Knowledge, evidence and learning for development

Cost-Effectiveness in Humanitarian Outcomes: Logistics[1]

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Question

What evidence is there that new logistic techniques and processes are cost effective and meet humanitarian outcomes? e.g. 3D printing, drones, biometric passports and digital identities.

Contents

1. Summary

Maintaining supply chains is crucial in responding effectively to humanitarian crises. Logistics accounts for between 60% and 80% of total expenditure of any humanitarian intervention. Therefore, the need for cost-effective humanitarian aid is greater than ever (Besiou & Van Wassenhove, 2020). This rapid review focuses on the cost effectiveness of new logistic techniques and processes in humanitarian settings.

Availability of data:

- In a commercial logistics context, the pursued objective is to minimise logistics costs; while in a humanitarian logistics context the objective is to minimise human suffering

[1] This rapid review is part of a series on cost-effectiveness in humanitarian settings, including reports on accountability and use of data. Therefore, these topics are not included here.

(Salomonsson, 2018). However, it is difficult to estimate the cost of ethical and computational suffering (Holguín Veras et al., 2012). As there are many non-budgeted costs that contribute to the functioning of a programme, the World Health Organization (WHO) recommends that cost-effective analyses (CEAs) of interventions also include these 'economic' costs, rather than only financial costs (Johns et al., 2003). Although older qualitative cost effectiveness analysis on suffering in the Somalian aid response is available (Netherlands Development Cooperation, 1994), no recent quantitative data was found quantifying suffering for this rapid review.

- There is little publicly available information on the required infrastructure and operational costs in humanitarian settings (Roblin, 2019). The recording of logistics costs in practice is still limited (GSMA, 2019; Hein et al., 2020). However, the evidence that is available is gender blind, and has no focus on disability.

Summary of current humanitarian logistic cost effectiveness:

- Timeliness is important: In terms of procurement, the early response to the El Niño 2015/2016 drought in Ethiopia saved between 18% and 30% of costs (Cabot Venton, 2016). Buying food at the most efficient time (i.e. in the first 3 months via existing pipelines - minimising combined purchasing and warehousing costs) would have been 20–30% cheaper than buying it at the height of the El Niño emergency (although this time point was not defined). Due to the low international vs high local prices of food at the time, it was only possible to analyse the economic cost savings to food and nutrition procurement; however, it is estimated that early funding had less effect on water supply to Ethiopia. The **humanitarian footprint** may be better at expressing the developmental impact that timely global health interventions in general, and cost-effective surgical humanitarian efforts in particular, may have in low and middle income countries (LMICs), as it can better account for the long-term societal gains in human development (Cardarelli et al., 2018).
- Pre-planned investment: In their model, Lacourt & Radosta (2019) reported that in the case of the 2010 Haiti earthquake, if Action Against Hunger had invested USD 124,257 approximately 14 months before the disaster, it would have been possible to save USD 1,013,508 in total (equitable to 42% of total expenditure). Similarly, in the case of the 2015 Nepal earthquake, 39% of total expenditure could have been saved by an investment of USD 42,139 two months before the disaster. However, IFRC modelling data found that the curve of savings from preparedness planning decreases after a certain point (the more time between preparing for a disaster until a crisis response starts, the bigger the amount of running costs that will need to be covered) (HELP Logistics et al., 2018). While there is a clear financial imperative for greater investment in preparedness, Kellet & Peters (2014) note that although greater investment in preparedness is cost effective (from USD 3.25 for every USD 1 spent, to USD 5.31), this has to be well-designed – otherwise it could fail and end up more expensive than 'business as usual'.
- Pre-positioning: Although no quantitative data is available, Duran et al. (2011) show that CARE International pre-positioned relief supplies in three facilities around the world - reducing response time from weeks to 48–72 hours, as well as reducing procurement costs by buying in larger quantities (bulk buying), reducing freight costs by using transportation resources more efficiently, and improving coordination with other responding organisations.

