# Proposition of an actor-centered measurement instrument for dynamic capabilities research

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**Abstract:**

Strategic management research increasingly seeks to identify processes and activities that constitute dynamic capabilities. At this juncture, researchers try to open the 'black box' of a complex, causal ambiguous construct in order to specify micro-foundations. This effort goes along with several empirical challenges that are only slightly addressed in current research. Therefore, the aim of our paper is to contribute to the methodology of empirical research on micro-foundations by proposing an actor-centered measurement instrument. Based on a review of measurement approaches in dynamic capabilities research, we develop a survey instrument that addresses both individual and organizational dynamic capabilities. We argue that surveying employees provides a reliable and parsimonious way of analyzing the collective mind of organizational members which is supposed to be an adequate method to deal with the causal ambiguity argument. Based on Teece' process model, we develop an action-based operationalization to get to the core of action and interaction. We test the psychometric properties of our survey instrument in a sample of 486 employees from five German organizations. We find dynamic capabilities as a higher-order construct that corresponds to individual capabilities. Particularly, we identify a set of four dimensions, (1) cooperation, (2) reflection and adaptation, (3) creative-problem solving and (4) dealing with complexity, that describe activities in order to reconfigure the organizational resource base. This action-based operationalization provides a basis for a deeper elaboration of micro-activities aiming at strategic renewal. The study's methodological and theoretical contributions with regard to the interdependence of individual and organizational dynamic capabilities are discussed. Finally, we highlight possibilities and limitations for the practical use of the instrument.

**Key words:** resource-based view, dynamic capability view, micro-foundations, survey research, interdependence of individual and organization

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## Introduction

Strategic management research increasingly seeks to identify processes and activities that constitute dynamic capabilities (DCs) in order to advance the understanding of differences in firm performance (Abell, Felin & Foss, 2008; Felin et al., 2012). In particular, the research field is in search for actions and interaction of lower-level entities that impact a firm's capacity to adapt to changes, to learn and to accumulate new skills for sustaining competitive advantages (Teece, 2007). In this regard, activities of individual and collective actors that impact organizational behavior and strategizing are highlighted (Augier & Teece, 2008; Eisenhardt, Furr & Bingham, 2010). However, empirical work on such micro-foundations is quite limited, yet. This may be traced back to new empirical challenges. The micro-foundations discussion shifts the research focus from DCs as an independent variable to a dependent variable of individual and collective action and interaction that does not only explain firm-level performance, but also has to be explained in itself. Thus, research on micro-foundations necessarily is connected to a specification of micro-activities and thus, opening the 'black box' of a causal ambiguous construct (Pavlou & El Sawy, 2011). At this point, established measurement approaches in strategic management research seem to reach limits. Empirical studies on DCs often refer to strategic outcomes that are mainly operationalized with proxy variables, or they use qualitative case studies with a historical perspective (Ambrosini & Bowman, 2009). Such approaches identify DCs post hoc and fail at identifying crucial individual and collective strategic activities (Zahra, Sapienza & Davidsson, 2006).

In our study, we seek to address the challenges of operationalization and measurement of DCs from a micro-perspective by proposing an actor-centered measurement approach. In doing so, we support the idea that an attempt to analyze micro-foundations goes along with the explicit integration of individual actors as unit of analysis in two ways: First, we assume that DCs can be measured by analyzing the collective mind of organizational members. We regard such an approach as an adequate method to deal with the causal ambiguity argument (King &

Zeithaml, 2001). Secondly, we suggest that the analysis of the interdependence of individual capabilities (ICs) and DCs enables drawing conclusions about the constituting activities and processes of DCs. We develop a measurement model that conceptualizes DCs and ICs in terms of specific action and interaction that contribute to the purposeful modification of a firm's resource base as well as to the integration of routines and ordinary capabilities. We transfer our measurement model into a standardized instrument for employee surveys and test it in a sample that consists of 486 employees from five German organizations. We present the evaluation of the instrument and identify second-order models for DCs and ICs. Subsequently, we illustrate the study's methodological and theoretical contributions with regard to the interdependence of ICs and DCs. Finally, we discuss how the developed instrument offers an access for organizations to diagnose strengths and weaknesses in order to deal with dynamic environments.

## 1. Measurement approaches in dynamic capabilities research

DCs have been conceptualized in manifold ways (e.g., Helfat et al., 2007; Teece, Pisano & Shuen, 1997; Winter, 2003). Most scholars agree on the understanding of DCs as a firm's ability and capacity to purposefully integrate, build, and modify its resource base, routines and ordinary capabilities (cf. Barreto, 2010; Wang & Ahmed, 2007). Accordingly, DCs represent higher-level capabilities (Winter, 2003) that change operational capabilities to address, and possibly shape, rapidly changing business environments (Helfat & Winter, 2011). Although there is growing consensus regarding the characteristics and effects of DCs, the field seems to remain fragmented with regard to their origins and influencing micro-aspects (Felin et al., 2012). Scholars increasingly make efforts to open that "black box" of DCs (Pavlou & El Sawy, 2011), e.g. focusing on knowledge, learning mechanisms, decision-making, and cognition (e.g. Augier & Teece, 2006; Corbett & Neck, 2010; Eisenhardt et al., 2010; Felin & Hesterly, 2007; Gavetti, 2005). However, this effort goes along with several empirical challenges.

In the following, we highlight major challenges for empirically researching micro-foundations of DCs. After that we review existing approaches to the operationalization of DCs as a basis for the development of our instrument.

### 1.1. Challenges for researching micro-foundations of dynamic capabilities

The basis for the discussion around micro-foundations may be seen in the notion that „[…] an organization cannot improve that which it does not understand" (Teece et al., 1997, p. 525). In fact, processes and routines are modelled as manifestations of organizational capabilities (cf. Winter, 2003), but the sources of such processes and routines itself remain unfathomed (Felin et al., 2012). Actually, much work has been done on the link between DCs and performance outcomes while the underlying origins seem to be blackboxed (Felin & Foss, 2006). The proposition of a direct link from DCs to performance without considering underlying activities and mechanisms leads unavoidably to the tautology problem (Priem & Butler, 2001; Kraaijenbrink, Spender & Groen, 2010). As a solution, the micro-foundations discussion shifts the research focus from DCs as an independent variable to a dependent variable of individual and collective action and interaction that does not only explain firm-level performance, but also has to be explained in itself. The focus is on "underlying individual-level and group-level actions that shape strategy, organization, and, more broadly, dynamic capabilities, and lead to the emergence of superior organization-level performance" (Eisenhardt et al., 2010, p. 1263). Felin and Foss (2006) specifically point out that the explanatory black boxes in the capabilities approach refer to a) individual-level foundations of capabilities with regard to action and interaction, and b) causal and social mechanisms that describe how individual action and interaction, organizational capabilities and firm-level outcomes relate to each other. Such a deeper understanding may also provide specific approaches for the management of change processes in practice.

