

Roots and Development of Capabilities in Economic Science: A Bibliometric Analysis

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Abstract--To achieve a sustainable competitive advantage a firm needs to pay close attention to its resources and capabilities. At present identifying and assessing capabilities is considered as one of the main challenges due to different constructs, understanding and perspectives about the term 'Capability' itself and the role it plays in strategic management. The objectives of this research is to use bibliometric analysis to profile and structure the body of knowledge of the research field 'Capabilities in Economic Science'. Co-word analysis is used to examine the relationships between different concepts of capabilities and their related sub-fields. The article shows that the research area of 'Dynamic Capabilities' is not only highly relevant to develop an innovation strategy, but also considered a disputed research domain. The result of this research illustrates and classifies the current body of knowledge to identify gaps for future research and collaboration.

I. INTRODUCTION

Observing the global economy, companies aim at a strategy that continuously leads the organization to a top market position, at this point they are able to cope with shifting market forces, competition and grow beyond their targets. To sustain an achieved market position and to reach business goals, firms need to focus on their competitive advantage.

Thought leaders for example Michael E. Porter or Gary P. Hamel contributed different models (e.g. Porters' model about Generic Competitive Advantage and Value Chains, or Hamel's concept about core competencies) to suggest directions for firms how to generate a competitive advantage and sustain their performance. Taking these models as examples researcher and economist pay high attention to firms' resources and capabilities and consider them as the main part of strategic management. Successful competitive strategies need to be developed based on special capabilities, scarce resources, resulting in distinctive competences, which confer value to the customer [1]. Based on the view that being different means that a capability gap between producer and its competitor exists, scholars research resources and capabilities as sources for competitive advantage [2].

A group of scholars [3-5] narrowed their research scope to resources as firms' sources for competitive advantage. Examining the attributes of firms resources, M. A. Peteraf [6] and Barney [7] argued that resources need to be immobile and heterogeneous to generate competitive advantage. Besides this M. A. Peteraf [6] and Barney [7] researched the criteria 'valuable', 'rare', 'inimitable' and 'non-sustainable' as necessary to create competitive advantage. Teece and

Pisano [8] observed, that companies are confronted with changing market conditions and need to adapt, integrate, and reconfigure their resources towards changing environments to sustain their market position. Based on that they built on the resource-based view and introduced the dynamic capability framework defined as an approach to generate sustainable competitive advantage.

Even though dynamic capabilities are researched for more than twenty years, it is still considered as an open construct with fundamental disagreements about the definition of dynamic capabilities, its borders and impact to firms' competitive advantage and firms' performance [9]. The work of Zahra [10] is one example that exhibits nine different definitions for the term dynamic capabilities. Recent research about dynamic capabilities [11] applied bibliometric analysis combined with round table discussions between the key players of this research field to structure the knowledge field and develop a general accepted construct for dynamic capabilities.

Due to a lack of a common accepted construct for 'Dynamic Capabilities' researcher are hindered to examine empirical support for this research field. Thus "Dynamic Capabilities" experiences critics about its utility. It also leads to the challenge of identifying and assessing dynamic capabilities within organizations [12]. Identifying capabilities itself as a first step for its assessment is considered a main challenge among economists [13]. Thus firms encounter difficulties assigning attributes and indicators for assessment purposes of capabilities. Current assessment methodologies of firms infer special capabilities from observed current firms performance in the market, instead of looking for other explanations. Talking about a halo effect, companies overestimate their own capabilities, resulting in misleading strategic choices and a loss of market share to their competitors [1, 14]. Based on research it seems that disagreements about the definition for capabilities is one cause for the challenge to identify and measure capabilities.

This paper goes beyond a bibliometric analysis for the term 'Dynamic Capabilities' and expands the bibliometric analysis to the knowledge field 'Capabilities in Economic Science'. Outcomes of a bibliometric analysis for capabilities will show a knowledge profile, including the development of the field, its key players and related subfields. In context to this the relevance and impact of the research area dynamic capabilities will be identified. Results of this work will be used to develop a coherent research agenda to investigate a construct for the term 'Capabilities' with determined

attributes in order to develop an assessment model for firms' capabilities in further research.

II. LITERATURE REVIEW

A. Dynamic Capabilities - A Framework for Competitive Advantage

The dynamic capability approach builds on the theory of the resource-based view, and researchers suggest a framework that addresses the shifting environments firms have to cope with. This is estimated as the main challenge for staying in an advanced competitive position [15]. Based on that Teece and Pisano [8] defined capabilities in their foundational work as 'part of strategic management to adapt, integrate, and re-configure internal and external organizational skills, resources, and functional competences toward changing environments' and provided a basic definition for the dynamic capability framework.

Researcher introduced the dynamic capability construct as a framework to achieve and maintain competitive advantage. Teece [16] suggests three categories of dynamic capabilities that a company needs to sustain performance:

- (1) Sensing – Analytical Systems to Learn, Sense, Filter, Shape and Calibrate Opportunities
- (2) Sizing – Enterprise Structures, Procedures, Designs and Incentives for Sizing Opportunities
- (3) Transforming/Reconfiguration – Continuous Alignment and Realignment of specific tangible and intangible Assets.

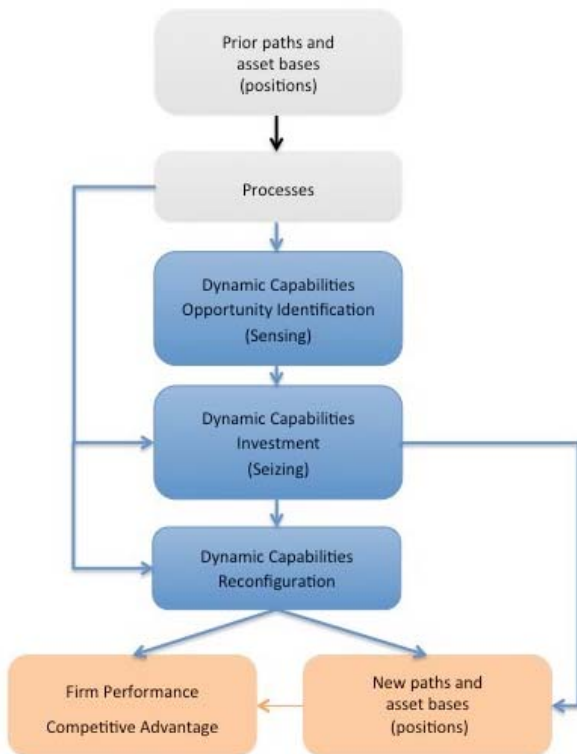


Fig. 1. Chain of Logic for Dynamic Capabilities adapted from [15]

Each category represents a subset of enterprise capabilities that need to be adapted to environmental conditions. Arend and Bromiley [12] criticized a lack of measurements models described in literature showing the impact of dynamic capabilities to firm performance and questioned the link between dynamic capabilities and competitive advantage.

Helfat and Peteraf [17] support the exhibition of Teece [16, 18] and explained that the opportunity identification (sensing), its investments (sizing), as well as its continuous adjustments (reconfiguration) will lead to new path and position and will thus affect firms performance and competitive advantage (Fig. 1). In context to this the path refers to company's strategy, which is affected by changes, resulting from the recognition and exploitation of opportunities [8]. Positions refer to company's current status quo in terms of their resource base. It includes tangible and intangible assets that need to be gained orchestrated and coordinated. That means, to sustain competitive advantage, it is necessary to develop dynamic capabilities that extend, create, integrate, modify and deploy resources [9, 16, 19, 20].

Researchers consider processes, path and positions as the core building blocks for dynamic capabilities [8, 17, 20]. The ability of a company to design, develop, implement and adjust processes, path and position, in order to gain competitive advantage is strongly influenced by the top management of a firm. For that reason the dynamic capabilities approach is also regarded and researched as a set of entrepreneurship capabilities [10, 20, 21]. According to Teece [20] firms strategy, their management and firms dynamic capabilities codetermine firms' performance. He supports Rumelt's [22] view that a strategy requires following actions:

- (1) Prescient Diagnosis
- (2) Guiding Policies
- (3) Coherent Action

Teece [20] brought Rumelt's [22] core activities for a successful strategic management into context with the three categories for dynamic capabilities sensing, sizing, and transforming. He then linked them to the needed type of management behavior (Table 1). He argued that it is part of strategic management to recognize and assess opportunities, which can be linked to 'prescient diagnosis' and is supported by entrepreneurship. Besides this, firms underlie continuously strategic choices and changes. The resulting decisions of these changes are expected to be made by the entrepreneur. To lead recognized opportunities to success resources need to be allocated and mobilized, thus administrative skills are necessary. Because of that Teece [20] linked 'Guiding Policy' to 'Seizing/Transformation' supported by administrative management. Since leadership skills are required to renew strategies and implement opportunities

resulting into strategic changes, 'Leadership' is assigned to 'Coherent action' and ,Seizing/Transformation'.

