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Sameer Prasad Jason Woldt Harish Borra Nezih Altay



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S.I.: DESIGN AND MANAGEMENT OF HUMANITARIAN SUPPLY CHAINS



Migrant supply chain networks: an empirically based typology

Sameer Prasad¹ · Jason Woldt² · Harish Borra³ · Nezih Altay⁴ D

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Abstract

Managing migrant supply networks is a critical issue both domestically and internationally. In this research, using a supply chain perspective, a typology is developed to provide recommendations for migration stakeholders. The typology can be used to assess factors within a migrant network including: pressure to migrate, the network agility, and the total cost of migration. The typology identifies specific investments that developmental agents can focus on to mitigate the pressure to migrate. In instances of genocide and other forms of forced migration, the model identifies ways stakeholders can support agile refugee flows to ensure faster and safer travel and to shorten transit times.

Keywords Migrant flows · Case-study · Push/pull systems · Humanitarian networks

Nezih Altay NALTAY@depaul.edu

Sameer Prasad prasads@uww.edu

Jason Woldt woldtj@uwosh.edu

Harish Borra harishborra52@gmail.com

- ¹ Information Technology and Supply Chain Management, College of Business and Economics, University of Wisconsin-Whitewater, Whitewater, WI 53190, USA
- ² College of Business and Economics, University of Wisconsin-Oshkosh, Oshkosh, WI 54901, USA
- ³ Sodhana Charitable Trust, Cheepurupalli, India
- ⁴ Department of Management and Entrepreneurship, Driehaus College of Business, DePaul University, Chicago, IL 60604, USA

1 Introduction

Lack of development, increasing political conflict, rampant corruption, and violence in many developing countries have created a climate that continues to drive individuals and families from their home countries in search of a better place to live (Turkeš et al. 2017). As a result, the number of refugees has doubled since 2011; it is estimated that more than 65 million people have been forced to move due to conflict, persecution, or human rights violations (UNHCR 2016). The resulting humanitarian and migration supply chains have correspondingly grown in scale and complexity (Jabbour et al. 2017; Oloruntoba et al. 2016; Seifert et al. 2018).

This permanent or semi-permanent change of residence has been defined as "migration", requiring at least three supply-chain components (Lee 1966): an origin (upstream), an intervening set of obstacles (midstream), and a destination (downstream). Migration presents many challenges for various stakeholders including migrants, local communities, NGOs, and governments (Kovács and Spens 2009). Among the most pressing challenges are resource constraints (Bhattacharya et al. 2014) and the effective and safe management of the flow of resources and people along migration paths (Balcik and Beamon 2008).

Unlike traditional operations management, Kovács and Spens (2009) noted that forced migration allows very little time for upstream preparation. At times, migrants have to quickly leave their homes without a clear destination, with very few resources (Mallett and Hagen-Zanker 2018). The midstream journey can be difficult for migrants with exposure to smugglers, family separation, increased injury and violence, and limited access to health-care (Gostin and Roberts 2015). Downstream, migrants also face challenges when they arrive at their destinations; individuals and families face adjustment challenges such as language barriers and potential discrimination that may limit their access to education and gainful employment (UNESCO 2019). Because migration is such a multifaceted issue, it needs to be viewed through the lens of stakeholder theory, thus understanding and accounting for the multitude of stakeholder roles upstream, midstream, and downstream.

Stakeholder theory is considered relevant in any context where it is important to consider the perspectives of different individuals or groups. Freeman's (1984) definition of a stakeholder is "any group or individual who can affect or is affected by the achievement of the organization's objectives" (pp. 48), including those at the core or periphery. Stakeholder theory suggests that an organization can find value in the identification, analysis, mapping, and prioritization of stakeholders. Within the humanitarian and supply chain literature, there is an increasing number of papers that discuss the critical role of different stakeholders along the humanitarian supply chain (Behl and Dutta 2018; De Camargo et al. 2017; Kunz and Reiner 2016). Specifically, Gupta et al. (2017) noted that while humanitarian organizations are often very different from for-profit enterprises due to their size and scope, stakeholder theory can also be useful in the humanitarian context to prioritize and balance the interests of stakeholders. In the migration context, stakeholders range from the individuals or groups that are directly involved in the migration process to those indirectly involved or affected. Stakeholders include communities from where migrants hail from, transit nations, NGOs, local and natiaonl governments, transit operators, and destination locales.

Stakeholder reactions to humanitarian and migration supply chains vary. For example, while some countries downstream view migrants as a valuable labor and cultural resource, other nations are much less receptive to migrants and refugees (Facchini and Willmann 2005). Similarly, stakeholder sentiment and interests may change over time. For instance,

over time, governments have constructed more restrictive policies in their acceptance of migrants from other countries (Huysmans 2000). Proponents of these policies offer arguments that unfettered migration poses economic, national, and social costs (Gushulak et al. 2009). Furthermore, governments have, with limited success, tried to reduce migration by offering location/development aid upstream in regions that are most susceptible (De Haas 2007). As a result, migration bottlenecks have emerged and new travel routes are created when migrants are prevented from or avoid traveling through nations with more restrictive migration policies (Dustmann et al. 2017; Long 2013). These nations and communities along the transit path are also critical stakeholders impacted by the migration process. Other critical stakeholders playing a more direct role in the migration process include Non-Governmental Organizations (NGOs). Researchers argue that NGOs must develop agile supply chains capable of minimizing response time and cost in order to be effective (Oloruntoba and Gray 2006; Zhang et al. 2019). However, NGOs, due to limited resources and expertise may be incapable of independently meeting the needs of the vast flows of migrants as they progress along their journeys (Kovács and Spens 2009). As such, a strategy needs to be formulated in order to balance the various stakeholder values in migrant chains. Donaldson and Preston (1995) suggested that stakeholder theory can guide the structure and the operation of an organization. In this research, we develop a prescriptive migrant network flow model by first identifying and analyzing core and peripheral stakeholders, creating a situational map, and identifying the different priorities.

To develop this mapping (framework), we used a braided approach combining literature reviews with case studies. Using an iterative process, we first reviewed the relevant migration and supply chain literatures. Next, we investigated eleven different domestic and international migration cases. Based on the literature review and the eleven cases, we developed a typology incorporating the pressure to migrate, agile flows, and total costs associated with such supply networks.

