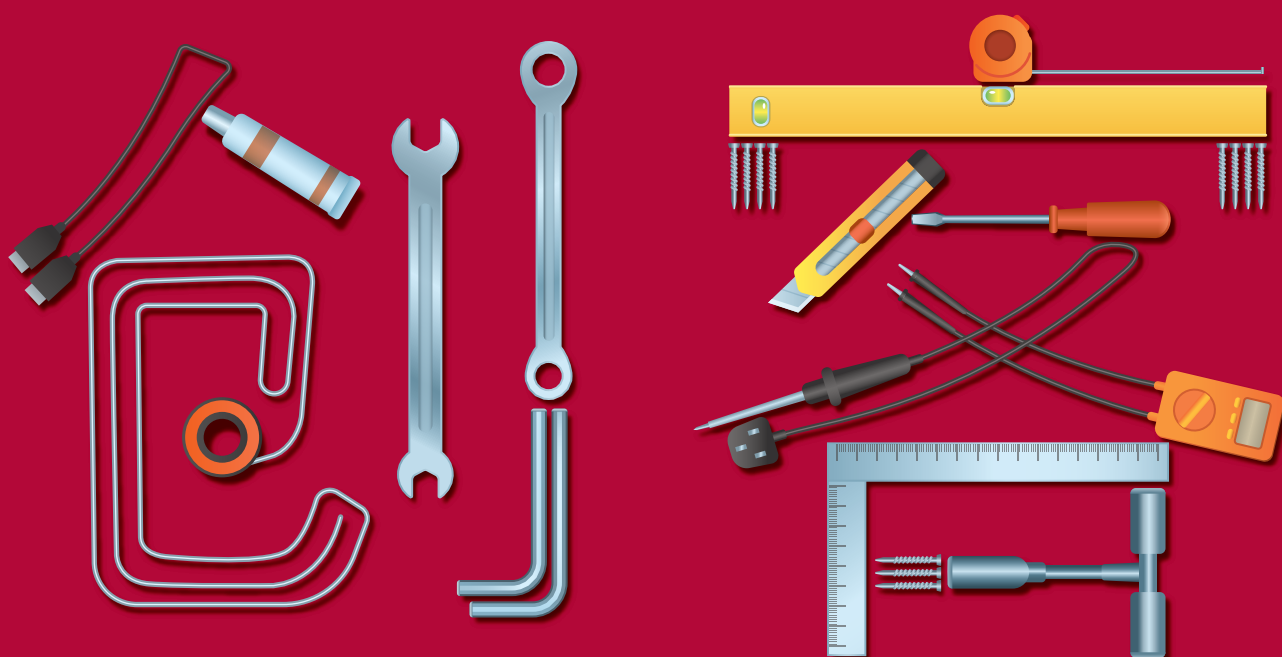


MADE IN CHINA



Makerspaces and
the search for mass
innovation

Tom Saunders and Jeremy Kingsley

March 2016

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The views expressed in this report are those of the authors and do not necessarily reflect the views of the project partners.

About Nesta

Nesta is an innovation foundation with a mission to help people and organisations bring great ideas to life.

We are dedicated to supporting ideas that can help improve all our lives, with activities ranging from early-stage investment to in-depth research and practical programmes.

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MADE IN CHINA

Makerspaces and the search for mass innovation

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FOREWORD

In 2010 the first makerspace opened in China. Fast forward to 2016 and there has been an explosion of spaces across the country, especially in 2015 when the government's spotlight fell on makerspaces as drivers of mass innovation and entrepreneurship.

The demand for new approaches to making and manufacture remains dynamic, with many spaces opening as others close. There is some feeling that the bubble is bursting after the 2015 boom. But with increasing focus from the government on creativity and innovation, captured in their 'Made in China' to 'Designed in China' campaigns, what will the future of the makerspace look like?

The British Council is working with and through makerspaces around the world. We see them as an important part of the changing nature of the creative industries, where both creative professionals and the public are initiating new ways of working together. They are fostering new forms of production, learning and business that can take advantage of new technologies while still recognising the value of traditional craft and design skills.

We also believe that makerspaces, and other forms of creative hubs, can foster new forms of cultural leadership. The convenors that build these spaces promote community spirit, vital to local and global economic and social development.

This report and collaboration with Nesta is the start of a much bigger conversation about how we can link makers in the UK and China more closely. We have a commitment to build a longer term programme that will explore what we can learn from the unique making culture in both countries and how these lessons can be shared globally.

Beatrice Pembroke and **Rebecca Shoesmith**,
Creative Economy team, British Council

EXECUTIVE SUMMARY

Made in China: makerspaces and the search for mass innovation

In China, making things is a national specialism: whether it's smartphones or air conditioners, a staggering proportion of the things we use every day are manufactured in the country. Indeed China today produces about a quarter of the world's goods, including 90 per cent of its personal computers, 70 per cent of its mobile phones and 60 per cent of its shoes.¹ But as China's manufacturing sector matures and the economy grows, companies are beginning to move their factories out of China to Vietnam, Bangladesh and even Mexico to take advantage of cheaper wages. As a result, the way that China makes things has to change – from low-cost components, assembly and labour-intensive processes associated with an often pejorative 'Made in China' label, to higher value, innovation-led activities that could see that label develop into a mark of quality. This could be the start of a new era of 'Designed in China.'

Against this background, 'makerspaces' – open workshops that provide access to a range of tools and resources for making physical objects – have spread rapidly across China in the last five years. For many, they signal a new age of grassroots innovation and promise to revolutionise ailing economic and educational systems.

The excitement around China's makerspaces reached a peak in early 2015 when China's Premier Li Keqiang visited Chaihuo makerspace in Shenzhen and spoke of the significance of the country's burgeoning maker movement. Since then many local governments, companies and schools across China have sprung into action, capitalising on central government interest and committing to opening makerspaces. There are dozens of articles about China's makerspaces and many claim that they have a lot to teach their foreign counterparts. As politicians in the west begin to look to makerspaces as a means of supporting startups, entrepreneurship, and democratised participation in manufacturing, China may become a model for how to do this. However, there are few systematic analyses of China's maker movement – even basic questions, such as how many makerspaces are there in the country and who uses them, to questions about business models, relationships with businesses and universities, and how and why they differ from their counterparts abroad, remain so far unanswered.

