VALUE NETWORKS: A DYNAMIC EVALUATION

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ABSTRACT

Value networks are designed, implemented and monitored to reveal alignment with the original design. A traditional and purely financial example is the comparison of budget against cost. However such a single measure cannot provide an overall view of the business. Researchers have started including other measures to allow a critical analysis of the business.

This shift form a simple measurement towards a complex measurement system gave rise to discussions about relevance and proportionality of sometimes subjective measurement systems. Away from cost and price, rose the importance of the term "value". But the multitude of value definitions, including the product-based and user-based definition, to mention just a few, has not converged to a globally valid answer.

We propose a methodology that does not need the definition of an absolute value but highlights the relative value of activities or processes. Such value measurements need to be accurate and show similar structure that will be referred to as "monitoring step". Within such a monitoring step resides by design a statement of risk, performance and cost that reflects an intrinsic formulation of value. The monitoring of at least two monitoring steps reveals the nature of included processes. The registration of a multitude of monitoring steps results in a representation of the entire value network, highlighting value adding and non-value adding activities. To verify the model, problem solving algorithms from operations research are employed, the system is validated by dynamic simulation and to complete the in-depth study the model is tested with real-world data from a multinational food & beverage company.

This methodology monitors the relative network value and provides a global decision landscape for better governance and ultimately corporate value.

INTRODUCTION

Value definition has been getting more and more complex as authors identified a multitude of aspects within the concept. In traditional operations or manufacturing business, value was attributed to tangible resources or products and concepts such as value chain or balanced score card aided in identifying value-adding activities. The Balanced scorecard introduced the concept of "you get what you measure". This widely accepted affirmation had two important consequences. First, focus shifted from the final good to activities and processes towards their relative importance to the business. Second, organizations started ranking activities systematically, which led to analysis, monitoring of activities and more process control.
A multitude of priority characteristics for activities and corresponding measurement systems were created, to reflect relative value of activities and links between them.

Aligned with advances of technology that made it possible to measure much more precisely and information technology advances in data collection and evaluation many global

organisations chose to measure performance indicators (KPIs) that had been chosen because they were easily measured. But unfortunately important performance indicators are not always easily measured and thus many measurement systems initially designed for value capture were very precise but directionally inaccurate in supporting a critical analysis of the business. To make matters worse two separate phenomena made value evaluation more complex. Already large organisations started incorporating even larger parts of their supply chains for strategical purposes. These purposes included minimization of the bullwhip effect, minimization of other uncertainties or competitive pricing. Supply chains optimization literature provided incentives for minimising uncertainties by exchanging information. Thus these same organisations created internal and external flows of information and now face the challenge of evaluating this information due to the complex systemic nature of internationalized global supply chains.

Accurate understanding of the business is shaped by the information a stakeholder is exposed to. If business internal stakeholders are exposed to different information flows with little overlap their perception of the business will differ. As stakeholders have but a partial understanding that encompasses but a fraction of the business, interaction between different stakeholders will be difficult and decisions such as priorisation of activities will become challenging.

