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A Critical Evaluation of the Sustainability Balanced Scorecard as a Decision Aid Framework

Fadwa Chaker [1*], Mohammed Abdou Janati Idrissi [2], Abdellah El Manouar [3]

[1, 2, 3] ENSIAS Engineering School, TIME laboratory, Madinat Al Irfane 10100, Rabat, Morocco.

** Corresponding author*

Abstract

Despite being one of the most renowned systemic thinking decision aid frameworks in sustainability management, the Sustainability Balanced Scorecard (SBSC) suffers from a fragmented literature on architecture design methodologies. These often depend on the modeler's viewpoint, contextual inputs and subjective assessment. A structured critical analysis of the existing architectures and their construction methodologies can make a clear contribution to this field of research. In this paper, we initially present an overview of the major decision aid frameworks used in sustainability management which we classify in two categories: operational methods and systemic approaches. Then, we focus on the SBSC and conduct a critical evaluation of this decision aid framework's key features and architectures in order to depict the most salient characteristics and conceptual flaws. We propose consequently some research directions for the construction of more promising SBSCs.

Keywords: Balanced Scorecard, Sustainability Balanced Scorecard, Sustainability decision aid frameworks, sustainability management, system thinking, system dynamics.

INTRODUCTION

Sustainability management is a serious challenge facing the modern mankind. Organizations are striving to successfully create and implement the right sustainability strategies. This task is particularly daunting at the moment managers feel they need to make the classical societal-economic trade-off. Yet, research has shown that companies that are most successful in creating "blue oceans" and reinventing double-digit growth businesses are those who quickly understood that the foundations for their business models need to be built around sustainable thinking and created shared value [1]. The question we ought to ask, therefore, is no longer the *why* but rather the *how*. How should firms and organizations integrate sustainability into their business models? Which tools, frameworks or approaches can help decision makers create competitive advantage around fair, equitable and eco-friendly growth strategies?

The literature on sustainability decision aid frameworks is abundant. However, two trends are noteworthy: The first one, which concerns the vast majority of studies, addresses operational decision aid including multi-criteria/multi-objective decision making methods, [2-4], artificial intelligence [5-7] or mathematical programming techniques [8], to help solve, among others, evaluation, selection or outranking problems. The second trend, the less widely explored one, pertains to system thinking approaches which cover such patterns as adaptive capacity, feedback, emergence, and self-organization [9].

This discrepancy in research coverage is of particular significance, especially when scholars contend that effective sustainability management requires a systemic all-encompassing analysis of ecosystems, with carefully drawn interconnections between social, political, environmental and economic factors [10].

The Sustainability Balanced Scorecard (SBSC) is one of the most renowned frameworks in system thinking approaches dealing with sustainability management [11]. However, a close analysis of the literature unveils that proposed architectures present some evident drawbacks that can benefit from further honing. A revised and systematic SBSC construction methodology is needed in order to make it more encompassing, more adaptive to various contexts, and less prone to human mental models' biases.

In this work, we present a holistic overview and categorization of the main decision aid frameworks used in sustainability management and Corporate Social Responsibility (CSR). Then, we focus on the SBSC and make a critical review of the corresponding architectures and construction methodologies. Finally, we propose some promising research avenues for a more robust SBSC.

OVERVIEW OF DECISION AID FRAMEWORKS IN SUSTAINABILITY MANAGEMENT

The aim of this overview is to depict the types and usage frequency of the main decision aid frameworks used in sustainability and CSR management over the past fifteen years. In order to efficiently reap the largest benefit from the existing literature, the synthesis method consisted of analyzing the major literature review works that have been

already published in referenced journals between 2002 and 2017. These review works are then classified by sustainability area. The selected areas are those which are most frequently found in the literature, they are: Energy (with derivative names such as green energy, bio energy, renewable energy, etc.), Forest management (including biodiversity, natural resource management, soil management, etc.), Water management (including watersheds, rivers, fresh water management), Supply Chain management (with linked concepts as green supply chain, sustainable supply chains, green suppliers...), and sustainable Technology management.

The major decision aid frameworks found in the literature can fall under two categories: operational decision aid methods and systemic decision aid approaches (figure 1). Operational methods help the decision maker solve a particular and a precisely formulated question inherent to CSR or sustainability. Examples include the measurement of the environmental impact associated with a given product's life cycle, the selection of the "best" green supplier based on a set of criteria, or the calculation of the sustainability score of a given corporation, etc. Generally, operational methods make use of analytical formulae and lead to crisp results. Systemic approaches look into a system as a whole and aim to help in the understanding of the interrelations that govern the elements of that system. Establishing connections and behavioral rules of lower level elements makes it possible to draw patterns, make forecasts and subsequently formulate a strategy.

We describe decision aid models and methods for sustainability management that are cited in the literature by adopting the following classification: the class of operational modeling methods, which includes analytical techniques, sustainability performance evaluation systems and other operational methods; and the class of system thinking approaches, which includes feedback and emergent self-organization approaches, the sustainability balanced scorecard, and other systemic approaches (0).

