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# Challenges and Strategies in Managing Nonprofit Operations: An Operations Management Perspective

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The Operations Management (OM) community is paying increasing attention to the analysis of nonprofit operations. However, what is it about this type of operations that makes it particularly interesting to OM scholars? We address this question by studying the objectives, actors and main activities of nonprofit operations and the most common challenges they face. In addition, we suggest tactical and operational strategies to address these challenges by considering works in the for-profit sector and in different applied areas. The ultimate goal of this paper is to inspire and stimulate OM researchers to develop significant theoretical and empirical models in this novel stream of literature.

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Keywords: nonprofit operations; operations management; challenges; tools and strategies

## **1. Introduction**

Goods and services are delivered to accomplish nonprofit goals in many different settings. For example, the Weatherization Assistance Program (WAP) provides free energy-efficient services to low-income families in the United States; it is sponsored by the Department of Energy and run by county-level community-based organizations. Another example is the massive relief operation in the aftermath of the 2010 earthquake in Haiti, in which the American Red Cross (ARC) spent \$148.5 million of cash donations to provide food, water, medical care, emergency shelter, cash grants, and other essentials in the first six months.

Although they appear to be very different, the operations of the WAP and ARC's relief actions are both examples of nonprofit operations. Thus, we define a nonprofit operation as a set of actions that focus on the provision of goods or services by a nonprofit organization (NPO). In turn, an NPO is an organization that is formed and operates with a goal different from earning profit. That is, if surplus income is realized, then it should not be distributed to the organization's shareholders as profit or dividends. This constraint is technically called the "nondistribution constraint" (Hansmann 1980) and if enforced, the organization can apply for tax-exempt status in many countries.

Market and government failure theory provides a reason for the existence of NPOs (Weisbrod 1977). When markets have characteristics such as information asymmetry, lack of competition, high search or bargaining costs, capital market imperfections, or other externalities, there is a lack of involvement of the for-profit sector. Usually, the government responds to the inefficiency by providing public goods. However, the public sector sometimes allocates these consumer goods or services inefficiently or fails to provide them in a way that the underserved communities need. In some cases, these inefficiencies are due to the strict rules and bureaucracy of the public sector. Other times, because elected officials' objectives include responding to majoritarian interests (i.e., they are interested in allocating resources and services according to the desire of the median voter), they fail to assist to minority groups. Private and public sector inefficiencies are known as market and government failures, respectively, and when one or both of these occur, NPOs step in.

Some authors consider public agencies and NPOs to belong to the same sector. Indeed, in case of market failure, both type of organizations can provide the needed goods or services and, often, they work together. In this setting, the NPO acts as the service provider and the government as the major funder. However, there are differences in the ways these two sectors operate that are relevant to Operations Management (OM) scholars. One difference, as highlighted before, is that the public sector orients its actions to provide a level of service that satisfies the average voter, whereas the nonprofit sector operates with the goal of serving specialized and niche groups (Oster 1995). Another difference is that the primary source of funding for the public sector is taxes, whereas for the nonprofit sector, it is donations. Despite the evidence of the existence of three different sectors, we alert the reader that in many places of this paper, we discuss differences between for-profit and nonprofit operations, but we do not technically discuss how a public operation might be different. OM researchers interested in analyzing public sector operations can start with the book written by

Pollock et al. (1994).

### *1.1 Nonprofit and for-profit organizations*

The nonprofit management literature has studied the major differences between NPOs and for-profit organizations (FPOs). In the following, we provide a list of differences with an emphasis on factors that cause nonprofit operations to be more inefficient than for-profit operations. The factors are general but not absolute, so exceptions can be found.

*Goals and performance metrics:* An FPO's primary goal is to obtain profit for its shareholders by offering products or services. An NPO can have multiple goals. One of these goals is to maximize the provision of a service or product, and if profits are obtained, they are reinvested in the NPO's cause.

*Stakeholders size and responsibilities:* NPOs tend to have a more complex set of stakeholders than FPOs of a similar size (Anheier 2000, Euske 2003). Anheier (2000) called this tendency "the law of nonprofit complexity". This diverse set of stakeholders is composed of board members, staff members, volunteers, clients, and beneficiaries. For example, nonprofit boards are typically larger than for-profit boards due to the need to include members of multiple constituencies and the need to show its prestige and reputation to meet additional fundraising needs (Anheier 2005). For NPOs, the large pool of stakeholders limits the control of the executive, which differs from the higher degree of autocratic control of FPOs (Euske 2003). Additionally, while FPOs are primarily responsible for their actions to their shareholders, NPOs are responsible to all their stakeholders (Hull and Lio 2006).

*Specific industries:* NPOs are present in industries where trust and reputation are important because it is hard to evaluate the quality of the good or service provided. This is especially true in developed countries that diligently enforce the "nondistribution constraint" and, by doing so, discourage these organizations from making false claims regarding the quality of their products to obtain extra surplus (Hansmann 1980). Moreover, NPOs engage in tax-exempt and donor-financed activities. The most predominant sectors are healthcare, education, community services, arts and culture, and humanitarian relief. In Section 5, we discuss the most pressing operational challenges that characterize each of these sectors.

*Challenging environments:* Difficult political and social environments, such as serving the socially excluded, difficult-to-reach geographical areas or very volatile environments, are challenging

settings where market and government failures are more likely to occur. Therefore, NPOs are often the only type of organization providing services in these environments. Operating in these environments is a major factor that makes the management of certain nonprofit operations a very complex task (Lewis 2001, Sahley 1995).

*Financial differences:* The financial model of NPOs is fundamentally different from that of FPOs for three reasons. First, NPOs cannot raise capital by issuing stock as FPOs do; second, NPOs rely on external donations as a source of equity capital, which may constrain the allocation of resources to the preferences of the donors (Fama and Jensen 1985); and third, the existence of the “nondistribution constraint” prohibits paying cash dividends from net revenues (Wedig 1994). One of the advantages of NPOs is that they can deliver goods and services at lower prices than FPOs because donors forgo claims on the cash returns earned from their donations (Fama and Jensen 1985).

*Workforce incentives:* NPOs’ employees are less driven by financial incentives and are more motivated to create societal changes than employees in FPOs (Mirvis and Hackett 1983). For this reason and because high salaries often conflict with the NPO’s stringent budget and nonprofit goal, nonprofit workers tend to receive lower salaries and fewer benefits than for-profit workers, making the ability to recruit and retain quality staff more challenging for NPOs (Wolf 1999). Additionally, volunteers are a type of workforce particular to the nonprofit sector.

*Risk taking:* There is a consensus in the management literature that NPOs tend to be more risk averse than FPOs (Wedig 1994). This risk aversion is directly related to the number of different stakeholders to which the organization is responsible (Hull and Lio 2006) and the fact that the failure of an NPO to carry out its mission places its ability to obtain future donations in jeopardy. Risk taking has been linked with innovation adoption and learning capabilities, which are two aspects for which NPOs are usually at a disadvantage compared with FPOs due to NPOs’ risk averse behavior (Hull and Lio 2006).

## *1.2 The nonprofit supply chain*

A process view of the operation will help us navigate throughout the different parts of a nonprofit operation as it is described in Figure 1. It can be observed that a simplified version of a nonprofit operation has the basic structure of any operation, which consists of suppliers, the provider and customers, with the addition of donors (in gray in Figure 1). Some of the terminology is adapted

to nonprofit operations: the provider is the NPO, and the customers are called beneficiaries. While we have already defined NPOs, beneficiaries are the recipients of the good or service the nonprofit operation provides and might or might not pay for it. For this supply chain to be entirely representative of a nonprofit operation, donors and donation flows also appear in the operation.

Commonly, in nonprofit operations, donors are driven by their own incentives and roles, and they may become a very powerful force. We further describe the major challenges that concern donors in Section 3.3. Associated with donors, flows of pecuniary and non-pecuniary (time and goods) donations can be part of the nonprofit operation (represented by gray arrows in Figure 1). Typically, these flows are necessary because they bring viability to an operation that would otherwise be unsustainable. In terms of donations, challenges include obtaining (i.e., fundraising) and managing donations, which are addressed in Sections 4.1 and 4.3, respectively.

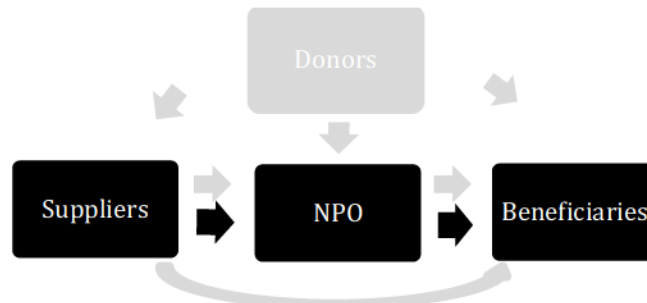


Figure 1: Major actors of a nonprofit supply chain.

### 1.3. Framework of the paper

This paper is organized into discussions of the objectives, actors and activities of nonprofit operations (Table 1). Section 2 discusses the objectives of nonprofit operations. Section 3 describes the roles and challenges of the major actors of a nonprofit operation. Section 4 discusses the most notable and challenging activities that occur in a nonprofit operation. Section 5 summarizes the different types of nonprofit operations. Finally, in Section 6 we briefly summarize the paper and provide some guidance for future research in the form of a call for research.

Table 1 Structure of the paper.

Objectives §2	Actors §3	Activities §4
Multi-criteria tools used by FPOs	NPO §3.1	Fundraising §4.1
Multi-objective optimization	Suppliers §3.2	Cross-subsidization §4.2
Equity	Donors §3.3	Managing donations §4.3
Efficiency	Beneficiaries §3.4	Allocation policies §4.4
Effectiveness		Pricing §4.5

We intend for this paper to be comprehensive, and we select references from a variety of fields such as OM, economics, nonprofit management, and sociology to better illustrate the concepts presented. This paper introduces and analyzes the peculiarities of nonprofit operations from an OM perspective, and its ultimate goal is to inspire and stimulate researchers to develop significant theoretical and empirical models in this novel stream of literature.