We propose a methodology, that does not affirm general truths about the business, but by proposing a recurring structure to data enables decision makers within the entire organization to relate activities in a meaningful way, building upon the value adding concept that acknowledges value adding activities contributing to the final value of a product. This methodology does not need a definition of an absolute value but highlights relative value of activities or processes. Instead of deducing value from strategic insights or value perceptions of processes or products, this methodology states that a value statement resides within the design of an activity within the network. By studying the networks components closely at the unit level we define those very simple structural building blocks, called monitoring steps. Within each monitoring step resides by design a statement of risk, performance and cost that reflects an intrinsic formulation of present value.
In order to propose a methodology that highlights relative value of activities or processes within each monitoring step, we need to consider stakeholder perspective and the influence on the unit of analysis. This estimation will then guide the application of different weights for each activity. These weights arise from two sources. An internal business perspective is important for value creation processes and activities. Different reasons are stated in literature. The value chain concept (Porter 1985) or the critical path analysis (Kelley 1961), emphasize that activities have to occur in a certain sequence or chain and are thus not independent. The house of quality (Hauser & Clausing 1988) states the importance of key process operations for proper process planning. But the house of quality also states the importance of customer perspective that has risen to jet more important levels for value creation, as in transitional concepts or service dominant logic (Vergo & Lusch 2006), where it is formulated as the main driver of value creation. Where business internal stakeholders contribute to capabilities and processes and know about interdependencies of activites and their impact on the product, the customers knowledge and perception of value includes benefits and sacrifices (Slater 1997, Slater and Narver 1992, Zeithamel 1988 and many others) of the customer.
The duality of perspectives takes in consideration different stakeholders knowledge and perception. Our methodology maintains this duality of perception acknowledging that the present value is a combination of stakeholders past, present and future value estimation. The Skandia navigator (Edvinsson and Malone 1997), states that past financial success supports

todays processes. Financial success is itself linked to past customer satisfaction. This indirect connection of processes building on past financial successes building on past customer satisfaction, creates delay in the value estimation. By including customer perspective directly in the activity weighting, this time gap is shortened, and distortions trough time are minimized. Measurement systems including past and present value estimation have been created with the convenience of precise estimation of their impact. However few measurement systems have included risk as future value estimation within their measurement systems for their probabilistic nature and lack of accuracy. Our methodology will combine past, present and future value estimations for each monitoring step so that impact of each activity on financial performance, time related performance (speed) and risk mitigation performance can be monitored including all available sources of information for best possible estimation of business impact. But where in the past companies were competing against each other, now entire networks compete. A trend supported by research of competitive advantage from a factory focus towards an international network (Shi and Gregory, 1998) with acknowledgement of an empirical research gap to help managers better design and operate global networks (Prasad and Babbar, 2000). Importance of studies of synergies for competitive edge within networks has been formulated as early as 1986 (Flaherty) for a coordinated network.
Within networks synergies and trade-offs become more important, as propagation of these effects within the network can have much higher impact, than anticipated by separated analyses. Thus the observation of the network as a whole is key for impact estimation, illustrating the necessity of a global perspective.

VALUE AND ITS CHALLENGES

Many different definitions of quality exist, each adding another aspect to the complex and multifaceted concept of quality (Garvin 1984).
Value and quality are closely connected. Based on personal needs and wants customers' perception of value (Zeithaml 1991; Kotler 2000) has also been stated more precisely as quality or qualities of the product perceived by customers (Bowman and Ambrosini 2000). The Transcendent definition states that even though quality cannot be defined, you know what it is. The Product-based Definition refers to the differences in the quantity of some desired ingredient or attribute. The Manufacturing-based Definition shows Quality as conformance to requirements. The User-based definition points out that quality is the capacity to satisfy wants. It is however the value-based definition that is of prevalent importance for the perception of quality (Garwin 1985). It states that quality is the degree of excellence at an acceptable price ("affordable excellence") and the control of variability at an acceptable cost. Perceived quality can be defined as the consumer's judgment about a product's overall excellence or superiority (Zeithaml 1991).
Within literature the term of "ob-jective quality" has been used, in order to describe measurable and verifiable superiority on some predetermined ideal standard or standards (Zeithaml 1991). Since quality is by nature always perceived, the aspiration to reach objective quality is bound to be an approximation with the awareness of subjective perception and it has been claimed that objective quality does not exist and that all quality evaluations are subjective (Maynes 1976). The general existence of objective perception has been widely discussed in literature for all achievement of scientific truth. Historical belief built on the existence of an objective reality, i.e. one that is independent of the knower (Holton 1993) and can therefore be accurately perceived through the human senses. The reconciliation of the view on the researcher and his or her perception has helped to reconnect established knowledge away from a personal opinion or private experience, towards recognizing personal