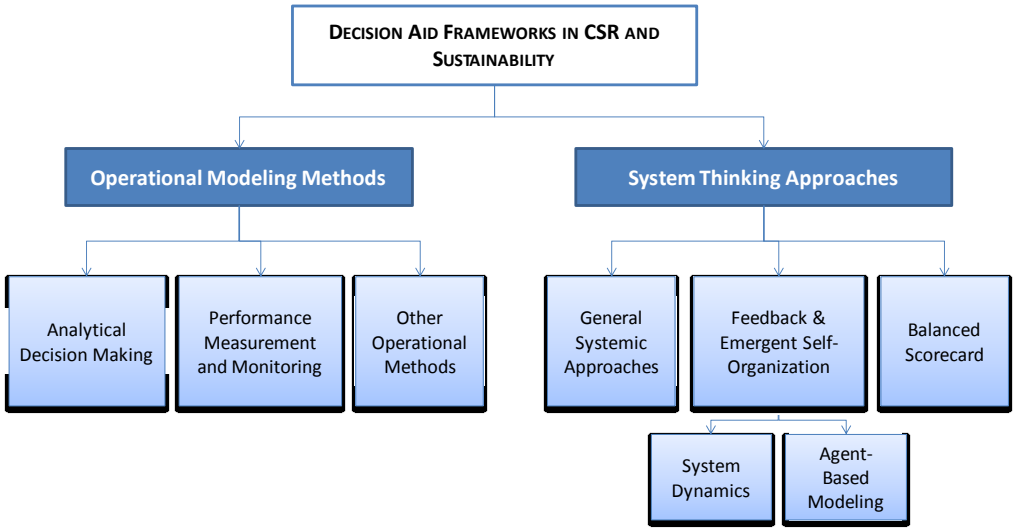


Figure 1: Classification of the decision making frameworks in CSR and sustainability management

Operational Modeling Methods

We distinguish two main sub-classes of methods in this particular context: analytical decision making methods, typically multi-criteria decision methods addressing, among other things, selection and outranking problems; and sustainability performance evaluation systems including stand-alone and composite indices, and sustainability performance management systems.

Analytical Decision Aid Methods

In this category, three major classes of techniques are widely used. They are: multi-criteria/attribute decision making (MCDM / MADM), mathematical programming (MP) and artificial intelligence (AI) (0). When generally dealing with such questions as ranking CSR indicators, selecting the best 'green' supplier, or choosing the most appropriate sustainability program, MCDM methods become a natural fit (eg. Govindan, Rajendran [12]; Diaz-Balteiro and Romero [13]; Huang, Keisler [14]). In other settings where the decision maker seeks to establish cause-effect links between the elements of a system, Decision Making Trial and Evaluation Laboratory (DEMATEL) is frequently adopted [15-19]. In order to optimize a decision function or reach a certain goal, mathematical programming (MP) methods are rather more strongly used [20-22]. Lastly, Artificial Intelligence (AI) methods, although being the least widely

used ones, present an important set of techniques to address CSR related questions [12].

Analytical methods are frequently encountered in their fuzzy extensions [18, 23-25] and are usually combined with one another to yield the best possible outcomes [15, 26-28].

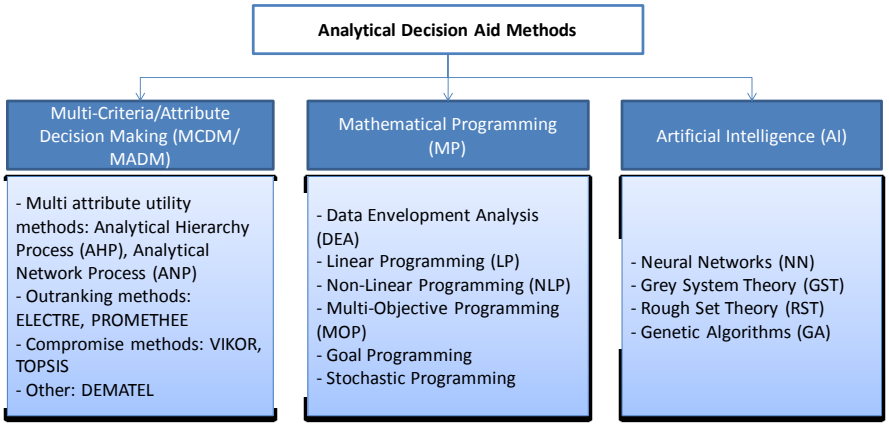


Figure 2: Most frequently used analytical decision aid techniques in CSR and sustainability

Performance Management and Monitoring

Performance monitoring and measurement models can be classified into two sub-sets: stand-alone and composite performance measurement indices; and comprehensive sustainability performance measurement systems (SPMS).

Stand-alone indicators give the performance levels of distinct areas or sub-areas of sustainability –for example, such indices measure separately carbon emissions, water consumption, or number of work-related incidents, etc. Various methods are used for the selection, weighting and calculation of sustainability indicators. In a holistic literature review, Ibáñez-Forés, Bovea [29] summarize the different quantitative and qualitative methods for indicator construction in sustainable technological alternative selection.

Composite indices (CIs) bring a more comprehensive coverage of sustainability performance. They aggregate different single indicators into one measure, summarizing multidimensional concepts [30]. They are useful decision making tools [31] in as varied areas as manufacturing, energy, education, development, among others. While some authors rely on existing CSR measures provided by rating agencies [32], others develop their own CIs. However, Paredes-Gazquez, Rodriguez-Fernandez [33] argue that CIs are useful measurement tools only if they are constructed following a transparent process. The authors thus propose a theoretical framework on how to construct a CI based on the guidelines of the handbook of OECD for constructing CIs [34].

Among the authors who developed CIs to capture the essential information on societal performance are Singh, Murty, Gupta, and Dikshit (2007); Hubbard [35] and Dočekalová and Kocmanová [36].

Sustainability Performance Management Systems (SPMS) are explored via three stages: design, implementation and use, and evolution [37]. A large array of research explored the design process of corporate SPMS [38-40]. In terms of implementation and use of corporate SPMS, research is still in its embryonic stages [37]. The few authors that addressed this area of research include Searcy, Karapetrovic [41]; Jørgensen [42]; Adams and Frost [43] and Searcy [44]. As for the evolution of SPMS, relatively few publications give insight into how the evolution of such systems should be accomplished [37].