In the following sections we review the relevant literatures, describe the methodology employed in this study, and identify and discuss the typology that was created. Following the typology, we discuss implication of this research and offer potential future research topics. We begin with a literature review outlining how supply chain collaboration strategies have been used in private sector supply chains to understand the relevance of using similar strategies in the human migration context.

2 Literature review and theoretical background

The network approach of strategic management theory (Gadde et al. 2003) was investigated to help underpin this research. According to the network approach, the interaction between and among different network partners is critical because the joint utilization of organizational resources determines the efficiency and effectiveness of the entire network. Today, the competitive pressure exerted on modern-day supply chains necessitates a high level of interconnectedness in exchanging material, information, and other resources (Stank et al. 2001; Stefansson and Russell 2008). Stank et al. (2001) identifies this interconnectedness as collaboration and defines it as "...a process of decision making among interdependent parties involving joint ownership of decisions and collective responsibility of outcomes" (p. 31). Because the activities of each firm are not isolated, interconnectedness and collaboration have been considered critical to business success.

Significant research exists to demonstrate the link between supply chain collaboration and improved business performance (Cao and Zhang 2011; Soosay and Hyland 2015). While the benefits of supply chain collaboration are vast, the areas where supply chain collaboration has historically been more effective is in reducing the transaction costs in a repetitive manufacturing environment (Skjoett-Larsen et al. 2003). Barratt (2004), found that the link between collaboration and supply chain outcomes is often ambiguous; therefore, we need to better understand the enablers and underlying conditions that allow collaboration to lead to successful outcomes. In addition, as supply chains evolve, these enablers also evolve. Today, supply chains must find ways to constantly adapt due to rapidly changing business conditions. Researchers have found a link between agility and positive supply chain outcomes including cost, quality, and flexibility (Lin et al. 2006; Hallgren and Olhager 2009). Compared to other operational strategies, the concept of agility has greater value in the migration context, where the operating environment is very dynamic and uncertain and the ability to quickly change is essential in ensuring high levels of quality (safety) and flexibility (Baharmand et al. 2017).

2.1 Dynamic pressures in migration networks

Both manufacturing and humanitarian supply chains are exposed to internal and external factors resulting in increased pressure along the supply chain. This pressure is often more intense for humanitarian supply chains for several reasons. As opposed to manufacturing supply chains that spend most of their life cycles in a steady state, humanitarian supply chains evolve through different life stages (planning, initiation, ramp-up, steady state, termination and transformation). Furthermore, humanitarian supply chains often contend with high levels of external pressure due to the strict oversight from politicized government donations and scrutiny from private investors (Day et al. 2012; Oloruntoba and Gray 2006; Ülkü et al. 2015). In addition, Day et al. (2012) found that humanitarian supply chain coordination is often a matter of life or death, while effective coordination in traditional consumer goods supply chains is a matter of profit or loss. Finally, in humanitarian supply chains, there is increased reliance on partnering among independent parties who may have no prior working relationship (Dubey et al. 2017; Venkatesh et al. 2018). Given the pressures and uncertainty with migrant networks, organizations need to focus on managing these unique supply chain constraints to ensure high levels of agility.

2.2 Flows

Maintaining smooth process flow is an integral part of achieving operational success for manufacturers over time (Bechte 1988; Flynn et al. 1995). Specifically, this improved flow results in better operational performance and increased competitive advantage as well as higher customer service and lower inventory (Flynn et al. 1995). As supply chains become more complex, process integration strategies may have to be extended beyond first tier supply chain partners (Goldsby and García-Dastugue 2003).

Strategies to coordinate the flow of product and information in the manufacturing context can often be more useful in improving humanitarian supply chains due to the severity of pressure in humanitarian chains. Manufacturing firms face Bill of Material (BOM) complexity when manufacturing different products and downstream complexity when moving the right product through the supply chain to the final customer. Poor planning or unexpected events can impact the manufacturing organization's ability to execute resulting in bottleneck pressure. In the humanitarian context, the travel route is usually less predictable, and varied group sizes, consisting of both men and women with different health and religious needs result in internal pressure that may be amplified. Similarly, the necessity of coordinate transportation needs among different NGOs and governments and the complexity of understanding varied legal rights from country to country along the migration route could result in delays, additional expenses health issues, and lack of safety.

2.3 Outcomes

All supply chains are outcome driven (Melnyk et al. 2010) and require processes to ensure that outcomes are achievable (Day et al. 2012), however, several important differences do exist in the expected outcomes of humanitarian supply chains as opposed to manufacturing supply chains. As opposed to a singular focus on traditional cost, agility assesses a supply chain's capability to manage cost factors that are relevant from a multitude of stakeholders, leading to a more comprehensive measure when assessing supply chain outcomes. In the humanitarian context, the priorities may include lead time to the final destination, health, border controls, aid provided upstream, the cost of the journey, and the failure cost in the event that the migrants do not reach their final destination.

Currently, in the migration supply chain literature there is no well-established model that properly captures the underlying dynamic migration pressures, agile networks, and outcomes. Hence, in this research we created a case-based typology that identifies the relevant variables associated with pressure, agile networks, and outcomes.

3 Methodology

To develop the typology, we used a multi-method braided approach. Specifically, we blended a case study methodology and a review of literature in an iterative fashion to develop the research question, identify variables, define the respective properties, and map out the relationships.

3.1 A multi-method approach

Each method has inherent strengths and weaknesses (Sieber 1973). Therefore, one advantage of a multi-method approach is that the unique characteristics of one method could potentially overcome a particular weakness of a second method and vice versa (Sieber 1973; Jick 1979). Furthermore, utilizing multiple methods can bring about triangulation, while still capturing a holistic understanding of the context. Finally, multi-methods allow for the possibility to stimulate researchers to more clearly define research questions (Jick 1979).

Case studies help motivate research questions, instigate new ideas, sharpen existing theories, and fill holes in current models (Siggelkow 2007); they are excellent illustrators of variables and the relationships among them. On the other hand, case studies have been criticized in terms of the power (ability to explain relationships), generalizability (small sample size and non-representative samples), and the lack of precision (Siggelkow 2007). Using typology built upon existing literature helps create an additional degree of power and generalizability by relying on evidence of prior studies. Furthermore, typology can ensure a high degree of precision. In this study, each of the typology structural variables

have three categories, creating $(3 \times 3 \times 3 \times 3) = 81$ unique classifications. Furthermore, the properties defining the respective structural variables can provide a finer classification beyond the three categories creating an enhanced precision level of the model.

