

## IMPORTANCE AND EVALUATION OF COMPLEXITY-CAUSING AND - INCREASING FACTORS AS A DETERMINING SUCCESS INDICATOR IN OUTSOURCING OPERATIONS

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### **Abstract:**

A substantial goal of complexity management consists of the avoidance of the so-called complexity trap, especially in large outsourcing operations. A recent study, in which a number of large companies participated, who had once outsourced services, confirmed that 70% of them have made significant negative experiences with outsourcing and again aspire an insourcing of services. As one of the main reasons for this "hidden complexity" has been indicated, which some years previous was one determining motives for the outsourcing. The aim of this paper is to provide a model for evaluating complexity-causing and -increasing factors. Based on the most recent theories in complexity management, success determining factors are being identified and the complexity-causing and -increasing factors confirmed by means of an industry survey. The result of the paper is a management model to identify complexity in business situations for example in outsourcing, in addition to the results of the expert survey on the impact of complexity are discussed and evaluated.

*Keywords: complexity trap, complexity management, process management, management model for complexity*

# 1. INTRODUCTION

Dealing with complexity is the central challenge of our time (Jischa, M., 2008). The socio-political and global economic development presents individual companies in the service industry with extraordinary challenges: globalization, penetration of new technologies, more dynamic product life cycles. Resource scarcity, demographic change, climate change and energy transition are only some selected megatrends that affect the company as external factors and the companies need to position their strategy (Spaeth, 2013). Complexity is due to the existing and further increasing global networking in all economic, political and social areas, more than ever an essential success factor for organizations (Schöneberg, 2014).

Within the framework of research it will be examined how complexity can be managed, if the external factors take over a dominant character. In an outsourcing situation, services, based on the contractual agreement, have to be designed at the customer interface and must be integrated and adapted to the internal processes of the service provider.

The motivation of the paper is due to the fact that complexity management is becoming increasingly important in science and industry, as companies need to deal more than ever with new markets, competitors and individual customer needs to remain on the market long term. Thomas Bauernhansl (representing the cooperation between the University of Stuttgart and the Fraunhofer Institute) has published at the MAV Innovation Forum 2014 the topic: "Manage complexity - the introduction of production systems in industry 4.0" and defined the management of complexity as a "new core competence". Bauernhansl also presented in 2013 a relevant study, in which directors and executives of leading German industrial companies were interviewed. 82% of respondents answered that the relevance of complexity will increase in future. 56% of all respondents indicated that they don't have any method or IT system to deal with the complexity (Bauernhansl et al., 2014).

## 1.1. Concepts and perspectives of complexity management in outsourcing projects

### *Project Industry 4.0*

The future project Industry 4.0 aims to enable the industry to be prepared for the future of production. Industrial production will be characterized by strong customization of the products under conditions of high flexibilised large-scale production, the degree of integration of customers and business partners in business and value-added processes and the coupling of production and quality services (BMBF, 2014).

The Fraunhofer Institute collaborates with various universities and industry, to develop the project Industry 4.0. In this context, the Institute published a study in 2013 which shows the three future-relevant topics identified as particularly important and urgent: *dealing with complexity, innovation capacity and flexibility* (Bauernhansl et al., 2014).

There are many industry experts who already implement approaches and concepts of Industry 4.0 in their companies. These confirm productivity gains of up to 50 percent, depending on the complexity of production use cases (Bauernhansl, 2015).

### *Managing Complexity in Outsourcing situations*

At the "2nd Aschaffenburg Management Day" at the University of Aschaffenburg, Eberhard Schott presented on the topic of "complexity" the characteristics of complex situations in the presentation entitled: „Komplexität als zentraler Faktor für Erfolg und Kosten des Outsourcings“ (translated: Complexity as a key factor for success and cost of outsourcing). There he discussed using the example of outsourcing projects (Schott, 2007). These characteristics are: unmanageability, opacity, networked, intrinsically dynamic, severe predictability of the consequences, politely.

Schott and Severidt analyze the dimensions of the negotiation process from the perspective of the provider. They state that a legal contract cannot cover all the options and therefore a way must be found to cover a corresponding flexibility of future-oriented uncertainties (Schott&Severidt 2004).

In his article *Komplexitätsfalle Outsourcing* (translated: Complexity trap Outsourcing) Schott notes as a core statement, that the level of complexity mainly depends on the nature and extent of the outsourced functions. Also, specifically for projects with staff transition, internal resistances impede the course of the project (Schott, 2007). As a result of substantive discussion Schott concludes that complexity in outsourcing can be limited by the following means:

- Reduce the scope of the project;
- Building confidence and not move rules or processes in the foreground;
- Set clear steps within the organization that are precisely defined and fixed by contract;
- Involve external know-how;
- Only set realistic goals;
- As a prerequisite for the outsourcing process, clear, identifiable structures and processes are set up.

