Sustainable Performance Measurement for Humanitarian Supply Chain Operations

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ABSTRACT

This paper proposes a performance measurement definition to consider sustainable development principles in the humanitarian supply chain operations (source, make, deliver). Previous research has shown the challenge for humanitarian organizations to consider the three sustainability pillars people, planet and profit in their decision-making processes. Based on field research with the International Federation of the Red Cross and Red Crescent (IFRC) and a literature review on humanitarian performance measurement and sustainability, we define a set of criteria, objectives and Key Performance Indicators that translates sustainability concepts to concrete humanitarian operations. Based on the Triple Bottom Line approach, the environmental and social dimensions are added to the economic dimension, which is standard in HSC literature and practice. The aim of this study is to set the basis for a Decision Support System (DSS) in operations planning.

Keywords

Humanitarian Supply Chain, Key Performance Indicators, Triple Bottom Line, sustainability

INTRODUCTION

The main objective of Humanitarian Supply Chains (HSC) is to ensure the distribution of relief items to beneficiaries when a humanitarian disaster occurs. As resources are scarce and budgets limited, performance measurement has become critical to achieve the aims of humanitarian operations (saving lives and reducing human suffering), and to secure donor funding (accountability) or economic viability. Typically, the HSC refers to criteria such effectiveness or efficiency to measure the success of their operations. This approach permits the HSC to maintain their position (order qualifier) in the humanitarian response "marketplace".

Beyond these economic considerations, the growing urgency of switching to sustainable development is gaining ground in public opinion. Major events like the Millennium Development Goals (MDGs), the 2030 Agenda for Sustainable Development (ASD), or the 2016 World Humanitarian Submit (WHS), promoted by the United Nations confirms this global trend. MDGs were the eight international development goals for 2015 established following the Millennium Submit, with an emphasis on social and environmental sustainability. The WHS committed to engage with local communities to enhance resilience. And the ASD emphasized the need to reduce disparity (eradicate poverty) as a major requirement for sustainable development. Thus, sustainability is a relevant topic that affects all organization functions, in all the sectors including public administration, corporate sector and non-profit.

Sustainability concept, and the links that sustainability has with supply chain operations, strongly suggest that sustainability is a requirement to do business in the twenty first century (Carter & Liane Easton, 2011). Also in Humanitarian Organizations, the concern for the long-term impact of operations is growing. Indeed, to maintain a competitive position (order winner), considering sustainability becomes fundamental.

> "We happily endorse the 2030 Agenda, and our network stands ready to partner with governments, UN agencies, civil society, the corporate sector and communities themselves to turn this ambition into a reality."
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> IFRC SECRETARY GENERAL, ELHADJ AS SY
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> New York, 25 September 2015

Several papers call for research on the sustainability of humanitarian response (Ira Haavisto & Gyöngyi Kovács, 2014; Kunz & Gold, 2015). However, practitioners do not have the tools to evaluate the impact of HSC operations. Kovacs highlighted the need to find a link between the short-term aims on operational performance and the long-term impact. Moreover, literature states that equity (Balcik, Beamon, Krejci, Muramatsu, & Ramirez, 2010) and sustainability (Ira Haavisto & Gyöngyi Kovács, 2014) are overlooked, although they are essential for aligning operational with longer-term objectives of humanitarian aid.

Consequently, the research question is: how to define and measure sustainability performance at the HSC operations?

This study aims at defining a set of performance criteria to asses the sustainability of HSC operations, the related objectives and Key Performance Indicators (KPIs) to quantify the impact based on the widely accepted triple bottom line (TBL): profit, people, planet. By performance criteria we mean the principle, by witch an activity will be measured. The objectives are the relation between the performance criteria and the aim of the organization. And the KPIs are the performance measurement related to each criterion (and objective). In other words, we address the problem of translating sustainable development principles into HSC decision-making.

This research contributes to the HSC and sustainability literature by merging both disciplines in a concrete and practical case. The proposal can be used as a reference by both practitioners and academics for HSC decision-making and for further research, respectively.

Approach & Research methodology

Once the research question was formulated, we started from a literature review on sustainable supply chain to obtain an overview of best practices and state of the art of sustainable performance. We reviewed also the existing literature on HSC and used previous field research observations to identify the performance criteria that humanitarian organizations consider (or would like to consider), aligned with their objectives as well as related KPIs. Field research was conducted on September 2015 at the Americas and Caribbean (A&C) IFRC Regional Logistic Unit (Panamá RLU). Then, we organize the findings per TBL dimensions to have a mapping of potential performance criteria, objectives and KPIs for sustainable HSC.

