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MEASURING EFFICIENCY IN MANAGEMENT DECISION MAKING - THEORETICAL ANALYSIS AND STATE OF RESEARCH

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Abstract

In the past many authors (cf. Gzuk, 1975; Hauschildt et al. 1983; Simon, 1997; Witte, 1988) have dealt with the issue of efficiency in management decision making and therefore various concepts were proposed on how to measure efficiency in management decision making. But very few, like Neuert (1984), have covered socio-economic efficiency measures within the decision making process, meaning the combination of economic efficiency measures like benefits, costs, time, etc. in decision making with behavioral efficiency measures of managers (Hauschildt et al., 1983). To give a clearer picture on the current status on how to measure efficiency in management decision making, this paper aims to provide an overview of different approaches and outlines the operationalization of a socio-economic efficiency measurement in decision making processes.

The Notion of Decision Making Efficiency

Organizations and respectively their members are interested in satisfying the purposes and aims of the organization so that at least in an indirect manner their own needs are satisfied. In the case of decision making within the organization, Gzuk (1975) believes the purpose or aim is to reach high quality within the decision making process. For Gzuk (1975), quality in this sense, can be substantiated as an activity to reach a purpose or aim. He refers to activity, in this context, also as efficiency. Gzuk (1975) sees the main purpose in managerial decision making in its relevant economic efficiency. Barnard (1938/1968) describes a personal or organizational action as effective, if a specific desired end is attained or a certain aim is reached. This action can also be considered as efficient if it satisfies motives of that aim. In the case that a certain aim is not reached but the motives are still satisfied, the action may not be effective but still efficient and the other way around. For Barnard, efficiency most likely relates to the satisfaction of motives of individuals in an organization and effectiveness relates to the achievement of certain aims of the organization. Hauschildt et al. (1983) see the main causes of efficiency of decision making processes by this complexity, mainly displayed by the type of decision (routine decision, decision of mid complexity or innovative decision), the amount of alternatives, and how much information is requested.

For Gzuk (1988), efficiency in general shows, how well a dedicated target is reached with a minimum of resources (output versus input). Gzuk understands, in this sense, the output as tangible or intangible results, and the input as the deployment of mental or tangible resources. For him efficient decisions are characterized by fulfilling the target with a comparatively low amount of resources (input). Simon (1997) describes efficiency more generally as the ratio between input and output. For commercial organizations, which are generally guided by profits, the criterion of efficiency is the yield of the greatest net income. The simplicity is related to the fact that money provides a common understanding for the measurement of efficiency in terms of output and income. But this concept needs to be expanded for specific activities in commercial organizations (e.g. personell department) or for non-commercial organizations where factors are involved which cannot be directly measured in monetary terms. For Simon (1997), to make an efficient decision, it is necessary to have empirical knowledge of the expected results that are associated with different alternative and possibilities. Neuert (1987) supports this view. He believes that efficiency can be characterized as an expression of a performance rate (output-input relation) and "quality". He explicitly differentiates the term effectiveness from efficiency. For him, effectiveness characterizes whether a measure is in general suitable to achieve a certain target. In this case efficiency can be seen as the "quality level" of the results within the decision making process. In the context of decisions, Gzuk (1975) sees efficiency as the degree of which a purpose is reached containing two additional conditions: first, the purpose is reached with a minimum use of resources (economic input) and the result of the decision ensures a problem solution which lasts for a longer period of time. It seems not to be enough to measure the efficiency of a decision by itself rather than the outcome of a mental or tangible activity (cf. Bronner, 1973, Gzuk, 1975).

Efficiency within the organization can also be reviewed by different approaches. Within the target approach, organizations have explicit targets and efficiency can be defined by the degree of target achievement. The systems approach considers, besides the targets, also the structures and processes of the system-environment relationship. Efficiency in this case evolves from a "concrete", uni-dimensional to an "abstract" and multidimensional construct. The organizational member approach considers the interests of the external stakeholders. An organization in this sense is efficient when the expectances of these members satisfied or fulfilled. Closely related to the organizational member's approach is the interest approach. The interest approach assumes that evaluating the same object will lead to different efficiency evaluations due to different evaluating persons and their individual value and preference structure as well as to their different interests. The management audit approach is a more application orientated approach. Within the management audit approach the organizational efficiency is determined by evaluating the organization through analyzing certain "parts" of it in periodical intervals with relevant questions and by variance analysis (budget-actual) of the key indicators (Grabatin).