Later Schott presented ten propositions on outsourcing, in which he reaffirmed: Outsourcing is complex. The impacts of complexity is not reflected enough (Schott, 2010).

Serdarasan refers to leading researchers in the subject area complexity, for example Wildemann, and also used concepts leading consulting companies. She classifies complexity drivers in the SC (supply chain) by their origin into the following groups:

- Internal
- Supply / demand interface
- External

Complexity inherent in the supply chain is observed in different forms and origins: static complexity, that is related to the connectivity and structure of the subsystems involved in the supply chain (e.g. companies, business functions and processes); dynamic complexity, that results from the operational behaviour of the system and its environment; and decision-making complexity that involves both static and dynamic aspects of complexity.

**Table 1:** Some drivers of supply chain complexity (Serdarasan, 2013)

Type	Internal	Supply/demand interface	External
Static	<ul style="list-style-type: none"> <li>- Number/variety of products</li> <li>- Number /variety of processes</li> </ul>	<ul style="list-style-type: none"> <li>- Type of product</li> <li>- Number/variety of suppliers</li> <li>- Number/variety of customers</li> <li>- Process interactions</li> <li>- Conflicting policies</li> </ul>	<ul style="list-style-type: none"> <li>- Changing needs of customers</li> <li>- Changing resource Requirements</li> <li>- New technologies</li> </ul>
Dynamic	<ul style="list-style-type: none"> <li>- Lack of control over processes</li> <li>- Process uncertainties</li> <li>- Employee related Uncertainties</li> <li>- Unhealthy forecasts / plans</li> </ul>	<ul style="list-style-type: none"> <li>- Lack of process synchronization</li> <li>- Demand amplification</li> <li>- Parallel interactions</li> </ul>	<ul style="list-style-type: none"> <li>- Changes in the geopolitical environment</li> <li>- Shorter product lifecycles</li> <li>- Trends in the market</li> <li>- Market uncertainties</li> <li>- Developments in the future</li> </ul>
Decision-making	<ul style="list-style-type: none"> <li>- Organizational structure</li> <li>- Decision making process</li> <li>- IT systems</li> </ul>	<ul style="list-style-type: none"> <li>- Differing and conflicting decisions and actions</li> <li>- Non synchronized decision making</li> <li>- Information gaps</li> <li>- Incompatible IT systems</li> </ul>	<ul style="list-style-type: none"> <li>- Changes in the environment</li> <li>- Factors that are out of span of control</li> <li>- Uncertainty of the unknown and uncontrollable factors</li> </ul>

Source: Serdarasan, 2013, p.796

Also Bongsug Chae used in the analysis of complexities in his publication "A complexity theory approach to IT-enabled services (IESS) and service innovation business analytics as an illustration of IES" the following three dimensions (Chae, 2014):

- Internal mechanism
- Environment
- Co-evolution.

Schoeneberg (Schoeneberg, 2014) recommends practical tools and methods of managing complexity. Holistic and interdisciplinary approach are in the foreground. Based on the current state of research, he transferred the management of complexity in various business situations, e.g. in the automotive industry or product management. He classifies the complexity drivers, even according to exogenous and endogenous further for the detailed and holistic approach. Based on past depictions he structured the complexity drivers, as shown in the following table:

**Table 2:** complexity drivers

Complexity Drivers		
View	Cluster	Criteria
External complexity drivers	Society complexity	<ul style="list-style-type: none"> <li>- changing values</li> <li>- environmental awareness</li> <li>- economic and environmental factors</li> <li>- political framework</li> </ul>
	Demand complexity	<ul style="list-style-type: none"> <li>- diversity of customer requirements</li> <li>- individuality of the demand</li> <li>- market dynamics</li> <li>- global requirements</li> </ul>
	Competition complexity	<ul style="list-style-type: none"> <li>- number of strength of competitors</li> <li>- changing markets</li> <li>- competitive dynamics</li> <li>- globalization</li> </ul>
	Procurement complexity	<ul style="list-style-type: none"> <li>- number of suppliers</li> <li>- procurement strategy and concept</li> <li>- fluctuations in demand</li> <li>- uncertainty of the delivery or quality</li> </ul>
Internal complexity drivers	Target complexity	<ul style="list-style-type: none"> <li>- number of tracked targets in parallel</li> <li>- dynamics of the target adjustment</li> <li>- maturity of goal achievement</li> </ul>
	Customer structure complexity	<ul style="list-style-type: none"> <li>- number of customers and customer groups</li> <li>- heterogeneity of customers and customer groups</li> <li>- level of participation</li> </ul>
	Product and product program complexity	<ul style="list-style-type: none"> <li>- structure of Products</li> <li>- product and version number</li> <li>- dynamics of the product changes</li> </ul>
	Technology complexity	<ul style="list-style-type: none"> <li>- technological change</li> <li>- availability (innovative) technologies</li> <li>- technology lifecycle</li> </ul>
	Process complexity	<ul style="list-style-type: none"> <li>- number of interfaces and design</li> <li>- degree of crosslinking of the processes</li> <li>- degree of standardization</li> </ul>
	Organization complexity	<ul style="list-style-type: none"> <li>- number of hierarchy levels</li> <li>- degree of centralization</li> <li>- number of organizational units</li> </ul>
	Structure complexity	<ul style="list-style-type: none"> <li>- number of distribution levels</li> <li>- number of stock, staff, equipment, ...</li> <li>- communication Systems</li> <li>- vertical integration</li> </ul>
	Planning and steering complexity	<ul style="list-style-type: none"> <li>- communication Systems</li> <li>- frequency and level of detail of the management and control area</li> </ul>

