Ting (2000), Diamantopoulos and Winklhofer (2001) and others who argue that once the data are collected, it is useful to assess whether the assumptions underlying the model hold empirically or not. Since empirical validation is accepted as the norm to validate structural model hypotheses, the same should apply to hypotheses about measurement models – to assess whether they perform as expected, as with a formative measurement approach. Coltman and others (2008: 30) conclude – contrary to Edwards (2011) – that both theoretical and empirical considerations suggest that formative models

are more plausible, according to their studies. A recent study by Diamantopoulos and Winklhofer (2001) also illustrates the utility of formative measurement principles in generating an index that results from the resource commitment to the export sales forecasting task. The empirical data is drawn from a survey of senior managers in an exporting firm. The authors found that following such formative measurement criteria is applicable and that the guidelines for constructing indices should prevent their use as “a handy excuse for low internal consistency” as critiqued by scholars who adhere to the reflective measurement approach (Bollen and Lennox 1991: 312).

When deciding between reflective and formative measures in the construction of the ESOC measures, we consider the exploratory nature and purpose of ESOC. Since ESOC should function as an employee-based assessment tool to capture their judgments and attitudes, it might seem that a reflective measurement approach should be applied. However, as the nature of the ESOC measures will be observed in time series – the variables’ dynamic behavior over time – which will constitute the construct(s) latent variables, there are some immediate drawbacks if relying initially on the reflective measurement approach. The co-variance analytical approaches of the reflective measurement method (i.e., factor modelling and structural equation modelling) are well-suited to explain psychological phenomena as observed in experiments or cross-sectional or longitudinal studies (Byrne 1998). Yet they were not developed for use with dynamic time series (Molenaar, Gooijer and Schmitz 1992). Exploratory factor analysis, confirmatory factor analysis, and structural equation modelling (SEM) are static models (Jöreskog 1993). SEM cannot capture the order relationships of a time-dependent process (e.g., Zhang and Nesselrode 2007). That is, SEM models are dependent on generalizing about a population



of subjects, and are less suited to generalizing variance in psychological phenomena over time, when individuals change. Consequently, when the dynamic models also imply change in individuals over time, and not as in a fixed longitudinal panel design, the static approach and SEM model fail. These models cannot precisely identify lead-lag co-variance relationships over time (Molenaar et al. 1992). There has been recent interest in using dynamic models to measure such datasets, but they are less precise when the data samples include small numbers. Advanced dynamic models should account for the variance over time of the variables, in conjunction with unbalanced panels, as individuals change during the sampling period.

However, the aim of this paper is not to repeat or continue the debate about reflective and formative measures. Rather, the authors take the middle ground, building on the work of both those who stress theoretical justifications for constructs and those who argue for empirical validation as part of the development of measures. In the first step of the construction of ESOC, as presented in this paper, we will use a formative measurement approach to test ESOC as a prediction tool in relation to economic performance.

Consequently, since we stress that the main purpose of this paper is to present the first stage of the development of ESOC in relation to financial performance in order to test whether employees' knowledge is of strategic value to management, we will follow formative measurement principles. However, we will perform a PCA to provide some indications of the structure (potential latent variables) and their constellations in the index for future studies. We will assess the predictability of such potential factors. In future studies of ESOC, reviews on advanced and highly complicated dynamic models will be

performed, which can capture the dynamic nature of possible latent variables in the index over time with changing individuals.

### **Financial Performance Indicators in the Hotel Industry**

In the hotel industry forecasting is usually based on traditional financial performance indicators although operators and investors use different industry statistics to assess operations and business developments. The most common performance indicators in the hotel industry are occupancy rate and revenue per available room (REVPAR) (Enz, Canina, and Walsh 2001). Occupancy rate is typically used as an important indicator in hotel performance-related research (e.g., Berger 1997; Jeffrey and Barden 2000, Enz et al. 2001). The studies referred to above established the effective performance assessment of occupancy, REVPAR, returns, and operating margins. While occupancy rate measures the share of rooms sold, REVPAR measures average revenue per available room (Wu, Hsiao and Tsai 2008). REVPAR thus accounts for both sold and unsold rooms, and is calculated as the product of the room occupancy rate and the average daily room rate. It increases when either the occupancy rate or the room rates increase, all things being equal (Schmidgall 2002). REVPAR makes it easy to compare hotel performance with competing operations, because it only includes room revenue and not revenues from other activities such as restaurants, conferences, etc. Since the present study is focused on the hotel industry it concentrates on performance related to the room rental.

### **Methods**

The ESOC is founded on the theoretical framework of confidence/sentiment indices and is constructed in a manner similar to the Index of Consumer Sentiment (ICS) (Katona, 1960). In the following, we explain stepwise how this methodology is implemented.

### *Step 1: Focus Groups*

The search for relevant indicators of the index was based on conversations with leading industry experts – including executives, frontline employees and academics – in Asia and Europe. We treated individuals as experts if they had experience as leaders and analysts in the industry. Conversations with practitioners took place in Singapore with two top managers from a legendary world class hotel. This organization is known for its well-trained service employees and superior communication flow between managers and employees. We also discussed relevant indicators with five executives and ten frontline employees in Scandinavia. The meetings with experts were arranged through email contact. Possible survey indicators generated from these meetings were later presented and discussed with academics at conferences in Australia, Sweden, and Portugal. In order to develop relevant indicators to judge the operational capabilities, we had to identify particular areas of the operational capabilities sensed by frontline employees. Hence, we addressed the following questions to experts: “Which significant people do the front employees talk to?”, “What do they perceive in their daily work?” and “What kind of operational performance issues do frontline employees build anticipations about? Results of conversations with professionals are shown in Table 1. These are areas that influence the daily sensing of frontline employees about operational performance, and arguably shape

their predictions about future changes in operational capabilities. The hospitality experts noted that frontline employees' socialization with colleagues from their own hotel and from competing businesses is a key characteristic of their daily operational work. Overall, the experts were positive and encouraging; these opinions established the motivation for the research presented in this paper.

Table 1. Framework for Pooling Judgmental Tasks: Domain Specific Sensed Operational Capabilities of Frontline Employees.