processes and involvement as being characteristic of human inquiry (Clark 1998). In particular hermeneutics talks about understanding of the social reality, which is never objective by reason of researchers lacking ability of objective observing.
Within this research a very general notion of quality will be used. A stringent definition could exclude relevant information and artificially narrow down existent discrepancies. A general notion of quality enhances capture of a complex reality and eventual lack of alignment among activities might be shown, independent of which definition is chosen. Such lack of alignment might arise precisely because of ill-defined notions of terms like quality or value within the value chain.
Quality is related to conformance, the degree to which a product's design and operating characteristics meet established standards (Garvin 1987). All products involve specifications of some sort. Standards are thus necessary for any kind of internal or external specification and reveal quality information (Juran 1951). To guarantee that required standards are met in conformance with requirements within the value chain (Humphrey and Schmitz 2001) standards convey information about consistency over time as well. In order to have value chain that produce with constant quality not only consistency but also robustness of value chains has to be considered. The goal of robust decision-making is to reduce risks (Ullman 2001). This multitude of value definition and overlap with quality definition shows the difficulty of finding a globally valid solution. This work approaches the challenge by defining only the most fundamental and basic structure called monitoring step that carries a assessment of risk, performance and cost and an intrinsic formulation of value.

3D IMPACT LEVEL ANALYSIS: RISK, PERFORMANCE, COST

Many models for operations optimization exist, with cost optimization being the most traditional approach (Beamon 1998). Performance measurement systems literature has been growing over the past decade in operations research. As performance measurement systems grew more complex, they started to include many parameters, the focal point of performance measurement systems being operations or manufacturing. The parameters also included cost, operational efficiency, quality of product and process and time (Verbeeten & Boons 2009, Pinheiro de Lima et al. 2009, Platts, 1995, Leong et al. 1990, Slack 1987). In the 3d impact level analysis, we will treat these variables individually, as they have different effects in the model.

WHY RISK?

Monitoring steps are present all trough value chains or networks. Each monitoring step is present because a measurement with conformance assessment and intervention needs to be executed. The decision maker preferred to invest in preventive actions instead of running a risk. In this perspective the presence of the monitoring step can be interpreted as benefits and sacrifices estimation in favor of the installation of the monitoring step.
In other words the creation of a monitoring step captures an implicit and informal value statement by the decision maker. As an alternative to executing a monitoring step, we propose the non monitoring step. In this case the monitoring step with measurement and conformance assessment does not take place and no intervention can happen. In operations this has consequences for customers such as malfunctioning computers or unhealthy food items that can even endanger the final user. In this perspective a monitoring step is but a mitigating action and its risk and risk mitigation implications can be weighted. Within the model risk is a estimate of probability, however by simulating the outcome potential scenarios will be executed and risk components will have present cost or performance

impacts. Literature on Managers Perspective on Risk has shown that Managers are focused on performance targets and insensitive to estimates of probability (March & Shapira 1987). It has been proposed that this insensitivity originates in challenges to measure justification of investment for risk reduction accurately and as a consequence to few resources for risk mitigation (Tang 2006). A statement that Repenning & Sterman (2001) so appropriately described as "Nobody gets credit for fixing problems that never happened". Within the 3d impact level analysis we address the discrepancy of systematic risk underestimations by building upon already existant, informal value statements of decision makers. Literature in risk analysis has focused on the use of expert judgments (Keeney and von Winterfeldt 1989; Hora and Iman 1989; Otway and von Winterfeldt 1992), subjective judgments (Morgan and Keith 1995) and probability issues (Merkhofer 1987; Mosleh et al. 1987). Within this study we will comply with Kaplan's definition of risk (1997) as (i) a set of options from which to choose, followed by (ii) an evaluation of the outcomes of each option and finally (iii) a value judgement of each outcome. Failure modes are identified and failure mode and effects analysis (FMEA) is conducted. The RPN (Risk priority number US Department of Defense 1949) composed of, Severity, Occurrence and Detection is extended. Severity now includes customer impact and process impact and Occurrence is composed of customer occurrence and process occurrence.