The Sustainable Supply Chain performance state of the art aimed at finding an accepted sustainable performance definition. As long as sustainability is a trending topic, the literature review was a qualitative selection of papers based on citation rate and non-exhaustive content analysis. Many authors use sustainability referring to Green Supply Chain, so we focused on papers with a wider definition of the term. Regarding HSC state of the art, even if it is not a new idea, we found few publications that refer to the concrete sustainable performance definition and measurement, like the dedicated book "Humanitarian Logistics and Sustainability" (Klumpp et al., 2015). We also considered humanitarian organizations reports and road maps to identify "best practices".

The HSC sustainability performance strategy was not the objective when the field research was conducted in 2015. The initial goal of the study was to support the IFRC HSC to become more cost-effective by developing innovative HSC approaches. With the aim of developing field-grounded research propositions, we based the research on empirical evidence (Eisenhardt, 1989). This consisted in studying the IFRC American and Caribbean (A&C) Regional Logistic Unit (RLU) case to identify weaknesses of the current activity model in terms of business processes, decision-making and information systems.

In practice, after conducting preliminary interviews with the Regional Logistics Development Coordinator (RLDC) of the IFRC A&C RLU, we designed guidelines, observations and mapping supports for semi-structured interviews and focus groups, inspired by previous field-research by the Disaster Resilience Lab (Comes et al. 2015). The fieldwork was conducted during a 10 days mission on October 2015 at the IFRC A&C RLU Panama site (office and warehouse). We interviewed all members of the RLU structure: Head, Service Officer, Procurement Officers, Logistic Officers and Warehouse Manager and Officers as well as the Panama Disaster Response Unit (PADRU) Coordinator.

The interviews and observations permitted to identify the current business processes and activities cartography, upcoming evolutions, and practitioner's needs, discussed on previous publications (Laguna Salvadó et al.,

2016), which confronted to the literature review permits to build a Sustainable Performance Measurement for HSC operations.

This contribution is structured as following: First, a background section introduces the concepts of sustainability, sustainable CSC and sustainable HSC. Second, the proposal sustainable HSC criteria, objectives and KPIs are presented. We conclude with the "house of HSC sustainable operations" and further works are discussed, with the introduction to a potential use on a practical case.

BACKGROUND

The topic we address derives from the universal challenge of sustainable development. It is a wide challenge that has already tackled in other fields. In this section we review concepts that relate sustainable development to HSC performance by going through the ideas relevant to Sustainable Supply Chains.

Sustainability

Sustainable development (or sustainability) modern definition was drawn during Brundtland Comission on 1983: "*development that meets the needs of the present without compromising the ability of the future generations to meet their own needs*" (Brundtland, 1983). It is a highly debated concept, and depending on people and organizations perspective, sustainability is addressed or understood really differently. Brundtland's definition is quite philosphal, and it's difficult to asses how to fit HSC performance on it. Pojasek's (2012) proposed an operationalised definition, which considers sustainability as "*the capability of an organisation to transparently manage its responsibilities for environmental stewardship, social wellbeing, and economic prosperity over the long term while being held accountable to its stakeholders*" (Pojasek, 2012). This concept is usually addressed as Corporate Social Responsibility for business organizations.

In literature, however, it is widely accepted to present sustainability as the balance between the dimensions environment, society and economy. This dimensions are connected entities that follow the TBL model (e.g. Carter and Rogers, 2008). The TBL is a systemic approach developed on the mid 90's by John Elkington to"*captures the essence of sustainability by measuring the impact of an organization's activities including its profitability and shareholder values and its social, human and environmental capital" (Savitz, 2012)*. It stresses the need to achieve a minimum performance for the three dimensions. However, no consensus regarding the tradeoffs and synergies across the economic, environmental and social objectives has been state. Moreover, there is not a standard definition of each dimension. Here, we define the TBL dimensions as:

- Economy or "Profit": relates to cost and productivity considerations. An organization has to use its resources so that it can consistently produce an operational profit, and sustain its activities. In HSC specifics, the operational profit corresponds to alleviating suffering of affected populations by responding to their humanitarian needs.
- Social, or "People": relates to proper and favorable business impact for employees, population, and the area in which the organization conducts its activities.
- Environment or "Planet": relates to environmental impact. It attempts to benefit the natural setting as much as possible or at least do no damage and decrease the environmental effect.