Today, more firms resort to internationally recognized and industry certified sustainability management systems, such as EMSs (environmental management systems) to measure their triple bottom line. ISO 14000 family is one of the most widespread SPMS, particularly ISO 14001, a leading EMS which registered 1 609 294 certificates issued worldwide in 2014 alone according to the 2014 ISO survey [45].

Other Analytical Methods

The literature on sustainability assessment provides with some other valuable techniques of which the most widespread are Life-Cycle Assessment (LCA) and Cost-Benefit Analysis (CBA).

LCA addresses the environmental aspects and potential environmental impacts (e.g. use of resources and environmental consequences of releases) throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling and final disposal [46]. LCA has been frequently used in recent

publications; it represents 8% coverage of decision making works on green energy [47], and 26% of publications on water management decision making [48].

CBA deals with the balance between the economic cost associated to a measure or a process and the environmental benefit or harm resulting from its introduction. In other terms, it reflects the relationship between the value created and the environmental effect involved in achieving it [29].

Overall, the literature synthesis on operational sustainability decision aid frameworks shows the strong predominance of analytical methods with a visible prevalence of CSR focused questions. MCDA techniques are generally more frequently used than other analytical methods while LCA and CBA are approximately as strongly prevalent as sustainability performance evaluation systems. We note that various individual methods are developed by scholars, they represent either general frameworks or a combination of existing ones (0).

Table1: Distribution of operational methods in CSR & sustainability decision making based on the major literature reviews

			Operational Decision Aid Methods				
			Analytical Methods		***Performance Assessment***	***Other Operational Methods***	
Area	**Major Reviews**		*MCDA*	*Other analytical*	*Indices/SPMS*	*LCA/CBA*	*Individual methods*
Energy	Strantzali and Aravossis [47]		76 %	--	11 %	13%	--
Forestry	Diaz-Balteiro and Romero [13] Ananda and Herath [49]		100% *	--	--	--	--
Water	Aivazidou, Tsolakis [48]		--	--	35% (WFA) 4% (ISO 4040/44/46)	26%	15% (individual) 20% (multiple)
Supply Chain	Tajbakhsh and Hassini [50]		8%	3% (AI, MP) 14% (computational & statistical)	8%	--	18% (Empirical case study) 7% (Questionnaire) 26% (General frameworks)
Technology	Ibáñez-Forés, Bovea [29]	**Indicator calculation**	5%	13%	--	65% (LCA/CBA and similar methods)	17% (Expert judgment)
		Optimal alternative selection	68%	--	--	--	32% (Direct comparison)

* Based on the literature works cited herein.

System Thinking Approaches

While operational decision making methods prove effective in tactical management of sustainability, system thinking allows gaining a strategic overview and longer term perspective of the various dynamics that take place within and across systems. System thinking is a useful lens to understand change across scales [9]. Generally, pertaining to sustainability management, we can categorize system thinking approaches under three main sub-categories: general systemic approaches, feedback and emergent self-organization [9], and the Balanced Scorecard [51].

General Systemic Approaches

We refer by general systemic approaches to some well-known system examination approaches that have been developed specifically to tackle sustainability issues. These approaches are developed by international organizations and are summarized by Meyar-Naimi and Vaez-Zadeh [52]. They include, among others, Pressure–State–Response (PSR), Driving Force–State–Response (DSR), Driving Force–Pressure–State–Impact–Response (DPSIR), Driving Force–Pressure–State–Effect–Action (DPSEA), and Driving Force–Pressure–State–Exposure–Effect–Action (DPSEEA). These frameworks were developed to analyze such sustainability issues as environment, energy, and resource management.

Supplementary frameworks have been proposed as well with fewer applications. They include Pressure–State–Impact–Response (PSIR) and Pressure–Carrying Capacity–State–Response (PCCSR) [52].

Feedback and Emergent Self-organization

Feedback loops describe the interconnectedness existing within a system. They represent the "secondary effects of a direct effect of one variable on another" causing a "change in the magnitude of that effect. A positive feedback enhances the effect; a negative feedback dampens it" [53]. Emergence occurs in complex systems when novel higher level structures and patterns arise due to interaction between lower level systems variables [54]. The most widely accepted sustainability decision aid modeling approaches representing feedback and emergence are System Dynamics (SD) and Agent Based Modeling (ABM).

Based on the concepts of feedback loops and causal loop diagrams, System Dynamics modeling brings the advantage of modeling the combinatory and dynamic complexity [55] of systems by joining the technical grounding from mathematics and engineering to the nonlinearities of social sciences, organizational behavior, and psychology. SD is particularly useful in addressing the subjectivity bias posed by human mental models [56-58]. These mental models are *"limited, internally inconsistent, and unreliable*" Sterman [59] (p.10).

SD models are essentially implemented on simulation tools. Pertaining to sustainability, SD has been used in as varied fields as, but not limited to, industrial processes [60], forestry projects management [61], supply chain management [62], and sustainable development [63, 64].

Agent-based modeling (ABM) is the computational study of social agents as evolving systems of autonomous interacting agents [65]. The key feature of agent-based modeling is that it involves a bottom-up approach to understanding a system's behavior. While traditional models take a top-down approach in which key aggregated variables are scrutinized in the real world and then reconstructed into a model, ABM looks into the properties of each individual agent and how the behavior of these individuals gives rise to the aggregate result [66].

An agent based model is composed of agents, interactions, and the environment. In addition, to build and run the model, a computational engine is needed. An agent is a self-contained, modular and uniquely identifiable individual. It is autonomous, self-directed, can function independently, and has a state that varies over time [67]. Interactions between agents in the model describe who is, or could be, connected to who, and by which rule or mechanism. Finally, the modeling environment is used to provide information on the spatial or geographic location of an agent relative to other agents [67].