At the same time, typologies that are based solely on past literature tend to be limited. New ways of thinking, relationships, surprises, and even gaps in current theories can be uncovered via case studies. For example, in this research, being in the field as part of the case study helped shape the research question. Furthermore, some surprises uncovered in this study include the realization that migration should be classified along a continuum of temporary to permanent and the importance of capturing the inherent total cost of the migration flows. The final research question that evolved is to assess the influence of migration pressure and the degree of network agility on the total cost of migration. Next, we discuss the case study; after that we develop the typology.

3.2 Case study

Because a main focus of this study was exploration, the case study methodology was most appropriate for this context. To establish external validity, we developed a framework using existing relationships among variables found in literature and paired those with information collected in the field. To ensure internal validity, Eisenhardt (1989) suggested that between four to eleven cases be selected as a sample. In this research, we used eleven cases to refine the constructs and properties to create the typology. Each case offers different locality characteristics (domestic/international, rural/urban, Asia, America), level of development, underlying conditions, destination locations, complexity, bottlenecks, and costs (see Table 1). The diversity of cases enabled us to study a range of different environments resulting in a rich depth of understanding that may not have been possible with other research methods. Below we will describe each of the cases.

3.2.1 Mandiravalasa village, A.P. India

Mandiravalasa village has a population of 1400–1500 of which 90–100 citizens have migrated permanently. Through the long-term support of Sodhana Charitable Trust and government resources, development has taken hold in the village. This development has resulted in positive outcomes including more employment opportunities, housing, and better access to education. On the other hand, pull factors still exist resulting in continued seasonal migration with few constraints on the flow. For example, business owners and their contractors in destination locations often provide housing, offer workers the ability to transfer money, and supply transportation to and from the village. This results in migrants arriving on time and healthy when they reach the job sites. Given that the labor is manual, men are more likely to undertake this migration journey. Upon completion of the work, successful migrants return home with the financial capability to build homes in the village.

3.2.2 Vedullavalasa village: schedule caste (SC) community, A.P. India

The Vedullavalasa community consists of a total population of 6300. Because of the semiurban environment and the availability of basic healthcare services, migration is primarily seasonal. Construction opportunities exist in Bangalore for men to earn around 50,000 rupees over a 3–4-month period while seasonal agricultural work also exists for women. Travel to Bangalore is not coordinated by the employers, but rather villagers have to

Table 1 Classification of	cases					
Outbound			Complexity	Bottlenecks	Destination	Total cost
Locality	Urban/rural mix	Development and underlying conditions				
Mandiravalasa, AP, India, Asia	Rural	Long-term Employ- ment, housing, access to education	Men, travel provided, healthy	Transport and funds provided, Right to migrate	Internal India, Asia	Low costs
Vedullavalas, AP, India, Asia	Semi-rural	Basic primary health care and access to education.	Men	Coordination not provided for, Right to migrate	Bangalore, India, Asia	Unhealthy and unsafe conditions
Purreyavalasa, AP, India, Asia	Semi-rural	Lack of farmland ownership, lack of income generating opportunities	Families	Coordination not provided for, Right to migrate	Chennai and Vijayawada, India, Asia	Unsafe working condi- tions
B. G. Palem AP, India, Asia	Semi-rural	Low wages, basic pri- mary health care and access to education	Husband and wife	Easy transit—2 h bus ride, Right to migrate	Vishakhapatnam, India, Asia	Low costs, construction and house work
Kondadadi, AP, India, Asia	Semi-rural	Low wages, basic pri- mary health care and access to education	Husband and wife	Coordination not provided for, Right to migrate	East/West Godavari and Hyderabad, India, Asia	Medium cost, construc- tion unsafe work
Rickshaw Colony, AP, India, Asia	Urban	Access to good infrastructure, good entrepreneurial oppor- tunities	Little seasonal or per- manent migration			
Bondapalli, AP, India, Asia	Semi-rural	Basic primary health care and access to education	Men	Coordination not provided for, Right to migrate	Chennai, India, Asia	Medium cost, construc- tion unsafe work
Korruvanivalas, AP, India, Asia	Rural	Low wages, no basic primary health care or access to education	Families	Given remoteness mod- erate difficult, Right to migrate	Gudivada, Rajahmun- dry and Bangalore, India, Asia	Medium cost, agriculture or masonry industries
Bihar, India, Asia	Rural	Limited employment, weak infrastructure	Families travel	Given remoteness mod- erate difficulty, Right to migrate	NCR of India, Asia	Unhealthy work, rag- picking

(continued)
Table 1

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kity Bo travel includ- No ferly f travel includ- No f	ottlenecks o coordination, dif- ñcult crossing o coordination, dif-	Destination Cox's Bazar District, Bangladesh, Asia US urban cities, North America	Total cost Dangerous transit Dangerous transit and navment to covotes
	ity Bc	ity Bottlenecks	ity Bottlenecks Destination
	travel includ- Nc	travel includ- No coordination, dif-	travel includ- No coordination, dif- Cox's Bazar District,
	erly 1	erly ficult crossing	erly ficult crossing Bangladesh, Asia
	travel includ- Nc	travel includ- No coordination, dif-	travel includ- No coordination, dif- US urban cities, North
	erly 1	erly ficult crossing	erly ficult crossing America

navigate on their own. The working conditions at the work sites can be harsh with minimal housing and food provided. Given the working and living conditions, migrants are at an increased risk of infection and disease.

3.2.3 Purreyavalasa, A.P. India

Purreyavalasa is a semi-urban community where very few residents own farmland; most lack the ability to generate income at a local level. Because of this, seasonal migration is quite prevalent. Villagers travel to Chennai to work in the construction industry. Migrants work 10–11 h per day and earn around 400 rupees per day. In spite of the harsh working conditions, employers do not provide any form of insurance for work-related injuries. The middlemen (contractors) do not provide any coordination services, and migrants rely upon their own social networks for travel arrangements and job opportunities. Permanent migration has also occurred with some 150 citizens out of a population of 1542 having settled down in Vijayawada A.P.

3.2.4 Palem village: A.P. India

B.G.Palem is a semi-urban village where low wages prevail. Villagers migrate to Vishakhapatnam, which is approximately a 2-h bus ride from B.G. Palem. Employment opportunities exist for men within the construction industry, while women find opportunities working in homes. Due to the short journey, there are few bottlenecks in transit, and the villagers do not rely on middlemen to assist with the travel. The migration starts as seasonal and gradually becomes permanent. Over time, half of these migrants settle down in Vishakhapatnam due to abundant employment opportunities and close proximity to B.G.Palem.

