7 QUANTITATIVE ANALYSIS OF THE SOFT FACTOR "COOPERATION CLIMATE" IN COLLABORATIVE NETWORKS

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In the following an approach for the quantitative inclusion of the soft-factor cooperation climate in the enterprise oriented performance analysis is presented. This quantitative analysis is realised by an adapted value benefit analysis in combination with the Repertory Grid methodology. Through this a comprehensive model representing value-adding process related and value-adding-process neutral phases has been developed. This framework can be integrated in a model for network management and operation. Although the model is of theoretic nature the result give evidence concerning the behaviour of participants in collaborative networks.

1. MOTIVATION

For the composition of successful and pervasive collaborative networks, the cooperation of all network participants is of fundamental meaning. In this connexion, one has to pay attention to the suitability by choosing the partner on the one hand but otherwise needs to include the soft factors in the evaluation. A meaningful consideration of important soft factors here completes the performance analysis of companies. In the following, the soft factor "Quality of Cooperation" will be presented together with possibilities for its entries within the performance analysis. Performance analysis here implies the entry as well as the validation and evaluation of a work performed by a company within a value-adding process. For this purpose, a comprehensive approach has been designed [Jähn 2005], in which the selected performance parameters are analysed in a quantitative form. By aggregation of the single degrees of performance, the result is a benefit measured value, which represents the total quality of a company's performance. In case of insufficient value performance here, the determined capital gains of a company, within an allocation of profits model belonging to the total approach [Jähn, 2007], can be reduced.

2. OPERATIONALISATION

The soft factor "Quality of cooperation" together with the performance parameter "Cooperation climate", can excellently be described as the totality of characteristics and attributes of a product or operations, which refer to its adequacy to complete given requirements. The product, in this case, is composed out of the cooperation of

the companies. The characteristics and attributes will be represented by soft-facts, which describe the quality of the cooperation, while the given requirements represent the target values of the single characteristics. However, a problem of this approach is that the characteristics and attributes of the quality of teamwork are not available in a quantitative form as such attributes describe soft / qualitative factors. Those soft-facts are normally described by linguistic variables which are represented by linguistic expressions like “high”, “little” or “middle”, alternatively “good” or “bad”. Therefore, next to the proper attributes, one has to find a possibility to transfer their qualitative forming into a quantitative value.

Approaches for the integration of soft-facts indeed can be found in different contexts in technical literature, but nevertheless, the quantitative analysis of soft factors always causes problems for scientists. Up to now, some approaches have been identified [Scott, 1991; Burt, 1992], which, however, cannot be used primary, as their evaluation results are unusable in the present case. The here added Repertory Grid methodology counts thereby to the most promising approaches, as there exists a simple proceeding, linked with effective evaluation methods and a high level of acceptance.

Nevertheless, there had to be developed a method, which helps to edit the data, collected by the Repertory Grid methodology, to be able to make a statement with regard to the quality of teamwork between the network participants under the focus of the company, which has to be analysed. For this purpose, the value benefit analysis has been chosen. It makes it possible to determine a weighting aggregated value, according to the meaning of the different aspects, which can directly flow into the weighting function. The next paragraph will focus on the cooperation and successive proceedings of the Repertory Grid method and value benefit analysis, within an investigation of the performance parameter “cooperation climate”.

3. PROCEDURE OF THE ANALYSIS

3.1. Overall Concept

First of all, a Repertory Grid questionnaire, including all elements and constructs, which are relevant for the task, needs to be designed. The analysis will eventually take place within the scope of a value benefit analysis, by converting the value benefit into an evaluation function for the performance parameter ‘cooperation climate’. Figure 1 shows this procedure. Thus it appears that both used methods can be applied in a neutral or in a specific way concerning the value-adding process. The contents of the single stages of the approach will be explained below.

3.2. Value-Adding-Process Neutral Steps

Determination of Elements

The preparation for the measuring of the performance parameter „cooperation climate“ by means of the Repertory Grid method, includes determination of the objects (elements), which need to be evaluated [Fransella, 1977]. It must be pointed out that the number of considered elements should have a reasonable size, as an adequate differentiation will not be possible with a number of elements, which is too low; the evaluation work will be too extensive and the statements will tend to

inconsistencies with a number of elements, which is too high; as a result, the evaluator will lose track. A number between six and twenty-five elements is recommended.

The elements, that need to be considered, involve primarily the companies, which were in direct contact with the analysed enterprises during the value-adding process. This includes all supplying and supplied firms and all administrative companies, which are also necessarily in contact with most producing companies. In order to avoid new identification of relevant elements for every value-adding process and for every company, all firms can be listed in the resources pool, whereas only the contacted firms will be evaluated later on.