Specific challenges for the empirical research on micro-foundations of DCs may be grounded in the conceptualization of the construct itself. DCs are described as a complex construct underlying causal ambiguity (Pavlou & El Sawy, 2011). Going back to the theoretical origin, the dynamic capability view is a further development of the resource-based view of the firm (Barney, 1991; Teece et al., 1997). Therefore, specific bundles of processes, resources and activities are considered as a source of superior performance (Amit & Schoemaker, 1993; Delery & Doty, 1996) even though their link to performance can be understood only imperfectly (Barney, 1991). This also goes along with the assumption that DCs exhibit common characteristics across firms but are idiosyncratic in their details (Eisenhardt & Martin, 2000). With respect to these theoretical roots, the development of DCs is affected by

the tacitness, complexity and specificity of underlying processes, activities, skills, resources, and their relationships. Thus, the generation of DCs would not only be incomprehensible for competitors but also for single organizational members (Reed & DeFillippi, 1990). This might become an iron curtain that prevents a deeper understanding of strategic action (Wilkens, Menzel & Pawlowsky, 2004). Moreover, empirical studies in this field are facing the challenge to address individual and organizational phenomena at the same time. If we accept that the micro-foundations perspective implies researching DCs as a dependent variable of micro-activities, it is essential to bridge DCs as a higher-level construct and individual action and interaction as a lower-level construct (Salvato & Rerup, 2011). Therefore, a consistent conceptual basis on the individual and organizational level seems to be an elementary requirement. This goes along with the development of a specific concept of actors in DCs research that enables closing the operationalization gap by deducing relevant strategic action and interaction (cf. MacLean, MacIntosh & Seidl, 2012; Montresor, 2004). Additionally, considering different levels of analysis raises questions with regard to reasonable practical ways of gathering multi-level data (Foss, 2011). In conclusion, taking on the micro-foundations perspective in empirical studies requires:

- Getting access to the different levels of analysis taking into account the veil of the causal ambiguity argument and considering reasonable expense
- Closing the operationalization gap by specifying indicators of DCs precisely in terms of strategic activities that are carried out by relevant actors throughout the organization, i.e. establishing a concept of actors in strategic management research
- Providing a consistent conceptual basis for addressing such strategic activities on the individual and organizational level alike in order to establish validity on both levels

### 1.2. Review of operationalizations in dynamic capabilities research

In the literature, to some extant the operationalization and measurement of DCs is still seen as an unsolved issue (cf. Ambrosini & Bowman, 2009; Barreto, 2010; Easterby-Smith, Lyles & Peteraf, 2009). However, a growing number of studies empirically deal with DCs. In absence of a widely accepted measurement tool, a great variety of empirical approaches has emerged. On the one hand, there is a plurality of qualitative studies that mainly focus on specific in-depth case studies and identify DCs for example as a successful reaction on radical market

change (e.g. Danneels, 2011; Gilbert, 2006; Harreld, O'Reilly & Tushman, 2007; Tripsas & Gavetti, 2000; Verona & Ravasi, 2003). On the other hand, qualitative studies use case comparisons to identify DCs (e.g. Bingham & Eisenhardt, 2011; Jantunen, Ellonen & Johansson, 2012; Newey & Zahra, 2009). Therefore, most of the qualitative studies identify idiosyncratic characteristics of DCs in a specific setting and deduce their existence post hoc from performance (Zahra et al., 2006). In this instance, we agree with Zahra et al. (2006, p. 923) who note that such approaches to the assessment of DCs "make it difficult or even impossible to separate their existence from their effects".

Quantitative studies that use proxy variables seem to suffer the same point of criticism (cf. Arend & Bromiley, 2009). In such quantitative studies DCs are operationalized in terms of (industry-specific) input and output factors. The most common proxy variables for describing DCs are such as R&D expenditures (e.g., Helfat, 1997; Hsu & Wang, 2012; Tsai, 2004), marketing expenditures (e.g., Dutta, Narasimhan & Rajiv, 2005), cycle time (e.g., Macher & Mowery, 2009), number of patents (e.g., Tsai, 2004; Rothaermel & Hess, 2007; Dutta et al., 2005), citations (e.g., Deeds, DeCarolis & Coombs, 1999; Rothaermel & Hess, 2007), number of units sold (e.g., King & Tucci, 2002), number of strategic alliances (e.g., Deeds et al., 1999; Rothaermel & Hess, 2007), usage of IT (Drnevich & Kriauciunas, 2011), technology usage (Stadler, Helfat & Verona, 2013) or working hours and frequency of tasks (Iansiti & Clark, 1994). In this instance, a major problem is to capture the theoretically postulated complexity of DCs. Input-output models cannot fully encompass the causal ambiguity of organizational capabilities (cf. King & Zeithaml, 2001; Powell, Lovallo & Caringal, 2006). They are closely related to success factor research and remain under-complex with respect to the basic theoretical assumptions. Especially the process perspective is neglected in the suggested operationalizations. However, recently some progress has been made with regard to this issue. A growing number of quantitative studies make an effort to operationalize DCs as a discrete construct. Such operationalizations explicitly assess the execution of activities and processes, performance figures relative to competitors, or the extent to which capabilities are possessed. This efforts lead to operationalizations such as the performance of 'New Product Development', 'New Process Development', 'Idea Generation' and 'Market Disruptiveness' (McKelvie & Davidsson, 2009), 'Marketing-related Capabilities' and 'Technology-related Capabilities' (Song et al., 2005), the extent of 'Coordination', 'Learning', and 'Strategic

Competitive Response' (Protogerou, Caloghirou & Lioukas, 2012), the effectiveness of 'Sensing', 'Learning', 'Integrating', and 'Coordinating' (Pavlou & El Sawy, 2011), or the frequency of processes emerging from 'Sensing', 'Seizing' and 'Reconfiguring' (Wilden et al., 2013). Although some of these operationalizations lead to industry-specific indicators, more and more studies refer to the framework provided by Teece (2007). He identifies clusters of activities and describes them in a process of (a) sensing opportunities and threats, (b) seizing opportunities, and (c) transforming the firm's intangible and tangible assets. This disaggregation can be seen as a step towards a comprehensive model of DCs.

