

# Integrating Social Sustainability in Value Stream Mapping: Panelized Post-Disaster Temporary Housing Case Study

M. Mora<sup>a</sup>, B. Akinci<sup>b</sup>, and L.F. Alarcón<sup>c</sup>

<sup>a</sup>Fundación Vivienda, Chile / Civil and Environmental Engineering, Carnegie Mellon University, USA

<sup>b</sup>Civil and Environmental Engineering, Carnegie Mellon University, USA

<sup>c</sup>Department of Engineering and Construction Management, Pontificia Universidad Católica de Chile, Chile

E-mail: [mimora@ing.uchile.cl](mailto:mimora@ing.uchile.cl), [bakinci@cmu.edu](mailto:bakinci@cmu.edu), [lalarcon@ing.puc.cl](mailto:lalarcon@ing.puc.cl)

**Abstract –**

The Triple Bottom Line (TBL) framework defined by Elkington in 1998 [1] proposed three aspects of sustainability: economical, environmental and social. However, several researchers have observed that further studies are needed to guide people and companies on how to achieve sustainable development. Specifically, many gaps are found in trying to implement social sustainability in processes within companies. This study aims to contribute to the integration of social sustainability in processes, with a specific focus on companies that fabricate and deliver post-disaster temporary housing. Our study is based on Value Stream Mapping (VSM) methodology, which previous research studies have identified as one of the main lean methodologies to analyze and identify waste in processes. Existing approaches based on VSM only attempted to integrate social sustainability of internal stakeholders into it. The research described in this paper aims to extend previous studies by integrating social sustainability of external stakeholders in companies' processes using VSM methodology. The analyzed system is the fabrication and delivery of panelized post-disaster temporary housing solutions where the post-disaster context is used to identify processes as well as internal and external stakeholders. Subsequently stakeholders' expectations and indexes that relate them with the outcomes of companies' processes are defined using existing research studies on social impact and on disaster management. Then, a model is proposed to integrate social sustainability of external stakeholders on VSM methodology. Finally, the proposed model is tested within an existing NGO that fabricates and delivers panelized post-disaster temporary housing in Chile.

**Keywords –**

Social sustainability; Value stream mapping; Lean and Sustainability; Post-disaster temporary housing; Panelized housing

## 1 Introduction

In 1987, the World Commission on Environment and Development (WCED) established by United Nations, proposed the most accepted definition of sustainable development: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own" [2]. However, as several researchers have stated, further studies are needed to guide people and companies on how to achieve sustainable development [3-10]. Then, in order to propose guidance on achieving sustainable development, Elkington in 1998 [1] proposed the Triple Bottom Line (TBL) framework defining three trends on sustainability: economic, environmental and social. Where economic sustainability aims for long-term business profits (including costs of products, services, programs, etc.); environmental sustainability aims for the preservation of natural ecosystems [1] and social sustainability aims for supporting and fostering long-term human and society's well-being [1].

The research described in this paper aims to contribute to the integration of social sustainability in processes of fabrication and delivery of panelized post-disaster temporary housing. Therefore, only the social sustainability aspect of TBL will be analysed within the disaster management context.

Most of the existing studies on social sustainability focus on supporting strategic decisions within companies, and limited research studies have focused on guiding processes' managers in process design towards social sustainability. Also, limited studies considered social sustainability within disaster management context, specifically for activities, such as fabrication and delivery of post-disaster temporary housing. The main objective of the research described in this paper is to contribute to the evaluation of existing fabrication and delivery processes of panelized post-disaster housing from social sustainability perspective. To achieve that objective, the research team focused on integrating social sustainability

into the Value Stream Mapping tool (VSM), which a well-known methodology to analyse processes is.



Figure 1. TBL diagram based on Elkington, 1998

## 2 Research Methodology

As it was stated before, the research presented in this paper aims to integrate social sustainability in the processes of fabrication and delivery of panelized post-disaster temporary housing using Value Stream Mapping methodology. This research builds on and extends prior studies on social impact, value stream mapping and post-disaster activities. In order to propose a plausible model for the integration of social sustainability, the post-disaster temporary housing context is used to define the system, participant stakeholders, as well as relevant indexes towards social sustainability. Finally, the proposed model was tested in a real scenario, the 2017 fire that affected Chile where 305 post-disaster temporary houses were built by the NGO Fundación Vivienda [11]. The results of the proposed model in the case study are shown and analysed in this paper.