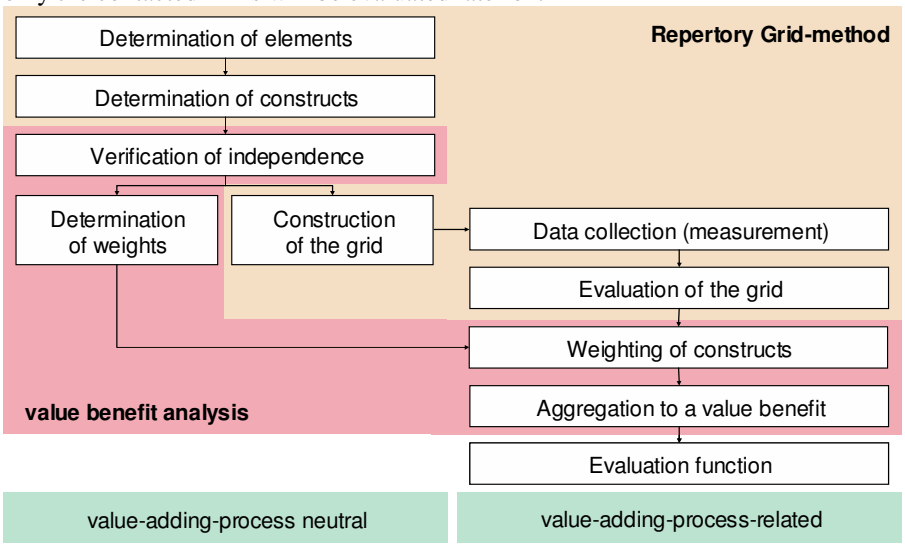

Figure 1: Quantification of the performance parameter ‘cooperation climate’

Besides the assessment of the enterprises, the company that needs to be evaluated had contact with during the value-adding process, the Repertory Grid method also provides the opportunity for self-evaluation. From a socio-scientific view, this seems to be absolutely reasonable, as a self-improving process can possibly be initiated through repeating self-reflection. This is especially the case when an enterprise also receives feedback after the evaluation of the questionnaires, containing the information, to which extent its self-evaluation corresponds with the evaluation by the other companies. Additionally, the self-evaluation also provides the opportunity to draw comparisons with the evaluation by other firms and to identify possible mispricing. The self-evaluation can for example be realised through the elements ‘me’ and ‘me – others’.

This possibility does not play a role for the analysis of the ‘cooperation climate’. Concluding, one needs to point out the possibility to measure perfection. With a number of elements, which is too high, only the elements with the most intensive contacts should be chosen. For the basic version of a Grid, this option was modified to make a statement regarding the construction of the questionnaires (‘Grid’) as well as the determination of the planned output possible. This can be achieved through the introduction of the element ‘ideal’.

Determination of Constructs

Selected decision makers determine the constructs on their own initiative, herefor for example thetriad method [Fransella, 1977] can be applied. For the measuring of the performance parameter ‘cooperation climate‘, a modified method is necessary, because a comparability with the perfection, the so-called nominal condition, should primarily be achieved through the evaluation. This perfection should basically derive from the strategic orientation of the network and should be determined against this background. On this account, one needs to develop a construct catalogue for the Repertory Grid of the performance analysis at first; on this basis, the quality of the cooperation for all firms can be determined. Indication for the characteristics of successful cooperation provide approaches of team evaluation and judgment in the area of work organisation, because a team can be seen as a network consisting of different key personnel, whereas the firms are represented by individuals in this case and while there are rather groups or departments in a team. Even if groups and individuals represent two different constructs from an ergonomic and organisational perspective, one can nevertheless develop some common points in form of constructs regarding relevant factors of success of successful cooperation. The summary by *Jeserich* [Jeserich, 1991; Schneider, 1995] can be seen as a basis. *Jeserich* identifies the six different categories sensibility, contacts, cooperation, integration, information and self- control. The description makes clear that this catalogue of features refers to (human) individuals. However, the practicability needs to be verified regarding the applicability with firms. Though, some interesting points come up, which can also be assigned to firms and which are suitable for a description of the quality of cooperation. The following features will be applied for the Repertory Grid and will be used for the constructs [Schneider, 1995]:

Sensibility

- Recognizes other people’s problems (sensitive for problems \ superficial)

Contacts

- Approaches others on his own initiative (talkative \ uncommunicative)
- Offers consultation (consultative \ denies consultation)

Cooperation

- Helps others, who are in difficulties (selfless \ selfish)
- Does not stand up against others on their expenses (open to compromises \ focused on asserting)
- Informs others of feelings of success (communicates success \ reserved)
- Does not apply instruments of power (convincing \ repressive)