WHY PERFORMANCE?

Performance is also defined by measurement against standard of time. But the nomenclature of [operational] Performance measurement systems often includes parameters exceeding those defined by performance. Parameters that for this study have been excluded.

Previous literature identified the value of using performance measurement systems and monitor performance improvements to identify business objectives (Bititci 1997). Manufacturing organizations have developed performance measurement systems based on cost and financial accounting practices. Performance is organized around different axes like cost (price/operational efficiency) or time (dependability and agility) (Pinheiro de Lima 2013). Last but not least different Performance Management Systems (PMS) include aspects of value (Otley 2003) or quality (Pinheiro de Lima 2013). However we limit the definition of performance to the axis of time.

WHY COST?

Financial estimation of activities including variable and fix cost is included in cost accounting systems (Cooper & Kaplan 1987). The cost estimation in this study will adhere to the estimation including variable costs and fix costs.

METHODOLOGY

MONITORING STEP

Goods dominant logic defined by the vehicle that transfers the value where as other value creation logic is dominated by the consumer (i.e. transitional concept, service dominant concept, Cova 2008). The advantage of being defined by the vehicle of value transfer or value creation is illustrated by the value chain logic (Porter 1985), that illustrated the added value in a chain or network environment. But this sequential logic to adding value can be preserved without its link to the good or resource. One can argue that at the beginning of any value estimation one can take all activities and by their pure existence all vehicles that

transfers value are non void. Consumer dominant value creation on the other hand is interesting as it can be used to align the product with the consumer, but then again it is difficult to align it with an organizations activities. In making the unit of value transfer a monitoring step both concepts can be integrated. Value measurement needs to be accurate and similar in structure. This structure that we call Monitoring step is defined by a "measurement" followed by a conformance assessment and an intervention.
In order to assess value information and define each monitoring step trough the value chain, general information about the overall value chain will be collected and all monitoring steps will be identified and mapped with the experts of chocolate value chain. The structure of a monitoring step includes a "measurement" followed by the conformance assessment and an action. For the conformance assessment the measurement is compared to a standard and conformance or non-conformance is attributed. An example for a monitoring step is elaborated in Figure 2.

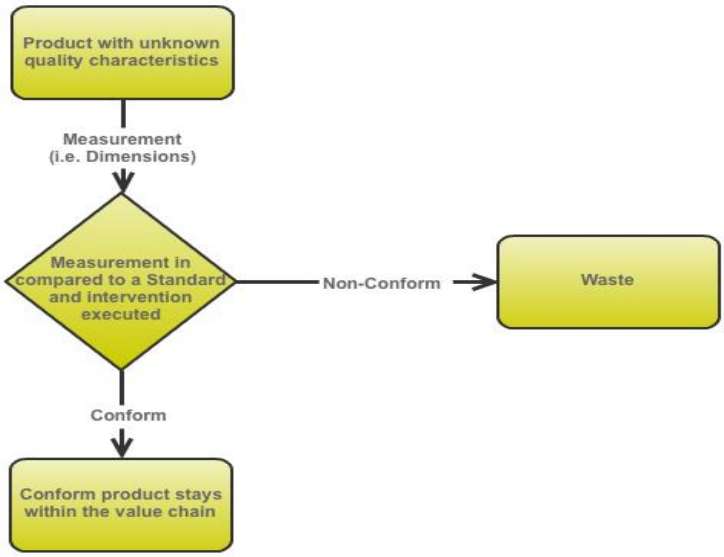

*Figure 2: this **Monitoring Step Flowchart** illustrates the process for one QOC. In this example a Product with unknown quality characteristics is measured. The measurement is compared to a standard and the intervention results in non-conform Products finishing as waste and conform products staying within the value chain.*

The identification of two monitoring steps reveals value of included activities. The identification of many monitoring steps allows comparison and destinction of value-adding and non-value adding activities. The measurement system then is executed for a non-control at the monitoring step and data is collected.
The options from which to choose are the presence or absence of the quality output control. Intuitively the absence of a quality output control will enhance risks. Figure 3. shows an example of an absent quality output control.