- Sharing storage & warehouses: Free or at-cost warehouse storage space and logistics support to international humanitarian organisations is available from UNHCR (Duran et al., 2011). Sharing storage space also provides good return of investment (ROI): in Myanmar this resulted in resource and time savings of USD 7,419 and 12.4 days, respectively for UNICEF and World Food Programme (WFP) responses (OCHA et al., 2017).
- Pooling: This is not a sufficiently developed practice in the humanitarian sector. However, evaluations have shown it to be effective in conflict settings, e.g. saving 37% of transport and storage costs for NGOs responding to vulnerable groups in the Central African Republic (CAR) (Lacourt & Radosta, 2019). Outsourcing also optimises transport management and price negotiation resources, therefore using a **third-party logistics (3PL) provider** is one of the success factors for the pooled logistics approach.

In terms of technological innovation, drones, big data, digital identities and artificial intelligence (AI), are slowly being introduced, hoping to make humanitarian operations more efficient and effective. Key highlights include:

- New technologies are becoming more cost effective than traditional technologies. Green or renewable energy (e.g. solar panels in camps) has saved UNHCR USD7.5 million per year in Jordan alone (Grafham & Lahn, 2018).
- 3D printing: More economic cost analysis for 3D printing is recommended (Salomonsson, 2018). Although it can be suitable for specific one-time needs (e.g. a 167-500% saving for umbilical cord clamps - Saripalle et al, 2016), there are challenges such as standardisation of equipment or procedures which may not be cost effective (Salomonsson, 2018).
- UAVs/drones: Modelling by Ochieng et al. (2020) shows that UAVs/drones were less cost effective than motorcycles to deliver laboratory samples in west Africa. The Swiss Foundation for Mine Action (FSD) costed UAVs/drones as being 50-5000% more expensive than mapping alternatives (Soesilo et al., 2016). Although a cost-effective, flexible complement to the supply chain due to their ability to be used in intense weather conditions, use of drones is not advisable in conflict affected settings (Salomonsson, 2018; Roblin, 2019).
- Biometric IDs: Modern biometric identification management systems, such as those used in refugee camps (GSMA, 2017) are comprised of hardware and software that are simple to install and easy to use, which reduces the need for intense training and ongoing management costs. Plus, biometric identification management helps save other costs such as the issuance of new ID cards, and replacing lost or damaged ID cards, or the time consuming and resource draining need to reset forgotten or stolen passwords.
- Digital aid transfers: Cost-efficiency analyses from WFP shows that providing rations through Bamba Chakula in Dadaab town was 15% more cost-efficient than in-kind assistance, and 6% more cost-effective in Kakuma camp (WFP, 2016; GSMA, 2017). Software used by the WFP to distribute aid in Iraq helped reduce food basket costs by more than 10% by making small changes, such as swapping out one commodity for something similar, or changing procurement sources without reducing nutritional values (Willitts-King et al., 2019). However, as the cost of internet data can vary across Sub Saharan Africa by more than 200 times, cost effectiveness can vary by country.
- Inventory technology: Radio Frequency Identification (RFID) technology is considered as a promising solution to address the problem of warehouse inventory inaccuracy.

Modelling by Biswal et al. (2018) predicted expected cost savings to be approximately USD 35,535 per season using RFID to reduce wastage in the humanitarian supply chain.

2. Logistical practices

Gaps in current data

In a commercial logistics context, the pursued objective is to minimise logistics costs**;** while in a humanitarian logistics context the objective is to **minimise human suffering** (Salomonsson, 2018). However, it is difficult to estimate the cost of ethical and computational suffering (Holguin Veras et al., 2012). As there are **non-budgeted costs** that contribute to the functioning of a programme, the World Health Organization (WHO) recommends that cost-effective analyses (CEAs) of interventions also include these 'economic' costs, rather than only financial costs (Johns et al., 2003). A qualitative assessment of cost-effectiveness of humanitarian aid to Somalia concluded that the same results could not have been achieved for 'less effort and investment', stating that a lower financial cost would have come at the expense of lives (Netherlands Development Cooperation, 1994: 166, 300). However, there is no quantitative data available to support this.

There is little publicly available information on the required infrastructure and operational costs in humanitarian settings (Roblin, 2019). **The recording of logistics** costs in practice is still limited (Hein et al., 2020). For example, air transport costs per flight for a charter flight can be in a low six-digit range (€ 100,000 – 200,000/ USD 108,078-216,157). However, these costs are subject to several influencing factors and cannot be generally assumed for all charter flights (Hein et al., 2020: 11).

