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Towards an Advanced Impact Analysis of Intangible Resources in Organisations

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Keywords

ADVIAN method, driver, impact analysis, intangible resource, knowledge capital, MICMAC method, performance measurement system

Abstract

The paper refers to the discussion of measuring and assessing knowledge capital. In particular, the interconnectedness of the intangible resources in organizations is not well represented in the methodical approaches. Moreover, the identification of driver resources which is strongly connected with this question is far from being solved in a satisfactory manner. Therefore, this article reviews existing methods of the scenario analysis in view of the performance measurement discussion and contributes towards an advanced analysis of resources in organizations.

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1 Introduction

One of the fundamental questions within the performance measurement and knowledge capital discussion concerns the differentiation of intangible resources. Most of the authors subdivide knowledge capital in human and social/ relational capital (Edvinson, Brünig 2000; Lev 2001; Edvinson, Malone 1997). Moreover, some authors distinguish structure capital that, however, includes also tangibles like information and communication technology. There is to ask whether the structure capital can be a part of the knowledge capital discussion (Sullivan 1998). From our point of view, structures are virtual in nature; they may be tangible but they can only become resources in the nexus of the intangible human and social capital of an organisation. Human and social capital attach importance to structures. Information technology, for example, only produces benefit whenever members of an organisation are able to use it due to their specific skills (human capital) and whenever they arrange and assure policies of common use (social capital):

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> "Intangibles are frequently embedded in physical assets (for example, the technology… in an airplane) and in labour (the tacit knowledge of employees), leading to considerable interactions between tangible and intangible assets in the creation of value." (Lev 2001, 7)

Firstly, as the example shows, there is a highly interconnectedness between intangible and, moreover, of tangible resources in organisations. Even though researchers and practitioners would not really deny the mutual impact of resources (e.g. Mouritsen *et al.* 2003; Marr, Roos 2005), measuring, assessing, and managing of knowledge capital is often attached to a non-chained listing of resources (Moldaschl, Fischer 2004). This means, often there is an entitative separation of resources and its management ratios in performance measurement systems (PMS).

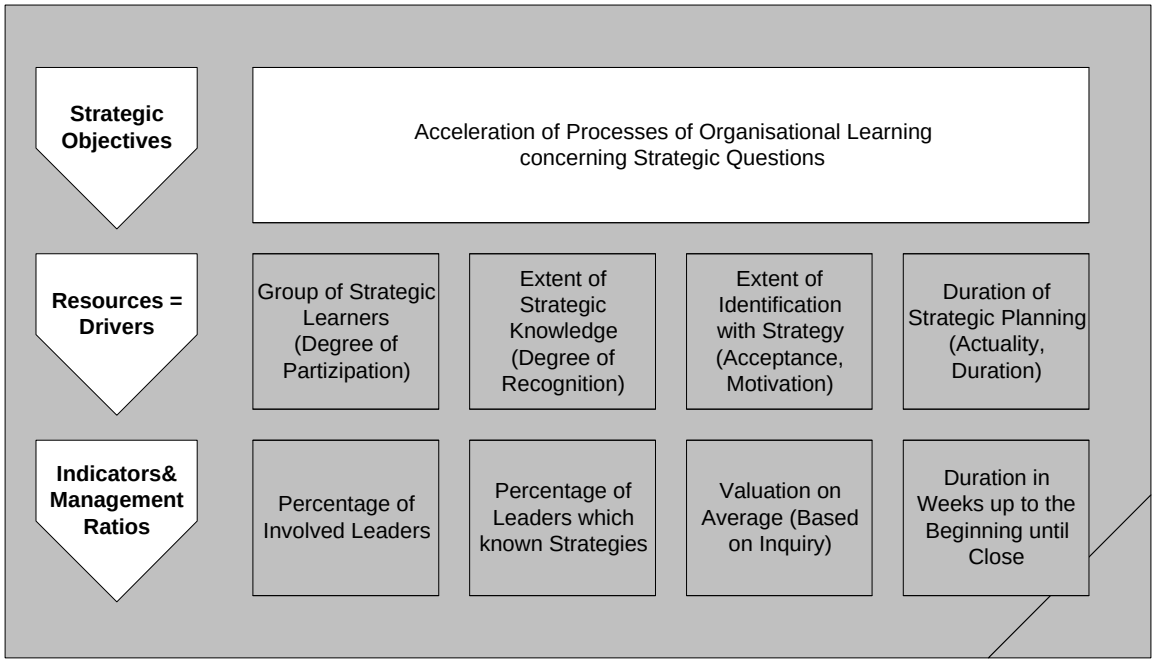


Figure 1: Example of listing intangible resources (according to Müller-Stewens, Lechner 2003, 725).