## **2. Objective(s) of a nonprofit operation**

While profit is the overall goal of a for-profit operation, no single goal can adequately represent all nonprofit operations. Anthony and Young (1988) claimed that the lack of a single nonprofit performance measure makes it challenging to fairly compare different entities by conducting a simple broad quantitative analysis. Additionally, the lack of such a measure also makes the decentralization and delegation of decisions within the same organization difficult.

Economics and management studies have considered the challenge of finding the best performance measure for NPOs. Kaplan (2001) suggested adapting the for-profit sector balanced scorecard framework to suit NPOs, for example, by changing the financial measures at the top of the scorecard to an “overarching” mission objective or including donors’ perspectives in customers’ perspectives. Similarly, the triple bottom line accounting approach used by some FPOs (e.g., B corporations) could be adapted to NPOs (Kim et al. 2016). In their book, published in 1986, economists James and Rose-Ackerman identified different types of NPO objectives: maximizing managers’ objectives (quality, quantity, product type, revenue, or revenue minus fundraising costs) while ignoring beneficiaries’ and donors’ preferences; maximizing ideological goals subject to survival constraints; and maximizing a dominant group’s interest (such as doctor’s income in hospital operations or time spent by tenured professors on research in a university setting).

To study operations involving multiple criteria or multiple agents, OM researchers often design models with multiple objectives. In general, these models do not have a single “best” solution; rather, the goal is to find the set of non-dominated solutions, where a non-dominated (a.k.a. non-inferior or Pareto optimal) solution is a solution for which an improvement in one objective requires the degradation of another. Specific multi-objective optimization techniques such as goal programming (GP), the weighted sum method, and the  $\epsilon$ -constrained method are used

to identify this set (Daskin 2011). Under this multi-objective setting, many nonprofit models include an equity or fairness objective combined with another conflicting objective (e.g., Balcik et al. 2010b, McCoy and Lee 2014). An equity measure is included because demand exceeds supply in many nonprofit settings (see Section 4.4), and it is important to consider distributional equity. Equity or fairness is a measure that reflects the notion that human beings believe that rewards, punishments and resources should be distributed according to a combination of different criteria: merit, need, equality, and procedural (Leventhal 1976). There is a large list of equity measures, where proportional fairness and max-min fairness are two of the most well-accepted and axiomatically justified measures (Bertsimas et al. 2011). Often, a combination of equity and efficiency measures is employed. Note that efficiency is also widely used in the for-profit sector and reflects the ratio of output to the total input needed to run an operation.

In addition to efficiency, other popular measures in the for-profit sector can be considered for nonprofit operations. One of the most often used measures is effectiveness, which represents overall output and is defined as the level of satisfaction of a need and the alleviation of its adverse impacts (Savas 1978). In fact, some scholars (Johnson and Smilowitz 2007, Savas 1978) claim that efficiency, effectiveness, and equity are the basic and essential conflicting measures that are considered in public settings and can also be applied to nonprofit operations. An example of this is Swaminathan (2003) who uses equity, efficiency and effectiveness measures in the context of free drug distribution by an NPO to multiple clinics. Additionally, each specific nonprofit applied area has unique features that drive the type of metrics that should be utilized, for example, response time for humanitarian relief operations or quality-adjusted life year for healthcare operations. Other measures that are particularly linked to nonprofit operations are equality, social welfare, poverty reduction, and sustainability (Berenguer 2016).

The involvement of multiple agents in a nonprofit operation exacerbates the challenge of measuring this type of operation because each agent might have conflicting and myopic goals. Inefficiencies have been attributed to coordination issues in different applied areas: global health supply chains (Kraiselburd and Yadav 2012), humanitarian logistics (Thomas and Kopczak 2005), and community-based operations (Johnson and Smilowitz 2007). We further discuss coordination issues in the next section.

### **3. Actors in a nonprofit operation**



In the following paragraphs, we describe the role of each actor in a nonprofit operation and the relationships with other organizations. We start by describing the NPO's intra-organizational relationships and the NPO's inter-organizational relationship with organizations (NPOs §3.1.1 and FPOs §3.1.2) external to the nonprofit operation. Next, we discuss the relationships between the other actors in the nonprofit operation (the suppliers §3.2, donors §3.3, and beneficiaries §3.4) and the provider NPO. Special attention is devoted to the donors' case because it includes peculiar challenges and there are interesting strategies that can be used to address the challenges. In general, coordination issues that arise between different actors in a nonprofit supply chain are exacerbated due to this sector's lack of formal contracting and insufficient investments in information systems technology (Bradley et al. 2003, Kraiselburd and Yadav 2012, Tomasini and Van Wassenhove 2009).

### *3.1 The nonprofit provider*

We first examine the intra-organizational structure of NPOs, which tends to be more decentralized than that of FPOs (Oster 1996). One reason for this decentralization is that local divisions (last-mile organizations) are devoted to their mission, and thus, their priority is to be responsive to their beneficiaries. This local focus, coupled with a lack of investment in information technology due to stringent budgets, can create information opacity between the different divisions of an NPO and lead to excessive administrative costs, which can result in inefficiencies (Bradley et al. 2003). Another factor that exacerbates decentralization is the earmarking of funds for specific units of the NPO. For instance, a single organization, such as World Vision International (WVI), could be running different programs (e.g., malaria and schooling programs) in the same province in Kenya. These programs are not allowed to share resources, such as the use of vehicles or spare parts, because they are funded by different donors (Bhattacharya et al. 2014). Regarding intra-organizational structures, it has been empirically tested that a franchise-type of model is preferred by NPOs over the regular FPO branch model (Oster 1996). The franchise model provides the necessary level of autonomy to local divisions (franchisees) to be able to run their operations and manage their finances independently from the headquarter NPO (Bilodeau and Steinberg 2006).

#### *3.1.1 NPO's relationships with other external NPOs*

According to Oster (1995), collaboration is more common between NPOs than between FPOs, and it is encouraged by multiple factors, including shared values and missions, shared volunteers,

shared lines of action with repeated interactions, the ability to credibly commit to cooperation, and low gains from competition. Such collaboration can greatly benefit all parties because they can share resources and increase service provision. Examples can be found in the early care and education area, where NPOs engage in interagency collaboration to use the resources (monetary and nonmonetary) attached to the collaboration to strategically address certain service gaps to improve care (Sowa 2009). Another more concrete example in the relief operations literature is the coordinated use of an IT tool by different organizations to improve last-mile distribution in refugee camps after the 2010 earthquake in Haiti (Ergun et al. 2014).

By contrast, several factors constrain collaboration between NPOs. Similar to the intra-organizational collaboration issues, Bhattacharya et al. (2014) stated that earmarking of donations, decentralized decision making and severe budget constraints are such key constraints. Donors disincentivize organizations to collaborate by funding individual organizations based on their stand-alone performance to address some particular situation. This makes it difficult for different NPOs to share resources and subsequently creates competition because resources are limited. In fact, NPOs may compete for the same pool of donations/funds, revenues, board members, labor, and/or beneficiaries. For example, competition is common in the early stages of relief response, when there is global attention and high funding levels, and organizations are reluctant to share information if it gives them a competitive advantage over others (Balcik et al. 2010a). Another example is nonprofit social marketing agencies that compete for clients and funding in the same space (Ritchie and Weinberg 2000).

### *3.1.2 NPO's relationships with external for-profit parties*

Nonprofit providers are becoming increasingly aware that collaborating with for-profit parties can be mutually beneficial. On one hand, NPOs obtain resources and expertise from the for-profit sector, and on the other hand, commercial organizations can benefit from opportunities to improve their impact on society, fulfilling their corporate social responsibility duties (Tomasini and Van Wassenhove 2009). There are numerous examples of such collaborations, such as the CARE-Starbucks Alliance in which CARE acted as the knowledge provider of Starbucks' development projects and Starbucks publicized CARE in its stores and shared with CARE the profits gained from selling special coffee packages from the project countries (Care 2016). Another successful partnership occurred when FedEx helped Heart to Heart International respond to humanitarian disasters by donating and ensuring expedited shipments in exchange for advertisement (Heart

2016). Researchers in nonprofit management have studied this type of partnership extensively (e.g., Austin 2000, O'Regan and Oster 2000). These partnerships come with challenges related to the different incentives of for-profit and nonprofit employees (as noted in Sections 1.1 and 4.6). According to O'Regan and Oster (2000), the different incentives and training of managers in these two types of organizations make it challenging to agree on the specifics of contracts as well as to successfully run operations.

NPOs compete with FPOs in certain environments. In some situations, a funder might finance both NPOs and FPOs in the same marketplace, which fosters competition. Examples can be found in Medicare and Medicaid programs, voucher schemes for education and workfare programs (Tuckman 1998). While NPOs have competitive advantage in terms of reputation, they might struggle to produce a higher quality and lower cost product or service than an FPO. Oster (1995) claimed that the type of competition that typically can be observed is monopolistic competition rather than perfect competition, that is, product competition rather than pure price competition. Furthermore, it is common to observe that both types of entities specialize in different market niches. For example, regarding childcare, for-profits can be observed in the areas of cities where the middle- to upper-income population lives, and thus, high fees can be charged to cover their costs; nonprofits are typically located in the centers of cities and near low-income populations. This difference is in line with the market failure theory, where for-profits will not enter a market that is inefficient for them. Additionally, the ability of NPOs to raise funds from different sources, other than fees, can help them remain financially sustainable (Oster 1995).

Some NPOs also run commercial operations to help finance their core nonprofit operations (i.e., cross-subsidize; see Section 4.2 for more discussion), which may cause competition with FPOs because these for-profit operations generate sales revenues. FPOs might claim unfair competition when an NPO's operation is subject to subsidization, for example, via tax-exempt outputs (Weisbrod 1988).