3.2.5 Kondadadi village: A.P. India

Kondadadi is a semi-urban village with low wages. Many villagers migrate seasonally (6 months) to Hyderabad where they engage in brickwork, while others find work in the puffed rice production industry. During harvest season, additional opportunities arise and many travels to East/West Godavari for agricultural work. While most migration is seasonal, approximately ten families have permanently migrated.

3.2.6 Rickshaw colony: A.P. India

The Rickshaw colony is located primarily in an urban setting. Residents have become entrepreneurs by setting-up profitable side stalls such as selling fruit, vegetables, and snacks. Because they are unable to leave their businesses, there is little seasonal or permanent migration.

3.2.7 Bondapalli village: AP India

The Bondapalli village is located in a semi-urban setting where villagers seasonally migrate to Chennai for construction work (4 months) or brickwork in Karnataka (6 months). While seasonal migration is prevalent, residents rarely migrate on a permanent basis.

3.2.8 Korruvanivalasa village: AP India

Korruvanivalasa is a distant village in the heart of the tribal area. Access to the village is difficult due to the poor transportation infrastructure (especially in the monsoon season). There is limited healthcare for villagers with the nearest primary health care facility located some 30 km away. Over the years, the government has invested in infrastructure by installing electricity and constructing brick and mortar "pukka" houses and community bathrooms. This development has resulted in mixed success as many of the pukka houses constructed were deemed unsafe. All of the households surveyed migrate seasonally with some 19% of the villagers now having permanently migrated to Gudivada, Rajahmundry, or Bangalore to work in the agriculture or masonry industries.

3.2.9 Bihar ragpickers in national capital region of India

Because there is limited employment in rural Bihar, many villagers have migrated to Delhi. The Bihari ragpickers in Delhi generate income by sorting through waste and collecting materials that can be reprocessed. The rag pickers work in tandem with India Pollution Control Association (organized sector) and make about 25,000 rupees (approximately \$350) per month for a family, which is significantly more than the average income in rural Bihar. Despite high incomes, poor working and living conditions result in poor health, and migrants regularly suffer from respiratory illnesses and intestinal problems. Furthermore, the education of children often gets disrupted given the transient nature of rag picking. Migrants find ragpicking opportunities using their own social networks, with one family following another family. Typically, the entire family migrates and participates in the ragpicking process with the husband collecting the waste and the wife and children sorting it.

Despite the limited economic development in Bihar, villagers were happy with the recent government funded development in their villages. For example, the government brought in electricity, funded education and healthcare, and provided resources for the construction of pukka homes and community toilets. In addition, Self Help Groups (SHGs) have also been funded and established to help villagers develop their own capacities.

This migration is considered permanent as villagers only go back to their village to attend special events (e.g., weddings, funerals, etc.). Transit is relatively easy, safe, short in duration (1-day travel time), and inexpensive. The solid waste godown (warehouse) owners help with the flow of money and material between the godowns and villages.

3.2.10 Rohingya refugees in Bangladesh

The Rohingya refugees migrated to escape violence in Myanmar and traveled into Bangladesh. The migrant flows consisted of entire families including: men, women, children, and elderly. As they made their journeys, no coordination for transit was provided and, in some cases, the route was dangerous. For example, one of the staging nodes along the migration path was an island that is prone to flooding. Although Bangladesh lacks economic resources and the refugee camps were underdeveloped, the Rohingya refugees felt Bangladesh was "heaven" to them. Prior to building schools or housing, the refugees first established a sense of community at refugee camps by building mosques (made of bamboo). Even though a bilateral agreement on repatriation exists allowing refugees to return home, most refugees chose to remain in Bangladesh.

3.2.11 Guatemala, North America

In Guatemala, the government faces significant challenges in providing basic services for its citizens. As a result, NGOs, primarily started by expatriates, are attempting to provide such services. The NGO network remains weak as it consists of multiple actors providing support without central coordination. For example, in Zone 3 of Guatemala City, 20–30 NGOs independently work with some 70,000 rag-pickers. In rural areas the situation is also dire as incomes depend on agricultural work that is prone to weather disruptions and logistical uncertainties. In even more remote areas (e.g. Highlands) food scarcity exists with little access to education and high levels of unemployment. As a result, many men join gangs and resort to thievery. Violence and protection rackets tends to be widespread, especially in Guatemala City. In addition, the growing number of women experiencing sexual assaults has become a problem.

On the other hand, many Guatemalans are quite familiar with the higher quality of services (education, healthcare and so on) and higher incomes in the US. Thus, the US becomes a beacon for Guatemalan migrants coming from Guatemala City and the Highland. Those choosing to migrate often utilize the assistance and coordination of "coyotes" or a chain of individuals that facilitate the flow. The services offered by coyotes are openly advertised in public buses and by word of mouth and can cost between \$5,000 and \$10,000 depending on the range of services provided.

3.3 Typology building

In this research, we borrow from the typology-building methodologies developed in the social sciences. Dubin (1969) found that utilizing an appropriate theoretical typology can help researchers improve their ability to understand (power) and predict (precision). Power and precision are important elements in model building. The ability to better understand the context paired with the finer ability to make comparisons results in an increased ability to improve services. We decided to develop a typology rather than a taxonomy (literally the law of order or classes). Taxonomies reflect a hierarchical classification as found in the animal kingdom (e.g. genus and species) (Marradi 1990); such hierarchical classification was not apparent in our framework.

In typologies, the structural variables are the foundation of the system. Each variable can consist of two or more properties that must be clearly defined to ensure the variables meet the requirements for additivity, synthesis, and consistency. These properties should be conceptually defined and should exist in a state, rather than a relationship (Melcher 1976). The result is that process variables are formed by the interaction among the various structural variables when activities actually occur (Melcher and Melcher 1980). In our research, we first correctly defined the properties of structural variables and then formulated the process variables. The structural variables were then cross-classified to map out the relationships among the process variables.