<b>Questions addressed to hotel experts</b>	<b>Operational capabilities areas</b>
Which significant groups of people do frontline employees interact with?	Co-workers in own and other departments, guests, managers, colleagues of other hotels in the local area.
What do they perceive in their daily work?	Their own job, coordination in own department, coordination between departments in the hotel, how guests enjoy services, how managers solve challenging issues, the hotel in relation to its competitors.
What kind of operational performance issues do frontline employees build anticipations about?	The future of their own jobs, future salaries, how problems are solved, how coordination works, how satisfied the customers seem to be, how the hotel develops its services, the hotel in relation to the competition, reputation of the hotel.

*Step 2: The Construction of ESOC Indicators*

From the table of relevant areas affecting frontline employees' sensing activities about operational performance, we constructed 13 indicators. We relied on the wording from the

ICS when creating the questionnaire. For instance, “Now turning to business conditions in the country as a whole – do you think that in the next 12 months we’ll have good times financially, or bad times or just about the same as now?” We used such anticipatory questions including “the next 12 months” and the type of ICS ranking to construct the items. The individual items were sampled from the list of frontline employees’ working areas, as presented in Table 1. We constructed questions related to employees’ expectations about competitiveness, innovativeness, prestige (reputation), guests’ satisfaction, managerial and team performance, and expectations about their own job situation.

The makeup of items that constitutes the ESOC was developed using a formative measurement approach (Bagozzi 1994; Diamantopoulos and Siguaw 2006) in order to test the method’s ability to predict financial performance. When using formative measures, our focus is on capturing variance in the dependent financial performance variable.

A PCA was conducted on the 13 ESOC items with orthogonal rotation (varimax) across hotels, holding the time domain constant and enhancing the independency between latent variables, to identify the structure and any number of potential latent variables of the construct. The analysis was performed using SPSS version 18. The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis,  $KMO=0.88$ , which is “great” according to Field (2009), and all KMO values for individual items were above 0.75, thus exceeding the acceptable limit of 0.5 (Field 2009). Barlett’s test of sphericity,  $\chi^2(78) = 2194.18$  ( $p < 0.001$ ), indicated that correlations between items were sufficient for PCA. An initial analysis was run to obtain eigenvalues for each component. Three components had eigenvalues above 1, in accordance with Kaiser’s criterion (5.149; 1.409; 1.046) and in combination explained 58.5% of the variance in the construct. The scree plot

was slightly ambiguous but showed inflexions that justified retaining only components 1 and 2; component 3 only comprised one indicator concerning employees' future interest in getting a job with another employer (ESOC13). As the latter indicator loaded negatively, probably since it was an inversed indicator, we omitted ESOC13 from the analysis. Consequently, we retained two components for further analysis. The indicator clusters suggested that component 1 represents "operational competencies" (constituting 8 indicators); component 2, which may be interpreted to represent "operational job attractiveness," is made up of four ESOC indicators. A reliability test was performed on the two components. Operational competencies and operational job attractiveness both have high reliabilities, with a Cronbach's  $\alpha=0.84$  and  $\alpha=0.76$ , respectively. See Appendix A for a complete list of the 13 ESOC indicators and related factor components and loadings.

All ESOC indicators have a five-point response scale, where values 1 and 2 on the scale indicate expectations of negative and modest negative development in operational capabilities, respectively, over the next 12 months compared with the present situation. A value of 3 indicates expectations of no change at all over the next 12 months, and 4 and 5 indicate employees' expectations of modest positive and positive development, respectively, over the next 12 months compared with the present situation.

### *Step 3: Consideration of Reliability and Validity in Construction of Formative Indicators*

Issues of validity and reliability of time-series studies have received little attention in comparison to the reflective measurement approach performed in cross-sectional (e.g., longitudinal) studies. The reason for this lack of attention is that time-series studies typically involve non-personal variables such as sales, advertising, and expenditures and

are not subject to human limitations that affect the quality of the measurements (Didow & Franke, 1984) . A literature review of formative indicators performed by Diamantopoulos and Winklhofer (2001) suggests some criteria for successful index construction.

*Content specification* involves capturing the range of resources that can tap into the forecasting task in fairly broad terms. Consequently, “breadth of definition is extremely important to causal indicators,” (Nunnally & Bernstein, 1994) as failure to consider all aspects of the construct will result in the exclusion of relevant indicators. In our case, we specified the domain of the focal construct as employees’ *intuitive judgments of operational capabilities*. We thus aim to capture the range of employees’ operational sensing activities that is cultivated through their daily work responsibilities. In our interviews with experts in the hotel industry, we sought to capture a broad range of central aspects concerning frontline employees’ perceptions of their daily work situation and operational performance. The specific indicators emerged from extensive conversations with experienced researchers that provided assurance that the indicators reflect important aspects of operational capabilities. Our PCA indicated two different factor components of the construct. As such, we assert that we have captured the diversity of the construct.

The external validity of formative measurement models is relevant for assessing the suitability of indicators. As Bagozzi (1994: 333) notes, “the best we can do ... is to examine how well the index relates to measures of other variables.”(Bagozzi, 1994) The ESOC was tested against an “organizational commitment scale” (ORGCOM), which is measured using the nine-item scales of Mowday, Steers and Porter (1979). The scale, employed in cross-sectional studies, is one of the most accepted measurements of affective commitment (Meyer, Paunonen and Gellatly 1989). We argue that the commitment items

are related to employees' sensing of operational capabilities, as they provide indications about employees' knowledge absorption capacity (Cohen and Levinthal 1990). The ORGCOM scale is included in the study to assess the specification and external validity of the ESOC measures. It was incorporated into the ESOCs survey and its items were observed monthly in the same way as the ESOC items.

Sample items in the commitment scale include "I talk up this organization to my friends as a great organization to work for" and "I would accept almost any type of job assignment in order to keep working for this organization." The response scale is a seven-point Likert scale ranging from one (strongly disagree) to seven (strongly agree). Prior studies have reported that the scale has acceptable levels of reliability and validity (Angle and Perry 1981; Price and Muller 1981; Parker and Kohlmeyer 2005). By converting to the ORGCOM index, we reduced the variance in the measure, turning the 7-point scale into a 3-point scale, where 1, 2, and 3 on the scale indicate a negative commitment, 4 is neutral, and 5, 6, and 7 indicate a positive organizational commitment.