Our report

This report analyses the prospects and dilemmas of China's makerspaces. It is aimed at those within China, as well as makerspaces around the world, and those who wish to understand how they can better support them.

To do this Nesta and its partners – the British Council and Hacked Matter – came together to carry out the first systematic survey of China's makerspaces. Building on Nesta's 2015 survey of UK makerspaces, we surveyed almost 100 makerspaces in China and the resulting dataset represents the most comprehensive picture of China's makerspaces to date. To add context to the findings of the survey we visited makerspaces in three major cities in China in October 2015 – Nanjing, Shanghai and Shenzhen, and interviewed the founders and managers of 12 makerspaces. We also held two expert workshops in London and Shenzhen.

Makerspaces - a definition

Makerspaces, hackerspaces and Fablabs are all names for a similar phenomenon. Fablabs are easy to identify: the term refers to a network of branded digital fabrication workshops that grew out of MIT in 2001. An organisation has to apply to the Fablab network in order to be able to use the name. Hackerspaces and makerspaces are harder to define. Hackerspaces are workshops where people can 'hack' hardware. They appeared in Europe in the 1990s, spreading to the US in the early 2000s. Alongside hackerspaces, makerspaces began to appear in the mid to late 2000s and grew out of the 'maker movement' promoted by *Make magazine*. No single organisation controls the hackerspace/makerspace movement, which means anyone can use the label. This is why conferences about making and makerspaces often spend a long time debating what exactly a makerspace is. For the purpose of this report we define it simply as an open access space (free or paid), with facilities for different practices, where anyone can come and make something.

Surveying China's makerspaces - nine key takeaways

In the report we analyse the survey in detail but here are the nine most interesting findings:

1. **Numbers: how many makerspaces are there in China?** They have spread rapidly over the past five years, from just one in 2010 to over a hundred in 2015.² In our survey, the number of makerspaces doubled in 2015.
2. **Geography: where are China's makerspaces?** Three-quarters are in large cities on China's developed east coast, the rest are in large northern and inland cities. So far, makerspaces are an urban phenomenon.
3. **People: who is a typical maker?** Makers are typically young, male, highly-educated and technically literate. Seventy-seven per cent are male and 54 per cent are currently studying at university. They are most likely to be studying engineering or electronics. A large number of makers are also school-age children.
4. **Facilities: what tools and materials do they have?** The typical Chinese makerspace is likely to specialise in electronics – 85 per cent stock electronics equipment and one in two spaces that specialise in a particular material focus on electronics. Spaces that focus on craft are in the minority.
5. **Types of space:** we have identified five types of makerspace in China:
 - a. **The community makerspace:** this would be familiar to anyone involved with makerspaces in the west; a mix of hobbyists and people working on ideas for products, sharing access to tools. They host workshops, organise training and have a strong community aspect.
 - b. **Hardware accelerators and incubators:** government interest in makerspaces has focused on their potential to incubate startups and create jobs, and most government-backed makerspaces are more accurately hardware incubators adopting the 'makerspaces' label because of the current excitement around this term in China.
 - c. **Kids' education clubs:** these are after-school and weekend clubs, run both by independent organisations and also within schools, where kids can make things. They differ from craft clubs in that they provide access to digital tools like 3D printers and open source hardware like Arduino. They are an expression of a desire to bring creativity and hands-on, project-based learning into China's education system.
 - d. **Open-access university labs:** many universities across China – mainly those with a focus on electronics and engineering – are setting up 'makerspaces' that provide access to digital manufacturing tools and other equipment to any student enrolled in the university. The idea is to promote innovation, potentially helping to incubate hardware startups.

- e. Makerspaces within companies:** From Foxconn, the world's largest consumer electronics manufacturer, to state-owned enterprises like the 14th Research Institute of the China Electronics Technology Group (CETC) in Nanjing, companies across China are opening in-house makerspaces to give employees the tools and space to test out new ideas that may eventually become new products, and to improve the creativity and problem-solving skills of their employees.
- 6. Money: how are spaces funded?** China's makerspaces are still experimenting with business models. One in five is funded by a parent company. Workshops, membership fees and donations are also a major source of income. Thirty-four per cent of makerspaces surveyed have received some form of government support, from funding to subsidised rent. One in four spaces has no income and relies on the support of volunteers.
- 7. Politics: how is the government supporting makerspaces?**
- a. High-level policy support:** The central government has indicated its interest through high-profile visits to makerspaces and by issuing several policy guidelines about makerspaces and 'mass innovation.'
 - b. Local government subsidies:** Provincial and city governments provide makerspaces with free workshop space or subsidised rents - almost one in five makerspaces have received this kind of support. Several local governments have also announced plans to invest large sums in setting up new makerspaces.
 - c. Encouragement and promotion:** Local governments play an important role in encouraging the maker movement. This includes organising maker events and competitions, promoting university-makerspace interaction and encouraging businesses to work with makerspaces on product development.
- 8. Relationships: Who are China's makerspaces connected to?** Two-thirds are connected to government - receiving funding and support and hosting events; two-thirds are connected to local manufacturers - who supply them with parts and organise small patch production runs for them; three out of four are connected to universities - hosting joint events, to access advanced equipment and running maker education courses; and 36 per cent have international connections, mainly through joint events and visits.
- 9. Challenges: What challenges do China's makerspaces face?**
- a. Funding:** Spaces that don't have a parent company struggle with developing a sustainable business model - 52 per cent highlighted this as an issue.
 - b. Membership:** Despite claiming large numbers of members, maintaining membership was a major concern for many spaces.
 - c. Skills:** New members rarely have the skills to use the tools in makerspaces, meaning makerspaces have to spend time and resources training them
 - d. Understanding and advocacy:** For many in China, 'Makerspaces' are synonymous with entrepreneurship and few people understand maker culture, which makes it difficult to recruit people interested in making. Government understanding of makerspaces as startup factories means that it is difficult for spaces that focus on other things to access government support.