## 3 State of the Art

Previous researchers have identified several interest topics in social sustainability. These topics are based on Elkington's social sustainability definition and aim to simplify and focus social sustainability analysis (see Colantonio 2009 research [4] for further social sustainability topics analysis). This research focuses only on Well-being of people and Basic needs (such as housing and food) topics. Therefore, the following sections summarize the state of the art of research studies that are relevant for these topics and this research.

### 3.1 Social Sustainability and Social Impact

Social sustainability has been studied in several fields, however, most of the developed methodologies have focused on the social impact of projects, programs and policies, hence they have not aimed to measure social

sustainability contribution of processes [12-14]. Most of these methodologies aim for development agencies and NGOs, such as the Social Life Cycle Assessment methodology (S-LCA), defined in the "Guidelines for Social Life Cycle Assessment of Products" published by the United Nations Environment Programme (UNEP) in 2009 [15-16]. This is one of the most accepted social impact methodologies, it is based on the structure of the Environmental Life Cycle Assessment methodology defined on the ISO 14044 and aims to provide a roadmap for social impact assessment of products.

Several previous studies have summarized and compared social impact methodologies and/or performed case studies. For example, Costa & Pesci (2016) [17] reviewed 12 different social impact models used by academics and practitioners. They focused on identifying stakeholders and defining metrics, and concluded that metrics have to be based on the relationship between stakeholders and the analyzed organization. Moreover, the research team stated that stakeholders' point of views have to be considered to define social impact metrics. In another study Dubois-Iorgulescu (2018) [18] performed 33 case studies to understand how a system's boundaries were defined in different situations. They found that most of the case studies assessed social impact at top management level and only few of them (three) assessed social impact at process level. Dubois-Iorgulescu (2018) [18] study also focused on identifying a cut-off criteria to dismiss unconnected elements in product chains. They detected that almost half of the analyzed case studies did not present clear definitions to include or exclude elements in particular systems.

Few studies have developed approaches to integrate social impact on processes. For example, Baumann et al. (2013) [19] examined the production of airbag systems and concluded that is better to adapt Environmental Life Cycle Assessment methodology (E-LCA) instead of S-LCA methodology to measure social impact of processes. The research team argued that social indexes and categories defined in S-LCA are unclear along the life-cycle, therefore they cannot be used in different life cycle stages [19]. In another study, Feschet et al. (2013) [20] studied how changes in the banana industry of Cameroon affected GDP and life expectancy using the Preston curve, which defines a relationship between GDP and life expectancy. This study concluded that multi-criteria analysis with several impact categories and stakeholders is needed to draw more accurate and stronger social impact conclusions [20]. In another study, Jorgensen et al. (2010) [21] attempted to analyze the social impact of particular choices among processes. In order to do it, the study defined two different scenarios: a baseline scenario, and a test scenario with changes incorporating some implemented management decisions. Although this study is an starting point, the research team only focused on the

social impact on the workers of the company and did not include external stakeholders in the analysis [21].

### 3.2 Social Sustainability in Value Stream Mapping

Several previous studies have identified synergies between lean and sustainable practices [15, 22-30]. However, most of the approaches have focused on the environmental part of sustainability and only few have focused on the social part. Moreover, as stated in the study done by Martínez-Jurado & Moyano-Fuentes (2014) [30], within which they reviewed 58 articles from 1990 to 2013 approaches targeting their lean and social sustainability integration have been developed only during the last few years [29-30].

Since VSM has been identified as one of the main lean methodologies to analyze processes [15][30], most of the previous approaches that integrate lean and social sustainability are based on VSM methodology. For example, the study done by Helleno, de Moraes, & Simon (2017) [31] aimed to integrate VSM with social and environmental sustainability in manufacturing processes in Brazil. They identified social and environmental indexes through a comprehensive literature review and tested them in three factories: a cosmetic products mill, a thermoplastic products mill and an aluminium appliances mill. Although the study integrated social sustainability in manufacturing processes using VSM, the impact on the community was only assessed using the domestic rate of production against the total products available in the market. Therefore, no other stakeholder expectations were included to assess social sustainability of the processes.