The macro-economical definition of sustainability, and the three categorical dimensions can explain the sustainable development on a conceptual level, but do not provide much guidance on how sustainability shall be addressed on the context of Supply Chain operations.

Sustainable Supply Chain

Sustainable supply chain management (SSCM), is defined by Seuring and Müller (2008) as "the management of materials, information and capital flows as well as cooperation among companies along the supply chain while integrating goals from all three dimensions of sustainable development, i.e. economic, environmental and social, which are derived from customer and stakeholder requirement".

While analyzing supply chain sustainability disclosure, Okongwou identified TBL performance as one of the main drivers (Okongwu, Morimoto, & Lauras, 2013). For the economic dimension the elements identified by them were the financial value generated and distributed to the stakeholders and the proportion of spendings on supplier development ; Regarding the environment dimension, they identified the recycling materials ratio or the amount of energy saved due to efficieny improvement. And for the social dimension they identified the rates of injury, occupational diseas, and the incidents of forced and child labour, the rate of trined people and the rate of incidents related to product safety.

Performance measurement has been wide developed on recent years. However, Gopal and Thakkar (Gopal & Thakkar, 2012) argue that in the specifics of supply chain performance measurement, there is a large scope for research to address various issues such as characteristics of measures and metrics, benchmarking of measures and use of management practices. Nonetheless, sustainability performance measures are abundantly found in literature. Some of the key measures, even if defined using different words, are related to emissions, energy use, hazardous wastes and recycling for the environmental dimension; health, safety, training and child labour for the social dimension; economic value generation and distribution for the economic dimension. Looking at these performance measures, Okongwou observed that the responsibilities of a firm go beyond the wellbeing of its shareholders to include the environmental, economic and social wellbeing of its employees, suppliers, customers, local communities and the society in general (present and future generations). We can also find theoretical development contributions, like the framework developed by Beske (Beske, 2012), which integrates dynamic management theories into SSCM practices.

Sustainable Humanitarian Supply Chain

Humanitarian organizations purpose is to alleviate human suffering. For a long time, it has been understood that getting the right resources to the right place and at the right time is crucial for a successful relief response. Thus, humanitarian organizations have concentrated their efforts on HSC performance improvements. Looking at HSC operations, we identify many opportunities to improve the balance between effectiveness and efficiency to boost the economical dimension (Laguna Salvadó, Lauras, Comes, & Van de Walle, 2015). An example of these challenges is the contingency stock management of humanitarian organizations, which shows a significant misalignment with actual needs, producing excessive stock coverage and important bullwhip effects all along the supply chain.

The origin of those misalignments is the difficulty to align the HSC with disasters characteristics: ramp up time (slow / sudden onsets), cause (natural, human made, complex) or affected area (national/ transnational). In addition, the different disaster management phases (preparedness, response, recovery, mitigation) ask for different objectives and are partially overlapping. The decisions taken on one phase can conditions the success of next phases. E.g. it happens that the response phase compromises the ability of the system during the recovery phase (Kunz & Gold, 2015).

HSC from big humanitarian actors, like IFRC, UNHRD or NGOs must handle with an operating environment with requirements (scaling up and down, time and place uncertainties…). Previous research highlighted that HSC like the one of IFRC are facing structural evolutions, driven by the strategic objective to improve local response capacity, responsiveness, or cost-efficiency (Laguna Salvadó et al., 2016). The challenge is to align these evolutions with the sustainable development approach.

Today, an HSC can be described with two differentiated parts: the upstream HSC, that includes the private suppliers, the permanent network of Logistic Units, and the distribution flows till the field entry hubs; and the downstream HSC, that includes the field entry hubs to the final beneficiaries. We focus on this study on the upstream part.

The strategic trends of international HSC is to develop country-level contingency stocks (Laguna Salvadó et al., 2016). This evolution contributes to the long-term sustainability of HSC by empowering the local community (local capacity). However, this strategy presents some challenges like the increase of the costs: immobilized inventory or multiplication of warehouses. Thus, the interest to consider the holistic TBL approach.

