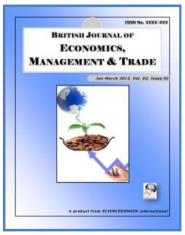


British Journal of Economics, Management & Trade
5(3): 299-318, 2015, Article no.BJEMT.2015.025
ISSN: 2278-098X

SCIENCEDOMAIN *international*
www.sciencedomain.org

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

Josef Neuert[1*], Christopher Hoeckel[2] and Manuel Woschank[3]

[1]Department of Business Administration and Economics, Fulda University, Marquardstrasse 35, D-36039 Fulda, Germany.
[2]Faculty of Management and Economics, University of Latvia, Biberstrasse 19, D-83098 Brannenburg, Germany.
[3]Faculty of Management and Economics, University of Latvia, Gemmersdorf 11a, A-9421 Eitweg, Austria.

Authors' contributions

The whole work was carried out in collaboration between all authors. Lead author: JN. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJEMT/2015/13486
Editor(s):
(1) Levi Perez, Department of Economics, University of Oviedo, Spain.
(2) John M. Polimeni, Faculty of Economics Albany College of Pharmacy and Health Sciences, New York, USA.
Reviewers:
(1) Togara Warinda, Accountancy, University of Zimbabwe, Zimbabwe.
(2) Gaurav Sankalp, School of Management Studies, Uprtou Allahabad, India.
(3) Anonymous, University of Galati, Romania.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=701&id=20&aid=6565

Original Research Article

Received 19th August 2014
Accepted 29th September 2014
Published 22nd October 2014

ABSTRACT

Aims: This paper aims to provide insights into the measurement of decision making efficiency and decision making behaviour 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 behaviour, supported by the findings of an experimental investigation.
Place and Duration of Study: The research paper evolved as a significant part of a comprehensive

**Corresponding author: E-mail: josef.neuert@w.hs-fulda.de;*

research project, investigating managerial decision making behaviour, conducted jointly at the University of Fulda (GER) and at the University of Latvia (LV) in 2012 and 2013, as a collaborative effort of doctoral students from the University of Latvia and doctoral supervisors from the University of Fulda. The research project at Fulda and Latvia utilized the results of an experimental research study which was conducted by Neuert at the University of Bayreuth (GER) earlier on (in 1983).

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 behavioural 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 behaviour 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.

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 behaviour is "located" within a measurable range of "statistical" indicators like standard deviation, standard error and variation coefficient.

Keywords: Decision making; behavioural patterns; efficiency measures; rationality vs. emotionality in decision making processes.

1. INTRODUCTION: BEHAVIOURAL 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. In an earlier paper the authors Neuert and Hoeckel of this paper [1] stated that "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 [2,3]. Although researchers like Schoemaker & Russo [4] argue that the use of rational decision making heuristics yields the best outcome, especially in complex situations [5], for others like Simon [6]" 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 [7,8,6,9] 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 [10], 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 behavioural efficiency measures of managers [8]. Therefore this paper presents an insight into socio-economic efficiency measures in management decision making by providing an application orientated approach.

The research methodology of this paper is twofold: Firstly, based on an intensive theoretical analysis potential cause-effect relations are discussed. Secondly, potential independent and dependent variables are pointed out as a causal analysis model. Thirdly, earlier experimental studies conducted by the author Neuert are introduced to refine the theoretical framework and to provide additional empirical insights. Fourthly, quantitative procedures are conducted to test the underlying formulated hypotheses. Finally, conclusions from the theoretical and empirical analyses are drawn and are transferred

into the development of the author's new rationality paradigm.

2. THEORETICAL FRAMEWORK: THE NOTION OF THE DECISION MAKING RATIONALITY AND DECISION MAKING EFFICIENCY FUNCTION[1]

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 [11]. 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 [11] 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 [12], because human behaviour frequently does not satisfy the considered assumptions of the "homo oeconomicus", which is described as a rational decision maker [13]. From a historical point of view, decision making theory differentiates decision making behaviour into "closed" and "open" models [14]. 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 of the decision makers is on the maximization of benefits or utilities by choosing the alternative that promises the highest level of return [15-17]. Kirsch [14] 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 [14]. Neuert [18] 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 behaviour 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 measureable decision making criteria [19,6]. Taking at least these implications into account shows us, that the model of rational behaviour attempts to fall short [20]. For Popper & Miller [21] it seems clear that empirical or psychological behaviour of human beings has little or nothing to do with the principle of "rationality" or what they call "situationally appropriate behaviour". For Popper & Miller [21] 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 [22,19,23,6]. 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 [6]. For March [22], 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 [14] illustrates similar restrictions like Simon and March, why individuals tend to act like the

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

"administrator" instead of the "homo oeconomicus". Whereas in the past, behaviour was only considered as being rational when given targets where maximized (optimized), today the concept of rational behaviour seems also to be appropriate when given targets are satisfied [14,19]. 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 [24], human behaviour 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 behaviour has to be considered as a combination of intuitive and rational behaviour.