Current practices

Logistics accounts for between 60% and 80% of total expenditure of any humanitarian intervention. Therefore, the need for cost-effective humanitarian aid is greater than ever (Besiou & Van Wassenhove, 2020). Each time a crisis arses, a new logistics chain is set in motion. However, research shows that logistics operations in isolation – e.g. where each non-government organisation (NGO) has its own logistics operation – are no longer tenable (Radosta, 2019). There are some examples of collaborative practices today, with the opening of certain organisations' humanitarian procurement centres (HPCs) to other humanitarian actors. Although these HPCs often offer a guarantee of quality, it is at a high price (Lacourt & Radosta, 2019: 13).

Need for change

Réseau Logistique Humanitaire research states that in order to meet humanitarian outcomes cost-effectively, **a change in operational strategy** is needed, moving from a model of fundraising and using funds to a model of fundraising and optimising these funds (Lacourt & Radosta, 2019: 22). Logistics must also become strategic in order to become part of the decision-making process, starting early, e.g. from the **assessment and programming stages** (Lewin et al., 2018; Lacourt & Radosta, 2019: 5).

Use of technological innovation

Drones, big data, digital identities and artificial intelligence (AI), are slowly being introduced, hoping to make humanitarian operations more efficient and effective. However, these innovations may not all be cost-effective yet (James & Gilman, 2015; Gregory et al., 2016; Salomonsson, 2018; Gilmore et al., 2019; GSMA, 2019). Using green technology and digital platforms may be a cost-effective solution.

Response by disaster typology

Research shows that it is not advised to use excessive **standardised** logistics for all responses to both natural and man-made disasters (Maïola, 2007; Chandes & Paché, 2010).

The humanitarian sector, as a whole, is failing to mount timely and adequate responses in the acute phase of conflict-related emergencies (de Castellarnau & Stoianova, 2018). Research shows that cost efficiency becomes a later concern (Van Wassenhove, 2006). In these instances, it is not simply about international versus local, but it is about **complementarity across organisations and operational approaches** that can help local organisations when their capacity is insufficient or when principled action is not possible on their part (Manis, 2018).

According to the World Economic Forum, **public-private partnerships** will become critical for climate-related humanitarian responses (Skou, 2020). **Green logistics** is gaining importance in humanitarian supply chains, as environmental costs also need to be accounted for - procurement and packaging in particular (Radosta, 2019). These costs can be offset by using **centralised** procurement systems, especially for more complex technical items, such as medicines, which would create economies of scale and lighten the overall workload (Lacourt & Radosta, 2019: 13).[2]

[2] See: Millington KA, & Bhardwaj M (2017). *Evidence and experience of health procurement in health sector decentralisation*. K4D Helpdesk Report. Brighton, UK: Institute of Development Studies. Brighton, UK: Institute of Development Studies. https://gsdrc.org/wp-content/uploads/2017/07/108-Evidence-and-experiences-of-other-countries-health-procurement.pdf

3. Annotated bibliography

Title	Author(s) and date	Link	Indicator of cost effectiveness	Core findings	Remarks
Warehouse efficiency improvement using RFID in a humanitarian supply chain: Implications for Indian food security system	Biswal AK, Jenamani M, & Kumar SK (2018).	https://doi.org/10.1016/j.tre.2017.11.010	**Inventory software comparison**: expected operational costs of warehouse efficiency with & without Radio Frequency Identification (RFID) technology	RFID technology is considered as a promising solution to address the problem of inventory inaccuracy. With a 4% level of shrinkage (e.g. due to loss, theft, miscounting, or damage of goods) and misplacement of 3% at the warehouse, for a 50,000 MT capacity warehouse, the expected savings will be approximately USD 35,535 in a single season (p218).	The marginal benefit of RFID deployment is more when the deprivation cost factor is low: this is because at higher value of the deprivation factor, increase in the deprivation cost outweighs the benefit from RFID. RFID creates value even at higher tag price (p218).

