

Original Research Article

Measuring Rational Behaviour and Efficiency in Management Decision Making Processes: Theoretical Framework, Model Development and Preliminary Experimental Foundations

ABSTRACT

Aims: This paper aims to provide insights into the measurement of decision making efficiency and decision making behavior by establishing a „holistic“ theoretical approach, which extensively considers quantitative, qualitative and situational cause-effect relations in decision making processes. Furthermore, the paper is supposed to show, how theoretical measures can be applied in an empirical environment within a particular decision making situation.

Study design: This research study is designed as a theoretical framework of business decision making behavior, supported by the findings of an experimental investigation.

Place and Duration of Study: The research paper evolved as a significant part of a comprehensive research project, investigating managerial decision making behavior, conducted at Fulda University (GER) and at the University of Latvia (LV) in 2012 and 2013.

Methodology: The methodology of this paper is based on the notion of “critical rationalism”. This approach requires that the theoretical framework of the research study, the “paradigm of socio-economic-quasi-rational behavioral patterns”, has to be tested via an empirical survey. The empirical study was conducted as a laboratory experiment by using a business simulation game as a research design.

Results: The findings of this research paper support the basic hypotheses that business decision making behavior generally ranges within an identifiable spectrum of activity patterns, which makes business decision making foreseeable to a certain extent. The applied statistical procedures (normal distribution tests, confidence intervals, multiple regression analyses, optimization algorithms) provide significant outcomes to a large extent. The sample of the experimental study was comprised of 65 advanced business management students and 16 professional managers, representing a subject sample of 128 decision making processes, altogether. The experimental investigation was conducted at the University of Bayreuth (GER).

Conclusion: The novel paradigm of decision making, outlined in this paper, can be verifiably applied for the analyses and the design of professional business decision making procedures and contexts. It further suggests that, by and large, actual decision making behavior is “located” within a measurable range of “statistical” indicators like standard deviation, standard error and variation coefficient.

Keywords: *decision making, behavioral patterns, efficiency measures, rationality vs. emotionality in decision making processes*

1. INTRODUCTION: BEHAVIORAL PATTERNS AND EFFICIENCY MEASURES IN DECISION MAKING PROCESSES

Finding opportunities to predict and respond faster is one of the main challenges which organizations face in a modern and dynamic competitive environment. Leaders and managers today and increasingly in future will therefore need to make major decisions without having the time to gather “all” required information in order to apply strictly analytical methods (cf. Agor, 1986; p. 49; Patton, 2003, p. 989). Although researchers like Schoemaker& Russo (1993, p. 29) argue that the use of rational decision making heuristics yields the best outcome, especially in complex situations (Bonabeau, 2003, p. 117), for others like Simon (1997, p. 139) efficient leaders and managers do not have the “luxury” of choosing between an analytic or an intuitive approach to solve managerial problems. Instead, it is more important to understand how different kinds of decision making approaches contribute to individually and/or organizationally acceptable results.

In fact, many researches (cp. Gzuk, 1975; Hauschildt et al. 1983; Simon, 1997; Witte, 1988) have developed and tested frameworks to measure the efficiency outcomes of management decision making by systematically considering the assumptions of the descriptive decision making theories.

But very few, like Neuert (1987), have considered a broader range of so-called socio-economic efficiency measures within the decision making process, combining economic efficiency measures like costs, time, etc. in decision making with behavioral efficiency measures of managers (Hauschildt et al., 1983, p. 258). Therefore this paper presents an insight into socio-economic efficiency measures in management decision making by providing an application orientated approach.

2. THEORETICAL FRAMEWORK: THE NOTION OF THE DECISION MAKING RATIONALITY AND DECISION MAKING EFFICIENCY FUNCTION¹

A rational choice within a decision making process can be described as an action which is consequential and preference-based and provides a desirable outcome (March, 1994, pp. 2-3). The “puristic” theory of rational choice assumes that decision makers share common sets of preferences and that the alternatives and their resulting consequences are determined by the environment. March (1994, p. 4) assumes that within a rational choice “... that all alternatives are known, that all consequences of all alternatives are known with certainty, and that all preferences relevant to the choice are known, precise, consistent, and stable.”

However, frameworks which were developed only based on the theory of rational choice seem to suffer from a lack of practical applicability (Bendoly et al., 2006, pp. 737-752), because human behavior frequently does not satisfy the considered assumptions of the “homo oeconomicus”, which is described as a rational decision maker (Mantel et al., 2006, pp. 822-838). From a historical point of view, decision making theory differentiates decision making behavior into “closed” and “open” models (Kirsch, 1970, pp. 25-26). Closed models can be characterized as a cohesive system where there is no consideration on how the “environment” might influence the decision making process. In closed models decision premises are taken for granted and therefore are treated as constant factors. In contradiction, open models do consider interactions between the decision making system and its environment. The closed model, which represents the “classical” or “neoclassical” view, is a typical rational choice model of economic decision making, where the preference

¹Parts of this chapter have been published in Hoeckel, 2012; Neuert &Hoeckel, 2013a, 2013b

of the decision makers is on the maximization of benefits or utilities by choosing the alternative that promises the highest level of return (cf. Bronner, 1973, p. 12; Jones, 1999, p. 299; Roth, 2008, p. 111). Kirsch (1970, p. 27) describes this rational model as the classical case of the "homo oeconomicus" where individuals are capable of rational conduct and motivated by self-interests to use their given resources in order to maximize their expected utility. For him the "homo oeconomicus" is characterized by three main assumptions: 1) the decision maker knows all alternatives and has all necessary information for a given problem situation available, 2) the decision maker can always indicate the best alternative and 3) the decision maker is motivated to maximize his utility by self-interests (Kirsch, 1970, pp. 27-40). Neuert (2004, p. 2) refers to this notion as the "economic man model". The economic man possesses a complete system of alternatives which allows him to choose among these alternatives. Also, he always has a complete awareness of these alternatives and no limits to the complexity of the "calculation", so that he can determine which alternative is best. Objective rationality would imply that, firstly, all behavior alternatives prior to the decision have been viewed in a "panoramic" fashion, secondly, that all consequences that would follow the decision on each choice have been considered and, thirdly, that one alternative is picked out of a whole set of alternatives with a system of values as measurable decision making criteria (cf. March et al., 1993, p. 159; Simon, 1997, p. 87). Taking at least these implications into account shows us, that the model of rational behavior attempts to fall short (Argyris, 1973, p. 254). For Popper & Miller (1995, pp. 351-355) it seems clear that empirical or psychological behavior of human beings has little or nothing to do with the principle of "rationality" or what they call "situationally appropriate behavior". For Popper & Miller this is referable to the fact that there are major individual differences, not only in knowledge and capabilities, which are part of the situation, but also into the judgment of the circumstances of a situation, in which human beings behave differently. Some behave appropriate to the situation and others do not.

Recognizing this was the initial point to transmute the closed model of the "homo oeconomicus" into the open model of the "administrator" which we can observe in the everyday life of "bounded" reality (cf. March, 1990, p. 272; March et al., 1993, pp. 158-160; Simon, 1978, p. 349; Simon, 1997, p. 118). The administrator is characterized by rather a satisficing than maximizing approach looking for the "good enough" solution by choosing alternatives without examining all possibilities. Doing this, the administrator ignores interrelations and complexity that enables him to make decisions by applying simple problem solving heuristics or so-called rules of thumb (Simon, 1997, p. 119). For March (1990, p. 272), the development of the idea of limited rationality was also forced by the fact that individuals and groups tend to simplify decision problems, because they have difficulties in anticipating or considering all possible alternatives and all available information. Kirsch (1970, pp. 89-92) illustrates similar restrictions like Simon and March, why individuals tend to act like the "administrator" instead of the "homo oeconomicus". Whereas in the past, behavior was only considered as being rational when given targets were maximized (optimized), today the concept of rational behavior seems also to be appropriate when given targets are satisfied (cf. Kirsch, 1970, p. 62; March & Simon, 1993, p. 162). Originally, rationality was only considered as individual rationality. Decisions to satisfy role expectations or social standards were therefore, per se, not seen as rational. But decision making theory by now also interprets rationality in the sense of social rationality. Therefore, when decisions are made to satisfy social standards or individual rolls, they are not anymore in contradiction with the rationality notion. For Neuert (2010, p. 4491), human behavior in decision making processes never shows a pattern of "pure" rationality, as rationality is limited by individual and/or collective constraints, like insufficient cognitive competences, psychological predispositions, feelings and emotions, norms and values, etc. In particular, human behavior has to be considered as a combination of intuitive and rational behavior.