TABLE 1. THE INTERRELATION OF DYNAMIC CAPABILITIES AND STRATEGY ADAPTED FROM [19]

<i>Strategy Kernel</i>	<i>Diagnosis</i>	<i>Guiding Policy</i>	<i>Coherent Action</i>
Related Dynamic Capabilities Clusters	Sensing	Seizing/Transformation	Seizing/Transformation
Nature of Managerial Orchestration	Entrepreneurial	Administrative	Leadership

Helfat and Peteraf [21] support the view that dynamic capabilities are part of strategic management and examined types of cognitive management capabilities necessary to build the dynamic capabilities sensing, sizing, and forming (Fig. 2). They argued that not only physical activities of firms' management are influencing the development of dynamic capabilities but also mental activities of the management. All dynamic capabilities have potential impact to strategic change, resulting in firm's performance.

Arend and Bromiley [12] stated that the challenge to evaluate dynamic capabilities on firms' performance and competitive advantage is caused by an unclear definition for dynamic capabilities and its attributes. Helfat and Peteraf [17] emphasized that dynamic capabilities rest upon resources and suggest evaluating dynamic capabilities on VRIN

characteristics (valuable, rare, inimitable and non-sustainable) estimated as key criteria for being competitive in the market. Eisenhardt and Martin [23] analyzed whether dynamic capabilities are showing VRIN characteristics and deduced that dynamic capabilities are valuable, 'somewhat rare' and substitutable. They argued that dynamic capabilities are built on processes, will develop common features to increase effectiveness and will show idiosyncrasy in details. Based on that, Eisenhardt and Martin [23] marked dynamic capabilities as best practices reasoning that the criteria inimitability and immobility are irrelevant for estimating the combativeness of dynamic capabilities. It leads them to the conclusion that dynamic capabilities are a source for competitive advantage but not for sustainable competitive advantage. Teece [20] agrees that dynamic capabilities can be depicted as best practices and suggests classifying dynamic capabilities in ordinary and dynamic best practices. He explained ordinary best practices as operational, administrative and governmental processes securing the 'technical fitness' of a firm, which is inevitable to assert oneself in the market. In contrast to ordinary best practices, dynamic best practices base on VRIN resources, turn into signature practices, leading to sustained competitive advantage. Referring to its distinction, Teece [20] evaluates firms' capabilities based on weak ordinary capabilities, strong ordinary capabilities and strong dynamic capabilities. The following Table 2 summarizes characteristics of each category for capabilities.

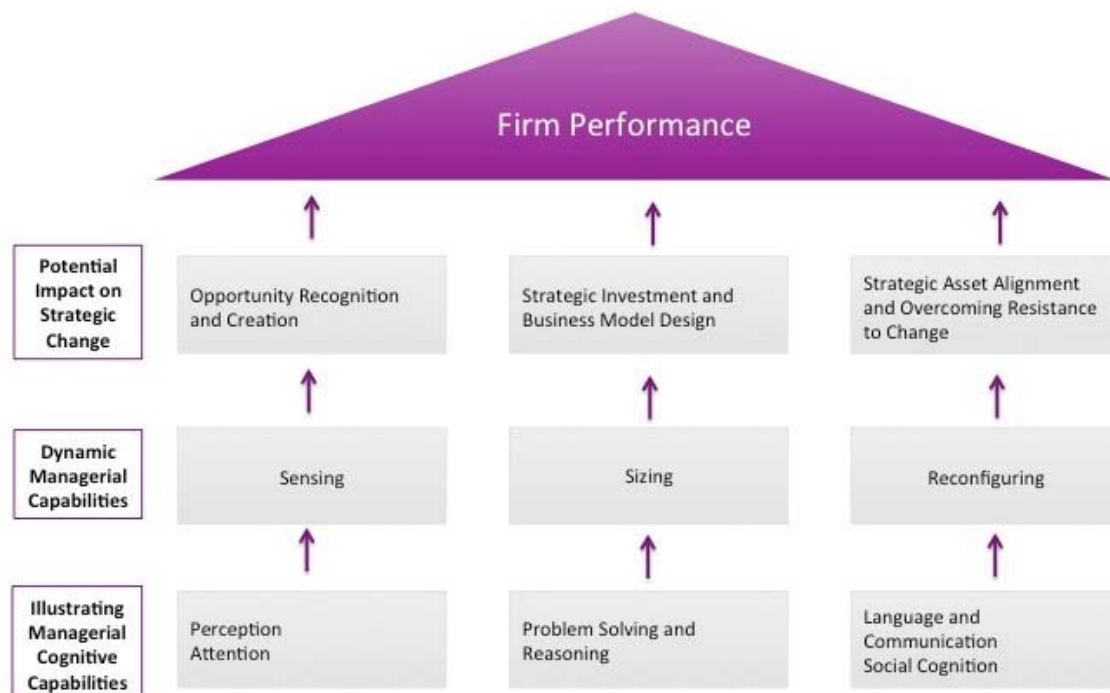


Fig. 2. Managerial Cognitive Capabilities, Dynamic Capabilities, and Strategic Change adapted from [20]

TABLE 2. ELEMENTS OF CAPABILITY FRAMEWORK ADAPTED FROM [19]

<i>Core Building Blocks</i>	<i>Weak Ordinary Capabilities</i>	<i>Strong Ordinary Capabilities</i>	<i>Strong Dynamic Capabilities</i>
Processes (Routines)	Sub-Par Practises	Best Practices	Signature Practices and Business Models
Positions (Resources)	Few Ordinary Resources	Munificent Ordinary Resources	Leadership
Paths (Strategy)	Doing Things Poorly	Doing Things Right	Doing the Right Things (Good Strategy)

B. Bibliometric Analysis

Bibliometric Analysis is a systematic quantitative approach to analyze scientific and technological publication based data with the goal of assessing the output of scientific literature [24, 25]. Since researchers encounter an increasing pressure to provide quantitative evidence for scientific work, bibliometric analysis is used to support objectivity of research investigations. Bibliometric analysis provides scholars with the opportunity to go beyond a snapshot of time for data collection and perform a longitudinal study by aggregating a large number of published papers over a self-determined timeframe [26]. Thus biases of surveys, which tend to be subjective or expert opinion based on a small group of representatives can be reduced [27-29]. Analyzing the core of literature, results of bibliometric analysis provide research landscapes, and illustrate relationships between research concepts, yielding new inspiration for research ideas and research problems. It supports researchers to understand the core of knowledge of a research field, their subfields and related fields. Based on that research trends are analyzed to generate research agendas or new research constructs [26-28, 30]. Beside this bibliometric analyses are examined within the industry as a tool for economists, e.g. applied for Technology Forecasting [31] and R&D Management [32, 33], Innovation Management and Intellectual Property [34, 35], or Strategic Management [29].

1) Techniques of Bibliometric Analysis:

The original measurement of bibliometric analysis is the Science Citation Index (ISI) established by Eugene Garfield in 1960 [36]. Based on a high number of citations researcher conclude a high impact of a publication and subsequently identify the core of a literature field [37]. Since it is not sufficient to count citations of published documents, co-citation and co-word analysis are additional methods to apply clustering, ordination and multivariate techniques in bibliometric analyses [28]. The results of Co-Citation Analysis shows the relationship between articles or authors[38]. Co-Word analysis refers to the content of a text and identifies the relationships between keywords or noun phrases representing the knowledge core of a paper. Looking for the frequency of co-occurrence of items, e.g. citations or words, clusters are built and strong or weak relationships between them can be measured [27]. If two items co-occur, researchers conclude the similarity of two articles and a high likelihood that the same research fields are addressed. The

frequency of co-occurrence indicates the strength of a relationship between research papers. Analyzing the results of bibliometric investigations, researchers suggest considering time related indicators, e.g. percentage of paper in time periods or observations of separate time periods to conclude the dynamic of a research field. Beside this, scholars review structural indicators e.g. linkage density of cluster, centrality and interdisciplinarity between clusters to interfere core content and impact of published data [27, 28, 39].

2) Bibliometrics for Dynamic Capabilities:

Scholars have worked out several revisions and refinements of the term ‘Dynamic Capabilities’ itself during the last decades. Researchers consider the research field dynamic capabilities as an open construct with fundamental disagreements and have undertaken bibliometric efforts to examine the intellectual core of dynamic capabilities, supporting the development of a commonly accepted construct e.g. [11, 26, 40, 41]. Analyzing the citation index, researcher identified work of Teece, Pisano and Shuen [18], Eisenhardt and Martin[23] , Zollo and Winter[42], Helfat and Peteraf [43] as well as Winter [44] as the core papers providing the foundations of dynamic capabilities. Further bibliometric analysis discovered the work of Teece, Pisano and Shuen [18] and Eisenhardt and Martin [23] as contrary core concepts for dynamic capabilities [38]. Peteraf, Stefano and Verona [45] consider that as a cause for an evolvement of two separate knowledge networks and two bodies of knowledge for dynamic capabilities. This perspective is supported by the results of the author map analyses of Wilden and Dowling [11]. Moreover Peteraf, Stefano and Verona [41] explored Resource Based View, Knowledge Based View and Behavioral Theory as the main heterogeneous theoretical roots for dynamic capabilities. According to Peteraf, Stefano and Verona [41] the named theories foster the development of different knowledge branches for dynamic capabilities. On one hand research papers aim at a discussion about dynamic capabilities related to the achievement of competitive advantage and their impact to firms’ performance. On the other hand research paper were published, that examine dynamic capabilities as enabler for organizations to cope with changing environmental conditions.