Another example is found in Faulkner & Badurdeen (2014) [28] study, within which the research team developed the sustainable value stream mapping methodology (Sus-VSM) to integrate social sustainability in VSM. They started reviewing methods that aimed to integrate sustainability in processes but found that none of the nine reviewed methods included specific social sustainability metrics. As in Helleno, de Moraes & Simon (2017) [31] study, they also recognized that different metrics are needed for different industries, therefore their focus was on defining generic social metrics that can be applied in several specific industries. However, the proposed social metrics only addressed physical work within processes and work environment inside the mills. Hence, only internal stakeholders were considered and no social sustainability assessment was done for external stakeholders.

In further studies related to Sus-VSM, Brown, Amundson, & Badurdeen (2014) applied Sus-VSM on three manufacturing contexts with different products and production volumes. They identified that several challenges arise when different system descriptions and

boundaries are considered. Hence, they concluded that case studies from different industries are needed to define comparable parameters and generalize metrics. Although this study provided insights about the applicability of Sus-VSM, it did not extend the social sustainability metrics defined by Faulkner & Badurdeen (2014) [28].

### 3.3 Social Sustainability in Post-Disaster

As it was identified at the beginning of this section, one of the social sustainability topics is people's basic needs. In a post-disaster context, the most accepted minimum standard for basic needs was defined by the Sphere Handbook, a standard that is meant to be used during disaster response and was developed by the International Red Cross and a group of NGOs involved in humanitarian aid [37]. This standard identifies the following basic needs areas: water supply, sanitation and hygiene, food security, nutrition, shelter and settlement and health [37]. Since this research is based on the post-disaster temporary housing context, only studies focusing on shelter and settlement assessment after a disaster are considered. However few literature exist in this context and only two studies were found, the first of them is Johnson (2007) [32] research that analyzed particular temporary housing projects after the 1999 earthquakes in Turkey. In this post-disaster situation, the Turkish government gave rental stipends to some of the affected people, but also built 40,621 emergency housing on 136 settlements nearby the affected cities. Johnson's analysis was done at the project level and his study provided the analysis of four projects: two of them lead by the government and two lead by NGOs. The analyses were done using the Logical Framework Analysis approach (logframe), an approach promoted by the US Agency for International Development (USAID) to define stakeholders' roles and to plan activities to achieve defined goals or impacts [12]. Although Johnson's (2007) study [32] identified the impacts of projects' objectives, the analysis was done at a project-level and no process was included. Furthermore, the study did not identify all of the stakeholders who participated in the project and hence did not analyze the impacts of the projects to all of the stakeholders. For example, in one of the projects the NGO Action by Churches Together was in charge, but their objectives specific processes objectives, such as construction times or local materials used, were not included in the study.

Another study that focused on post-disaster temporary housing is Mora & Akinci (2018) research [11], which is the starting point of the research described in this paper. This study focused on measuring the social impact of innovation in processes of fabrication and delivery of post-disaster temporary housing. The research team adapted S-LCA methodology to identify the system, participating stakeholders and their objectives, and to identify processes. Through a case study based on data

from NGO Fundación Vivienda in the post-disaster situation generated by 2017 fire in Chile, the research team identified social impacts that can be influenced by the processes of fabrication and delivery of post-disaster temporary housing. Then, they analyzed the innovations done in the case study and proposed indexes to measure the social impacts. However, the research team only used S-LCA definitions to define the indexes and they did not include any other social sustainability or impact methodology.