The Economic Case for Early Humanitarian Response to the Ethiopia 2015/2016 Drought	Cabot Venton C (2016).	https://static1.squarespace.com/static/5567b109e4b0101076d7f0bd/t/581b75e0cd0f68b05009b283/1478194658325/Ethiopia+Contingency+Analysis.pdf	**Timeliness** of various **procurement** cost scenarios for early/late/no response[3]	Early procurement (i.e. in the 3 months after funding released) using USD 39.8 million DFID contingency funding was estimated to have avoided the need for an additional USD 6.3-7.4 million- an overall saving of approximately 18%.	Droughts can make these fluctuations more severe and, in Ethiopia, it was calculated that buying food at the most efficient time (i.e. within the first 3 months, minimising combined purchasing and warehousing costs) would have been 20–30% cheaper than buying it at the height of the El Niño emergency. **However, nutrition and WASH costs are not included in this analysis, due to lack of data availability. Early funding is estimated to have less of an effect on water supply (p32).**

[3] Food aid typically takes between 3-5 months from funding to distribution, and therefore timely funding for food is critical to protect against pipeline breaks. Further to this, in this particular crisis, local food supplies were **more expensive** than internationally procured food, specifically due to this drought and the pressure that it has put on food supplies and prices. With limited port capacity for delivering food to the region, timely response was even more critical to ensure that the ports did not get backed up (p14).

Cost-effectiveness of Humanitarian Pediatric Cardiac Surgery Programs in Low- and Middle-Income Countries	Cardarelli et al. (2018).	DOI: 10.1001/jamanetworkopen.2018.4707	Computations on cost-effectiveness of intervention, & humanitarian footprint secondary outcomes, e.g. potential gains in life expectancy (**DALY** [disability-adjusted life-years] averted), years of schooling, & gross national income per capita for each survivor.	Overall programme service costs for 2015 were USD 3,210,873, with an estimated cost per surgery of USD 6,831. Cost-effectiveness of the intervention was USD 171 per DALY averted. Each survivor in the cohort (390 of 424) potentially gained 39.9 DALY, 3.5 years of schooling, and USD 159,533 in gross national income per capita during his or her extended lifetime at purchasing power parity and 3% discounting.	Early paediatric cardiac surgery seems to be at the same cost-effectiveness level as many currently funded health interventions (p7). **However, costs for local personnel, infrastructure, and locally obtained medications & disposables were not included in this study.** An intervention in LMICs is considered cost-effective as long as the cost per DALY averted is lower than the annual gross national income (p9).
Pre-Positioning of Emergency Items for CARE International	Duran S, Gutierrez MA, & Keskinocak P (2011).	https://www.researchgate.net/publication/220249923_Pre-Positioning_of_Emergency_Items_for_CARE_International	Model to evaluate **pre-positioning** in CARE International & effect on response time	Currently, the United Nations Humanitarian Response Depot (UNHRD, http://www.unhrd.org) and some national governments are offering free or at-cost warehouse storage space and logistics support to international humanitarian organisations, making the implementation of such a pre-positioning network financially and logistically feasible (p224).	**No monetary figures are available.** However, based on these results and other factors, CARE has now pre-positioned relief supplies in three facilities around the world - reducing response time from weeks to 48–72 hours, reduce procurement costs by buying in larger quantities, reduce freight costs by using transportation resources more efficiently and improve coordination with other responding organisations (p237).

Reducing the cost of humanitarian operations through disaster preparation and preparedness	Goldschmidt KH, & Kumar S (2017).	https://link.springer.com/content/pdf/10.1007%2Fs10479-017-2587-z.pdf	**Preparedness**	In 2012, the United Nations launched a social media campaign, 'Act Now, Save Later', to highlight the benefits of investing in disaster preparedness, asserting that 'every single dollar of aid spent on preventing and mitigating disasters saves an average of seven dollars in humanitarian disaster response.'[4]	No calculations or citations were given to support this cost benefit ratio (p2).
The Costs of Fuelling Humanitarian Aid	Grafham O, & Lahn G (2018).	https://www.chathamhouse.org/publication/costs-fuelling-humanitarian-aid/2018-12-10-Costs-Humanitarian-Aid2.pdf	**Energy** (Jordan)	Moving Energy Initiative (MEI) research in Jordan shows that solar power (making annual savings of USD 7.5 million for UNHCR) now powers the majority of camp facilities and many households, resulting in reduced bills. Using diesel boilers for heating instead of electricity is more cost effective due the to the high cost of electricity.[5] [6]An environmental performance peer review by the UN Environment Management Group (EMG) in 2017 estimated that moving from diesel boilers to electrical systems would cost one organisation over USD 14,000 per year (p33).	**Not enough data on the fuel efficiency of vehicles available to offer a comprehensive comparison of cost-effectiveness.** Nonetheless, based on secondary sources and anonymous auditing of existing operations, it is clear that poor fuel efficiency of vehicles is a problem for humanitarian agencies.