The challenge to enhance sustainable HSC has been addressed on the literature, but most of the works addresses only one or two of the dimensions, and usually from a strategically point of view, or with focus on reporting and accountability (Carter & Rogers, 2008). Kunz and Gold (2015) have developed a framework of sustainable HSC where performance is conceptualized as flowing from a strategic reconciliation between relief organization's enablers (resources, capabilities and commitment) and beneficiaries' requirements, via an optimal supply chain design. In this paper, we therefore conceptualize HSC from an operational point of view. Based on SCOR reference model, the four main processes of the Supply Chain are: Plan, Source, Make, Deliver, Return and Enable. According to this model, Plan includes the processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements. However, Return and Enable processes are not yet considered in the HSC, so we do not address them on this works. Based on the business processes identified during the field research, the operational processes of the upstream HSC are then:

- Source (buyer-supplier relationship) that includes the processes that procure goods and services to meet planned or actual demand. Decision-making may be limited (or based) by framework agreements with suppliers that aim at reducing costs and ensuring the items disposal.
- Make (transformation processes) that is comprised of the processes that transform product to a finished

state to meet planned or actual demand. On the concrete case of HSC, make processes can relate to: (i) kitting activities (relief items consolidation). It is an operation that can reduce costs or improve performance (Vaillancourt, 2015), a,d (ii) the contingency stock management, which existence has became standard on humanitarian logistics to ensure first response capacity.

- Delivery (outbound logistics) that includes all processes, which provide finished goods and services to meet planned or actual demand.

Decision-making on supplier's selection, transport modes, routing, packaging, etc. puts Supply Chain managers on a privileged position to impact the environmental and social performance dimensions on positive or negative, as Carter and Easton emphasized (2011).

PROPOSAL

There is no universal definition of the three TBL categories; neither is there an accepted standard to measure it. Even if this lack of standardization can be seen as a weakness, it provides the possibility to adapt this general framework to any organization. The TBL approach comes from the for-profit sector, however, authors such as Remida or Kunz and Gold (Klumpp et al., 2015; Kunz & Gold, 2015) already made the assumption that it is a substantial part of the sustainable humanitarian system. In this adaptation process, the set of KPIs have to be identified by stakeholders, experts, and selected also according to the ability to collect the necessary data (Hall, 2011).

However, there is significant literature on the CSC and HSC that deals with one or several of the TBL dimensions. Based on literature, and field observations and practitioner's discussions, a set of criteria, objectives and KPIs is presented below.

Economic dimension

Traditional CSC performance is directed towards financial and operational indicators (Kunz & Gold, 2015). In HSC, the added value of operations is defined by accomplishing general humanitarian ambitions like "saving lives". To do so, the main criteria to evaluate HSC performance are generally effectiveness, efficiency, and equity (Gralla, Goentzel, & Fine, 2014).

Effectiveness is the capability of achieving the organization's target. On a "value driven" organization, the target will be to satisfy the customers needs. In HSC, donors ask for specific aims and target levels such as numbers of households that are provided with humanitarian relief items, shelter, or education. In HSC literature, the effectiveness objective usually corresponds to the demand satisfied. To measure it, different KPI are proposed like population coverage, order fulfilment, stock-out minimization, etc. By looking at the specifics of the three HSC processes, we define the effectiveness KPI of "source" as the effective replenishment, for "make", the strategic contingency stock level maintenance and for "deliver", the needs coverage (real demand) on time.

Equity considerations are still an exception in the humanitarian setting. We considered it as a complement of effectiveness if it is part of the value attended by stakeholders (donors and beneficiaries respectively): respect humanitarian principles. It also can be considered in the social dimension, as it has a direct link with societal wellbeing. In fact, equity it has been define as the intersection between people and profits (Carter & Liane Easton, 2011). Tzur measured the equity of HSC using the Gini Index (Tzur, 2016), a non-linear measurement of inequality. Others have used the deprivation cost approach (Holguín-Veras, Pérez, Jaller, Van Wassenhove, & Aros-Vera, 2013) or amount of suffering of the victims, or the disparity in demand satisfaction. Non-discriminatory distribution is an objective for the "making" and "distribution" processes (contingency stock maintenance, needs coverage). For the sourcing process, Field-observations at the IFRC shows that the objective is the respect of commercial fair competition.

Efficiency can be defined as the ability to avoid wasting resources to attain a target. In HSC, this dimension corresponds to the minimization of operations costs. Although making profit is not their objective, also non-profit organizations care about financial well being, since financial stability is crucial to their missions and survival. Cost KPIs have already been used as an objective function in many humanitarian distribution models (Benita M. Beamon & Burcu Balcik, 2008). Regarding the upstream HSC, Beamon and Balcik identified three dominating costs: the cost of supplies, distribution costs, and inventory holding costs. Other costs that can be considered are the kitting or consolidation costs (cost of building emergency item kits).