Again, the authors refer to their earlier paper Neuert & Hoeckel [1] pointing out that "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 [7] believes that the main purpose or aim is to reach high procedural quality within the decision making process. For Gzuk [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 [7] sees the main purpose in managerial decision making in the outcome which is measured as economic efficiency. Barnard [25] 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. [8] 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 [26] 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 [6] 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. personnel department) or for non-commercial organizations where factors are involved which cannot be directly measured in monetary terms. For Simon [6], 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 [10] 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 [7] 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 [15,7].

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 [14,24,21]. More likely it seems that there are several degrees of decision

making rationality [10]. In this case Neuert [10] 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 behaviour 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 [10] 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 fulfilment 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 [7] 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 between output and input, and second, a decision must provide results which ensure that the aspired objectives will be achieved [7].

To set up a measurement for the total "efficiency in the decision making process, Gzuk [7] advocates the establishment of a multi-dimensional indicator model (Fig. 1). This multi-dimensional indicator model contains four efficiency dimensions: The target-output relation, the input-output relation, the target-input relation and the feasibility of 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 making outcome [10,1]. To achieve an acceptable "security" of the measurement of efficiency Gzuk [26] advocates that for each dimension there should be more than just one indicator. Multiple dimensions will enhance the model reliability and lower errors in measurement [27].

Grabatin [28] reviewed the decision making efficiency from an organizational perspective, splitting 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 constraints 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 up 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 fulfilment and into socio-economic efficiency factors. For the socio-economic efficiency, Grabatin introduces efficiency criteria like satisfaction [1] of the individual, motivation, etc.

Decision making outcomes in business management can be characterized by different dimensions of efficiency. Neuert [10] describes, one dimension as the "material" efficiency, where the measurement is a realistic "input and output" in commercial activities which can be measured with "objective" criteria like earnings, profitability, growth and financial independence. Bronner [15] refers to this part of efficiency as the economic efficiency. A further dimension can be seen as the individual efficiency. For Neuert [10], in contrast to the "material" efficiency, the "individual" efficiency considers rather "subjective" results of the decision making process. As "subjective" results he understands expected results of teams or individual efforts, identification with team work, self-reflection of "group behaviour 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) behaviour during the decision making process. Bronner [15] 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 [15], 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)" [1].

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

Fig.1. Multi-dimensional indicator model for the total efficiency measurement
Source: Gzuk, 1975, p. 57

To operationalize the measurement of the "total" efficiency, Neuert [10] has modified the multi-dimensional model of Gzuk. In Neuert' smulti-dimensional model (Fig. 2) the "total" efficiency is split in the formal efficiency, the material efficiency and the individual efficiency (A,B,C).

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 [10].

5. DEVELOPMENT OF A NOVEL PARADIGM OF SOCIO-ECONOMIC QUASI-RATIONAL BEHAVIOURAL PATTERNS: "THE HOMO SOCIO-OECONOMICUS CONDITIONALIS–N SIGMA–M STANDARD (OUTCOME) ERROR–P VARIATION (COEFFI-CIENT) THEOREM (HSOCNϭMEPVC)

The issue of rationality and rational behaviour has been highly disputed in business research, business practice, literature, and academia ever since [29,30]. Karl Popper considers the "principle of rationality" as a methodological postulate, which implies that human behaviour follows the rules of a model that explains cause-effect relations in reality [31]. In this sense, rationality is not at all an empirical or psychological phenomenon, but just an outline of behavioural patterns which may be applied "a-priori" in problem solving situations [31]. On the other hand, Popper himself points out that human behaviour 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" [31].

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 [32]. In particular, the neo classical economic approach, pre-eminently 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 [33].

The paradigm of the homo oeconomicus requires so called "rational behaviour" 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" [34].

The homo oeconomicus concept of rational behaviour is based on the following assumptions: Unlimited information about the structure of problem situations, existence knowledge about the alternatives and consequences of behavioural options; constant and non-contradictory system of targets and preferences; unlimited cognitive capabilities and ability to formulate and follow the utility maximization algorithm [35].

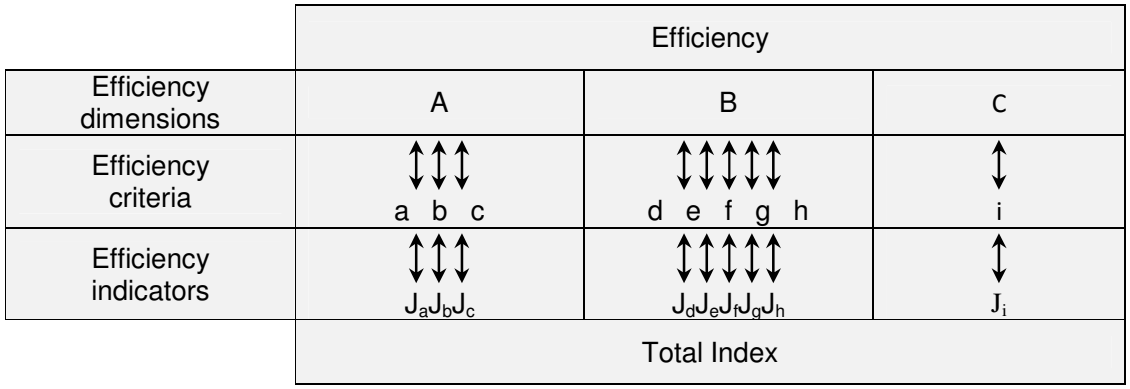


Fig. 2. Operationalization of the multi-dimensional model to measure the total efficiency
Source: Neuert, 1987, p. 114

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 behavioural and experimental economics, e. g. [36-42] and especially-in former times–by Simon [23] and Selten [43]. 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 evolvements 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 behaviour, 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 [44,45], 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 behaviour 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 [10] in form of the following pertinent decision behaviour elements: Target orientation (DTO), process organization (DPO), information acquisition and evaluation (DINF), decision making cognition (DCOG) and reflection (DREF) [46-48].