However, most of the studies that use Teece' framework, conceptualize DCs as an independent variable of new opportunities and sustained performance outcomes. They show, for example, impacts of DCs on organizational performance in terms of firm survival and growth (Wilden et al., 2013) or on profitability and market performance (Protogerou et al., 2012). Concrete action and interaction underlying DCs are still underrepresented in this perspective. Moreover, the challenges going along with the causal ambiguity argument seem unsolved, yet. The data collection in these studies is based on surveying single managers from multiple different organizations as key informants (e.g. Pavlou & El Sawy, 2011; Protogerou et al., 2012). Therefore, the picture of an organization arises from the evaluation of a single manager or different managers who are asked about differing topics. At first glance such an access seems comprehensible because managers represent key persons that seem to be aware of unobservable processes in their area. However, in a resource-based logic it is argued that the complex links of resources, processes and strategic activities resist a precise identification not only for competitors but also for single organizational members, even the top management (Reed & DeFillippi, 1990). For example Powell et al. (2006) point out that the management's perception of firm performance is impacted by causal ambiguity. This may lead to biased, mostly overestimated, evaluations.

According to these considerations, we can state that significant progress has been made on the operationalization of DCs as a discrete, multi-dimensional construct. Such approaches provide valuable insights into constituting dimensions as well as into direct or indirect effects of DCs. At the same time, the mentioned approaches do not seem unrestrictedly transferable to the micro-foundations perspective since concrete action and interaction of individual and collective actors as well as the causal ambiguity argument are addressed insufficiently.

## 2. Development of an actor-centered measurement instrument

In this section, we present our proposal of an actor-centered measurement instrument for research on micro-foundations of DCs. First, we explicate the fundamental considerations that lead the development of our measurement tool. Second, we introduce our conceptual basis for the individual and organizational level of analysis. Finally, we present the survey design.

### 2.1. Starting point for the development of the measurement instrument

According to the challenges for empirically researching micro-foundations of DCs, we suggest a measurement approach that explicitly addresses the micro-level. For the development of our instrument we accept sequences of action and interaction as the unit of analysis and, thus, take on an actor-centered perspective. Following our objective to develop an approach that enables specifying links between the individual and organizational level, we regard a quantitative approach as suitable. A standardized quantitative approach seems a prerequisite for examining causal relationships between different levels of capabilities. Moreover, a standardized instrument enables surveying a large number of respondents on a consistent basis. This is of particular interest since DCs are a causal ambiguous construct and perceptions of processes and activities can be assumed to vary within an organization (cf. Johnson & Hoopes, 2003). Therefore, it seems insufficient to use top manager or other single gatekeepers as informants for the data collection. We propose to capture that variance by surveying employees throughout the organization in order to get access to the collective mind of an organization, i.e. the shared perceptions and interpretations concerning the execution of strategic activities (cf. Wilkens et al., 2004). In doing so, we follow the suggestion that the analysis of the collective mind of organizational members is an adequate method to deal with the causal ambiguity argument (King & Zeithaml, 2001). As subjects of the assessment we develop indicators that describe concrete action and interaction on the individual and collective level. Therefore, the respondents do not need to be aware of the specific contributions of processes or strategic activities to the organization's capabilities. The respondents assess the execution of every-day-activities. The relevance of these activities for the purposeful modification of the organization's resource base is founded theoretically. To develop such an action-based operationalization we refer to the model of Teece (2007) which is increasingly used to establish indicators for empirical approaches. In contrast to existing

approaches, we use this framework to deduce specific actions that are connected to the execution of sensing, seizing and transforming on both the individual and the organizational level. For this purpose, we enrich the framework of Teece with considerations from competence research that are rooted in organizational behavior and behavioral psychology.

### 2.2. A conceptual framework for measuring individual and dynamic capabilities

Conceptually, our starting point is the process model of Teece (2007) which disaggregates DCs into three interlocking components: sensing, seizing and transforming. Based on this conceptual framework it seems possible to specify critical strategic activities that constitute DCs and, subsequently, aim at modifying the organizational resource base. In the following, we briefly summarize the foundations of sensing, seizing and transforming in order to specify the underpinning actions and interaction currently discussed in research.

Since proactively responding to a changing environment requires searching for new information (March, 1991) and new knowledge combination that is specific to the context (Eisenhardt & Martin, 2000), *sensing* refers to analytical systems and capacities to scan, filter and shape opportunities and threats (Teece, 2007). Therefore, getting access to new information and shaping opportunities by the usage of new information seem important. Following Teece (2009), this involves the understanding of latent demand, the development of industries and markets, as well as responses of suppliers and competitors. On a micro-level, Teece (2009) highlights cognitive and creative capacities of individuals. Individual and organizational knowledge and learning processes can lead to the creation of new opportunities. This is associated to a systematic observation of external and internal developments and their interpretations in relation to existing knowledge and novel solutions. In this regard, Hallin, Andersen and Tveterås (2012) emphasize the importance of locally held operational knowledge. They found that the sensing performed by "frontline employees" is a better predictor of organizational performance than executive judgments and, therefore, concluded that employee sensing can serve as a basis for evaluating the effectiveness of key operational capabilities. Their findings suggest that the observations of employees throughout the organization, as well as their creativity and ability to understand customer decision making can be significantly valuable for strategic alignment.

*Seizing* the opportunities sensed requires strategizing around investment decisions and leveraging products and services from one application to another (Teece, 2007). Hence, seizing refers to unbiased decision-making in ambiguous situations which goes along with the creation of "an environment where the individuals involved in making the decision […] feel free to offer their honest opinions, and look at objective (historical) data in order to escape from closed thinking" (Teece, 2007, p. 1333). Furthermore, Teece (2009) refers to the importance of building networks within and outside the organization in order to prevent biased decisions and to create new solutions. Thus, communicating goals, values and expectations, as well as motivating others may be critical activities for the seizing capability.