We combined the literature review and case study field data to identify the properties of the structural variables and to create the respective process variables. The process of identifying properties was iterative. First, the literature was combed for possible properties, and compared with the field case studies. In other cases, the properties surfaced from

Table 2 Properties for push	h and pull process variables				
Process variable	Properties	Reference	Low	Medium	High
Push-sourcing location	Employment level	Martin and Zürcher (2008), Zimmermann (1994)	Sufficient	Underemployment	Severe unemployment
	Wages	Martin and Zürcher (2008), Chiquiar and Hanson (2005)	Comfortable	Subsistence level	Extreme poverty
	Civil society	Etling et al. (2018), Widgren (1990)	Elections/stability	Authoritarian	Civil war, genocide
	Violence (gender, gangs)	Decker et al. (2008)	Safe	Unsafe at times	Extremely violent
	Government services (educa- tion, health care, housing).	Docquier and Marfouk (2006), Gushulak and MacPherson (2000)	Quality services available	Services available but poor quality	Services unavailable
	Debt	Friebel and Guriev (2006)	Lack of debt	Manageable debt	Potential loss of assets or bonded labor
Pull-destination location	Jobs	Heitmueller (2005)	Unemployment		Plentiful
	Salaries and working condi- tions	Bhagwati (1979)	Marginally better income and working conditions		Significantly better income and working conditions.
	Government services Family reunification	Schachter and Althaus (1989) Kofman (2004), Boyd (1989)	Insignificantly better services No family connections		Quality services Network of family available

Table 3 Properties fo	r BOM complexity and degree of t	bottlenecks variables			
Process variable	Properties	Reference	High	Medium	Low
BOM complexity	Group Gender	Gushulak et al. (2011) Pessar and Mahler (2003)	Family Women	Couple	Individual Men
	Specific health care needs	Sargent and Larchanché (2011), Thomas (2016)	Complex diseases to care for		Healthy
	Specific cultural/religious needs	Hagan and Ebaugh (2003)	Food, social restrictions on mobility		No restrictions
Degree of bot-	Inter-organization coordination	Taran (2001)	Single-stage	Two-stage	Multi-echelon
tlenecks along	Transportation	Sjaastad (1962)	Unavailable		Low cost and frequent service
supply chain	Border controls	Pécoud and De Guchteneire (2006), Spijkerboer (2007)	Physical and legal barriers		No controls
	Cultural similarities	Bhugra and Becker (2005), Park (1928)	Low		High
	Legal rights	Crépeau et al. (2007)	None	Right for safety and transit	Right to enter final destination

	Degree of push		
	Low	Medium	High
Degree of	f pull		
High	(3, 1) Medium pressure	(3, 2) High/medium pressure— Bihar	(3, 3) Very high pressure— Guatemala migrants, Roh- ingya refugees,
Medium	(2, 1) Low/medium pressure—Vedullav- alasa, B.G.Palem, Kondadadi	(2, 2) Medium pressure—Purreyav- alasa, Korruvanivalasa	(2, 3) High/medium
Low	(1, 1) Low pressure— Mandiravalasa, Bondapalli, Rickshaw Colony	(1, 2) Low/medium	(1, 3) Medium pressure

 Table 4
 Pressure structural variable

Rickshaw Colony has minimal migration

interviews in the field and were then reconciled with the literature. The respective references for the various properties are listed in Tables 2, 3, and 4.

4 Toward a theory of migration flow

4.1 Migration pressure structural variable

Push and pull systems have been described as operational paradigms to explain the flow of product, people, and information in manufacturing and service environments (Olhager and Östlund 1990; Pyke and Cohen 1990; Spearman and Zazanis 1992; Venkatesh et al. 1996). With roots in the manufacturing environment, push and pull are terms that that gained popularity in the 1970's; they refer to different strategies of releasing work to a production system (Spearman and Zazanis 1992). Research has shown that each strategy has implications regarding cost, flexibility, and customer service (Cachon 2004; Özbayrak et al. 2004). In this research, we interconnect push and pull concepts from the production planning context to the migration context. The migration literature identifies push factors as negative factors pressuring individuals and families to leave their home communities. On the other hand, pull factors are identified as factors that encourage individuals or families to leave because advantages exist beyond their home communities.

4.1.1 Push systems

Push systems are the mechanisms of manufacturing execution historically utilized by traditional Western manufacturers (Özbayrak et al. 2004; Spearman and Zazanis 1992). Push systems, by definition, are systems that do not put any limits on the amount of Work In Process (WIP) inventory. A similar analogy can be made in the migration context, where the "inventory" is people in the process of migrating. In traditional push systems, operational processes are completed in a successive fashion. When one operation is completed, the product is pushed to the next operation on a defined process route. Similarly, in the migration context, people are pushed to the next processing center along a defined route. Push systems often incur additional carrying costs due to excess work in process and finished goods inventory (Sarker and Fitzsimmons 1989). In the migration context, this additional carrying cost is placed upon individuals, communities, and organizations caring for the migrants along the journey.

4.1.2 Pull systems

As opposed to push systems, pull systems are more reactionary and are designed to be more service motivated (Karmarkar 1986). In the pull environment, downstream operations pull inventory from previous operations as needed (Spearman and Zazanis 1992). By definition, pull systems are strategically designed to limit the amount of WIP within a system (Hopp and Spearman 2004). As a result, downstream demand pulls production through the system (Spearman et al. 1990; Spearman and Zazanis 1992). In the migration context, pull is the pressure from downstream nations encouraging emigration. In such environments, there is limited amount of WIP (people) in transit, and downstream demand pulls people through the migration path.

Pull systems require responsiveness to upstream demand resulting in greater levels of production process flexibility achieved over time. As a result, pull systems are considered "lean" (Spearman and Zazanis 1992). Pull systems also have limitations (Huang and Kusiak 1998). To be effective, pull systems require firms to be tightly aligned with suppliers and quickly respond to market changes in order to meet demand expectations (Spearman and Zazanis 1992).

Ultimately, there is a general consensus that rarely are push or pull systems exclusively utilized (Bonney et al. 1999; Chen et al. 2002; Zhao et al. 2005) and most manufacturing systems contain characteristics of both push and pull (Hopp and Spearman 2004; Pyke and Cohen 1990). Likewise, in this research, we argue that elements of both push and pull are also present in the migration context.