[4] UNDP (2012). Putting Resilience at the Heart of Development: Investing in Prevention and Resilient Recovery. https://www.preventionweb.net/files/27644_heartofdevundpenoutinenglish.pdf

[5] Media reports an increase of electricity charges of 7-10%, which results in and increase of over JD100,000 (USD 140,857) in the electricity bills: https://www.jordantimes.com/news/local/house-energy-committee-stakeholders-call-examining-spike-electricity-bills

[6] The Footprint Project's mission is to "turn every disaster into an opportunity for sustainable development." It offers resilient **mobile power alternatives** customised for their disaster relief partners' missions. Although a published breakdown of costs is not available for review, an expert consulted for the rapid review emphasised the importance of evaluating the initial high-upfront cost of solar and batteries with the long-term, *true* cost of diesel generators, e.g. their impact on pollution.

3D Printing and Disaster Shelter Costs	Gregory M, Hameedaldeen SA, Intumu LM, Spakousky JJ, Toms JB, & Steenhuis HJ (2016).	https://ieeexplore.ieee.org/document/7806594	Comparison: 3D disaster shelters vs conventional construction methods	The researchers had trouble finding accurate costs for 3D printed housing. They could not include the cost or feasibility of transporting a printer to a disaster location.	3D printers can cost from USD 400 to USD 175,000.[7] 3D printing has been used for low-cost shelters. To print buildings layer by layer with a 3D printer is presented as a low-cost and quick option to construct shelters or other necessary buildings in humanitarian settings.[8]
Navigating the Shift to Digital Humanitarian Assistance: Lessons from the International Rescue Committee's Experience	GSMA (2019).	http://www.cashlearning.org/downloads/user-submitted-resources/2020/01/1579889843.IRC_Report_R2_WebSpreads%20(1).pdf	**Digital cash transfers**	Digitising cash transfers can introduce efficiencies that can reduce costs in the long term. For example, staff no longer have to travel with physical cash to distribution sites and hand out cash to clients individually (p9). **However, mobile money set-up costs are expensive (p16).**	The International Rescue Committee (IRC) has not yet conducted cost-efficiency analyses. Assumptions will continue to be tested.

[7] 3D Hubs (2018). *3D Printer Guide.* https://www.3dhubs.com/best-3d-printer-guide

[8] See: Thilmany, 2010 and Saripalle et al., 2016.

Refugees and Identity: Considerations for mobile-enabled registration and aid delivery	GSMA (2017).	https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2017/06/Refugees-and-Identity.pdf	The GSMA **Digital Identity** Programme: passports Syrian refugees in Iraq	ID cards for Iraqi nationals are issued at the local offices of the Civil Status Affairs Directorate, which are located all over the country; registration fees are approximately USD 8. A Syrian passport normally costs USD 9, acquiring a passport through an intermediary can push the price up to as much as USD 150; the government in Damascus reports that the fee for a passport issued at a consulate abroad jumped to USD 400 (p21).	The Biometric Identity Management System (BIMS) used since 2015 is a great cost saver.[9] Such systems are comprised of hardware and software that are simple to install and easy to use, which reduces the need for intense training and ongoing management costs. Plus, biometric identification management helps save other costs, such as the issuance of new ID cards, and replacing lost or damaged ID cards, or the time consuming and resource draining need to reset forgotten or stolen passwords.