## 4 Integrating Social Sustainability in VSM in Post-Disaster Temporary Housing Context

### 4.1 System Definition

There are several examples of temporary housing approaches around the world, Wagemann (2012) [33] identified 53 different types of temporary housing for post-disaster contexts implemented only from 2001 to 2011 [33]. These designs have been proposed by several architects and organizations and one of the first identified approaches was proposed in 1944 by Jean Prouvé to support temporary housing for refugees [33-34]. More recent architects have been working in this topic, like Shigeru Ban that have successfully implemented emergency housing since 1995 in diverse post-disaster contexts [35]. Other proposals and designs are from the governmental side, for example in Chile temporary housing is regulated by the National Office of Emergency (ONEMI). This governmental office defined the minimum surface, insulation and fire-resistance rating for the envelope, as well as transportation and installation requirements for the temporary housing used in Chile [36].

Although sometimes the terms shelter and temporary housing are interchanged, there is a clear distinction between them. The most accepted definitions of these terms were provided by Quarantelli in 1995 [38]:

- *Emergency shelter*: Refers to short period accommodation (most of the times only overnight) outside its own home immediately after the occurrence of a disaster. For example, a friend's house can be considered as an emergency shelter.
- *Temporary shelter*: Refers to short period accommodation (days to months) during post-disaster. For example, a tent or a rented apartment can be considered as a temporary shelter.
- *Temporary housing*: Refers to long period accommodation (months or years) used until people can return to a permanent house. For example FEMA trailers used after Katrina 2005 in New Orleans can be considered in this category [39].
- *Permanent housing*: Refers to permanent

accommodation (years). It can be a repaired house or a new one.

All of these approaches aim to resume normal life after a disaster [37], the former two accommodations aim for short time periods after a disaster, while the latter two accommodations aim for long periods [38]. Documented examples of post-disaster accommodations are found in Johnson (2007) [32] study, where people first moved to tents (temporary shelter), then to temporary housing and then to permanent housing. In another documented example, after the 8.5 Richter scale earthquake in Chile people moved directly from emergency shelters to temporary housing and then to permanent housing [40].

The research described in this paper focuses on temporary housing and external stakeholders, therefore only activities and external stakeholders involved in the fabrication and delivery of temporary housing are studied. Moreover, the temporary housing system analyzed in this research is a sub-area of disaster management, which aims to reduce the impact of disaster on communities and encompasses the management of pre-disaster and post-disaster stages [41]. Additionally, four stages can be identified in any disaster management strategy: mitigation, preparedness, response and recovery [41-44]. Preparedness and mitigation are pre-disaster activities, and response and recovery are post-disaster activities [37]. This research narrows the analyzed system to the fabrication and delivery of post-disaster temporary housing in response and recovery stages.

Several stakeholders, such as governments, local and international NGOs, private contractors, communities and final users are involved in each one of the disaster management activities. Although their final goal for disaster management is the same, specific objectives can vary amongst them. For example, private companies could aim to provide standardized low-cost solutions while NGOs could aim to provide community-based solutions [45]. Moreover, several strategies exist to implement post-disaster housing reconstruction. According to Barenstein (2006) [46], who analyzed reconstruction approaches after the earthquake of Gujarat, India, the differences between post-disaster housing strategies are: location (of the new house), funding (for materials and labor), fabrication (of the new house), delivery (of the new house) and on-site construction. For example, in an owner-driven strategy, affected families can be in charge of financing a solution, while in a subsidiary or a contractor-driven approach externals, such as NGOs or governments, provide financial assistance to the affected families [46].

The research described in this paper is based on a subsidiary approach, hence, the housing solution is financed, fabricated, delivered and built on-site by externals, who are not families that are affected by a disaster. This research also considers that new housing solutions are installed where houses were prior disaster.

## 4.2 Identification of Stakeholders

While previous studies narrowed the integration of social sustainability in VSM to internal stakeholders, the research presented in this paper aims to include external stakeholders when integrating social sustainability in VSM. However, the internal or external classification of the stakeholders is not straightforward and depends on the analyzed system. In the context of post-disaster temporary housing construction, previous studies identified the following participating stakeholders during response and recovery: affected families; NGOs and donor agencies; local and national governmental agencies; housing suppliers and housing on-site builders [32] [37] [47]. Therefore, since this research only focuses on the fabrication and delivery processes of panelized post-disaster housing, internal stakeholders are those in charge of the fabrication and delivery processes of the housing, while external stakeholders are the ones that receive the outcome (post-disaster temporary housing) including intermediates and final user.