Beside an identification of core paper and theoretical roots for dynamic capabilities, researcher have investigated related knowledge areas influencing the theory building process for dynamic capabilities. Peteraf, Stefano and Verona [41] depict

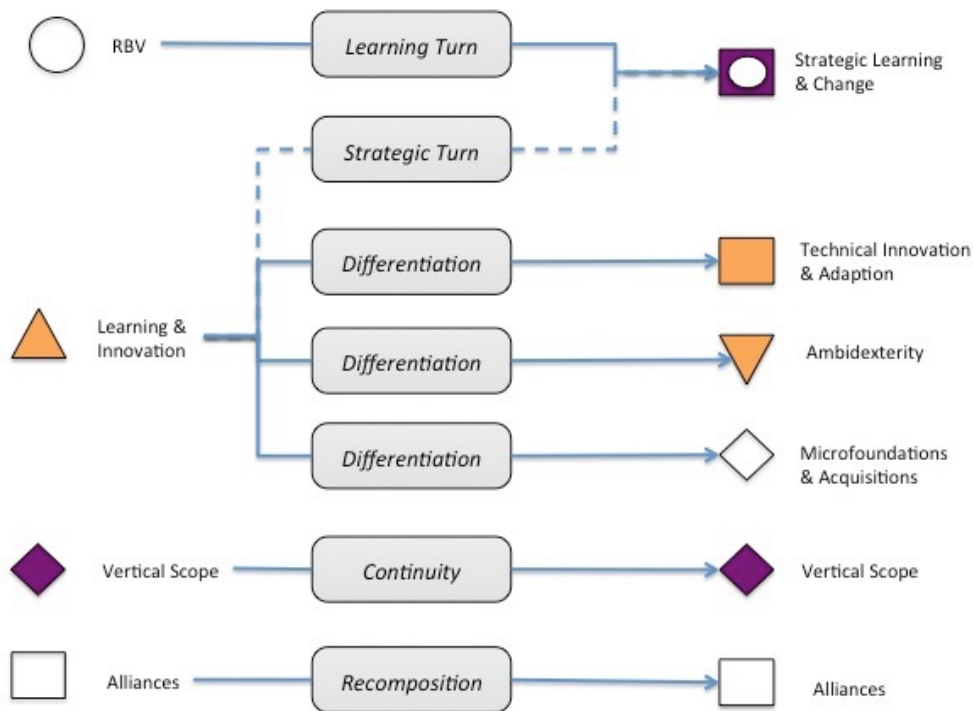


Fig. 3. Development of pattern of Dynamic Capabilities Research adapted from [25]

Resource Based View (RBV), Transaction Cost Economics, Learning Theory, Social Theory and Social Psychology as related knowledge domains, where RBV reveals the strongest relationship to the cluster dynamic capabilities. To evaluate the knowledge core for dynamic capabilities, Güttel and Vogel [26] divides their observation period into 1994-2008 and 1994-2011. Their results of a publication analysis show an exponential growth of publication since 1994 and doubled amount of relevant papers from 2009 until 2011. Taking these time periods into consideration Güttel and Vogel [26] explored a shift in knowledge cluster for dynamic capabilities. Their results are illustrated in Fig 3.

Güttel and Vogel [26] infer Strategic Learning and Change as the core cluster for dynamic capabilities emerging from the former core cluster resource based view. According to their analysis, arguments from RBV and learning theory in context to configuration processes merged together into the cluster “Strategic Learning and Change”. Observing a turning point 2009, Güttel and Vogel [26] regard the resource based view as integrated in the research agenda of dynamic capability since then. Wilden and Dowling [11] bibliometric results show a research shift from strategy and performance linked models of dynamic capabilities to integrative investigations of performance, dynamic capabilities and resource-based view. It supports Güttel and Vogel [26] conclusion that theories about resource based views have influenced the development of the dynamic capability construct.

Wilden and Dowling [11] determined the scientific documents of Teece, Pisano and Shuen [18] and Teece [16] as foundational work for dynamic capabilities. Thus they infer the time period 1997-2006; 2006-2011; and 2011-2015 for their assessment. According to Wilden and Dowling [11] Teece’s second core paper, which depicts dynamic capabilities as processes of sensing, seizing and forming gave the impulse for process-orientated models for dynamic capabilities. Discussions about dynamic capabilities as basis of competitive advantages and the importance of market environmental conditions and change became rare.

Moreover Wilden and Dowling’s [11] findings present resources, learning, routines and performance as a knowledge core for dynamic capabilities. They observed a focus shift to micro-foundational and cognitive models, including discussions about enablement of dynamic capabilities. Management and human resource related topics to dynamic capabilities occur and technology and R&D related topics are declining at the same time.

3) *Dynamic Capabilities - First Construct:*

Researcher used their results of bibliometric analysis to propose a basic definition of a construct for dynamic capabilities. As mentioned before researchers have examined two main knowledge domains and author networks for dynamic capabilities. For that reason Peteraf, Stefano and Verona [38] suggest integrating both approaches and providing a metaphor (Fig. 4) as a starting point for a construct.

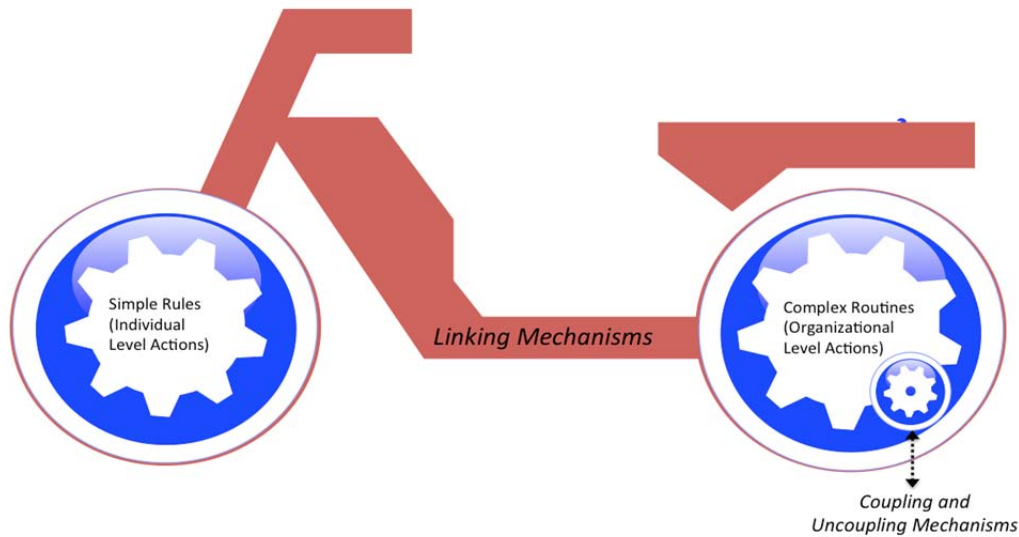


Fig. 4. The Organizational Drive Train adapted from [38]

Referring to the definition and discussion about dynamic capabilities as routines which existence encounter boundary condition in high velocity markets Peteraf, Stefano and Verona [38] assume that companies need both complex and simple routines, independent from their market environment. In that way they overcome the discussion of boundary condition for the existence and application of dynamic capabilities as exhibited in the chapter before. Based on that the illustration shows that both stable and adaptive processes operating simultaneously in an organization, which need to be linked and coordinated.

Wilden and Dowling [11] concluded from their bibliometric analysis and roundtable discussion that dynamic capabilities are ‘multilevel phenomenon’ and proposed ‘The House of dynamic capabilities’ (Fig.5). In their point of view dynamic capabilities are the ‘pillars’ integration all organizational level, directed by the overall strategic orientation. They support the view that routines, illustrates an enabler in their figure, are the foundation and regulate the behavior within and across all levels.



Fig. 5. The House of Dynamic Capabilities adapted from [11]

Outcomes of bibliometrics analysis for ‘Dynamic Capabilities’ present a broad variety of connections to fields and subfields, leading into complexity [17, 40]. Literature Reviews illustrated the results of bibliometric analysis, showing that two knowledge branches have been evolved. This circumstance leads to fundamental disagreement about the construct and explains the confusion about meaning and utility among scholars. Thus an unclear theoretical framework exists for dynamic capabilities, which is additionally a cause for the lack of empirical research within this research area.

C. Research Scopes and Objectives

Researcher aim at developing a theoretical framework for dynamic capabilities and applied bibliometric analysis in order to develop foundational constructs which presents all perspectives. The Literature Review shows first outcomes, e.g. the house of dynamic capabilities, nevertheless dynamic capabilities are still considered as an open construct that needs to be researched further.

The scope of this investigation is to build on the bibliometric analysis for the term dynamic capabilities and broaden the knowledge map focusing on the term ‘capability’. The research objective of this work is profiling the body of Knowledge for ‘Capabilities’. The author considers dynamic capabilities as a part of the research area capabilities. The author’s point of view the term dynamic refers to a behavior of a capability. For evaluation purpose of capabilities it is necessary to provide a definition with attributes that can be assessed. To identify core elements for the development of a commonly accepted construct for capabilities the author deems it necessary to include capabilities in bibliometric analysis. By creating a knowledge

profile of capabilities and by analyzing knowledge clusters, the relevance of the research area dynamic capabilities within the knowledge field itself can be identified. Examining key players and professional network of the field, new potential collaboration among scholars can be inferred, which researchers of dynamic capabilities have not yet thought of.