Dimensions and Approaches of Decision Making Efficiency and Efficiency Measurement

Decision making in business management can be characterized by different dimensions of decision efficiency. Neuert (1987) describes as one dimension the material efficiency, where

the measurement is a “realistic” input and output comparison in “commercial” activities which can be measured by objective criteria like earnings, profitability, growth and financial independence. Bronner (1973) refers to this part of efficiency as the economic efficiency. As it seems undisputed that the individual behavior also has a major impact on the decision making outcomes, the individual efficiency can serve as a further dimension of the decision making efficiency (Neuert, 1987). For Neuert (1987) in contrast to the material efficiency, the individual efficiency shows rather subjective results of the decision making processes. As “subjective results” he understands expected team outcomes, identification with the team work, self-reflection of the group behavior and the individual role within the group. In sum, he characterizes the individual efficiency as the subjective evaluation of the decision makers concerning the results of their decision making process as well as the self-reflection on their behavior during the decision making process. Bronner (1973) supports this view. For him it is also not possible to measure the individual efficiency on an objective base. He advocates measuring it via the personal activity of the decision maker within a decision making group and the satisfaction of other group members with his activity, in addition to the estimation of the overall achievement of the decision making group. For Bronner (1973), within the decision making process, time or time pressure is usually an influencing factor. He believes, there is also a dimension of “temporal” efficiency. “Temporal” efficiency again is an objective criterion because it can be measured by time. For Bronner time, in this sense, can be a direct measurement (e.g when trying to reduce lead time in a process) or an indirect measurement (e.g. measuring not quantifiable deployment of persons or material in rather complex mental processes).

Grabatin (1981), reviewing efficiency from an organizational perspective, splits the total efficiency into different efficiency dimensions. For him, the dimensions are the “general” economic efficiency, the efficiency of the internal system, which includes indicators to evaluate organizational processes and the necessary constrains for the realization of the organizational efficiency. Typical criteria for the general economic efficiency (for Grabatin) are turnover, profit, market share, etc. For the necessary constraints he picks criteria like flexibility, growth, communication, etc. Grabatin splits the internal system efficiency dimension again into various dimensions, like the efficiency of the organizational structure, the efficiency of the task fulfillment and socioeconomic efficiency factors. For the socioeconomic efficiency, Grabatin introduces efficiency criteria like satisfaction of individuals, motivation, etc.

According to Nutt (2008), decision makers in real life business report that rapid actions are a key factor for them. In this case he sees the duration of the decision making process as a relevant indicator for measuring efficiency. On the other hand, efficiency also depends on the “quality” of the decision and this also needs to be taken into account. In this sense the duration is measured by the elapsed time from the point of recognition until the time when the decision is adopted or abandoned. To Nutt objective indicators to value the quality of the decision are preferred. But as they are mostly difficult to collect and they need to be converted into common metrics and those conversions again can be argumentative and hard to describe, he advocates for measures by informants who subjectively estimate the values. Therefore the

quality of the decision is rated by an anchored rating scale using five anchors. A rating of 5 (outstanding) is to be given to a decisive contribution which provides an exceptional quality. A rating of 1 (poor) is to be given to a decision which had no impact or merit. The rating of 4 is termed good, the rating of 3 is adequate and the rating 2 is disappointing. To avoid the fact that decision makers can make self-serving estimates on rating the quality of the decision, Nutt advocates that only two secondary informants value the quality of the decision. These two informants value the quality of the decision independently along the rating scale and without discussion. To enhance the precision of rating the quality and move the subjective estimates to a rather true value, Nutt introduces the estimate-discuss-estimate (EDE) procedure. He therefore computes the initial results and then has them discussed by the informants. When the individual results are far off, the informants need to explain this with compulsory arguments, which are then weighted. Taking the average out of the second rating with weighted arguments seems, for Nutt (2008), to raise the rating toward a true value.