#### *Step 4: Pre-testing*

Since procedures used to assess the validity and reliability of scales composed of reflective measures differ from formative indicator studies (Diamantopoulos and Winklhofer 2001; Diamantopoulos and Siguaw 2006), our purpose with the pre-testing was to establish face validity for the measures. The "real" performance of the indicators requires testing them over time.

The pre-testing of the ESOC survey consisted of two steps. First, two professional survey experts from Questback.com tested it in order to examine the structure of the



survey's indicators and to ensure that the questions were easily understood. The first pre-test demonstrated the need for more informative and simplified wording. The style of the survey was also corrected, and the use of different types of variables in the indices was determined to be too complex both in relation to the survey and from an analytical point of view. Next, the survey was pre-tested in the hotel field setting with ten third-year bachelor hospitality students. The students were considered highly qualified to assess the content of the survey as they held positions in the industry. The second pre-test raised some concerns about the language of the survey. Although the survey would be distributed in two Scandinavian countries, English is the primary working language in global hotel chains. In our sample there would be foreign employees that would not speak a Scandinavian language. Consequently, it was decided to use English in order to standardize the survey for international purposes.

#### *Step 5: Data Sampling*

The ESOC indicators were observed in three parallel time-series surveys conducted in three hotels affiliated with three different international chains located in Norway and Denmark. Only hotels representative of the industry were considered and the final sites were selected based on management's willingness to co-operate on the extensive data sampling from frontline employees and managers during the project period. Hence, three hotels were invited to participate in the study: two four-star hotels in Norway and a five-star hotel in Denmark. We assumed that data sampling at three hotels would resonate with the workload in collecting and following up on monthly responses during the data sampling period. Only

four- and five-star hotels were included in the sample; they had a similar size (number of employees). We chose size as a criterion for selecting the individual hotels in order to ensure homogeneity in the sample. Hotel size tends to influence both the type and amount of knowledge sharing between employees and management in hotels (Ruiz Mercader, Meroño Cerdán and Sabater Sánchez 2006). Four- and five-star hotels in Scandinavia have a quite similar hierarchical structure compared to lower-scaled hotels. The hotels included in the sample employ 120, 110, and 125 employees, respectively (including full- and part-time employees), and are medium-sized businesses according to the European Commission definition of small and medium-sized enterprises (SMEs). A single industry such as the hospitality industry, a homogenous company size and relatively homogenous surroundings (Norway and Denmark) of the sample of hotels should reduce error variance, and thus improve the power of the study.

The ESOC survey items were monitored electronically between the 10<sup>th</sup> and the 16<sup>th</sup> of each month. The ESOC items were monitored with “Hotel 1” from February 2006 to June 2007, “Hotel 2” from April 2006 to September 2007, and “Hotel 3” from May 2006 to September 2007. This generated a total of 626 completed questionnaires.

In the hotel industry, frontline personnel work shifts. Therefore, to ensure that we reached the entire population of frontline employees, we used a longer data-sampling period. It should be noted that the respondents within the pool of frontline employees changed from observation to observation. In the survey, the individuals were asked to provide a personal code with the last three letters of their mother’s name and the number of children she has. Tracking the personal codes, we looked into the possibility of turning the

time series into a balanced panel study to follow the same individuals over time, but due to the high turnover in the industry, a balanced data panel could not be obtained.

Consequently, we considered the relevance of a balanced versus an unbalanced data set in measuring operational capabilities, which reflects dynamic capabilities as a higher order construct (Danneels 2008; Dosi, Nelson and Winter 2002; Protogerou et. al. 2011; Schreyoegg and Kliesch-Eberl 2007; Teece 2007). According to Teece et al. (1997: 516), dynamic capabilities can be conceived as “the firm’s ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments.” In support of this, Nielsen (2006: 60) argues that the operationalization of dynamic capabilities must involve the flows to and from the firm's stock of knowledge-based resources. The flow of knowledge does not only entail the creation of new knowledge, but also includes changing the states of the knowledge in consideration (e.g., from isolated and unconnected to integrated with other knowledge bases, or from non-codified to codified knowledge). Thus, since the dynamic flow of knowledge by the frontline employees is the focal point of this study, we recognize that an unbalanced data panel is more suitable than a balanced data panel that tracks particular individuals over time. It is the flow of knowledge, rather than particular individual behavior, which is relevant for this preliminary ESOC study.

Each month, a survey link was sent to department managers at the different hotels, who then forwarded the link to their employees. Newly hired employees were not included in the sample, as they would have difficulties in judging different firm activities and their performance.

The population of frontline employees at each hotel included all hospitality associates from all kinds of front office stations, restaurants, show kitchens, housekeeping departments, conference and banquet departments, and sales departments. See Table 2 and 3 for descriptive statistics about the respondents from each hotel and the distribution of respondents per department.

Table 2. Characteristics of Frontline Employees

Control variables	Hotel 1 (N=208)	Hotel 2 (N=279)	Hotel 3 (N=139)
Gender	Female=51%	Female=71%	Female=65%
Years in the chain	M=2.27 SD=1.72	M=3.71 SD=2.55	M=10.63 SD=7.59
Years in the industry	M=5.60 SD=3.68	M=6.15 SD=3.92	M=13.32 SD= 6.47

Table 3. Distribution of Frontline Employees by Hotel Department<sup>a</sup>

	Hotel 1 (N=208)	Hotel 2 (N=279)	Hotel 3 (N=139)
Front office	35.6	37.6	23
Banquet/Bar/ Meetings/Events	4.8	8.2	28.1
Guest services	17.8		
Reservations		20.8	
Housekeeping	20.2	22.2	6.5
Restaurant	11.5	7.9	2.2
Kitchen	9.6		4.3
Sales department			26.6
Other	0.5	3.2	9.3

<sup>a</sup> Distribution in percentages

The response rate for each month varied from observation to observation and from hotel to hotel (in the range of 10-50%) and was influenced by several factors. First, there is in general a high turnover among hospitality employees, resulting in a lower response rate. Second, seasonality and the workload are other factors that are likely to influence the response rate on a monthly basis; during busy periods, answering the ESOC survey is given a lower priority by managers and front office personnel. Access to email at work is also a factor that influences the response rate. In the hotels included in our study, it is common for only a few employees in the housekeeping, banquet, and bar departments to have email

access at work. However, even if the response rate varies, it is important to bear in mind that frontline employees in the ESOC survey are viewed as “experts,” in that they give their expert predictions of the future based on their experience in the front office and in customer-contact positions. Hence, the ESOC’s validity does not depend on a high response rate, although it is desirable.