[9] https://www.barbourproductsearch.info/the-advantages-of-a-biometric-identification-blog000508.html#

Supply Chain Expenditure and Preparedness Investment Opportunities A Cooperative Study	HELP Logistics, KLU, & IFRC (2018).	https://www.ifrc.org/PageFiles/91193/HELP_IFRC_ROI-Report_20190307_External.pdf	Development of a dynamic Return on Investment model to investigate the saving potential of supply chain **preparedness investments** (by investing in the 5 identified elements (i.e. personnel, IT/processes, pre-positioning, supplier engagement, and local actors) over a preparedness period of 1 year).	At day 365 (equal to 365 preparedness days), the optimal cost RoI ratio of 1:7 is reached. The investments made at that point in time across all elements, as per one possible scenario estimated with the IFRC team, add up to USD 151,456 resulting in cost savings of USD 1,222,905 and reduction of 36 days in lead time (p16).	Costs and lead times are decreased **However, this requires a certain amount of running costs (staff, IT licences/support, warehouse buildings and equipment, etc.); this is why the curve of savings decreases after a certain point (the more time between preparing for a disaster until a crisis response starts, the bigger the amount of running costs that will need to be covered) (p17-18).**
Shrinking the Supply Chain: Hyperlocal Manufacturing and 3D printing in Humanitarian Response	James E, & Gilman D (2015).	https://www.unocha.org/sites/unocha/files/Shrinking%20the%20Supply%20Chain.pdf	3D printing	Basic fused deposition modelling 3D printers cost between USD 1,000 and USD 3,000. However, this price is fast reducing in line with Moore's Law.[10] Machines that can produce filament (the medium in which objects are made) from recycled plastic bottles already cost less than USD 300 (p10).	**Durability is also important in cost effectiveness.** Developing units that are robust and resistant to dust, moisture and temperature extremes, and which can use batteries, solar power or other alternative energy sources, will be critical.

[10] Moore's Law holds that "The number of transistors incorporated in a chip will approximately double every 24 months." It is used to refer to "exponential capability increases." www.intel.ly/1BiqaDS

Dare to prepare: taking risk seriously. Financing emergency preparedness: from fighting crisis to managing risk	Kellet J, & Peters, K (2014).	https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8748.pdf	ODI preparedness scenarios	Estimated benefit-to-cost ratios (BCR) ranged (depending on different scenarios) from USD 3.25 for every USD 1 spent, to USD 5.31 (p81-82).	While the analysis provided a clear financial imperative for greater investment in preparedness, the authors stress that this has to be well-designed – otherwise it could fail and end up more expensive than 'business as usual'.
Strength in numbers. Towards a More Efficient Humanitarian Aid: Pooling Logistics Resources	Lacourt M., & Radosta M (2019).	https://reliefweb.int/sites/reliefweb.int/files/resources/RLH_Strength_In_Numbers_2019_EN_LD.pdf	**Procurement** preparedness & **pooling** management**:** scenarios with & without investment	Pre-defined emergency preparedness framework, scenarios with and without investments in the following areas: personnel, IT processes, prepositioning of contingency stocks, supplier management and local actors. In the case of the Haiti earthquake, the model showed that if Action Against Hunger had invested USD 124,257 approximately one year and two months before the disaster, it would have been possible to save USD 1,013,508 in total, which equals 42% of total expenditure. Similarly, in the case of the Nepal earthquake, 39% of total expenditure could have been saved by an investment of USD 42,139 two months before the disaster (p11).	Adoption of best management practices by organizations rather than third parties in the logistics chain can lead to savings of over 7% of annual operating costs (p10). The NGO Atlas Logistique pooled road vehicles in the Central African Republic (CAR) - resulting in 37% saving in funding. Outsourcing also allowed human resources to be optimised: by assigning a dedicated expert for transport management and negotiation.[11]

[11] Negotiating power would be increased by consolidating the needs of a number of organisations; supply costs and delays would be reduced; and it would save time for headquarters thanks to order pooling.