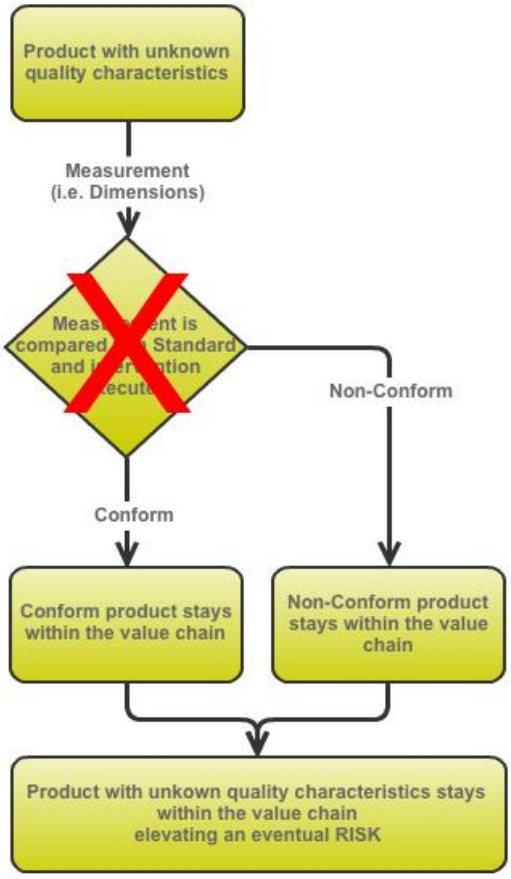

Figure 3: ***this Non Monitoring Step Flowchart*** *illustrates the absence of a Quality Output Control (QOC). In this example conform and non-conform Products remain within the value chain, the quality characteristics stay unknown and an eventual risk occurs.*

By designing this very simple structural building block, we are designing a weight statement that implicitly carries different statements of value contribution. As we are trying to identify value adding activities, the first step is identification of activities, which are always "tangible". This leads to the establishment of a list of activities, which implicitly states that any activity that is existing in a value chain or network today, is considered as non void of value.

OPERATIONS RESEARCH MODEL

To study the entire product value chain the research framework relates value monitoring step approach with risk analysis revealing risk perception mechanisms within the value chain ultimately influencing the competitive advantage. The research approach is qualitative and thus descriptive and explanatory (Robson 2002) as well as quantitative.
The study investigates the chocolate bar production from the very beginning of the value chain, starting with the cocoa bean to chocolate bar manufacturing, to the shelves of the retailer. The access to such information that leads to the creation of the case study results from the unique collaboration with a multinational food & beverage corporation and the insights on the global chocolate value chain. The operational research model is formulated.
Let $f = 1/N(\omega \Sigma (p^{(c)}x_i + p^{(nc)}(1 - x_i) - \Sigma (r^{(c)}x_i + r^{(nc)}(1 - x_i))))$ be the objective function to be maximized under the budget constraint $B \geq \Sigma (f_i + v_i n_i)x_i$ with ω as a

