

This research explored how co-design can help to address market failure barriers preventing technology innovation in the field of child prosthetics. The aim was to ensure a balance between 'clinical pull' and 'technical push' in translating research in child prosthetics into everyday use. Funded by the Department of Health working in collaboration with Devices for Dignity, the research involved building a network of clinicians, academics, industry experts, and crucially, children and families. Co-design research methodologies were adopted to develop a service design solution ensuring the voices of children and their families were central throughout. Four parallel lines of inquiry were established to deliver this ambition: 'needs assessment', 'proof-of-concept', 'meaningful outcome measures' and 'learning from other contexts'. Langley and co-author Wheeler undertook a needs assessment engaging children and families nationally, conducted through workshops, phone calls and postal activity packs specifically tailored to a range of ages. This was then complemented by a series of one-day sandpit events in Salford, Bristol, London and Sheffield which brought key stakeholders together. This included children with prosthetic limbs, their parents, health care professionals from the NHS and private sector, academics from a range of institutions and

disciplines with an interest in prosthetic limb innovation, and commercial organisations. These ranged from those well-established in the prosthetics market and medical device sector to 'Fred- in-his-shed' organisations with no knowledge of medical device regulation but with prototypes and ideas well-liked by children and parents. Research has led to the creation of a national StarWorks network, national database of children with prosthetic limbs, ten proof-of-concept innovation projects and the development of plans for a Social Enterprise. The work has been disseminated through journal articles and conference papers, referenced in Nature Journal and cited by Involve (NIHR) as an exemplar of how to undertake co-production.



Above: co-production participants at our second innovation sandpit

## List of Published Outputs

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### Starworks 1

A. WHEELER, Gemma , MILLS, Nathaniel and LANGLEY, Joe (2020). The Starworks Project: Annual Report to National Institute for Health Research 2017-2018. Project Report. Sheffield Hallam University. [Monograph]

B. WHEELER, Gemma, MILLS, Nathaniel and LANGLEY, Joseph (2020). The Starworks Project: Annual Report to National Institute for Health Research 2018-2019. Project Report. Sheffield Hallam University. [Monograph]

C. Mills N, Wheeler G, Langley J. “Case study 3: The National Institute for Health Research (NIHR) Child Prosthetics Research Project”, pages 27-37 in ‘INVOLVE (2019) Co-production in Action: Number Two’. Southampton, INVOLVE. Accessed 16-04-2020 online: <https://www.invo.org.uk/wp-content/uploads/2019/11/Co-production-in-action-No2.pdf>

### Starworks 2

D. WHEELER, G, LANGLEY, Joe and MILLS, N (2019). Risk & reward: Exploring design’s role in measuring outcomes in health. Design Journal, 22 (sup1), 2231-2234. [Article]

E. LANGLEY, Joseph, WHEELER, Gemma, MILLS, Nathaniel and HERON, Nicola (2020). Starworks: Politics, Power and Expertise in co-producing a research, patient, practice and industry partnership for child prosthetics. In: CHRISTER, Kirsty, CRAIG, Claire and CHAMBERLAIN, Paul, (eds.) Design 4 Health 2020 Proceedings. Design 4 Health, Sheffield Hallam University, 314-322. [Book Section]

F. Starworks Ambassador Network and Facebook group

G. Starworks Social Enterprise

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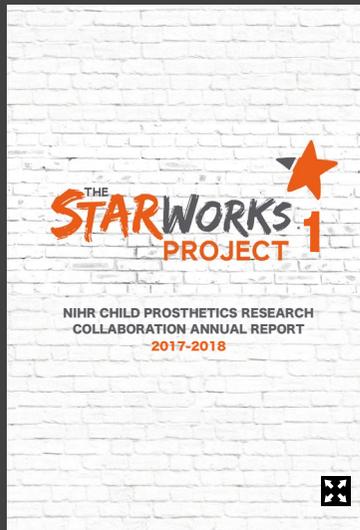
## A. The Starworks Project: Annual Report to National Institute for Health Research 2017-2018

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- WHEELER, Gemma, MILLS, Nathaniel and LANGLEY, Joe (2020). The Starworks Project: Annual Report to National Institute for Health Research 2017-2018. Project Report. Sheffield Hallam University. [Monograph]

This report was submitted to NIHR as a summary of Y1 of Starworks 1 and published by Sheffield Hallam University with permission from the NIHR in December 2020. It summarises the first three steps of Starworks 1:

- Multi- stakeholder unmet needs assessment
- 4 x multi-stakeholder innovation sandpits
- Commissioning of 10 x Proof-of-Concept innovation projects

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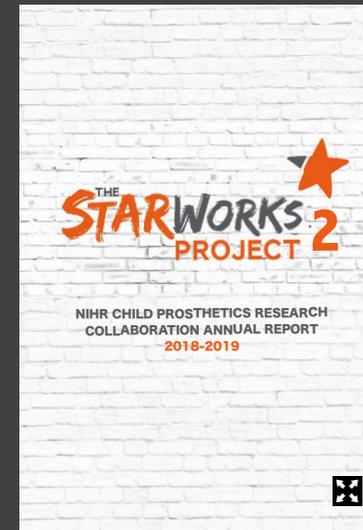
## B. The Starworks Project: Annual Report to National Institute for Health Research 2018-2019

WHEELER, Gemma, MILLS, Nathaniel and LANGLEY, Joseph (2020). The Starworks Project: Annual Report to National Institute for Health Research 2018-2019. Project Report. Sheffield Hallam University. [Monograph]

This report was submitted to NIHR as a summary of Y2 of Starworks 1 and published by Sheffield Hallam University with permission from the NIHR in December 2020. It summarises the latter steps of Starworks 1:

- Development of the 10 Proof-of-Concept innovations with continued engagement of children and families
- Continued development and growth of the Starworks network
- Identification of specific research needs to support innovation in this field with a focus on the need for Meaningful Outcome Measures