In defining the push and pull variables, we draw from the literature coupled with evidence from our case studies. Martin and Zürcher (2008) categorized push and pull factors into economic and non-economic classifications. The push economic factors have been identified as unemployment or underemployment, whereas the non-economic factors pushing migrants from a region are political and civil unrest (Etling et al. 2018). On the other hand, pull factors have been identified as comparative advantages in other nation states. Individuals or groups can be pulled from certain countries with the promise of job opportunities (economic). Similarly, individuals can migrate from one country to another to unite with other family members (non-economic). As a result, using only economic theories to explain migration provides an incomplete perspective. Economic theories alone fail to explain why individuals from countries of similar economic status do not migrate at the same rate. Research suggests that social factors are critically important in the decision to migrate and the direction of migration flow (Castles 2010; Piore 1979). For example, contacts in different countries and family networks can serve as safety nets pulling more migrants to certain geographies, despite prevailing economic trends (Massey 1987). As part of the case study, we relied on the migration literature to first identify properties of the push and pull variables (see Tables 2, 3, 4). The properties were refined through an iterative process that included interviews with NGO officers and staff members, UN officers and migrants.

4.1.3 Properties and creation of pressure structural variable

The following properties were identified as sources of push including employment level, prevailing wages, civil mechanisms in the society, level of violence, services provided by the government, and the level of debt. These properties were classified in terms of three categories (see Table 2). For each community, these six properties additively can classify the level of push into low, medium, and high cells. The pull variable is measured by the following properties in the destination locale including the availability of jobs, prevailing salaries and working conditions, availability of government services and family reunification. Likewise, the properties of the pull variable also range among three levels. The properties can be combined in an additive fashion to create a pull variable with a low, medium, and high classification. The push and pull variables then can be cross-multiplied to create a pressure structural variable containing nine (3×3) cells. Based upon structured interviews with NGO staff members, UN officers, and villagers/migrants, we were able to classify the various cases into the pressure structural variables (Table 4). We found that the pressure to migrate is extremely high (3, 3) for the Guatemala migrants and Rohingya refugees, high (3, 2) for migrants from Bihar, India, moderate (2, 2) for Purreyavalasa and Korruvanivalasa, and relatively low/medium (2, 1) for villagers in Vedullavalasa, B.G.Palem, and Kondadadi. Finally, the pressure to migrate was low (1, 1) for the residents in Mandiravalasa and Bondapalli.

4.2 Migration agile flow structural variable

Operating environments that are turbulent are subject to intense time pressure and require a more agile approach (Cozzolino et al. 2012). Because many modern-day organizations operate in dynamic environments and under tight time constraints, the ability to quickly and efficiently adapt to unanticipated changes is important for many supply chain systems (Shareef et al. 2018). This requires a shift in the organization's focus from simply a lean approach to one that also includes elements of supply chain agility. Swafford et al. (2006) define supply chain agility as "a supply chain's capability to adapt or respond in a speedy manner to a changing marketplace environment" (pp. 172). As such, in this research we adapt supply chain agility to the network flows of migrants.

Agility is particularly critical within migration networks where many disasters are unpredictable, and quickly delivering services to refugees can be a matter of life or death (Day et al. 2012). Because of this pressure in the humanitarian context, organizations must quickly deploy limited resources in a compressed timeframe. As such, we examine the network flows in terms of two elements potentially impacting agility: Bill of Material (BOM) complexity of the migrants and the degree of bottlenecks along the network path.

4.2.1 BOM complexity

Over time, managing manufacturing processes and supply chains systems has become more complex. Simon (1962) defines complexity in a system as "...a large number of parts that interact in a non-simple way" (pp. 468). In its simplest form, this can be applied to a manufactured product. For example, products with complex bills of materials are associated with higher production cost and less production flexibility (Balakrishnan and Geunes 2000), and organizations with higher levels of product variety

are associated with supply chain processes that are more complex (Balakrishnan and Geunes 2000). Hence, product and process simplicity results in supply chains that are more agile and flexible (Coronado Mondragon et al. 2004). In the humanitarian context, an underexplored research area involves migrant groups that are associated with different levels of complexity (Behl and Dutta 2018). In this research, we define the BOM complexity variable based upon grouping, gender, age, health needs, and cultural/ religious needs. The grouping size reflects whether men are traveling alone or whether families/children are also making the journey (Table 3). The simplest BOM structure would be represented when men travel alone where the security and safety precautions are minimal. On the other hand, women and children add to the degree of BOM complexity because additional resources are needed to ensure that proper safety and services are provided along the transit journey. In addition, because some migrants making the journey are ill or may fall ill, additional services such as providing medication and treatment become necessary. On the other hand, healthy individuals require fewer resources and less care resulting in simpler BOMs. Finally, some migrant groups might have cultural or religious requirements (e.g. food provisions) resulting in a BOM that is more complex.

4.2.2 Degree of bottlenecks along paths

In a traditional production system, a forecast is generated to anticipate future customer demand. Using that forecast, a Master Production Schedule (MPS) is generated to calculate the finished good quantities that are needed. The MPS coupled with the BOM helps create the Materials Requirements Plan (MRP) to identify the necessary raw materials, components, and subassemblies needed to manufacture the finished goods. Necessary production levels can then be calculated by work center and bottlenecks can then be identified. In this traditional production environment, lack of visibility can cause coordination problems. For example, because work is simply sent to the next work center without concern for the workload at the next work center, surges or delays in upstream production could result in WIP stock level increases or production delays. As a result, the downstream work center must communicate with the work center upstream to plan for the timing and quantity of demand in order to mitigate delays. For example, Devika et al. (2016) found that lack of communication downstream resulted in lack of process integration and increased inventory.

Similarly, in the migration context, investments in migration management have resulted in reduced bottlenecks (Spearman and Zazanis 1992). This is done with coordination and planning to alleviate pressure points along the migration path. On a micro level, for-hire migrant brokers can facilitate pre-departure training, organize medical tests, and collect citizenship documentation (Goss and Lindquist 2000). In situations where individuals are migrating for work, a recruitment company hired by a potential employer can anticipate, expedite, and assemble the necessary documentation to avoid travel delays (Xiang and Lindquist 2014). In addition, the literature also identifies the importance of family and social connections to help navigate and finance a smooth migration journey (Boyd 1989; Curran and Rivero-Fuentes 2003). Similarly, on a macro level, NGOs can work with upstream and downstream partners to communicate migrant needs and fluctuations in demand patterns (Jahre and Jensen 2010; Schulz and Blecken 2010). This interorganizational cooperation results in more supply chain visibility and can increase the probability that appropriate resources are available (Tatham and Pettit 2010).