To define the concept of efficiency by Gzuk (1975) it is necessary to have a purpose or aim, a realized output or result and an input or the use of resources. For Gzuk (1975), to achieve efficiency in the decision making process there are two conditions which need to be fulfilled: first, a decision must realize the most efficient ratio between output and input and second, a decision must bring results which ensure that the aimed objectives will be achieved. To operationalize the measurement of efficiency in the decision making process, Gzuk (1975) advocates establishing a multi-dimensional indicator model. This multi-dimensional indicator model contains four efficiency dimensions: The target-output relation, the input-output relation, the target-input relation and the provision for the realization of the decision. Within those efficiency dimensions indicators need to be established to enable the operationalization of the model which then allows the measurement of the "total" efficiency of a decision (Neuert, 1987). To achieve an acceptable certainty on the measurement of efficiency, Gzuk (1988) advocates that for each dimension there should be more than one indicator.

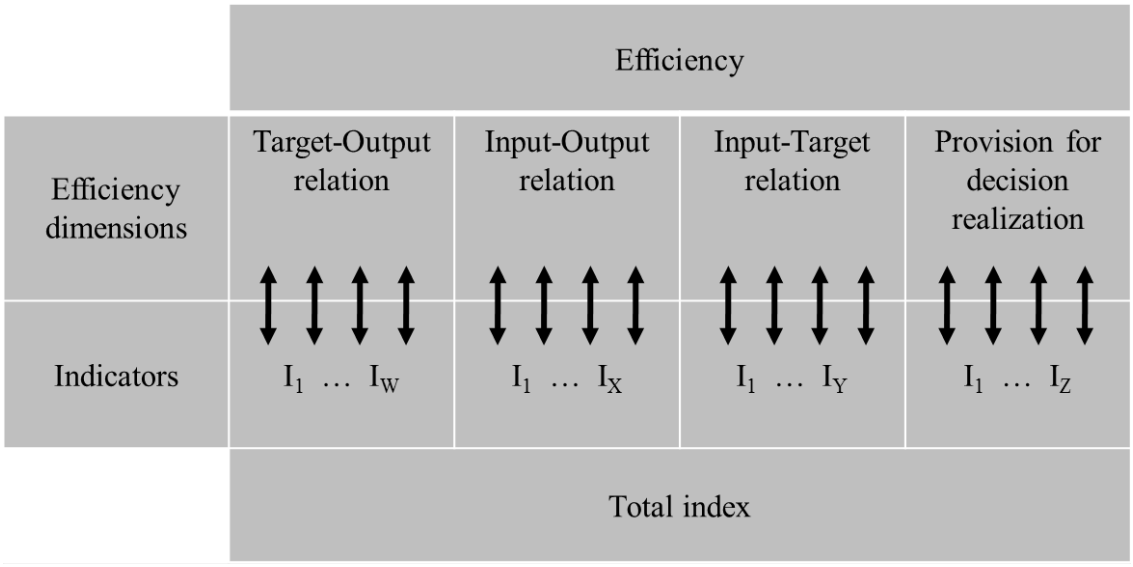

Figure 1: Multi-dimensional indicator model for the efficiency measurement

By definition the decision making process can be understood as a target orientated process (target-output relationship) where from a current/actual state we aim to reach a future/target state. In this sense the decision making with its various sub processes can be seen as a formal instrument for solving problems by taking choices when selecting between alternatives (Gzuk, 1975). The comparison between those alternatives can be described as formal efficiency. The level of the formal efficiency can be determined by comparing the aimed target or the desired situation with the current situation. In this sense a higher coincidence between the targeted and the current state/situation indicates a higher efficiency and in turn a lower coincidence between the targeted and the current situation indicates a lower efficiency.

To measure the total efficiency Neuert (1987) has modified the multi-dimensional model of Gzuk. In Neuert's multi-dimensional model there are three relevant dimensions, the formal efficiency, the material efficiency and the individual efficiency.