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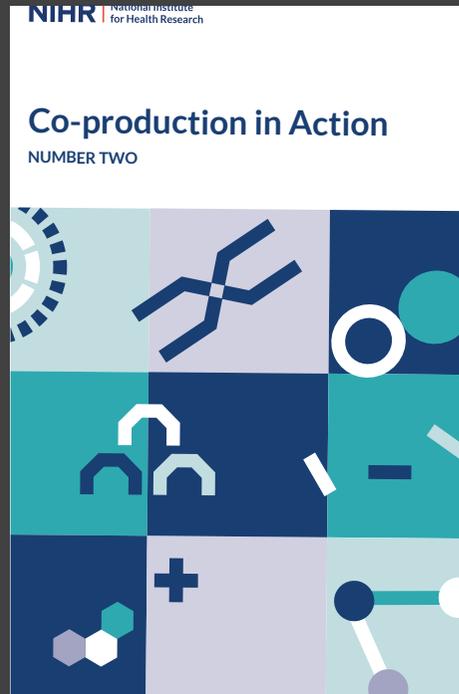
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## C. Case Study 3 – Co-production in Action Number 2.

Mills N, Wheeler G, Langley J. “Case study 3: The National Institute for Health Research (NIHR) Child Prosthetics Research Project”, pages 27-37 in ‘INVOLVE (2019) Co-production in Action: Number Two’. Southampton, INVOLVE. Accessed 16-04-2020 online: <https://www.invo.org.uk/wp-content/uploads/2019/11/Co-production-in-action-No2.pdf>

This publication summarises the ‘active’ co-production work of Starworks 1 and expresses how our creative co-design methods embodied and enacted the five key principles of co-production of Health Services Research.

The publisher of this report is NIHR INVOLVE



Left: Front cover of report

## D. Risk & reward: Exploring design’s role in measuring outcomes in health.

WHEELER, G, LANGLEY, Joe and MILLS, N (2019). [Risk & reward: Exploring design’s role in measuring outcomes in health](#). *Design Journal*, 22 (sup1), 2231-2234. [Article]

This peer reviewed conference paper summarises a conference workshop relating to the research theme of Outcome Measures identified towards the end of Starworks 1.

This was picked up and continued in Starworks 2, identified as priority by all stakeholder groups.



Left: Front cover of report

## E. Starworks: Politics, Power and Expertise in co-producing a research, patient, practice and industry partnership for child prosthetics.

LANGLEY, Joseph, WHEELER, Gemma, MILLS, Nathaniel and HERON, Nicola (2020). [Starworks: Politics, Power and Expertise in co-producing a research, patient, practice and industry partnership for child prosthetics](#). In: CHRISTER, Kirsty, CRAIG, Claire and CHAMBERLAIN, Paul, (eds.) Design 4 Health 2020 Proceedings. Design 4 Health, Sheffield Hallam University, 314-322. [Book Section]

An invitation to present the work at the D4H international conference in Amsterdam 2020 was unfortunately cancelled due to COVID. However this paper was published in the proceedings.



Left: First page of conference paper

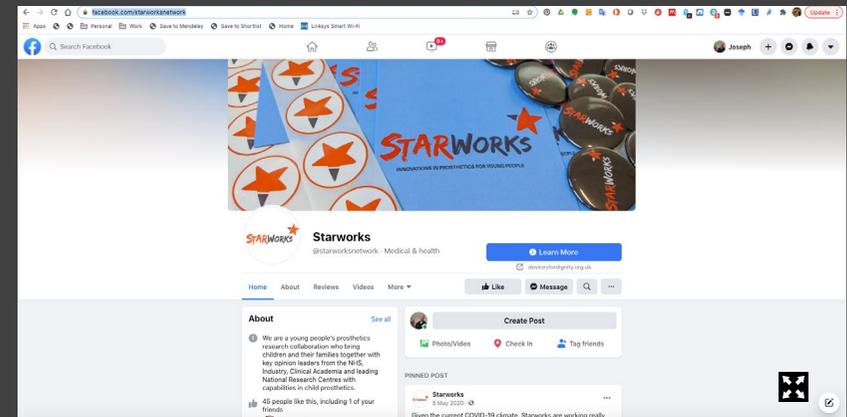
## F. Starworks Ambassador Network and Facebook group

<https://www.facebook.com/starworksnetwork>

This social media platform was an important output of the project. It was developed as a space for children with limb loss and their families to share experiences and ideas directly relating to innovation for prosthetics and other aspects of life for children with limb loss, and their families.

Its primary function is fulfilling the key principles of co-production such as building relations and valuing perspective and knowledge of stakeholders. In this specific media, we are giving a place and space for voices that have historically been disempowered from the innovation dialogue.

As part of this group we also created a special Ambassador Network for the children, including siblings of those with limb loss, as a way of recognising the value of their experiential knowledge and awarding them some authority to engage with clinicians, academics and innovators on equal terms.



Above: Home page of Facebook group

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## G. Starworks Social Enterprise



The Starworks Network grew throughout starworks 1 & 2, increasing in both membership and activity. The questions of sustaining the network and its activity was a continuous theme. The idea of a social Enterprise was presented to the NIHR which was instrumental in securing further funding for phase 2 of the work.

Langely subsequently undertook a 5 day training programme delivered by Dr Nicola Dickens in the different kinds of Social Enterprises, how to set them up and run them, securing community investments, measuring value, issuing social value certificates and securing social responsibility investments from industry.

Dr Dickens is an expert in Social enterprise's having completed the very first PhD exploring social enterprise value and then gone on to advise the coalition government on Social Enterprise

policy and legislation, with a specific emphasis on health related social enterprises. These changes were intended to make it easier for NHS healthcare professionals, who were previously specific barred from setting up health related social enterprises, to do so – or be part of social enterprises.

These changes were made to recognise the lack of economic value and incentive behind some health innovations that often prevented such innovations from being scaled and implemented. Yet they often carried social value.

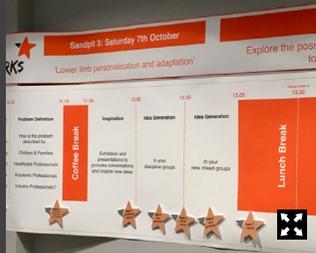
Progress on the social enterprise has been delayed due to COVID but the project has been granted 6 months extension by NIHR in which to achieve this. A letter in the additional information section, from Prof Wendy Tindale, overall lead for the NIHR Starworks programme, explains our ambition and the COVID related delay.