4.2.3 Properties and creation of agile structural variable

Based upon the literature and evidence from the case study interviews, the following properties for the degree of bottlenecks variables were identified (Table 3): inter-organizational coordination, family downstream coordination transportation ease, border controls, cultural similarities, legal rights of the migrants, and cultural similarities along the network path. Inter-organizational coordination can include zero-level, two-level, or multi-level points along the network. Similarly, transportation can either be non-existent, somewhat available, or frequently available. Border control can be both physical and legal in nature, preventing the free flow of migrants. Cultural similarity of the migration population to that of the locals can also vary from minimal to extensive as the migrants move along their migration path. Finally, some migrants might enjoy a degree of legal status, protection, and rite of passage while others may be more vulnerable.

Based upon structured interviews we classified the agility structural variable for each of the eleven cases (Table 5). We found that for Rohingya refugees there was a low (1, 1) degree of agility, while Guatemala migrants faced low/medium levels of agility along the path (2, 1). Migrants from Bihar and villagers in Vedullavalasa, Purreyavalasa, and Kondadadi were classified as having medium level of agility. B.G.Palem and Korruvanivalasa villagers faced a medium/high level of agility. Finally, villagers from Mandiravalasa faced the highest level of agility.

4.3 Total cost of migrant network (TCMN)

In manufacturing environments, research has shown a positive link between agile strategies and high levels of firm performance (Christopher and Towill 2000; Qrunfleh and Tarafdar 2014). Yet, higher levels of agility are not necessarily associated with lower costs. Mason-Jones et al. (2000) found that while lean strategies prioritize cost reduction, agile strategies aim to maximize service. While agility captures both a firm's internal performance and service to the market, it fails to capture costs that cascade through the supply chain. Because agility emphasizes service as a primary focus, this orientation could result in higher internal costs, yet higher service and lower external costs. As a result, it is critical to study the relationship between supply chain agility and calculate costs along the supply chain to assess the Total Cost of Ownership (TCO).

	BOM complexity		
	High	Medium	Low
Degree of b	ottlenecks along supply chain		
Low	(3, 1) Medium agility <i>Bihar</i>	(3, 2) Medium high agility	(3, 3) High agility Mandirava- lasa, Rickshaw Colony
Medium	(2, 1) Low/medium agility Guatemala migrants	(2, 2) Medium agility Vedul- lavalas, Purreyavalasa, Kondadadi, Bondapalli	(2, 3) Medium high agility B.G.Palem, Korruvanivalasa
High	(1, 1) Low agility <i>Rohingya</i> refugees	(1, 2) Low/medium agility	(1, 3) Medium agility

Table 5 Agility structural variable

Originating in the purchasing literature, the TCO is a philosophy and a tool used to understand the true cost of buying a particular good or service from a supplier (Ellram 1995). Evidence suggests that firms with a better TCO understanding make better decisions resulting in higher levels of competitiveness and profitability (Ellram and Siferd 1998). In the procurement context, TCO considers costs beyond purchase price to compare the longterm outcomes among several decision alternatives (Ferrin and Plank 2002). Similarly, in the manufacturing context, the TCO principle has been used to understand TCO for larger capital expenditures beyond the acquisition price to also consider the cost to use, maintain, and dispose of assets (Monczka and Trecha 1988). Over time, the TCO concept has been extended to other contexts comparing information technology choices (David et al. 2002) and has been used as a process improvement tool in the service sector (Hurkens et al. 2006). In addition, Ellram (1995) suggests that TCO concepts can be extended to the entire supply chain as a means to understand total channel costs. These end to end supply chain costs could include costs associated with research and qualification of suppliers, order placement, product purchase, shipping, holding inventory, overhead, product inspection, product replacement, and product disposal (Ellram 1995; Ferrin and Plank 2002). These researchers found that the TCO framework can be used when the firm is able to translate performance measures into monetary terms in order to compare decision alternatives.

The TCO framework could also be useful in the migration context to balance respective stakeholder priorities. Even if migrants are prepared for the travel costs associated with the journey, many migrants are unable to fully anticipate the range of costs involved from origin to destination. Furthermore, network supporters such as NGOs, governments, communities, and international agencies bear many of the unanticipated costs. These costs may be associated with procuring food, shelter, transportation, and documentation (Xiang and Lindquist 2014). In addition, migration comes with significant health and safety risks. Migrants are often exposed to violence, communicable diseases, substance abuse, and sexual abuse. Furthermore, psychosocial issues often arise as migrants become separated from the social structure they were previously accustomed to (Carballo and Nerukar 2001; Gushulak and MacPherson 2000; Gushulak et al. 2009). Finally, attempting to enter a country illegally may result in incarceration and legal charges limiting future employment opportunities (Gushulak and MacPherson 2000).

Based upon the literature and the field case study, the total cost of migrant network is accumulated by taking into consideration the lead time of the journey, health and safety of migrants in transit, internal failure cost of travel and supplies, and external failure (see Table 6); these properties range from low to high. Lead time in transit can range from days to months and even years. Even if migrants can reach their destination, the difficulty of the journey could result in migrants succumbing to serious health problems. Dangerous conditions may result in some migrants getting raped, assaulted, and even kidnapped. As migrants make their journey, the travel costs can range from minimal to extremely expensive. Total costs may be low if the migrants reach their final destination and are able to effectively participate in the new society. However, total migration costs will increase if migrants are deported or stuck in intermediate locations.

Based upon the interaction of the pressure structural variable (Table 4) with the agility structural variable (Table 5), we have created a Total Cost of Migrant Network (TCMN) process variable (Table 7). The various cases are classified within this table. Thus, on the extreme end of the continuum, the Rohingya refugee network incurs the highest levels of TCMN (3, 3), while migrants from Mandiravalasa village incur the lowest levels of TCMN (1, 1). The Guatemala migrants incur relatively high levels of TCMN (2, 3). The migrants from Bihar and villagers in Purreyavalasa are associated with moderately high levels of

	High	High (months/years)	Death, rape, kidnapping, serious health aliments	Migration process repeated	Expensive journey	Deported or stuck in intermediate location	
	Medium					Reach sub- stitute	point
	Low	Low (days)	Healthy upon arrival	Single journey	Inexpensive journey	Reach final destination point	
	Reference	Shannon et al. (1973)	Zimmerman et al. (2011)	De Haas et al. (2015)	Carrington et al. (1996)	De Haas et al. (2015)	
migrant network (TCMN)	Properties	Lead time to desired final destination	Health (quality)	Rework (internal failure)	Cost	Failure	
Table 6 Properties total cost of 1	Structural variable	Total cost of migrant network (TCMN)					

			Pressure	
		Low	Medium	High
Agility	Low	(3,1) Medium TCMN Rickshaw Colony	(3,2) High/medium TCMN	(3,3) High TCMN Rohingya refugees
	Medium	(2,1) Low/medium TCMN Bondapalli Konda	(2,2) Medium TCMN Purreyavalasa Bihar idadi	(2,3) High/medium TCMN
		Vedund	<i>watas</i>	Guatemala migrants
	High	B.G.P.	alem Korruvanivalasa	
		(1,1) Low TCMN Mandiravalasa	(1,2) Low/medium TCMN	(1,3) Medium TCMN

 Table 7
 Total cost of migrant network (TCMN) structural variable

TCMN (2, 3), while Vedullavalasa, Kondadadi and Korruvanivalasa networks incur relatively moderate levels of TCMN (2, 2). Finally, B.G.Palem network incurs low to medium level of TCMN (1, 2).