The final cluster, *transformational capabilities*, includes the abilities to manage threats and to reconfigure assets and organizational structures in order to prevent inertia (Teece, 2009). This includes combining know-how within and outside the organization, and enabling novel approaches for assembling and integrating resources (cf. Lee & Kelley, 2008). Establishing procedures for sharing and integrating knowledge in a collaborative surrounding as well as the creation of proper learning settings may be critical for transforming (cf. Teece, 2009).

All in all, sensing, seizing and transforming are viewed as interacting clusters that are underpinned by different activities on multiple levels. But although individual and collective levels are addressed, the framework does not provide a clear bridge between the levels. Moreover, from an action-based perspective, sensing, seizing and transforming partly require similar action and interaction. For example, social actions like building and maintaining reliable networks seem important to seize opportunities but also to transform the organization's assets and structures. Sharing and combining knowledge even seem to be important for the execution of all three process clusters. Therefore, we see a need for specifying observable action and interaction in order to establish a distinct multi-dimensional measurement model.

From a conceptual point of view, common ground for individual and collective action and interaction is required. Regarding the theoretical roots of DCs and the activities described in the framework of Teece (2007), a central subject across the levels is the capacity to act and to create new solutions in ambiguous and dynamic situations. Such capacities are systematically described in competence research (cf. Campion et al., 2011; Spencer & Spencer, 1993). In organizational behavior and behavioral psychology competences refer to the successful and

self-organized coping with changing requirements in ambiguous situations which is a result of problem-solving skills, knowledge and abilities (cf. Erpenbeck, 2009; Shippmann et al., 2000). First articles in strategic management research point to the potential of the competence construct. For example Salvato and Rerup (2011) show that it "provides a starting point to bridge individual and organizational levels of analysis" (p. 474).

**Figure 1. Analytical framework representing the translation of Teece' cluster of activities into action and interaction**


Wilkens and Gröschke (2008a) explicitly outline actions and interactions that are necessary to deal with ambiguous situations. They refer to theories of action that can explain action from a multi-level perspective. In particular, they take into consideration the Theory of Complex Adaptive Systems (Kauffman, 1993, 1995; Holland 1995) and the Social-Cognitive Theory (Bandura, 1986) to capture the process and activity character of competence on multiple levels. They adopt an agentic perspective that explains both individual motivation to act and collective efficacy. Following Bandura (2000) collective attainments are not only the products

of shared knowledge and skills but also of interactive and coordinative dynamics of their transactions. On this basis, Wilkens and Gröschke (2008a, b) describe actions that focus on the purposeful selection of information and the relating of new information to existing action options. This is associated with the reflection of options to act and the systematic use of feedback mechanisms. Reflecting information, decisions and behavior in general seems to be fundamental for acting effectively in ambiguous situations. Furthermore, they identify specific activities of knowledge creation and combination as crucial to deal with ambiguous situations. These activities are targeted at the purposeful application of knowledge in different situations. Further, they connect the addressing of changes to the capability to collaborate with different stakeholders within and outside the organization. Wilkens and Gröschke (2008a, b) translated these actions and interactions into an item battery that encompasses 23 items on the individual level and 21 items in the organizational level. We use these items as the basis for our measurement model in order to specify the process model provided by Teece (2007). Figure 1 displays our general framework.

### 2.3. Survey design

As outlined above, we use an actor-centered approach to get to the core of action and interaction that underpin DCs on a micro-level. Additionally, we integrate ICs to capture the link between the individual and organizational level. This goes along with the notion to identify DCs as a function of corresponding ICs. Therefore, we transferred our approach into a standardized survey instrument that can be targeted at all employees of an organization. In order to proactively address potential problems of self-reports in a cross-sectional design, we adopted several measures to optimize the psychometric properties of the instrument (Mabe & West, 1982; Podsakoff et al., 2003). To avoid ambiguity and ensure understandability of the questionnaire, all instructions and verbalization of items were previously discussed with key people in the organizations surveyed (above all, workers council, CEO, technical director, HR manager). If necessary, verbalizations were adapted or added to with case-specific examples. Furthermore, all respondents were informed about how the data would be used; anonymity and data confidentiality of the responses were assured in staff meetings with participation of the workers' council, with data privacy statements and in the cover letters. The respondents were also asked to answer the questions spontaneously as honestly as possible and it was

emphasized that there were no right or wrong answers. Following the recommendations of Mabe and West (1982) for capability measures, instructions in the questionnaire followed the principle of social comparison (e.g., with colleagues holding similar positions/an average successful organization in same industry). Our action-based items were measured on a seven-point Likert scale ("does not apply at all" to "applies fully"). We used numerical anchors to illustrate equidistance (Rohrmann, 2007). All items aim at actions required to deal with continuous strategic renewal and emphasize social actors' actually realized performance. Sample items are displayed in Appendix A.

## 3. Evaluation of the instrument in employee surveys

Following the framework of Teece, DCs describe a multi-dimensional construct. Therefore, the task for the evaluation of our instrument is to capture that multi-dimensionality of DCs and corresponding ICs. We applied the survey instrument in five German organizations and used exploratory factor analyses as well as confirmatory factor analyses in order to establish the dimensionality of the operationalization.

### 3.1. Methodology of data collection and sample

To test our instrument we applied it in five German organizations. The application took place in the context of a larger research project. The five organizations are subjected to different but dynamic competitive environments (plant engineering, retailing, health care, ecclesiastical non-profit, automotive). The environmental challenges have been previously discovered in structured interviews with key informants of the organizations (CEO, technical director, HR manager) in order to assure the suitability of the organizations for the purpose of our study. For instance, the plant engineering company is particularly influenced by political and fast technical changes and it is affected by the market entry of Chinese competitors. On the contrary, dynamics in the hospital association evolve from legal, political and technical changes, such as complex medical guidelines and a low half-life of knowledge. In order to provide a survey instrument with validity in different industries, it is especially interesting to analyze industrial contexts with different challenges for organizations. Based on the preference of each organization, the survey was either provided online or as a paper-pencil version. Following the idea to analyze the collective mind of the organizational members to

get access to crucial strategic actions and interactions the questionnaire was targeted at all employees of each organization. In total, we surveyed 486 employees, i.e. we realized an averaged response rate of 52%; differing in the cases between 36% and 87% (Table 1).