Heat, Light and Power for Refugees Saving Lives, Reducing Costs	Lahn G, & Grafham O (2015).	https://www.energy4impact.org/file/1706/download?token=JAt4JLKU	Research from the Moving Energy Initiative (MEI): **Green logistics**	**The cost of fuel is not easy to estimate**: sometimes biomass will be collected for 'free'; in other cases fuel prices are much higher in remote camps than for the general population. Conservative estimates suggest expenditure would be at least USD 200 per year per family of five, which works out at a global total of USD 2.1 billion per year. That cost is paid chiefly by displaced people, with some of the expense supplemented (often at a much higher cost per unit) by humanitarian agencies and host governments (p4).	**Technology innovations are becoming more cost effective than traditional technologies** (p9). The widespread introduction of improved cookstoves and basic solar lanterns could save USD 323 million a year in fuel costs, in return for a one-time capital investment of USD 335 million for the equipment (p5).
Return on Investment in Emergency Preparedness	OCHA, UNHCR, UNICEF, & WFP (2017)	https://interagencystandingcommittee.org/system/files/return_on_investment_in_emergeny_preparedness_phase_2.pdf	Changing WFP's logistics strategy in Diffa, Niger Emergency stock pre-positioning, and an agreement between UNICEF and WFP to share storage space in Myitkyina, Myanmar	Pre-positioning resource savings (Niger): USD 28,496, 12 WFP full-time equivalent salaries (FTEs) (p12). Myanmar: Resource and time savings of USD 7,419 and 12.4 days, respectively.	Funding issues were most often raised by NGOs particularly in relation to covering costly activities, such as water trucking or food distributions to displaced population sites, while other activities were less affected.[12]

[12] de Castellarnau, M. & Stoianova, V. [MSF] (2018). *Bridging the emergency gap*: Reflections and a Call for Action After a Two-Year Exploration of Emergency Response in Acute Conflict. https://sohs.alnap.org/help-library/bridging-the-emergency-gap-reflections-and-a-call-for-action-after-a-two-year (p72).

Uncrewed aircraft systems versus motorcycles to deliver laboratory samples in west Africa: a comparative economic study	Ochieng WO, Ye T, Scheel C, Lor A, Saindon J, Yee SL, Meltzer MI, Kapil V, & Karem K (2020).	https://doi.org/10.1016/S2214-109X(19)30464-4	Comparative scenario analysis: UAS vs motorcycles in Liberia (based on the 2013–16 west African Ebola virus disease epidemic)	Under the routine scenario, the per sample transport costs were USD0·65 (95% CI 0·01–2·85) and USD0·82 (0·56–5·05) for motorcycles and UAS65, respectively. Per-sample transport costs under the emergency scenario were USD24·06 (95% CI 21·14–28·20) for motorcycles, USD27·42 (95% CI 19·25–136·75) for an unadjusted UAS model with insufficient geographical coverage, and USD34·09 (95% CI 26·70–127·40) for an adjusted UAS model with complementary motorcycles. Motorcycles were more cost-effective than short-range UAS (i.e. UAS30). However, with increasing range and operational lifespans, UAS became increasingly more cost-effective	Given the current level of technology, purchase prices, equipment lifespans, and operational flying ranges, UAS are not a viable option for routine transport of laboratory samples in west Africa. Field studies are required to generate evidence about UAS lifespan, failure rates, and performance under different weather conditions and payloads. **The break-even point for UAS occurred at a purchase price of USD10,000, operational range of 65 km, and lifespan of 3000 flight hours. Systems costing over USD30 000 were not cost-effective under any scenarios**
Benefits and challenges of implementing emerging technologies in a humanitarian supply chain	Salomonsson K (2018).	https://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8963575&fileOId=8963577	Supply chain **technological innovations**	Literature search on 3D printers are most useful on country level. Standardisation of equipment and processes may not be cost effective for 'one-time' needs, especially as missions can be so different (p44, 47). With UAVs (drones), payload limitation affects how related it is to the job of a logistician (p50).	The researcher advises cost analysis to be performed for these technologies, as no figures are available. Use of drones is not advisable in conflict affected settings.