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

- Human decision making and problem solving behaviour 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 behaviour 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 behaviour within a certain measurable interval, which can be determined by a "variance index" and by a "standard error index" of actual empirical decision making behaviour 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 (HSOCnσmEpVC). 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 behaviour 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 behaviour 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 behaviour 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 [10].

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 behaviour and decision making efficiency among a specific population of decision makers. This "linear function" is displayed as the Ideal Distribution Function (G1) in Fig. 3.
- We presume that empirical data will not support this classical concept. Instead, the degree of the decision making efficiency (and behaviour), 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 Fig. 3.
- The classical concept of the homo oeconomicus model implies that there is a strictly linear relationship between rational decision making behaviour 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 behaviour nor "complete" decision making efficiency.
- Fig. 3 exemplifies the "absolute" degree of rational behaviour 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.
- 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 behaviour (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 ±2σ, proposing a probability of 0.9545 of the expected decision making behaviour range.

As a consequence, actual decision making behaviour (resp. decision making efficiency) deviates from ideal decision making behaviour (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 ±2σ and SE=0.04.

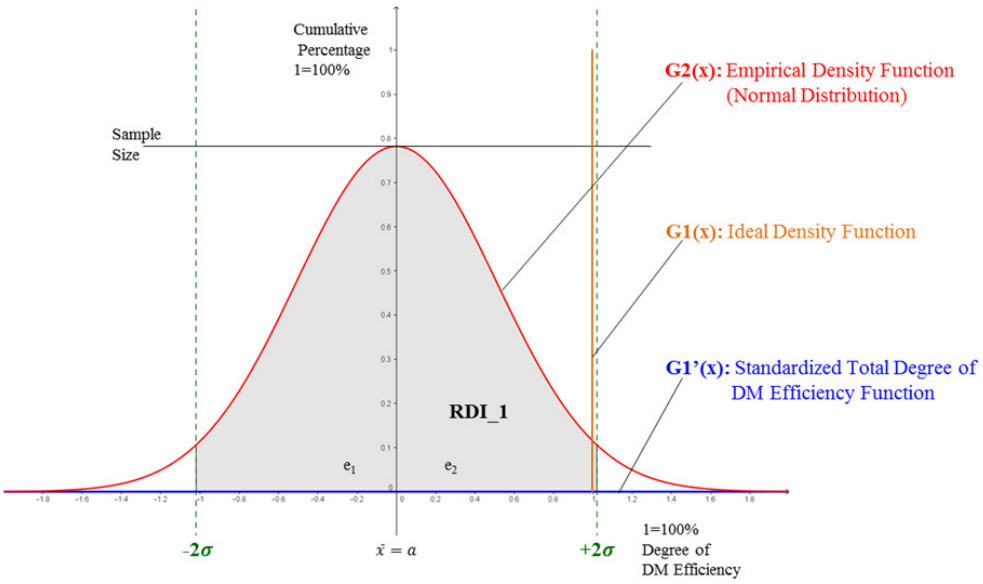
Given that, we can determine our first "Rationality Deviation Index **(RDI_1)**", via G1'-G2.

The following computation develops an empirical **RDI_1** by using data from a laboratory experiment [10], investigating actual decision making behaviour and decision making efficiency. As a result, decision making behaviour (operationalized as outlined in chapter 3) follows an empirical normal distribution function (confirmed by statistical test procedures [10]).

Using the empirical data, exemplified by the rational decision making behaviour criterion "target orientation" (DTO), we develop the RDI_1 as follows: $\bar{x}_{DTO} \approx 0.35$; s = 0.14; s2 ≈ 0.02 (s=σ)

This leads to the following formula:

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



$$\text{RDI\_1} = \int_{-2\sigma}^{+2\sigma} G1'(x)dx - \int_{-2\sigma}^{+2\sigma} G2(x)dx$$

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 behaviour in relation to decision making efficiency

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):

RDI_1 = -0.3455

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

With an expected probability of 0.9545 (±2σ), the empirical degree of rational decision making behaviour deviates with a value of -0.3455 from the ideal homo oeconomicus behaviour. 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 "misbehaviour" 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 behaviour, 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 behaviour is empirically tested by the data of the laboratory experiment. Prior to that, the theoretical outline of decision making behaviour and decision making efficiency has to be specified as follows again:

- There is a cause-effect relationship between decision making behaviour 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 behaviour the higher the degree of decision making efficiency.
- The degree of decision making rationality refers to the degree of the fulfilment 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 behaviour and decision making efficiency are placed within a certain measurable range.

