HUMANITARIAN INNOVATION FUND

Development and Implementation Phase Grant Final Report

Organisation Name	Field Ready

Project Title	Rapid manufacturing: refining the approach
Partner(s)	Griffith University, Singularity University, Maya Design and Practical Action Publishing
Problem Addressed / Thematic Focus	Supply Chains
Location	California, Haiti, Nepal
Start Date	July 2015
End Date	18 Months
Total Funding	149,927
Total Spent	149,927

Reporting Period	July 2015–December 2016
Type of Innovation	Process Innovation
Project Impact Summary	This project has allowed us to demonstrate that manufacturing in the field can result in more cost-effective and timely delivery of vital aid supplies. We have helped to foster a momentum in the humanitarian sector towards an openness to exponential technologies

PROJECT ACTIVITIES AND OUTPUTS

*Please go to **Appendix 1** and attach the final workplan, showing all work that was actually completed.*

1. With reference to the final workplan, what have been the key achievements of the project?
The focus of our activity shifted during the course of the project, from Haiti to Nepal. This was needed due to a deterioration in the security situation in Haiti which hampered our ability to operate safely and within budget. The development of our partnership with World Vision in Nepal provided an opportunity to continue to develop our innovation and to understand the application of the approach in a different context.

As noted above, the date for the completion of several of the deliverables for the project had to shift within the project period to accommodate the needs of external partners, and to effectively manage the security situation. Whilst this impacted on dates, there were no negative impacts on the quality of the outputs themselves and no changes had to be made to the outlines of the project.

INNOVATION OUTCOMES

Whether this innovative project was successful, not successful, or a mix of both, the HIF would like you to report as much detail as possible, so that success can be built on and failures can be learned from. By 'success' we mean that the innovation has achieved the planned positive impact/outcome, or that it has performed better than the current process, product or system.

2. Has the project demonstrated the success of the innovation? *(Please choose only one answer.)*

☒ Completely successful
☐ Significantly successful
☐ Partially successful
☐ Completely unsuccessful

2b. Please select the successes that your project have achieved:
(You may choose more than one)

☒ There is real evidence that the project achieved the planned outcome(s)
☒ There were perceived contributions or improvements to the planned outcome(s)
☒ Learning was achieved within the project cycle
☒ 'Lessons learned' were gathered and circulated to humanitarian stakeholders and actors
☐ The completion of this project has led to another innovation
☐ Other *(please comment)* _____

2c. Please select the challenges your project has encountered:
(You may choose more than one)

☐ The project did not complete its planned activities

☐ There is no real evidence that the project achieved the planned outcome(s)
☐ There were few perceived contributions or improvements to the planned outcome(s)
☐ Learning was not achieved within the project cycle
☐ 'Lessons learned' were not circulated to humanitarian stakeholders and actors
☐ Other *(please comment)* _____

_____

2d. If there is any evidence for the successful performance of the innovation, please describe it further:

Yes –furthermore, we have begun to develop evidence that the approach can be used to meet needs that would otherwise go unmet, for example by the repair of specialist equipment through the creation of bespoke parts, or rapid prototyping for local manufacture of items that would otherwise be unavailable.

We have conducted technical assessments of individual items that we have manufactured, to demonstrate that they are able to perform to required standards of safety and durability. We have tested items with users in the field, with short cycles of feedback and iteration, in the course of the design process.

We have conducted an economic study of our work in Nepal, examining the full costs of a number of the items we have manufactured and comparing these with the costs of the best available alternatives. In some cases, items achieved more than 90% cost savings. The study also explored the perspectives of aid workers and local/international merchants, to better understand the potential implications of wider adoption of this approach, and particularly the potential impact on the outcomes of humanitarian interventions.

We have gathered feedback from the humanitarian sector in the course of our training and dissemination activities. This has highlighted both the potential barriers to the wider adoption of our approach and some of the ways in which our approach is most effectively explained to others. This evidence will be key to understanding how our approach might best be scaled. We have been approached by new prospective partners at an increasing rate, which we believe is evidence in itself that there is growing recognition in the sector of the opportunities to make more use of the manufacturing technologies we have introduced.