Integration

- Recognizes where and why conflicts develop and looks for solutions (solves conflicts \ creates conflicts)
- Orientates different interests on one aim (oriented on network \ individualist)
- Defines rules (adheres to rules \ expands rules)

Self-control

- Does not react to attacks aggressively (able to accept criticism \ not able to accept criticism)
- Does not create stress with others (aspires harmony \ rebellious)
- His mood can be predicted (predictable \ moody)

One can see that many descriptions have only been summarised to one term. Partly, the descriptions have also been used as an association basis to reason on further important quality features regarding cooperation in the network. If the number of considered constructs seems to be too high, one can aspire a summing up in construct categories. Construct categories unit various similar constructs and will be treated as analog to constructs further on.

Verification of independence of Constructs

A further value-adding process neutral step focuses on the verification of the constructs regarding independence. Both, reciprocal preference independence and difference independence of the constructs is essential due to two points. On the one hand independence must be verified to make an application of the value benefit analysis with the additive model possible; on the other hand will this be the condition for the determination of the weighting with established methods. A consistent Grid is guaranteed additionally. In case independences of constructs could be determined, those must be eliminated with proper methods. The most effective method is a summing up of the construct categories. After the summing up, a new verification on independence will be essential until it can be verified doubtlessly.

Determination of weightings of Construct Categories

To get a significant result regarding the degree of performance of the performance parameter 'cooperation climate', the single constructs respectively if needed the construct categories will be assessed according to their importance. For this, the weighting of the single constructs, respectively construct categories, must be determined. This can be realised with an established method like the Trade-off-method [Eisenführ, 2003]. The identified weightings can be used over a longer time period, but should be checked from time to time regarding plausibility and suitability by means of recalculation and should be corrected if required.

Construction of the Grid

After this verification regarding independence of constructs respectively construct categories, the questionnaire (Grid) can be designed, independent from the determination of the weighting. For this, elements and constructs / construct categories will be brought together in the form of a matrix, whereas the elements will be put into columns and the constructs into rows. In this way, a rough questionnaire of the Repertory Grid is created; an example is displayed in figure 2.

It gets obvious that every construct category is represented by different constructs, whereas dependence within a construct category is unproblematic, because the result will only be considered for the evaluation of the Grid for every construct category in an aggregated form. The central factor of success for the data collection by means of the Grid is the cooperation of all firms, which have participated in a value benefit process in the production network. Basically one must assume that the effort, which is needed for filling in the Grid, will be felt as a negative burden. This relates to the expenditure of time and work, which causes costs. From this perspective, firms must already be convinced at the point of the admission into the resource pool that cooperation is absolutely necessary and that it is normally positive. To keep the effort for the firm low, it is recommended that the number of constructs is minimised to a justifiable amount, as displayed in figure 2. However, the number of constructs automatically results from the number of contacted firms.

It is also important to develop a proper scale for the evaluation of the constructs in terms of characteristic values. Application of three discreet gradations for the

feature pole and the antipole of the constructs are common for the Repertory Grid method and also thinkable for the given domain; whereas '3' expresses the strongest value in the feature pole and '-3' expresses the strongest value of the antipole. The possibility of a neutral valuation by using zero must be discussed; if this is not possible, no neutral valuation can be made. However, neutral valuation is permitted in the given case. Therefore, an evaluation scale consisting of seven evaluation possibilities for every construct is designed. It must be emphasized that a valuation with '-3' cannot be automatically considered the worst and „3" cannot be considered the best, but represents a quantified statement regarding the value. Consequently, the feature pole cannot be interpreted as positive and the antipole as negative. The actual aspired valuation will be made possible by the element „ideal". This valuation will be hold by selected decision makers, e.g. by representatives of single firms, also independent from a certain value-adding-process and therefore on a long-term basis. The element „ideal" does not need to be ranked with the extreme valuations '-3' or '3' necessarily; theoretically, every valuation, also a neutral one (0), is possible. With this high degree of flexibility, problems can occur regarding the evaluation, which will be dealt with in detail in the next but one paragraph 'Evaluation of the Grids'.

In this way a Repertory Grid questionnaire ('Grid') is created, which is generated by the network management for every firm, which takes part in a value-adding-process. After the completed formulation of the Grid, all conditions for the value-adding-process related application of this method are fulfilled.