**Table 1. Overview of sampling**

| Industry | Main products or services | Sampling unit | No. of employees / sample size |
|---|---|---|---|
| Plant engineering | Ready-to-use nonwoven machines | Entire organization | 171 / 112 |
| Retailing | Specialist sports products | Entire organization | 86 / 75 |
| Health care | Hospital association | Entire organization | 139 / 73 |
| Non-profit | Management of a diocese | Entire organization | 376 / 137 |
| Automotive | Steering systems, R&D | One business location | 162 / 89 |

The gender distribution seems to vary according to the industry, from 10% of female participants in the automotive company to 40% in both the hospital association and the ecclesiastical non-profit organization. Most of the respondents are between 40 and 49 years old (35%), 29% between 50 and 59, 21% between 30 and 39, 10% between 20 and 29, and the remaining 5% over 60. Job tenures differ corresponding to the age distribution. Most of the employees surveyed are qualified workers, holding a university degree or having a vocational education.

### 3.2. Testing the dimensionality of the measurement model in exploratory factor analyses

In order to establish the dimensionality of our measurement model, we adopted exploratory factor analyses. In a first step, we inspected missing values as well as the distribution of items, their means, standard deviations, difficulty and item-total correlation. We excluded eleven data sets from the sample due to more than 10% missing values. All remaining missing data were completely missing at random referring to the test of Little (1988). Therefore, we were able to apply the EM algorithm in order to create a complete data set (cf. Scheffer, 2002). Unsurprisingly for capability measures, all items tend to negative skewness. Three items on individual level were excluded because of extreme distributions, low difficulty and low item-total correlation (< .30). The remaining items were included in exploratory factor analyses. Since we assume DCs and ICs to be multi-dimensional constructs, indicators built are supposed to belong to the same latent factor and, thus, axes are not required to be orthogonal. Therefore, we applied principal axis analyses with promax rotation.

On both levels the Kaiser-Meyer-Olkin scores (.887 resp. .953) and the Bartlett's test of sphericity display acceptability for the application of the method. All items showed a high measure of sampling adequacy (> .80). During the analyses, we excluded three more items on the individual level and four items on the organizational level because of weak commonalities and/or weak loadings and/or cross-loadings. The resulting factor structures illustrate ideal loading patterns. For both capability levels four factors were extracted, explaining 44% (ICs) respectively 76% (DCs) of variance. The four factors extracted reveal a high correspondence on the both levels and describe the activities aiming at *cooperation*, *reflection and adaptation/learning*, *creative problem-solving* and *dealing with complexity* (Table 2).

**Table 2. Factors of DCs and ICs as results of exploratory factor analyses**

| Factor | Description | No. of items | IIK | Alpha | ITK | Factor loadings |
|---|---|---|---|---|---|---|
| *Dynamic Capabilities (DCs),* $\alpha_{overall}$*: .967* | | | | | | |
| Cooperation | Activities targeted at purposefully building and maintaining relationships with other actors on the market in order to expand the organization's options to act, and to reinforce intra-organizational collaboration | 5 | .75 | .94 | .76-.88 | .60-.97 |
| Reflection and Adaptation | Activities of analyzing, evaluating and adjusting the effectiveness of organizational development processes, structures and projects | 3 | .83 | .94 | .83-.89 | .68-.88 |
| Creative Problem-Solving | Activities targeted at experimenting with novel approaches, integrating new strategies, and using creativity techniques to create new problem solutions | 4 | .72 | .91 | .75-.83 | .66-.98 |
| Dealing with Complexity | Activities of observing, absorbing and structuring environmental change, sensible selection and systematical elaboration of information, and the regulation of responsibilities | 5 | .71 | .92 | .67-.86 | .55-.86 |
| *Individual Capabilities (ICs),* $\alpha_{overall}$*: .871* | | | | | | |
| Cooperation | Actions aiming at a flexible adapting to different persons, demanding but also offering help, dealing constructively with conflicts, holding on to commitments | 5 | .36 | .74 | .43-.59 | .45-.80 |
| Reflection and Learning | Actions of reflecting and evaluating conducts and acts, inviting and putting feedback into practice, and adapting others strategies for own improvements | 5 | .37 | .75 | .46-.60 | .40-.71 |
| Creative Problem-Solving | Actions of applying own knowledge to various problem situations, using creative methods and striking out on new paths to develop problem solutions | 3 | .52 | .76 | .46-.70 | .42-.92 |
| Dealing with Complexity | Actions of planning, priority setting and monitoring of tasks and steps, managing time and goals effectively, getting one's ideas across | 4 | .32 | .66 | .40-.51 | .39-.67 |

With regard to first generation methods, the factors show satisfying properties. The item-total correlation (ITK), inter-item correlation (IIK) and values for Cronbach's Alpha point to a good correspondence between the items and the scales (Table 2). For Cronbach's Alpha all scales reach the general recommendation of > .70, except for individual 'Dealing with Complexity' with $\alpha = .66$. Given the number of items and the early stage of test development this value seems acceptable. The factors correlate between .44 and .59 on the individual level and between .67 and .76 on the organizational level. An additional exploratory factor analysis considering for all items simultaneously (unrotated and using varimax rotation) indicated a clear separation of ICs and DCs. There is no general factor apparent and the factors jointly explain 65% of variance. Following the logic of the Harman's one factor test, this indicates that common method variance is unlikely to confound the results (Podsakoff et al., 2003).
All in all, the exploratory factor analyses support the assumption that DCs and ICs are multi-dimensional constructs with corresponding dimensions.