Organizations and respectively their members are interested in satisfying the purposes and aims of the organization so that in an indirect manner their own requirements are satisfied. In the case of decision making within the organization, Gzuk (1975, p. 5) believes that the main purpose or aim is to reach high procedural quality within the decision making process. For Gzuk (1975, p. 7), quality in this sense can be substantiated as an activity to reach a purpose or a target. He refers to the activity, in this context, also specified as the "efficiency". Gzuk (1975, p. 11) sees the main purpose in managerial decision making in the outcome which is measured as economic efficiency. Barnard (1938/1968, pp. 19-20) 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, p. 256) see the main causes of efficiency of decision making processes in the "situational" complexity, mainly displayed by the type of decision (routine decision, decision of mid complexity or an innovative decision) and the amount of alternatives, and how much information is requested.

For Gzuk (1988, pp. 125-127) efficiency in general is how well an allocated target is reached with a minimum of resources (output versus input). Gzuk, in this sense, understands 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 aim of the target with a comparatively low amount of resources (input). Simon (1997, pp. 250-257) 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. That 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, p. 262), it is necessary to gain empirical knowledge of the expected results that are associated with different alternative possibilities in order to make an efficient decision. Neuert (1987, p. 109) supports this view. He believes that efficiency can be characterized as an expression of the performance rate, output-input relation, and quality "realization". 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. Gzuk (1975, p. 15) sees efficiency as the degree of which a purpose is reached by considering two additional conditions: firstly, the purpose is reached with a minimum use of resources (economical input) and, secondly, 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, p. 39; Gzuk, 1975, p. 16).

3. OPERATIONALIZATION OF THE DEGREES OF DECISION MAKING RATIONALITY

The theoretical framework clearly indicates that decision making is neither a totally rational nor an irrational process (cf. Kirsch, 1970; Neuert, 2010; Popper & Miller, 1995). More likely it seems that there are several degrees of decision making rationality (Neuert, 1987, p. 81). In this case Neuert (1987, p. 82-108) outlines five criteria which specify the concept of decision making by allowing to evaluate different degrees of decision making rationality: 1)

The degree of target orientation (DTO) which measures the orientation on formalized goals, because rational behavior is only possible if there are defined rules, guidelines and aims available, 2) the degree of process organization (DPO) which measures the procedure of structuring the decision making process, 3) the degree of information acquisition and evaluation (DINF), which measures the activities of information utilization in order to set appropriate target orientated actions, 4) the degree of decision making "cognition" (DCOG) which measures the formal logic of the decision making heuristics utilization and 5) the degree of reflection (DREF) meaning the ongoing control of expected decision making outcomes against the actual ones and the learning from the empirical experience for similar future situations.

For Neuert (1987, pp. 235-256) from a business management perspective, these elementary criteria of procedural decision making rationality can be operationalized in the following way:

1) The degree of target orientation displays how accurately the target system is defined and how intensive it is aspired, based on the characteristics of the content, the defined timeframe, the development of specific target dimensions and how consistently the targets are pursued by the decision makers. 2) The degree of process organization measures the degree of sequencing and structuring within the decision making process. The degree of organization in this case can be characterized by three indicators, the content character of the problem-situation, meaning how is a problem situation split in smaller sub-problems, the chronology of the necessary decision making steps considering the time which is needed for the decision making process and the personal assignment of sub-problems (within group decisions). 3) As the degree of information intends to measure the "quality" of the information acquisition, the information collection can again be divided into the depth and breadth of the information, explaining how much of the accessible information was actually addressed. The breadth of information means e.g. whether "all" competitors were included when evaluating the market situation, and the depth of information means e.g. the situation of each competitor about their turnover, earnings, etc., were considered. 4) The degree of decision making "cognition" is less about the "content quality" of the decision rather than the fulfillment of the required steps of the decision making process (defining the target criteria, collecting alternatives, outlining consequences, evaluating and "weighting" of the target criteria and their consequences, and coming up with the "situationally" logic decision). In this case the "decision making cognition" can be evaluated on the basis of how the five steps of the ideal decision making process are actually included in the "empirical" decision making process. 5) The degree of reflection can be seen as the combination of the degree of documentation and the degree of control activities. The degree of documentation, in this case, is about how exactly the decision making process development is accessible and reproducible. The degree of control measures the activity of evaluation of the achieved results in comparison with the expected situation/results before the decision making process. Both activities can be measured e.g. by a five point LIKERT scale from "no activity at all" to "very precise activity".

As a result those five separate criteria for decision making rationality can be amalgamated to a multidimensional degree of rational decision making.

4. MEASURING THE DIMENSIONS OF DECISION MAKING EFFICIENCY

To state the concept of decision making efficiency more precisely for Gzuk (1975, p. 40) it is necessary to create a purpose or an aim, a realized output or result, and an input resp. the use of resources. In order 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

226 between output and input, and second, a decision must provide results which ensure that the
227 aspired objectives will be achieved (Gzuk 1975, p. 5).

228
229 To set up a measurement for the “total” efficiency in the decision making process, Gzuk
230 (1975, pp. 54-57) advocates the establishment of a multi-dimensional indicator model
231 (

232 Fig.1). This multi-dimensional indicator model contains four efficiency dimensions: The
233 target-output relation, the input-output relation, the target-input relation and the feasibility of
234 the “realization” of the decision. Within those efficiency dimensions indicators need to be
235 established to enable the operationalization of the model which then allows the
236 measurement of the “total” efficiency of a decision making outcome (Neuert, 1987, pp. 113-
237 114). To achieve an acceptable “security” of the measurement of efficiency Gzuk (1988, p.
238 130) advocates that for each dimension there should be more than just one indicator.
239 Multiple dimensions will enhance the model reliability and lower errors in measurement
240 (Weiber&Mühlhaus, 2010, pp. 92-93)

241

Efficiency				
Efficiency dimensions	Target-output relation	Input-output relation	Target-input relation	Actions for decision realization
Efficiency indicators	$\updownarrow\updownarrow\updownarrow\updownarrow$ $I_1 \dots I_W$	$\updownarrow\updownarrow\updownarrow\updownarrow$ $I_1 \dots I_X$	$\updownarrow\updownarrow\updownarrow\updownarrow$ $I_1 \dots I_Y$	$\updownarrow\updownarrow\updownarrow\updownarrow$ $I_1 \dots I_Z$
Total index				

242

243 **Fig.1. Multi-dimensional indicator model for the total efficiency measurement**

244 *Source: Gzuk, 1975, p. 57*

245

246 Grabatin (1981, p. 52) reviewed the decision making efficiency from an organizational
247 perspective, splitting the “total” efficiency into different efficiency dimensions. For him, the
248 dimensions are the “general” economic efficiency, the efficiency of the internal system, which
249 includes indicators to evaluate organizational processes, and the necessary constraints for
250 the realization of the organizational efficiency. Typical criteria for the general economic
251 efficiency for Grabatin are turnover, profit, market share, etc. For the necessary constraints
252 he picks up criteria like flexibility, growth, communication, etc. Grabatin splits the internal
253 system efficiency dimension again into various dimensions, like the efficiency of the
254 organizational structure, the efficiency of the task fulfillment and into socio-economic
255 efficiency factors. For the socioeconomic efficiency, Grabatin introduces efficiency criteria
256 like satisfaction of the individual, motivation, etc.

257

258 Decision making outcomes in business management can be characterized by different
259 dimensions of efficiency. Neuert (1987, p. 115) describes, one dimension as the “material”
260 efficiency, where the measurement is a realistic “input and output” in commercial activities
261 which can be measured with “objective” criteria like earnings, profitability, growth and
262 financial independence. Bronner (1973, pp. 39-40) refers to this part of efficiency as the
263 economic efficiency. A further dimension can be seen as the individual efficiency. For Neuert
264 (1987, p. 117), in contrast to the “material” efficiency, the “individual” efficiency considers
265 rather “subjective” results of the decision making process. As “subjective” results he
266 understands expected results of teams or individual efforts, identification with team work,
267 self-reflection of group behavior and the individual role within the group. In sum, he
268 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, p. 40) 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 via 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, pp. 42-43), within the decision making process time or time pressure is usually an influencing factor. He believes that there is also a dimension of temporal efficiency. Temporal efficiency again is an objective criterion, because it can be measured by time needed or allocated. 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).

To operationalize the measurement of the “total” efficiency, Neuert (1987, p. 114) has modified the multi-dimensional model of Gzuk. In Neuert’s multi-dimensional model (Fig.2) the “total” efficiency is split in the formal efficiency, the material efficiency and the individual efficiency (A, B, C).