*Step 6: Considerations of Response and Non-response Biases*

Since the same ESOC questions were repeated each month, response bias was likely to affect the study’s level of reliability. We assumed that systematic response errors would occur due to fatigue, boredom, misinterpretation of the questions, and/or unwillingness to answer the ESOC survey (Aaker, Kumar and Day 2001). Yet, the research design of three parallel time-series studies with a relatively high number of observations should account for threats to reliability as a consequence of response bias.

Non-response biases may also have occurred, as we asked department managers to forward the survey link to their employees. We tried to prevent selection bias in the monthly emails to the managers by emphasizing the importance of including all employees in the respective departments to make the research results more reliable.

*Step 7: Construction of the ESOC*

The construction of the ESOC largely follows the structure and computation of the ICS. First, a diffusion measure was constructed for each of the 13 questionnaire items. The diffusion measure was calculated as the difference between the number of positive and negative responses in each time period (month) divided by the total number of responses in

that period (month), plus 100. If the positive responses outnumber the negative ones, the diffusion measure is larger than 100; in the opposite case, it will be lower than 100. This can be formulated as:

$$X_{it} = \frac{(\text{No. of positive responses}_{it} - \text{no. of negative responses}_{it})}{\text{Total no. of responses}_{it}} + 100 \quad (3)$$

where  $X_{it}$  is the diffusion measure,  $i$  is the questionnaire item, and  $t$  is the time period. The ESOC index is then calculated by aggregating the 13 diffusion measures for each period and then dividing by the sum of the base period:

$$ESOC_t = \frac{\sum_{i=1}^{13} X_{it}}{\sum_{i=1}^{13} X_{i0}} \times 100 \quad (4)$$

To follow the convention, we multiplied by 100 to get the usual representation of an index, where the base period is equal to 100. Using this computation, an ESOC value greater than 100 indicates that frontline employees are positive about the future state of the operational capabilities, relative to the base period, while an ESOC value less than 100 indicates that employees are negative about the future state of the operational capabilities. The variations in ESOC values for the three hotels are displayed in Figure 1 . Aggregation appears to be reasonable, as there is a high degree of agreement among respondents, as shown in Appendix B.

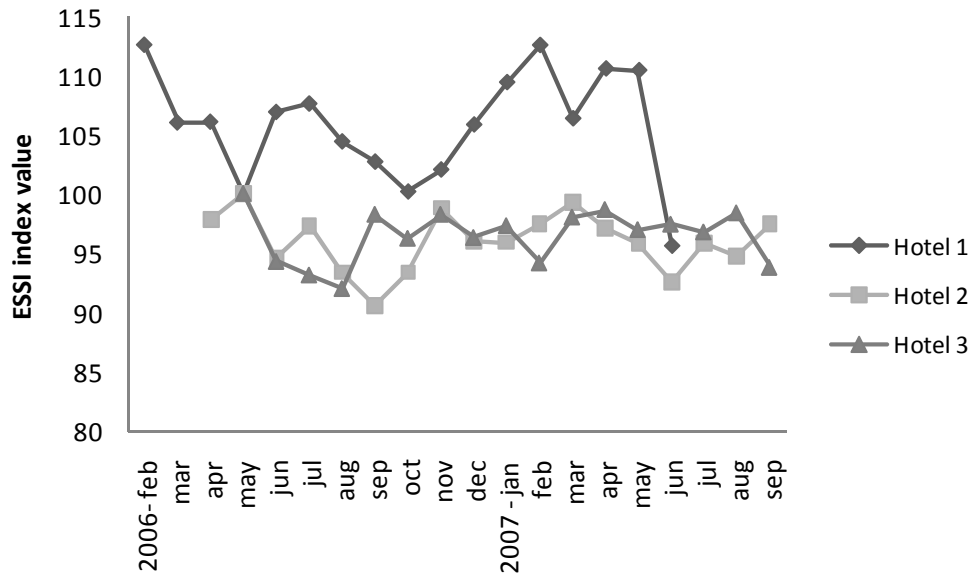


Figure 1. Constructed ESOC for Hotels 1, 2 and 3

*Step 8: Construction of Performance Indicators*

A number of variables influence hotels' financial performance, such as macroeconomic variables, seasonality, competition, etc. We use ESOC indicators to forecast how a hotel firm is likely to perform *relative to the rest of the industry* in the relevant regional hotel market. Because we choose to focus on the financial performance of the hotel relative to the rest of the marketplace, the effects of common market movements on the hotel's performance indicators will be filtered out.

As a performance measure for hotel  $i$  at time  $t$  ( $Pfm_{i,t}$ ), we take the difference between the return of a hotel and the average return in the local hotel industry:

$$Pfm_{i,t} = \Delta \ln(R_{firm})_{i,t} - \Delta \ln(R_{industry})_{i,t}, \quad (5)$$



where  $R_{firm}$  and  $R_{industry}$  are REVPAR for the hotel firm and the local hotel industry, respectively. Variable transformation using the first difference of the logarithms approximates percentage change. As a result,  $\Delta \ln(R_{industry})_{i,t}$  can be viewed as an estimate of the average return in the hotel industry. While this is not strictly true, because the REVPAR only takes into account revenues and not costs, the lodging business is characterized by large fixed costs and modest variable costs, so most variation in return will be due to variation in revenue. In other words,  $Pfm_{i,t}$  measures the excess return of the hotel firm compared with the hotel industry average.

The measure of excess return ( $Pfm_{i,t}$ ) to a large degree filters out the effects of common market movements such as capacity changes in the hotel industry, economic upturns or downturns, seasonality, and other common market factors, so that only hotel-specific variations in return remain. As a result, the ESOC is used to predict whether an enterprise is performing better or worse than the market. However, when there is a strong correlation between the hotel and the market, there will be little variation to explain. The correlation between  $R_{firm}$  and  $R_{industry}$  for Hotels 1, 2, and 3 are 0.94, 0.97, and 0.86, respectively. This means that for Hotel 2 there is very little variation in  $Pfm_{i,t}$  to predict.