We propose that there is no observable "zero" decision making behaviour and that there is no "absolute" decision making efficiency as well.

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

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

$$\text{DME efficiency} = 0.71x_{DTO} - 0.61x_{DTO}^{2} \quad (2)$$

(standardized empirical regression function)

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

This leads to the **Rationality Deviation Index 2 (RDI_2)**:

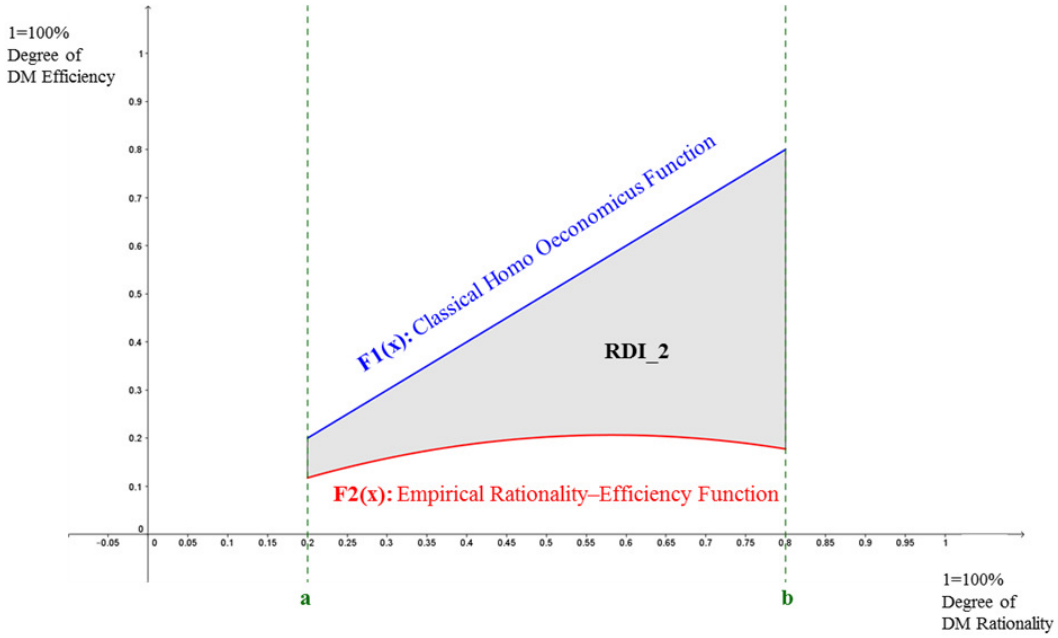
Definite Integral between "classical homo oeconomicus function" (F1) and "empirical rationality-efficiency function" (F2):

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

RDI_2 = 0.1895

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

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



$$\mathbf{RDI\_2} = \int_a^b \boldsymbol{F1(x)dx} - \int_a^b \boldsymbol{F2(x)dx}$$

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

Whereas our hypothesized standard error in our HSCO-Theorem is 0.04,the empirical average standard error of decision making behaviour in the lab experiment was about 0.02 (see Table 1 below). Applying the algorithm for **RDI_1** from above that leads to a modified **RDI_1'** (-0.0581), which amplifies the substantiation of our basic hypothesis (see Appendix).

Finally, we develop a **Rationality Deviation Index 3 (RDI_3)** via including the empirical variation coefficient of our laboratory findings and the application of the confidence interval estimation procedure, in order to determine the potential range of actual quasi-rational behaviour, based on a certain dispersion (±2σ) and a certain standard error (SE = 0.04).

The respective results of the laboratory experiment were the following:

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

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

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

This leads to the following **RDI_3**:

$$0.35–2 * 0.02 \leq \mu \leq 0.35+2 * 0.02$$
$$0.31 \leq \mu \leq 0.39$$

Variation coefficient 1 = 0.14/0.31 = 0.45;
Variation coefficient 2 = 0.14/0.39 = 0.36; (5)
Average variation coefficient = 0.405.

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

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

$$0.35 – 2 * 0.04 \leq \mu \leq 0.35 + 2 * 0.04 = 0.27 \leq \mu \leq 0.43 \quad (6)$$

Variation coefficient 1 = 0.14/0.27 = 0.52;
Variation coefficient 2 = 0.14/0.43 = 0.33;
Average variation coefficient = 0.422.

This means that hypothetically the rationality of decision making behaviour iterates about 42% around the mean.

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

This leads to the following algorithm:

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

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

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 behaviour is located within the range of 0.2 and 0.6 (degree of target orientation (DTO)). The proportion of the hypothesized decision behaviour and the theoretical decision behaviour is 77/92.4=0.833.

It means that with an expected probability of 83.3 %, the empirical decision making behaviour 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 behaviour deviates measurably from the ideal homo oeconomicus image, but within a somewhat tolerable range, when it comes to professional business and management decisions (PBD).