5 Discussion

In this research, we developed a new framework to connect push/pull process variables with BOM complexity and degree of bottleneck pressure along migrant networks while also considering the total cost of migration. This framework is of significance as it connects the migration literature with the supply chain literature and correspondingly differentiates and defines properties for process variables among different stakeholders.

The framework developed in this paper can be used to provide recommendations based upon an examination of stakeholders' trade-offs between investments in development (mitigating push properties) relative to investments managing migration flows to ensure agility (e.g. safer passage). Specifically, the model provides specific areas (properties) where resources can be channeled from one process variable to another. Similar to manufacturing supply chains, more investment in development upstream could potentially reduce more expensive expenditures to create agile flows downstream. For example, some countries fund and implement border controls to ensure a high degree of bottlenecks in the network path (Table 3). Instead, some funding could potentially be diverted to ensuring the push conditions ameliorate the sourcing location (Table 2).

The typology also provides a way to directly compare the level of migration pressure faced among communities locally and globally (Table 4). This will help local, regional, and global organizations assess different levels of push and pull migration and then rationalize resource allocation. Furthermore, the model provides insights into assessing the level of agility of different migrant flows across the world (Table 5). Finally, in Table 7, it is possible to compare the total cost incurred among migrant groups. The typology developed in this research can provide direct recommendations for practitioners and offer insights for future research. Finally, the typology provides innovative prescriptions for the developmental sector and those supporting migration management.

5.1 Development

To reduce the flow of mass migration, it is critical that governments and development agencies focus upon reducing the push conditions (Table 2) at the local level. Thus, resources should be targeted to reduce unemployment, boost wages, build an equitable civil society, provide better government services (e.g., education, healthcare, housing), and reduce debt (e.g., debt forgiveness or micro-credit loans). Similarly, to reduce the strength of the pull conditions of destination locations, governments could subsidize comparable employment opportunities in local villages.

5.2 Management of migrant flows

5.2.1 Genocide and other forced migrations

It is possible that violence and genocide might be prevalent in certain regions of the world where the civil society collapses. In these situations, the government may be unable or unwilling to provide services to certain groups. As such, there would be intense pressure (push) to migrate. It is critical for such refugees to be supported by services that facilitate a more agile migration flow. Agencies supporting the refugees should expect a complex BOM with entire families migrating, an increased risk of health problems, and must be cognizant of the unique cultural and religious needs of the migrants. The NGOs and developmental agencies should look to support upstream and downstream coordination among supporting partners, develop inexpensive and frequent transportation between the transit hubs, help gain legal rights for refugees, work in removing physical and legal barriers at border crossings, and facilitate family reunifications at the destination countries.

5.2.2 Economic migrants

Many economically advanced countries are concerned with the challenges of mass migration at their borders; especially if it consists of migrants seeking a better life. To control the flow, developed countries can either reduce the pressure (Table 4) or reduce the agility (Table 5) of migrant flows. To reduce pressure, economically developed nations can invest in reducing the push factors by increasing the development of communities where the migrants originate. Simultaneously, they can also reduce the agility of flow by erecting both legal and physical barriers along the network paths, discouraging transit nations from providing legal rights for domicile or travel, and discouraging coordination with upstream and downstream agents to guide the flow. Sometimes NGOs and other agencies are forced to work indirectly or operate in tandem with smugglers. As a result, more severe penalties for smugglers or those facilitating illegal entry would make certain migration routes less agile. In the following section, we offer explanation pertaining to how the knowledge could be applied at a micro level with a specific NGO.

5.3 Justification of the framework

The results of this research were shared with an NGO (Sodhana Charitable Trust) and the framework applied in practice to ensure external validity. In interviews with the economic migrants cared for by Sodhana Charitable Trust, it became apparent that the villagers were only focused on the direct income earned through seasonal migration while working on construction sites and in other harmful destinations. In their cost/benefit understanding, there did not appear to be a long-term understanding of potential costs due to injury and diseases. Hence, based upon this research framework, Sodhana Charitable Trust now provides information to current migrants about the long-term health costs of poor working and living conditions. This additional information aids villagers in making more educated decisions in assessing the total costs and benefits of the migration journey.

5.4 Future research

The typology sheds interesting insights that might be explored in future research. In the interview process, it became apparent that in situations where the network was agile and push pressure was not significant year-round, migration was more seasonal. This reverse flow could potentially be applicable for the manufacturing sector. The proper combination of push and pull pressures coupled with agile systems would allow for products to easily be moved from downstream to upstream locations (e.g. inventory reallocation).

In the developmental/migration context, it might be possible to measure the specific costs of push, pull, BOM complexity, and supply constraint properties to come up with an actual total cost of migrant networks. This data would then provide a more precise method in comparing trade-offs. Furthermore, the same data and functions could be used to come up with an optimal allocation model between developmental aid and border barriers. Finally, the development of communities is a long-term proposition; it would be interesting to see the dynamic effects of investments on the development and migration flows over time.

6 Conclusion

In this research, we contribute to the migration literature by borrowing concepts from supply chain management literature and applying those to the migration context. Similar to how the supply chains of manufacturing organizations must manage a set of objectives to minimize the total cost of ownership, humanitarian supply chains must also manage a different set of stakeholder objectives to minimize the total cost of the migrant network. Using the typology developed here, we are able to map the unique forces contributing to the total cost of the migrant network and make targeted recommendations that NGOs can use to better balance costs. This research is transformational in that it provides a generalization of push/pull, agility, and costs across two historically diverse fields. The model ensures a high degree of internal and external validity given the threading of the literature review and the case studies.

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