### *3.2 Suppliers*

Owing to the nature of nonprofit operations, some mechanisms and tools used to manage the relationship between suppliers and for-profit providers cannot be directly implemented in the nonprofit context. For example, in humanitarian relief logistics, tools that are used by the commercial sector to improve logistical coordination, such as no-show penalty fees or overbooking,

are not observed in the relationship between suppliers and NPOs (Dolinskaya et al. 2011). In general, for NPOs in the humanitarian relief sector, OM scholars claim that there is an absence of formal contracts between suppliers and nonprofit providers, which triggers challenges in terms of sharing risks and costs (Balcik et al. 2010a, Dolinskaya et al. 2011).

In-kind donations represent a type of supply that is particular to nonprofit operations and can be observed in any applied area (see more details in Section §4.3.1). This type of donation has an uncertain nature that can affect the regular sourcing of procured supplies. On one hand, due to in-kind donations, the level of the procured supplies can decrease on average; on the other hand, accepting in-kind donations can increase the variability in the procurement process. In the area of humanitarian relief operations, a third type of stock related to pre-positioned supplies is added to in-kind donations and procured supplies. Despite the existence of these three different sources of supplies, Balcik and Ak (2014) claimed that post-disaster procurement is the most common sourcing method in humanitarian relief operations, which alludes to the regular procurement practices in for-profit operations. From this discussion, we observe that there is an opportunity to study and put into practice new contract mechanisms that exploit the unique features of the supplier-nonprofit provider relationship.

### *3.3 Donors*

For nonprofit operations that depend on donations, the power of donors is important and typically increases with the amount of funds. Major donors can influence organizational change, shape future agendas and investments, and help monitor the performance of nonprofit operations (Fama and Jensen 1985). This enforcement role played by the donor arises from the lack of an equity market and the lack of clear and quantifiable performance measures for nonprofit operations (Oster 1995). Notably, the role of angel and venture capital investors in startups and social enterprises might have some parallelisms with the role of donors in NPOs, especially in the early stages of startup growth.

In the following, we delve into the characteristics of the vertical relationship between donors and NPOs (§3.3.1) and the horizontal relationship between multiple donors in a nonprofit operation (§3.3.2).

#### *3.3.1 Donors' relationship with NPOs*

In the United States, the government is the major donor to NPOs. Studies on the relationship between the government (donor) and NPOs (provider) can be found in the economics literature on the transactional model (e.g., DeHoog 1984 and Grønbjerg 1993). In this model, the government provides financial resources to reduce the startup costs of NPOs so they can quickly respond to specific community needs (Salamon 1987).

OM researchers are beginning to study the donor-provider contractual relationship in nonprofit operations. In relation to the aforementioned enforcement role of the donor, Privett and Erhun (2011) studied auditing-based contracts between a funder and an NPO by using the principal-agent framework. The study claimed that proper auditing improves overall efficiency in the nonprofit sector.

Governments and international agencies sponsor nonprofit and for-profit providers to sustain certain operations that offer products or services with a societal impact (e.g., solar stoves, vaccines and food). OM scholars have rarely studied this relationship where the provider is an NPO. One example is Berenguer et al. (2017b) who compared the purchase and sale subsidy of a donor through a for-profit and nonprofit channel when pricing is exogenous and endogenous. They found that when the recipient of funds is an NPO, a purchase subsidy is always more effective. However, this is not always true for FPOs, where a sale subsidy is preferable when the overall subsidy donated is large and the firm has pricing power.

### *3.3.2 Multiple donors' relationships in the same nonprofit operation*

Empirical studies show evidence that points to a persistent lack of coordination in the aid efforts of major donors in different nonprofit applied areas (Aldasoro et al. 2010). This lack of coordination is one of the major factors causing aid ineffectiveness because it imposes higher transaction costs and creates negative incentives (Bigsten 2006). OM works have recently corroborated this thesis in the global health and humanitarian relief sectors, which are two nonprofit sectors that usually involve large global operations. Berenguer et al. (2016) empirically observed that donation flows from multiple donors increase managerial inefficiency in the global health environment. In the humanitarian relief field, it has been observed that a combination of multiple donors and a high operational mix of development and disaster response programs lead to a decline in service levels (Besiou et al. 2014).

Various strategies that can create an environment that favors donor coordination have been discussed in the development economics literature (e.g., Knack and Rahman 2007) as well as in

the global health OM literature (e.g., Kraiselburd and Yadav 2012). These can be categorized into two major strategies: establishing a leading coordinating organization and having independent organizations publish various donor performance metrics.

Regarding the first strategy, the coordinator can be the leading donor organization (e.g., a UN agency or the military), a supra-organization (such as the Global Fund or the Clinton Health Access Initiative, (CHAI)), a coalition or partnership of the donors (e.g., Interagency Supply Chain Group (ISG)), or the local government. The coordinator can enable the pooling of donations; oversee product purchases, transportation services, and inventories; and promote capacity and information sharing. However, pooling makes it difficult, if not impossible, to track the impact of individual donor's funds, so donors do not have full visibility of their specific donations (Gulrajani 2016, Kraiselburd and Yadav 2012). Regarding disaster relief, Stapleton et al. (2010) claimed that the main objectives of the coordinator are to guarantee visibility, a unified objective, trust, and a brand name for the alliance. In addition, Dolinskaya et al. (2011) noted that coordination by command has been the most effective coordination mechanism in humanitarian relief.

In the for-profit sector, global supply chain companies act as coordinators by providing trade and logistics services to suppliers in the same for-profit supply chain space. An example in the consumer goods space is Li & Fung, which specializes in matching retailers (uncertain demand) with suppliers (capacity). Although this type of FPO could act as a coordinator in nonprofit operations, this rarely occurs.

The second strategy is having independent organizations publish various donor performance metrics (e.g., think-tank organizations such as the Center for Global Development). Examples of these measures include “how each donor proliferates aid across recipients and sectors” and “the frequency of delegation to lead donors” (Knack and Rahman 2007). Publishing these figures may encourage donors to mitigate the effects of donor fragmentation by increasing their willingness to collaborate more with other donors or by concentrating on fewer and larger donation operations. However, to our knowledge, it is still uncertain what level of impact this strategy has and what specific performance metrics are more effective for achieving this goal. This strategy has parallelisms in the for-profit sector, where independent organizations publicly disclose some aspects of FPOs' performance, such as their environmental performance, to nudge FPOs to be more responsible.

### *3.4 Beneficiaries*

For a nonprofit operation, the types of “clients” can be classified as those in the public administration literature: paying consumers, beneficiaries, and obligatees (Alford 2002). Beneficiaries receive the service for free, so they do not participate in an economic exchange with the provider. For this type of customer, rather than trying to serve the greatest possible demand, the provider’s major challenge is to ration the offered goods or services, which are limited by budget constraints. Additionally, another relevant decision is how to segment paying and non-paying clients. Obligatees have to be persuaded to receive the service; thus, they are served against their will, for example, prisoners in a nonprofit private prison. This classification reveals a few major differences between the customers of a nonprofit and those of a for-profit operation. For the sake of simplicity, in this paper, we refer to all types of clients of a nonprofit operation as beneficiaries.

Demand uncertainty is a challenge in any operation, but it is a particularly common issue in nonprofit operations. Nonprofit operations often face abrupt changes in demand (especially in disaster relief settings), mostly due to the following reasons: 1) lack of information sharing between multiple stakeholders, and 2) a shortage of available funding for collecting data, monitoring and demand forecasting. The latter is particularly true in developing regions, where it is challenging to obtain reliable public information, such as market size, income levels, or even the location of various populations (Levine et al. 2008). In addition, most NPOs do not appreciate the long-term payoff of gathering and analyzing data for forecasting, which contributes to a shortage of funding for this purpose (Bradley et al. 2003).

If resources and strategic decision making are devoted to mitigating the effects of demand uncertainty, NPOs can implement strategies that are often used in the for-profit sector. We provide, in the following, a list of these strategies, with examples of studies and implementations in the nonprofit sector:

- Strategic tools such as agile supply chains or pull systems (Oloruntoba and Gray 2006).
- Pre-positioning (Akkihal 2006, Apte 2009, Balcik and Beamon 2008, Duran et al. 2011) and stockpiling (Adida et al. 2011, Beamon and Kotleba 2006, Bravata et al. 2006), which are location and inventory management strategies, respectively.
- Risk pooling, which aggregates multiple types of demand to compensate for demand fluctuations in different sites or organizations (Balcik et al. 2010a, Jack and Powers 2004).

- Stochastic dynamic programming as the tool for making operational decisions (Lien et al. 2009, McCoy and Brandeau 2011).
- Forecasting techniques to estimate future demand (Levine et al. 2008, Van der Laan et al. 2016).
- Simulation (Das et al. 2008) and system dynamics (Fleßa 2003) models.

#### **4. Activities in a nonprofit operation**

In this section, we review the most interesting and challenging activities that take place in nonprofit operations, including fundraising, cross-subsidization, managing donations, supply and resource allocation, pricing, and workforce management.

##### *4.1 Fundraising*

As indicated initially when discussing their financial differences, NPOs have different means of raising capital than FPOs because they cannot issue stock and cannot easily obtain loans backed by shareholder investment (Privett 2012). The most common ways to raise funds are through seeking donations, winning grants, employing volunteers, charging fees, utilizing bonds, and accruing investment earnings (Steinberg 2006). A critical operational challenge related to fundraising is assessing how much money should be spent on fundraising efforts. Indeed, a competition for donations could increase fundraising costs to exceed a level that donors would find acceptable. Oster (1995) stated that fundraising efforts should follow a marginal analysis, so when fundraising efforts yield higher revenues than incremental costs, fundraising should be expanded. A similar problem is characterizing the determinants of giving. Empirical works have studied the efficient and optimal design of multiple strategies such as direct marketing strategies (Durango-Cohen et al. 2013) and donor-institution interactions such as class reunions of alumni (Netzer et al. 2008). Additionally, ways to increase (private or public) donation revenues have been modeled. For example, McCardle et al. (2009) used a utility function model to show that a tiered donation structure allows the recipient organization to receive larger donations because different tiers are associated with different reputations.