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● Starworks has been a long-term project spanning two rounds of funding; Starworks 1 & 2. Presented here is an overview of how this body of work unfolded through a variety of activities and methods in these two phases.  
 ○ Cutting across all the methods is our meta-approach to co-production using design methods and practices to ‘manage’ relationships, power, inclusivity etc. These wrap around and through every method and activity outlined below.

Starworks 1

1. Multi-stakeholder unmet needs assessment
2. Innovation Sandpits
3. Proof-of-Concept projects



Starworks 2

1. Proof-of-concept projects
2. Continued needs assessment & prioritisation
3. Research enquiries:
  - a. Activity limb evaluation
  - b. Meaningful outcome measures
4. Network development:
  - a. Growth & activity
  - b. Children & families empowerment
  - c. Sustainability – Social Enterprise design



## Starworks 1:

### Setting up the network:

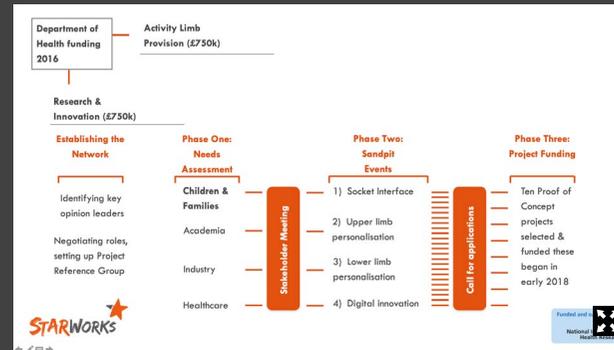
This body of work was initiated in circumstances described in the Telegraph article reference in 'Extra Information' and expanded upon in output E. This describes the political setting of this body of work and the combination of top-down and bottom-up approaches to our co-production. The importance of being transparent and visible at all stages was crucial and our visual design methods played a roll in this throughout.

### Needs assessment:

Whilst a needs assessment was carried out for each stakeholder group shown in the illustration on the right, these were carried out by other academic or health innovation groups that it was strategically important to give a role to in the network.

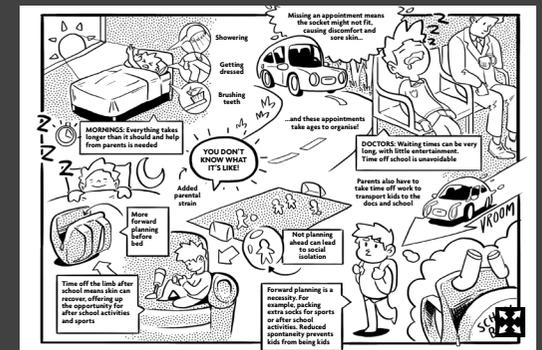
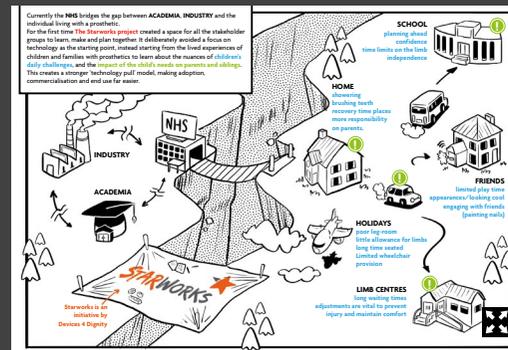
Our specific focus was on the children and families.

We used a wide range of creative and visual methods working in small groups, travelling around the country to meet these small groups in facilities provided by the local rehab or prosthetic limb clinics. Outputs A-C expand on these methods in greater depth and our dissemination webinar linked to output C makes the explicit links with the key principles of co-production.



### Innovation sandpits and proof-of-concept funding:

Four innovation sandpits were consciously held at 'neutral' venues: at Media City in Salford, @Bristol museum (now called M Shed), at the Wellcome Trust in London and at ICE Sheffield. Outputs A-C detail these events in great depth and report on the numbers of different people that attended, the format of these events and the outputs.



Examples of two visual summaries derived from the needs assessment work that were used as prompts and provocations in the subsequent sandpit.

These played a role as both method and dissemination, being visual representations of the multiple perspectives of the network that was used to broaden the views, focus and scope of the innovation work of all stakeholders yet also used to tell those outside the network, funders and other academics about the work of the network.



## Starworks 2:

### Proof-of-concept projects continued:

Our role in this phase of work was to project manage the ten proof-of-concept projects and specifically ensure that the perspectives and children and families were sustained within these individual projects. Our fear was, that once funded, the academics, healthcare professionals and industry collaborators would 'revert to type' and begin to ignore the voices of the children and families.

### Continued needs assessment & prioritisation:

Through the website and network events we continued to collect more unmet needs from individuals, adding them to our growing library.

We began to verify these through academic and grey literature as well as using visual representations and social media to elicit wider feedback to establish whether these were idiosyncratic or widespread. Here the power of our growing network paid dividends as the collective reach of the individuals within it, across all stakeholder groups, proved extensive.

We used this network to begin to prioritise these unmet needs based on responses from the network.

### Research enquiries:

Aside from technology innovation needs and projects, other unanswered research questions arose from the network members. Two of these were what was the impact of the activity limbs funded by DoH and a need to develop Outcome Measures that were meaningful to children, families, healthcare professionals, academics and industry.

### Activity limb evaluation:

The first of these was given to our charity partner Limbpower to address as they had the vital connection with all the children who had received activity limbs.



### Network growth and development:

A multi-channel communications strategy was sustained throughout the course of Starworks 1 & 2, reaching out to all stakeholder groups through email, website, social media, newsletters, events, and meetings.

The development ultimately moved towards a social enterprise model as stated previously.

The model for this social enterprise is to be based on the stakeholder groups of patients & families, healthcare professionals, industry and academia. Each group is to have representation in the social enterprise 'ownership' and management in such a way as to build equity between these stakeholders into the very structure of the social enterprise through shared values, reciprocity and through a system of recognising all contributions including those not traditionally monetised.