Then, since this study is based on a subsidiary approach, we considered as external stakeholder the stakeholders that are funding labor and materials as well as the stakeholders in charge of on-site construction (including those that coordinate on-site construction) and final user of the housing solution. For example, in a governmental subsidiary approach, government funds labor and materials while fabrication, delivery and on-site construction can be performed by private contractors or NGOs.

## 4.3 Identification of Relevant Social Sustainability Indexes

As it has been described in previous sections, most of previous studies proposed social sustainability indexes for internal stakeholders. Only Helleno, de Moraes & Simon (2017) [31] proposed social sustainability indexes to assess an external community. However, the indexes proposed by them are not applicable to the system defined in this research since their indexes were defined for mass consumption products in a regular context. Then, in order to propose suitable indexes to assess social sustainability for external stakeholders in a post-disaster temporary housing context, several methodologies that have aimed to assess social sustainability were studied and summarized in Table 1.

Table 1. Summary of social sustainability indexes from social impact methodologies and studies

Methodology or study	Stakeholder	Qty. of indexes
Social Life Cycle Assessment [48]	- Workers - Consumer - Local Community	No indexes were proposed

	- Society	
	- Value chain	
Global Reporting Initiative (GRI) [49]	- Workers	58
	- Consumer	21
	- Local Community	18
	- Society	
	- Value chain	11
		54
Social Vulnerability index [50]	- Local Community	11
Fontes et al. (2018) [51]	- Workers	No indexes were proposed
	- Consumers	
	- Local Community	
Jorgensen et al. (2010) [21]	- Local community	4
Lagarde & Macombe (2014) [52]	- Local community	6
Feschet et al. (2013) [20]	- Society	1
Baumann et al. (2013) [19]	- Society	8
Handbook for emergencies [53]	-Consumer	7

Although several social sustainability indexes were identified in this research, not all of them allow social sustainability assessment of external stakeholders in the defined post-disaster temporary housing system. Moreover, from all the identified indexes, only the following indexes can be estimated using information from the processes of fabrication and delivery of post-disaster temporary housing and provide information to guide processes' managers in process design towards social sustainability.

1. *Percentage of products and services assessed for improvement:* This index is from Global Reporting Initiative (GRI) [49] and it enables the assessment of the ratio of processes that have been re-designed towards social sustainability. Therefore, it assesses internal processes and provides information to processes' managers.
2. *Total number of incidents for noncompliance of regulations:* This index is also from GRI [49] and it allows the assessment of how many stakeholder requirements have not been fulfilled towards social sustainability. Therefore, it assesses internal processes and provides information to processes' managers.
3. *Content of substances that can cause environmental or social impact:* This index is also from GRI [49] and it enables the identification of products that can negatively impact social sustainability of external stakeholder. Therefore, it assesses internal processes and provides information to processes' managers.
4. *Demand fulfillment:* This index is based on the Handbook for emergencies [53] and Mora & Akinci' study [11] and it enables the assessment of the speed

of the delivery of the solution towards social sustainability. Therefore, it assesses internal processes and provides information about external stakeholders that oversee on-site construction, on-site coordination and final users to processes' managers.

5. *On-time arrivals*: This index is based on [53] and [11] studies and allows the assessment of the arrival expectation of the stakeholders. Therefore, it assesses internal processes and provides information about external stakeholders that oversee on-site construction, on-site coordination and final users to processes' managers.

#### 4.4 Integrating System, Stakeholder and Social Sustainability Indexes to VSM

Value stream are the processes or actions required in a plant or company to produce a product from raw material and deliver it to a customer [54]. Therefore, Value Stream Mapping (VSM) is a plot of all of the processes and information flows to fabricate a product within a given company or plant. This plot allows decision-makers to analyse the current state of the production and to define a “future state” (or desired state) of the flow and processes [54]. In the research described in this paper, we modelled only processes and information flows that relate fabrication and delivery of post-disaster temporary housing with the identified external stakeholders and that can be assessed by the proposed indexes.