Charity auctions are organized by charities or NPOs to raise money for their projects and are considered a subset of auctions specific to the nonprofit sector. Engers and McManus (2007) compared equilibrium bidding and revenue across three charity auction formats: first-price winner-pay, second-price winner-pay, and first-price all-pay. Theoretically, the all-pay auction dominates



the winner-pay auctions. For an empirical study of bidding behavior in charity auctions and lotteries, refer to Schram and Onderstal (2009). An interesting practice that is used in the for-profit sector and could be commonly adopted in the nonprofit sector is crowdfunding, through which ventures or projects are funded by raising many small amounts of money using the internet as the major platform.

#### *4.2 Cross-subsidization*

When funds are not sufficient and sales are a possible revenue stream, cross-subsidization is a strategy that consists of blending for-profit and nonprofit practices by subsidizing charity services with fee services. This strategy has been used by NPOs in sectors such as healthcare and arts and culture. An example of cross-subsidization is the Aravind Eye Hospital in India, where profitable fee-charging hospitals subsidize care at free hospitals. An example of OM works in this area is de Véricourt and Lobo (2009) who studied the dynamic allocation of hospital assets between for-profit and nonprofit activities to maximize social benefit in this two-revenue types (donations and sales) setting. In the economics literature, Segal and Weisbrod (1998) claimed that these two types of revenue are not independent and estimated a set of structural and reduced-form empirical models using data from five different nonprofit industries showing that a significant negative relationship exists between donations and sales. They claimed that donations crowd out commercial activities since NPOs have a certain aversion to commercial activities because they do not fully maximize revenues that are not related to the mission. This topic can be further studied in OM research; researchers could further analyze this dependence and explore the link between sales and donations to improve donation forecasting or fundraising efforts.

#### *4.3 Managing donations*

The major revenue sources of a nonprofit operation can be divided into three types: fees from the provision of services or goods, grants from the government, and private donations. To gain a sense of the weight of each of these revenue sources, we refer to a recent study by the John Hopkins University Center for Civil Society Studies, which found that NPOs from a pool of 12 different countries on average derived 43% of their revenue from fees charged for services, 32% from government sources, and 23% from private philanthropic donations (Salamon et al. 2013). Furthermore, private donations can take three basic forms: cash, time, and goods (or in-kind), and each form has its own peculiarities. For the sake of simplicity, in this paper, we use the term

donation to refer to any revenue flow that is not a fee obtained for a service or a good.

We start this section by describing the major characteristics of two specific types of donations: in-kind donations and grants. Voluntary labor is discussed in Section 4.6. We then highlight the major challenges of managing donations, earmarking and addressing uncertainty, which are associated with most types of donations. Strategies to mitigate these challenges are also provided following the description of each challenge.

#### *4.3.1 In-kind donations*

Corporations make in-kind donations to offload overstocks, claim tax deductions, or enter new markets (Hellenius and Rudbeck 2003). Individuals donate in-kind gifts to be helpful, and some prefer to donate in-kind over cash because of issues related to trust and efficacy (Ülkü et al. 2015). However, nonprofit providers strongly prefer cash donations over in-kind donations (Tomasini and Van Wassenhove 2009). Cash donations provide flexibility, whereas in-kind donations are earmarked-at-source donations that are difficult to coordinate in terms of matching the best timing and best size with demand. Moreover, the quality of the supply may be inadequate, and resources otherwise devoted to relevant activities need to be redirected to handling, sorting, and testing the in-kind donations, which entail costs. Thus, recipients of in-kind donations should assess whether demand for the items exists and if it is worthwhile to accept this type of donation (Hellenius and Rudbeck 2003).

Ülkü et al. (2015) studied this problem analytically by replicating the donor's decision process of whether to make a cash or in-kind donation. They developed a model to maximize the total cash collected by the NPO while minimizing unsolicited or inappropriate in-kind donations. These scholars determined the optimal amount of cash to collect and made recommendations regarding the minimum cash solicitation amount.

#### *4.3.2 Grants*

As mentioned above, we classify grants as a type of donation, but they certainly have some specific characteristics. Grants have a more concrete timeframe in which NPOs need to apply for and request a specific amount of funds. Grantee organizations make the decisions, and if a grant is awarded, it is for a specific purpose (earmarked). Determining the amount of money to request for the grant and the portfolio of grants to apply for are interesting aspects of the process. Regarding the overall portfolio of donations of an NPO, empirically tests have identified the relationships that exist between different types of donations. For example, it has been tested that government

grants crowd out private donations; i.e., an increase in government grants reduces the fundraising efforts of NPOs (Andreoni and Payne 2003). This effect could be viewed differently – it could be negative because the NPO will receive fewer donations, but it could also mean that government grants are a more efficient fundraising strategy for the organization.

#### *4.3.3 Earmarking*

Donations to nonprofit operations can be earmarked for specific projects. In fact, for some international agencies, earmarked funds represent a significant portion of all their funding. For example, 70% of United Nations organizations' funding was earmarked in 2012, and for the World Bank Group, it was 40% (Tortora and Steensen 2014). Although earmarking can reduce costs and increase donations, it has the negative effect of constraining the budget, thus triggering different inefficiencies. In particular, in the context of humanitarian aid, Toyasaki and Wakolbinger (2011) found that with earmarked private donations, the overall percentage of fundraising costs is lower. However, inefficiencies have been observed in the form of employing excessive fleet sizes by NPOs that apply vehicle replacement policies with earmarked donations from multiple donors (Pedraza-Martinez et al. 2011). Lower service levels have also been observed with earmarked funding in decentralized vehicle supply chains (Besiou et al. 2014). Studying a mix of disaster and development operations, Aflaki and Pedraza-Martinez (2016) found that increasing public awareness of development programs helps organizations obtain more non-earmarked donations for disaster activities. Lack of trust is one of the major drivers of earmarked donations, as noted for in-kind donations. Thus, increasing transparency by publicizing the NPO's activities and performance can improve trust and reduce earmarking.

#### *4.3.4 Uncertain donations*

Individuals and private firms make donations that often do not involve formal commitments or contracts specifying a particular quantity or time. This results in commitment unreliability, which makes the flow of donations (pecuniary and non-pecuniary) highly uncertain in terms of both the quantity and timing of these funds. These conditions greatly affect the efficiency, scalability and sustainability of nonprofit operations (Lewis 2001). In the following, we suggest a series of strategies that could help mitigate the uncertainty of donations. These strategies can be classified as ex-ante (forecasting, financing, and traditional funding) and ex-post (payment for results (PfR) funding), where forecasting and financing are tools very commonly used in the for-profit sector.

A standard OM method that helps mitigate the effects of supply uncertainty is forecasting future donations. For example, Davis et al. (2016) used predictive modeling to estimate future in-kind donations to a local food bank. Financing is another ex-ante strategy for mitigating donation uncertainty. For example, the Pledge Guarantee for Health is a bridge financing mechanism designed by the United Nations to reduce funding volatility by facilitating short-term credit while guaranteeing future donor commitment for the procurement of health commodities (United Nations Foundation 2011). When the previously mentioned strategies are unavailable, operational strategies can be utilized. For example, when credit is unavailable and external funding is unreliable in terms of timing, Natarajan and Swaminathan (2014) proposed using a finite-horizon periodic-review inventory model to determine the optimal procurement policy. Among other results, this work claimed that receiving partial funding in a timely manner may actually be better than delayed full funding.

PfR is an ex-post funding approach that consists of postponing payment until after the implementation of an operation is complete and outcomes are observed. OM scholars are beginning to study this feedback loop type of funding. For example, Devalkar et al. (2016) studied the differences between traditional funding (i.e., ex-ante funding) and PfR funding by modeling the tradeoff between the information asymmetry inherent in funding inputs and exposing the NPO to shortfall risk by making funding contingent on output. They observed that PfR is not always the best option from a social welfare perspective because under PfR, when there is high output uncertainty, the nonprofit provider is more reluctant to invest a large amount of funding in the project. Devalkar et al (2017) suggested using a hybrid funding approach for which there are traditional donors that fund ex-ante and also ex-post donors. These scholars found that this hybrid approach could deliver up to twice the benefit of the traditional funding approach.

#### *4.4 Allocation policies*

Nonprofit operations often have limited supplies and donations available at hand. Moreover, sometimes, services or goods are provided for free or at a price below their marginal cost. Under these circumstances, demand easily exceeds supply, and a priority or rationing policy must be established based on fairness or other nonprofit measures. Rationing has been theoretically studied in OM for cases in which customers of different priority classes arrive in sequence (e.g., Topkis 1968) and for cases in which there is information asymmetry but no priority class (e.g., Cachon

and Lariviere 1999). The literature in this area mostly focuses on the supplier-customer relationship, with profits or costs as the main objectives. Waiting lists, explicit queuing, and first-come first-served schemes are possible rationing strategies that are commonly used in nonprofit operations. FPOs prefer to avoid these mechanisms and opt for expanding capacity or increasing prices (Steinberg and Weisbrod 1986). The differences between NPOs and FPOs are also reflected in situations in which eligibility requirements need to be set for rationing purposes. NPOs tend to restrict eligibility to those who are not able to pay or to a particular target group who would benefit the most from the product or service. In contrast, FPOs tend to use eligibility requirements to screen for unobservable willingness to pay (Steinberg and Weisbrod 1986).

Concerning different nonprofit applied areas, rationing is particularly relevant in humanitarian relief and healthcare operations. As noted by de la Torre et al. (2012), no publication on humanitarian relief provides standard priority guidelines for scenarios in which demand exceeds supply. However, a common practice is to give preference to the most vulnerable, particularly in the case of malnourished children. A few humanitarian organizations follow the *Sphere Handbook* to satisfy the minimum needs for a selected subset of the overall population (The Sphere Project 2011). In the healthcare setting, organ allocation is a resource allocation problem where demand exceeds supply. This problem has been studied extensively in OM. For example, Zenios et al. (2000) solved a dynamic resource allocation problem to assign kidneys to wait-listed patients. A three-criterion objective function was developed including one efficiency and two inequity measures. Another example is Alagoz et al. (2004), who employed a Markov decision process to study the optimal timing for a living-donor liver transplant. This work maximized the patient's health, measured as quality-adjusted life expectancy. NPOs and FPOs could be responsible for making these allocation decisions, where FPOs are not necessarily free to choose allocations that simply maximize profits due to regulations and other possible constraints. It would be interesting to study allocation policies under different settings where NPOs or FPOs are in charge.