3. Please show the components of the project which contributed the most to any *successes*:
(where 1 = most influence 3 = least influence)

Component	*1*	*2*	*3*	*N/A*
Design and placement of the innovation	☐	☐	☒	☐
The methodology or approach to collecting evidence	☐	☒	☐	☐
Context	☐	☐	☒	☐
The availability of resources and capacities (financial, human, technical etc.)	☐	☐	☒	☐

Success in identifying and responding to different project and innovation risks	☐	☐	☒	☐
Strength of relationships and collaborations within the team and with other stakeholders	☐	☐	☒	☐
The process was flexible and responsive to emerging results	☐	☒	☐	☐
Ability to draw on experience and expertise of existing practice, codes and standards	☐	☐	☒	☐
Other:	☐	☐	☐	☐
Other:	☐	☐	☐	☐

4. Please show the components of the project which contributed the most to any unsuccessful elements of the project

Component	*Yes– contributed to failures*
Weaknesses in the design and placement of the innovation	☐
The methodology or approach to collecting evidence	☐
Context	☐
A lack of access to resources and capacities (financial, human, technical etc.)	☒
Difficulty in identifying and responding to different risks	☐
Lack of good relationships and collaboration within the team and with other stakeholders	☐
Having a process that was not flexible or responsive to emerging results	☐
No ability to draw on experience and expertise of existing practice, codes and standards	☐
Other:	☐
Other:	☐

5. What are the top three, key lessons learnt relating to the innovation? *This should relate to the innovation or the sector in which it operates, rather than project implementation.*

1. Our experience of delivering this project has helped us to develop our focus on the various aspects of the wider ecosystem that are necessary to support the further development of the innovation. In particular, we have gained an appreciation of the different models of local manufacturing that might be developed to engage most effectively with the local economy in disaster affected countries. An example of this would be our work on integrating our approach with livelihoods interventions that typically arise at later stages in a disaster response.

2. We have also developed our understanding of how to effectively engage expertise that exists globally in the technologies we are applying in the humanitarian context. This understanding

has come through our engagement with the 'Humanitarian Makers' community that we have nurtured online, and equally thorough our collaboration with academics in the US and Europe.

3. There have been a number of important technical learning points from our field trials, and these have been captured in the technical documents amongst the key deliverables for this project. Two techniques we attempted to introduce into our work – injection moulding and the manufacturing of recycled plastic filament – proved to be impractical at this time. We have shared our results with others working to address this issue and we are confident that we can make progress on both of these in the coming years.

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6. Do the final outcomes support the initial rationale for the innovation?

☒ Yes, completely
☐ Yes, significantly
☐ Partially
☐ No, not at all

Please describe further:

7. How has your understanding of the innovation changed through the project period?

Our initial understanding of the innovation was that by using local manufacturing it would be possible to reduce procurement costs, shortcut supply chains, and improve the ability to fulfil unique and difficult to meet needs in the field. Whilst we believe that this rationale still stands, we have considerably increased the depth of our knowledge as to how this can be achieved, and in which circumstances our approach can be the most effective.

8. Did the innovation lead to any unexpected outcomes or results? How were these identified and managed?

The level of cost savings realised by items we have manufactured has exceeded our expectations. Whilst we originally envisaged that 50% cost savings would be achievable, we have found that in the case of more complex items the savings can often be more than 75% or even 90%.

Indeed, from an economic perspective, we realised that the gains can be even higher. For example, where we were able to repair a complex piece of equipment, such as an incubator or power supply, through the creation of bespoke spare parts then the financial gain can be many times higher than the cost of manufacturing.

Similarly, in one case where we were able to apply new manufacturing techniques to rapid prototyping of items that could then be mass produced locally using traditional techniques and locally available facilities, considerable economic benefit was realised.

METHODOLOGY

9. Was the methodology successful in producing credible evidence on the performance of the innovation?

☒ Yes, completely
☐ Yes, significantly
☐ Partially
☐ No, not at all

Please describe further:

As described in the 'Innovation Outcomes' section, above, the methodology we employed produced credible evidence of performance in the form of technical assessments and field tests, the economic study, and feedback from the sector.

PARTNERSHIPS AND COLLABORATION

10. How and why did the partnership change during the course of the project?

The focus of our activity shifted during the course of the project, from Haiti to Nepal. This was needed due to a deterioration in the security situation in Haiti which hampered our ability to operate safely and within budget. The development of our partnership with World Vision in Nepal provided an opportunity to continue to develop our innovation and to understand the application of the approach in a different context.

As noted above, the date for the completion of several of the deliverables for the project had to shift within the project period to accommodate the needs of external partners, and to effectively manage the security situation. Whilst this impacted on dates, there were no negative impacts on the quality of the outputs themselves and no changes had to be made to the outlines of the project.