Thus, we propose the performance criteria, objective and KPIS as presented in Table 1 to define and quantify the economic TBL performance dimension of the HSC operations.

Table 1 Economy criteria, objectives and KPIs

Criteria	HSC Objective	Source	Make	Deliver	KPIs
Effectiveness	To satisfy demand on time			x	Needs coverage on time
			x		Contingency stock level
		x			Replenishment on time
Equity	Non-discriminatory distribution		x	x	Gini Index, deprivation cost
		x			
	Fair competition				Sourcing process quality
Efficiency	Cost reduction	x			Acquisition cost
			x		Holding cost
			x		Kitting cost
				x	Distribution cost

Environmental dimension

The environmental impact of increasingly globalized Supply Chains has been widely investigated since the 1990's . It has received huge attention and is the most developed concept of the TBL. "Green business", or the corporate's commitment to environmental protection has been demonstrated that leads to competitive advantages (Esty & Winston, 2009), as it seen as an opportunity for growth and profit. Thus, corporations have an incentive to publish more and more environmental policy statements, without any mechanism to control. This behaviour has generated some scepticism, and the creation of the "green-washing" term. One approach to face this skepticism in the light of many ineffective policies is the adoption of international standards like ISO 14001, which is implemented by many supply chain companies.

The CSC literature contends that logistic operations can influence particularly pollution (i.e. air, noise), and the conservation of resources (i.e. energy, water, etc.) (Murphy & Poist, 2003). Thus, we make the hypothesis that performance on those two areas constitute the environmental dimension on the specifics of HSC.

The objectives of measuring environmental pollution are mostly to reduce green house gas (GHG) emissions, and to manage hazardous materials resources. Hazardous materials are rare in HSC, but they may be present as part of the wastes (e.g., medical disposals, which was an important consideration in the Ebola response). However, we consider that its management is part of the downstream HSC, out of the perimeter of this study. Regarding GHG, the most widely used KPI is CO2 direct and indirect emissions, or the carbon footprint, coming from life cycle assessment approaches (LCA) (Baumann, 2011). Carbon emissions can be differentiated between two categories: stationary source (emissions from material processing, manufacturing, and warehousing) and non-stationary source (emissions from inbound and out-bound logistics) (Sundarakani, de Souza, Goh, Wagner, & Manikandan, 2010). On the green SCOR reference model best practices and performance metrics are suggested by each of the SCOR processes regarding pollution reduction and resource conservation. However, there is not an agreed framework for measuring i.e the environmental footprint of the supply chain.

The resource conservation objective is to reduce wastes like energy, water, packaging, etc. Resources are consumed all along the Supply Chain processes. Inventory immobilization (contingency stock) generates significant energy consumption especially in warm countries (air conditioning). Choices on the packaging or transportation mode may influence the quantity of packaging consumption.

We summarize the criteria on the environmental dimension in Table 2.

Table 2 Ecology criteria, objectives and KPIs

Criteria	Objective	Source	Make	Deliver	KPI
Pollution	Reduce GHG emission	x	x	x	Carbon Footprint
Ressource conservation	Reduce waste (energy, water, packaging…)	x	x	x	Resources consumption

Social

The Social dimension is the least developed in the TBL framework; it has been typically neglected in quantitative models (Brandenburg et al. 2014). In holistic social definitions, there are many criteria that can be found: education, equity and access to social resources, health and well-being, quality of life, and social capital.

We differentiate between internal and external factors. In HSC operations, internal factors are related to labour conditions and external factors with community empowerment. Both criteria builds the social sustainability performance as Table 3 shows.

Labour conditions are related with the 2030 ASD, which aims at enhancing prosperity by reducing poverty and economic disparity (wages), gender equality or decent work. The labour conditions objective for the HSC seeks to preserve health and security of employees, and ensure good conditions of work (Baumann, 2011).

One pillar of a humanitarian's organization strategy (HWS 2015) is to empower local communities with the aim of improving disaster resilience (amongst others) (Comes, 2016). Community empowerment can be seen as an external influence including contribution to employment and the creation of wealth. Many authors refer also to positive impact of local sourcing as an action of community empowerment (Kovács & Spens, 2011; Kunz & Gold, 2015) with a positive impact on regional economic development. Therefore, the current trend is favouring local sourcing wherever possible (Ira Haavisto & Gyöngyi Kovács, 2014).