The goods and services provided in some of the nonprofit settings discussed thus far can be classified as meeting critical needs, thus a stockout in such operation can often result in the loss of lives, which makes controlling potential shortages a high priority. OM scholars have developed several modeling tools to represent and limit the occurrence of these high-value loss and stockout situations. These tools include the following:

- defining shortage cost for unmet demand to prioritize stockout avoidance (e.g., Pierskalla (2005) defined shortage costs at blood centers based on the cost of processing, handling, and transporting blood in an emergency)
- providing alternative services during emergencies (e.g., Nagurney et al. (2009) designed supply chain networks with the option of outsourcing the production, storage, and delivery of critical products)
- developing a service level to control for stockouts (e.g., Samii et al. (2012) used two service levels for low- and high-priority demand in the inventory rationing of influenza vaccines)

#### *4.5 Pricing*

Traditionally, pricing in nonprofit operations is employed to control service allocation to the desired beneficiaries rather than due to motivations related to collecting revenue. Although FPOs typically establish the lowest prices at or above the marginal costs of serving a particular income-based group of customers, in nonprofit operations, the prices for low-income customers are often set below the marginal cost. However, revenue-generating NPOs are starting to adopt novel pricing schemes grounded in the for-profit sector such as value-based pricing and dynamic pricing (e.g., NPOs in the arts and culture). It would be interesting to further study these pricing schemes in nonprofit settings to see whether there might be any structural differences.

Steinberg and Weisbrod (1986) listed the most general pricing schemes used by NPOs: free to all comers, a uniform fee, and a more elaborate fee structure. Regarding the latter, sliding-scale fees, multi-part prices with separate access and usage charges, and nonlinear prices with caps and deductibles are the most popular schemes used by NPOs. These scholars hypothesized that NPOs use sliding-scale fees more often than FPOs because NPOs have a larger income-based range of consumers due to also serving clients who are unwilling or unable to pay. Therefore, the rates NPOs offer are more diverse. In addition, because consumers support the NPO's mission, they are more likely to reveal their willingness to pay and are more willing to accept the redistribution that accompanies this type of pricing mechanism.

For some goods and services (for instance, disaster relief), it is not advisable to charge a fee. Oster (1995) identified the factors to be considered in deciding whether to charge fees. It is recommended to avoid charging fees when public goods are distributed (i.e., goods that, when given to others, do not incur incremental costs), when there are large positive externalities

associated with the consumption of the good or service, when the cost of collecting the fees exceeds the benefit generated by the fees collected, and in circumstances in which donors or staff believe it is unacceptable to charge a fee. FPOs may also offer free services but typically offer them to customers they know have potential to be converted into paying customers or only to specific customer segments via price discrimination (Chestnut et al. 2018).

Finally, there is a type of pricing that is particular to NPOs -- this occurs when beneficiaries are required to pay in a non-monetary form, such as labor or supplies (Steinberg and Weisbrod 1986). This mechanism is used when it directly supports the NPOs mission or when it supplies scarce resources such as labor or material.

#### *4.6 Workforce management*

NPOs tend to be more labor-intensive than capital-intensive; thus, workforce management is a very important task. The management of volunteers and the retention of paid employees are the two major challenges of workforce management in NPOs.

Voluntary labor is one of the most distinctive features of the nonprofit sector. Volunteers represent an average 2.2% of the total workforce according to a recent 13-country study (Salamon et al. 2013). Bilodeau and Steinberg (2006) highlighted a few key aspects that need to be considered when modeling this type of labor. The first is that voluntary labor should be modeled the same way as cash donations. Moreover, these scholars note that empirical works have indicated that complementarity exists between donations of time and money. The second key notion is that although volunteer labor is free, accepting it entails the same costs for recruitment, training, supervision and retention that are incurred for any paid employee of any organization. Since volunteers do not have a contracted obligation to work, one of the major challenges is managing uncertain behavior. An example of OM work in this area is Sönmez et al. (2016), who modeled voluntary labor as a stochastic process in the context of food bank gleaning operations, where pickup volunteers and gleaning foods are both stochastic, and the model maximizes the total volume gleaned. NPOs need to devise rewards to keep volunteers engaged and reduce this uncertainty, for example, using a hierarchical structure for volunteers similar to the staff hierarchy (Oster 1995) or assigning volunteers to interesting tasks related to the NPO's mission rather than mundane tasks (Wolf 1999). These activities imply that there is a certain amount of collaboration

between volunteers and paid workers. This type of scheduling problem could be an area for future OM research.

As mentioned at the beginning of this paper, paid NPO workers have lower salaries and fewer benefits than paid FPO workers. This wage gap can be seen as a labor donation to the NPO's mission (Weisbrod 1977). Despite the existence of self-selection, where NPO employees are less driven by financial incentives and are more motivated to create societal change, the turnover rates are higher for NPOs than for organizations in other sectors (Nonprofit HR 2016). Well-known strategies that can be used to retain talent include employee recognition efforts, flexible working options and professional development opportunities, but these might be seen as “luxuries” by NPOs. Nonetheless, NPOs tend to underestimate the hidden costs of turnover (Nonprofit Leadership Alliance 2018), which might be considerably higher than retention costs.

## **5. Different types of nonprofit operations**

There are multiple ways to classify NPOs and by extension, nonprofit operations. For instance, NPOs can be classified as advocacy or service delivery organizations based on their main purpose and activities (Lewis 2001). Advocacy NPOs seek to induce the government to “do the right thing” and try to change the status quo, especially in areas related to social justice and the environment. In contrast, service delivery NPOs are dedicated to providing goods or services to meet direct needs such as education and healthcare. Another popular classification of NPOs distinguishes between relief and development operations (Byman 2000). A relief operation is a short-term activity focused on providing goods and services to minimize the immediate risks to human health and survival. Alternatively, a development operation is a longer-term activity focused on community self-sufficiency and sustainability.

Nonprofit operations can also be classified based on their different applied areas. The most relevant areas are healthcare, education, community services, arts and culture, and disaster relief. In the following, each area is reviewed and its particular operational challenges are highlighted.

### *5.1 Healthcare*

NPOs have an active role in healthcare; some hospitals, community health centers, and other healthcare facilities such as blood banks are NPOs. Economists have paid particular attention to nursing homes and claim that the proliferation of nonprofit nursing homes has occurred due to the



fact that it is not easy to evaluate the quality of service because the direct beneficiary might not be a useful source of information (the same applies to daycare centers). Due to the nondistribution constraint, NPOs are less likely to abuse the system by providing low quality service (Hansmann 1980). Common financial practices used in the healthcare field are cross-subsidization and governmental reimbursement programs for services rendered to patients. Some specific operational problems in this area include the organ allocation problem, the scheduling of scarce resources (e.g., beds and staff), and the medical facility location problem. For these problems, specific healthcare metrics can be considered such as quality-adjusted life year (QALY) and disability-adjusted life year (DALY). Other relevant issues in healthcare operations are related to supply perishability (e.g., organs and blood) as well as demand uncertainty (e.g., patient arrivals). Global health care is a subarea of healthcare that deserves special mention. The goal of global health care is to provide essential medicine to people in low- and middle-income countries. This requires a global operation that includes a wide range of different actors involved in the financing and distribution of drugs. Global health experts agree that many of the observed operational problems in this area are caused by coordination issues across multiple stakeholders with widely divergent objectives (Kraiselburd and Yadav 2012).

### *5.2 Education*

Although the presence of NPOs in the education field is significant, it has not received much attention from the OM community. One challenging problem is the college admission problem, which could be analyzed as a stable marriage problem (Gale and Shapley 1962). A second issue that is very specific to education is the management of revenues, which are typically a mix of tuition fees, government funding and private donations. Fundraising strategies to increase private donations have become more relevant since public institutions have reduced educational funding (Durango-Cohen et al. 2013). Another interesting problem in the education field is the impact of collaborations between different institutions for knowledge creation. One example is the creation of for-profit spin-offs by nonprofit universities (Gumport and Snyderman 2006).

### *5.3 Community services*

The OM community has studied community services in the area of community-based OR (Johnson and Smilowitz 2012, Parry and Mingers 1991). By community service we refer to any service provided to an entire community or to a specific underserved or underrepresented target population.

Examples of the goods and services that are provided include food, energy assistance (e.g., the weatherization program), homeless shelters, family development housing, and budget counseling. For this type of NPO, challenges related to the selection of the target population are common. Moreover, due to the close proximity of the NPO with the end beneficiaries, the most relevant operational issues are facility location, spatial planning and delivery-routing decisions. There is also a recurrent and ongoing discussion regarding the use of equity measures combined with efficiency/effectiveness measures (Johnson 2011). In the United States, a significant percentage of community-based organizations, called community action agencies, have a strong relationship with the government via the Community Action Program. This program's different funding mechanisms and overall donor-NPO power-control relationship is one of a kind (Privett 2012).

#### *5.4 Arts and culture*

Price discrimination based on different types of seats is commonly used by organizations in the performing arts industry. Additionally, NPOs in this industry might ask individuals to volunteer to pay an additional amount if the price of the ticket is lower than the value they place on the performance. This strategy is successful due to the existence of the nondistribution constraint (Hansmann 1980). Cross-subsidization is also a very common practice used by NPOs in the arts and culture. For example, museums heavily promote gift shops and special exhibitions that finance the activities that lose money but drive the mission of the NPO. Some decisions about these practices are related to the pricing and volumes assigned to these profit-generating activities (Rose-Ackerman 1986). Interesting questions arise from these activities such as whether they damage the reputation of the NPO or whether, by offering these activities, NPOs are competing with similar activities offered by FPOs. A second interesting challenge is related to the management of volunteers, including recruiting and retaining them and determining which tasks should be assigned to them, as these tasks might overlap with the tasks of paid staff (Wolf 1999).