Attribut Pole	Ideal	Actor 1	Actor 2	Actor 3	Actor 4	Network-Coach	Antipole
sensitive for problems							superficial
talkative							uncommunicative
consultative							denies consultation
selfless							selfish
open to compromises							focused on asserting
communicates success							reserved
convincing							repressive
solves conflicts							creates conflicts
oriented on network							individualist
adheres to rules							expands rules
able to accept criticism							unable to accept criticism
aspires harmony							rebellious
predictable							moody

Figure 2: Repertory Grid for 'cooperation climate'

3.3. Value-Adding-Process Specific Steps

Collection of Data

Regarding the operational structuring of the performance analysis in picture 1, the data collection must be assigned to the stage of measuring. The specialty is that a complete automatisation with the soft factors is not possible and therefore, a manual

collection is needed. After completion of the value-adding process, the involved firms are supplied online with the Grid, which must be completed within a proper time slot and can be filled in online as well. Representatives of the single firms will complete the matrix with the evaluation numbers for the contacted firms and for all constructs in the given area and afterwards, they will forward this to the network management. Upon receipt of all Grids, the evaluation process can begin.

Evaluation of the Grids

After return of the Grid, detailed information will be available. Normally, evaluations by various firms are available for the analysed elements (firms). It is important to make the figures of the calculation of a firm-specific aggregated performance measured value (value benefit of the performance parameter 'cooperation climate') amenable in a proper way. Different approaches are possible for this. In principle, the evaluation of the Grid can be performed by means of IKT, as all needed data is available. This process represents a pre-stage for the actual performance evaluation.

The most common methods for the evaluation of the Repertory Grid questionnaires are the manual evaluation, the cluster- and principal component analysis [Raeithel, 1993; Fransella 1977]. Those methods primarily focus on the clinical-diagnostic aspect of the Repertory Grid method, as similarities regarding evaluation of elements are identified. In this context, the manual evaluation is the simplest method. As a quantitative consideration is the objective, the manual evaluation cannot be applied. The cluster analysis gives useful motivation through its quantitative orientation for the analysis of the Grid in the given context. Especially the consideration of distances with both methods seems a reasonable approach, although the desired results are different. So the deviation of the nominal output from the actual output regarding the performance analysis with the single constructs respectively construct categories comes to the fore. As this also applies to the soft factors, the nominal output must be defined and the actual output must be compared with the nominal output. The actual output is measured by means of questionnaires; the nominal output can be determined by means of a survey in advance. By contrast, the elements are compared with the mentioned 'classic' evaluation method. Regarding the performance analysis, elements which represent the nominal output, can be compared with elements which represent the actual output. Here, the distance measures play an important role.

Weighting of Constructs respectively Construct Categories

As mentioned before, single construct categories are available for the specific weightings. These weightings can be applied regarding the aggregation into a firm-specific value benefit. The determination of the weightings can take place by using a suitable method (e.g. Trade-off-method) being performed by entitled decision makers [Eisenführ, 2003]. From an operational structuring view of the performance analysis, the determination of weighting of constructs or construct categories can be counted to the evaluation stage.

Aggregation into a Value Benefit

Even the aggregation into a value benefit of the performance parameter 'cooperation climate' belongs to the evaluation stage. Through multiplication of the weightings of the single construct categories with the single characteristic values of the construct categories and through adding together those figures, it is possible to get an overall statement regarding the performance parameter 'cooperation climate'. The result is a

numerical value without measurement, which represents the value benefit of the performance parameter 'cooperation climate' of a firm covering all construct categories. This value can be made amenable directly with an evaluation function of the firm-based performance analysis.

3.4. Generation of an evaluation function

After determination of the value benefit, one needs to determine a suitable evaluation function for the 'cooperation climate'. It should be considered, which developing of the value benefit function gives a realistic respectively a desired picture. The interpretation of the value benefits complies with the environmental conditions, the intentions of the decision makers and last but not least with the measure of the available data. As the value benefits can be put into a certain interval depending on the scaling, it stands to reason to takes those values as a proper evaluation, so that a linear relation between the value benefit and the evaluation of this performance parameter seems to be reasonable and so that one only needs to perform a standardisation on values between zero and ten for the evaluation. This value directly goes into the calculation of the overall performance of a firm.

4. CONCLUSION

The consideration of soft factors regarding the performance analysis is essential. Using the example of 'cooperation climate', a theoretical approach is introduced, which allows a quantitative collection, evaluation and analysis of the collected data is possible. The result in the form of an aggregated measured value can be included in an integrated concept of the performance analysis [Jähn, 2005]. For the realisation of the approach, collecting of 'Real-World-data' is indispensable. With the collection of the evaluations of the constructs, assumed as ideal, data is already available. In the next step, the results of the approach must be verified and evaluated by means of assessment of network members. At this stage of work in already can be concluded that applicability within an operator concept for networks is possible.

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