Table 1. Empirical absolute and weighted standard errors and variation coefficients (the weighting factors were developed by a multiple regression analysis)

Standard errors, weighting factors and variation coefficients								
	SE	**WF_R**	**VC**	**WFR**			SE	Standard error
DTO	0,0100	0,2050	0,4000	0,2050			WF_R	Weighting factor from emp. reg. analysis
DPO	0,0100	0,2780	0,3200	0,2780				
DINF	0,0140	0,0920	0,2200	0,0920			VC	Variation coefficient
DCOG	0,0150	0,2720	0,8200	0,2720			DTO	D. o. target orientation
DREF	0,0100	0,1530	0,2000	0,1530			DPO	D. o. process org.
							DINF	D. o. information
							DCOG	D. o. DM Cognition
SE	**WF**	**SE_W**		**VC**	**WF**	**VC_W**	DREF	D. o. reflection
0,0100	2,2283	0,0223		0,4000	0,7374	0,2950	SE_W	Std. error (weighted)
0,0100	3,0217	0,0302		0,3200	1,0000	0,3200	SUM_SE_W	Sum of SE_W
0,0140	1,0000	0,0140		0,2200	0,3309	0,0728	AVG_SE_W	Average of SE_W
0,0150	2,9565	0,0443		0,8200	0,9784	0,8023	VC_W	Var. coef. (weighted)
0,0100	1,6630	0,0166		0,2000	0,5504	0,1101	SUM_VC_W	Sum of VC_W (w.)
	SUM_SE_W	**0,1275**			**SUM_VC_W**	**1,6001**	AVG_VC_W	Average of VC_W
	AVG_SE_W	**0,0255**			**AVG_VC_W**	**0,3200**		

6. PRELIMINARY EXPERIMENTAL EVIDENCE AND ANALYTICAL IMPLICATIONS OF THE "HSOCNϬMEPVC 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 behaviour 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:

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

$$DME = -1.59 + 2.85x_1 - 3.18x_1^2 + 2.35x_2 - 0.58x_2^2 + 1.83x_3 - 1.12x_3^2 + 2.06x_4 - 0.47x_4{}^2 + 0.86x_5 - 0.60x_5{}^2$$

(multiple r^2=0.67) (9)

DME = Total decision making efficiency function,
x1 = target orientation (DTO),
x2 = process organization (DPO),

x3 = information acquisition and evaluation (DINF),
x4 = decision making cognition (DCOG),
x5 = 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 behaviour differs in terms of "professional" decision making versus "private" decision making [49].

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 [50]. In this context, business and economic research should focus on approaches like "mechanism design" [51] and "soft paternalism" [52].

Also Reinhard Selten's "Theory of Aspiration Adaptation" [53] primarily deals with the explanation of human conduct apart from a business and professional decision making environment. In addition, Nash et al. [54] 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" [54].

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 Behaviour" **(SQDB)** suggests the following propositions:

- Actually, decision making behaviour varies according to different situational and structural contexts of the decision making task and problem.
- Generally, decision making behaviour 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. [55].

- 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 behaviour as follows (Fig. 5):

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

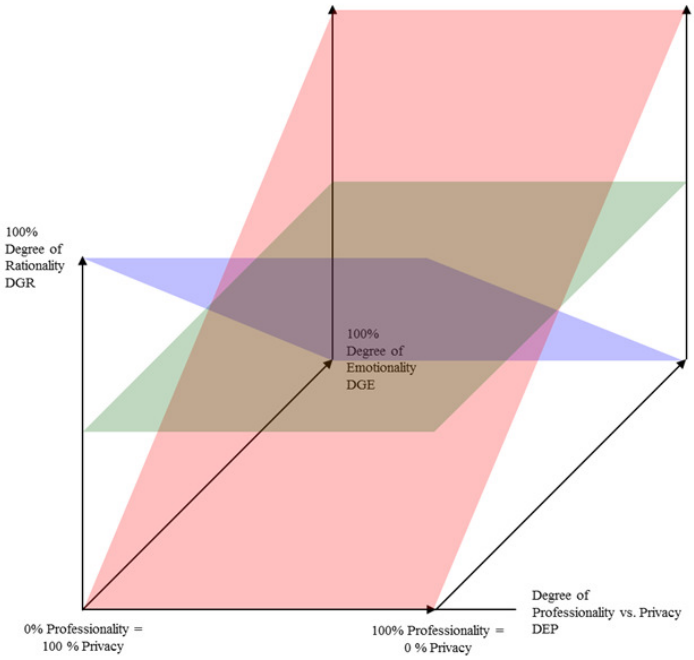
Again it is outlined that the degree of rationality and the degree of emotionality in decision making behaviour are "contradictory" to each other.

This leads to the following "sketches" (Fig. 6 and 7) of quasi-rational behaviour in the respective decision making situations and structures:

According to our theorem, professional business decisions are performed with a relatively high degree of rationality (and a relatively low degree of emotionality).

Private consumption decisions are dominated by emotionality and less by rational reasoning. Private appraisals of finance decisions (e.g. private investment decisions, private housing decisions, private job decisions, etc.) are located somewhere in between rational reasoning and emotional influence.