Five trends driving China's maker movement

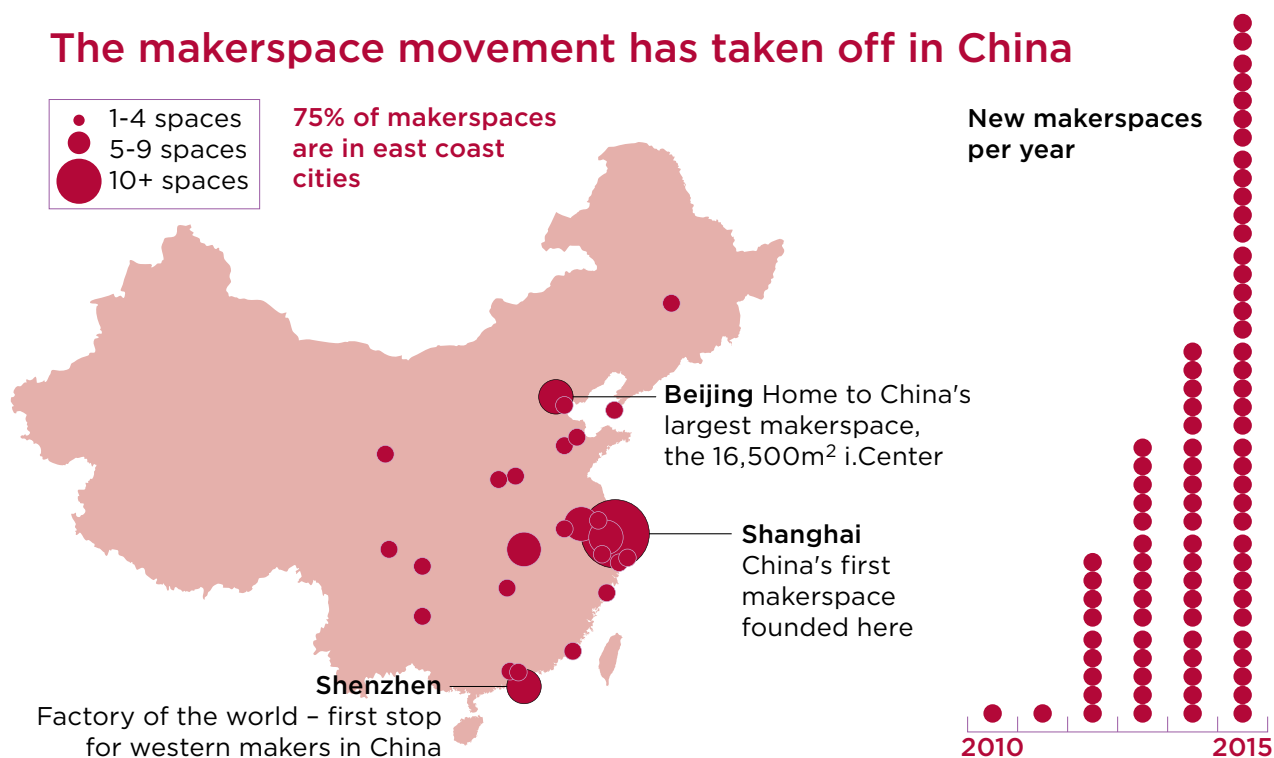
First imported into China in 2010, the term 'makerspace' now refers to a range of activities and spaces, many of which meet a unique need of China's social and economic situation. Below, we highlight the five trends that are driving China's maker movement:

- 1. A changing economy means the way that China makes things has to change.** Manufacturing is at the heart of the Chinese economy, but global economic forces are pushing up wages in China, making low-cost, labour-intensive manufacturing much less lucrative for Chinese companies. A shift in sophistication and a greater focus on innovation and design are now required. For many companies, makerspaces represent the potential to release the creative, innovative energy of their employees.
- 2. A search for innovation-led development is key to the Chinese government's interest in makerspaces.** No longer satisfied with 'made in China, designed elsewhere', for the past ten years the government has sought to put China on a path to innovation-led development. Realising that top-down edicts can only go so far, the government hopes that makerspaces can foster grassroots innovation, and entrepreneurship, helping to drive the next phase of innovation-led economic growth in China.
- 3. Makerspaces represent a desire for radical reform of the education system.** Rote learning served China well when 'Made in China' was the main driver of the economy, but a transition to 'Designed in China' requires more creativity, more freedom of expression and more freedom of thought. Makerspaces potentially represent a way to bring these values into the traditional education system.
- 4. China's urban middle class are looking to reconnect with craft, just like their western peers.** While manufacturing is still a major part of the Chinese economy, millions of young Chinese graduates will never need to work with their hands. For them, makerspaces are a reflection of a desire to be creative and make physical objects. Furthermore, the urban middle classes are starting to get more time off work and some of them are turning to making to fill it.
- 5. Shanzhai - a system of rapid, open-source, iterative innovations - is key to understanding China's makerspaces.** Weaker IP protection and cut-throat competition mean that companies and entrepreneurs place less emphasis on protecting their inventions in China, instead attempting to innovate quicker than their competitors. As a result, China's makers have easy access to thousands of cheap, open-source electronics components, which are an extremely useful resource for grassroots innovators and makers.

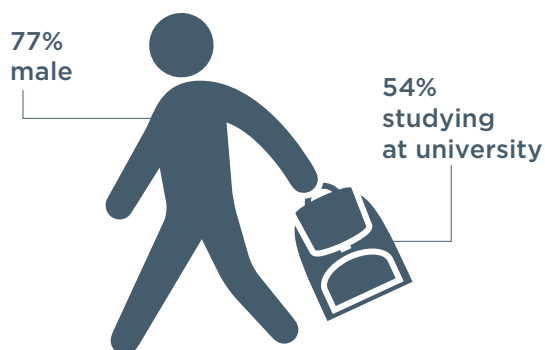
The Chinese maker movement is still in its infancy. As with any new movement, it's difficult to predict what it will look like a few years from now. In our survey, several respondents said that makerspaces will be so common in schools and businesses that no one will talk about them anymore. Others said that the maker bubble will burst in the next couple of years, government funding will be pulled or won't materialise, and a core of 'real' makerspaces will be left struggling without funding or support. Whatever the truth of these two visions, government, business and education institutions will continue to experiment with the meaning of making and makerspaces, taking the maker movement in new directions, which could potentially provide useful models and lessons for the international community of makers and those who wish to support them.