<https://www.nature.com/articles/d41586-018-06861-9>

Hickey, G., Richards, T., & Sheehy, J. (2018). Co-production from proposal to paper. *Nature*, 562(7725), 29–31. <https://doi.org/10.1038/d41586-018-06861-9>



Commentary in 'Nature' by external co-production expert using Starworks as exemplar case study

WHEELER, Gemma and MILLS, Nathaniel (2018). *The Starworks Project: Achievements and Next Steps*. In: International Society of Prosthetists and Orthotists UK MS Annual Scientific Meeting, Grand Harbour Hotel, Southampton, 12 Oct 2018 - 13 Oct 2018. International Society of Prosthetists and Orthotists UK. (Unpublished) [Conference or Workshop Item]

Conference presentation

This presentation summarised the first year of Starworks 1 to a domestic national audience of Prosthetists and Orthotists and offered the opportunity through Q&A for immediate audience response and engagement

It summarises the first three steps of Starworks 1:

- Multi-stakeholder unmet needs assessment
- 4 x multi-stakeholder innovation sandpits
- Commissioning of 10 x Proof-of-Concept innovation projects

The Starworks Project: Achievements and Next Steps

**Presented at:**  
The International Society of Prosthetists and Orthotists (ISPO) UK MS Annual Scientific Meeting, 12-13 October 2018, Southampton

**Written by:**  
Gemma Wheeler (Lab4Living, Sheffield Hallam University and Nathaniel Mills (NIHR Devices for Dignity MIC, Royal Hallamshire Hospital, Sheffield)

**Presented by:**  
Gemma Wheeler

Summary

This talk was a guest speaker presentation to the ISPO-UK conference in order to discuss the progress to date of The Starworks Network; a child prosthetics research collaboration funded by The Department of Health via the National Institute of Health Research.

Abstract

Following the announcement in March 2016 of the government's investment of £1.5 million in child prosthetics, National Institute for Health Research (NIHR) Devices for Dignity MedTech Co-operative were given the role of leading the £750,000 fund created to "incentivise the development of new breakthrough innovative prosthetic products for the NHS." The agreed approach was to pump-prime the formation of a Child Prosthetics Research Collaboration, which brought together children and their families with key opinion leaders from the NHS, industry, clinical academia and leading national research centres with capabilities in child prosthetics. The aim of this work was to increase research focus across the system to accelerate the translation of new inventions and developments in child prosthetics into everyday use. This initiative is centred on the needs of children, patient and families and the NHS and will ensure there is the ideal balance of 'clinical pull' and 'technical push' to create an energetic environment in which to innovate.

This talk will give an overview of the approach taken to developing a new, much-needed collaborative research network in the field of child prosthetics, including:

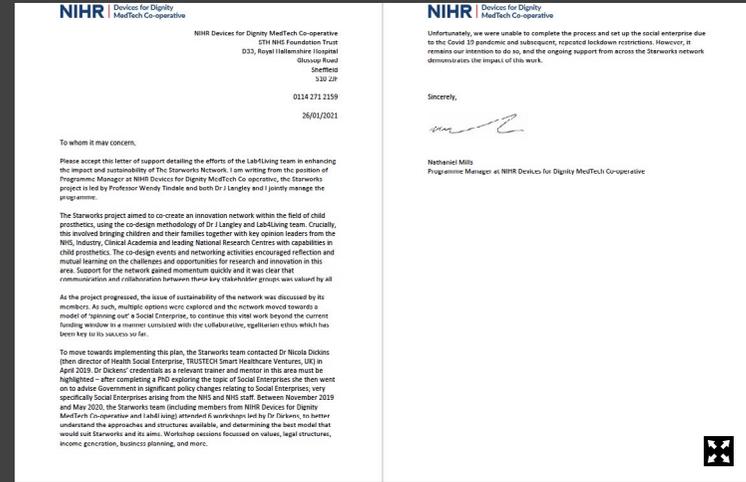
- Establishing the network
- A multi-stakeholder needs assessment, considering the perspectives of children and families, clinicians, academics and industry experts.
- A series of 'Sandpit' events, bringing together these key stakeholders to collaboratively explore and innovate in emergent challenge areas
- The funding of ten 'Proof of Concept' projects that respond to these challenge areas, whilst keeping children and families in the centre of the research focus.

As part of this talk, we are also pleased to confirm that Starworks has received further funding from the NIHR to continue to develop the network, reinforcing its current foundations and also extending its reach. We will give an insight into initial plans for 'Starworks 2', and hope that this talk will encourage families, clinicians, academics and industry experts to reach out to us, learn more, and help us to grow the network further.