scaling parameter, $p^{(c)}$the performance associated with the monitoring step i when monitoring is performed, $p^{(nc)}$the performance associated with the monitoring step i when monitoring is not performed, $r^{(c)}$risk $_i$ associated with monitoring step i when monitoring is performed, $r^{(nc)}$the risk associated with the $_i$ monitoring step i when monitoring is not performed, f_i the fix cost, v_i the variable cost and n_i the sample associated with the monitoring step i. $X = (x_1,x_2,...,x_n)$ of length N is a solution of the objective fuction f, where $x_i \in \{1, 0\}$. Due to the discrete formulation of monitoring , with the alternatives to perform or omit each monitoring step i, the optimization problem becomes combinatorial (Aarts & Lenstra, 2003) and difficult. The use of multiple performance criteria, noteably performance and risk that have to be optimized concurrently, makes this a multiobjective optimization problem. However exhaustive search methods have proven performant in finding the guaranteed optimum (CPLEX) and able to solve the difficult problem in reasonable amount of time.

DATA COLLECTION

This study comprises multiple value chains for different products in order confirm validation of findings. The food & beverage company chocolate bar production value chain will be succeeded by the food & beverage company coffee production, followed by a third product value chain from outside the food & beverage company conglomerate.
For each value chain multiple data sources will be employed to permit validation of findings by triangulation (Denzin 1978). Triangulation by different data sources comprise the internet, public visits of value chains where possible (i.e. “Visit at Maison Cailler Broc”) and archival sources, followed by expert interviews, firm internal quality documentation (i.e. Critical monitoring steps, etc.) and extracts from food & beverage company programmes (GLOBE, NCE). To corroborate data quality the researcher will constantly seek feedback from informants (Blumer 1969; Denzin 1978) including a debriefing during interviews and seeking confirmation of value chain map after the interview.
Conducting qualitative interviews is particularly useful for accessing individual attitudes and values. Open-ended questions and flexible questions are likely to get a more considered response than closed questions and provide better access to interviewees’ views, interpretations of events, understanding, experiences and opinions (Kvale 2009). In this research semi-structured, open-ended expert interviews will be conducted. The semi-structured guideline provides comparability of respondents making use of the same questions. On the other hand the semi-structured approach also gives enough flexibility to the researcher to raise follow-up questions for increased richness of the data being obtained (Patton 1980) and to favor “depth interviews” (Reason and Rowan 1981). With empathy and active listening the researcher will seek to create an atmosphere conductive to open and undistorted communication (Gubrium and Holstein 1997) while at the same time managing his/ner own subjectivity. The rapport between the interviewee and the researcher is built on the ability to convey empathy and understanding without judgment (Patton 1980).
In expert interviews the selection of the interviewees is of crucial importance. The interviewer has a strong directive function in order to exclude unproductive topics. Challenges with expert interviews include that the interviewee turns out not being the expert. In this case the interview is still conducted in order to maintain atmosphere conductive to open communication within the firm and be able to apply the snowball principle. However

the confidentiality of data is confronted with the experts' responses and confronting results are carefully evaluated with regards to source including expertise for best possible confidentiality of results. The snowball principle is applied to identify and interview the experts following the value chain.
Overall the interviews are developed in order to provide a rich description of reality with enough flexibility means to access to information that might not have been obtained via other sources.

VALIDITY AND LIMITATIONS

The criticism of an objective reality (Holton 1993) leads to the supposition, that results are subjective and dependent of the researcher (King et al. 1994). The recognition of personal processes and involvement of the researcher a characteristic of human inquiry has been stated important in all establishment of knowledge (Clark 1998). It is however particularly true in the qualitative research, where the rich descriptions (Miles and Huberman 1994) of real-world situations are the very essence of the research.
This research is designed in order to attempt the best possible results that show the characteristics of transparence, reliability, construct validity, credibility, confirmability and applied usefulness. Corroboration of outcomes trough different sources might confirm a generalizable nature of findings, however this is not s primary goal of this research, as alternative findings revealing a more complex underlying dynamics with a context-respecting set of explanations (Jick 1979) seem equally possible. The 3d Impact analysis will be tested in collaboration of one food & beverage company. In order to estimate generalizability it is planned to apply the model on at least two value networks, which will be limited to the food & beverage industry at first.