ABM has been largely used in diverse sustainability application areas such as CSR dynamics [68], ecosystem management [69], sustainable fishing [70], freight transport [71], sustainable urban management [72], and land use optimization allocation [73].

The Balanced Scorecard

In 1992, Kaplan & Norton introduced the Balanced Scorecard (BSC) as an instrument for monitoring organizational performance from a wider angle than the traditional financial viewpoint [51]. This approach is based on the assumption that capital investment is no longer the only determinant of firms' success, and that such factors as customer satisfaction, innovation ability and adaptability are more and more viewed as essential elements of a firm's long term success. Increasingly, the BSC turned into a "valuable support for successful decision making" [74]. The BSC's perspectives are:

- **Financial perspective:** includes the traditional financial ratios reflecting the firm's economic achievements. In the BSC, the financial perspective indicates whether the transformation of a strategy leads to improved economic success [75]. Measures chosen in this perspective should reflect the product

or service life-cycle stages which are summarized by Kaplan and Norton [51] as rapid growth, sustain, and harvest.

- **Customer perspective:** describes the firm's customer value proposition via a set of objectives, measures, and initiatives reflecting how the firm wants to be perceived by its customers. It defines the market segment and reflects the positioning that the firm desires to have to be competitive in the marketplace.
- **Internal Processes perspective:** focuses on the internal production or service processes that take place throughout the value chain. It reflects the firm's ability to adapt, change, and innovate.
- **Learning & Growth Perspective:** measures the strength of internal capital including human capital, information capital and organization capital. (eg. employee motivation, training and progress, information systems, databases and networks, culture and leadership). Internal capital represents the infrastructure that drives performance and allows the firm to achieve the three dimensions above Kaplan and Norton (1996).

The BSC allows decision makers to more fairly balance the needs of shareholders and stakeholders. In addition, it *"... addresses a serious deficiency in traditional management systems: their inability to link a company's long-term strategy with its short-term actions"* Kaplan and Norton (1996). Moreover, Mooraj, Oyon [76] demonstrate that the BSC is a "*necessary good*" for today's organizations. They show that the BSC does "*improve on current systems in a variety of ways. It provides relevant and balanced information in a concise way for managers, thereby reducing the time for 'digestion' of information and increasing the time for decision making*."

Nevertheless, the BSC has been mainly criticized for involving an overly subjective assessment of strategy drivers by managers. Atkinson, Waterhouse [77] argue that the BSC fail to:

- Adequately highlight employees and suppliers' contribution to achieve strategic objectives;
- Clearly identify the role of the community in defining the environment within which the firm evolves;
- Present performance as a two-way process by which not only the firm can assess stakeholders' contribution to achieving corporate goals, but also stakeholders can measure and assess the extent to which the firm is responding to their demands now and in the future.

From a conceptual perspective, critics are concerned with the unclear and often ambiguous concept of causality, and the complexity and time involved in the BSC's development [78]. Barnabè [79] contends that a particular limitation of the BSC is that "*it basically considers unidirectional cause and effect linkages; it does not consider time delays and suffers from relevant limitations both in the design phase and in its implementation and use*." (p.447) In addition, executives fail to see the tangibles benefit they can reap from the framework; "*many BSC implementation processes fail and therefore, [authors] have begun to focus on the limitations, consequently suggesting alternative or complementary approaches able to overcome [the BSC's] flaws.*" [79] (p.452).

One of these complementary approaches is the Dynamic Balanced Scorecard.

a. The Dynamic Balanced Scorecard

The visible limitations of the BSC approach has led researchers to explore ways of overcoming some of them. Barnabè [79] outlines the necessity to incorporate the BSC approach with System Dynamics thinking. This combination had already been explored in earlier works mainly via case studies [78, 80, 81] where authors explain by example the benefits accrued from applying system dynamics tools to the BSC. David Norton wrote*: "dynamic systems simulation would be the ultimate expression of an organization's strategy and the perfect foundation for a Balanced Scorecard"* [82] (pp 14-15).

b. The Sustainability Balanced Scorecard

The Sustainability Balanced Scorecard (SBSC) is another derivative of the traditional BSC that aims to integrate social and environmental considerations within corporate management in a structured way. The growing concern about sustainability issues has spurred researchers' and practitioners' interest into developing various forms of the SBSC using either case studies or conceptual frameworks. A recent systematic review of SBSC architectures covering 69 papers [11] presents a well structured categorization that gives us the foundation for a deeper critical analysis of those architectures, and therefore a solid grounding for improved construction methodologies and more robust SBSCs.

THE SUSTAINABILITY BALANCED SCORECARD: A CRITICAL EVALUATION

In this critical evaluation of SBSC architectures, we rely on the papers considered in the systematic review of SBSC architectures [11]. In addition, we opt to analyze in more detail a few papers which are most referred to in the literature and which present a clear conceptual design framework (0).

Based on the analysis, we determine four common key features and five conceptual flaws.