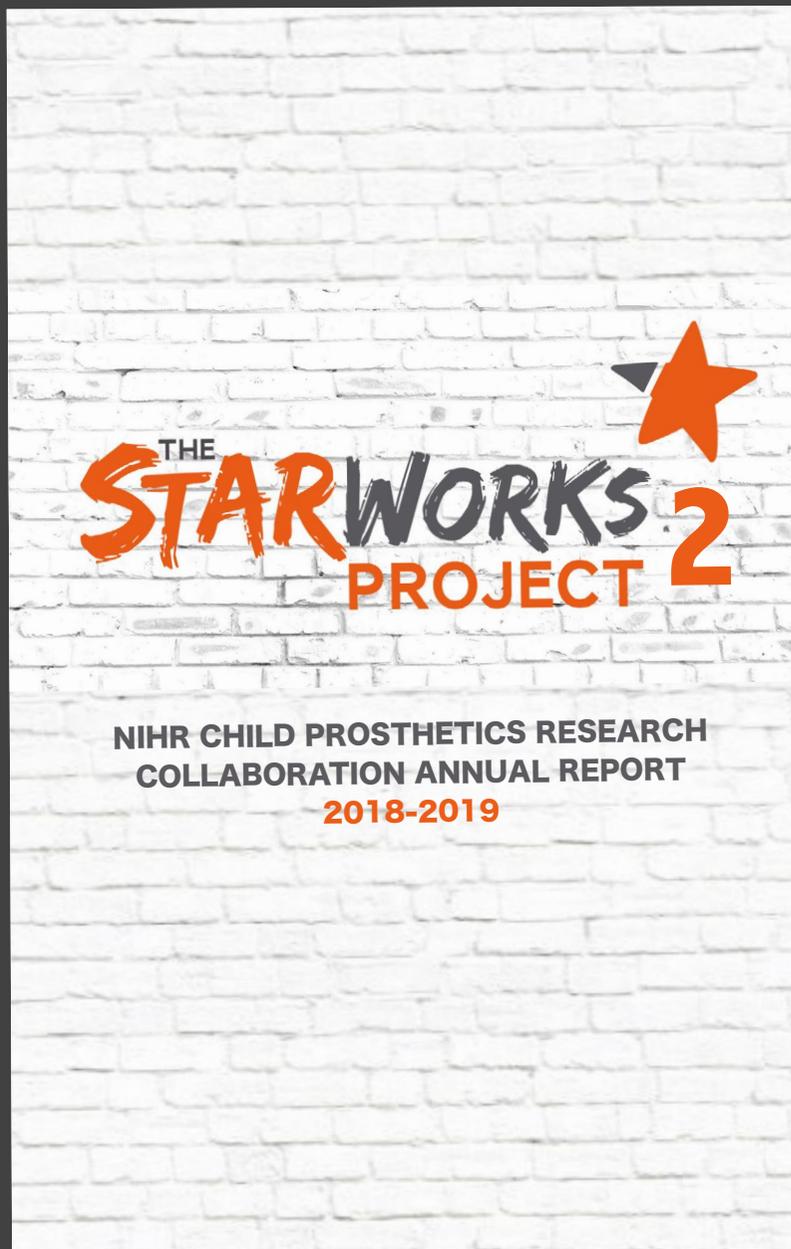
<https://www.telegraph.co.uk/finance/budget/12195031/New-running-blades-for-500-amputee-children-after-1.5million-NHS-boost-in-2016-Budget.html>



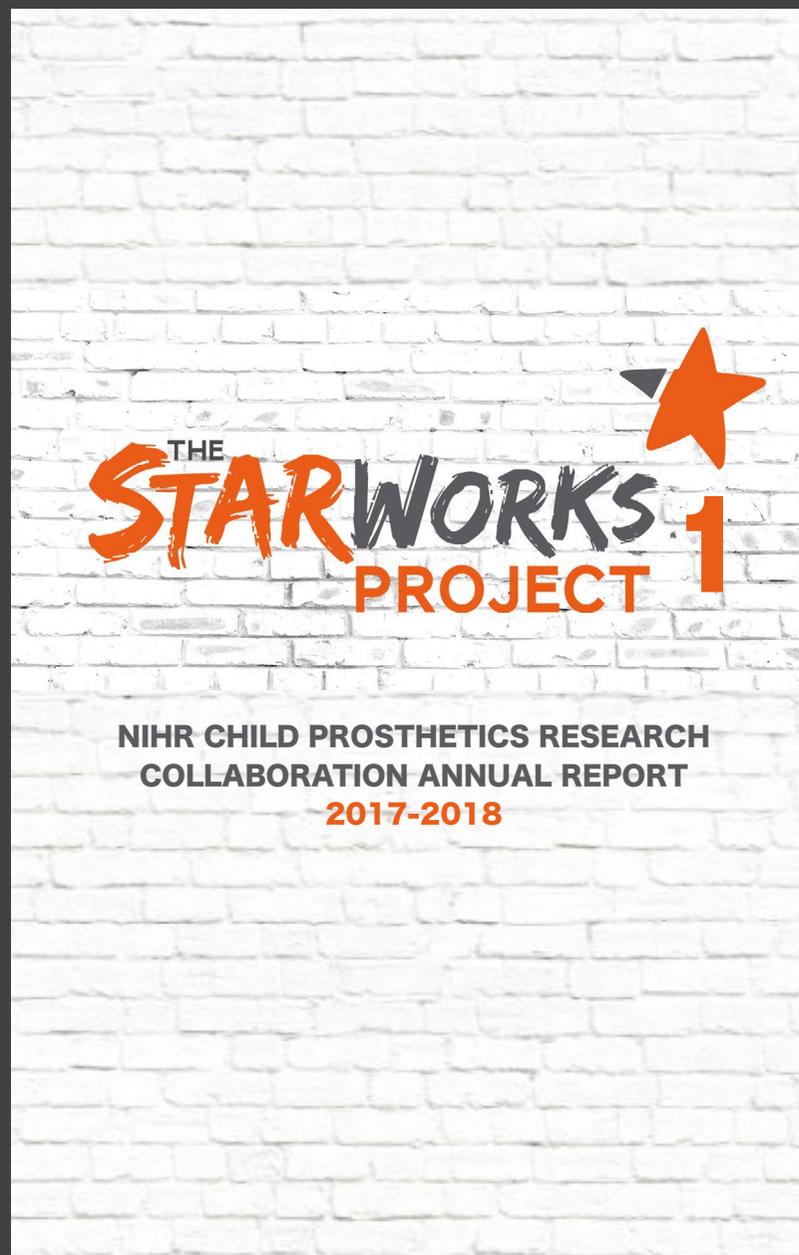
Telegraph article describing the government announcement of the funding award and the background to the decision behind this award



Letter from Starworks Clinical Director stating the intention to delay the social enterprise launch



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facebook.com/starworksnetwork

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*i* We are a young people's prosthetics research collaboration who bring children and their families together with key opinion leaders from the NHS, Industry, Clinical Academia and leading National Research Centres with capabilities in child prosthetics.