11. Are there plans to continue your partnership, either while scaling up this innovation or on other projects?

☐ Yes, with this innovation
☒ Yes, with another project
☐ Maybe
☐ No

Please describe further:

We have been able to continue our work with World Vision on a number of projects.

DISSEMINATION

12. Please describe any steps taken to disseminate the outcomes of the project.
Please include all completed and forthcoming, as well as all planned and unplanned products (for example, research and policy reports, journal articles, video blogs, evaluations).

Training and dissemination of our approach has been a core focus of this project. We had identified at the outset that a low awareness in the humanitarian sector of the capabilities of new manufacturing technologies is a key barrier to more widespread adoption of our approach.

Key dissemination activities have included:

- Delivering training courses to aid workers in the field.
- Speaking at sector conferences across North America, Europe and Asia.
- Publication of articles and videos.
- The production of a book on humanitarian innovation (publication forthcoming, by Practical Action Publishing)

13. Has the project received any third party coverage during the project (from news media, third party blogs, researchers or academics etc.)?

The most significant publication resulting from this project is our book, 'Managing Humanitarian Innovation: The Cutting Edge of Aid,' which will be published in 2017 by Practical Action Publishing.

Our project has received extensive third-party coverage, as indicated by the list of selected publications included as an annex.

SCALE UP AND DIFFUSION – WHAT NEXT?

14. Is the project or innovation to be replicated or scaled up?

☒ Yes, we will scale up in the same or similar context
☐ Yes, we will scale up within our organisation (including running more pilots or trials)
☐ Yes, we will replicate the innovation/project in another context or country
☐ Yes, the innovation/project will be replicated or scaled up by another organisation or stakeholder
☐ Yes, other
☐ No

If you answered *yes* to question 14, please answer 14b:

14b. What model are you pursuing to scale up or sustain your innovation?

☒ Applying for more donor funding
☐ Selling the innovation or patent
☐ Cost recovery (for example, selling your service or being paid as a consultant to implement the innovation)
☐ Innovation to be taken up by organisation or government as standard and included in standard planning and core funding by them
☐ Other_____

Please describe further:

15. If the project or innovation could be replicated or scaled up, please list the three most important issues or actions that will need to be considered:
(where 1 = most important and 3 = least important)

Suggestion/issue	*1*	*2*	*3*
1 Awareness At the beginning of the grant period, there was low awareness amongst aid workers of the potential of 3DP and local manufacturing. We have made strides to educate and share our approach and garnered a lot of interest from aid workers in adopting this innovative approach. In order for this to be more widely adopted we need to continue to raise awareness and share our approach with humanitarians and foundations alike.	☐	☐	☒
2 Supply Producing large quantities through distributed manufacturing–and even the ability to aggregate supply for the customer–is currently a barrier. This goes beyond technology and involves contracting warranty, quality assurance, insurance and legal/regulatory compliance issues (issues that are not unique to the humanitarian sector but that arise from novelty). To overcome this barrier, we will build on our existing efforts to: get 'ahead of the issues '(such as by participating in licensing for a);seek legal support with benchmarking and risk management; engage a range of policy makers; build a more diverse team to include for example ,more commercial expertise; strengthen our culture of strong listening and human–centred design; and improve documentation of the rationale for key decisions	☒	☐	☐
3 Demand supply chain problems can easily create demand for incremental improvements to the existing paradigm of humanitarian logistics (such as RFID tracking, private sector partnerships or even cargo drones) rather than demand for the transformation of supply chains through local production. This can manifest as a barrier. Our approach so far has been to: be as 'frictionless' as possible (by delivering like–for–like replacements of common humanitarian supplies rather than more novel options); using our networks well; integrating closely with humanitarian agencies (including through emerging lab networks); and speaking and listening at important humanitarian sector events. As we scale, we anticipate this barrier will get higher and that we will need to be increasingly sophisticated. We anticipate the need to: significantly invest in our monitoring, evaluation, impact assessment and learning activities; fully engage agencies in the value chain by delivering not just on cost but on livelihood, localisation and environmental priorities; fit well with the cash programming; build our designs into aid agency logistics catalogues; engage in research to inform change in procurement practices; and raise more awareness amongst humanitarian sector leaders/donors.	☐	☒	☐

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Appendix 1. Final Workplan

Below is a table that is the same as the workplan that you submitted with your original application. There are **three ways** to respond to this section.

1. If there have been no changes at all through the project you may cut and paste your original workplan here.

2. If there have been changes to the project but these changes **were previously reported to the HIF** in an *Agreement Amendment* form, please adjust your original workplan so that these changes are recorded in it here.