III. METHODOLOGY

Scopus provides more than 60 million records which can be searched for capabilities. To make sure that the data outputs match the research scope ‘Capabilities’ investigated in the research field Economic and Science, the author refines the first search. As illustrated in Fig. 6 the first search query delivered more than two hundred thousands hits. Since this investigation will focus on capabilities researched in economics science, it is necessary to pick research results matching this research field. For that reason the data output is limit to the subject areas Business Management, Decision Science, Economics and Finance. To increase the reliability of the research the second refinement narrows the scientific output down to the document types journals, conference paper and articles in press.

Finally, the used search boolean for ‘Capabilities’ yielded 19975 hits in Scopus. The outcomes were checked for unrelated publications and authors within the Scopus’ search results. After removing noise the search results involved 19903 hits. The author uses this output and the tool ‘Analysis Search Results’, provided by Scopus, to start with the bibliometric analysis. The results of bibliometrics supported by Scopus include an exhibition of the top ten authors, their author- and article metrics.

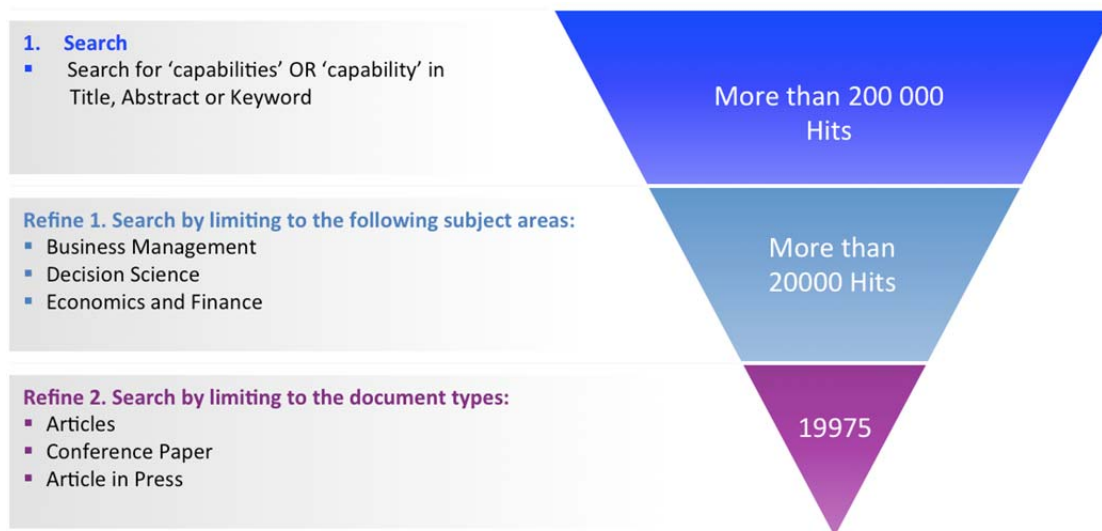


Fig. 6. Search Boolean for Data Sample

For the analysis of the collaboration among researchers and for analysis of the knowledge fields that are related to capabilities, the Software Vantage Point was used. Before conducting the analysis a dataset needs to be prepared. Matching the set search query for ‘Capabilities’ 19903 records were extracted from Scopus to Endnote. This represents the ‘Capability Publication Database’. The author used Endnote to clean the dataset and to remove 148 duplicates. It leads to a database of 19755 records. Each record within the ‘Capability Publication Database’ includes information about: Author (s), Document title, Year, Source Title, Volume, Issue, Pages, Citation Counts, Keywords, Source and Document Type. These items are used by Vanatge Point to perform bibliometric analysis.

IV. RESULTS

A. Research Community

Results of the set search query in Scopus show that 167 authors address the field ‘capabilities’. Fig. 7 illustrate the top 10 authors, ranked by their number of published documents for the knowledge field ‘Capabilities’. Purpose pf the research paper is to focus on these top ten authors to investigate the question of how the main author impacting the research field ,capabilities’.

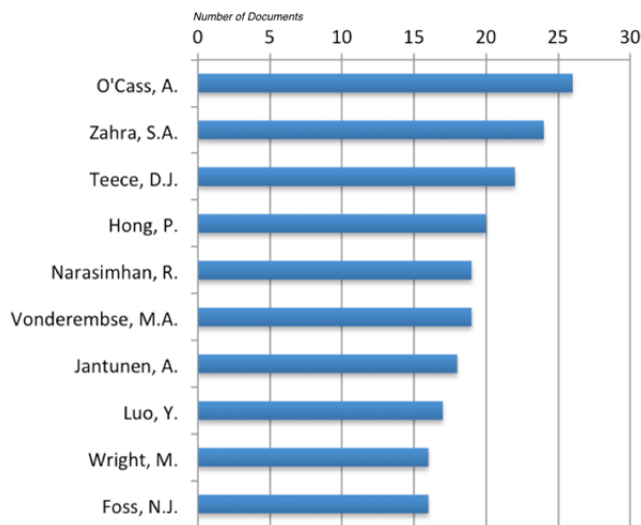


Fig. 7. Leading authors, recorded in Scopus Database - Total number of publications

Peteraf, Stefano, and Verona [42]; Güttel and Vogel [26]; Stefano, Peteraf, and Verona [36] performed a bibliometric analysis to investigate the main influencer of the research field ‘Dynamic Capabilities’. Based on their investigations, the following Fig. 8 emphasized all authors, considered as researcher for the field ‘Dynamic Capabilities’.

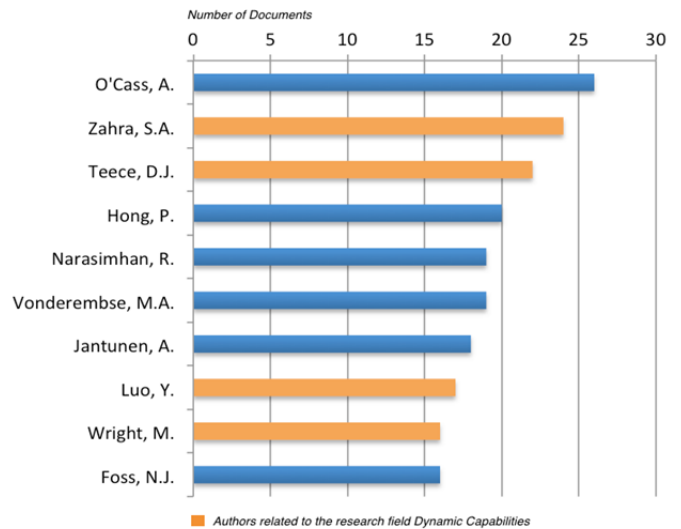


Fig. 8. Leading authors recorded in Scopus Database - Total numbers of Publications

With regard to the former outcome, the next diagram ‘Citation Overview-Top Ten Authors’ (Fig. 9) shows a citation overview of each author listed in Fig. 7 and Fig. 8. These citation counts (exclude self-citations) are referring to all documents, each author published within the research field ,Capability’.

The digram ‘Citation Overview – Top Ten Authors’ indicates, that D.J. Teece has the most citations with an overall number of 10589 quotes. In 2013 Teece reached the highest citation counts of 1211. Scopus counts 2146 citations overall for S.A. Zahra, representing the second position. In 2012 S.A. Zahra reached the highest number of citations with 319 counts. M.A. Vonderemse is ranked third position with 1113 citations. He could reach a peak in 2014 with 168 citations.

In context to Fig. 9, the following Table 3 summarized documents with the most citations and its year of publication for each author. After that the Fig. 10 provides a citation overview of documents listed in Table 3.

Data of the Table 3 and Fig. 10 show that the citation counts of Teece’s work are significantly higher than the citation counts of the other authors. Teece’s work is cited 17 times more than Zara’s document. The value of the peak within Teece’s graph is 801 citations in year 2011. Zahra’s graph is showing the highest point at 69 citations in year 2013. Comparing the values of both authors the difference leads to of 732 counts.

Teece’s graph also represents an optimum curve, marking a plateau that stretches from 2010 until 2014. During this time period the average value of citations for this paper is 751. The graph of Zahra’s citation counts indicates a similar behavior. From 2012 – 2015 the average citations for her paper are 65.