#### *5.5 Disaster relief*

Most organizations in this area rely solely on donations, including some unwanted in-kind donations (Kovács and Spens 2007). Another relevant characteristic of disaster relief operations is that they are short term and sudden. Thus, forecasting, planning and coordination are extremely challenging tasks. Consequently, pre-positioning is a very key and specific strategy associated with this type of operation. Because these operations are generally short-lived and unexpected, studies

on performance metrics for disaster relief operations have been especially prolific and particularly emphasize the evaluation of response times (Beamon and Balcik 2008, Schiffing and Piecyk 2014). The following is a small sample of references that examine humanitarian logistics: Altay and Green (2006), Ergun et al. (2010), Thomas and Kopczak (2005), and Van Wassenhove (2005).

## **6. Conclusions and call for research**

The study of nonprofit operations is an emerging and important research area that is still underrepresented in OM. There is a need to develop analytical and empirical models that are tailored to nonprofit operations. In past years, some efforts have been undertaken in this direction. For example, *Annals of Operations Research* journal published a special issue about “Operations Research in the Public Sector and Nonprofit Organizations” (Sinuany-Stern and Sherman 2014) and *Production and Operations Management (POM)* journal has recently published a special issue dedicated to “Not-for-profit Operations Management” (Berenguer et al. 2017a). This article aims to stimulate future OM research on nonprofit operations by highlighting the key features of such operations and the associated major challenges and strategies, which are summarized in Table 2. To conclude this article, we now identify some interesting research directions that we think deserve more attention from the OM community.

### *6.1 Operational decisions and efficiencies*

For revenue-generating NPOs, certain operational decisions can be refined and improved upon by adopting practices grounded in the for-profit sector. For example, NPOs can adopt more efficient pricing mechanisms, such as value-based pricing, dynamic pricing, or transfer pricing for global supply chains. Investing in marketing is an operational decision that is not necessarily unique to FPOs and should be explored by NPOs. Donations and sales have been shown to be interdependent and this relationship could be exploited to improve forecasting or fundraising efforts.

Workforce scheduling is another operational decision with particular features for NPOs because they are faced with uncertain flows of volunteers, austere salaries, and mission-based incentives. OM scholars can help NPO managers by designing workforce scheduling methods that consider these features.

Nonprofit operations are particularly vulnerable with situations related to scalability and sustainability. We speculate that operations’ missions and funding constraints are major causes of

this vulnerability because they force NPOs to be responsive. This type of environment conflicts with prioritizing efficient practices such as exploiting economies of scale (Euske 2003). We encourage OM researchers to further investigate these issues.

### *6.2 Strategic decisions: coordination problems and investment decisions*

As we just mentioned, NPOs' motivation to follow their social goals incentivizes them to be responsive to beneficiaries instead of prioritizing the efficiency of their operations. This behavior, in addition to uncertain funding, can inhibit planning and adversely impact long-term investment decisions (Sahley 1995). As noted in this paper, one of the major causes of this issue is the lack of investment in information technology. As mostly observed in the for-profit sector, information visibility can mitigate inefficiencies, which improves an organization's usage of resources and could also improve the NPOs' social goals. Therefore, formal studies on the (economic and social) value of information in nonprofit operations would be very beneficial.

Further study is needed on coordination mechanisms that can foster effective collaboration between different entities in nonprofit operations. For example, operating by command is a successful mechanism for nonprofit operations in the humanitarian relief sector, and this mechanism is substantially different from the contracts typically used in the for-profit environment. In effect, the contractual relationships with NPOs have particular features that should be carefully considered. Special attention should be given to the performance metrics used, the supply sourcing mix, and the funding mix and its constraints. Formal studies on the (social and economic) value of collaboration are interesting.

### *6.3 Empirical research and benchmarking studies*

To our knowledge, formal performance comparisons between the operations of NPOs and those of FPOs have not been carried out in the OM literature. Healthcare and education are two different applied areas in which both types of organizations coexist and data can be easily found for this type of research. This type of analysis would be particularly useful for instances in which donors need to select an organization to sponsor (e.g., award a grant) or subsidize or when clients want to choose the type of organization that provides the highest quality of service. If differences between the two types of organizations are indeed observed, it would be interesting to identify the differences in operational and strategic decisions and the differences in terms of the positioning of each type of organization in an efficient frontier analysis.

The OM community can make an interesting and significant contribution by empirically analyzing the use of the process view approach and its fundamental process metrics for nonprofit operations. A general framework can be developed to analyze the performance of various NPOs and identify where improvement can be achieved. Grouping NPOs by sector could also provide further insights.

#### *6.4 Innovation in running nonprofit operations*

Unique features of nonprofit operations highlight the need to use innovative ways to manage them because these features do not appear in the for-profit or public sectors. Some of the most interesting features are associated with donations, for example, the management of voluntary labor, gifts-in-kind, and charity auctions. The study of the use of new online platforms and new funding mechanisms as well as their impact on nonprofit operations is also an important area of research in OM. Utilizing efficient mechanisms is critical because NPOs have budgets that are very limited, highly earmarked and highly uncertain. In this paper, we have mentioned a few funding mechanisms such as traditional funding schemes, bridge financing, and PFR. We encourage OM scholars to carry out empirical and analytical works that study the efficacy of different funding mechanisms. Special attention should be devoted to feedback loop funding and its effects on operational decisions and performance.

As previously discussed, the risk averse behavior of traditional NPOs inhibits innovation. While the study of risk aversion (both empirical and analytical) is interesting and deserves more attention, we suggest that OM researchers analyze new business models suitable for nonprofit ventures. On a similar note, social enterprises are positioned between the for-profit and nonprofit sectors and follow practices borrowed from the for-profit sector to achieve an overall goal that can be defined as “social value” (Dees et al. 2001). Social enterprises are gaining momentum over traditional NPOs due to the attractiveness of the goods and services they offer and their innovative business models. We believe that traditional NPOs can learn from this type of organization because they face similar challenges related to raising funds, scalability and sustainability.

Table 2 Challenges and strategies of nonprofit operations.

<b>Challenges</b>	<b>Some tools and strategies</b>
Finding the best performance metric	<ul style="list-style-type: none"> <li>- Multi-objective optimization</li> <li>- Equity/efficiency combination ^</li> <li>- Balanced scorecard approach*</li> </ul>

	- Triple bottom line approach (B corporations)*
Lack of coordination between different actors	- Formal contracting - Investment in IT to share data - Operating by command ^
Lack of coordination between different donors	- Establishing a leading coordinator - Publishing donor data - Using for-profit global supply chain companies (e.g., Li & Fung Inc.)*
Scalability and sustainability problems	- Guaranteeing funding to exploit economies of scale - Adopting strategies from social enterprises*
Shortage of supply	- Efficiently managing in-kind donations ^ - Pre-positioning supplies
Shortage of funds	- Fundraising - Using a tiered donation structure ^ - Cross-subsidizing ^ - Applying for grants - Using volunteers ^ - Using direct marketing strategies* - Crowdfunding*
Demand uncertainty	- Improving forecasting - Using agile supply chains or pull systems - Pre-positioning supplies - Risk pooling - Using modeling tools: stochastic dynamic programming, simulation and system dynamics tools
Earmarked donations	- Increasing public awareness of less popular programs^ - Improving trust by increasing transparency (e.g., use of online platforms)
Uncertain donations	- Using ex-ante strategies: forecasting, bridge financing^, and traditional funding - Using ex-post strategies: payment for results (Pfor) funding^ - Focusing on hybrid ex-ante and ex-post funding ^
Allocation when supply is lower than demand	- Rationing with and without priority classes - Using wait lists - Using explicit queuing - Using modeling tools: shortage costs, outsourcing for emergency services, and service levels
Pricing	- Price discrimination - Non-monetary payments with labor or supplies ^ - Value-based pricing* - Dynamic pricing* - Transfer pricing for global supply chains*
Management of volunteers	- Using a tiered volunteer structure ^ - Assigning interesting tasks
Employee retention	- Recognizing employees' efforts - Providing flexible working options - Providing professional development opportunities
Lack of innovation	- Adopting strategies from the business models of social enterprises *

Note: ^: Practices that are particularly used by NPOs;

\*: New practices from the for-profit sector that have not been commonly used by NPOs.

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## References

- Adida, E., DeLaurentis, P.C.C., & Lawley, M.A. (2011). Hospital stockpiling for disaster planning. *IIE Transactions*, 43(5), 348–362.
- Aflaki, A. & Pedraza-Martinez, A.J. (2016). Humanitarian funding in a multi-donor market with donation uncertainty. *Production and Operations Management*, 25(7), 1274-1291.
- Akkihal, A.R. (2006). Inventory pre-positioning for humanitarian operations. Master of Engineering. thesis, Massachusetts Institute of Technology.
- Alagoz, O., Maillart, L.M., Schaefer, A.J., & Roberts, M.S. (2004). The optimal timing of living-donor liver transplantation. *Management Science*, 50(10), 1420–1430.
- Aldasoro, I., Nunnenkamp, P., & Thiele, R. (2010). Less aid proliferation and more donor coordination? The wide gap between words and deeds. *Journal of International Development*, 22(7), 920-940.
- Alford, J. 2002. Defining the client in the public sector: A social-exchange perspective, *Public Administration Review*, 62(3), 337-346.
- Altay, N., & Green, W.G. (2006). OM research in disaster operations management. *European Journal of Operational Research*, 175 (1), 475-493.
- Andreoni, J. & Payne, A. (2003). Do government grants to private charities crowd out giving or fund-raising?, *American Economic Review*, 93(3), 792-812.
- Anheier, H.K. (2000). Managing non-profit organisations: Towards a new approach. Centre for Civil Society, London School of Economics and Political Science.
- Anheier, H. K. (2005). *Nonprofit Organizations: Theory, Management, Policy*. Routledge: Taylor and Francis Group.
- Anthony, R.N., & Young, D.W. (1988). *Management Control in Nonprofit Organizations*. Irwin, Homewood.
- Apte, A. (2009). Humanitarian logistics: A new field of research and action. *Foundations and Trends in Technology, Information and Operations Management*, 3(1), 1–100.
- Austin, J.E. (2000) Strategic collaboration between nonprofits and businesses. *Nonprofit and Voluntary Sector Quarterly*, 29(1), 69–97.
- Balcik, B., & Beamon, B.M. (2008). Facility location in humanitarian relief. *International Journal of Logistics Research and Applications*, 11(2), 101–121.
- Balcik, B., Beamon, B.M., Krejci, C.C., Muramatsu, K.M., & Ramirez, M. (2010a). Coordination in humanitarian relief chains: Practices, challenges and opportunities. *International Journal of Production Economics*, 126(1), 22-34.
- Balcik, B., Iravani, S., & Smilowitz, K.R. (2010b), A review of equity in nonprofit and public sector: a vehicle routing