As the example in Figure 1 shows, strategic objectives are often traced back up to single resources, indicators, management ratios, but the relation between the resources is lost in detail:

> "Working down,… the organizational assets [resources; annotation of authors] are listed in rows, classified according to the above-mentioned taxonomy. The performance dimensions, i.e. strategic objectives, are listed in columns.(…) The above weighting identifies the importance of the assets in an isolated and static fashion…" (Marr *et al.* 2004, 318).

Most of PMSs recommend to link the performance measurement of knowledge capital to quality improvement (e.g. General Electric "Trotter" by Müller-Stewens, Lechner 2003), to strategy (e.g. Balanced Scorecard by Kaplan, Norton 1996), or to innovation and learning (e.g. EFQM Model by European Foundation of Quality Management 1993). According to these deliberations, the measurement and assessment of knowledge capital should be linked to strategic objectives and resulting organizational change. However, an useful formulation of strategies and operative objectives has to reflect the interconnectedness of the underlying resources as well. Social systems like organisations cannot be described in mono-causal manners; their knowledge capital is an expression of a complex interaction of tangible and intangible resources (Dierickx, Cool 1989; Teece *et al.* 1997; Roos *et al.* 1997). Therefore, an important task of this paper will be to help clarifying what are the direct und indirect relationships between them and how they can become visible from a methodical point of view.

Secondly, the authors of the Balanced Scorecard (Kaplan, Norton 1996), the General Management Navigator (Müller-Stewens, Lechner 2003), or the Value Creation Map (Marr *et al.* 2004) speak about resources as drivers, key values or key success factors which are 'adjusting screws' of the organisation. The fact that not only the output of an organisation should be observed and measured by indicators (e.g. customer satisfaction, employee satisfaction) leads to the conclusion that also its resources are object of performance measurement. For intervening activities organisations must be able to reflect which resources they can influence to improve organisational results (Gomez, Probst 1995). The question how resources can be qualified as *drivers* is unanswered within the knowledge capital discussion. If we do not define all identifiable resources – like in Figure 1 - as drivers, it is unclear so far, which of the resources are of a special interest. Most of the authors argue similar to Roos *et al.* and identify the drivers with reference to their importance without a more detailed, helpful specification:

> "Key success factors (KSFs) indicate, as their name implies, the vital criteria that the particular strategy must meet in order to success. (…) There is no limit to the number of key factors a company can identify. If the company enumerates too many criteria, however, then it could be a good idea to prioritise them and concentrate only on the most important ones." (Roos *et al.* 1997, 65.)

However, we agree that the qualitative impact of resources in organisations is different so that we are able to qualify some resources as drivers and others not. Besides, an unambiguous method to demarcate resources as drivers is still missing. Realizing the mutual impacts of resources in organisations and the different importance of single resources (drivers and non-drivers) within social systems on the one hand, and the insufficient demarcation and methodology on the other hand, we will develop an advanced methodical access (advanced impact analysis; later referred to as ADVIAN method).

2 New Methodical Access: Advanced Impact Analysis of Intangible Resources (ADVIAN Method)

2.1 State of the Art: Impact Analyses

The impacts of the elements of a system have been discussed in other research fields of business management as well. Strategic planning and forecasting research use different procedures in order to determine mutual influence of impact factors (named resources in this paper in connection with PMS) of prospective scenarios of organisations and its environment. There are two well-known methods: The MICMAC method was originally developed by Godet (1979) and the Networked Thinking method (originally named "*Methode des vernetzten Denkens*") by Vester and von Hesler (1980). Later on, several authors referred to these methods (e.g. Götze 1991; Gomez, Probst 1995; Gausemeier *et al.* 1999) in their scenario analysis, but these deliberations did not influence the performance measurement discussion so far. On the one hand, there are some important findings on the indirect and direct relations of resources in organisations generated by the MICMAC method and the Networked Thinking method. However, on the other hand, some methodical shortcomings are obvious if these methods are used within the PMS discussion. This chapter will address these shortcomings and will give an outlook to an advanced impact analysis of resources in organisations while measuring knowledge capital.