In a time-series context, taking the first difference of the logarithmic transformed values removes any deterministic and stochastic trends from the series, as long as it is not integrated of an order of two.

## Empirical Models

To test whether the ESOC can be used to predict financial performance, we began by constructing hotel performance measures according to Equation 5. Then we proceeded with the distributed lag models, where the usefulness of the ESOC variable as a leading indicator is evaluated using Granger causality tests.

## Estimation of Models

For the empirical models, we opted for parsimoniously specified distributed lag models. This seemed to be a sensible choice, given the short time series available and the types of variables used. First, the data are in first difference form, which implies they should be stationary. Second, the ESOC index can most likely be considered exogenous because it is based on questionnaire items that involve a number of different aspects of the hotel that are not directly related to room rates and occupancy. Third, a large part of the monthly variation in REVPAR has been filtered out in the performance measure variable (*Pfm*), which means that less information should be needed to account for the remaining variation and, consequently, there should be less chance of omitted variable bias. Hence, a distributed lag estimated by ordinary least squares OLS should yield unbiased coefficients.

The models are specified as follows:

$$Pfm_{i,t} = \sum_{j=1}^q \delta_j \Delta \ln ESSI_{i,t-j} + u_{i,t} \quad (6)$$

$$Pfm_{i,t} = \sum_{j=1}^q \delta_{i,j} \Delta \ln ORGCOM_{i,t-j} + u_{i,t} \quad (7)$$

where  $Pfm_{i,t}$  is the performance measure introduced in Equation 5 for hotel  $i$  at time  $t$ . We used a general-to-specific modeling strategy, where lag length is reduced until the highest significant lag. Because we have few observations, we generally start out with four lags. For the majority of the models, one or two lags were sufficient to obtain an error term that is normally distributed and not serially correlated.

We also tested our two factor components (operational competencies and operational job attractiveness) in a prediction contest with ESOC:

$$Pfm_{i,t} = \sum_{j=1}^q \delta_j \Delta \ln OPCOMP_{i,t-j} + u_{i,t}, \quad (8)$$

$$Pfm_{i,t} = \sum_{j=1}^q \delta_{i,j} \Delta \ln OPJOBAT_{i,t-j} + u_{i,t} \quad (9)$$

We now turn to the empirical results for two of the three hotel cases.

## Results

In presenting the results, we first examine the ESOC's convergent validity in relation to organizational commitment measures and the prediction contest between the latent factors. Then we proceed with the results of the empirical models.

The correlation coefficients between ESOC and ORGCOM for the three hotels support the assumption that ESOC contains information that is also captured by the organizational commitment construct. The correlations between ESOC and ORGCOM are relatively high:  $r=0.479$  for Hotel 1,  $r=0.445$  for Hotel 2, and  $r=0.224$  for Hotel 3.

Consequently, we can conclude that ESOC and ORGCOM have information in common. We expected this finding, as employees' job commitment should reflect the firms' level of knowledge absorption. Cohen and Levinthal (1990) suggested that, for instance, job rotation increases the effectiveness of knowledge absorption because it enhances the complementarity of experience in the firm. The creation of quality circles, the use of problem solving methodologies, and other management practices that promote employee participation also facilitate the exchange, transformation, and exploitation of knowledge. However, as represented by the correlation coefficients, ESOC is different from ORGCOM. Below, we examine the forecastability of ESOC for the three cases individually and then we proceed to test it against ORGCOM.

*Estimated Single-Equation Models for Cases, ESOC, and ORGCOM*

The ESOC predictors appear to be statistically significant in the estimated models. These models concern Hotels 1 and 3. For Hotel 2, the ESOC index does not appear to contain valuable information for forecasting purposes for the data period in question. We concentrate on the results from the models, as presented in Table 4, that yields significant results before we return to a more general discussion about ESOC's usefulness in forecasting.

For Hotel 1, the ESOC index appears to be useful for forecasting the performance measure based on REVPAR. The estimated model is written as:

$$Pfm_{1,t} = -0.006 + 0.954\Delta \ln ESSI_{2,t-2} + u_{2,t} \quad (10)$$

(0.016) (0.416)

Table 4. Models of Performance using ESOC and ORGCOM Jointly

Performance ( <i>Pfm</i> )					
	Hotel 1		Hotel 2	Hotel 3	
	Full model	Specified model	Full model	Full model	Specified model
$\Delta \ln \text{ESOC}_t$	-0.4074 (0.309)		0.2338 (0.806)	-0.3454 (0.779)	
$\Delta \ln \text{ESOC}_{t-1}$	<b>-1.2290**</b> <b>(0.024)</b>		-0.1166 (0.885)	2.1320 (0.352)	
$\Delta \ln \text{ESOC}_{t-2}$	0.5977 (0.395)	<b>1.2238***</b> <b>(0.000)</b>	0.0587 (0.932)	<b>2.7951*</b> <b>(0.082)</b>	<b>2.5686*</b> <b>(0.052)</b>
$\Delta \ln \text{ORGCOM}_t$	0.2174 (0.244)		-0.0515 (0.821)	-0.3932 (0.578)	
$\Delta \ln \text{ORGCOM}_{t-1}$	0.1088 (0.383)		-0.1241 (0.624)	0.7613 (0.105)	
$\Delta \ln \text{ORGCOM}_{t-2}$	-0.0424 (0.383)	-0.1122 (0.496)	0.0491 (0.586)	0.5011 (0.187)	0.4778 (0.159)
Constant	0.0041 (0.746)	0.0035 (0.754)	-0.0113 (0.505)	-0.0197 (0.585)	-0.0064 (0.803)
Observations	14	14	15	14	14
R-squared	0.68	0.36	0.06	0.60	0.39

p values in parentheses

\* significant at 10%, \*\* 5%, \*\*\* 1%

Standard errors for the estimated coefficients are reported in parentheses. Only the second lag of the ESOC variable is statistically significant. It has the expected sign (i.e., a change in the ESOC index is associated with a change in the performance indicator *Pfm* in the same direction). The long-run effect of a 1% change in the ESOC index is associated with an almost 0.95% change in performance after two months. The  $R^2$  is 31%, which, although modest, can still be important in a dynamic and competitive industry.