Based on the stated definitions of system, stakeholders and indexes, Figure 2 shows a generic model developed to integrate social sustainability for external in VSM for the subsidiary approach of post-disaster temporary housing. The arrows between the stakeholders indicate there is a relationship between them, however, these relationships can change among different scenarios, therefore the direction of the double-headed arrows must be defined in the analyzed scenario.

The main difference between the proposed model and the regular VSM model and also with Sus-VSM model proposed by Faulkner & Badurdeen (2014) [28] is that the proposed model considers multiple external stakeholder receiving the product while previous models considered only one external stakeholder receiving the product. This modification enables the identification of all the participant external stakeholders as well as their expectations on the outcome. In the context of the research presented in this paper, this modification aims to represent all the participant external stakeholders and their expectations towards social sustainability in the subsidiary approach of the fabrication and delivery of post-disaster temporary housing.

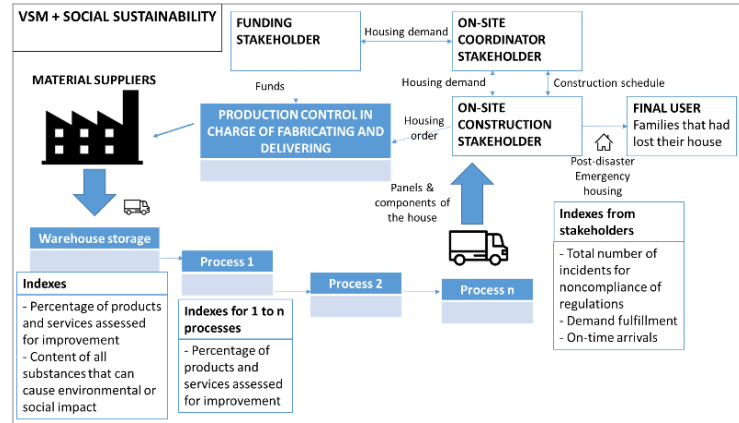


Figure 2. Generic model for social sustainability integration of external stakeholders in VSM

#### 5 Case Study: Panelized Post-Disaster Temporary Housing Processes at Fundación Vivienda, Chile

The proposed model was tested with the NGO Fundación Vivienda in Chile. Specifically, data from the 2017 Fire in Chile from Mora & Akinci (2018) study [11] and on-site interviews were used to feed and test the model. In this event, Fundación Vivienda was in charge of fabricating and delivering the houses and the external stakeholders were:

6. *Funding*: NGO TECHO-Chile (data from interviews with NGO's director of operation)
7. *On-site coordination*: Local governments [11]
8. *On-site construction*: NGO TECHO-Chile [11]
9. *Final user*: Families who had lost their house [11]

Based on the identified external stakeholders and the identified process within Fundación Vivienda, Figure 3 shows our proposed model applied to this case study. Additionally, changes to the fabrication and delivery processes were documented in Mora & Akinci (2018) study [11], therefore the proposed indexes can be calculated for an initial state (before the changes were applied) and for a future state (Figure 3). The calculated indexes are shown in Table 3 and they enabled the comparison between the initial and the final state of the system.

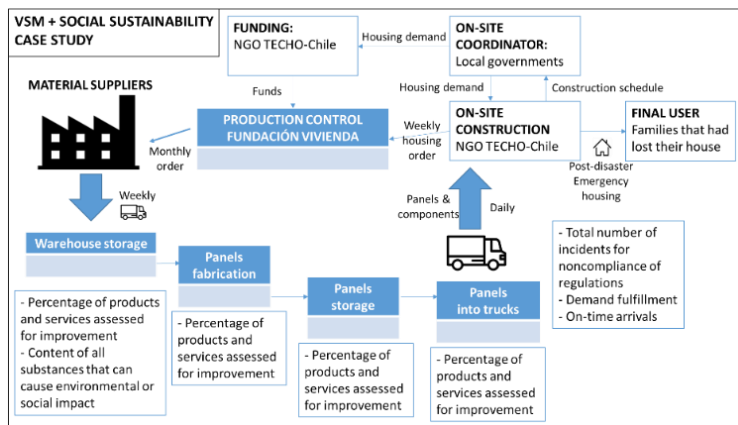


Figure 3. Proposed model to integrate social sustainability in VSM applied in 2017 Fire in Chile case study