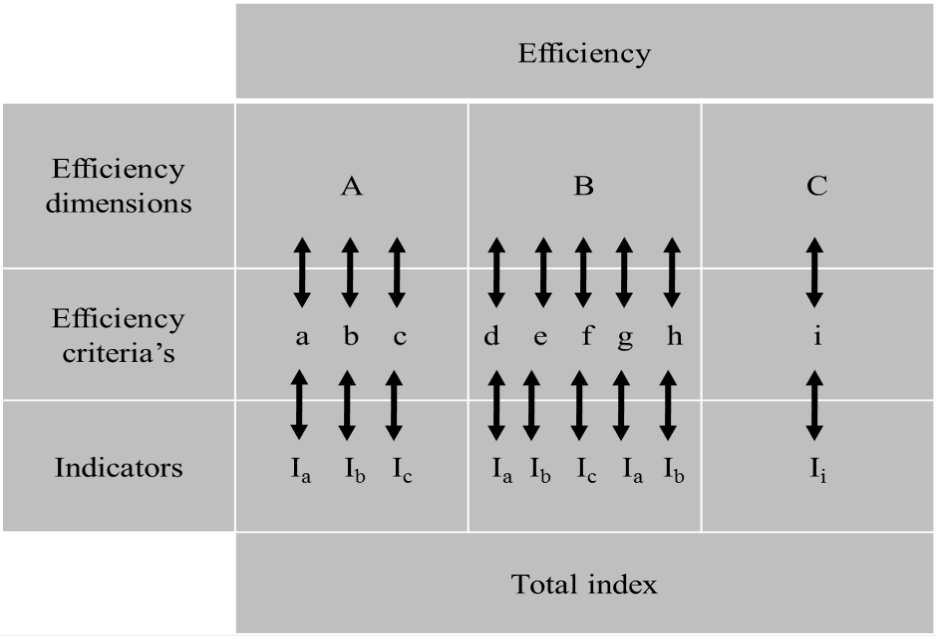

Figure 2: Modified multi-dimensional indicator model for the efficiency measurement

Each dimension can have from one to several efficiency criteria. A criterion for the formal efficiency could, for example, be the comparison between a targeted situation and the actual situation. The formal efficiency in this case reflects more the qualitative aspect of the decision making efficiency. In turn, the material efficiency reflects more the quantitative part of the decision making efficiency. Management science has created a series of key indicators to display the material efficiency in decision making. Mostly these are measures which indicate economic achievements as input-output relationships with performance indicators like profitability, costs and returns or costs and benefits. The formal and the material efficiency rather deal with the "hard facts" and reflect more the economic and therefore the "objective" detectable and reproducible side of the decision making. The individual efficiency reflects more the socio-psychological and "subjective" part in decision making and therefore deals with results which can be considered as "soft facts" and are related to the emotions, feelings, acceptance and satisfaction of individuals. From a more general view the authors see the

individual efficiency here as the subjective expectance of the decision maker when comparing the factual results and the formerly planed results after the decision making processes. The individual efficiency is more characterized by the decision makers hope to fulfill the expectation. The individual efficiency in this sense can also be described as the satisfaction of the decision maker concerning the achieved results (Neuert, 1987).

The classification of the three efficiency dimensions (the formal, the material and the individual efficiency) seem to provide a relevant concept to measure various dimensions of efficiency in the management decision making processes. The single efficiency dimensions are suitable to measure special aspects of the decision making processes under a certain view but still need to be combined to result in a comprehensive efficiency concept, the total efficiency. There are various concepts being developed (cf. Grabatin, 1981, Gzuk, 1975, Neuert, 1987) on how to combine the different efficiency dimensions to satisfy the efficiency concept and to achieve the total "socio-economic" efficiency. Grabatin (1981) advocates an "efficiency analysis of the organization" as an approach to determine the efficiency of organizations in general. In this case he defines an n-dimensional area which is limited by negotiated tolerance (target) limits. As satisfying solutions are in the focus instead of optimal solutions, the tolerance or target limits frame a valid solution space which then can be defined as the area of the efficient organization. Neuert (1987) criticizes this approach, as tolerance (target) limits always need to be known, which does not seem to be the case in reality. Grabatins concept also does not give the possibility to weight the efficiency dimensions differently. Gzuk (1975), in his approach, defines an algorithm for the construction of the total efficiency index, where the total efficiency of a decision is measured by the positive discrepancy of the worst possible efficiency profile. As in this approach the possibility to weight different dimensions of efficiency is up to the user, this concept also does not seem to be suitable for the real life business. Neuert (1987) has conducted a survey, taking a representative sample from the business management population, to evaluate the weighting of different efficiency dimensions as they are present in reality to setup a "amalgamation" concept. The evaluation indicated the material efficiency with a 70% weight, the formal efficiency with a 20% weight and the individual efficiency with a 10% weight.