Citation Counts

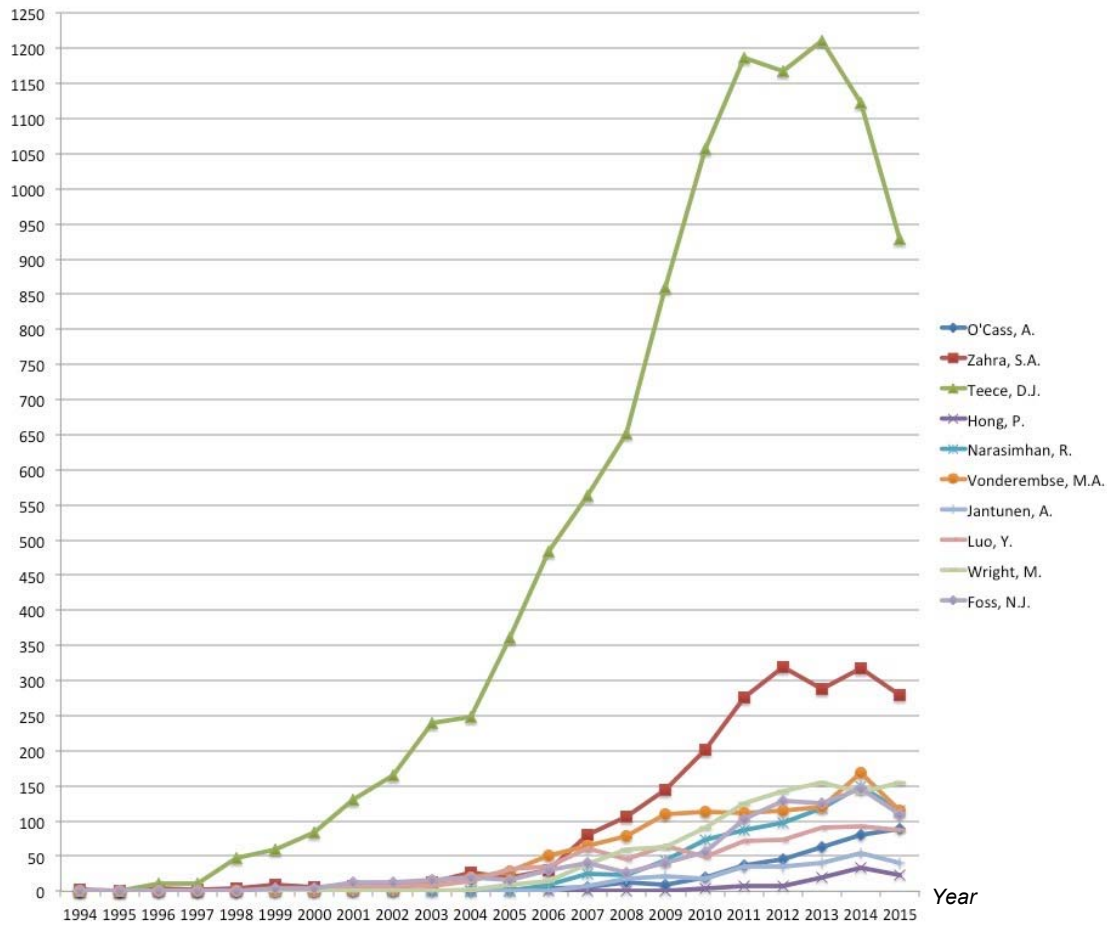


Fig. 9. Overall Citations Top Ten Author

TABLE 3. MOST CITED PUBLICATIONS RECORDED IN SCOPUS DATABASE

<i>Title</i>	<i>Author</i>	<i>Year of Publication</i>	<i>Times Cited</i>
Dynamic Capabilities and strategic management	Teece, D.J.	1997	7409
Entrepreneurship and Dynamic Capabilities: A review, model and research agenda	Zahra, S.A.	2006	427
Critical junctures in the development of university high-tech spinout companies	Wright, M.	2005	245
Managing beyond the factory walls: Effects of four types strategic integration on manufacturing plants performance	Narasimhan, R.	2007	186
Absorbing the concept of absorptive capacity: How to realize its potential in the organization field	Foss, N.J.	2010	175
Manufacturing flexibility: Defining and analyzing relationships among competence, capabilities, and customer satisfaction	Vonderembse, M.A.	2003	162
Determinants of entry in an emerging economy: A multilevel approach	Luo, Y.	2001	141
Does industry matter? Examining the role of industry structure and organizational learning in innovation and brand performance	O'Cass, A.	2006	95
Knowledge-processing capabilities and innovative performance: An empirical study	Jantunen, A.	2005	92
Shared knowledge and product design glitches in integrated product development	Hong, P.	2008	30

Citation Counts

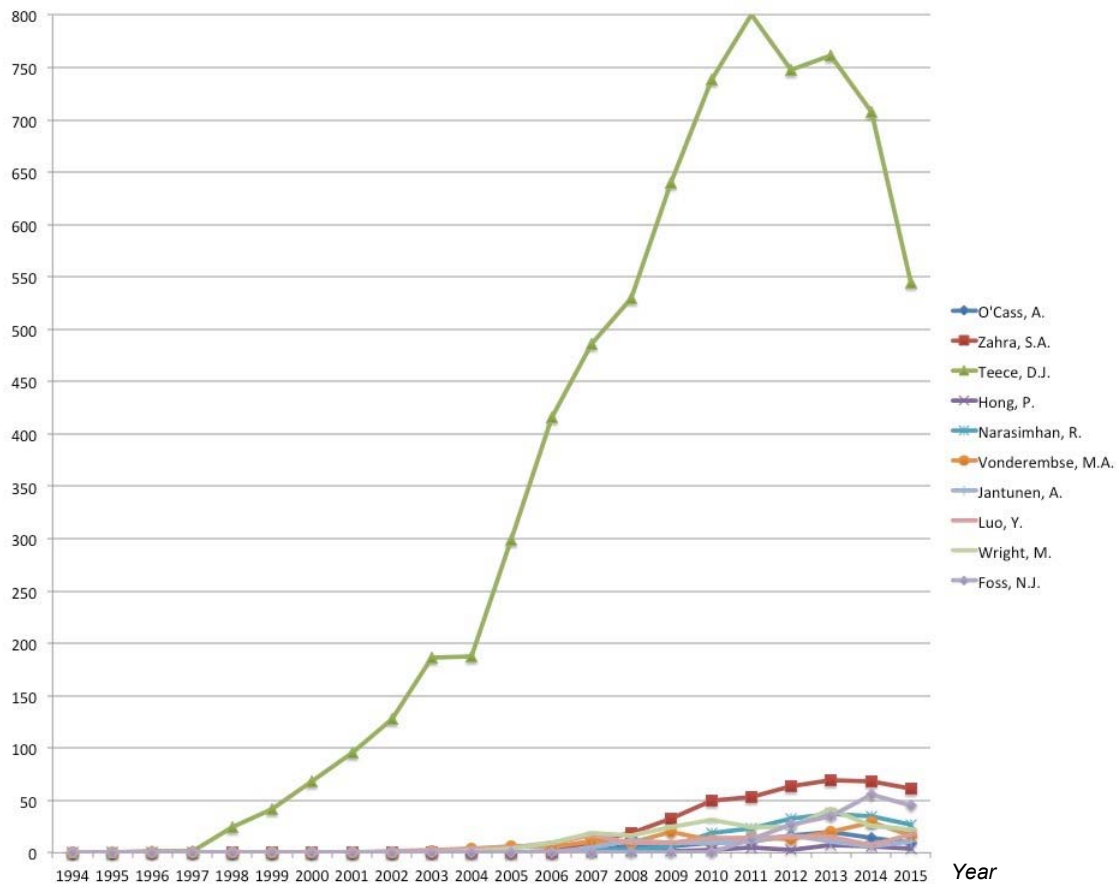


Fig.10 Citation Counts - Most Impacting Paper

What is more, the diagram depicts significant growths of several documents. In example Wright citation value for his work increased significantly from 25 to 42 and denotes a peak in year 2013. One year later its value decreased to 26 citations. The citations of R. Narashiman's work experienced an indicative growth from 6 to 19 citations in year 2009 and reached the highest value of 37 citations in year 2013. Another jump can be recognized in the graph of Y. Luo from 7 counts to 18 in year 2014.

B. Collaboration

First the authors were ranked based on their records. Records are based on number of published papers for that author. For example, if Constance E. Helfat and Margaret A. Peteraf are co-authoring in two papers, the record of Helfat equals 2 and the record of Peteraf equals 2 as well. Vantage point listed 31036 authors with at least one record. Fig. 11 illustrates the top ten authors ranked by their number of records.

To create a co-author map in Vantage Point the top 54 authors out of 31036 entries were used. These 54 entries include all top ten authors, depicted in Figure 9 as an

outcome from Scopus. Besides, these 54 authors published 19 or more records.

Number of Records in Vantage Point

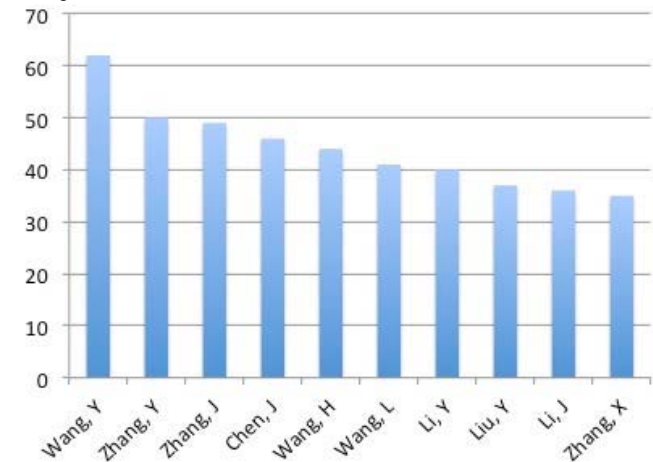


Fig. 11. Leading authors recorded in Vantage Point

VanatgePoint provides three types of maps. To show clusters and relationships among researchers within the field