Both methods, the MICMAC and Networked Thinking are based on impact matrices. In an impact matrix the identified impact factors are listed and connected. The impact strength of each factor on each other factor is estimated. Thus, the impact matrix presents only the **direct** connections between the impact factors and by definition there is no direct impact of an impact factor on itself. Vester and von Hesler quantify the impact by the numbers 0, 1, 2, 3

(no impact, weak impact, medium impact, strong impact). Godet only uses 0 and 1 (no impact, impact). A very simple example of an impact matrix is given in Figure 2.

							activity
	impact	**on IF1**	**on IF2**	**on IF3**	**on IF4**	**on IF5**	direct sum
	of IF1	**0**	1	0	0	0	**1**
	of IF2	0	**0**	1	0	0	**1**
	of IF3	0	0	**0**	1	0	**1**
	of IF4	0	0	0	**0**	1	**1**
	of IF5	0	0	0	0	**0**	**0**
passivity	direct sum	**0**	**1**	**1**	**1**	**1**	

0	0	1	0	0	1
0	0	0	1	0	1
0	0	0	0	1	1
0	0	0	0	0	0
0	0	0	0	0	0
0	0	1	1	1	

0	0	0	1	0	1
0	0	0	0	1	1
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	1	1	

0	0	0	0	1	1
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	1	

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	

Figure 2: Very simple example of an impact matrix and according MICMAC matrices of the order 2 to 5.

Here, only 5 impact factors (IFs) are determined. Since there is no direct impact of an impact factor on itself the main diagonal of the matrix is left empty or set to 0. In this simple example IF1 has a weak impact on IF2, IF2 a weak impact on IF3, IF3 a weak impact on IF4 and IF4 a weak impact on IF5. We have chosen this very simple example because in this way the shortcomings of the two methods become more obvious later on. The so set-up matrix does not contain indirect impacts. An **indirect** impact is the influence of an impact factor on another even if there is no direct impact. Exemplarily in Figure 2 for instance there is no direct impact of IF1 on IF3 but IF1 has an impact on IF2 which in turn has impact on IF3. Thus, the indirect impact is not meant in the sense of Marr *et al.* (2004). Their so-called "indirect dependences" exclusively describe the direct impacts in our comprehension. Contrary to our understanding as well, the "direct dependences" of Marr *et al.* only designate the relative importance of each resource for the achievement of each strategic objective (similar to Figure 1).

Both the MICMAC method and the Networked Thinking try to quantify the importance of each impact factor within a system. In the Networked Thinking this is done by an active sum, which is the sum over the rows of the matrix. The higher the active sum the higher is the influence of the given impact factor on all other factors in the system. The dependence of an impact factor is estimated by the passive sum, which is the sum over the columns of the matrix. The higher the passive sum the higher is the impact of all other impact factors in the system on the given impact factor. In the example all impact factors except IF5 have the active sum 1. According to Vester and von Hesler this would mean that IF1-IF4 have the same importance. However, it is easily seen that this is not the case because IF1 has not only direct influence on IF2 but also indirect influence on IF3, IF4, and IF5. Godet's MICMAC method considers the indirect impacts by raising the matrix to the power of 2, 3, and so on. The result is the number of indirect impact paths. This works only if the classification is 0 or 1 (no impact or impact). The MICMAC matrices up to the order 5 are given in Figure 2 as well. Each order can be used to identify the importance of the impact factors by the active sum. Normally, the MICMAC algorithm is repeated until there is a stable order of the impact factors (see for example Sharma *et al.* 1995). However, our simple example shows that this is not possible for every system. The 5^{th} order matrix (and every higher order) only consists of 0. Thus, no classification can be done. Figure 2 shows that the well accepted methods for impact analysis are not universal. Other authors have adapted the ideas of Vester/ von Hesler and Godet but could not solve the shortcomings. For instance Gausemeier *et al.* 1998 only mention the importance of the consideration of indirect impacts but do not calculate the indirect impacts. Since the Networked Thinking considers only direct impacts while the MICMAC method was developed in order to consider also indirect impacts some authors have adapted the two methods by combining the classifications: 0 or 1 in the Networked Thinking is replaced by 0 in the MICMAC method and 2 and 3 is replaced by 1, respectively (see Götze 1991).