China's makerspaces in numbers

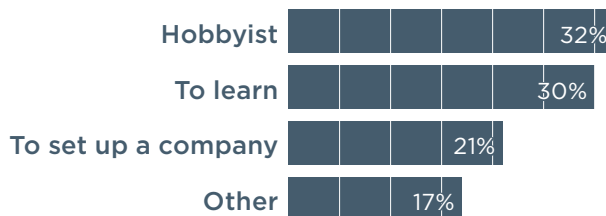
The makerspace movement has taken off in China



China's makers: young, male, educated

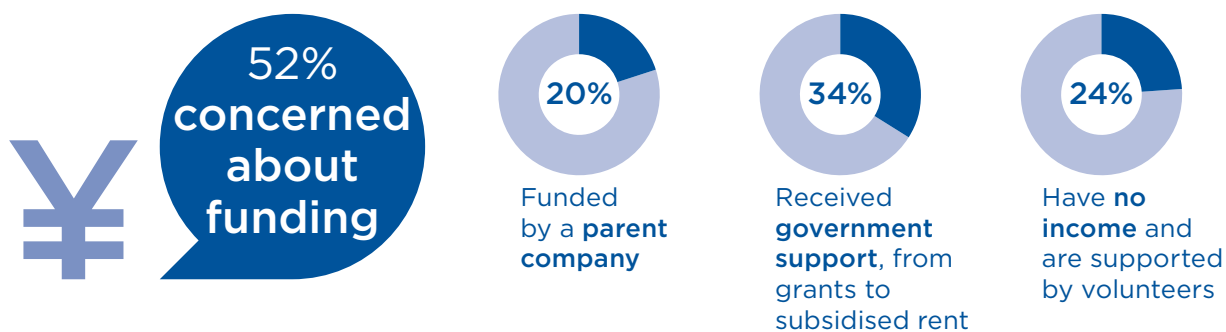


Why do people visit your makerspace?



'Other' includes visits from government officials and companies

Main challenge: Funding



1. A snapshot of China's makerspaces

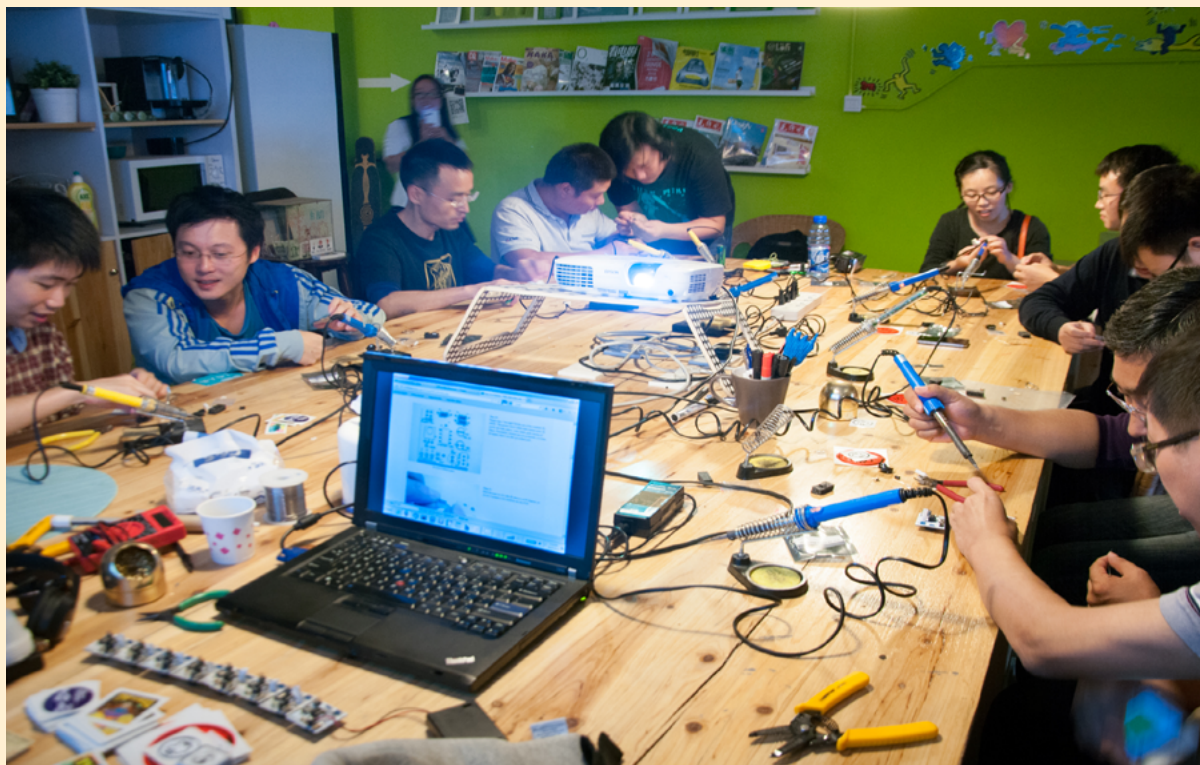
1. A snapshot of China's makerspaces

At Nanjing Makerspace on the east coast of China, large crates arrive every day containing things you might never expect to see in a makerspace – fridge-freezers and other white goods, solar panels and bathtubs. These and other consumer products are sent to Nanjing Makerspace by companies in the hope that members of the makerspace might be able to improve their design or solve a tricky problem. The ‘smart ball’ used in Haier’s latest washing machines is one example: at a hackathon – an event where people collaborate and compete on hardware challenges – Haier organised with Nanjing Makerspace, one member came up with the idea of placing absorbent balls between the inner and outer drum of the washing machine to keep it clean and as a result extend its lifespan. Haier went on to commercialise the idea, paying the inventor from Nanjing makerspace a fee for his troubles.