3D printing for disaster preparedness: Making life-saving supplies on-site, on-demand, on-time	Saripalle S, Maker H, Bush A, & Lundman N (2016).	**DOI:** 10.1109/GHTC.2016.7857281	Non-profit **preparatory** work with **3D printers**	Umbilical cord clamps can only be obtained in bulk from China at prohibitive cost. Research with midwives uncovered a supply chain problem involving umbilical cord clamps for new-born babies – simple clips which prevent dangerous infections. The main supply chain for these items comprises volunteers from the United States, who bring them in their backpacks. Most clinics could not secure a supply. When they are available on the market they typically cost USD1, and can cost as much as USD3. A 3D printed clamp costs just USD0.60.	
Drones in Humanitarian Action: A guide to the use of airborne systems in humanitarian crises	Soesilo D et al. (2016).	https://reliefweb.int/sites/reliefweb.int/files/resources/Drones%20in%20Humanitarian%20Action.pdf	Mapping use: drones vs alternatives	Mapping drones used in humanitarian settings cost USD 539-21,576 (p16). However, satellite imagery, which is a common solution for base maps, is cheaper - costing around USD 270-432 for 25 km² (p29).	
The Economic Case for Early Humanitarian Response to the Ethiopia 2015/2016 Drought	Venton CC (2016).	https://static1.squarespace.com/static/5567b109e4b0101076d7f0bd/t/581b75e0cd0f68b05009b283/1478194658325/Ethiopia+Contingency+Analysis.pdf	**Procurement** (timeliness & local savings) in large-scale logistics	Replacing food with locally available food stocks (which are more expensive in this crisis than international grains) is estimated to cost an additional USD 111 million as compared with the cost if this food had been procured on time. If this same analysis is conducted to include the caseload under the PSNP, the additional cost of late procurement as compared with early rises to an estimated USD 127-271 million for food procurement alone.	Using an estimated cost of USD90 per person for a 9-month food distribution, these findings suggest that the cost savings could have ensured food aid to an additional 1.4 million to 3 million people.

The humanitarian 'digital divide'	Willitts-King B, Bryant J, & Holloway K (2019).	https://www.odi.org/sites/odi.org.uk/files/resource-documents/digital_divide_lit_review_web_0.pdf	Software for delivering food assistance (The 2019 USD 45 million partnership between the WFP and data analytics and intelligence gathering firm Palantir Technologies, based on WFP's supply chain optimization tool called Optimus).	So far, Optimus has saved WFP more than USD30 million in the operations where it is being used and tested; it could increase annual savings by as much as USD100 million once it is rolled out more broadly. In Iraq, it helped reduce food basket costs by more than 10% by making small changes, such as swapping out one commodity for something similar or changing procurement sources without reducing nutritional values.[13] However, **cost of the internet has to be considered**: the cost of 500MB data across Sub Saharan Africa 'varies by more than 200 times, from USD0.35 in Madagascar to USD81 in Guinea Bissau'.	In the name of increased efficiency and cost savings, the highly sensitive data of the 92 million people served annually by the WFP was being put at risk (p15). Despite the widespread adoption of biometrics with the aim of reducing fraud, there has been **no publicly available effort to compare the cost to organisations of establishing and operating biometrics systems with the cost of fraud (p17).**
Bamba Chakula: Delivering digital cash in Kenya's refugee camps	World Food Programme (2016).	https://ec.europa.eu/echo/field-blogs/stories/kenya-introducing-digital-cash-dadaab-worlds-biggest-refugee-settlement_en	Digital food voucher/cash transfer programme, Kenya	This completely digital programme is more cost-effective, convenient, and secure than delivering in-kind rations. Cost-efficiency analyses from WFP shows that providing rations through Bamba Chakula in Dadaab town is 15% more cost-efficient than in-kind assistance, and 6% more cost-effective in Kakuma camp (GSMA, 2017: 18-19).	The higher prices of commodities, combined with the cost to WFP of delivering a higher transfer value in Kakuma, leads to decreased cost-efficiency compared to Dadaab.

[13] WFP (2019). https://www.wfp.org/news/palantir-and-wfp-partner-help-transform-global-humanitarian-delivery

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Key websites

- Green logistics: http://www.greenlogistics.org
- Footprint Project: https://www.footprintproject.org/
- Field Ready: https://www.fieldready.org/
- Zipline: https://flyzipline.com/
- Building Blocks: https://innovation.wfp.org/project/building-blocks
- ID2020 Alliance: https://id2020.org/

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