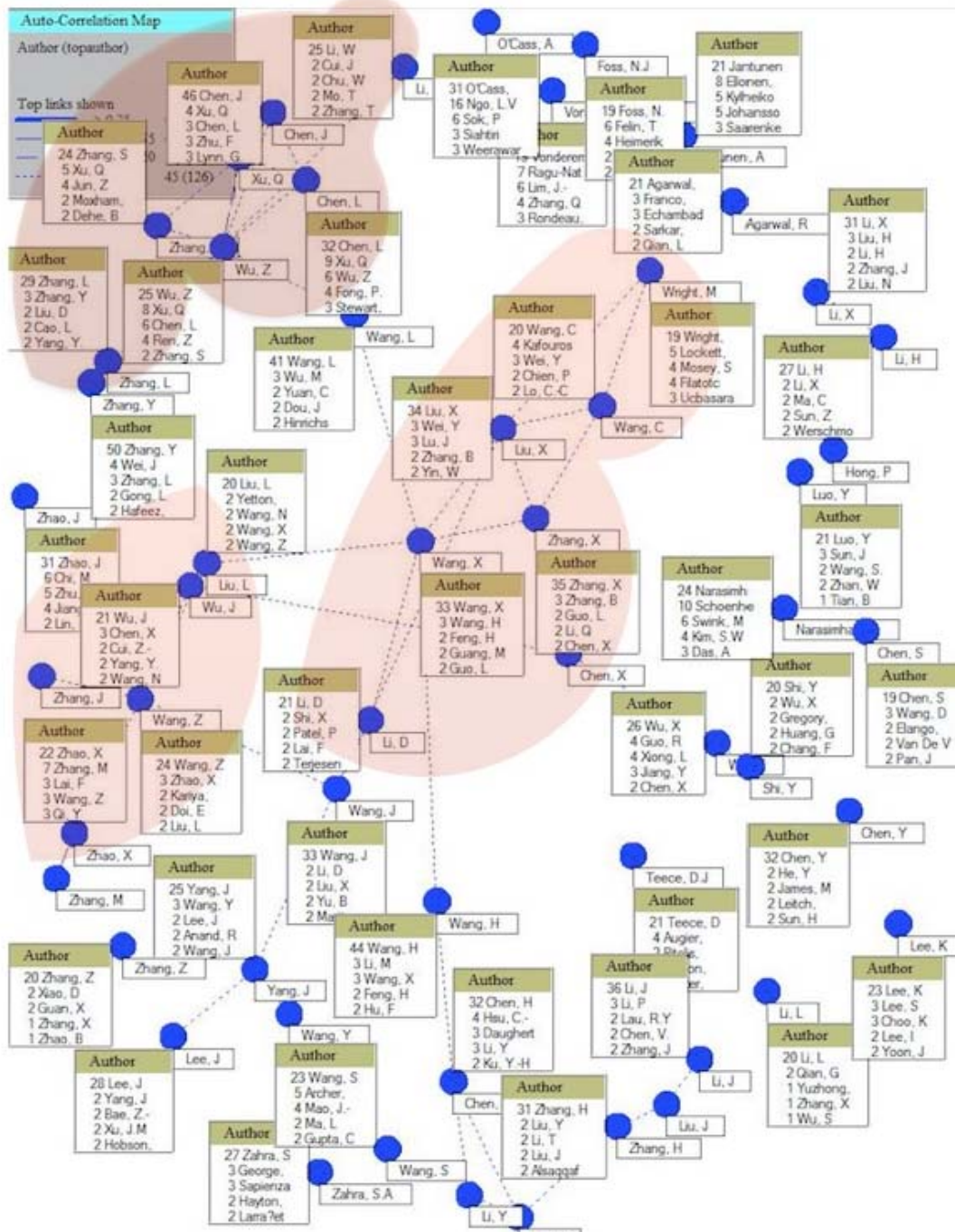


Fig. 13. Professional networks and collaboration (co-author map detailed)

Fig. 14 emphasizes the top ten authors, identified by Scopus as presented in Fig. 7 and Fig. 8. In addition, researcher considered as main influencer of the knowledge field ‘Dynamic Capabilities’ are marked orange, as it was done in Fig. 8. It is notable, that M. Wight is the only author who is connected to a collaboration cluster. Moreover, a

strong distance from S.A. Zahra to D.J. Teece, Y. Luo, and W. Wright can be identified. A close distance exists between Y. Luo, and P. Hong. A. O’Cass, N.J. Foss, M.A. Vonderemse and A. Janutunem also indicating a close distance between the nodes.

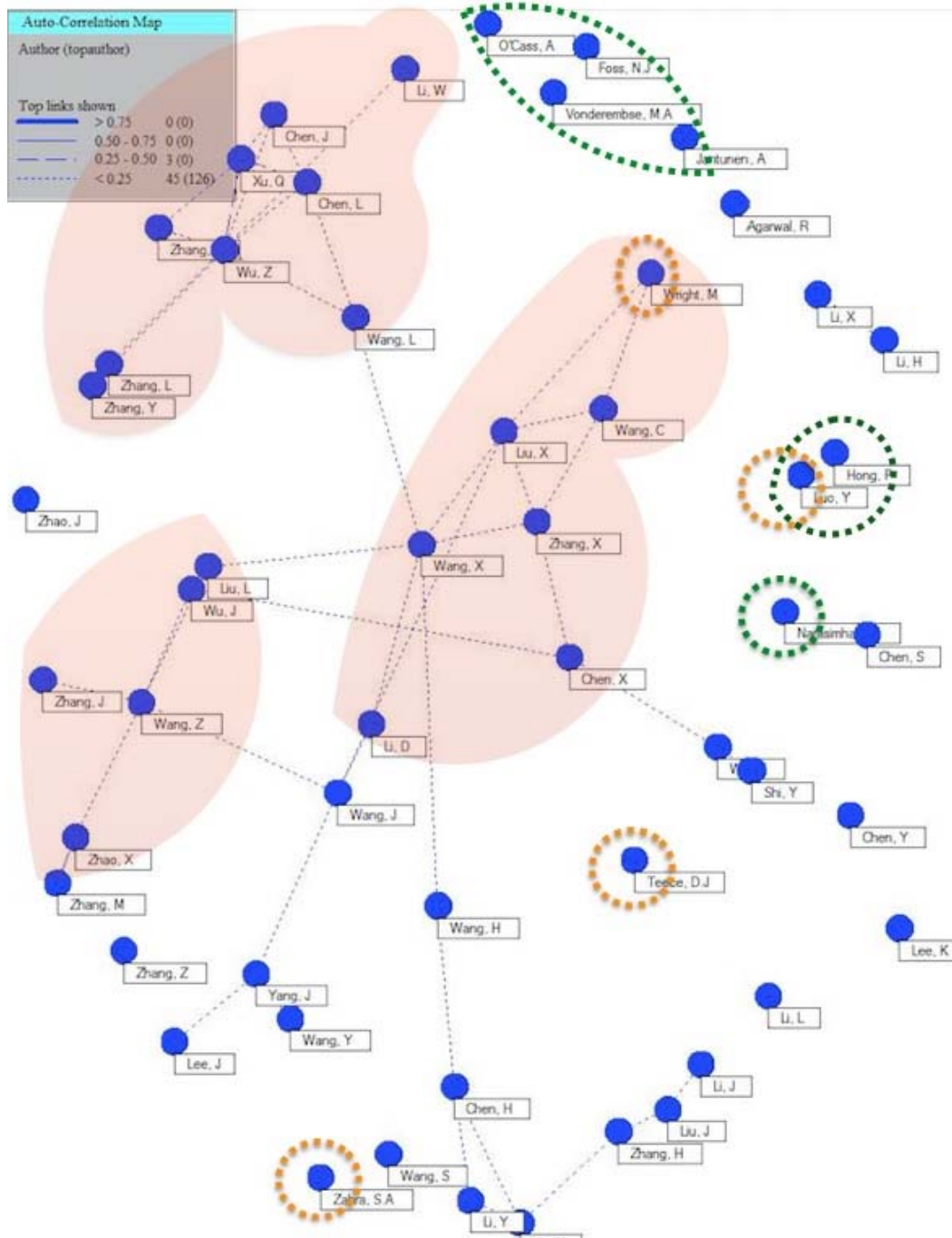


Fig. 14. Professional networks and collaboration (co-author map) -leading authors, recorded in Scopus Database

C. The Body of knowledge for capabilities in Economic science

The keyword-maps created by Vantage Point are used to investigate which knowledge clusters are determining the research field 'Capabilities'. Vantage Point creates factor maps based on descriptors (index terms) that are provided in almost each entry of the search result [48]. For this investigation 2079 keywords were extracted from the

'Capabilities Publication Database'. Keywords with a higher value than 15 in their occurrence, are considered for this research. Beside this, expert opinions were used for cleaning of the keyword-dataset. It leads to a dataset of 1218 keywords that are loaded in Vantage Point for factor maps. The clustering within the factor maps are results of the principal component analysis (PCA), supported by VantagePoint's technology. Vantage Point determines factor-loading values

for each keyword, resulting in 'keyword-sets'. Thus nodes contain various keywords that are combined depending on their frequency of co-occurrence [48].