- perspective, in Cochran, J.J. (Eds.), *Wiley Encyclopedia of Operations Research and Management Science*, Wiley, Hoboken, NJ.
- Balcik, B., & Ak, D. (2014). Supplier selection for framework agreements in humanitarian relief. *Production and Operations Management*, 23(6), 1028-1041.
- Bhattacharya, S., Hasija, S., & Van Wassenhove, L.N. (2014). Designing efficient infrastructural investment and asset transfer mechanisms in humanitarian supply chains. *Production and Operations Management*, 23(9), 1511-1521.
- Beamon, B.M. & Balcik, B. (2008). Performance measurement in humanitarian relief chains. *International Journal of Public Sector Management*, 21(1), 4-25.
- Beamon, B.M., & Kotleba, S.S. (2006). Inventory modelling for complex emergencies in humanitarian relief operations. *International Journal of Logistics Research and Applications*, 9(1), 1–18.
- Bertsimas, D., Farias, V.F., & Trichakis, N. (2011). The price of fairness. *Operations Research*, 59(1), 17-21.
- Berenguer, G. (2016). Modeling approaches and metrics to evaluate nonprofit operations. Advances in Managing Humanitarian Operations, book edited by Altay, N., Haselkorn, M. P., Zobel, Christopher W., Springer.
- Berenguer, G., Keskinocak P., Shanthikumar, J.G., Swaminathan, J. & Van Wassenhove L.N. (2017a). A Prologue to the Special Issue on Not-for-Profit Operations Management. *Production and Operations Management*, 26 (6), 973-975
- Berenguer, G., Feng, Q., Shanthikumar, J.G., & Xu, L. (2017b). The effects of subsidies on increasing consumption through for-profit and not-for-profit newsvendors. *Production and Operations Management*, 26 (6), 1191-1206.
- Berenguer, G., Iyer, A., & Yadav, P. (2016). Disentangling the efficiency drivers in country-level global health programs: an empirical study. *Journal of Operations Management*, 45, 30-43.
- Besiou M., PedrazaMartinez A. J., & Van Wassenhove L. N. (2014). Vehicle Supply Chains in Humanitarian Operations: Decentralization, Operational Mix and Earmarked Funding, *Production and Operations Management*, 23(1), 1950-1965.
- Bigsten, A. (2006). Donor Coordination and the Uses of Aid, Working paper, Göteborg University.
- Bilodeau, M., R. & Steinberg. (2006). Donative nonprofit organizations. *Handbook of the Economics of Giving, Altruism and Reciprocity*, 2, 1271-1333.
- Bradley, B., Jansen, P. & Silverman, L. (2003). The nonprofit sector's \$100 billion opportunity. *Harvard Business Review*, 81(5), 94–103.
- Bravata, D.M., Zaric, G.S., Holty, J.E.C., Brandeau, M.L., Wilhelm, E.R., McDonald, K.M., & Owens, D.K. (2006). Reducing mortality from anthrax bioterrorism: strategies for stockpiling and dispensing medical and pharmaceutical supplies. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, 4(3), 244–262.
- Cachon, G.P., & Lariviere, M.A. (1999). Capacity choice and allocation: Strategic behavior and supply chain performance. *Management Science*, 45(8), 1091–1108.
- Care. (2016) <http://www.care.org/about/partnerships/corporate-partners/our-partners>, accessed March 2018.
- Chestnut, J., Ahn, H.S., Anupindi, R. Giving It Away to Increase Profits: Price Discrimination and the Effect of Free Goods.
- Das, T.K., Savachkin, A.A., & Zhu, Y. (2008). A large-scale simulation model of pandemic influenza outbreaks for



- development of dynamic mitigation strategies. *IIE Transactions*, 40(9), 893–905.
- Daskin, M. (2011). *Service Science*, John Wiley & Sons Inc.
- Davis, L.B., Jiang, S.X., Morgan, S., Nuamah, I., & Terry J.R. (2016). Analysis and Prediction of food donation behavior for a domestic hunger relief organization. *International Journal of Production Economics*, forthcoming.
- de la Torre, L.E., Dolinskaya, I.S. & Smilowitz, K.R. (2012). Disaster relief routing: integrating research and practice. *Socio-Economic Planning Sciences*, 46(1), 88–97.
- de Véricourt, F., & Lobo, M.S. (2009). Resource and revenue management in nonprofit operations. *Operations Research*, 57(5), 1114–1128.
- Dees, J.G., Emerson, J., & Economy, P. (2001). *Enterprising nonprofits: A toolkit for social entrepreneurs*. John Wiley & Sons Inc.
- DeHoog, R.H. (1984). *Contracting Out for Human Services: Economic, Political, and Organizational Perspectives*. State University of New York Press, Albany.
- Devalkar, S.K., Sohoni, M.G., & Sharma, N. (2016). Payment for Results: Funding Non-profit Operations, Indian School of Business, working paper.
- Devalkar, S.K., Sohoni, M.G., & Arora, P. (2017). Ex-post funding: How should a resource-constrained non-profit organization allocate its funds? *Production and Operations Management*, 26(6), 1035-1055.
- Dolinskaya, I.S., Shi, Z.E., Smilowitz, K.R., & Ross, M. (2011). Decentralized approaches to logistics coordination in humanitarian relief. T. Doolen, E. Van Aken, eds., *Proceedings of the 2011 Industrial Engineering Research Conference*.
- Duran, S., Gutierrez, M. A., & Keskinocak, P. (2011). Pre-positioning of emergency items for CARE international. *Interfaces*, 41(3), 223–237.
- Durango-Cohen, E.J., Torres, E.L., & Cohen, P.L. (2013). Donor segmentation: when summary statistics do not tell the whole story. *Journal of Interactive Marketing*, 27, 172-184.
- Engers, M. & McManus, B. (2007). Charity auctions. *International Economic Review*, 48(3), 953-994.
- Ergun, O., Karakus, G., Keskinocak, P., Swann, J., & Villarreal, M. (2010). Operations research to improve disaster supply chain management. *Wiley Encyclopedia of Operations Research and Management Science*, John Wiley & Sons, Hoboken, NJ.
- Ergun, O., Gui, L., Heier Stamm, J.L., Keskinocak, P. & Swann, J. (2014). Improving Humanitarian Operations Through Technology-enabled Collaboration. *Production and Operations Management*, 23(6), 1002–1014.
- Euske, K.J. (2003). Public, private, not-for-profit: everybody is unique?, *Measuring Business Excellence*, 7(4), 5-11.
- Fama, E.F. & Jensen, M.C. (1985). Organizational forms and investment decisions. *Journal of Financial Economics*, 14, 101-119.
- Fleßa, S. (2003). Decision support for AIDS control programmes in Eastern Africa, *OR Spectrum*, 25(2), 265–291.
- Gale, D., & Shapley, L.S. (1962). College admissions and the stability of marriage. *American Mathematical Monthly*, 69(1), 9–15.
- Grønbjerg, K.A. (1993). *Understanding Nonprofit Funding: Managing Revenues in Social Service and Community Development Organizations*. Jossey-Bass, San Francisco.

- Gulrajani, N. (2016). Bilateral versus multilateral aid channels. Strategic choices for donors. Overseas Development Institute Report.
- Gumport, P.J., & Snyderman, S.K. (2006). Higher education: evolving forms and emerging markets. The non-profit sector: a research handbook. 2<sup>nd</sup> Edition. 462-484.
- Hansmann, H.B. (1980). The role of nonprofit enterprise. *The Yale Law Journal*, 89(5), 835–901.
- Heart to Heart International. (2016). <http://www.hearttoheart.org/nepal-earthquake-relief-by-the-numbers/> . accessed March 2018.
- Hellenius, R., & Rudbeck, S. (2003). In-kind donations for nonprofits. *McKinsey Quarterly*, 4, 23–27.
- Hull, C.E., & Lio, B.H. (2006). Innovation in non-profit and for-profit organizations: Visionary, strategic, and financial considerations. *Journal of Change Management*, 6(1), 53-65.
- Jack, E.P., & Powers, T.L. (2004). Volume flexible strategies in health services: a research framework. *Production and Operations Management*, 13(3), 230–244.
- James, E., & Rose-Ackerman, S. (1986). *The Nonprofit Enterprise in Market Economics*. Harwood Academic Publishers, London.
- Johnson, M.P., & Smilowitz, K. (2007). Community-based operations research. *INFORMS Tutorials in Operations Research*, 102-123.
- Johnson, M.P. (2011). *Community-Based Operations Research: Decision Modeling for Local Impact and Diverse Populations*. Springer, New York.
- Kaplan, R.S. (2001). Strategic performance measurement and management in nonprofit organizations. *Nonprofit Management and Leadership*, 11(3), 353–370.
- Kim, S., Karlesky, M.J. Myers, C.G., & Schifeling, T. (2016). Why Companies Are Becoming B Corporations? *Harvard Business Review*, June 17.
- Knack, S., & Rahman, A. (2007). Donor fragmentation and bureaucratic quality in aid recipients. *Journal of Development Economics*, 83, 176–197.
- Kovács, G., & Spens, K.M. (2007). Humanitarian logistics in disaster relief operations. *International Journal of Physical Distribution and Logistics Management*, 37(2), 99–114.
- Kraiselburd, S., & Yadav, P. (2012). Supply chains and global health: an imperative for bringing operations management scholarship into action. *Production and Operations Management*, 22(2), 377-381.
- Leventhal, G.S. (1976) What Should Be Done with Equity Theory? New Approaches to the Study of Fairness in Social Relationships. Department of Psychology, Wayne State University, Detroit, Michigan 48202.
- Levine, R., J. Pickett, N. Sekhri, & Yadav, P. (2008). Demand forecasting for essential medical technologies. *American Journal of Law and Medicine*, 34, 269–297.
- Lewis, D. (2001). *The Management of Non-Governmental Development Organizations: An Introduction*. Routledge, London.
- Lien, R., Iravani, S.M.R. & Smilowitz, K.R. (2014), Sequential resource allocation for nonprofit operations, *Operations Research*, 62(2), 301-317.
- McCardle, K.F., Rajaram, K., & Tang, C.S. (2009). A decision analysis tool for evaluating fundraising tiers. *Decision*