Table 3 Social criteria, objectives and KPIs

Criteria	Objective	Source	Make	Deliver	KPI
Local communities empowerment	Local suppliers (and market) development	x	x	x	Local suppliers selection rate
	Create job and wealth	x	x	x	Local employment
Labor conditions	Ensure good conditions of work and preserve health and security of employees	x	x	x	HSE quality assessment

DISCUSSION & FURTHER RESEARCH

This study aims to translate sustainability concepts into a measurable HSC performance definition. The proposal set up concrete criteria, objectives and KPI set for analyzing the operations impact on the TBL approach. Figure 1 illustrates the proposed approach with the "House of HSC Sustainable Operations".

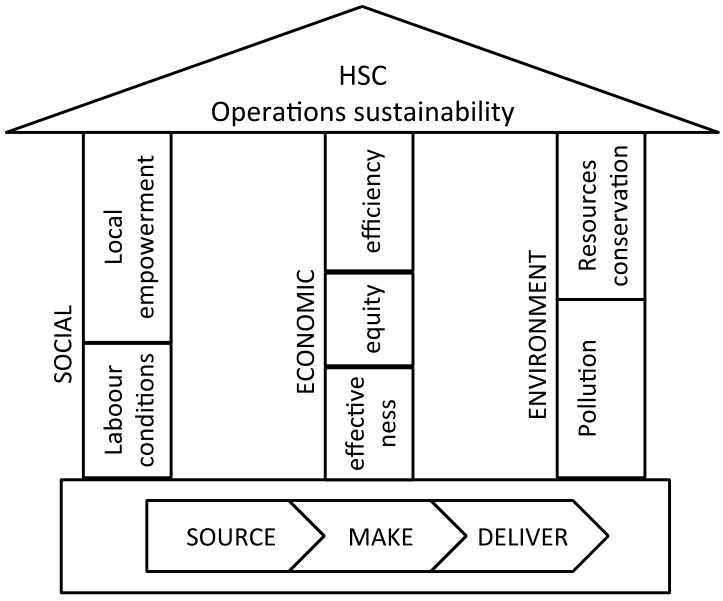

Figure 1. The House of HSC Sustainable Operations

The House of Sustainable Operations is based on the HSC operational processes: Source, Make, Deliver. Each pillar is built on the related sustainable performance criteria. To enhance an overall sustainable performance, the three pillars have to be balanced, so the roof is in equilibrium. This image reflects the importance of considering all the TBL performance objectives to enhance an overall sustainable performance. Carter and Rogers (2008) emphasize that organizations which pursuit to maximize performance of all the three pillars simultaneously will outperform organizations that only maximize the economic performance, or the ones that attempt to achieve high levels of social and environmental performance without explicit considerations of economic performance. Thus, enhancing sustainable performance may become an "order winner" even in the humanitarian sector.

One limitation of this proposal is the lack of consideration of sustainability as a holistic approach as suggested by many authors (Brandenburg et al. 2014; Carter and Rogers 2008; Okongwu, Morimoto, and Lauras 2013). The focus has been on the operations of the HSC, even if indirectly the strategy has been considered. Nonetheless, we have not considered the impact of other organizational process, for example, the design of the HSC, which has an impact on the TBL performance achievement. While in the past, a fragmented and siloed approach was typical, where Decision-Makers did not recognize the interrelationships between strategic of the overall organizational issues and operations. Thus, next steps will include working explicitly towards an integration of this proposal with the strategic processes of the HSC.

Planning HSC upstream operations

The main ambition of our proposal is to establish a basis to quantify the sustainability of HSC operations. One of the next steps is to implement this performance framework in a concrete case.

Even though HSC must deal with an increasing number of crises, the humanitarian setting is characterized by a lack of planning (Ira Haavisto, Gyöngyi Kovács, 2014). Moreover, sustainability assessments are typically used for reporting (ex posteriori), and not for planning or operational decision-making (a priori). Previous research highlights the potential of using DSS to improve decision-making capacity, especially on the future evolutions of the HSC, where the warehouse locations tend to increase (Laguna Salvadó et al., 2016). The development of Decision Support Systems (DSS) to coordinate the operations between the network members may facilitate efficient and effective flows of both physical and information, to quickly adapt to demand changes, and to introduce the TBL approach on the Decision making process.

The sustainable HSC performance suggested on this study is intended to be the base to develop DSS that permit to optimize the planning of the HSC operations regarding the TBL impacts. Today there are few (or no) performance measurement considered during tactical HSC decision-making. Therefore, we aim at developing a DSS that contributes to bridging the gap between academics and practitioners by considering field-grounded practitioners needs.

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