The first outcome (Fig. 15) shows three areas with a higher density of nodes and 10 individual nodes. The individual nodes of this map show the industries 'Semiconductor', 'Paper', 'Printing' and 'Tourism'. Beside this 'Software engineering', 'Support Vector Machines' and 'Information Retrieval Systems' occur as separated knowledge fields. The left area includes nodes related to the healthcare sector as well as to the knowledge field management and organization. This field is separated from the other knowledge cluster. In the upper zone you can spot one node 'IT capability', holding the term capability itself. It is connected to the knowledge areas 'Strategic Planning',

'Supply Chain Management' and 'Enterprise Resource Management'. A weak relation to 'Petroleum Industry' can be identified. The zone on the right hand side covers nodes, representing the textile industry. There is a second knowledge cluster 'Process Capabilities' labeled with the term 'Capability' within this zone. There are two more nodes representing an industrial sector: 'Construction' and 'Civil Defense'. The biggest knowledge cluster is Sustainable Economy involving the keyword Technology Management and a weak link to Converging Technology.

The term 'Dynamic Capability' does not occur, neither as a cluster, nor as a single keyword. Moreover there is no connection line with a value > 0.5 between the nodes, except in the left area. Thus no strong relationships between the knowledge fields can be inferred.

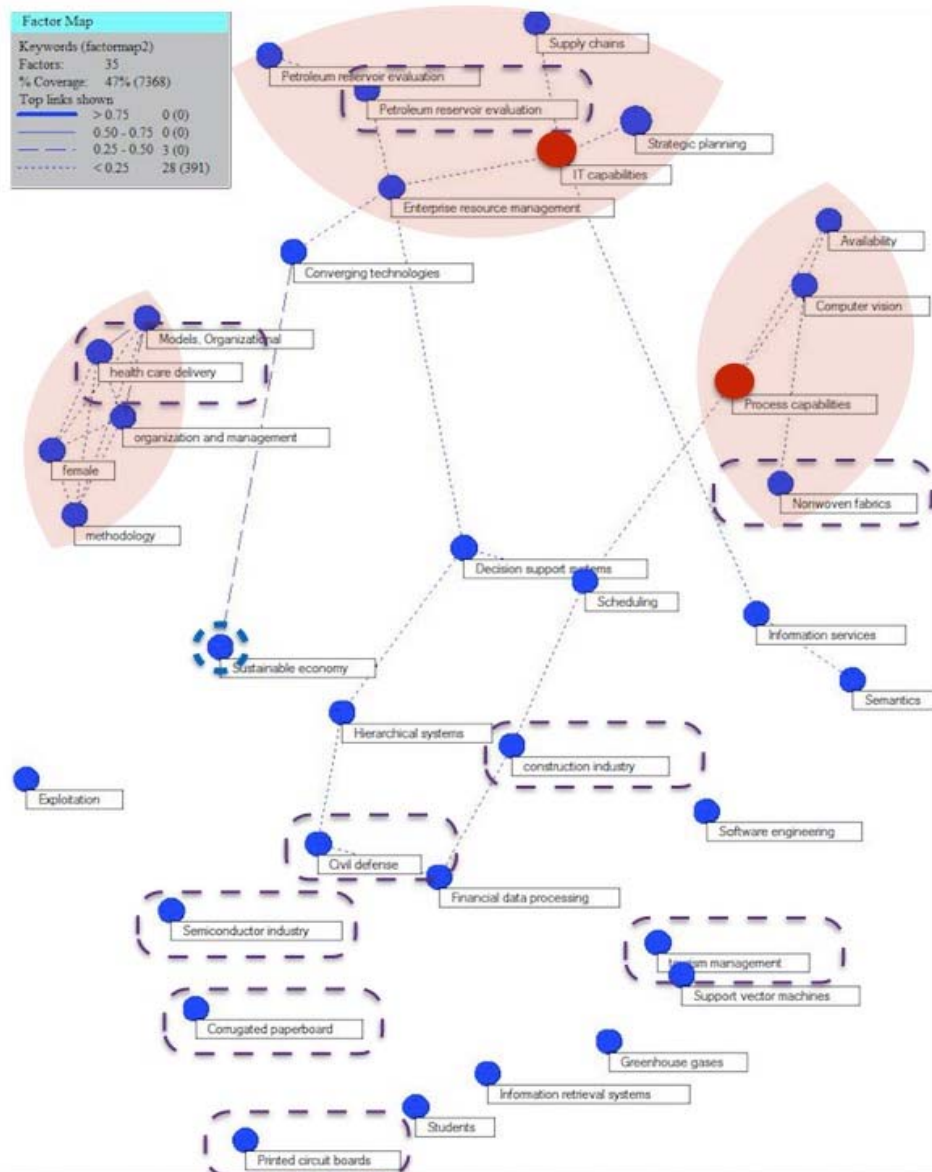


Fig. 15. Knowledge map (clusters of keywords related to capabilities)

An additional factor map (Fig. 16) was generated without the term 'Capability' or 'Capabilities' itself. Nevertheless the node 'IT Capability' and 'Process Capabilities' are still existing. The areas, which were identified in the 'Knowledge map' (Fig. 15), don't exist in this map (Fig. 16). The left cluster area of the 'Knowledge map' (Fig. 16) became smaller and excluded the cluster 'Models', 'Organization' and 'Methodology'. The node 'Sustainable Economy', which has the highest factor value within the 'Factor map -

Keywords', shows a stronger connecting line to 'Converging Technology'. It connects to the node 'Semiconductor Industry', which was an individual node before. It is worth noting that the node 'Strategic Planning' appears closer to 'Semiconductor Industry'. Comparing both knowledge maps (Fig. 15 and Fig. 16) with regard to their occurrence of individual nodes, 'Petroleum Reservoir Evaluation' is the only node, which was added as an individual cluster in Fig. 16.

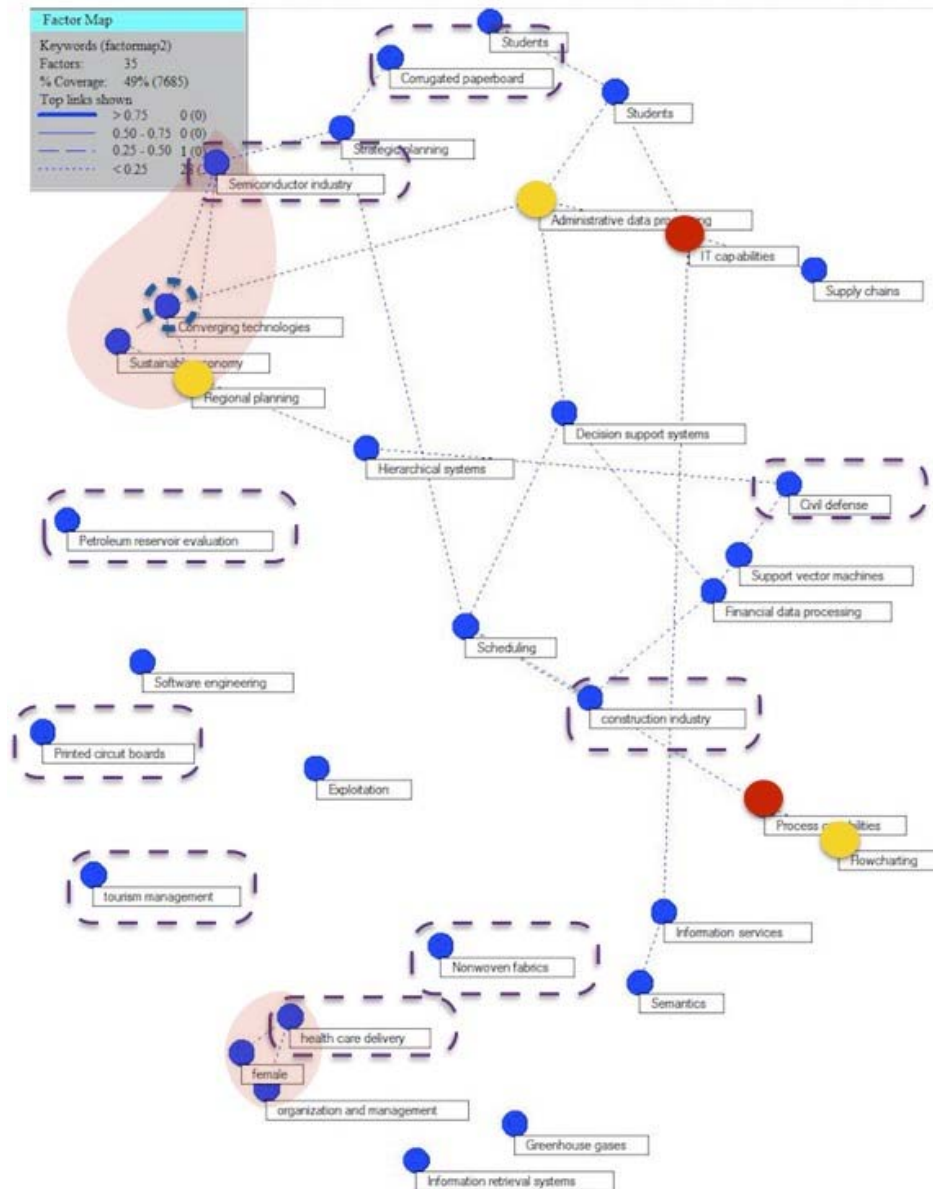


Fig. 16. Knowledge Map - Without the keyword Capability

V. DISCUSSION

A. Community & Collaboration

The objective of this research was not only to understand and to structure the body of knowledge for ‘Capabilities in Economic Science’, but also to examine the relevance of the research field ‘Dynamic Capabilities’ within the knowledge area ‘Capabilities in Economic Science’. Therefore the key authors and the collaboration of the research community have been analyzed through their professional network. The tools Scopus and Vantage Point apply different metrics for the ranking of the authors. Because of that different key authors were identified during the analysis. The outcome of Scopus listed authors, who are part of European and American affiliations. Four authors (i.e. D.J. Teece; S.A. Zahra; Y. Luo and M. Wright) out of the ten authors were presented as main authors from the research field ‘Dynamic Capabilities’. Based on the keyword information provided in the search results, the author, A. Jantunen, is also related to ‘Dynamic Capabilities’, whereas the other authors represent different knowledge fields, e.g. Marketing or Information Technology.