Table 2: Strengths and limits of some major contributions to sustainability balanced scorecard design\

Reference	Construction Method	Strengths	Limits
Epstein and Wisner [83]	1. Start with defining key S&E performance metrics. 2. Translate these into the BSC framework. 3. Cascade the metrics from headquarters to divisions, SBUs, EH&S (Social and Environment, Health & Safety), and support functions. 4. Create customized scorecards per SBU to reflect their individual market and operational challenges.	• Forces managers to define S&E metrics for each level of the BSC • Integration of S&E considerations throughout the value chain (all four aspects of the BSC) • Focuses on cascading the BSC through SBUs and functional units, which allows to cover all organizational levels	• Particular focus on Social and Environmental (S&E) responsibility. The components of ethics and governance are not discussed. • Does not show how metrics relate to one another and lead to the ultimate bottom line. Seems like a loose collection of good, but somewhat scattered, indicators. • Ends up with too many metrics as opposed to a concise snapshot of the organization's sustainability performance.
Figge, Hahn [75]	1. Determine SBU. 2. Determine exposure of SBU to S&E aspects. 3. Determine strategic relevance of S&E aspects and decide of whether a fifth dimension should or should not be added. 4. Integrating indicators to all perspectives.	• Procedural method. • Discusses when and how social and environmental aspects have strategic relevance to the business unit.	• Limited to social and environmental aspects. • Proposes a scorecard for every SBU, which could result in a selection of disparate scorecards that yet need to be connected to one another to make sense of the whole corporate strategy.
Gminder and Bieker [84]	1. Corporate vision and mission. 2. Clarify sustainability strategies. 3. Deduct sustainability objectives. 4. Identify causal relationships. 5. Define indicators, targets and measures. 6. Integrate into core management system.	• The four approaches of the integrated SBSC present a well structured framework which gives solid grounding for developing a SBSC. • Theoretical background is supported with workshops and fieldwork with partner companies.	• Does not specify what the term "sustainability strategies" cover: does it mean actions, programs, or roadmap? How is a sustainability roadmap drawn? • Does not specify *how* the cause-effect relations are established. • Does not tackle *how* defined indicators will be integrated into the existing management system.
Bieker and Waxenberger [85]	1. Commitment of top management to sustainability. 2. Set goals, vision and mission. 3. Define guiding principles for the company. 4. Consider the public as a partner and a referee in the sustainability development process. 5. Empower employees, raise awareness about, and integrate in daily business, social, environmental and ethical concerns. 6. Includeethical metrics to account for key stakeholders. 7. Develop ethical indicators to measure the "ethical performance" of a firm. 7. Establish ethical auditing as a means of controlling and feedback.	• Addresses the aspect of ethics and integrity management from a philosophical perspective and a business perspective. • Discusses in relevant detail each step of the process.	• Presents the SBSC creation process as an *art* drawing basically from philosophical and social science backgrounds. This process is surely purposeful but nonetheless complex with no straightforward "ready-to-use" formula for usually very busy business executives. • Does not specify how the SBSC should be practically designed –whether there should be an additional perspective for ethics or society for example.

Sidiropoulos, Mouzakitis [86]	1. Start with the conventional BSC, and add a new perspective for ecology management. 2. Define indicators for the new perspective based on pre-existing environment management frameworks and systems.	• Highlights the ecological dimension in sustainability assessment.	• Assumes that green behavior should be planned and assessed at the operations/manufacturing strategy level. • Does not address the social aspect of sustainability. • Does not address ethics and governance.
Dias-Sardinha and Reijnders [87]	1. Design the traditional BSC. 2. Add governance, social and environmental indicator categories to the financial perspective (Triple bottom line perspective). 3. Add internal and external stakeholder indicator categories to the customer perspective (stakeholder perspective). Introduce ethical aspects. 4. Add social and environmental measurements to the remaining two categories.	• The triple bottom line perspective is more comprehensive than the single financial dimension. • Attending to the needs of stakeholders as a whole allows to cover the entire value chain requirements in terms of social and environmental considerations. • The conceptual model is supported with real market data from 13 Portuguese companies.	• Ethics management is addressed as part of the stakeholders perspective whereas this aspect is actually omnipresent across all organizational dimensions [85]. • Governance is addressed at the highest level of the BSC –considered as a result indicator–whereas it could be the cause of the success or failure of businesses–a cause indicator [88, 89].
Hubbard [35]	1. Start with the conventional BSC and add two quadrants for social and environmental performance to end up with six quadrants. 2. Define performance indicators for each quadrant. 3. Determine a rating on a scale (1 - 5) for each indicator. 4. Average indicators' ratings for each of the six components into a single rating. 5. Average the overall ratings into a single performance index (OPSI). 6. Follow the same steps with prior year data and compare.	• Simplicity of design, easy to replicate. • One single indicator to be tracked by managers.	• Does not specify which indicators to use in the composite index. How are they selected? Which ones are most important? • Does not clarify the aggregation methodology of the composite index. What are the weighs used? How are they calculated? • A single indicator is generally not reflective enough of how well the company is doing in each area of sustainability. A good performance in one area can compensate a bad performance in another area, which can mislead decision making.
Hansen, Sextl, and Reichwald (2009, 2010)	1. Determine the overall integration option of the social perspective. 2. Create the non-market perspective (community perspective). 3. Decide to keep community-related goals in the community perspective. 4. Define input, output and impact community metrics.	• The general structure of the BSC is determined before the metrics (indicators) are defined (general to detail orientation). • Authors distinguish between input, output and impact community-related metrics and include them to the BSC. • Allows to incorporate community involvement in corporate strategy.	• The relationships between metrics are not systematic and rather established based on subjective judgment. • The triple bottom line is not wholly achieved (the environmental component is missing).