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



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. 5. Degree of rationality, degree of professionality/privacy, degree of emotionality

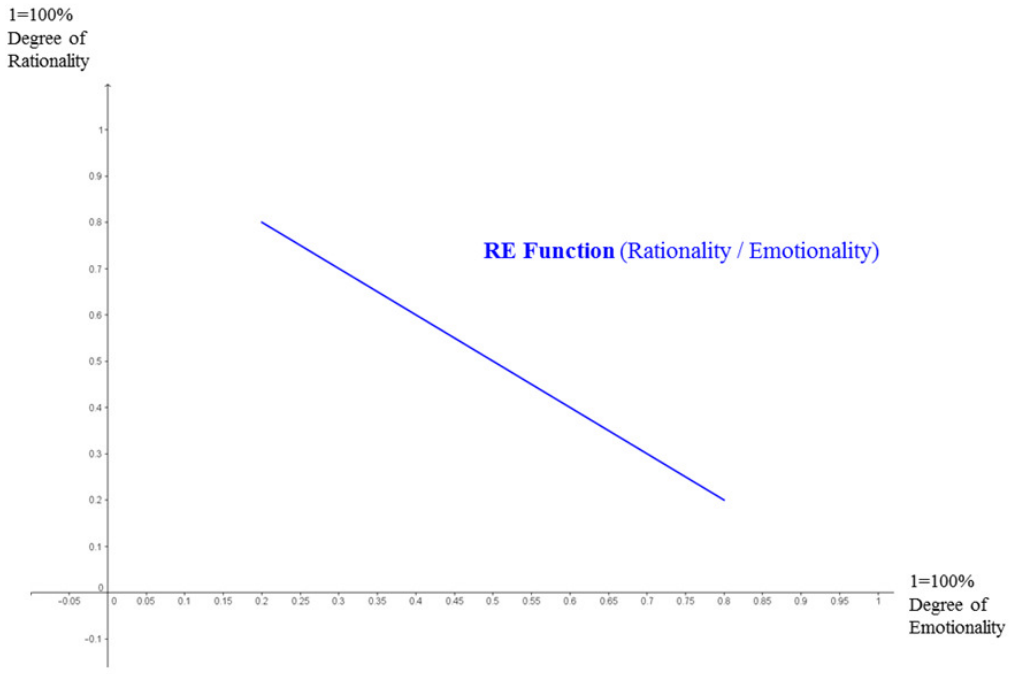
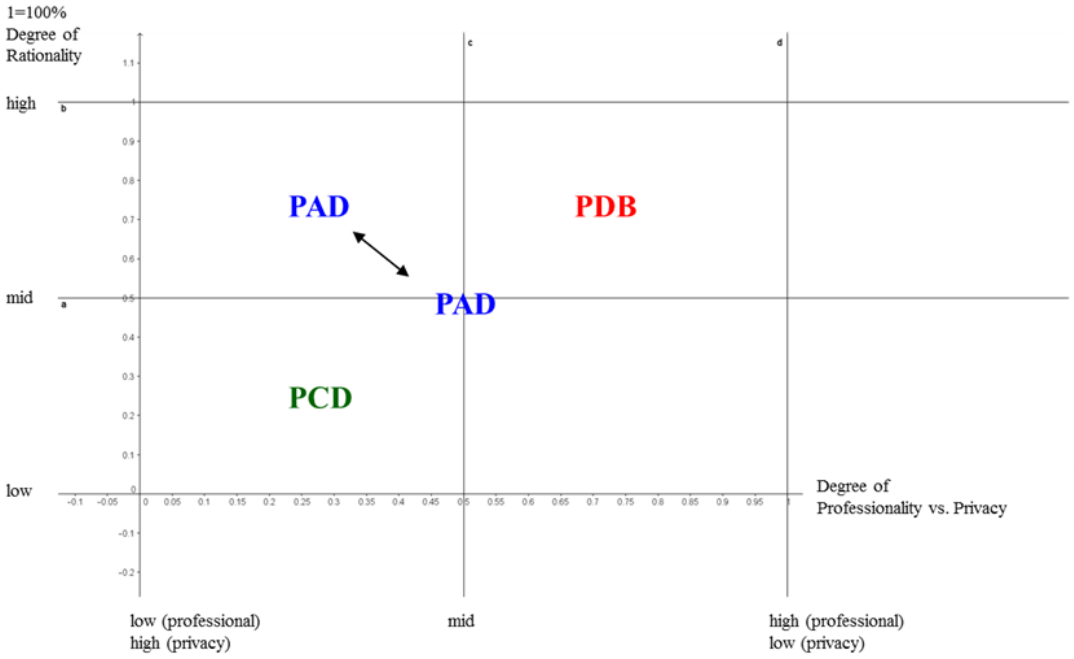


Fig. 6. Degree of rationality versus degree of emotionality



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

Fig. 7. Degree of rationality and degree of professionality / privacy

7. TENTATIVE CONCLUSIONS

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

- There is no "linear" function between decision making efficiency and the decision making rationality (DME ≠ DMR).
- The degree of rationality and the degree of decision making efficiency depend on the situational and structural context of the decision making task (e.g. strategic business decisions, private consumption decisions, political decisions, etc.), indicating that professional decisions are generally conducted more along rational reasoning than private decisions.
- Decisions, per se, are influenced by a variety of individual behavioural patterns (e.g. cognitive ability, emotions, norms and values, personal interaction, cultural contexts, etc.). Those individual variables intervene with the structural and situational contexts.