The calculation of the active and passive sum is not the last step in the classification of the importance of the impact factors. The two reference numbers for each impact factor, active and passive sum, should be combined in order to qualify the importance of each impact factor in the system. There are different possibilities to classify the impact factors. Brenner (1999) for instance groups the impact factors into active (active sum > average active sum, passive sum < average passive sum), passive (active sum < average active sum, passive sum > average passive sum), critical (active sum > average active sum, passive sum > average passive sum), and buffering (active sum < average active sum, passive sum < average passive sum). However, this Boolean classification does not make differences between the "active" or "critical" impact factors and thus the same importance is ascribed to all impact factors in a group. Another possibility to classify the impact factors is to use the product and quotient of active and passive sum as well (Schlange 1995; Vester 2002). In principle, this allows a continuous classification without narrow fixed groups (Vester 2002). But, Schlange uses the product and quotient only to group the impact factors. His groups are named active, reactive, critical and inert. In general, the described classifications are not universal because the used formulas depend on the number of impact factors. Furthermore, a quotient cannot be calculated if the passive sum is 0.

2.2 ADVIAN Method

The ADVIAN method tries to overcome some shortcomings of the Networked Thinking and the MICMAC method. In particular we want to combine the advantages of both methods in order to fulfil the requirements of a classification of resources as drivers in a more elaborated way. Thus, the ADVIAN method should be based on an impact matrix as well (in Figure 4 referred to as ADVIAN matrix). The estimation of the impact strength should be classified as

no impact, weak, medium and strong impact (0, 1, 2, 3; more subdivisions are possible with this method). And finally, also indirect impacts should be considered. In the ADVIAN method the identified factors are named resources (R). We want to consider the same example like in Figure 2. The calculation of the active and passive sums is extended from the direct sums to indirect ones as shown in Figure 3.

							activity				
	impact	**on R1**	**on R2**	**on R3**	**on R4**	**on R5**	direct sum	2nd order	3rd order	4th order	**sum**
	of R1	**0**	1	0	0	0	**1**	1	1	1	**4**
	of R2	0	**0**	1	0	0	**1**	1	1	0	**3**
	of R3	0	0	**0**	1	0	**1**	1	0	0	**2**
	of R4	0	0	0	**0**	1	**1**	0	0	0	**1**
	of R5	0	0	0	0	**0**	**0**	0	0	0	**0**
passivity	direct sum	**0**	**1**	**1**	**1**	**1**					
	2nd order	0	0	1	1	1					
	3rd order	0	0	0	1	1					
	4th order	0	0	0	0	1					
	sum	**0**	**1**	**2**	**3**	**4**					

Figure 3: Enhanced classification of resources (R) due to consideration of indirect impacts.

The second order active sum considers that the 'direct activity' (=direct active sum) of a resource is forwarded to each resource to which it is connected by direct impact. Thus, an activity of second order is defined. The third order active sum considers this for the second order active sum and so on. Finally, the sum of all orders is calculated and processed. The example in Figure 3 now reveals that the resource of the highest activity indeed is R1 and the resource of the highest passivity is R5. It should be noted that the described formalism is not sufficient to identify the drivers of an organization. The formalism only replaces former mathematical approaches so far.