Sundin, Granlund [90]	1. Define the strategy statement and the vision. 2. Translate the vision into broad goals. 3. Determine the criteria for the goals to be achieved. 4. Extract corresponding priorities. 5. Conclude the areas in which the priorities will be measured. 6. Turn the areas into BSC perspectives. 7. Define metrics for each perspective.	• The focus on balancing the needs of multiple stakeholders. • A top-down inclusive approach of deriving perspectives. • Perspectives and measures are structured into outcomes and enablers. • Non-market objectives are integrated within the strategic BSC's perspectives, which confers them strategic importance.	• Relationships between indicators and perspectives are based on "*experience and common sense*", which "*could not be statistically validated*" as mentioned by the authors. • The classification of perspectives into enablers and outcomes remains heavily subjective and based, once again, on managers' intuition.
Hsu, Hu [91]	1. Determine the SBSC's perspectives:replace the finance and customer perspectives with sustainability and stakeholders perspectives respectively as suggested by Dias-Sardinha and Reijnders [87]. 2. Define the SBSC measures using fuzzy Delphi method with a group of experts. 3. Determine relationships among perspectives and measures. 4. Apply ANP method to determine the ten most important measures of the SBSC.	• Combination of two decision making techniques to construct the SBSC (Fuzzy Delphi and ANP). • Systematic selection of the most important measures using a powerful decision making technique (ANP).	• The relationship among perspectives and measures are not defined based on a systematic analytic method but rather solely on subjective judgment of the experts involved in the experiment. • The proposed framework is applied to the semiconductor industry and is not generalized to other fields of research.
Wati and Koo [92]	1. Build upon the conventional BSC to introduce Green IT components and measurements. 2. Construct the Green IT BSC around the four perspectives: Finance, Stakeholders, Future orientation and Processes. 3. Define Green IT metric for each perspective. 4. Define cause-effect relationships among metrics.	• Focuses on the environmental perspective in Green IT management • Integrates Green IT measures within the four perspectives of the scorecard.	• Does not envisage the correlations between the social aspect and Green IT. • Does not discuss ethics in the proposed Green IT BSC.
Nikolaou and Tsalis [93]	1. Start with the conventional BSC 2. Define GRI-based indicators for each perspective. 3. Score indicators using a proposed scoring-benchmarking technique. 4. Calculate the total score per perspective. 5. Calculate the total SBSC score.	• Standardization of indicators using the GRI social and environmental framework. • Proposes a new, simple and concise scoring-benchmarking technique. • Analyzes sustainability performance across sectors using a case study application.	• The aggregation method is based on unweighted addition, which gives equal importance to accountability and performance in the score calculation. • Equal weights are given to perspectives across industries in calculating the total SBSC score. • The methodology can be conducted only on firms following the GRI reporting framework with consistently published sustainability reports.

Key Features of Existing SBSC Architectures

Structure

Hansen and Schaltegger [11] distinguish three types of architectures: *hierarchical, semi-hierarchical*, and *non-hierarchical (network)*.

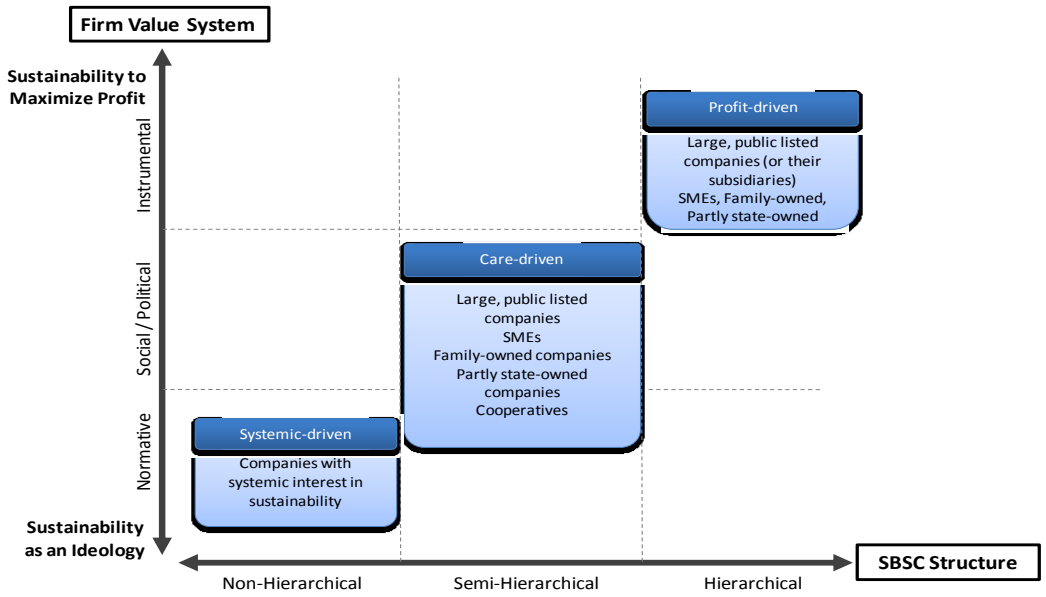
A *strictly hierarchical* structure features the conventional hierarchy of the BSC, that is a structure based on the ultimate profit-driven objective; the financial perspective. With more than 60% frequency, this type of architecture accounts for the majority of SBSC design structures mentioned in the literature.

In *semi-hierarchical* SBSC structures, two major modifications are made: the cause-effect chains, and the bottom line. In these architectures, the direct cause-effect links pointing upwards to the financial perspective are relaxed to make other objectives stand for their own and not necessarily as a cause for ultimate financial goals. The second modification concerns broadening the financial perspective to include other non-financial goals [87, 94, 95]. While both strictly hierarchical and semi-hierarchical architectures place social and environmental perspectives at the top level with the financial goal, in the former architecture, social and environmental objectives are expected to contribute directly or indirectly to financial objectives. However, this link is not mandatory in semi-hierarchical architectures where social and environmental goals can exist in their own right, ensuring thereby a more balanced governance of stakeholder group interests. Papers which propose semi-hierarchical structures represent 13% of the total number of relevant publications.