The number of publications is considered as a metric indicating impact and productivity of an author within a research field. Thus, at first, it can be concluded that the research field ‘Dynamic Capabilities’ is a major part of the knowledge field ‘Capabilities’. The high number of publications from various authors related to the field dynamic capability is as an argument supporting this conclusion.

Another perspective yields the described analysis of the citation counts, indicating not only impact but also recognition of an author within a science field. The results show that D.J. Teece, S.A. Zahra and M. Wright have the highest number of citations counts. This measurement also implies a significant influence of ‘Dynamic Capabilities’ to the research field ‘Capabilities in Economic Science’. However a high popularity of authors or a certain paper can be a cause for high citation counts. Thus it was necessary to examine the most cited paper and its citation trends. The findings of this examination demonstrate that D.J. Teece’s graph occurs with the value of more than 10000 as an outlier within the diagram. Nevertheless D.J. Teece, S.A. Zahra and M. Wright still dominate the knowledge field ‘Capability’ even if their citation counts of the most cited paper is eliminated. It expresses the recognition of the research done by the authors and its impact to the evolvement of the knowledge field ‘Capabilities’.

Additionally, results of the citation trends of the authors, related to dynamic capabilities, support opinions of Helfat and Peteraf [19]; Stefano, Peteraf, and Verona [38] or Güttel and Vogel [26] claiming that ‘Dynamic Capabilities’ are one of the most energetic research fields.

Additional analysis of the key authors and their collaboration was done with the application of the software Vantage Point. The findings of this analysis are different from the presented results supported by Scopus. The top ten authors, listed by Vantage Point, belong mainly to Asian

affiliations. Authors, ranked on high positions by Scopus, dropped to a lower position. Examples are S.A. Zahra, who is ranked on position 25 and D.J. Teece, who takes position 43. Considering only influence of one research field to another research field based on their number of records, shown in Vantage Point, this measurements supports researchers, e.g. Arend and Bromiley [12], arguing against the utility and relevance of the knowledge field Dynamic Capabilities. Nevertheless, taking the ‘Auto-Correlation Map’ generated by Vantage Point into account, D.J. Teece, S.A. Zahra, Y. Luo, M. Wright and A. Jantunen occur as individual nodes with the highest factor value within their cluster. This implies a high frequency of occurrence, indicating a significant impact within the research field ‘Capabilities in Economic Science’.

The results of the ‘Auto-Correlation Map’ of Vantage Point also underline the research results of Peteraf, Stefano, and Verona [42], investigating the cause for disagreement and irritation about the dynamic capabilities construct itself. They examined that two separate bodies of knowledge for ‘Dynamic Capabilities’ are based on two separate research communities: D.J. Teece and S.A. Zahra. Outcomes of Auto-Correlation Maps in this investigation lead to similar results. D.J. Teece and S.A. Zahra occur as individual nodes with a high distance between them, supporting the findings of Peteraf, Stefano and Verona [42].

In general, the ‘Auto-Correlation Map’ displays spread positions of the nodes and weak connection among them indicate a low level of collaboration among the researchers.

B. Knowledge Fields

Factor maps with keywords were generated to infer knowledge fields related to ‘Capabilities in Economic Science’. Summing up the results of the analysis, knowledge areas can be separated in areas dealing with theories and principles concerning capabilities and areas representing concepts and applications of capabilities for practitioners. Based on the high number of nodes, representing industrial areas for capabilities, researchers are aiming at examining applications instead of theories related to capabilities.

Comparing knowledge nodes to constructs developed upon bibliometric analysis of Wilden and Dowling [11] and Peteraf, Stefano and Verona [42], some knowledge nodes can be rediscovered as part of current frameworks for dynamic capabilities. Examples are the knowledge cluster ‘Organization & Management’, ‘Strategic Planning’ or ‘Process Capabilities’. Results depict that these identified knowledge cluster are not only related to each other but also to nodes representing various industries. This emphasizes the approach of Wilden and Dowling [11] to illustrate the Dynamic Capability Construct’ as a ‘house’, integrating different theories with different level of enterprises.

Moreover, the identified knowledge nodes related to ‘Process Capabilities’ support the fundamental theory for dynamic capabilities of e.g. Winter [44], Teece, Pisano, and

Shuen [18] considering capabilities as processes that need to adjust to environmental changes.

As presented in the literature review, the dynamic capability framework was originally examined as an approach for achieving competitive advantage [19]. Neither 'Competitive Advantage' nor 'Dynamic Capabilities' occur as a node within the keyword-maps. Thus, the frequency of the keyword 'Competitive Advantage' or 'Dynamic Capabilities' was not sufficient to create an individual knowledge cluster by Vantage Point. Taking this into account the application of dynamic capabilities as a framework for practitioners to achieve competitive advantage should be questioned. The non-existence of an isolated individual node for 'Dynamic Capability' itself additionally underlines doubts concerning the utility and relevance of dynamic capabilities.

C. Recommendations

With regard to the keyword maps, identified researchers of the community 'Dynamic Capability' could include theories of the knowledge field Marketing in their investigations for a common construct. To achieve this, collaboration among O'Cass and researchers from the dynamic capability community, e.g. D.J. Teece or S.A. Zahra is worth suggesting. O'Cass is regarded as a main representative of Marketing Strategies. Results of the Co-Author Map show, that O'Cass has a high frequency of occurrence within the research field 'Capabilities in Economic Science'. According to this, a significant impact and recognition of his work can be inferred. Furthermore, keywords of his publication indicate researches concerning competitive advantage and the resource-based view. This is considered as fundamental theory for the dynamic capability framework. For these reasons, this collaboration is suggested for future research.

D. Opportunities for Future Research

With regard to the keyword maps, identified researchers of the community 'Dynamic Capability' could include theories of the knowledge field Marketing in their investigations for a common construct. To achieve this, collaboration among O'Cass and researchers from the dynamic capability community, e.g. D.J. Teece or S.A. Zahra is worth suggesting. O'Cass is regarded as a main representative of Marketing Strategies. Results of the Co-Author Map show, that O'Cass has a high frequency of occurrence within the research field 'Capabilities in Economic Science'. According to this, a significant impact and recognition of his work can be inferred. Furthermore, keywords of his publication indicate researches concerning competitive advantage and the resource-based view. This is considered as fundamental theory for the dynamic capability framework. For these reasons, this collaboration is suggested for future research.

This investigation summarizes different perspectives of practitioners and researcher related to the term 'Capability'. As presented in the literature review, capabilities are

considered and investigated as a source for competitive advantage. Thus capabilities play an essential role for firms within our economy. The huge amount of records for the term 'Capability' and the results of the BA underline how practitioners focus on capabilities.

The outcome of the BA shows that investigations about capabilities are related to specific industries. In context to this factor maps illustrated, that different theoretical concepts, e.g. Process Theories or Supply Chain Management, are applied in researches for capabilities.

Industrial specifics are one reason why investigations for general accepted constructs for the definition of capabilities are challenging.

For that reason future research for theories and concepts about capabilities needs to focus on models that can be adjusted and applied for different industries. Based on a developed and commonly accepted approach for defining capabilities, firms are able to identify them as a source for competitive advantage. Models for definition and identification of capabilities will be the foundation for future research about capability assessment frameworks.

To continue research for a common accepted construct for the term 'Capability' outcomes of this research will be used. Based on the same data set, it will be build on the results of the BA and expand it to further scientometric investigations. Keywords related to investigations about the practical applications of capabilities within industries will be excluded from the data set to focus on theoretical concepts for capabilities. Future research will also perform Cross-Correlation Maps based on authors and keywords. In that way deeper insight about science fields belonging to authors can be inferred. This supports researchers to identify proper counterparts and more opportunities for collaborations in their future research.

This work yielded different perspectives of the relevance and utility of the research field 'Dynamic Capabilities' based on BA. Motivations for this research goal were observed disagreement and confusion about the term 'Dynamic Capabilities' itself among literature. To investigate a commonly accepted construct for 'Dynamic Capabilities' suggestions for related knowledge fields and collaboration for further research were made. Research of this field should involve practitioners of different industries to apply their framework and continue empirical research. It would leverage the bias concerning the utility and the lack of empirical support for this framework. Suggestions for industries were inferred based on the keyword maps.

This investigation also shows which metrics are applied by different tools supporting BA. In that way various perspectives about authors and knowledge fields were gained, influencing the research area 'Capabilities in Economic Science'.

Summing up the results of the BA an upward publication trend can be recognized. It underlines the interests and value of investigations for future research in the area 'Capabilities in Economic Science'.

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