*👍* 45 people like this, including 1 of your friends

**Create Post**

Photo/Video Check In Tag friends

**PINNED POST**

**Starworks**  
5 May 2020 · *🌐*

Given the current COVID-19 climate, Starworks are working really

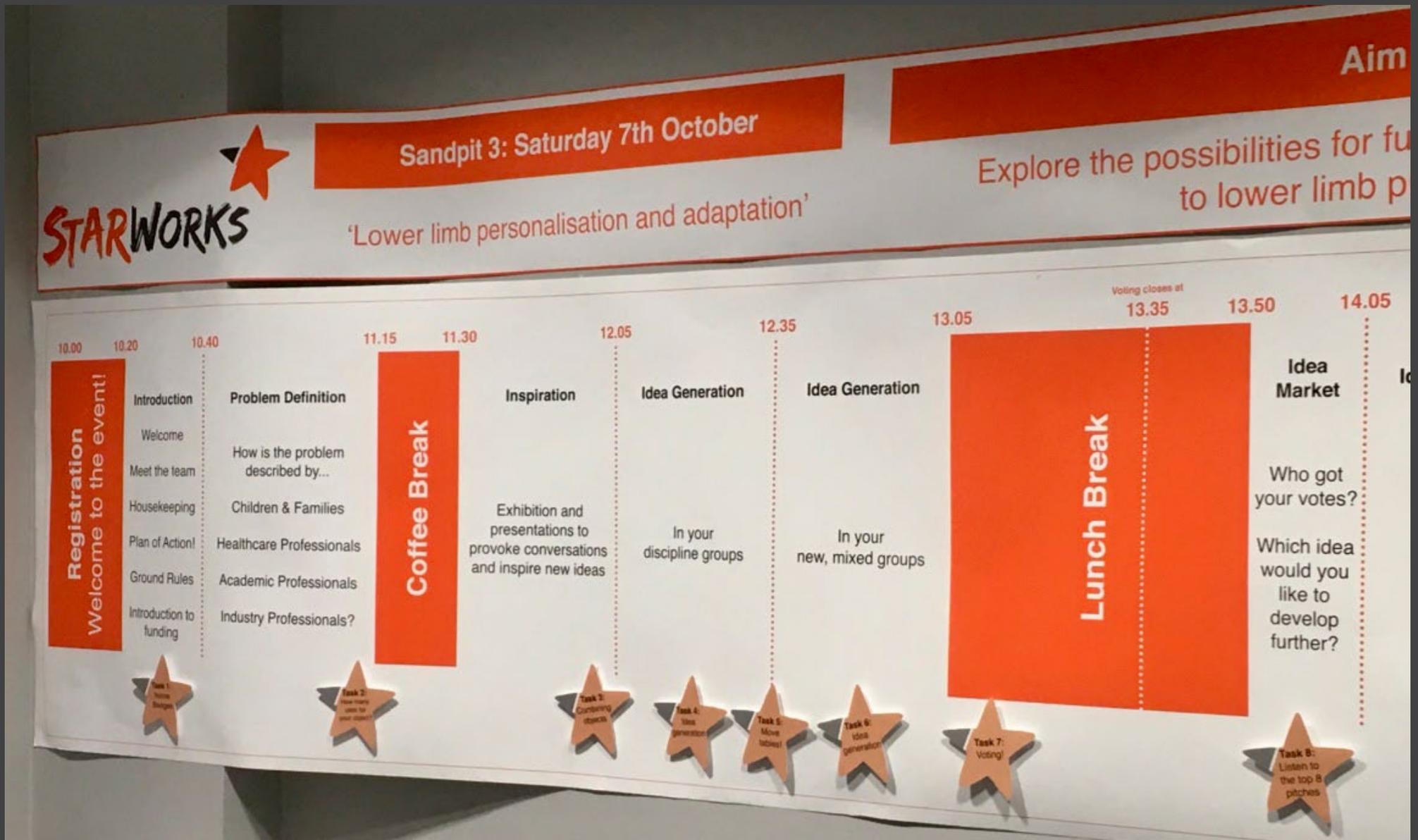
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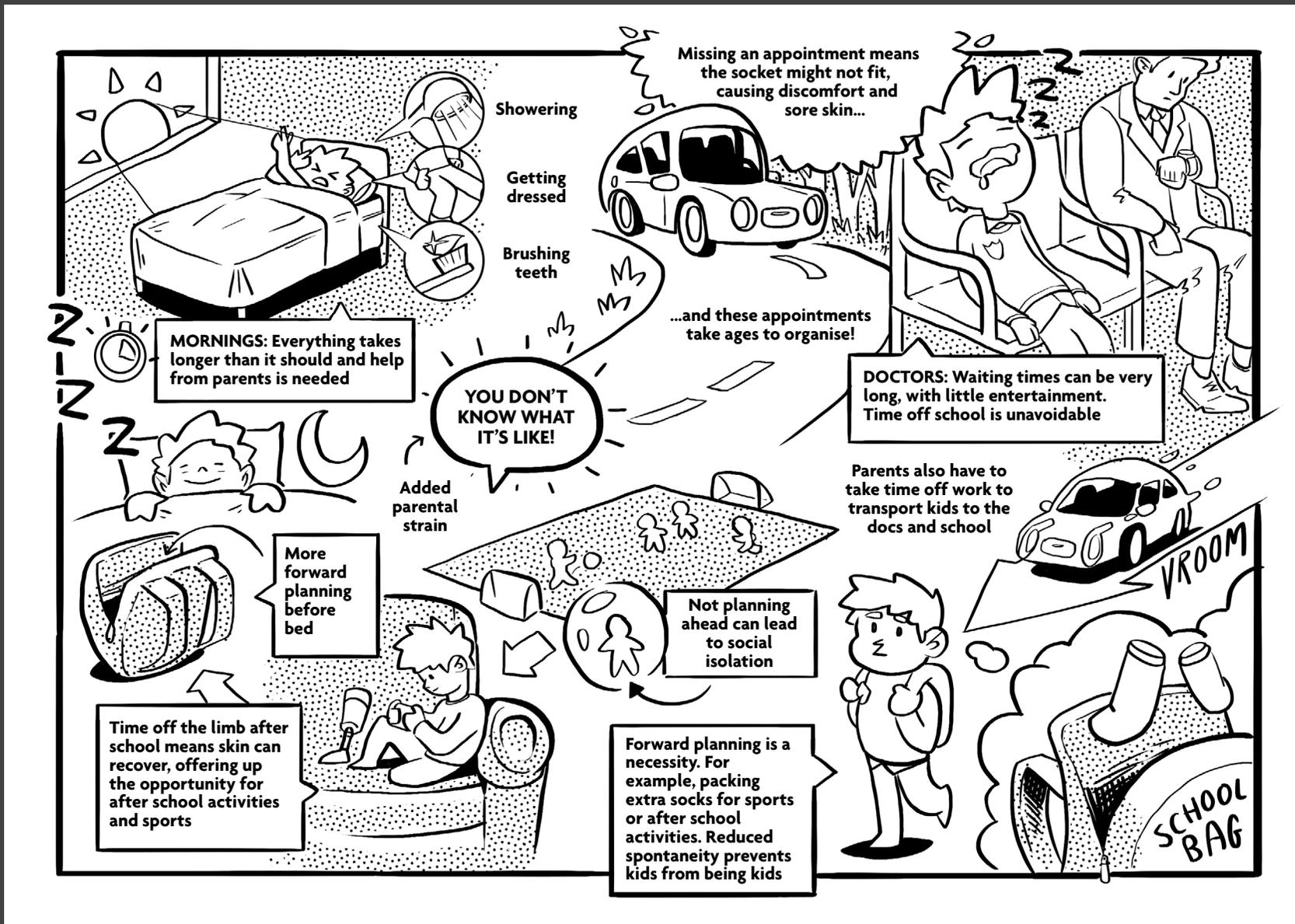
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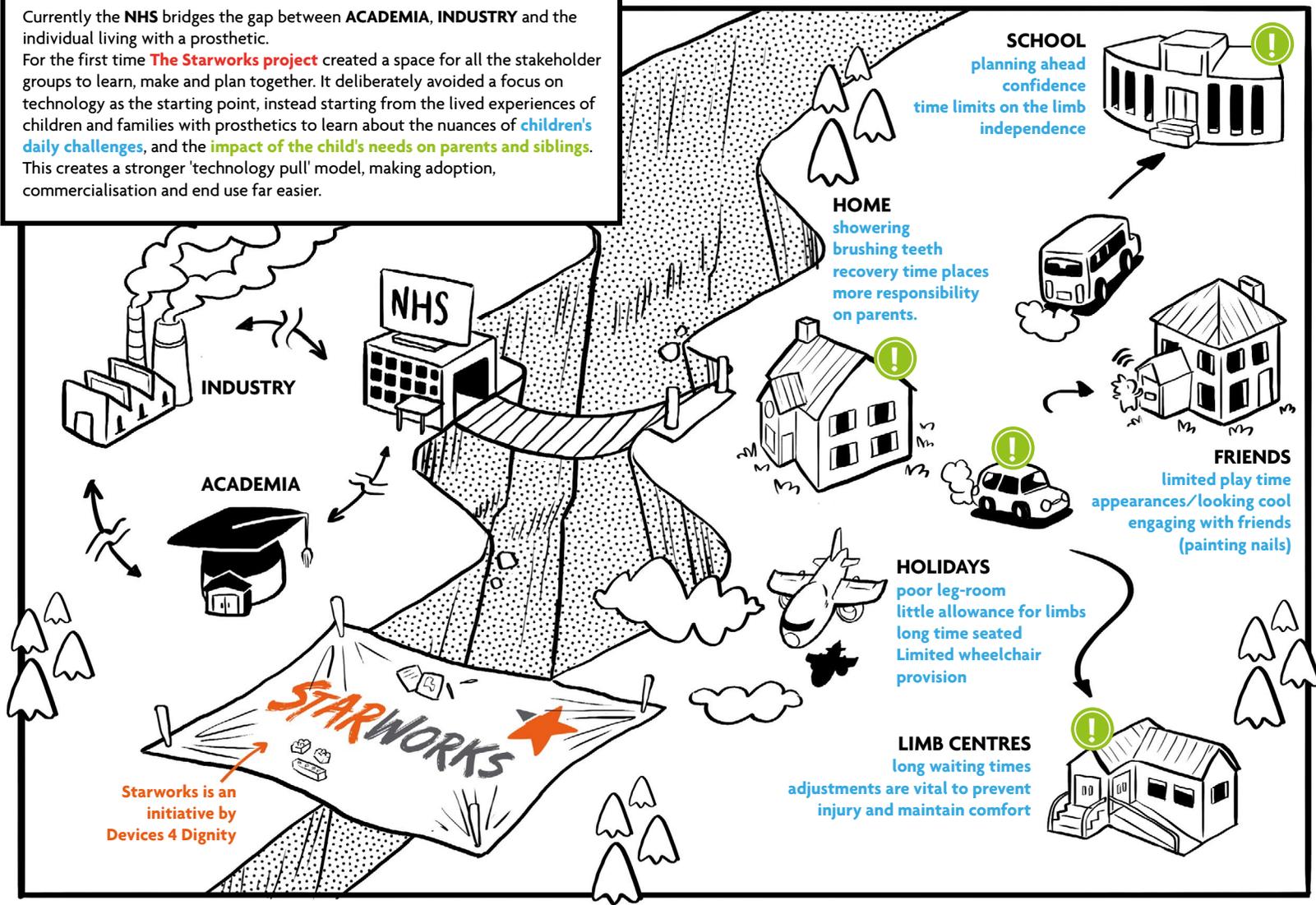