	Efficiency		
Efficiency dimensions	A	B	C
Efficiency criteria	$\updownarrow\updownarrow\updownarrow$ a b c	$\updownarrow\updownarrow\updownarrow\updownarrow\updownarrow$ d e f g h	$\updownarrow$ i
Efficiency indicators	$\updownarrow\updownarrow\updownarrow$ J _a J _b J _c	$\updownarrow\updownarrow\updownarrow\updownarrow\updownarrow$ J _d J _e J _f J _g J _h	$\updownarrow$ J _i
	Total Index		

Fig.2. Operationalization of the multi-dimensional model to measure the total efficiency
Source: Neuert, 1987, p. 114

Each dimension can include one or several efficiency criteria. A criterion for the formal efficiency could be, e.g., the comparison between a targeted aim and the actual target realization. A criterion for the material efficiency could be the comparison between the profit and the time used for an action and a criterion for the individual efficiency could be the personal satisfaction with the process and its outcomes. To measure those criteria in various dimensions, adequate indicators have to be defined (Neuert, 1987, p. 160 ff.).

5. DEVELOPMENT OF A NOVEL PARADIGM OF SOCIO-ECONOMIC QUASI-RATIONAL BEHAVIORAL PATTERNS: “THE HOMO SOCIO-OECONOMICUS CONDITIONALIS – N SIGMA – M STANDARD (OUTCOME) ERROR – P VARIATION (COEFFICIENT) THEOREM (HSOCN6MEPVC)

The issue of rationality and rational behavior has been highly disputed in business research, business practice, literature, and academia ever since (cf. Nehring, 2011, p. 37 ff., Engels, 2012, p. 25 ff.). Karl Popper considers the “principle of rationality” as a methodological postulate, which implies that human behavior follows the rules of a model that explains cause-effect relations in reality (Popper, 2002, p. 352 f.). In this sense, rationality is not at all

an empirical or psychological phenomenon, but just an outline of behavioral patterns which may be applied “a-priori” in problem solving situations (Popper, 2002, p. 354). On the other hand, Popper himself points out that human behavior is not at all based on a uniform format of conduct but on “obviously huge individual differences, not only in terms of knowledge and capability – which are part of the (problem-, n.b.a.) situation but of the judgment and comprehension of the (problem-, n.b.a.) situation; and that means that human beings therefore behave differently, some in line with the (problem-, n.b.a.) situation, others not” (Popper, 2002, p. 354).

In economics, business administration and management sciences the model resp. the paradigm of the “homo oeconomicus”, the “economic man”, has been dominating the relevant theory (Schirrmacher, 2013, p. 28 ff.). In particular, the neo classical economic approach, preeminently represented by scholars like Milton Freedman, Gary Becker and Eugene Fama et al. has produced a myriad of publications, based on the notion of the homo oeconomicus approach (Horn, 2012, pp. 31-38, pp. 57-63, pp. 165-172). The paradigm of the homo oeconomicus requires so called “rational behavior” in a way that decisions will be made independently from others, following the individual utility optimization within a given problem and decision situation as a “rational choice” (Heuser&Priddat, 2013, p. 13).

The homo oeconomicus concept of rational behavior is based on the following assumptions: Unlimited information about the structure of problem situations, existence knowledge about the alternatives and consequences of behavioral options; constant and non-contradictory system of targets and preferences; unlimited cognitive capabilities and ability to formulate and follow the utility maximization algorithm (Klages, 2014).

Especially, in the course of the 2008 worldwide financial crises - but also already many years before - the notion of the economic rationality paradigm has been heavily challenged, in particular by representatives of the behavioral and experimental economics, e.g. Akerlof&Shiller (2010), Ariely (2010), Bolton &Ockenfels (2014), G  th et al. (2013), Kahnemann&Tyversky (1979), Smith (2009), and especially - in former times – by Simon (1978) and Selten (1998). Foremost Simon’s approach of “Bounded Rationality” and Seltens “Aspiration Adaptation Theory” have turned out as seminal foundations of theoretical approaches which do not emphasize human ability of total rational choice and judgment, but pointing out – based on empirical evidence – that human conduct is heavily influenced also by factors like emotions, societal conditions, cultural norms and values, cognitive limitations, temporal evolvments and environmental changes, etc.

As a consequence, the question arises whether the paradigm of rational conduct in decision making and problem solving processes has to be and can be adjusted in accordance with actual human behavior, based on empirical evidence.

Karl Poppers “Logic of Scientific Discovery” maintains that a theory is set of cause-effect hypotheses has to be developed first and then has to be tested against reality. In a restrictive manner this means that in the first place the empirical reality has to be “neglected”. It is obvious that this would never be the case. Apart from intensive discussions in psychology, socio-psychology, sociology, and political science (cf. Glasersfeld, 1997, Detel, 2011), we assume that theoretical developments are never independent from real world situations and conditions we are living in constantly.

In order to develop a more realistic image of human behavior in decision making and problem solving processes, we suggest a kind of a reverse theory development approach. At first we consider and scrutinize the empirical field, of course guided by our criteria of interest

how decisions are made and problem solutions are being achieved. Those criteria have been outlined by Neuert (1987, pp. 87-107) in form of the following pertinent decision behavior elements: Target orientation (DTO), process organization (DPO), information acquisition and evaluation (DINF), decision making cognition (DCOG) and reflection (DREF) (cf. Hauschildt, 1977, Joost, 1975, Witte & Hauschildt, 1972).

Based on empirical evidence under those criteria, we develop a modified theory of socio-economic “quasi rational” behavior, emphasizing the following theoretical elements:

- Human decision making and problem solving behavior in particular and varying situations and problem structures are not uniform but dispersed.
- The degree of dispersion is influenced by elements like cognitive capabilities, decision making and problem solving structure and situation, emotions, norms, societal customs, etc.
- The “rationality” of decision making behavior varies with the degree of “professional” vs. “private” characteristics of the decision making situation, meaning that professional decisions (e.g. business decisions) are more likely in line with the “classical” homo oeconomicus approach than decisions in the private life (e.g. private consumption decisions).
- However, the “range of conduct” in decision making processes deviates from observably “normal” decision making behavior within a certain measurable interval, which can be determined by a “variance index” and by a “standard error index” of actual empirical decision making behavior and outcomes.

Those theoretical considerations can be summarized in form of novel quasi-rationality paradigm, which we label the “homo socio-oeconomicus conditionals – n sigma – m standard (outcomes) error p variation (coefficient)-theorem (HSOCnÖmEpVC). This paradigm is based on the following tentative assumptions:

- We only consider, in a first step, strategic business and managerial decisions which have to be made and performed by business leaders and managers at relatively high up hierarchical echelons.
- Decision making behavior in terms of the application of managerial decision making criteria, like target orientation, process organization, information acquisition and evaluation, decision making cognition, and degree of reflection and control of conduct in decision making and problem solving processes, generally follows a normal distribution. The respective decision making behavior criteria do have an impact on the respective decision making efficiency and outcomes.
- Decision making efficiency and outcomes also follow a normal distribution.

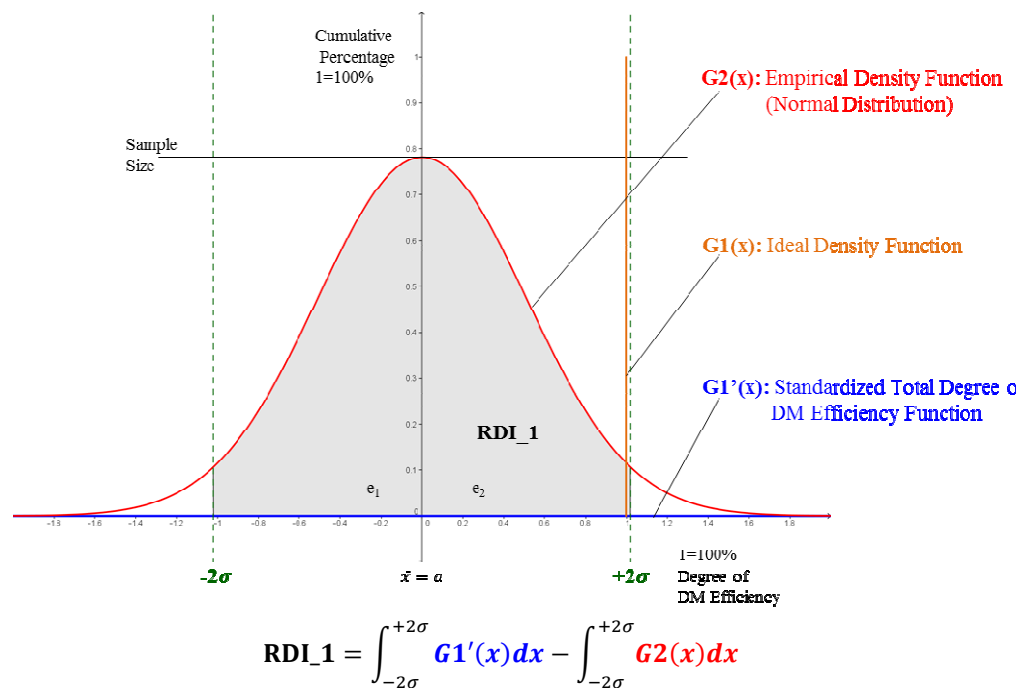
Given those assumptions our basic hypothetical theorem can be formulated as follows:

Decision making behavior and decision making outcomes within a “professional strategic business context” do not exceed in all likelihood a deviation of a “two sigma variance”, a “standard outcome error of four (SE=0.04)” and a “variation coefficient of five (VC=0.5)” within a given normal distribution decision making context.