Source: Schöneberg, 2014, p. 17

Junichi Kato and Richard Schoenberg use a fundamentally different structure in the paper "The impact of post-merger integration on the customer-supplier relationship". The individual content however (processes, organization, technology, cooperate ...) is almost identical to the complexity drivers by researchers already shown (Kato, J., Schoenberg, R., 2014).

Mohamad Ghozali Hassan, Abdul Aziz Othman & Mohd Azril Ismail used the "Partial Least Squares Structural Equation Modeling (PLSSEM)" tool to investigate the factors of environmental dynamism impact on the strategic outsourcing success in outsourcing management. The concept consists of three dimensions of environmental dynamism, which consist of the different possible levels of competition in a market that a company faces, distinct technological changes, and unsystematically fluctuating level of customer demand products. Cumulatively, the three dimensions of environmental dynamism represent frequency of change in demand, technological change, and competition level that indicate the organizational ability to understand complexity and instability in the changing environment that is required for strategic outsourcing success. This research shows conventional views of the influence of the three dimensions of environmental dynamism (customer demands, competition levels, and technological changes) on outsourcing success (Hassan, Othman & Ismail, 2015).

*Enterprise Project Management in Outsourcing situations*

Enterprise Project Management (EPM) is a field of organizational development that helps companies to make changes in a transformation phase. Enterprise Project Management enables a system to support a company's resources organized in a direct relationship with the vision of leadership and mission, strategy, goals and objectives. An integrated framework for on-boarding governance can be used from the organization, technology and process perspectives in outsourcing projects (Basu, S., Singhal, S., Li, L., Stephenson, B., Yao W., 2012).

Rocha describes the core components and the framework (see Table 3), which are necessary for the implementation of a project governance (Rocha, 2014).

**Table 3:** Core components for project governance

Components	Scope
<i>Strategic Alignment</i>	The responsibility of the EPG is to ensure that the projects are in line with corporate strategies and objectives and that the project is implemented effectively and productively.
<i>Risk Management</i>	Risk management is a systematic process of identifying and assessing business risks and taking action to protect a company. Companies need risk management to carry out a review of possible risks and to avoid incurring losses (due to avoidable errors).
<i>Portfolio management</i>	The portfolio provides a big-picture view. As projects and programs are engines of value creation portfolio offers the connection between strategy and execution with clarity about the dangers involved. It facilitates the appropriate sort, add and remove projects from the entire scope.
<i>Organization</i>	An effective EPG assumes that the leading people to be organized and their contributions are modelled. An appropriate organizational structure, roles and responsibilities are required for all participants.
<i>Stakeholder Engagement</i>	In every company different parties and interest groups exist, therefore there are also different expected results from the project stakeholders. There is a communal social need that the company's activities are transparent to make organizational and project decisions comprehensible. For this reason, the analysis of the impact of projects on the social community through a stakeholder engagement plan must be designed, taking into account external and internal stakeholders.
<i>Performance Evaluation</i>	To achieve an effective project portfolio for EPG, the overall performance of the project is to periodically measure and monitor. This serves as a basis to ensure that the business objectives consistent with the changing environment during the project.
<i>Business Transformation</i>	Effective business transformation requires a continuous process established to enable the company to implement business strategies to achieve its vision to achieve. This requirement is entered into at any time, because vision and strategy must constantly adapt depending on the development of economic influences. Business agility, or the ability to achieve business transformation, is a measure of management and business success and as such essential in the monitoring of the EPG.

Source: Rocha, 2014, p. 43-44.

**1.2. Pre-conclusion**

The objective of the project "Industry 4.0" and "complexity management", to prepare the industrial manufacturing for future challenges is similar at the top level. Also similar is the methodological determination of the mega-trends of the business world. In the study by the Fraunhofer Institute it has been pointed out that mastering the complexity is a mission-critical action field of the future. Due to the actuality of the project "Industry 4.0" no concrete methods and instruments in the science and practice exist. The detailed specifications (processes, organization, technology, dynamics of the environment

and other factors) the complexity drivers by several researchers are almost the same. Also similar is the fundamental separation between internal and external perspective.