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

- Human decision making is never neither completely rational, nor irrational.
- The degree of rationality resp. emotionality in decision making processes coincides with the subjective perception of the decision maker whether the required decision is more professionally or more privately structured.
- The degree of rationality resp. the degree of emotionality is heavily influenced by individual capabilities resp. socialization based pre-experiences and pre-"judices".
- However, given empirical evidence, the degree of rationality in decision making processes can be determined also for forecast purposes within a certain range of expectable decision making behaviour in given decision making contexts.
- Our analytical considerations and empirical findings may be transferred into a potential theory of conditionalized "spectral" rationality, meaning that decision making

behaviour is “variable” on the one hand, but satisfactorily “predictable” on the other hand.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Neuert JO, Hoeckel CA. Measuring Efficiency in Management Decision Making-Theoretical Analysis and State of Research. Business Management Strategies and Research Development–Discussion Paper. 2013a;8:6–16.
2. Agor WH. How Top Executives Use Their Intuition to Make Important Decisions. Business Horizons. 1986;29:49–53.
3. Patton JR. Intuition in decisions. Management Decision. 2003;41(10):989–996.
4. Schoemaker PJ, Russo EJ. A Pyramid of Decision Approaches. California Management Review. 1993;36:9–31.
5. Bonabeau E. Don't Trust Your Gut. Harvard Business Review. 2003;116–123.
6. Simon HA. Administrative behavior. A study of decision-making processes in administrative organizations. New York (NY): Free Press; 1997.
7. Gzuk R. Messung der Effizienz von Entscheidungen. Tübingen: Mohr; 1975.
8. Hauschildt J, Gmünden HG, Grotz-Martin S, Haidle U. Entscheidungen der Geschäftsführung. Typologie, Informationsverhalten, Effizienz. Tübingen: Mohr; 1983.
9. Witte E. Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: Mohr; 1988.
10. Neuert JO. Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf: Wilfer; 1987.
11. March JG. A Primer on Decision Making. How Decisions Happen. New York (NY): The Free Press; 1994.
12. 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.
13. Mantel SP, Tatikonda MV, Liao Y. A behavioral study of supply manager decision making: factors influencing make versus by evaluation. Journal of Operations Management. 2006;24(6):822-838.
14. Kirsch W. Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden: Gabler; 1970.
15. Bronner R. Entscheidung unter Zeitdruck. Tübingen: Mohr; 1973.
16. Jones BD. Bounded Rationality. Annual Review of Political Science. 1999;2:133–150.
17. Roth G. Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich und andere zu ändern. Stuttgart: Klett-Cotta; 2008.
18. Neuert JO. The “Economic Man” Model vs. the “Social Man” Model of Human Conduct–Behavioural Patterns in Interactive Processes: Findings from an Experimental Study. The Journal of the American Academy of Business. 2004.
19. March JG, Simon HA, Guetzkow HS. Organizations. 2nd ed. Cambridge (MA): Blackwell; 1993.
20. Argyris C. Some Limits of Rational Man. Organizational Theory. Public Administration Review. 1973;33(3):253–267.
21. Popper KR, Miller D. Lesebuch. Ausgewählte Texte zu Erkenntnistheorie, Philosophie der Naturwissenschaften, Metaphysik, Sozialphilosophie. Tübingen: Mohr; 1995.
22. March JG. Decisions and organizations. Cambridge (MA): Blackwell; 1990.
23. Simon HA. Rational Decision Making in Business Organizations. American Economic Review. 1978;69(4):493–513.
24. Neuert JO. The Impact of Intuitive and Discursive Behavioral Patterns on Decision Making Outcomes: Some Conjectures and Empirical Findings. WDSI Annual Conference Readings Lake Tahoe (USA). 2010:4471–4496.
25. Barnard CI. The functions of the executive. Cambridge (MA): Harvard University Press; 1968.
26. Gzuk R. Messung der Effizienz von Entscheidungen. In: Witte E. Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: Mohr; 1988.