What’s going on here is part of an exciting new chapter in the story of how things are made in China. As low-cost production starts to move abroad in response to inflation and higher wages, Chinese companies are beginning to move up the value chain, focusing on innovation and design. Makerspaces are part of this story. Originally a western import, they were used mainly by expats and returnee students who had been members of makerspaces in the west and wanted to continue to socialise with like-minded hobbyists, to experiment and make things in their spare time in China. However, in the last five years the Chinese government, businesses, schools and universities have all taken an interest in the concept, recognising the potential of maker culture to transform production by nurturing and harnessing the creative energy of grassroots innovators. As such, the makerspace concept is adapting to meet the needs of the Chinese economy and society, and the maker movement in China is now fantastically diverse. Here’s a snapshot of what is going on:

- Inside the Shenzhen plant of Foxconn, the world’s largest consumer electronics manufacturer, the company hopes that its in-house makerspace will promote a new wave of innovation by encouraging its employees to play and work on new ideas.³
- Tsinghua University’s i.Center is a 16,500m² makerspace, the largest in China. It was set up in 2013 to give students a practical education, access to advanced tools and to promote entrepreneurship. It hosts weekly hacking workshops and an annual ‘maker day’, open to the public.
- Ruichuang Makerspace is based in the 14th Research Institute of the China Electronics Technology Group (CETC), a major state-owned conglomerate focusing on defence R&D. It has set up a maker programme for its new engineering recruits where they attend the in-house makerspace weekly to work on ideas for products. Those who go through the programme are much better at problem solving and also have higher confidence levels.
- Maker Mountain is a hardware accelerator and incubator in Shenzhen. It provides office space, on-site prototyping and seed funding for successful applicants to the programme.
- Litchee Lab is an example of the type of maker education for children that is springing up across China, teaching hands-on creativity, critical thinking and freedom to experiment. It hopes to be part of a revolution in the education system.

1. A snapshot of China's makerspaces



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Chaihuo Makerspace (circa 2013)

The context for this report

If you're reading this in a developed country, chances are you rarely make physical products, especially in a work context. 'Work' most likely means sitting in front of a computer screen for eight hours a day. After half a century of production outsourcing, there is both nostalgia for working with one's hands and a desire to relearn the knowledge and skills needed to make things. Furthermore, the space to make physical products is scarce in western cities, which are almost wholly devoted to the service economy. These are some of the drivers of the global 'maker movement'.

In China it's different. Making things is a national specialism, from a rich, deep-rooted craft heritage to its more recent dominance in mass manufacturing as the world's factory for consumer goods. As a result, nostalgia for the production of physical goods and the need to relearn production skills are not issues in China. And yet makerspaces have spread rapidly in the last five years, from just one in 2010 to over a hundred in 2015. More and more blogs, articles and academic papers have been written about the potential of China's makerspaces, yet they are still little understood outside of China.

The excitement around China's makerspaces reached a peak in early 2015 when China's Premier Li Keqiang visited Chaihuo makerspace in Shenzhen and spoke of the significance of the country's burgeoning maker movement. Since then many local governments, companies and schools across China have sprung into action, capitalising on central government interest and committing to opening makerspaces. As politicians in the west begin to look to makerspaces as a means of supporting startups, entrepreneurship, and democratised participation in manufacturing, China may become a model for how to do this.

1. A snapshot of China's makerspaces

Why has China, which has such a different economic and industrial heritage from the west, adopted the idea of 'making' – a western concept – so wholeheartedly? What is going on in China's makerspaces and what lessons, if any, can UK makerspaces and those who hope to support them seek to learn from China? With international attention set to focus on China's makerspaces in 2016 with the global Fablab conference, Fab12, scheduled to take place in Shenzhen in August, now seems like a good time to search for these answers.

Translating makerspaces

The Chinese term for maker 创客 is not an invention by the government, but was coined by China's makers themselves. They chose the term to distinguish their work from the more negative 黑客 or hacker – 创客 has the benefit to connote related words such as 创新 (innovation), 创业 (startup a business), and 创意 (creativity). The character 创 features in all of these words and so the meaning of 创客 itself is flexible and can be used in a variety of ways.

Silvia Lindtner, *Mass Making in China: Cultivating an Entrepreneurial Mindset*.

Data collection

To answer these questions we ran the first comprehensive survey of China's makerspaces. Working with Hacked Matter, a Chinese research consultancy founded by David Li, the founder of China's first makerspace, we adapted Nesta's 2015 survey of UK makerspaces to the unique Chinese context and surveyed almost 100 spaces. The resulting data represents the most comprehensive overview to date of China's makerspaces.

Collecting the data for the survey posed several difficulties. Most Chinese makerspaces do not register themselves in the global makerspace directory, and they do not keep their websites up to date. It is also difficult to find makerspaces using search engines. Instead, we posted a link to the survey in 30 of the most popular makerspace groups on WeChat, the widespread Chinese messaging app. Many members of these groups are founders or active members of makerspaces around China. We first ran a pilot with ten makerspaces to test the questions then launched the revised survey in November 2015.

Building on this survey, we visited makerspaces in three major cities in China in October 2015 and interviewed the founders and managers of 12 makerspaces. Nesta's research trip was run in conjunction with one undertaken by nine makers and academics from the UK. This project, called 'Living Research', was developed by the British Council and the Arts and Humanities Research Council. Discussions with them during and after the trip offered a unique opportunity to view China's makerspaces through the lens of those who are involved in the maker movement and have been invaluable in contextualising the findings of the survey results. We also held two expert workshops, in London and Shenzhen.

Makerspace - a definition

It is tricky to define exactly what a makerspace is as there are no restrictions on who can use the label. Some take a broad view, defining it as any space where people can make things. Others see makerspaces as synonymous with digital fabrication and don't include traditional arts and crafts activities. The degree to which a space is open to the public is also an important factor - private workshops are usually excluded from the definition.

For this report we used the same definition as Nesta's 2015 survey of UK makerspaces: "an open access space (free or paid), with facilities for different practices, where anyone can come and make something."⁴

1. A snapshot of China's makerspaces

While this definition might seem very broad, for China it excludes a large number of spaces that self-identify as makerspaces. Many organisations that don't provide access to tools have started calling themselves makerspaces in response to government and media interest in the concept. In reality these spaces are mainly incubators, accelerators and coworking spaces. Lots of companies that offer specific manufacturing services to businesses, e.g. 3D printing and laser cutting, have also begun to call themselves makerspaces. Both of these types of spaces have not been included in the survey.⁵ Therefore, while the latest plan for economic and social development by the NDRC, China's planning ministry, claims that there are 2,300 makerspaces in China, we believe, and our survey confirms, that there are much closer to 100 spaces that could realistically be called makerspaces.