## 2. COMPLEXITY MODEL IN OUTSOURCING SITUATIONS

The modelling of a complex model for outsourcing projects is influenced by the central question to what extent the Enterprise Project Management (EPM) can be used. This is discussed in the following research.

### 2.1. Concepts and perspectives of complexity management in outsourcing projects

To investigate the effectiveness of the main components of the Enterprise Project Management (EPM) on the complexity drivers, 50 experts are interviewed. All respondents have been working for at least 10 years in a responsible position in the large-scale outsourcing environment. The lowest value, and thus the least impact on the complexity drivers are 0, the maximum 10 points. The results are averaged among all participants. To compare the main components to each other, the values are summarized at the end of the table. To evaluate the external and internal main components separately add on the mean values were also calculated and shown.

The study was carried out in the 4th quarter of 2014. All respondents are EU citizens. In the following table the results are shown.

**Table 4:** Results of the study - external drivers

Results of the evaluation of the complexity drivers								
	cluster	alignment	risk management	portfolio management	organization	stakeholder management	performance evaluation	business transformation
External complexity drivers	Society complexity	8	4	5	6	7	9	8
	Demand complexity	6	6	4	5	6	8	7
	Competition complexity	8	5	8	6	6	8	7
	Procurement complexity	4	5	6	7	4	8	8
	Average external drivers	6,5	5	5,8	6	5,8	8,3	7,5

Source: own schema, 2015

**Table 5:** Results of the study - internal drivers and sum of drivers

Results of the evaluation of the complexity drivers								
Internal complexity drivers	Target complexity	7	5	7	5	6	5	6
	Customer structure complexity	9	5	4	7	7	6	5
	Product and product program complexity	8	5	7	4	5	7	7
	Technology complexity	4	6	7	5	4	6	6
	Process complexity	8	6	4	4	5	5	6
	Organization complexity	9	6	5	9	6	6	7
	Structure complexity	8	5	8	9	7	7	7
	Planing and steering complexity	8	6	7	6	9	7	6
Average internal drivers	7,6	5,5	6,1	6,1	6,1	6,1	6,2	
sum of 12 drivers	87	64	72	73	72	72	80	

Source: own schema, 2015

## 2.2. Interpretation of the study results

The main component with the highest value is "alignment". The respondents believe it is very important that a common strategy of the companies involved supports the project. Even "business transformation" is rated as very significant to achieve positive or negative effects on the complexity drivers. Furthermore, it is striking that "risk management" is assessed in all considerations to be low. The interpretation is that risk management is indeed viewed as important by participants, however, the direct effect to the complexity drivers are considered rather low. The respective sum of the other core components are all rated at a comparable level (value 72-73). The external driver is to measure more important. The high values of the "Alignment" are based mainly on the internal complexity drivers.

The importance and ways to control complexities through the EPG model, is the external drivers average more awarded (value 7.5) as the internal drivers (value: 6.2). The component "performance evaluation" has the highest individual value of the survey. This means that an ongoing consideration of the environment, in parallel with the course of the project, is a very effective method to evaluate complexities.

## 2.3. Pre conclusion

Overall of a total of 84 criteria to be assessed only 10 criteria were rated less than 5 points. This high correlation (in the form of high values) shows that the two approaches have quite a high compatibility and the project approach EPG is a useful complementary approach to utilize a complexity management in outsourcing projects. It should be noted that the internal and external complexity drivers relate to each of the contractors. The finding of the study is that the component "alignment" should be included in the contractor selection. Similarly, the alignment, in the form of a joint strategy is to operationalize in the strategic management of all participating units.

### 3. CONCLUSION

The complexity evaluation model, as a combination of the two approaches, which are on the current state of scientific knowledge, provides a very useful instrument ready to assess complexities in outsourcing projects. This is the basis to take the necessary measures to control the complexity drivers. By further detailing and expanding the circle of participants in the survey, this approach can be further explored. By early consideration and operational establishment of complexity management in outsourcing projects, the emergence of a complex trap can be prevented and the emerging and unavoidable complexity, due to numerous uncertainties can be visualized and thus manageable. In practice, the service agreement between the parties should consider a common management complexity. Likewise, should the other contents of the cooperation agreement, regulate the handling of emerging complexities and uncertainties in principle to give rise to "incalculable risks". The management of complexity in the projects can be a unique selling point for outsourcing providers to avoid the emergence of a complex trap for all businesses involved and lead the project to success together. The scientific and practical status of implementation of outsourcing projects is to expand through a consideration of complexities. After a situational adaptation (size and extent of the scope of the project, the number of organizations involved, the type and number of different services, industry-specific characteristics, ...), the present model can be a useful tool for this purpose.

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