### 3.3. Individual capabilities and dynamic capabilities as second-order constructs

We further inspected the structure of the measures by using confirmatory factor analyses (maximum likelihood algorithm, AMOS 21). In consequence of the results of the exploratory factor analyses, we estimated reflective second-order models (Jarvis, MacKenzie & Podsakoff, 2003) for ICs and DCs that represent holistic constructs using *cooperation*, *reflection and adaptation/learning*, *creative problem-solving* and *dealing with complexity* as first-order constructs.
The analyses give support for the second-order structures (Table 3), showing good fit with regard to common fit indices (cf. Baumgartner & Homburg, 1996; Hair et al., 2006; Hu & Bentler, 1999). With regard to the significant chi-square, we have to consider that the value is likely to be overestimated due to skewness, sample size and complexity of the models. However, normed chi-square, CFI, TLI, RMSEA and SRMR point to a good fit of the models. On the contrary, single-factor models did not fit the data well. Following our suggestion of analyzing the interdependence of individual actor's capabilities and organizational DCs, we also tested a combined model that takes into consideration both levels. This model also shows a good fit (Table 3) and all loadings and weights are significant at $p < .001$.

**Table 3. Model fit of second-order-models compared to single-factor models**

| Construct | Model | Normed $\chi^2$ | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|
| Individual Capabilities (ICs) | Second-order | 2.110 | .954 | .937 | .048 | .048 |
| | Single factor | 5.183 | .821 | .763 | .094 | .065 |
| Dynamic Capabilities (DCs) | Second-order | 2.659 | .982 | .973 | .059 | .027 |
| | Single factor | 12.491 | .869 | .814 | .156 | .057 |
| Combined Model ICs-DCs | | 1.986 | .958 | .951 | .045 | .045 |

In order to assess the dimensionality, reliability and validity of the measures with the use of second generation methods, we applied indicator reliability, composite reliability, average variance extracted (AVE), $\chi^2$-difference statistic, and Fornell-Larcker criterion (Fornell & Larcker, 1981). The reliability values in each model exceed the recommended level of > .40 for indicator reliability (Bagozzi & Baumgartner, 1994) and are above the threshold of .60 for composite reliability (Bagozzi & Yi, 1988). The values for indicator and composite reliability derived from the combined model are displayed in table 4, together with the correlations. The AVE is .786 for DCs and .658 for ICs and, therefore, clearly exceeds the requirement of > .50 (Fornell & Larcker, 1981). Consequently, the indicators seem sufficient in their representation of the second-order constructs.

**Table 4. Correlation matrix, indicator and composite factor reliability**

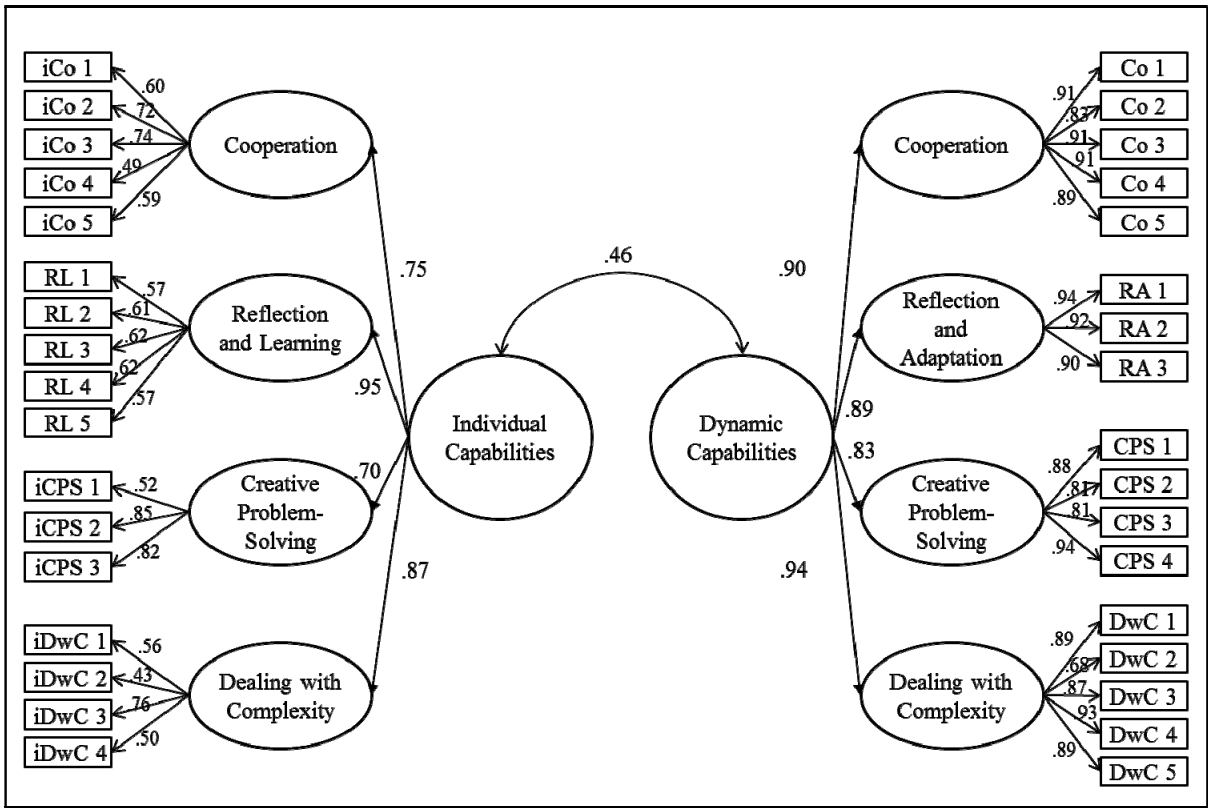
| | | Construct | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | Individual Capabilities (ICs) | (.88) | | | | | | | | | |
| 2 | | Dynamic Capabilities (DCs) | .44 | (.94) | | | | | | | | |
| 3 | INDIVIDUAL | Cooperation | .71 | .31 | (.50) | | | | | | | |
| 4 | INDIVIDUAL | Reflection and Learning | .94 | .42 | .66 | (.88) | | | | | | |
| 5 | INDIVIDUAL | Creative Problem-Solving | .70 | .31 | .50 | .66 | (.49) | | | | | |
| 6 | INDIVIDUAL | Dealing with Complexity | .87 | .39 | .62 | .82 | .61 | (.76) | | | | |
| 7 | ORGANIZATION | Cooperation | .39 | .89 | .28 | .37 | .27 | .34 | (.79) | | | |
| 8 | ORGANIZATION | Reflection and Adaptation | .40 | .89 | .28 | .37 | .28 | .35 | .79 | (.80) | | |
| 9 | ORGANIZATION | Creative Problem-Solving | .36 | .82 | .26 | .34 | .25 | .32 | .73 | .73 | (.67) | |
| 10 | ORGANIZATION | Dealing with Complexity | .42 | .95 | .30 | .39 | .29 | .37 | .84 | .85 | .78 | (.89) |

in parentheses: composite reliability for ICs and DCs; indicator reliability for first-order factors