China's makerspaces in numbers

Category	Statistics	
Number of spaces surveyed	93	
Average size	521m ²	
Location	75% in cities on the east coast of China	
Founded by:	Individual	56%
	Local government	23%
	Informal group	13.5%
	University	5%
	School	2.5%
Average number of members	100	
Profile of a Chinese maker	University students	54%
	Male	77%
Why do people visit makerspaces?	'It's my hobby'	32%
	'To learn'	30%
	'To set up a company'	21%
	other (includes visits from government officials and large companies)	17%
Average number of staff	Full time	5
	Part time	5
	Volunteers	11
Average income	100,000 RMB (24% of spaces have no income)	
Makerspaces that have commercialised products?	38% - includes members getting products funded on Kickstarter and startups successfully creating products through maker incubation programmes	
Makerspaces with links to manufacturing	73% - includes working with companies on hackathons and getting prototypes built	
Makerspaces with international links	36% - includes links with universities and attending international maker events	

2. Making for kicks

2. Making for kicks

Why did you set up a makerspace?

“To spread craft culture and a spirit of practical experience.”

MakerFamily, Beijing

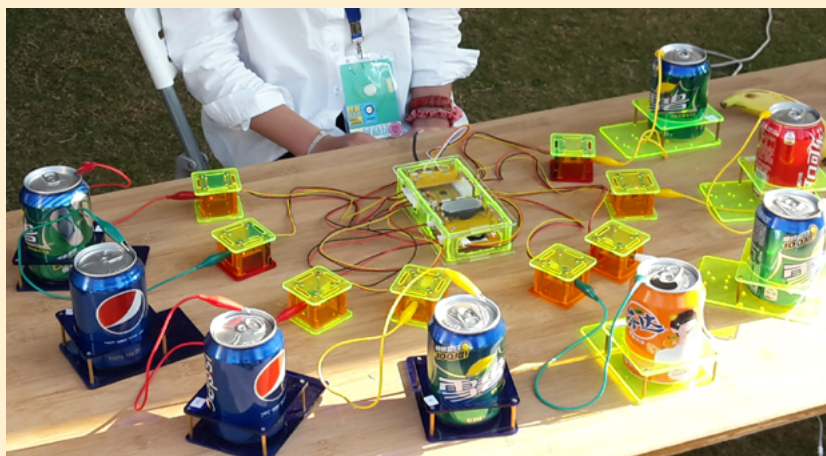
“To promote the development of open source hardware and software in China.”

oa25 open source group, Shanghai

“Because we needed a space where like-minded people can come together and create things.”

SZDIY, Shenzhen

China's first hackerspace, XinCheJian, was founded in 2010 (see case study 1, page 24). The first makerspaces were very similar to those in the west, largely because expats and Chinese returnee students were copying what they had seen outside of China. These hobbyist style spaces have continued to grow slowly across China - prominent examples include SZDIY and Chaihuo, both in Shenzhen. Much like their counterparts in the west, they organise workshops and hackathons and members use the space to make anything they are interested in. During our visits to these types of spaces we saw all manner of DIY creations, from go-karts to electronic drum-kits. These projects are primarily about the joy of making. They represent the rise of making as a hobby, largely for China's urban middle class, who, like their western counterparts, are largely employed in jobs that don't involve manual work.



Tom Saunders CC BY SA 2.0

Shanghai Maker Carnival

Making as a hobby is not really part of the media narrative on making in China, which sees makerspaces as largely about entrepreneurship. But our survey confirmed that hobbies are a major reason why people visit makerspaces, making up a third of all visits. This compares to just over one in five visits that are about setting up a company and 30 per cent of visits that are about education/learning.

Having time for hobbies, at least for working-age people, is fairly new for China. The last several decades of rapid economic growth left little time for the individual to explore their interests. *“Getting rich first”* was how Duncan Hewitt described it in his 2008 book of that title.⁶ Now, many Chinese white collar workers are relatively rich and they're looking for something more than the nine-to-five job.

2. Making for kicks

When it comes to what people are making in China's makerspaces, it is largely focused on electronics and digital fabrication: three out of four spaces are equipped with digital fabrication machines - 3D printers, laser cutters etc., 85 per cent stock electronics equipment and one in two spaces that specialise in a particular material, focus on electronics. In contrast, just under one-third of spaces said that they work with fabrics (32 per cent) and one-fifth of spaces said that they work with stone, clay and ceramics.



Huaqiangbei electronics market

There are a number of potential reasons for this focus on digital fabrication and electronics over craft and other practices. Makerspaces around the world have a strong digital focus: in Nesta's survey of UK makerspaces, digital fabrication tools were the most commonly reported type of tool that makerspaces hold.⁷ Alongside this, our survey of Chinese makerspaces found that over half (54 per cent) of makerspaces members are currently studying at university. While the survey did not ask what courses these students are studying, it was clear from our visits to makerspaces in China that the majority of them are studying engineering and electronics. A third potential reason for the focus on electronics in China's makerspaces is the abundance of cheap electronics components that those interested in making can purchase at wholesale electronics markets like Huaqiangbei in Shenzhen (pictured above) and also online.

3. A search for innovation-led development

As makerspaces started to develop in China they began to show commercial potential. Stories about ‘makers’ setting up companies and getting their products onto crowdfunding platforms piqued the government’s interest - could makerspaces help foster entrepreneurship, innovation and ultimately economic growth?

For the past ten years the Chinese government has been searching for ways to support and promote innovation-led economic growth. The Made in China 2025 strategy, published in 2015, is part of this search. It is about changing the model from cheap manufacturing to one which is focused on innovation, creativity and design.⁸ According to Jin Xiaofei, co-founder of Nanjing makerspace, *“The government wants to persuade people to stop copying and to build their own things and makerspaces are a big part of that.”*⁹

Alongside innovation and entrepreneurship, a second driver of government interest in makerspaces is their potential to solve the graduate unemployment problem. Every year, roughly 7.5 million students enter the job market and with a slowing economy, it’s proving more difficult for them to find jobs.¹⁰ As Jin Xiaofei told us, *“Startups and entrepreneurship are one way to solve the employment problem and makerspaces could be the space where those startups are born.”*¹¹

How does the government support makerspaces?

It starts with high-level political support. While China has moved a long way towards becoming a market economy, there are still elements of the command and control economy in place. Small signals from government are watched closely by companies and local policymakers, to get an idea of what the government’s priorities are and where it will invest.