All the reported specification tests from the PcGive software were used, which includes tests for normality, heteroscedasticity, autocorrelation, and model specification (RESET), and suggested that the above model is well specified. A test of Granger causality rejected the null hypothesis that the two lagged ESOC indices are not significantly different from zero at the 5% significance level and with an  $F_{2,12}$  value of 6.7547.

The other model that yields significant results relates to Hotel 3. The results are:

$$Pfm_{1,t} = -0.002 + 2.430\Delta \ln ESSI_{2,t-1} + 3.752\Delta \ln ESSI_{2,t-2} + u_{2,t} \quad (11)$$

(0.037) (1.476) (1.406)

Both of the included ESOC lags have the expected sign, but as in model (10) for Hotel 1, only the second lag of the ESOC variable is statistically significant. The long-run response for a 1% increase in the ESOC index is more than 6% increase in the performance indicator after two periods, which is a considerably larger response than in model (8). On the other hand,  $R^2$  is 39%, which is quite similar to model (8).

The results are presented in Table 5 and 6 below. The reported specification tests indicate well-behaved residuals. A test of Granger causality rejects the null hypothesis that the two lagged ESOC indices are not significantly different from zero at the 5% significance level with an  $F_{2,15}$  value of 7.5179.

ORGCOM is only a significant predictor of performance for Hotel 1. The results of the estimated model:

$$Pfm_{1,t} = -0.003 + 0.261\Delta \ln ORGCOM_{1,t} + u_{1,t} \quad (12)$$

(0.015) (0.121)

The current value of ORGCOM is significant at the 5% level. This model has an R<sup>2</sup> of 24%, and the specification tests indicate that the model is well specified, with a well-behaved error term. However, while the model specification is relatively acceptable, ORGCOM's value in forecasting is limited, because only the current value is significant. This means the model cannot forecast the future, but only predict the present.

We also estimated models with ESOC and ORGCOM jointly as predictors. The results of these estimations are presented in Appendix C. For Hotels 1 and 3, two different specifications were used, one with the current value, value lagged one period and value lagged two periods for both ESOC and ORGCOM. The other specification only included the second lag of the two variables. ESOC variables remain significant in these models, providing further evidence of ESOC for forecasting purposes.

*Prediction Contest Between Operational Competencies and Operational Job Attractiveness*

We further considered the prediction of the two factor components “operational competencies” (OPCOMP) and “operational job attractiveness” (OPJOBAT) jointly. We find that models with OPCOMP have significant parameter estimates for Hotels 1 and 3 whereas OPJOBAT has none for the three hotels. The estimated models for OPCOMP with significant parameters are:

$$Pfm_{1,t} = -0.002 + 0.415\Delta \ln OPCOMP_{1,t} + u_{1,t}$$

(0.015) (0.149) (13)

$$Pfm_{3,t} = -0.010 + 1.552\Delta \ln OPCOMP_{3,t} + u_{1,t}$$

(0.045) (0.704) (14)

With an R<sup>2</sup> of 0.35 and 0.26, respectively, they are similar in performance to ESOC.

This preliminary study of ESOC provides some indications that its content and external validity are acceptable, since we use three parallel hotels that belong to different chains, and we test against organizational commitment as a validation instrument. The results also indicate two factor components (operational competencies and operational job attractiveness) of the construct of *employees' intuitive judgments of operational capabilities* constitutes where only the former component predicts our performance measure.

The validity of the ESOC study indicates that two-thirds of the hotel sample is significant. The relatively short data period implies that additional empirical studies are needed to settle this issue. In the future, the sample size should be increased to include a larger number of firms in comparable industries of capital intensive services. If the ESOC can progressively predict financial performance in two-thirds of the firms, then its validity should be considered satisfactory. On the other hand, if the ESOC's ability to forecast decreases as the sample size increases, then its limitations must be discussed in terms of potential systematic restrictions of the model, and whether there are identifiable patterns of decreasing predictability for some hotel categories and not for others.

## **Discussion**

In this study, we have explored whether it is possible to predict financial performance based on frontline employees' sensing and prediction of changes in operational capabilities and accumulated knowledge using a new intuitive judgment indicator, the ESOC. In this initial study of the ESOC, we applied a formative measurement approach and observed 13 ESOC indicators in three time series (three hotels) during 18 months. The results indicate that the ESOC is a useful predictor of changes in economic performance for two out of



three firms. ESOC was tested against the nine-item organizational commitment scale by Mowday, Steers and Porter (1979) and is found to contain information that is different from the ORGCOM scale. We performed a PCA and found that two latent components in particular (OPCOMP and OPJOBAT) make up the index. The results indicated that operational competencies are close in performance to ESOC. This finding suggests that further data collection and testing are needed to determine whether OPCOMP or the aggregate ESOC is the most appropriate predictor of firm performance.

In testing ESOC, we used the part of the variation in revenue per available room that is independent of movements in the market at large. This measurement is analogous to the excess return concept used in finance, and provides a benchmark that reflects how the enterprise is performing relative to the local industry participants. For Hotel 1, the long-run response for a 1% increase in the ESOC is almost a 0.95% increase after two periods with an  $R^2$  of 31%. For Hotel 3, the ESOC also proves statistically significant, with an almost 6% increase in the performance indicator after two periods with an  $R^2$  of 39% as a consequence of a 1% increase in the ESOC. For Hotel 2, in which ESOC does not demonstrate any predictive power, the correlation between the hotel's and the overall hotel market's revenue is 0.98. As a result, very little variation remains to be predicted, and this may explain why ESOC did not prove useful in this case. Consequently, we conducted a telephone interview with the former director of Hotel 2 to examine why the hotel's performance is highly correlated with the performance of the market. One factor in particular became apparent in this interview. The hotel and its affiliated chain corporation operate with dynamic pricing that follows the market; it was one of the first hotel groups in the world to adopt this strategy. In the measurement period from February 2006 to

September 2007, when we collected the ESOC data, it was still common for hotels to operate with a given set of fixed rates. However, according to the hotel director the shift to a dynamic pricing model is gaining popularity because the internet has made hotel pricing largely transparent. Dynamic pricing allows a company to negotiate a discount off the “best available price” rather than pay a fixed price.