Further, the two superior factors in the combined capability model show satisfying discriminant validity following the $\chi^2$-difference test and the Fornell-Larcker criterion. The

$\chi^2$-difference of the competing model is significantly higher than that of the unconstrained model (> 3.84). The AVE of each superior latent factor is higher than the variance shared between DCs and ICs ($AVE_{ICs}$ = .658, $AVE_{DCs}$ = .786, $r^2$ = .196). For criterion validation of the superior factors, we integrated scales for individual "self-efficacy" and "collective efficacy" (Schwarzer & Jerusalem, 1995) as general indicators for the ability to act in ambiguous situations. ICs relate to individual self-efficacy with .859 ($p < .001$) and DCs relate to organizational-level collective-efficacy with .825 ($p < .001$). Figure 2 illustrates the capability model and provides the loadings of the factors as well as the interrelation of ICs and DCs. ICs and DCs correlate highly significant (r = .456). Therefore, the estimated model clearly indicates a relationship between the capabilities of individuals throughout the organization and the DCs of the organization itself.

**Figure 2. Representation of the capability model including DCs and ICs**




In a last step of test evaluation, we examined the measurement invariance of the capability model (Byrne, Shavelson & Muthén, 1989; Steenkamp & Baumgartner, 1998). This is of particular interest since we applied the survey instrument in five different organizations. Therefore, we estimated different multi-group models and compared the fit of unconstrained

measurement models with the baseline model. We find significant standardized factor loadings and satisfying discrimination for each group. Thus, we can assume configural invariance. We tested for invariance of factor loadings to investigate if the second-order factors have comparable loadings, and if their relationships are equal across cases. The fit of this model with constrained measurement weights shows no large differences compared to the unconstrained model. For the measurement intercepts between groups we found some variance but can assume partial invariance (cf. Byrne et al., 1989). This is in line with the consideration of idiosyncratic capability structures in the DCs research.

In sum, the results of the model testing indicate that the developed measurement model is reliable and valid in the representation of action and interaction required for strategic renewal on both the individual and the organizational level. Starting with an explorative approach we find four distinct capabilities that together represent ICs and DCs. Moreover, the results suggest that the measurement model can be applied in different dynamic contexts in order to analyze the specific capability structure of an organization. Additionally, a significant relationship between the capability levels is clearly indicated. Therefore, the developed measurement approach enables analyzing the influences between the individual and organizational capabilities on a consistent basis. All in all, we can conclude that the model provides an access for analyzing critical action and interaction that foster DCs.

## 4. Discussion

In this paper we presented an actor-centered measurement approach and evaluated a related survey instrument that integrates DCs and ICs. In consideration of recent developments on the discussion around micro-foundations of DCs, it was our aim to address the challenges of operationalization and measurement from a micro-perspective. We proposed the idea to explicitly integrate individual actors as unit of analysis to overcome the constraints that are connected to measurement approaches using input-output factors or general proxies for performance. Furthermore, we promote the idea that the analysis of the collective mind of organizational members provides a reliable access to a causal ambiguous construct. Therefore, the objective of our study was not only to develop an operationalization that specifies DCs in terms of action and interaction but also to provide an instrument that allows for the interdependence of DCs and ICs.

### 4.1 Theoretical and managerial implications

This study has three major findings with impact for both theory and practice. First, it provides a conceptualization of DCs in terms of concrete activities of individual and collective actors and, thus, builds a bridge between the individual and the organizational level. We empirically identified a set of four capabilities required to deal with dynamics that is valid on the two levels. Second, the study suggests a quantitative measurement approach for analyzing DCs in consideration of causal ambiguity. As a result of the study, we can present a survey instrument that can be applied in different dynamic contexts to analyze the capability structure of organizations. Third, our results empirically support the existence of a link between the capabilities of individual actors and the dynamic capabilities of the organization. These findings have implications for conceptualizing and measuring DCs from a micro-perspective, and point to practical approaches with regard to organizational change processes.

Referring to the recent literature, the developed operationalization contributes to the opening of the black box of DCs (Felin & Foss, 2006; Pavlou & El Sawy, 2011). The operationalization goes beyond input-output-models and the identification of DCs post hoc, and therefore, provides an access to a deeper elaboration of the nature and development of DCs. With the specification of action and interaction that constitute DCs, we follow the calls for empirical approaches that take into consideration the impacts of individual and collective actors on strategic renewal (e.g., Abell et al., 2008; Salvato & Rerup, 2011). In particular, we identified *cooperation*, *reflection and adaptation/learning*, *creative problem-solving* and *dealing with complexity* as action-based manifestation of the process model provided by Teece (2007). From our results we conclude that sensing, seizing and transforming require actions and interactions that can be specified with these four dimensions on the organizational and on the individual level. By not focusing on strategic processes but on specific actions, it is possible to propose a multi-dimensional construct that specifies activities which are carried out by organizational actors in order to reconfigure the organizational resource base. In doing so, we also addressed the challenge to shed more light on the causal ambiguous interrelations of strategic actions (King & Zeithaml, 2001). By developing a measurement approach that analyzes the collective mind of organizational members, we allow for the notion in the resource-based view that the links between resources, processes and strategic activities are inaccessible for single organizational members (Reed & DeFillippi, 1990). Instead, we exceed

the idea to rely the identification of these interrelations on the shared mental models of an organization's members (Wilkens et al., 2004). Since our operationalization focusses on concrete action and interaction, the organizational members do not need to have expert knowledge on specific strategic processes, resources or their adjustment. This may provide insights into alternative methodological approaches in DCs research.