This **first basic hypothesis** will be tested by the collected empirical data of the decision making laboratory experiment conducted by Neuert (1987).

The theoretical outline of our basic hypothesis can be summarized as follows (cf. Fig.3):

- The classical concept of the homo oeconomicus considers no deviation in the degree of decision making behavior and decision making efficiency among a specific population of decision makers. This “linear function” is displayed as the Ideal Distribution Function (G1) in Figure 3.
- We presume that empirical data will not support this classical concept. Instead, the degree of the decision making efficiency (and behavior), based on experimental findings, will, in all likelihood, follow a normal distribution. This assumption is displayed as the first derivative of the Empirical Normal Distribution Function (G2) in Figure 3.
- The classical concept of the homo oeconomicus model implies that there is a strictly linear relationship between rational decision making behavior and decision making outcomes. Again we propose that this relationship will not be supported by the empirical data. Moreover, empirical data will neither provide absolute degrees of rational decision making behavior nor “complete” decision making efficiency.
- Figure 3 exemplifies the “absolute” degree of rational behavior in relationship to “complete” decision making efficiency, depicted as the density function of the Standardized Total Degree of Decision Making Efficiency Function (G1') and the Empirical Density Function (G2), following a Normal Distribution Function.



Rationality Deviation Index 1 (RDI_1) = Definite Integral between **G1'(x): Standardized Total Degree of DM Efficiency Function** and **G2(x): Empirical Density Function (Normal Distribution)**

Fig.3. Degree of rational behavior in relation to decision making efficiency

- G1' equals the density function of the basic function y (DM Efficiency) = 1 (meaning that each single “absolute” rational decision maker will achieve “complete” decision making efficiency). This means that (for G1: $\bar{x} = 1$, and $\sigma = 0$) $G1' = 0$.
- Empirically, the actual density function approaches the formula of the Normal Distribution Density Function (G2).

- We hypothesize that usually resp. actually observable decision making behavior (leading to a certain empirical degree of decision making efficiency) does not exceed a standard error of $SE=0.04$ (according to the basic hypotheses) and an expected dispersion from the mean of $\pm 2\sigma$, proposing a probability of 0.9545 of the expected decision making behavior range.

As a consequence, actual decision making behavior (resp. decision making efficiency) deviates from ideal decision making behavior (resp. homo oeconomicus decision making efficiency), measured by the determined integral of the density functions $G1'-G2$. $G2$ is further specified by the proposed limits of $\pm 2\sigma$ and $SE=0.04$.

Given that, we can determine our first "**Rationality Deviation Index (RDI_1)**", via $G1'-G2$.

The following computation develops an empirical **RDI_1** by using data from a laboratory experiment (Neuert, 1987), investigating actual decision making behavior and decision making efficiency. As a result, decision making behavior (operationalized as outlined in chapter 3) follows an empirical normal distribution function (confirmed by statistical test procedures; Neuert, 1987, p. 282 ff.).

Using the empirical data, exemplified by the rational decision making behavior criterion "target orientation" (DTO), we develop the **RDI_1** as follows: $\bar{x}_{DTO} \approx 0.35$; $s = 0.14$; $s^2 \approx 0.02$ ($s=\sigma$)

This leads to the following formula:

$$\mathbf{RDI_1} = \int_{-2\sigma}^{+2\sigma} G1'(x)dx - \int_{-2\sigma}^{+2\sigma} G2(x)dx \quad (1)$$

Under the assumption that the standard error should not exceed a value of $SE=0.04$ the empirical value for s (σ) = 0.5060. The standard error is computed as follows: $e = \frac{s}{\sqrt{n}}$ (n = sample size in experiment = 160):

$$\mathbf{RDI_1} = -0.3455$$

This result for the **RDI_1** has to be interpreted as follows:

With an expected probability of 0.9545 ($\pm 2\sigma$), the empirical degree of rational decision making behavior deviates with a value of -0.3455 from the ideal homo oeconomicus behavior. However this value is a non-standardized digit. In pure form the non-standardized result would suggest a deviation range of about 35% potential rational "misbehavior" in comparison to "complete" rationality.

In order to gain a notion whether **RDI_1** can be considered as a (relatively) low or high deviation from ideal homo oeconomicus behavior, we have to find a standardized deviation value, which will be performed under the development of the **Rationality Deviation Index 2 (RDI_2)** as follows:

As mentioned above, our novel paradigm of decision making behavior is empirically tested by the data of the laboratory experiment. Prior to that, the theoretical outline of decision making behavior and decision making efficiency has to be specified as follows again:

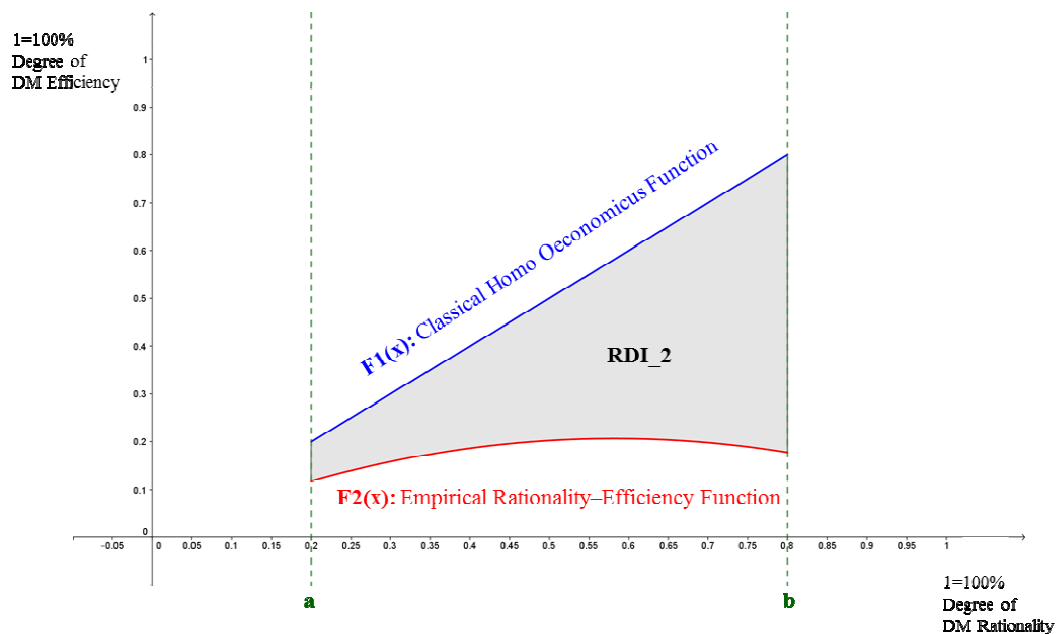
- There is a cause-effect relationship between decision making behavior and decision making efficiency.

- Within the context of our “professional strategic business decisions” (PBD) we presume the following proposition: The higher the degree of rationality of decision making behavior the higher the degree of decision making efficiency.
- The degree of decision making rationality refers to the degree of the fulfillment of the above outlined decision making conduct criteria.
- The “Classical Homo Oeconomicus Function” (F1) between decision making rationality and decision making efficiency is a linear one, claiming that there is no decision making efficiency by 0% rationality and a 100% decision making efficiency with a 100 % decision rationality.

This leads to our **second basic hypothesis**: Given our “professional strategic business decision making” context (PBD), actual decision making behavior and decision making efficiency are placed within a certain measurable range.

We propose that there is no observable “zero” decision making behavior, and that there is no “absolute” decision making efficiency as well.

This notion can be summarized as follows (cf. Fig.4):



$$RDI_2 = \int_a^b F1(x)dx - \int_a^b F2(x)dx$$

Rationality Deviation Index 2 (RDI_2) = Definite Integral between **F1(x): Classical Homo Oeconomicus Function** and **F2(x): Empirical Rationality-Efficiency Function**

Fig.4. Homo oeconomicus function vs. the empirical rationality function

F2 represents the Empirical Rationality-Efficiency Function for target orientation (laboratory experimental data):

$$DME \text{ efficiency} = 0.71x_{DTo} - 0.61x_{DTo}^2 \text{ (standardized empirical regression function)} \quad (2)$$

The empirical data proposes, that there is no decision making efficiency (behavior) beneath 0.2 (a) and no decision making efficiency (behavior) above 0.8 (b).