Exemplary Excursus: Decision Efficiency Distribution Measurement

From an empirical point of view the question arises, how decision making efficiency is comprised of not only from a theoretical angle but particularly how it is "shaped" in "real world cases". In this context, it is of special interest if in reality business decisions are made according to the requirements of rational conduct and/or to which degree actual decision making behavior and decision making efficiency deviate from the ideal decision making/decision efficiency function, assuming that increasing degrees of decision making rationality induce increased levels of decision making efficiency (cf. Isen, 2008).
The data sets gained from an own laboratory experiment, conducted by Neuert (Neuert, 1987) and replicated in 2007 (in a slightly modified way, Neuert, 2010) provide the following empirical findings:

- There is indeed a functional relation between the degree of rational behavior and the degree outcomes efficiency in strategic business decision making processes;

- however, there is no linear relation observable, but a degressively shaped function, approximately depictable by a second degree function($y=a+bx+cx^2\ldots$);
- in addition, by standardizing the described regression function, it is empirically obvious that none of the "tested" decision makers within the experimental sample shows a decision making behavior with a degree of less than ca.20% of "standard rationality", but also none of them exceeds a degree of more than 80% "standard rationality";
- also, the degree of decision making efficiency is indeed shaped along the expectations of the formulated degressive regression function, suggesting that none of "tested" decisions was either "totally inefficient" or "totally efficient".

Given those experimental findings, there is-in particular- another research question evolving, reasoning whether any kind of typical distribution patterns concerning business decision making behavior (and thus decision making efficiency) can be theoretically developed and empirically observed.

Dealing with this research question we utilize the analytical procedures of the Lorenz-curve and the Gini-coefficient in order to form a hypothetical outline of a "generalizable" decision making efficiency distribution and to empirically examine the actual "concentration measures" of the "distributive patterns" of decision making outcomes (Krapp & Kraus, 2013).

Applying the Lorenz-curve approach to our research question, it suggests that the actual distribution of decision making efficiency outcomes within a "population" or a sample of real world decisions more or less strongly deviates from a linear distribution, based on the notion that decision efficiency is "equally" distributed over a sample divided into quintiles (cf. Cowell, 2011). The Lorenz-curve indicates the actual concentration or dispersion of the decision making efficiency measures within the specific quintiles (i.e. 20% of the sample efficiency "very low" up to20% "very high") in comparison to the 45-degree line of the coordinate system, depicting the accumulated portions of the sample quintiles of the decisions made on the x-axis, and the respective accumulated average degrees of decision making efficiencies on the y-axis (Krapp & Kraus, 2013).

In order to measure the actual distribution of the empirically gained decision efficiency data within our experimental sample quintiles, we utilize the concept of the Gini-coefficient (GC).The GC measures the areas between the 45-degree y/x-linear line and the "empirical" curve, gained by the experimental data of decision efficiency assigned to the respective sample quintiles.

The experimental data are based on a sample of advanced business students (n1=65) and a "reference" sample of business managers (n2=16) with a total sample size of 81. All of the experimentees had to fulfill 4 strategic business decision rounds each, ultimately providing an overall sample of ca. 320 single decision making measures pertaining to the respective degrees of decision making rationality and the respective degrees of decision efficiencies as well (Neuert, 1987).The results were the following ones:

- The average degrees of decision efficiency vary between 0.2 (meaning 20% of the optimal decision making efficiency) and 0.8 (80% of the optimum);
- those data represent the following distribution of the average decision efficiencies within the sample quintiles (Qn):Q1=0.2; Q2=0.4; Q3=0.5; Q4=0.6; Q5=0.7);
- the accumulated decision efficiency averages are Q1=0.2; Q1-2=0.3; Q1-3=0.37; Q1-4=0.42; Q1-5=0.48.