DISCUSSION AND CONCLUSION

The 3d Impact Level Analysis creates a value network of monitoring steps with intrinsic value estimation. The need of measurement systems for entire value networks has raised challenges in how to make measurement systems precise and accurate to reflect impact on the entire business. Literature and complexity of global value networks have led to specialized and thus fragmented perceptions, leading to often precise measurement systems of only parts of the system. Such measurement systems then optimize subsystems leading to a sub optimization of the global system. The simplicity of the 3d Impact Level Analysis makes it applicable on the entire business, evaluating value adding and non-value adding activities. In order to avoid common pitfalls, not only the type and origin of information, but also the holistic grasp of the entire network is essential. It is this holistic perspective that allows an overall estimation of relative value and highlight synergies and trade-offs among axes or activities. But businesses are not only more global, but also more complex. For the same reason it is essential to include all vehicles of value transfer, as different stakeholders might have a different vision of the entire network. Goods are but one vehicle of value transfer and monitoring steps structure allows application of 3d Impact Level Analysis on multiple vehicles of value transfer in order to allow inclusion of activities that do not directly transfer their added value within the operations processes. By applying the same structure within one network we promote mutual understanding of benefits and sacrifices of different activities for all stakeholders, so that decision makers from different parts of the value network, such as marketing and operations, can interact with the same argumentation of alignment, synergies and trade-offs among activities. The 3d Impact Level Analysis this creates overlapping perspective on complex value networks and a common view for decision makers on value

adding activities and their priority. Trade-offs are present in many strategic or operational decisions. Unfortunately trade-offs are rarely formally targeted in a performance measurement system for overall business evaluation and so resilience and performance of networks are evaluated separately. The radically simple structure of this model in contrast to other OR models differentiates our study from many others. No data on industry specific or control variables exists and first model does thus not include these variables.
As the 3d Impact Level Analysis highlights synergies and trade-offs for alignment of activities, it will support decision makers to keep the overview of their global supply chains even when those are complex and difficult to grasp intuitively. This model then supports decision makers to focus on areas of their value network that are most challenged and challenging. The traditional use of measurement systems with only cost or time related performance measurements, with past and present estimations have led to partial views of the business and do not reflected the entire business. The 3d Impact Level Analysis includes past, present cost and time related performance measurements, deliberately adding risk. The accuracy of past and present performance indicators is essential and makes their measurement systems accurate, but studies in many fields as recent as portfolio analysis or as ancient as philosophy or physics have not been able to impose the same rigor of accuracy on future estimates. But estimates of risk have an important impact on business, such as risk estimation or continuity is key for customer satisfaction in the food & beverage industry. The future estimate of risk in this model incorporates an important understanding to our model. Even though exclusion of those estimates makes measurement systems more accurate, the failing to formally include these measurements make the models directionally vague. This leads to the earlier mentioned disconnected or informal estimates of risk and consequently to underestimated risks.
The operationalization of this value statement makes this model unique and the subsequent estimations of value networks make it directionally accurate. Important phenomena like performance improvement and loss of resilience will be distinguished by the model and put into the perspectives of the three axes. The 3d Impact Level Analysis states the necessity of revealing trade-offs within the same value network in order to dislodge competitive advantage that lies within synergies of alignment.

NEXT STEPS

As it is the model has been run on CPLEX and solutions have been shown robust and coherent. To complete the in-depth study the model is tested with real-world data from a multinational food & beverage company to highlighting value adding and non-value adding activities showing dynamics among monitoring steps within the value chain and the associated activities, but also synergies between performance, risk and cost. We will be able to dynamically estimate the real-world applicability of the model and the consequences of the network information for global value chains. By simulating the value chain the model robustness and sensitivity will be dynamically estimated to ultimately increase company value and competitive advantage. Future Research should include different data sets from different industries for generalization purposes with or without manufacturing in order to create industry specific data and to test for control variables.

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