517 This leads to the **Rationality Deviation Index 2 (RDI_2)**:
 518 Definite Integral between “classical homo oeconomicus function” (F1) and “empirical
 519 rationality-efficiency function” (F2):

$$\text{RDI}_2 = \int_a^b F1(x)dx - \int_a^b F2(x)dx \quad (3)$$

$\text{RDI}_2 = 0.1895$

520
 521

522 This result means, that the actual empirical deviation of decision rationality (resp. decision
 523 making efficiency) deviates with a value of about 19% from the ideal homo oeconomicus
 524 decision making behavior (this result is standardized by the homo oeconomicus rationality
 525 function $y = x$; minimum rationality = 0, maximum rationality = 1).

526

527 **RDI_2** (0.1895) is actually sufficiently in line with the (unstandardized) **RDI_1** (-0.3455).
 528 Given the more precise context of the (standardized) computation procedure it is however
 529 recommended to focus on **RDI_2**.

530

531 Whereas our hypothesized standard error in our HSCO-Theorem is 0.04, the empirical
 532 average standard error of decision making behavior in the lab experiment was about 0.02
 533 (see table below). Applying the algorithm for **RDI_1** from above that leads to a modified
 534 **RDI_1'** (-0.0581), which amplifies the substantiation of our basic hypothesis (see Appendix).

535

536 Finally, we develop a **Rationality Deviation Index 3 (RDI_3)** via including the empirical
 537 variation coefficient of our laboratory findings and the application of the confidence interval
 538 estimation procedure, in order to determine the potential range of actual quasi rational
 539 behavior, based on a certain dispersion ($\pm 2\sigma$) and a certain standard error (SE = 0.04).

540

541 The respective results of the laboratory experiment were the following:

542

	SE	WF_R	VC	WFR
DTO	0,0100	0,2050	0,4000	0,2050
DPO	0,0100	0,2780	0,3200	0,2780
DINF	0,0140	0,0920	0,2200	0,0920
DCOG	0,0150	0,2720	0,8200	0,2720
DREF	0,0100	0,1530	0,2000	0,1530

SE	Standard Error
WF_R	Weighting Factor from emp. Regression Analysis
VC	Variation Coefficient
DTO	Degree of Target Orientation
DPO	Degree of Process Organization
DINF	Degree of Information
DCOG	Degree of DM Cognition
DREF	Degree of Reflection
SE_W	Standard Error (Weighted)
SUM_SE_W	Sum of SE_W
AVG_SE_W	Average of SE_W
VC_W	Variation Coefficient (Weighted)
SUM_VC_W	Sum of VC_W
AVG_VC_W	Average of VC_W

SE	WF	SE_W
0,0100	2,2283	0,0223
0,0100	3,0217	0,0302
0,0140	1,0000	0,0140
0,0150	2,9565	0,0443
0,0100	1,6630	0,0166
SUM_SE_W		0,1275
AVG_SE_W		0,0255

VC	WF	VC_W
0,4000	0,7374	0,2950
0,3200	1,0000	0,3200
0,2200	0,3309	0,0728
0,8200	0,9784	0,8023
0,2000	0,5504	0,1101
SUM_VC_W		1,6001
AVG_VC_W		0,3200

543

544 **Fig.5. Empirical absolute and weighted standard errors and variation coefficients**
 545 **(the weighting factors were developed by a multiple regression analysis)**
 546

547 The confidence interval statistical procedure was conducted exemplarily for the rationality
 548 criterion "target orientation (DTO)", based on the following formula:
 549

$$\bar{x} - z * SE_{\bar{x}} \leq \mu \leq \bar{x} + z * SE_{\bar{x}} \quad (4)$$

550
 551 For: $\bar{x}$ = empirical mean of target orientation (DTO) behavior; z = transformational value of
 552 standard deviation; $SE_{\bar{x}}$ = empirical mean of standard error; μ = estimated confidence interval
 553 of "target orientation (DTO) behavior".
 554

555 This leads to the following **RDI_3**:

$$\begin{aligned} 0.35 - 2 * 0.02 &\leq \mu \leq 0.35 + 2 * 0.02 \\ 0.31 &\leq \mu \leq 0.39 \\ \text{Variation coefficient 1} &= 0.14/0.31 = 0.45; \\ \text{Variation coefficient 2} &= 0.14/0.39 = 0.36; \\ \text{Average variation coefficient} &= 0.405. \end{aligned} \quad (5)$$

556
 557 The **RDI_3** (based on the empirical standard error) suggests that the average deviation of
 558 quasi-rational decision making behavior iterates about 41% around the empirical mean.
 559

560 The **RDI_3'** (based on our hypothetical standard error of 0.04) leads to the following result:

561 This leads to the following **RDI_3'**:

$$\begin{aligned} 0.35 - 2 * 0.04 &\leq \mu \leq 0.35 + 2 * 0.04 = \\ 0.27 &\leq \mu \leq 0.43 \\ \text{Variation coefficient 1} &= 0.14/0.27 = 0.52; \\ \text{Variation coefficient 2} &= 0.14/0.43 = 0.33; \\ \text{Average variation coefficient} &= 0.422. \end{aligned} \quad (6)$$

562
 563 This means that hypothetically the rationality of decision making behavior iterates about 42%
 564 around the mean.
 565

566 In addition, we develop the expected probability of the empirically observed decision making
 567 behavior, which is "located" within the above outlined range, corresponding to the average
 568 variation coefficient. Therefore, we use the z-value transformation procedure, referring to the
 569 theoretical and, in our case, empirical normal distribution. In our laboratory experiment, the
 570 minimum degree of "target orientation (DTO) behavior" was 0.2, the maximum 0.6.
 571

572 This leads to the following algorithm:

$$\begin{aligned} \text{Pr}(z > 1): 0.39 - 0.35 / 0.14 &= 0.29 (\text{z-value}) \\ F(z) &= 0.61; 1 - 0.61 = 0.39 \\ \text{Pr}(z < 1): 0.31 - 0.35 / 0.14 &= -0.29 (\text{z-value}) \\ F(z) &= 0.38; 1 - 0.38 = 0.62 \\ F(b - \mu/\sigma) - F(a - \mu/\sigma) &= 0.23 \end{aligned} \quad (7)$$

573
 574 This result means that about 77% of the expected decision behavior is located within the
 575 range of our hypothesized variation coefficient. However, the empirically observed decision
 576 making behavior ranges between 0.2 and 0.6 (minimum c and maximum d).
 577

577 This leads to the following algorithm:

$$F(d - \mu/\sigma) - F(c - \mu/\sigma) = 0.076 \quad (8)$$

This result means that about 92.4 % of the theoretically expected decision behavior is located within the range of 0.2 and 0.6 (degree of target orientation (DTO)). The proportion of the hypothesized decision behavior and the theoretical decision behavior is $77/92.4=0.833$.

It means that with an expected probability of 83.3 %, the empirical decision making behavior ranges between our hypothesized span, thus substantiating our proposition concerning the assumptions of the 2σ , 4 Standard Error, 5 Variation Coefficient Theorem.

Eventually, all of our empirical analyses support the basic hypothesis, stating that empirical decision making behavior deviates measurably from the ideal homo oeconomicus image, but within a somewhat tolerable range, when it comes to professional business and management decisions (PBD).

6. PRELIMINARY EXPERIMENTAL EVIDENCE AND ANALYTICAL IMPLICATIONS OF THE “HSOCN6MEPVC THEOREM” OF QUASI-RATIONAL CONDUCT IN DECISION MAKING PROCESSES

Our empirical data from the laboratory experiment tentatively substantiate our basic hypothesis that actual and real world decision making behavior significantly deviates from the homo oeconomicus assumption. Our findings can be further corroborated by an empirical multiple regression analysis concerning the relationship between the degree of decision making rationality (DMR) (measured by the complex of decision making independent variables; see chapter 3) and the degree of decision making efficiency (DME) (measured as the total efficiency dependent variable; see chapter 3):

The Empirical Multiple Regression Function reads as follows:

$$DME = f(DMR\{x_1 \dots x_5\})$$

$$DME = -1.59 + 2.85x_1 - 3.18x_1^2 + 2.35x_2 - 0.58x_2^2 + 1.83x_3 - 1.12x_3^2 + 2.06x_4 - 0.47x_4^2 + 0.86x_5 - 0.60x_5^2 \quad (9)$$

(multiple $r^2=0.67$)

DME = Total decision making efficiency function, x_1 = target orientation (DTO), x_2 = process organization (DPO), x_3 = information acquisition and evaluation (DINF), x_4 = decision making cognition (DCOG), x_5 = reflection (DREF)

This regression equation clearly delineates that there is (an overall sufficient) a significant relationship between high degrees of rational decision making and high degrees of decision making efficiency ($p = 0.075$), esp. in view of the multiple coefficient of determination ($r^2 = 0.67$).