Table 3. Summary of indexes of initial and final state of the processes and information flow in the case study

Index	Initial state	Final state
Percentage of products and services assessed for improvement	0%	100%
Total number of incidents for noncompliance of regulations	0%	9.8%
Content of substances that can cause environmental or social impact	0	0
Demand fulfillment	75%	84%
On-time arrivals	66%	92%

## 6 Case Study Discussion

The case study demonstrated that the model proposed in this research can enable social sustainability assessment of external stakeholders in VSM. As it has been stated, this was not possible in previous VSM approaches because they only considered one final user of the outcome, but the model proposed in this research enabled the representation of the several stakeholders that exist between the factory (that is fabricating and delivering the outcome) and the final user. For example, in this case study, NGO TECHO-Chile was an external stakeholder although it was not the final user of the outcome.

Moreover, when changes were done to the processes, the indexes proposed in the model enabled social sustainability assessment of external stakeholders. This is important to processes' managers because the comparison between the indexes of an initial and final state enables the social sustainability evaluation of the changes. Also, the proposed indexes enabled internal processes evaluation towards social sustainability of external stakeholders. For

example, the index "percentage of products and services assessed for improvements" indicates whether the company is improving products and services towards external stakeholders. Another proposed index is "total number of incidents for noncompliance of regulations" which can assess whether changes done impacted the compliance of the outcome according to the external stakeholders' requirements. In this case study the changes done increased this index, which means that some of the changes negatively impacted the social sustainability expectations of the external stakeholders.

Another proposed index that assessed company's processes towards social sustainability is the "content of substances that can cause environmental or social impact" index. In this case study, the company was not using harmful substances or products in its process flow, therefore this index is 0, and must be supported.

Finally, "demand fulfillment" and "on-time arrivals" indexes represent the social sustainability expectation about the outcome of the NGO TECHO-Chile and affected families. A 100% index means that changes done to the fabrication and delivery processes were fulfilling social sustainability expectation of these external stakeholders. In this case, when comparing initial and final states, a positive change in the indexes is noticeable, which means that the changes done to the processes maximized social sustainability of external stakeholders.

It is important to mention that the model proposed in this research is based on a subsidiary reconstruction approach to build post-disaster temporary housing, therefore housing solutions were financed, fabricated, delivered and built on-site by people or companies that are not the families affected by a disaster. Then, further studies are needed to validate the model with other reconstruction approaches, such as the owner-driven approach.

## 7 Conclusions

The model proposed in this research aims to contribute to the integration of social sustainability assessment of external stakeholders in VSM in a post-disaster temporary housing context. In order to do it, the proposed model enables the evaluation of existing processes towards integrating social sustainability perspective of external stakeholders into processes. Moreover, the proposed model enables the integration of additional external stakeholders and not only the final user of the outcome. This external stakeholder's integration enables the addition of different stakeholders' expectations on the outcome, towards social sustainability in VSM. Also, in order to integrate these expectations, the research presented in this paper defined specific indexes that were tested in a case study and demonstrated their suitability to

integrate social sustainability's point of view into processes.

Moreover, the case study used to test the model demonstrated that the proposed model with the proposed indexes can be applied in a subsidiary approach to fabricate and delivery post-disaster emergency housing. The case study also demonstrated that the proposed indexes enabled the integration of external stakeholders' social sustainability point of view within existing processes of fabrication and delivery of the housing solutions. Finally, the calculated indexes also enabled the assessment of changes done to processes towards social sustainability. Therefore, the model and indexes proposed in this research are valuable to processes' managers for process design towards social sustainability of external stakeholders.

## 8 Perspectives

This study was useful to understand what social sustainability indexes are useful in a post-disaster temporary housing system and how they can be included in VSM. However, only stakeholders that received the outcome of the processes were considered, hence other stakeholders have to be studied in detail as well. Moreover, surveys with statistical validity must be done to evaluate social sustainability indexes' relevance to its associated stakeholders.

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