3. If there have been changes which were **not previously reported to the HIF**, please **also** fill in Table 2 (which is on the next page). In particular, please make sure to explain any budget various greater than 15% in Table 2.

Please paste your final workplan in here >

Please see attached.

Expected Results	**Main Planned activities**	**Implementation period** Months																	**Responsible party**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	
Planning and preparation	Preparation/Planning																			Team Leader (Director)
	Procurement																			
a. Research	Study parameters established																			Team Leader
	Study on economic impact and review																			
b. Training	Establish needs and possibilities																			

	Refinement of materials																			Manufacturer and Field Designer
	Training delivery and materials testing																			
c. Improve hardware/software	Identification of modifications to be made																			Engineer
	Adjustments by coordinating with manufacturers																			
d. Knowledge sharing**	Conference attendance																			All Senior Staff
	Article drafting																			
	Book preparation																			
	Publication submissions																			
MEL, wrap up and reporting	Monitoring (onsite & remote)																			Team Leader with external MEL Specialist
	Evaluation																			
	Review meetings																			
	Final Reporting																			

* Field Ready staff costs will be spread across all activities as needed.

** There are of course many steps involved in publishing articles and a book. Field Ready is already in discussions with Practical Action Publishing about those. Public release may happen after the end of the project period but all activities and expenses are expected to be finalized.

Table 2: Changes to Workplan

For every change in the final workplan that is different to your original worktable AND that has not already been reported to the HIF, please add a record in this table. Changes can include alterations to the methodology, project process or innovation design, for example.

Change (as referenced in workplan above)	Reason for change	Overall impact of change
1.		
2.		
3.		
4.		

List of Field Ready Publications

1. Eric James, Laura James. 3D Printing Humanitarian Supplies in the Field. (20 April2016)
2. Srinivas Saripalle, Abi Bush, Naiomi Lundman. 3D Printing for Disaster Preparedness: Making Life-Saving Supplies On-Site, On-Demand, On-Time.

List of Third-Party Publications

1. Brenna Sniderman, Vikram Rajan, Parker Baum. 3D Opportunity for Life: Additive Manufacturing Takes Humanitarian Action. (15 July 2016) *dupress.deloitte.com*
2. Nick Hall. 3D Printers Can Change Humanitarian Aid. (8 August 2016) *3dprintingindustry.com*
3. Barun Bajracharya . 3D Printing Humanitarian Solutions. (2 December 2016) *spotlightnepal.com*
4. Timothy Whitehead. 3D Printing in Developing Economies. (24 February 2016) *practicalaction.org*
5. Jaron Soh . 8 Social Innovators Accelerating Change in Nepal. (8 November 2016) *huffingtonpost.com* and *glocalkhabar.com*
6. Clare Scott. A Simple, 3D Printed Pipe Fitting Has Huge Implications for Disaster Relief. (30 December 2015) *3dprint.com*
7. Emma-Claire LaSaine. Field Ready Uses 3D Printing to Create Disaster Relief Supplies. (12 September 2015) *borgenproject.org*
8. Field Ready: The Startup Using 3D Printing for Disaster Relief. (1 September 2016) *medium.com* and *pinterist.com*
9. For Earthquake Ravaged Town, 3D Printing Saves Lives. (3 May 2016) *msnbc.com*
10. Emma Birchley. How 3D Printing is Helping With Relief Efforts. (22 May 2016) *news.sky.com*
11. Nathan Parker. How the First Humanitarian Maker Faire Advocated for Empowerment, Not Charity. (3 October 2016) *makezine.com*
12. Humanitarian Makers Getting Field Ready with Dr. Eric James – WTFFF 3D Printing Podcast 402. (29 December 2016) *itunes.apple.com*
13. Kelli Rogers. In Nepal, Oxfam Earmarks Earthquake Response Funds for 3-D Printing. (14 November 2016) *devex.com*

14. Our Most Popular Webinars of the Year, From Behavior Change to 3D Printing in Disasters. (19 December 2016) *engineeringforchange.org*
15. Gary Marshall. Weren't we Supposed to Have 3D Printers Everywhere by Now?. (22 May 2016) *techradar.com*
16. Sam Jones. When Disaster Strikes, it's Time to Fly in the 3D Printers. (30 December 2015) *theguardian.com*
17. Caleb Kraft. White House Honors Champions of Change. (13 June 2016) *makezine.com*