In 2015, Premier Li Keqiang visited Chaihuo makerspace in Shenzhen. During his visit, he said: *“Makers show the vitality of entrepreneurship and innovation among the people, and such creativity will serve as a lasting engine of China’s economic growth in the future.”*¹² In addition to this, in January 2015 the State Council, China’s highest administrative body, issued guidelines on ‘Mass Innovation and Entrepreneurship.’¹³ These guidelines are designed to support and promote what the government calls ‘mass makerspaces’, which it defines as *“service platforms for entrepreneurship”* and hints at a range of support that it will offer, including space and subsidies.

As a result of these high-level policies, local governments across China have begun to offer makerspaces a large amount of support. The types of support differ depending on the provincial or city government. For example in 2015, Chenzhou, a city in Hunan province in central China, set aside funding to build five makerspaces in the city. To be eligible for funding, an organisation needs to commit to setting up a makerspace that is between 1,000m²-10,000m² and, among other support measures, will receive a grant of £20,000 for equipment and interior design, 50 per cent rent subsidy for three years, and a £3,000 annual operating subsidy.¹⁴

Survey results confirmed that government has a strong interest in supporting makerspaces. Two-thirds of makerspaces said they have a relationship with government and 34 per cent said that they had received some form of government support. Often, this relationship is about

3. A search for innovation-led development

funding, including free office and workshop space, as well as grants. Just under one-fifth (19 per cent) of spaces received support relating to office space, either subsidised rent or free space.

This is a trend that is likely to carry on growing, as several government-backed incubators that we talked to said that they were planning to offer free space to makerspaces. Furthermore, 11 per cent of spaces surveyed said that they received financial support from the government. Other makerspaces said that they receive policy support, although it wasn't clear what this means.

Government support is important to the makerspaces we surveyed, as half (52 per cent) said funding was a problem. However, as the government is largely interested in supporting spaces that focus on entrepreneurship, it often has requirements that mean community-based makerspaces and those that focus on craft are unable to access funding. For example, many local governments only fund makerspaces if they commit to taking on very large premises (in the above example of Chenzhou this is 1,000m²) yet most makerspaces are much smaller than this (the average size in our sample was 500m²). Some local governments also require makerspaces to have a minimum amount of savings in the bank, which is difficult for many makerspaces to achieve, given that one-quarter of them have no income whatsoever.

In many instances, organisations have also set up new makerspaces when requested to do so by the local government. For example, the Northern Experimental maker centre in Tianjin told us: *"The local government asked us to set up the makerspace in order to improve the culture and environment for innovation in the city and to promote the maker spirit."* Two other spaces in the survey said that they were managed or directed by the government. This number is likely to increase in future as the government continues to set up its own makerspaces.

Many of the makerspaces that local governments have given support to would be a bit of a culture shock for visitors used to making in the UK, as they typically do not have tools on site and look just like any other office space. They are, in effect, incubators, accelerators and co-working spaces that recruit teams of hardware startups.

Shenzhen - city of industrial design

When western makers and entrepreneurs come to China, they usually head straight to Shenzhen. There, they will find a world of factories, industrial designers, hardware accelerators and markets stocked with every conceivable component. It's no wonder then that *The Economist* called Shenzhen *"the best place in the world for a hardware innovator to be."*¹⁵

As China's first 'special economic zone', Shenzhen began to receive foreign investment to set up factories for contract manufacturing in the 1980s. The city later became home to some of the world's largest manufacturers such as Foxconn, which produces devices for Apple. Alongside contract manufacturing for international brands, Shenzhen is the birthplace of several of China's biggest electronic brands such as Huawei, ZTE and TCL. Later on, manufacturing companies in Shenzhen started to incorporate design into their business and industrial design companies and studios grew rapidly to fulfil their needs. As a result, in 2008 Shenzhen was appointed a UNESCO City of Design.

The most famous landmark in Shenzhen for makers is the Huaqiangbei electronics market. Consisting of dozens of multi-storey electronics shopping centres spanning five city blocks, they are full of every kind of electronic component you can imagine, all available at wholesale prices. Beyond components, Huaqiangbei is a dense collection of human capital, knowledge and networks that can help with sourcing, prototyping and producing all sorts of hardware products. For example, Huaqiangbei International maker centre,¹⁶ Hax and Dangerous Prototypes are all based in the area. The first two are incubators for hardware startups, while the latter creates open source hardware projects.¹⁷

4. Makers meet industry

Why did you set up a makerspace?

“Wish more startups come out of the makerspaces and grow to become great companies.”

i+ Makerspace, Hefei

“To lower the barriers to entry so that more people can become entrepreneurs.”

Ruichuang Makerspace, Nanjing

“We wanted to promote maker culture, to improve the links between the aviation industry and the public and to bring more knowledge into aviation.”

Xingtandi Makerspace, Shanghai

“To stimulate innovation within our company.”

GSY group makerspace, Shanghai

The government is not the only sector that has begun to take an interest in makerspaces. Starting around 2012, large companies and manufacturers began to explore how they could engage with the maker community. Now, China's makerspaces are highly connected to businesses: in our survey two-thirds of makerspaces said that they work with either local companies or local manufacturers.

One way businesses are collaborating with makerspaces is on product development through hardware hackathons. The idea is similar to software hackathons: a company sets a group of makers a challenge that they've been having difficulty with and participants come up with ideas, first brainstorming what could be done, then tinkering with the products. For example Haier, China's largest white goods manufacturer, regularly hosts hackathons with Chinese makerspaces. Local governments across China also organise hackathons, inviting makerspaces from across the country to come up with ideas about how to improve the products of local companies. For makerspaces, the prize money that they get from winning hackathons can be an important revenue stream and a good way to diversify their income sources.

In the west, hackathons are about learning, building networks and coming up with ideas for new products and potentially new companies. But they are generally not about hacking a company's products – indeed companies do their best to keep the inner workings of their technology at arm's length. This could mean that China is much further ahead of the curve than the west, or it could point to a problem with the Chinese innovation system. For example, it may be that the services that universities provide to companies in the UK – consultancy, contract research etc., are not as well developed in China. Another issue to consider is that the looser IP environment in China may mean that companies are more willing to open up the product development process to large numbers of people – they know that it is the speed of innovation that gives them the advantage, rather than trying to protect every idea that they have.

As well as working with makerspaces on product development, many companies are setting up their own makerspaces. There are many ways that this can happen. Firstly, open-source hardware companies such as Seeed studio and DFRobot have set up makerspaces (see case studies on page 26 and 25). There are a variety of motivations for this – it is a useful marketing tool for their open source kits that are mainly used by makers and it is a good way to support and promote the maker movement, which is ultimately good for their companies. These makerspaces tend to be very sustainable, as they are supported by the philanthropy of their parent companies.