Non-hierarchical SBSC structures represent perspectives in a network configuration where all aspects of the scorecard are closely interconnected. No particular dimension is targeted as the ultimate objective to be maximized.

Value System

This categorization is augmented by the interesting link Van Marrewijk [96] establishes between the SBSC architecture and the firm's value system (0). It is found that companies which adopt a strictly hierarchical SBSC structure tend to have a more strongly profit-driven value system that is motivated by pragmatic profit maximization. This type of value system is qualified as *instrumental* [11]. In contrast, non-hierarchical SBSC architectures reflect predominantly a *normative –or ethical–*approach whereby "*the firm is seen as having responsibilities to a wider set of groups than simply shareholders*" [35]. This view differs from the conventional strategic stakeholders theory in that it does not consider including stakeholders for instrumental purposes. On the contrary, the normative perspective entails considerations for stakeholders for ideological, ethical and moral obligations [90]. Finally, it is found that semi-hierarchical SBSC structures are more related to the *social/political* approach as they allow to balance the conflicting interests of different stakeholders via the simultaneous pursuit of multiple objectives. In this approach, managers discard profit maximization for satisfactory balance creation. Accordingly, decisions "*ensure an outcome that is at least minimally satisfactory along all dimensions*" [90] (p. 208).



Relationship between firm value system and SBSC structure

Orientation

Nearly all studies adopt a detail-to-general orientation as opposed to a general-to-detail one. Specifically, in most papers found in the literature, authors start with analyzing BSC indicators and focusing on *how* these will be integrated into the existing scorecard. Then, they establish –in various ways and for those which do it– the cause-effect relationships among indicators, in order to deduct, subsequently, the firm's strategy map. Gminder and Bieker [84] and Bieker and Waxenberger [85] propose to define the sustainability strategy before delving into objectives and indicators, but they do not provide much detail on how the definition of such strategies should be undertaken.

Confinement

The greatest majority of the studies covered (more than 70%) build essentially on Kaplan and Norton's BSC framework and the causal relationship structure predefined in this framework. This leads to two direct consequences. First, when no social and environmental (S&E) dimension is explicitly added or merged with existing ones based on the original BSC framework (this is especially the case for strictly hierarchical and semi-hierarchical models), authors focus on methods of selecting S&E indicators and how those could be best incorporated into the system. Second, few authors address ethics and governance issues as part of the sustainability problem.

Consequently, most cited works found in the literature remain confined to Kaplan and Norton's traditional view of the BSC hierarchy, placing financial objectives at the top and all other objectives as direct or indirect contributors, and attempting to introduce –or slot in– sustainability, or some aspects of it, along with the causal relationships as initially assumed in the original BSC framework.

Conceptual Flaws

Based on the key features depicted earlier, we pinpoint the following conceptual flaws in the SBSC construction methodology.

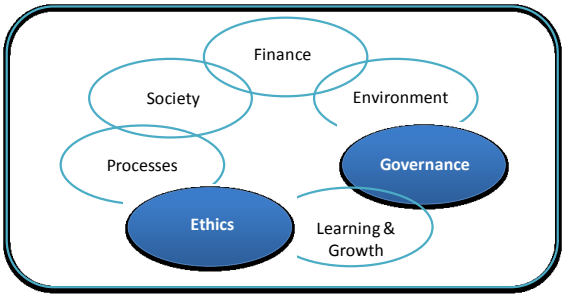
Perspectives

Few studies have incorporated Ethics and Governance into the SBSC as two distinct and equally important perspectives. Some explored only the ethics side such as Bieker [97] and Bieker and Waxenberger [85], while others looked exclusively into governance as in the work by Dias-Sardinha and Reijnders [87].

Yet, recent research highlights the importance of both governance and ethics for economic growth. Examples include historical evidence from the 1997-98 Asian financial crisis which highlights governance as a significant factor that explains not only the financial crisis, but also the differences in corporate performance across countries (Mitton [89]). Poor corporate governance and "weak enforcement of shareholder rights had first-order importance in determining the extent of exchange rate depreciation and stock market collapse in 1997-98" Johnson, Boone [88] p.3.

Furthermore, Some of the most scandalous business failures of the century were mainly driven by unethical behavior of top executives [98, 99]. Many researchers and business analysts pointed out ethics as one of the root causes of the 2008-2009 global recession [100-103]. Greed, self-interest and lack of empathy are often cited as common traits of the "corporate psychopaths" responsible for the crisis [102, 103].

Thus, when SBSCs do not systematically consider Ethics and Governance as two necessary sustainability perspectives –besides social and environmental ones– the resulting decision aid framework is flawed and may not guarantee the successful creation and implementation of sound sustainability strategies (0).



Ethics and Governance as distinct perspectives of the SBSC

Design Orientation

The SBSC related literature works mostly adopt a detail-to-general orientation whereby the sustainability strategy is based first on defining key objectives and metrics, then, on drawing the overall strategy map. This order of design seems in contradiction with the normative principle of strategy creation which stipulates rather a general-to-detail approach where the general roadmap is first designed, then objectives and metrics are determined [104].

This order is crucial and is remindful of the famous quote from legendary Chinese military strategist Sun Tzu: "*Strategy without tactics is the slowest route to victory. Tactics without strategy is the noise before defeat*." When trying to define operational objectives and specific metrics for sustainability management a step before outlining the overall sustainability strategy map, we are doing just that: tactics without strategy.

However, most of the literature on SBSC design overlooks this paramount principle in strategic management. While the detail oriented approach mostly found in papers allows to have a good understanding of the metrics involved in the scorecard and how they are integrated into it [87, 91, 93], it presents the major drawback of discarding the important step of defining the sustainability strategy map first and foremost.