However, the empirical data of the laboratory experiment only focus on the decision making context within “professional strategic decision” situations (PBD). In business and economic research as well as in business and management reality it is frequently claimed that human decision making behavior differs in terms of “professional” decision making versus “private” decision making (cf. Rogall&Gapp, 2013).

In recent times, the question has been heavily discussed whether public and governmental measures should be applied in order to impact private decision making, aiming at societally desirable individual decisions (cf. Thorun, 2010). In this context, business and economic research should focus on approaches like “mechanism design” (e.g. Ockenfels, 2014) and “soft paternalism” (e.g. Thaler&Sunstein, 2003).

Also Reinhard Selten's "Theory of Aspiration Adaptation" (1998, p. 191-214) primarily deals with the explanation of human conduct apart from a business and professional decision making environment. In addition, Nash et al. (2012) emphasize the research question, how the "transfer (of) power to another person successfully promotes cooperation by balancing the tension between short-term incentives to defect and long-term incentives to keep cooperation going" (Nash et al., 2012, p. 1-6).

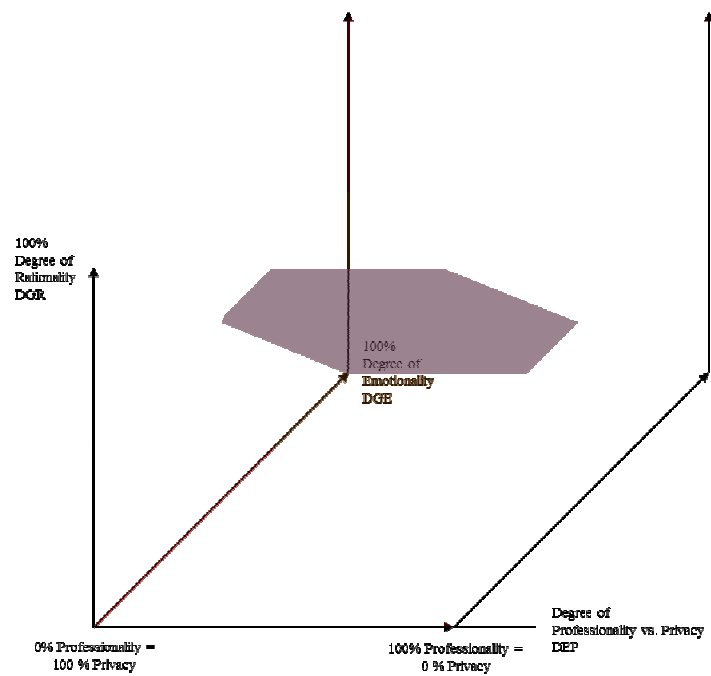
Those theoretical considerations – pars pro toto – have initiated our additional theoretical outline for a differentiated proposition, stressing the degree of human rational conduct in varying decision making contexts. Our **"Theorem of Structural and Situational Conditionalized Quasi-Rational Decision Making Behavior" (SQDB)** suggests the following propositions:

- Actually, decision making behavior varies according to different situational and structural contexts of the decision making task and problem.
- Generally, decision making behavior is influenced – apart from the context variables decision structure and decision situation – by "individual" variables like cognitive capabilities, emotions, feeling, personality traits, norms and values, societal customs, etc. (cf. Neuert & Hoeckel, 2013b).
- Tentatively, we suggest a threefold quasi decision making rationality model, comprised of the following structural and situational conditions:
 - Private Appraisal of Finance Decisions (PAD),
 - Professional Business Decisions (PBD),
 - Private Consumption Decisions (PCD).

Derived from that classification, the **SQDB** is comprised of the following basic hypotheses:

- H_{B1} : The degree of decision making rationality depends on the structural and situational context of the decision making task.
- H_{B2} : The degree of decision making rationality depends on the "individual" variables like cognitive capabilities, emotions, feeling, personality traits, norms and values, societal customs, etc.
- H_{B3} : The situational and structural variables intervene with the individual variables and vice versa.

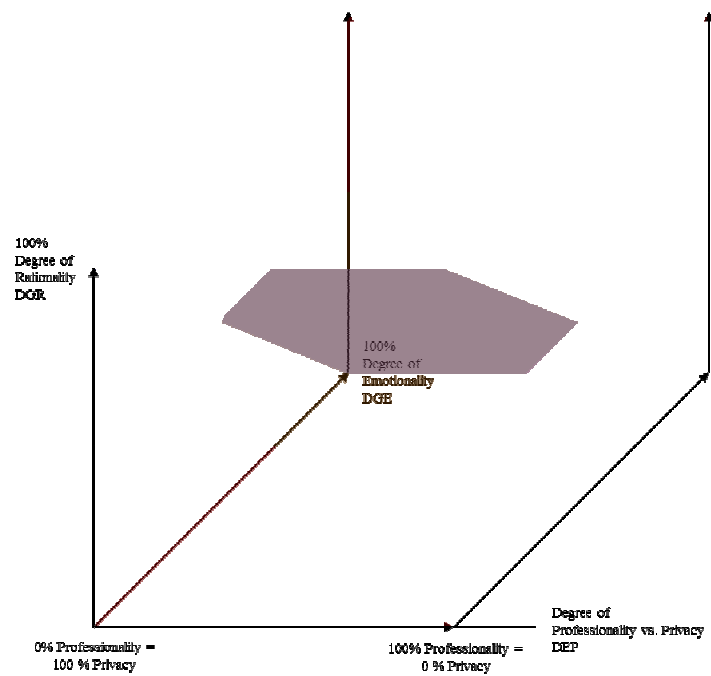
Based on these hypotheses, we outline the model of SQDB, concerning varying degrees of quasi-rational decision making behavior as follows:



Function_1: $DGR_{high} / DGProf_{high} / DGE_{low}$
Function_2: $DGR_{low} / DGProf_{low} / DGE_{high}$
Function_3: $DGR_{medium} / DGProf_{medium} / DGE_{medium}$

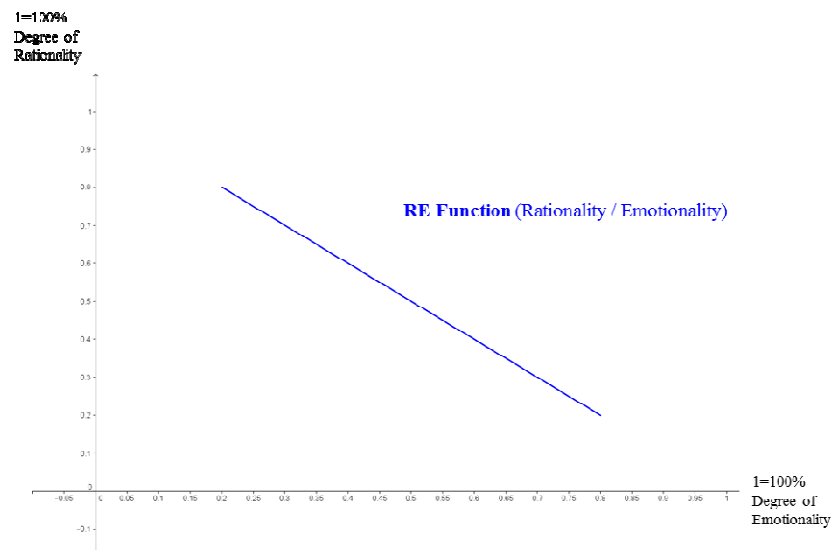
Fig.6. Degree of rationality, degree of professionalism/ privacy, degree of emotionality

The theorem suggests that the degree of rationality is positively in line with the degree of professionalism in contrast the degree of to privacy and negatively linked to the degree of emotionality in decision making situations and structures and vice versa.



Function_1: $DGR_{high} / DGProf_{high} / DGE_{low}$
 Function_2: $DGR_{low} / DGProf_{low} / DGE_{high}$
 Function_3: $DGR_{medium} / DGProf_{medium} / DGE_{medium}$

667



668

669

670

671

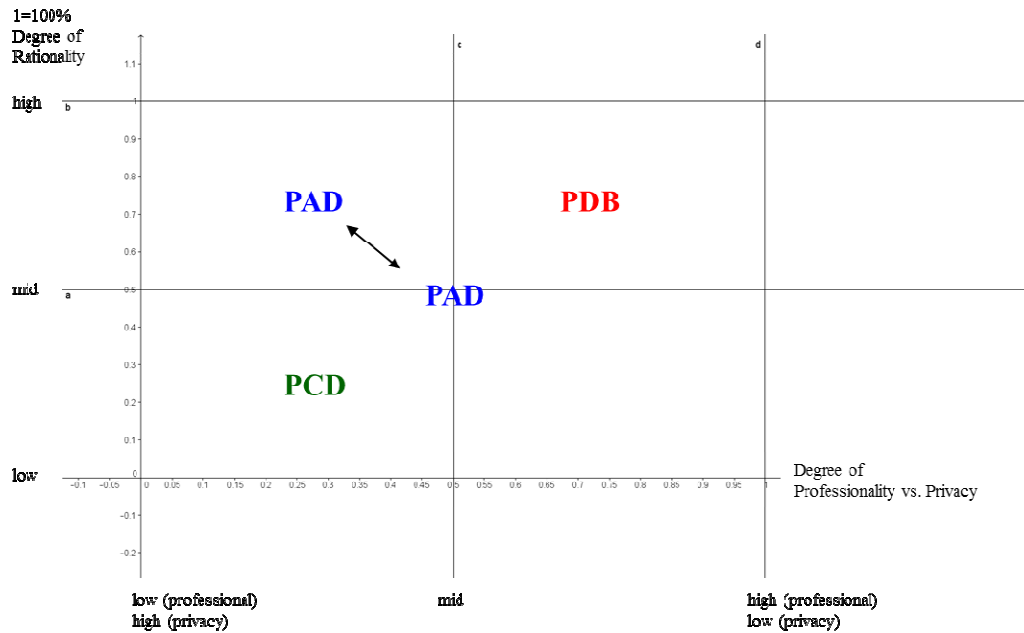
Fig.7. Degree of rationality versus degree of emotionality

672

Again it is outlined that the degree of rationality and the degree of emotionality in decision making behavior are “contradictory” to each other.