- Analysis*, 6(1), 4–13.
- McCoy, J.H., & Brandeau, M.L. (2011). Efficient stockpiling and shipping policies for humanitarian relief: UNHCR's inventory challenge. *OR Spectrum*, 33(3), 1–26.
- McCoy, J.H., & Lee, H.L. (2014). Using fairness models to improve equity in health delivery fleet management. *Production and Operations Management*, 23(6), 965–977.
- Mirvis, P.H. & Hackett, E.J. (1983). Work and work force characteristics in the nonprofit sector, *Monthly Labor Review*, 106(4), 3-12.
- Nagurney, A., Yu, M., & Qiang, W. (2009). Supply chain network design for critical needs with outsourcing. *Papers in Regional Science*, 90(1), 123-142.
- Natarajan, K. V., & Swaminathan, J. M. (2014). Inventory management in humanitarian operations: Impact of amount, schedule, and uncertainty in funding. *Manufacturing & Service Operations Management*, 16(4), 595-603.
- Netzer, O., Lattin, J., & Srinivasan, V. (2008). A Hidden Markov Model of Customer Relationship Dynamics, *Marketing Science*, 27(2), 185-204.
- Nonprofit HR (2016). 2016 Nonprofit employment practices survey results, Nonprofit HR.
- Nonprofit Leadership Alliance. (2018). <https://www.nonprofitleadershipalliance.org/cost-of-employee-turnover/>, accessed March 2018.
- Oloruntoba, R., & Gray, R. (2006). Humanitarian aid: an agile supply chain? *Supply Chain Management: An International Journal*, 11(2), 115–120.
- Oster, S.M. (1995). Strategic management for nonprofit organizations: Theory and cases. Oxford University Press, USA.
- Oster, S.M. (1996). Nonprofit organizations and their local affiliates: a study in organizational forms. *Journal of Economic Behavior & Organization*, 30(1).
- O'Regan, K.M., & Oster, S. (2000). Nonprofit and For Profit Partnerships: Rationale and Challenges of Cross-Sector Contracting, *Nonprofit and Voluntary Sector Quarterly*, 29(1), 120-140.
- Parry, R., & Mingers, J. (1991). Community operational research: its context and its future. *Omega*, 19(6), 577–586.
- Pedraza-Martinez, A.J., Stapleton, O., & Van Wassenhove, L.N. (2011). Field vehicle fleet management in humanitarian operations: A case-based approach. *Journal of Operations Management*, 29(5), 404–421.
- Pierskalla, W. (2005). Supply chain management of blood banks. *Operations Research and Health Care*, 70(2), 103-145.
- Pollock, S.M., Rothkopf, M.H., & Barnett, A. (1994). Operations research and the public sector. Amsterdam: North-Holland
- Privett, N., & Erhun, F. (2011). Efficient funding: Auditing in the nonprofit sector. *Manufacturing & Service Operations Management*, 13(4), 471–488.
- Privett, N. (2012). Operations Management in community-based nonprofit organizations, M. Johnson (Ed.), *Community-Based Operations Research*, 167, 67-95. Springer, New York.
- Ritchie, R.J.B., & Weinberg, C.B. (2000). A Typology of Nonprofit Competition: Insights for Social Marketers, *Social Marketing Quarterly*, 6(3), 64–71.

- Rose-Ackerman, S. (1986). *The economics of nonprofit institutions: studies in structure and policy*. Oxford University Press, USA.
- Sahley, C. (1995). *Strengthening the capacity of NGOs: cases of small enterprise development agencies in Africa*. Intrac Oxford.
- Salamon, L.M. (1987). Partners in public service: The scope and theory of government-nonprofit relations. *The nonprofit sector: A research handbook*, 99–117.
- Salamon, L. M., Wojciech Sokolowski, S., Haddock, M., & Tice, H. S. (2013). *The State of Global Civil Society and Volunteering: Latest findings from the implementation of the UN Nonprofit Handbook*.
- Samii, B., Pibernik, R., Yadav, P., & Vereecke, A. (2012). Reservation and allocation policies for influenza vaccines. *European Journal of Operational Research*, 222(3), 495-507.
- Savas, E.S. (1978). On equity in providing public services. *Management Science*, 24(8), 800 - 808.
- Schiffing, S. & Piecyk, M. (2014). Performance measurement in humanitarian logistics: a customer-oriented approach, *Journal of Humanitarian Logistics and Supply Chain Management*, 4(2), 198 – 221.
- Schram, A. & S. Onderstal. (2009). Bidding to Give: An Experimental Comparison of Auctions for Charity. *International Economic Review*, 50(2), 431-457.
- Segal, L., & Weisbrod, B. (1998). Interdependence of Commercial and Donative Revenues. B. A. Weisbrod, *To Profit or Not to Profit: The Commercial Transformation of the Nonprofit Sector*, 105–127. Cambridge: Cambridge University Press.
- Sinuary-Stern, Z., & Sherman, H.D. (2014) Operations research in the public sector and nonprofit organizations, *Annals of Operations Research*, 221(1), 1–8.
- Sönmez, E., Lee, D., Gomez, M. I., & Fan, X. (2016). Improving food bank gleaning operations: An application in New York State. *American Journal of Agricultural Economics*, 98(2), 549-563.
- Sowa, J.E. (2009). The collaboration decision in nonprofit organizations: views from the front line. *Nonprofit and Voluntary Sector Quarterly*, 38(6), 1003-1025.
- Stapleton, O., Van Wassenhove, L.N. & Tomasini, R. (2010). The challenges of matching corporate donations to humanitarian needs and the role of brokers, *Supply Chain Forum: An International Journal*, 11(3), 42-53.
- Steinberg, R. (2006). Economic theories of nonprofit organizations. In W. Powell & R. Steinberg (Eds.), *The nonprofit sector: A research Handbook* (p. 659) (2nd Edn). New Haven: Yale University Press
- Steinberg, R., & Weisbrod, B.A. (1986). Pricing and rationing by nonprofit organizations with distributional objectives. *To Profit or Not to Profit: The commercial transformation of the nonprofit sector*, 64-82.
- Swaminathan, J.M. (2003). Decision support for allocating scarce drugs. *Interfaces*, 33(2):1–11.
- The Sphere Project. (2011). *The Sphere Handbook*. <http://www.sphereproject.org/>, accessed March 2018.
- Thomas, A.S., & Kopczak, L.R. (2005). *From logistics to supply chain management: the path forward in the humanitarian sector*. Fritz Institute.
- Toyasaki, F., & Wakolbinger, T. (2011). Impacts of earmarked private donations for disaster fundraising, *Annals of Operations Research*, 1-21.
- Tomasini, R., & Van Wassenhove, L.N. (2009). *Humanitarian Logistics*. Palgrave Macmillan, UK.

- Topkis, D.M. (1968). Optimal ordering and rationing policies in a non-stationary dynamic inventory model with n-demand classes. *Management Science*, 15(3), 160–176.
- Tortora, P., & Steensen, S. (2014). Making earmarked funding more effective: Current practices and a way forward. *Better Policies for Better Lives Report No. 1*.
- Tuckman, H.P., (1998). Competition, commercialization, and the evolution of nonprofit organizational structures. B. A. Weisbrod, To Profit or Not to Profit: The Commercial Transformation of the Nonprofit Sector, 105–127. Cambridge: Cambridge University Press.
- Ülkü, M. A., Bell, K. M., & Gray-Wilson, S. (2015). Modeling the impact of donor behavior on humanitarian aid operations. *Annals of Operations Research*, 230(1), 153-168.
- United Nations Foundation. (2011). The pledge guarantee for health. <http://www.unfoundation.org/what-we-do/campaigns-and-initiatives/pledge-guarantee-for-health/>, accessed March 2018.
- van der Laan, E., van Dalen, J., Rohmoser, M., & Simpson, R. (2016). Demand forecasting and order planning for humanitarian logistics: an empirical assessment. *Journal of Operations Management*. Forthcoming.
- Van Wassenhove, L.N. (2005). Humanitarian aid logistics: supply chain management in high gear. *Journal of the Operational Research Society*, 57(5), 475–489.
- Wedig, G.J. (1994). Risk, leverage, donations and dividends-in-kind: a theory of nonprofit financial behavior. *International Review of Economics and Finance*, 3(3), 257-278.
- Weisbrod, B.A. (1977). *The Voluntary Nonprofit Sector: An Economic Analysis*. Lexington Books, Lexington.
- Weisbrod, B.A. (1988). *The Nonprofit Economy*. Harvard University Press.
- Wolf, T. (1999). *Managing a nonprofit organization in the twenty-first century*. Simon & Schuster Inc.
- Zenios, S.A., Chertow, G.M., & Wein, L.M. (2000). Dynamic allocation of kidneys to candidates on the transplant waiting list. *Operations Research*, 48(4), 549–569.