Moreover, this study provides a consistent conceptual basis for bridging the individual and the organization level. Interactions between activities on the different organizational levels are viewed as critical in the process of shaping routines and capabilities (Felin et al., 2012). By referring to competence research, we focused on capacities to act and problem-solving capabilities in ambiguous situations as definitional basis for the cross-level operationalization. This enables the explication of a concept of actors for strategic management research by referring to an agentic perspective (cf. Bandura, 2000). Additionally, the cross-level operationalization facilitates to investigate the relationships between capabilities on the individual and organizational level (cf. Salvato & Rerup, 2011). Following Felin and Hesterly (2007) skills and capabilities are heterogeneous between individuals, and therefore, their contribution to the organizational performance varies. Thus, an investigation of the links between ICs and DCs can increase the comprehension of what makes differences and drives variations in the behavior and organizational performance in certain ways (Felin et al., 2012). Highlighting the interdependence of ICs and DCs reflects that DCs can be rooted in individual action and their interaction (Felin & Foss, 2009). Furthermore, an elaboration of this interrelation provides a basis for examining causal and social mechanisms that help to understand how individual and collective actors contribute to the modification of an organization's resource base (Felin & Foss, 2006). It allows for testing possible mediating or moderating effects of structures and processes influential for the development and deployment of DCs (cf. Felin et al., 2012). At the same time, analyzing the constituting micro-variables of DCs provides a way to avoid the tautology that is inherent when analyzing DCs as somehow firm-specific independent variable of superior performance (Kraaijenbrink et al., 2010). Additionally, our results show that the measurement model has validity in different organizations, operating in different industries. Therefore, we regard the measurement approach as a basis for analyzing idiosyncrasies and commonalities of DCs (Eisenhardt & Martin, 2000). Using the instrument in a variety of organizations would enable

the empirical identification of differences and similarities in the representation of DCs. Therefore, also industry-specific effects could be obtained. This may also bring clarity to the question if DCs are only valuable in high velocity markets or also advantageous in more traditional industries (e.g., Eisenhardt & Martin, 2000; Zahra et al., 2006).

Form a practical point of view, the developed survey instrument can be applied in order to examine an organization's strength and weaknesses in addressing environmental change and, therefore, to support the development process of DCs. The instrument can help to manage change processes in ambiguous situations by not only monitoring capabilities but also by providing specific measures to their future advancement. For example, in combination with data feedback sessions with employees from different working areas, the data gathered with the instrument can be used to specify necessary interventions for recent and future organizational developments. Since it is a standardized quantitative instrument it does not only provide a parsimonious way for analyzing a large number of employees but also for integrating further variables of interest, e.g. in the context of annual employee surveys. A regular application of the survey instrument would enable a continuous monitoring process which can be assumed to be of high interest in order to proactively respond to dynamically changing environments. The instrument may be also used to identify the capability structure of an organization allowing for specific contributions of individual and collective actors. In this instance, the use of the instrument can indicate critical transfer problems across the capability levels – for example if the results reveal high capabilities for the employees but low capabilities for the organization. Integrating additional variables from organizational behavior, such as motivation or work structuring, can create opportunities for identifying and shaping specific measures in order to foster the development and deployment of ICs and DCs. For example one can derive measures in order to motivate and to empower employees to participate in change processes. This may be of particular interest since highly capable employees can make major impact on strategic decisions. At the same time, there is no guarantee that employees contribute with their capabilities to the organizational level. With the help of our instrument, such critical linkages can not only be made transparent but also measures to shape them can be developed. Therefore, the application of the instrument in practice allows testing for organization-specific leverage effects with regard to strategic change processes. Additionally, critical points in the organization, like interfaces between

different business divisions, can be focused to deduce strategic developmental steps. The instrument enables analyzing differences in the capabilities of business divisions or even crucial teams. For instance, organizations may be interested in the question, if the capabilities of different employees and divisions interact in an advantageous way for the organization. Therefore, we assume that the instrument can support strategic decision-makers with regard to the future alignment of resources.

### 4.2. Limitations and future research directions

Some limitations of the present study have to be considered. The first limitation derives from the cross-sectional design of the study, which does not allow to approve causality or to fully capture procedural developments. Therefore, in future research the instrument may be applied in the context of longitudinal studies to examine the long-term developmental process of DCs with regard to influencing micro-variables. Further, using longitudinal studies enables approving the causality of the relationship between ICs and DCs. Second, the generalizability of the instrument can be further supported by applying it in a higher variety of organizations operating in different industries. A more comprehensive data base, for example, can be used to derive findings concerning (industry-specific) commonalities and idiosyncrasies of DCs. Third, aiming at a further validation of the instrument, variables that may influence the evaluations of respondents, such as personality traits (cf. Podsakoff & Organ, 1986), could be integrated. Although we regard such factors not as very likely to impact the results due to the action-based operationalization and the survey design that considers recommendations for the use of self-evaluations (Mabe & West, 1982; Podsakoff et al., 2003), this possibility cannot be completely ruled out, yet. Finally, the variables used in this study were limited to individual and organizational capabilities. As mentioned above, future research may draw conclusions with regard to the causal and social mechanisms that describe how individual action and interaction, organizational capabilities and firm-level outcomes relate to each other (Felin & Foss, 2006). This seems particularly valuable given our finding that ICs and DCs correspond to each other. In sum, we believe that our measurement approach and survey instrument contain the potential to deepen the understanding of the micro-activities that constitute DCs.

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# Appendix

A 1: Sample Items

| Variable | | Sample item[1] |
|---|---|---|
| **Dynamic Capabilities** | Cooperation | *"Important contacts are maintained continuously in our organization"* |
| | Reflection and Adaptation | *"In our organization, we critically assess the effectiveness of completed projects"* |
| | Creative Problem-Solving | *"In our organization, we on and off give new methods a try in order to develop problem solutions"* |
| | Dealing with Complexity | *"In our organization, we systematically analyze environmental conditions"* |
| **Individual Capabilities** | Cooperation | *"In the face of problems, I do not hesitate to seek others' assistance"* |
| | Reflection and Learning | *"I actively seek feedback from others in order to increase my performance"* |
| | Creative Problem-Solving | *"In order to develop new problem solutions, I often make use of creative approaches"* |
| | Dealing with Complexity | *"Even if the situation is vague, I am able to estimate how much time it will take to finish a task"* |
| **Self-Efficacy** | | *"If an unexpected situation occurs, I am confident about my ability to do my job"* |
| **Collective Efficacy** | | *"In our organization, we are confident that we can manage difficult tasks even in adverse situations"* |

[1]Sample items translated into English for illustration