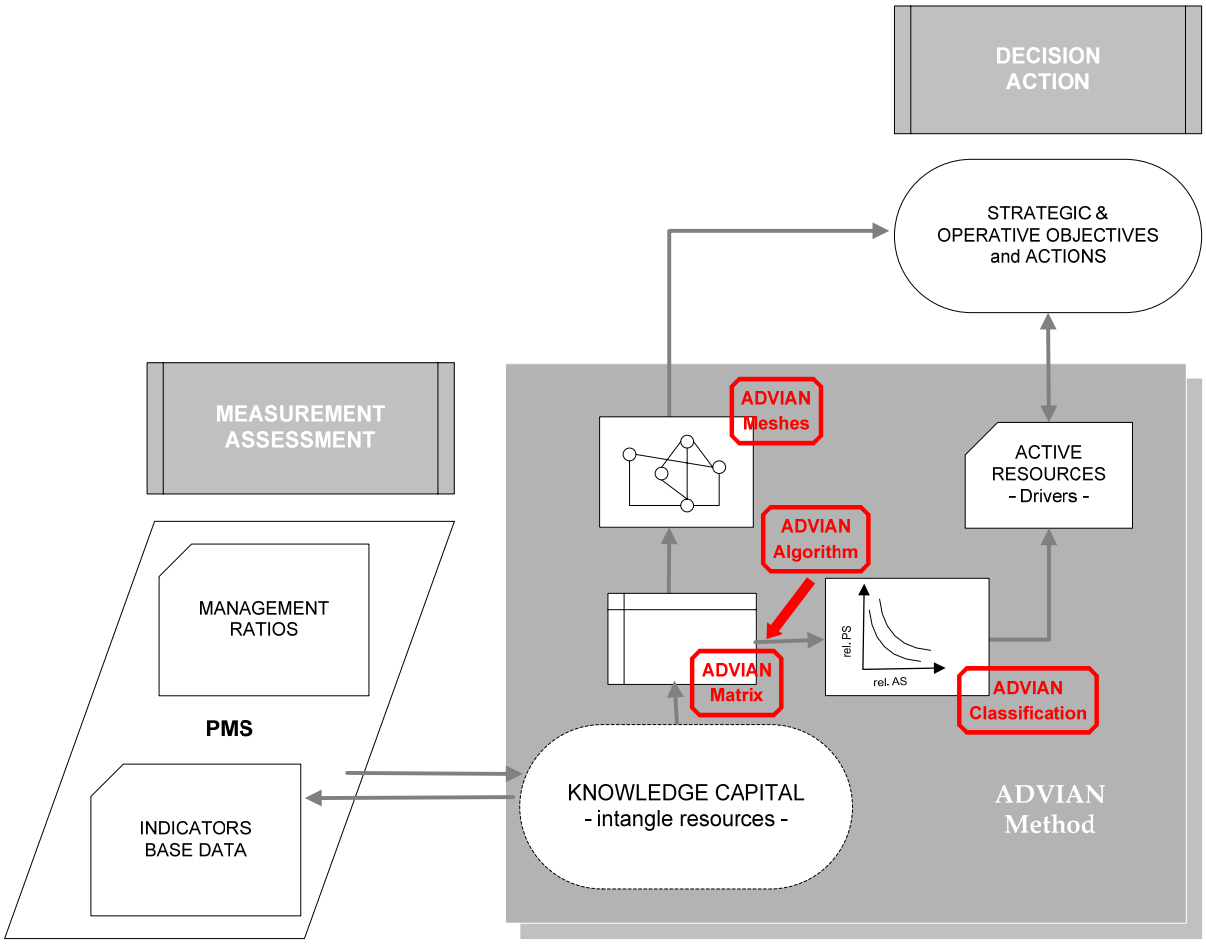


Figure 4: The ADVIAN method as the link between performance measurement and strategy.

However, as seen in Figure 4, before the calculation can be done the identification of the resources is the first step. The second step is the determination of the impact strength of a resource on the other resources; this means the setting-up of the ADVIAN matrix with direct impacts. These direct impacts from one resource to another is illustratable in another shape as a network (in Figure 4 called ADVIAN meshes; similar e.g. Gomez, Probst 1995; Vester 2002; Sammer *et al.* 2003).

Likewise, after setting up the ADVIAN matrix the enhanced algorithm (ADVIAN algorithm) for the calculation of active and passive sum can be carried out. The so calculated sums have to be used to classify the resources (drivers, non-drivers) in the next step. The classification algorithms used in the literature and mentioned in the last section have been shown to be either to narrow or not universal. Due to the mentioned shortcomings the later step has to be enhanced as well (ADVIAN classification). However, this is not the scope of this paper and will be presented later.

As Marr *et al.* (2004) state there is a strong need to link the PMS to strategy. As Figure 4 shows, in discussing the resources of an organization and assessing the drivers in a more elaborated way the ADVIAN method supports the linkage between strategic resources decision and action and the efforts of measuring and assessing these resources. The identified resources of a PMS are correlated to each other by a quantitative determination of the direct impact strengths in the ADVIAN matrix. Later on, these quantified impacts can be filled up with qualitative descriptions as a basis of strategy outlines. Moreover, the consideration of indirect impacts and the resulting driver identification enables organizations to decide more easily where strategies can strike up.

After all, it should be mentioned firstly, on the one hand this method bases (or should base) on a discussion process among the organizational members. The method makes the results of this discussion process easily visible. Secondly, on the other hand users of the ADVIAN method should resist the danger to a mono-causal interpretation of resource impacts and understand organizations as simple cause-consequence relations. The results of the ADVIAN method represents: a. one possible ‘picture’ of the organizational resources, b. the subjective even though common shared assessment of organizational members, c. nothing but a *status quo* of the current resource situation of an organization that can become dynamic in strategic processes.

3 Methodical Outlook

The ADVIAN method provides a procedure that combines the advantages of two well accepted impact analysis methods, the MICMAC method and the Networked Thinking method, and avoids some of their shortcomings in view of the knowledge capital discussion. The impact strength of the different factors can be classified from “no impact” to “strong impact”, independently of the chosen subdivision of the scale. Further, also indirect impacts are considered. The ADVIAN method also contains an advanced classification algorithm of the importance of the considered impact factors which will be the scope of another paper.

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