27. Weiber R, Mühlhaus D. Strukturgleichungsmodellierung. Eine anwendungsorientierte Einführung in die Kausalanalyse mit Hilfe von AMOS, SmartPLS und SPSS. Berlin: Springer; 2010.
28. Grabatin G. Effizienz von Organisationen. Berlin: Walter de Gruyter; 1981.
29. Nehring M. Homo oeconomicus-ein universell geeignetes Modell für die ökonomische Theorie? Hamburg: Diplomica; 2011.
30. Engels A, Knoll L. Wirtschaftliche Rationalität. Soziologische Perspektiven. Wiesbaden: Springer VS; 2012.
31. Popper KR. The logic of scientific discovery. London: Routledge; 2002.
32. Schirrmacher F. Ego. Das Spiel des Lebens. München: Blessing; 2013.
33. Horn KI. Die Stimme der Ökonomen. Wirtschaftsnobelpreisträger im Gespräch. München: Hanser, 2012.
34. Heuser UJ, Priddat BP, Spoun S. DIE ZEIT erklärt die Wirtschaft. Was man wirklich wissen muss. Hamburg: Murmann; 2013.
35. Klages H. Der Homo Oeconomicus-Menschenbilder in Wirtschaft, Politik und Verwaltung; 2014. Acessed 01 August 2014. Avaliable: http://www.dhv-peyer.de/klages/.../HomoOeconomicus.ppt
36. Akerlof GA, Shiller RJ. Animal Spirits: How Human Psychology Drives the Economy. Princeton (NJ): Princeton University Press; 2003.
37. Ariely D. Predictably irrational. The hidden forces that shape our decisions. New York (NY): Harper Collins; 2010.
38. 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.
39. Güth W, Klimt H, Ramser HJ, Stadler M. Homo oeconomicus 30 (2). München: Accedo; 2013.
40. Kahneman D, Tversky A. Prospect Theory: An Analysis of Decision under Risk. Econometrica. 1979;47(2):263–291.
41. Kahneman D. Thinking, fast and slow. London: Penguin; 2012.
42. Smith VL. Rationality in economics. Constructivist and ecological forms. Cambridge: Cambridge University Press; 2009.
43. Selten R. What Is Bounded Rationality? In: Gigerenzer G, Selten R. Boundedrationality. The adaptive toolbox. Cambridg MA) MIT Press; 2001.
44. Glasersfeld Ev. Radikaler Konstruktivismus. Ideen, Ergebnisse, Probleme. Frankfurt am Main: Suhrkamp; 1997.
45. Detel W, Geist und Verstehen. Historische Grundlagen einer modernen Hermeneutik. Frankfurt am Main: Vittorio Klostermann; 2011.
46. Hauschildt J. Entscheidungsziele. Zielbildung in innovativen Entscheidungs-prozessen. Theoretische Ansätze und empirische Prüfung. Tübingen: Mohr; 1977.
47. Joost N. Organisation in Entscheidungsprozessen. Eine empirische Untersuchung. Tübingen: Mohr; 1975.
48. Witte E, Hauschildt J. Das Informationsverhalten in Entscheidungsprozessen. Tübingen: Mohr; 1972.
49. Rogall H, Gapp K. Homo heterogenus: Das neue Menschenbild in den Wirtschaftswissenschaften. Das Wirtschaftsstudium. 2013;42(12):1573–1577.
50. Thorun C. Was die Verbraucherpolitik von der Verhaltensökonomie lernen kann. WISO direkt. 2010;1–4.
51. Ockenfels A. Mechanismus-Design-Theorie: Die Fortschritte sind gewaltig; 2014. Acessed 01 August 2014. Available: http://www.handelsblatt.com/politik/oekonomie /nachrichten/interview-zum-nobelpreis-mechanismus-design-theorie-die-fortschritte-sind-gewaltig/2873140.html.
52. Thaler RH, Sunstein CR. Libertarian Paternalism. The American Economic Review. 2003;93(2):175-179.
53. Selten R. Aspiration Adaptation Theory. Journal of Mathematical Psychology. 1998;42:191-214.
54. Nash JFJr, Nagel R, Ockenfels A, Selten R. The agencies method for coalition formation in experimental games. PNAS Proceedings of the National Academy of Sciences of the United States of America. 2012;109(50):20358-20363.
55. Neuert JO, Hoeckel CA. The Impact of Personality Traits and Problem Structures on Management Decision-Making Outcomes. Journal of Modern Accounting and Auditing. 2013b;9(3):382–393.

APPENDIX I

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

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

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

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

Rationality Deviation Index 2 (RDI_2):

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

$$\begin{gathered}\mathrm{F1(x)}: y = x \\ \int_a^b F1(x)dx = \int_{0.2}^{0.8} (x)dx = 0.32 - 0.02 = 0.3 \\ \mathrm{F2(x)}: y = 0.71x - 0.61x^2 \\ \int_a^b F2(x)dx) = \int_{0.2}^{0.8} (0.71x - 0.61x^2)dx = 0.1231 + -0.0126 = 0.1105\end{gathered} \tag{A3}$$

APPENDIX II

In the following paragraph we will shortly describe the structure of our laboratory experiment, conducted by Neuert at the University of Bayreuth (GER) in 1983, based on the management simulation FINIS. The management simulation game FINIS was developed by Horst Guenther and Lutz Kruschwitz at the Free University of Berlin. It was tested and further developed both in an academic and practical environment and modified for the use in our laboratory experiment in order to provide an isomorphic or at least a homomorphic projection of realistic planning and decision making processes. FINIS includes all corporate functions and requires a total of 15 types of decisions in the functional areas of purchasing, inventory management, investment planning, production, sales and finance. The laboratory experiment consisted of five experimental series involving four groups of advanced business management students (in total 65 participants) and one group of senior managers (in total 16 participants). The managers and students were separated and randomly assigned to homogenous groups. The experimental timeframe implied eight planning periods within the five experimental series. The length of one planning period was between 80 min and 240 min. The statistical analyses of the experimental data were conducted with IBM SPSS Statistics. The data were tested with the following statistical procedures: Statistics all, correlation analysis, multiple regression analyses, canonical correlation analyses, analyses of variances, F-test and t-test.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=701&id=20&aid=6565