In order to compute the Gini-coefficient (GC) for our empirical efficiencies distribution, we have to take into account that the “45-degree” line starts out at the 0.2 level on the y-axis and ends at the 0.8 level on the y-axis, because the actual data do neither “deceed” nor exceed the 0.2 resp. the 0.8-echelon.The linear line has to be shaped accordingly and the efficiency average values have to be modified by a 0.2-subtraction as well, accordingly. Thus, the actual modified values read as follows: Q1=0; Q2=0.1; Q3=0.17; Q4=0.22; Q5=0.28. Finally, the relative contribution of each quintile to the overall decision efficiency of the experimental sample has to be computed. Therefore, the single experimentees (n=81) degrees of decision efficiencies per round have to be added up and assigned to each quintile in relation to the total sum of decision efficiencies (x% for each of the 5 quintiles as a relation between the total sum of 320 single efficiency measures divided by the sum of each relative quintile for n=81 that means 16 “lowest” efficiencies up to 16 “highest” efficiencies. The “shares” of each quintile are as follows: Q1=8%; Q2=12%; Q3=40%; Q4=30%; Q5=10%. This empirical distribution approximates a “normal distribution”. The following table depicts the development of the GC:

Table 1: Gini-coefficient of decision efficiency distribution

	Quintiles				
	1	2	3	4	5
Cumulated portion of decision makers (n=81) in %	20	20	20	20	20
Standardized cumulated average decision efficiency degree	0.0	0.1	0.17	0.22	0.28
Relative "share" of decision making efficiencies per quintile (p)	0.08	0.12	0.40	0.30	0.10

Gini-coefficient computation:

$$GC = \frac{2 \times \sum_{i=1}^{n} i \times p_i - (n+1)}{n} \quad (1)$$

$$GC = \frac{2 \times (1 \times 0.08 + 2 \times 0.12 + 3 \times 0.40 + 4 \times 0.30 + 5 \times 0.10) - (5+1)}{5} \approx 0.09$$

The GC of 0.09 suggests that the distribution of decision making efficiency in our experimental sample shows a fairly equal dispersion of “low”, ”average” up to “high” degrees of decision efficiencies and thus represents a normal distribution of decision making performance.

The concept of the Lorenz-curve and the Gini-coefficient can be further demonstrated by the following graphical representation:

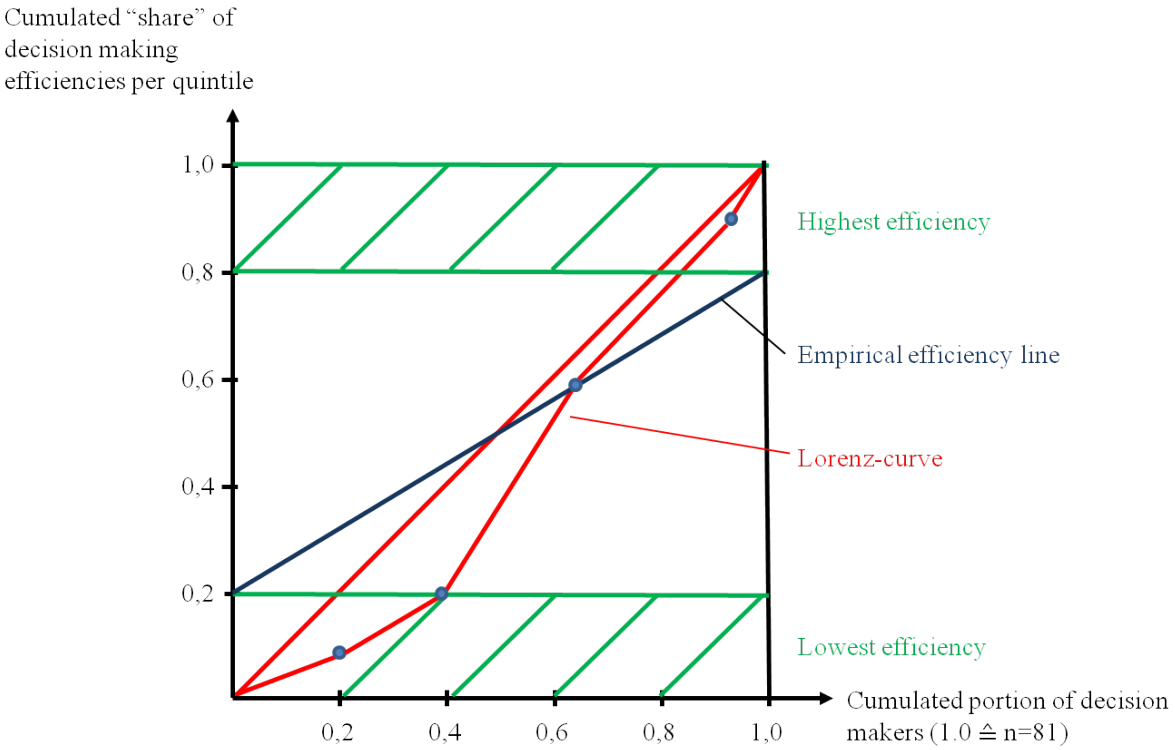

Figure 3: Empirical decision efficiencies and Lorenz-curve

The Lorenz-curve approach and the Gini-coefficient represent one possible concept-among various others (cf. Newell et al., 2011) to measure the distribution of decision making efficiency and decision making rationality, based on the assumption of “rational choice” behavior and in comparison to that the respective deviation of “actual conduct” in “real world” decision making processes.

Remaining Operationalization Issues of the Measurement of Decision Making Efficiency

Management science has created a series of key indicators to display efficiencies in decision making. Mostly these are measures which indicate economic activities as input-output relationships with performance indicators like profitability, costs and returns or costs and benefits (Neuert, 1987). So whenever profitability, costs or returns can be brought into relationship with decision making effort these indicators seem to provide a valid base to measure management decision making efficiencies. But especially in complex environments or decision making situations where rather qualitative issues are addressed it sometimes seems rather difficult to directly measure costs and returns. In this context the time consumption of the decision making process, as an indirect measure for costs, can serve as a

suitable indicator for the material efficiency (cf. Bronner, 1973, Nutt, 2008). As the time as a measurement indictor does not give any indication on quality of the decision making process, which is also a main criterion of efficiency (Gzuk, 1975), the measurement of the formal efficiency can give an indication on the quality of the decision making process. The formal efficiency in this case can be measured by comparing the results of problem solutions to the "optimal results". The formal efficiency in this case can either be evaluated by quantitative facts like a calculation, if it pertains to a rather mathematical task, or by an expert's solution, if it pertains to a rather qualitative task.

The socio-psychological efficiency can be represented by the individual or personal efficiency and represents the more "subjective part" within the decision making process, dealing with results which can be considered as "soft facts" and are related to emotions, feelings, acceptance and satisfaction of individuals. The individual efficiency is more characterized by the decision makers hope to fulfill the expectation and in this sense can also be described as the satisfaction of the decision maker concerning the achieved results. As in this case it is rather hard or almost impossible to track personal "attitudes" (like satisfaction, self-reflection, etc.) by observing participants, the utilization of a questionnaire which contains mainly questions about the personal satisfaction of the participants on solving the problem tasks, how systematic they rate their approach solving the task and how they rate their own cognitive style, seems to appropriate. In this case the satisfaction and acceptance of the decision making behavior of the participants describe their individual efficiency.

Examples of phrases within a questionnaire (Neuert, 1987) could have the following structure:

How satisfied were you today with your problem solution process?

very unsatisfied	1	2	3	4	5	very satisfied

To which degree can you identify yourself with the final problem solution?

very little	1	2	3	4	5	very much

These two questions would measure the satisfaction of the participants concerning their decision making process. According to the needs of the decision making problem the structure of the questionnaire needs to be setup in detail.

Conclusion

Various authors (cf. Gzuk, 1975; Neuert, 1987; Nutt, 2008) in the literature have identified several kinds of efficiency terms and measures, like the material, the formal and the individual efficiency in one or the other way. Therefore, the models of Gzuk (1975) and Neuert (1987) seem to provide a solid foundation for the measurement of decision making efficiencies. Unfortunally, there a not many studies conducted having used this methodology to measure decision making efficiencies and therefore there is not much to compare or to draw deeper conclusions on how these indicators might reflect the "reality". Therefore more research studies concerning improved measurement approaches of decision making behavior

and decision making performance could provide a deeper insight and would allow for creating more standardized “application” how to measure various kinds of decision problem situations and solutions.

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