As for Hotel 2, the pricing of hotel rooms was adjusted from day to day or from hour to hour based on RateView and Hotelligence systems. These systems highlight competitive price positions, monitor best rate guarantees, and validate rate parity. This real-time market pricing strategy ensures that changes in REVPAR in the hotel unit align with REVPAR changes in the local market. Incorporating the implications of these types of automated pricing techniques is essential for further development of ESOC.

### *Theoretical Implications*

The importance of devising mechanisms that can aggregate locally held knowledge for the purposes of decision-making and planning has long been stressed in social science (e.g., Hayek 1945; Teece 2007). A major finding in this paper is that employee sensing of changes in operational capabilities, as aggregated by the ESOC, has significant short- to medium-term predictive power on firm performance. The main findings of the paper thus suggest that ESOC is a potential new mechanism for capturing locally held employee knowledge that could be of strategic value for managerial decision-making. We believe our findings provide strong support for our theoretical expectations. The consistency of our ESOC results across two different samples (time series) seems to demonstrate the robustness of the methodology. The results also provide some indications about a potential

method for operationalizing dynamic capabilities through employees' sensing of operational capabilities (Helfat and Peteraf 2003; Teece 2007; Winter 2003).

Our preliminary results support the proposition that frontline employees possess expert knowledge that is valuable for predicting the firm performance in capital intensive service organizations like hotels. However, in one firm ESOC did not predict our performance measure. In an interview with the former director, we found that dynamic pricing strategies may result in perfect fluctuations with the market at large and consequently influence the strength in predicting our performance measure. We thus argue that in future studies of ESOC it is critical to explore alternative performance measures that can filter out external market movements and meet the challenge of growth in dynamic pricing by the hotel industry, where prices are based on flexible models and fluctuate according to the individual market demand at a particular time, as well as the particular market's typical rates.

Moreover, the results of the study suggest that we have extended the theory of judgmental forecasting. Our results indicate the utility of systemizing collective human knowledge and judgments as a forecasting tool. While the formative indicators of ESOC prove some indications of the significance of using employee environmental sensing to predict the future state of the company, such indicators may represent employees' predictions about changes in operational capabilities.

The results also indicate the value of applying the ideas of consumer confidence indices to a disaggregate level. The ESOC study is innovative in that no studies have actually focused on frontline employees' collective accumulated knowledge as an unexploited resource that can be used to forecast firms' economic performance.

Moreover, given the relatively short data period of this study, additional empirical studies are needed to demonstrate the index's validity. Future studies should include an increased sample size within the industry and including other industries such as transportation, logistics, and financial services. It is relevant to examine what happens when the sample size increases, to explore the model's limitations in terms of potential systematic restrictions and whether there are identifiable patterns of predictability for some hotel categories and not for others.

One important aspect we were not able to explore due to the short data period is out-of-sample forecasting. Most of the items in the monthly survey comprised questions related to 12 months into the future. An important question is how long it takes, on average, from the time a "symptom" in the hotel business is detected by frontline employees until it manifests itself in the accounting sheets of the firm. One can reasonably imagine a considerable time lag from frontline employees signaling a problem until the company's profits are affected. This will be an issue for future studies.

A related issue is sampling frequency. If there is a considerable time lag between symptom and effect (disregarding any links between the two manifestations), one may argue that a quarterly data frequency is more appropriate. From a firm perspective, lower-frequency data sampling will also be less costly. Monthly sampling of the staff is time consuming, especially if it involves several survey questions. Hospitality businesses are often very busy and tend to have low profit margins, which implies that costs can soon outweigh the benefits of a data sampling scheme when it becomes time consuming.

In future ESOC studies, new indicators that can strengthen employees' predictions of changes in operational capabilities should be examined, and insights into the underlying

latent phenomena of the construct should be enhanced. The latter will require the construction of dynamic factor models that are based on a covariance structure modeling for testing models of relationships between the ESOC variables over time. Since individuals are likely to change from observation to observation, the construct can be the starting point for operationalizing dynamic capabilities as presented by the micro-foundations literature (Teece 1997, 2007). Future studies of ESOC should consider dynamic models for short time series and be able to take changing subjects into account. To our knowledge, such an approach has not been explored in dynamic factor analysis or other dimension-reducing techniques in time-series analysis.

#### *Practical Implications*

The ESOC index comprises 13 items on a five-point scale that address various aspects of the enterprise. The more positive the frontline employees are towards various ESOC predictors, the higher their responses on the five-point scale. This is important because it implies that the ESOC index is not only potentially useful as a forecasting tool; it can also gauge the present state of the business and provide early warning signals from frontline employees regarding various operational changes in the organization. Furthermore, if we consider judgmental forecasting models in addition to standard time-series models, the ESOC may provide potentially useful information for the forecaster (Edmundson, Lawrence and O'Connor 1988; Goodwin and Wright 1993).

Consequently, in future ESOC studies, the focus should be on examining the advancements of the index in relation to managerial decision-making in dynamic strategic renewal processes. Studies should empirically assess employees' qualitative evaluations of

why they predict/expect a given change in operational capabilities, following up items from the quantitative assessments. Such qualitative explanations could serve as innovation inspiration for managerial decision-making. Future studies should also evaluate the economic effects of managerial decision-making that results from such innovation activities by management as fostered through employees' environmental sensing and leading quantitative and qualitative predictions about the business.

## **Conclusion**

In this initial study of the ESOC, based on three short time series, we empirically demonstrate that this new managerial prediction instrument has promise. The major challenges in developing an effective, practical, and leading indicator for hospitality businesses – which can predict their future financial performance based on employees' intuitive judgments and leading predictions of the future state of the business – are related to time consumption, construction of the performance measure, validity, and the explanatory power of the instrument. This implies that future studies should use large-scale samples of firms in comparable industry contexts to further validate the index and perfect the measurement instrument. This includes examining a dynamic factor model approach to predict potential latent variables of the construct *employees' intuitive judgments of operational capabilities*, taking into consideration the variation in subjects from one questionnaire to the next. Future analysis requires further refinements of ESOC variables to incorporate a few significant explanatory financial performance items. The factor analysis performed in this initial study indicates some possible latent variables that may be tested further, and new items may be developed.