673

674 This leads to the following “sketch” of quasi-rational behavior in the respective decision
675 making situations and structures:
676



PAD (mid/mid to mid/high) = Private Appraisal of Finance Decisions
PDB (high/mid) = Professional Business Decisions
PCD (low/low) = Private Consumption Decisions

677
678 **Fig.8. Degree of rationality and degree of professionalism / privacy**
679

680 According to our theorem, professional business decisions are performed with a relatively
681 high degree of rationality (and a relatively low degree of emotionality).
682 Private consumption decisions are dominated by emotionality and less by rational reasoning.
683 Private appraisals of finance decisions (e.g. private investment decisions, private housing
684 decisions, private job decisions, etc.) are located somewhere in between rational reasoning
685 and emotional influence.

686
687 As a further research task, our **SQDB** model has to be tested and further developed via
688 theoretical elaboration and empirical investigation.
689

690 7. TENTATIVE CONCLUSIONS

691
692 The preliminary empirical evidence of our research study, based on our novel paradigm of
693 quasi-rational decision making, leads to the following analytical conclusions:
694

- 695 • There is no “linear” function between decision making efficiency and the decision
696 making rationality ($DME \neq DMR$).
- 697 • The degree of rationality and the degree of decision making efficiency depend on
698 the situational and structural context of the decision making task (e.g. strategic
699 business decisions, private consumption decisions, political decisions, etc.),

700 indicating that professional decisions are generally conducted more along rational
701 reasoning than private decisions.

- 702 • Decisions, per se, are influenced by a variety of individual behavioral patterns (e.g.
703 cognitive ability, emotions, norms and values, personal interaction, cultural contexts,
704 etc.). Those individual variables intervene with the structural and situational
705 contexts.

706

707 Based on those conclusions and implications, our novel paradigm of quasi-rational decision
708 making behavior suggests the following theoretical elements:

709

- 710 • Human decision making is never neither completely rational, nor irrational.
- 711 • The degree of rationality resp. emotionality in decision making processes coincides
712 with the subjective perception of the decision maker whether the required decision is
713 more professionally or more privately structured.
- 714 • The degree of rationality resp. the degree of emotionality is heavily influenced by
715 individual capabilities resp. socialization based pre-experiences and pre-"judices".
- 716 • However, given empirical evidence, the degree of rationality in decision making
717 processes can be determined also for forecast purposes within a certain range of
718 expectable decision making behavior in given decision making contexts.
- 719 • Our analytical considerations and empirical findings may be transferred into a
720 potential theory of conditionalized "spectral" rationality, meaning that decision
721 making behavior is "variable" on the one hand, but satisfactorily "predictable" on the
722 other hand.

REFERENCES

1. Agor WH. How Top Executives Use Their Intuition to Make Important Decisions. *Business Horizons*. 1986; 29: 49–53.
2. Akerlof GA, Shiller RJ. *Animal Spirits: How Human Psychology Drives the Economy*. Princeton (NJ): Princeton University Press; 2003.
3. Argyris C. Some Limits of Rational Man. *Organizational Theory. Public Administration Review*. 1973; 33 (3): 253–267.
4. Ariely D. *Predictably irrational. The hidden forces that shape our decisions*. New York (NY): Harper Collins; 2010.
5. Barnard CI. *The functions of the executive*. Cambridge (MA): Harvard University Press; 1968.
6. Bendoly E, Donohue K, Schulz KL. Behavior in Operations Management: assessing recent findings and revisiting old assumptions. *Journal of Operations Management*. 2006; 24 (6): 737–752.
7. Bolton, GE, Ockenfels A. Does laboratory trading mirror behavior in real world markets? Fair bargaining and competitive bidding on eBay. *Journal of Economic Behavior & Organization*. 2014; 97: 143–154.
8. Bonabeau E. Don't Trust Your Gut. *Harvard Business Review*. 2003; May: 116–123.
9. Bronner R. *Entscheidung unter Zeitdruck*. Tübingen: Mohr; 1973.
10. Detel W. *Geist und Verstehen. Historische Grundlagen einer modernen Hermeneutik*. Frankfurt am Main: Vittorio Klostermann; 2011.
11. Engels A, Knoll L. *Wirtschaftliche Rationalität. Soziologische Perspektiven*. Wiesbaden: Springer VS; 2012.
12. Glasersfeld Ev. *Radikaler Konstruktivismus. Ideen, Ergebnisse, Probleme*. Frankfurt am Main: Suhrkamp; 1997.
13. Grabatin G. *Effizienz von Organisationen*. Berlin: Walter de Gruyter; 1981.
14. Güth W, Klimt H, Ramser HJ, Stadler M. *Homo oeconomicus* 30 (2). München: Accedo; 2013.
15. Gzuck R. *Messung der Effizienz von Entscheidungen*. Tübingen: Mohr; 1975.
16. Gzuck R. *Messung der Effizienz von Entscheidungen*. In: Witte E. *Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus"*. Tübingen: Mohr; 1988.
17. Hauschildt J. *Entscheidungsziele. Zielbildung in innovativen Entscheidungs-prozessen. Theoretische Ansätze und empirische Prüfung*. Tübingen: Mohr; 1977.
18. Hauschildt J, Gmünden HG, Grotz-Martin S, Haidle U. *Entscheidungen der Geschäftsführung. Typologie, Informationsverhalten, Effizienz*. Tübingen: Mohr; 1983.
19. Heuser UJ, Priddat BP, Spoun S. *DIE ZEIT erklärt die Wirtschaft. Was man wirklich wissen muss*. Hamburg: Murmann; 2013.
20. Hodgkinson GP, Sadler-Smith E, Burke LA, Claxton G, Sparrow PR. Intuition in Organizations: Implications for Strategic Management. *Long Range Planning*. 2009; 42 (3): 277–297.
21. Hoeckel CA. The Impact of Personality Traits and Behavioral Patterns on the Outcomes of Business Management Decision Making – A Framework for an Empirical Study. *New Challenges of Economic and Business Development Conference Proceedings Riga (LV)*. 2012: 259–269.
22. Horn KI. *Die Stimme der Ökonomen. Wirtschaftsnobelpreisträger im Gespräch*. München: Hanser; 2012.
23. Jones BD. Bounded Rationality. *Annual Review of Political Science*. 1999; 2: 133–150.
24. Joost N. *Organisation in Entscheidungsprozessen. Eine empirische Untersuchung*. Tübingen: Mohr; 1975.
25. Kahneman D. *Thinking, fast and slow*. London: Penguin; 2012.