Therefore, the detail-to-general orientation that is adopted in most SBSC design methods presents a clear discrepancy in this area of research, and can therefore seriously undermine the decision making process based on the SBSC framework.

Design Confinement

The confinement of existing architectures to the traditional BSC hierarchy, especially the instrumental and socio-political

ones, does not offer the greatest possible flexibility to capture the changing dynamics of business, society, and the environment in general.

In particular, we argue that SBSC's architecture ought to vary across industries and sectors. The nature of the firm's activity (primary sector vs. secondary or tertiary sectors) dictates each time a different priority order of sustainability objectives. As priorities vary across industries and sectors, so do the strategies and the SBSCs that support them.

This rigidity that results from existing architectures confinement to the traditional BSC hierarchical leads to a narrow appreciation of reality and a possible misconception of the real drivers of sustainable growth.

In order for the SBSC to be an effective decision support framework, it has to show greater structural flexibility and increased adaptability to organizational contexts.

Structural Relationships

We found that in all proposed SBSC architectures, the cause-effect relationships established between indicators are strongly based on local managers' intuition, best knowledge and judgment of the firm's context. This is particularly worrisome considering the danger posed by human mental models.

Mental models prevent us from simulating complex systems with an acceptable degree of accuracy, they can distort our processes of constructing the models supposed to help resolve these very complexities. Mental models could prevent us, for example, from realizing the very existence of some non-obvious relations among variables in a system [105]. Research has shown that it is often assumed that events have a single major cause, and as soon as this first sufficient cause is identified, people stop short of considering other potential causes [106]. In this context, the strategy map construction could be loaded by many human judgmental streams filled with errors and unexpected missed judgments (Nikolaou and Tsalis [93]).

Consequently, existing SBSC architectures fail to systematically present controlled processes for defining unbiased cause-effect relationships amongst both perspectives and indicators. This failure can dangerously mutilate the decision making process, and the strategies based upon it.

Time Dimension

While the dynamic BSC has been explored in a few studies over the past decade (section *II.2.3.a.*) as a vehement response to the static feature of the classical BSC, none of the works has proposed a methodological and unbiased approach for introducing time dimension, via system dynamics models, into the BSC or the Sustainability BSC. These works are based on personal mental models and subjective appreciation of organizational issues, leading easily to subjectivity bias, which is a particularly important flaw in existing system dynamics modeling.

Research has shown that our representation of the world depends on the way we look at, think about, and act upon systems, more particularly, system dynamics modeling depends on the modeler's points of view and understanding of the context subject to study [107] causing a subjectivity bias to occur. To overcome this subjectivity bias, Chaker, El Manouar [105] critically analyzed the design process of system dynamics as a strategic decision making approach, pinpointed a deficiency in the design process, and proposed an alternative methodical technique for an unbiased model employing a mathematical decision aid technique.

Inter-dimensions causality in traditional system dynamics modeling, which is the basis for existing dynamic BSCs, has been severely criticized by many authors [78, 79, 108, 109] who argue that the constructed models are mere representations of our 'mental models', not of the real world.

Therefore, a clear gap exists today in proposing a structured and unbiased methodology for constructing and using the dynamic BSC and SBSC as effective decision aid tools.

FUTURE RESEARCH AVENUES

The critical analysis conducted above gives insights on some interesting perspectives that could bring a net advancement to research in SBSC architecture design.

- Future research should explore how ethics and governance can be integrated systematically into the SBSC as major sustainability components and growth drivers.
- To ensure a healthy sustainability strategy creation process, future work should consider a general-to-detail approach in the SBSC construction process. Scholars should look into methodologies that address the strategy map creation first, then tackle corresponding indicators and metrics.
- If empirical research has demonstrated a variation in SBSC architectures based on firm value system (0), no research so far has explicitly studied the variation and correlation between SBSC architecture and firm industry/sector. Proposing a dynamic model that captures such a correlation will bring a net advancement in this area of research.
- Future work should also investigate overcoming inter-dimension causality bias in the SBSC framework by proposing novel methodologies for defining, and if possible, quantifying, the cause-effect relationships in the model.

- An important addition can be brought to the literature space by proposing a technique to overcome mental models bias in system dynamics modeling. A systematic method for constructing the models will make it possible to build a robust dynamic SBSC that is more representative of reality than of managers' mental models.

CONCLUSION

The literature on decision aid frameworks for CSR and sustainability management is rich and diverse. An overview of existing studies allows identifying two main subsets: operational decision aid methods; and systemic decision aid approaches.

However, despite the importance of adopting a systemic lens in addressing sustainability related issues, few studies focus on this field of research. Thus, understanding the strengths and limits of existing system thinking frameworks helps us to pinpoint potential deficiencies and to pave the way, consequently, for future research directions. In this paper, we opt to analyze the construction methodologies and design architectures of the Sustainability Balanced Scorecard (SBSC) as one of the most widely used systemic thinking frameworks in sustainability management.

A rigorous analysis of the literature allows depicting four key features that help to describe existing works: architecture structure, connection to the value system, design orientation, and design confinement. Five major conceptual flaws are also found: scorecard's perspectives; detail-to-general orientation; confinement to the traditional balanced scorecard; intuitionist causal relationships; and mental models bias in dynamic balanced scorecards (time dimension).

As a result, future research should investigate systematic methods for constructing a SBSC that is more holistic (with ethics and governance as two additional and distinct perspectives of the scorecard), more adaptive (with structures varying across industries and organizational contexts) and strategic (with the general strategy map first and specific metrics second).

In addition, future research endeavors should look into overcoming the fundamental limitations posed by mental models design in system dynamics modeling. Future works should explore methods that permit to translate the static SBSC into a dynamic one following a systematic and least possibly subjective process.

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