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## APPENDIX A

### ESOC Indicators and Related Factor Components

Indicators	Principal Components	Factor Loadings
<i>ESOC1</i>		
Please think about the level of respect that associates of other competing hotels show you because you work for Hotel X. How do you think their level of respect will be for you in the next 12 months versus now?	<i>Operational competencies</i>	0.491
<i>ESOC2</i>		
How do you think the ability of Hotel X in developing new and creative services, systems and processes will be in the next 12 months compared with now?	<i>Operational competencies</i>	0.775
<i>ESOC3</i>		
How do you think the ability of Hotel X to compete in the hotel industry will be in the next 12 months compared with now?	<i>Operational competencies</i>	0.731
<i>ESOC4</i>		
Please think about the guests who have recently visited or stayed in Hotel X. How do you think they will talk about their experiences at the hotel to others during the next 12 months?	<i>Operational competencies</i>	0.660
<i>ESOC5</i>		
How do you think your department manager will solve problems successfully in your department during the next 12 months compared with now?	<i>Operational competencies</i>	0.455
<i>ESOC6</i>		
How do you think that the management of Hotel X will solve problems successfully in the hotel during the next 12 months compared with now?	<i>Operational competencies</i>	0.592
<i>ESOC7</i>		
In the department where you work, how do you think the teamwork will be during the next 12 months versus now?	<i>Operational competencies</i>	0.507
<i>ESOC8</i>		
How do you think the cooperation between departments will be during the next 12 months compared with now?	<i>Operational competencies</i>	0.627
<i>ESOC9</i>		
How interesting do you think your job assignments will be in the next 12 months versus now?	<i>Operational job attractiveness</i>	0.653
<i>ESOC10</i>		
In the next 12 months, do you think you will be more or less interested in entering a higher position at the hotel versus now?	<i>Operational job attractiveness</i>	0.759

Indicators	Principal Components	Factor Loadings
<i>ESOC11</i> In the next 12 months, do you think your chances for being offered a higher position at the hotel will be worse or better versus now?	<i>Operational job attractiveness</i>	0.786
<i>ESOC12</i> In the next 12 months, do you think your earnings (including bonuses and tips) at the hotel will be worse or better compared with now?	<i>Operational job attractiveness</i>	0.699
<i>ESOC13</i> In the next 12 months, do you think you will be less or more interested in getting a job with another employer compared with now?	-----	-0.792

## APPENDIX B

### Agreement of Employees in Responses

The objective of this appendix is to measure respondents' agreement. Measurement of 13 items in three hotels during 18 periods (months) could result in as many as a total of 702 intra-class correlation coefficients. To economize calculations and the visualization of intra-class variation, we used a simpler approach. For each respondent, we calculated the mean score across the 13 items. This calculation was made for each hotel and each period. The mean of the 13 items on the individual respondent level is treated as a proxy for the aggregated ESOC.<sup>1</sup> Variation in the monthly computed ESOC will indicate the level of agreement among employees in their responses.

The items are based on a five-point Likert scale, so magnitudes of the proxy ESOCs will be between 1 and 5. The results of this procedure are shown for each hotel separately in Figures B1-B3. For each consecutive period, the mean and 95% confidence interval is plotted. For Hotel 1, the magnitude of the confidence intervals increases towards the end of the sampling period due to a reduction in the number of responses. Besides this observation, it is clear that the 95% confidence intervals are relatively narrow, which implies that there is a high degree of agreement among respondents. This seems to justify our presumption of aggregating employees' sensing.

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<sup>1</sup> It is not possible to calculate the ESOC on the respondent level in the same manner as on the aggregate level, since the aggregate ESOC is based on counting the number of employees with positive and negative responses (see equations 4 and 5 in the article).

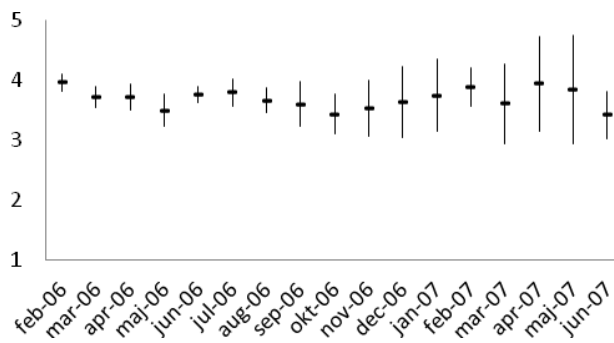


Figure B1. Mean with 95% confidence interval of Hotel 1

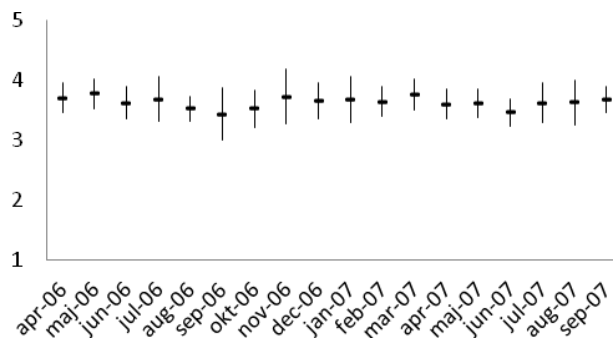


Figure B2. Mean with 95% confidence interval of Hotel 2

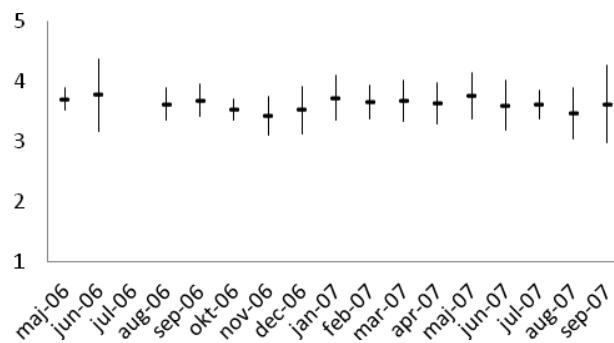


Figure B3. Mean with 95% confidence interval of Hotel 3