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Currently the **NHS** bridges the gap between **ACADEMIA**, **INDUSTRY** and the individual living with a prosthetic.  
 For the first time **The Starworks project** created a space for all the stakeholder groups to learn, make and plan together. It deliberately avoided a focus on technology as the starting point, instead starting from the lived experiences of children and families with prosthetics to learn about the nuances of **children's daily challenges**, and the **impact of the child's needs on parents and siblings**.  
 This creates a stronger 'technology pull' model, making adoption, commercialisation and end use far easier.



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Department of Health funding 2016

Activity Limb Provision (£750k)

Research & Innovation (£750k)

**Establishing the Network**

Identifying key opinion leaders

Negotiating roles, setting up Project Reference Group

**Phase One: Needs Assessment**

Children & Families

Academia

Industry

Healthcare

Stakeholder Meeting

**Phase Two: Sandpit Events**

1) Socket Interface

2) Upper limb personalisation

3) Lower limb personalisation

4) Digital innovation

Call for applications

**Phase Three: Project Funding**

Ten Proof of Concept projects selected & funded these began in early 2018



Funded and supported by **NHS** National Institute for Health Research

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The image shows a screenshot of a Twitter interface. On the left is a navigation sidebar with icons for Home, Explore, Notifications, Messages, Bookmarks, Lists, Profile, and More, along with a blue 'Tweet' button. The main content area shows a tweet by Joseph Langley (@JoeLangley\_) from November 20, which has been retweeted by Dr Gem Wheeler and Stephen W. MacGregor. The tweet text reads: 'NIHR INVOLVE booklet on 'Co-production in action' was launched today. https://www.invo.org.uk/wp-content/uploads/2019/11/Co-production-in-action-No2.pdf ... See Case Study 3 for our contribution @natwm10 @gem\_wheeler @Lab4Living Cochrane training webinar on the back of this scheduled for this Friday: https://training.cochrane.org/co-production-action ...'. A 'Tweet Analytics' overlay is displayed in the foreground, showing the following data: 'Impressions' (4,609) and 'Total engagements' (146). Below the analytics is a 'View all engagements' button and a 'Promote your Tweet' section with a 'Promote your Tweet' button. The background shows a 'Trends for you' section with various topics and a search bar.

**Retweeted**  
by Dr Gem Wheeler and Stephen W. MacGregor

**Joseph Langley** @JoeLangley\_ · Nov 20  
NIHR INVOLVE booklet on 'Co-production in action' was launched today.  
https://www.invo.org.uk/wp-content/uploads/2019/11/Co-production-in-action-No2.pdf ... See Case Study 3 for our contribution @natwm10 @gem\_wheeler @Lab4Living  
Cochrane training webinar on the back of this scheduled for this Friday:  
https://training.cochrane.org/co-production-action ...

**Tweet Analytics**

**Joseph Langley** @JoeLangley\_  
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Cochrane training webinar on the back of this scheduled for this Friday:  
https://training.cochrane.org/co-production-action ...

Impressions 4,609  
times people saw this Tweet on Twitter

Total engagements 146  
times people interacted with this Tweet

[View all engagements](#)

**Promote your Tweet**  
Your Tweet has 4,609 total impressions so far.  
Get more impressions on this Tweet!

[Promote your Tweet](#)

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The image shows a Twitter interface with a tweet by Joseph Langley (@JoeLangley\_) from November 20. The tweet text is: "NIHR INVOLVE booklet on 'Co-production in action' was launched today. https://www.invo.org.uk/wp-content/uploads/2019/11/Co-production-in-action-No2.pdf ... See Case Study 3 for our contribution @natwm10 @gem\_wheeler @Lab4Living Cochrane training webinar on the back of this scheduled for this Friday: https://training.cochrane.org/co-production-action ...". A 'Tweet Analytics' modal is open over the tweet, displaying the following data:

Metric	Value
Impressions	4,612
times people saw this Tweet on Twitter	
Total engagements	146
times people interacted with this Tweet	
Link clicks	70
clicks on a URL or Card in this Tweet	
Detail expands	29
times people viewed the details about this Tweet	
Likes	27
times people liked this Tweet	
Retweets	13
times people retweeted this Tweet	
Profile clicks	6
number of clicks on your name, @handle, or profile photo	
Replies	1
replies to this Tweet	

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NIHR Devices for Dignity MedTech Co-operative  
STH NHS Foundation Trust  
D33, Royal Hallamshire Hospital  
Glossop Road  
Sheffield  
S10 2JF

0114 271 2159

26/01/2021

To whom it may concern,

Please accept this letter of support detailing the efforts of the Lab4Living team in enhancing the impact and sustainability of The Starworks Network. I am writing from the position of Programme Manager at NIHR Devices for Dignity MedTech Co-operative, the Starworks project is led by Professor Wendy Tindale and both Dr J Langley and I jointly manage the programme.

The Starworks project aimed to co-create an innovation network within the field of child prosthetics, using the co-design methodology of Dr J Langley and Lab4Living team. Crucially, this involved bringing children and their families together with key opinion leaders from the NHS, Industry, Clinical Academia and leading National Research Centres with capabilities in child prosthetics. The co-design events and networking activities encouraged reflection and mutual learning on the challenges and opportunities for research and innovation in this area. Support for the network gained momentum quickly and it was clear that communication and collaboration between these key stakeholder groups was valued by all.

As the project progressed, the issue of sustainability of the network was discussed by its members. As such, multiple options were explored and the network moved towards a model of 'spinning out' a Social Enterprise, to continue this vital work beyond the current funding window in a manner consistent with the collaborative, egalitarian ethos which has been key to its success so far.

To move towards implementing this plan, the Starworks team contacted Dr Nicola Dickens (then director of Health Social Enterprise, TRUSTECH Smart Healthcare Ventures, UK) in April 2019. Dr Dickens' credentials as a relevant trainer and mentor in this area must be highlighted – after completing a PhD exploring the topic of Social Enterprises she then went on to advise Government in significant policy changes relating to Social Enterprises; very specifically Social Enterprises arising from the NHS and NHS staff. Between November 2019 and May 2020, the Starworks team (including members from NIHR Devices for Dignity MedTech Co-operative and Lab4Living) attended 6 workshops led by Dr Dickens, to better understand the approaches and structures available, and determining the best model that would suit Starworks and its aims. Workshop sessions focussed on values, legal structures, income generation, business planning, and more.

Unfortunately, we were unable to complete the process and set up the social enterprise due to the Covid-19 pandemic and subsequent, repeated lockdown restrictions. However, it remains our intention to do so, and the ongoing support from across the Starworks network demonstrates the impact of this work.

Sincerely,



Nathaniel Mills  
Programme Manager at NIHR Devices for Dignity MedTech Co-operative

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