- 775 26. Kahneman D, Tversky A. Prospect Theory: An Analysis of Decision under Risk.
776 *Econometrica*. 1979; 47 (2): 263–291.
- 777 27. Kirsch W. Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der
778 Entscheidungstheorie. Wiesbaden: Gabler; 1970.
- 779 28. Kirchgässner G. Wissenschaftlicher Fortschritt in den Wirtschafts-wissenschaften: Einige
780 Bemerkungen. In: Universität St. Gallen, Schweizerisches Institut für Aussenwirtschaft
781 und Angewandte Wirtschaftsforschung, Lepoldina und CESifo – Working Paper. 2011;
782 09: 1-33.
- 783 29. Klages H. Der Homo Oeconomicus - Menschenbilder in Wirtschaft, Politik und
784 Verwaltung. 2014. Accessed 01 August 2014. Available: [http://www.dhv-](http://www.dhv-speyer.de/klages/.../HomoOeconomicus.ppt)
785 [speyer.de/klages/.../HomoOeconomicus.ppt](http://www.dhv-speyer.de/klages/.../HomoOeconomicus.ppt).
- 786 30. Mantel SP, Tatikonda MV, Liao Y. A behavioral study of supply manager decision
787 making: factors influencing make versus buy evaluation. *Journal of Operations*
788 *Management*. 2006; 24 (6): 822-838.
- 789 31. March JG. Decisions and organizations. Cambridge (MA): Blackwell; 1990.
- 790 32. March JG. A Primer on Decision Making. How Decisions Happen. New York (NY): The
791 Free Press; 1994.
- 792 33. March JG, Simon HA, Guetzkow HS. Organizations. 2nd ed. Cambridge (MA):
793 Blackwell; 1993.
- 794 34. Mintzberg, H. The Fall and Rise of Strategic Planning. *Harvard Business Review*. 1994;
795 January-February: 105–114.
- 796 35. Nash JF Jr, Nagel R, Ockenfels A, Selten R. The agencies method for coalition formation
797 in experimental games. *PNAS Proceedings of the National Academy of Sciences of the*
798 *United States of America*. 2012; 109 (50): 20358-20363.
- 799 36. Nehring M. Homo oeconomicus - ein universell geeignetes Modell für die ökonomische
800 Theorie? Hamburg: Diplomica; 2011.
- 801 37. Neuert JO, Hoeckel CA. Measuring Efficiency in Management Decision Making -
802 Theoretical Analysis and State of Research. *Business Management Strategies and*
803 *Research Development – Discussion Paper*. 2013a; 8: 6–16.
- 804 38. Neuert JO, Hoeckel CA. The Impact of Personality Traits and Problem Structures on
805 Management Decision-Making Outcomes. *Journal of Modern Accounting and Auditing*.
806 2013b; 9 (3): 382–393.
- 807 39. Neuert JO. Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang
808 zwischen Planungsverhalten und Planungserfolg. Spardorf: Wilfer; 1987.
- 809 40. Neuert JO. The Impact of Intuitive and Discursive Behavioral Patterns on Decision
810 Making Outcomes: Some Conjectures and Empirical Findings. *WDSI Annual Conference*
811 *Readings Lake Tahoe (USA)*. 2010: 4471–4496.
- 812 41. Neuert JO. The “Economic Man” Model vs. the “Social Man” Model of Human Conduct –
813 Behavioural Patterns in Interactive Processes: Findings from an Experimental Study.
814 *The Journal of the American Academy of Business*. 2004.
- 815 42. Nutt PC. Investigating the Success of Decision Making Processes. *Journal of*
816 *Management Studies*. 2008; 45 (2): 425–455.
- 817 43. Ockenfels A. Mechanismus-Design-Theorie: „Die Fortschritte sind gewaltig“. 2014.
818 Accessed 01 August 2014. Available: [http://www.handelsblatt.com/politik/oekonomie](http://www.handelsblatt.com/politik/oekonomie/nachrichten/interview-zum-nobelpreis-mechanismus-design-theorie-die-fortschritte-sind-gewaltig/2873140.html)
819 [/nachrichten/interview-zum-nobelpreis-mechanismus-design-theorie-die-fortschritte-sind-](http://www.handelsblatt.com/politik/oekonomie/nachrichten/interview-zum-nobelpreis-mechanismus-design-theorie-die-fortschritte-sind-gewaltig/2873140.html)
820 [gewaltig/2873140.html](http://www.handelsblatt.com/politik/oekonomie/nachrichten/interview-zum-nobelpreis-mechanismus-design-theorie-die-fortschritte-sind-gewaltig/2873140.html).
- 821 44. Patton JR. Intuition in decisions. *Management Decision*. 2003; 41 (10): 989–996.
- 822 45. Popper KR. The logic of scientific discovery. London: Routledge; 2002.
- 823 46. Popper KR, Miller D. Lesebuch. Ausgewählte Texte zu Erkenntnistheorie, Philosophie
824 der Naturwissenschaften, Metaphysik, Sozialphilosophie. Tübingen: Mohr; 1995.
- 825 47. Rogall H, Gapp K. Homo heterogenus: das neue Menschenbild in den
826 Wirtschaftswissenschaften. *Das Wirtschaftsstudium*. 2013; 42 (12): 1573–1577.

- 827 48. Roth G. Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich
828 und andere zu ändern. Stuttgart: Klett-Cotta; 2008.
- 829 49. Selten R. Aspiration Adaptation Theory. *Journal of Mathematical Psychology*. 1998; 42:
830 191-214.
- 831 50. Schirrmacher F. Ego. Das Spiel des Lebens. München: Blessing; 2013.
- 832 51. Schoemaker PJ, Russo EJ. A Pyramid of Decision Approaches. *California Management*
833 *Review*. 1993; 36: 9–31.
- 834 52. Selten R. What Is Bounded Rationality? In: Gigerenzer G, Selten R. *Boundedrationality.*
835 *The adaptive toolbox*. Cambridge MA) MIT Press; 2001.
- 836 53. Simon HA. Rational Decision Making in Business Organizations. *American Economic*
837 *Review*. 1978; 69 (4): 493–513.
- 838 54. Simon HA. Administrative behavior. A study of decision-making processes in
839 administrative organizations. New York (NY): Free Press; 1997.
- 840 55. Smith VL. Rationality in economics. Constructivist and ecological forms. Cambridge:
841 Cambridge University Press; 2009.
- 842 56. Thaler RH, Sunstein CR. Libertarian Paternalism. *The American Economic Review*.
843 2003; 93 (2): 175-179.
- 844 57. Thorun C. Was die Verbraucherpolitik von der Verhaltensökonomie lernen kann. *WISO*
845 *direkt*. 2010; September: 1–4.
- 846 58. Tversky A, Kahneman D. Advances in Prospect Theory: Cumulative Representation of
847 Uncertainty. *Journal of Risk and Uncertainty*. 1992; 5: 297–323.
- 848 59. Weiber R, Mülhauß D. Strukturgleichungsmodellierung. Eine anwendungsorientierte
849 Einführung in die Kausalanalyse mit Hilfe von AMOS, SmartPLS und SPSS. Berlin:
850 Springer; 2010.
- 851 60. Witte E. Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus".
852 Tübingen: Mohr; 1988.
- 853 61. Witte E, Hauschildt J. Das Informationsverhalten in Entscheidungsprozessen. Tübingen:
854 Mohr; 1972.
- 855

856 **APPENDIX**

857

858 **Rationality Deviation Index 1 (RDI_1)** with SE=0.04:

859

$$\begin{aligned} \text{RDI}_1 &= \int_{-2\sigma}^{+2\sigma} G1'(x)dx - \int_{-2\sigma}^{+2\sigma} G2(x)dx = 0 - 0.3455 = -0.3455 \\ G1'(x) &= 0 \\ G2(x) &= \frac{1}{\sigma * \sqrt{2\pi}} * e^{-\frac{1}{2} * \left(\frac{x-a}{\sigma}\right)^2} = \frac{1}{0.5060 * \sqrt{2\pi}} * e^{-\frac{1}{2} * \left(\frac{1-0.35}{0.5060}\right)^2} = 0.3455 \\ \sigma &= S_E * \sqrt{n} = 0.04 * \sqrt{160} = 0.5060 \end{aligned} \quad (\text{A1})$$

860

861 **Rationality Deviation Index 1' (RDI_1')** with SE=0.02:

$$\begin{aligned} \text{RDI}_1 &= \int_{-2\sigma}^{+2\sigma} G1'(x)dx - \int_{-2\sigma}^{+2\sigma} G2(x)dx = 0 - 0.0581 = -0.0581 \\ G1'(x) &= 0 \\ G2(x) &= \frac{1}{\sigma * \sqrt{2\pi}} * e^{-\frac{1}{2} * \left(\frac{x-a}{\sigma}\right)^2} = \frac{1}{0.2530 * \sqrt{2\pi}} * e^{-\frac{1}{2} * \left(\frac{1-0.35}{0.2530}\right)^2} = 0.0581 \\ \sigma &= S_E * \sqrt{n} = 0.02 * \sqrt{160} = 0.2530 \end{aligned} \quad (\text{A2})$$

862

863 **Rationality Deviation Index 2 (RDI_2):**

$$\text{RDI}_2 = \int_a^b F1(x)dx - \int_a^b F2(x)dx = 0.3 - 0.1105 = 0.1895$$

$$\begin{aligned} F1(x): y &= x \\ \int_a^b F1(x)dx &= \int_{0.2}^{0.8} (x)dx = 0.32 - 0.02 = 0.3 \end{aligned} \quad (\text{A3})$$

$$\begin{aligned} F2(x): y &= 0.71x - 0.61x^2 \\ \int_a^b F2(x)dx &= \int_{0.2}^{0.8} (0.71x - 0.61x^2)dx = 0.1231 + -0.0126 = 0.1105 \end{aligned}$$

864