4. Makers meet industry



Tom Saunders CC BY SA 2.0

Nanjing Makerspace

Members of Nanjing Makerspace regularly come up with ideas for commercial products at Hackathons. In this photo, co-founder Jin Xiaofei of Nanjing Makerspace holds up a solar panel (right) which a company sent to the makerspace. One member came up with the idea of using the company's solar cells to create a flexible solar charger for camping (left). The maker received compensation for coming up with the idea.

Other companies are setting up makerspaces as a way to support and promote innovation within their companies. One prominent example of this is Foxconn, the world's largest electronics manufacturer. For Foxconn, it is about unleashing the creativity of its workers - the hope is that by giving workers access to space and tools and allowing them to make whatever they want, they will come up with product ideas which Foxconn could eventually commercialise.¹⁸ Several companies are setting up makerspaces for this purpose in China. However, it is important not to oversell the significance of these experiments - Foxconn's factories are some of the largest in the world, whereas the makerspace is just a large brightly coloured workbench with a few 3D printers and other tools placed around it.

Perhaps more promising is the way that companies are using in-house makerspaces as a learning tool. The idea here is that offering employees a space where they can build anything they like and test out their ideas will help them become more creative, improve their problem-solving skills and ultimately make them better at their job. Ruichuang makerspace, which is based within the 14th Research Institute of the China Electronics Technology Group (CETC) a state-owned company in Nanjing (see case study on page 28), is a typical example of this in practice. New recruits to the company are put through a three-month maker programme, where they attend the makerspace once a week to work on their ideas, often with the help of technicians. The organisers of Ruichuang Makerspace have found that recruits who go through the programme are able to develop their own ideas much faster than those who don't. The programme has also had a positive impact on confidence levels, creativity and problem-solving areas where the Chinese education system has traditionally struggled.

5. Makerspaces and an education revolution

Why did you set up a makerspace?

“To use the interest around the maker movement to get kids interested in science and technology and help them develop STEM skills and abilities.”

Baoshan home makerspace movement

“To let children from our area have the same opportunities to interact with advanced technologies as children in Beijing and Shanghai do.”

Zibo makerspace, Zibo, Shandong

“Because I thought it would have a very good impact on teaching and learning for children.”

Wenzhou Makerspace

“Lanzhou is a third-tier city and doesn't have advanced manufacturing industry like other parts of the country. But we can't give up because of this. We don't have makers, so we need to train some. We are working with middle and infant schools to promote maker education so that children here can access the best education.”

LXT makerspace, Lanzhou

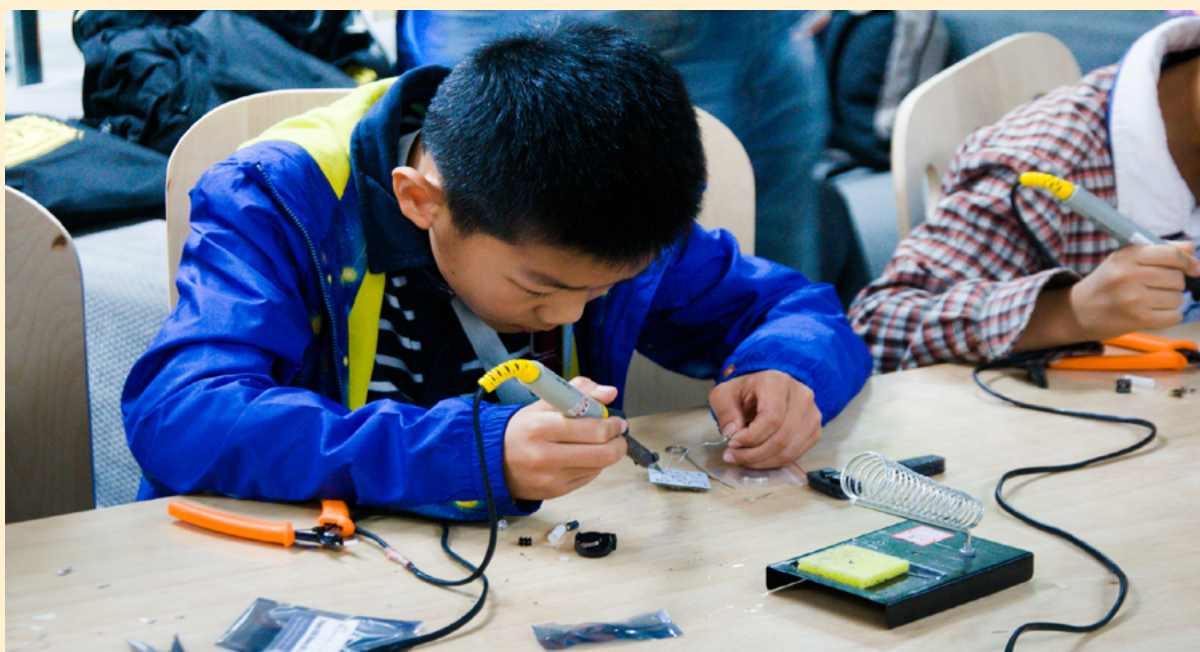
It's not just companies that are trying to use makerspaces to reform China's education system. Makerspaces themselves put a lot of effort into education: 92 per cent of makerspaces surveyed said that they provide training, with two-thirds of spaces offering classes and formal courses. Many schools and universities are also setting up in-house makerspaces, or working with established makerspaces to run maker education courses. Why are educators so interested in making?

As the Chinese economy first started to grow rapidly in the 1970s, the skills it needed were those associated with low-cost labour, for example the ability to follow instructions. Later on, as the economy developed and started to focus on more advanced manufacturing, China's education system became adept at producing graduates with a strong grasp of the fundamentals of science and engineering. However, as China's economy matures it is becoming expensive for companies to outsource manufacturing to China. As a result, Chinese companies now need to focus much more on design, creation and innovation to make a living. The Chinese education system is regularly criticised for not being able to provide the skills required by this innovation-led economy.

Makerspaces offer a very different type of education from that which is available in the Chinese education system. They provide a space where members can experiment, play and explore their ideas. Many makerspaces combine this with workshops and, more importantly, opportunities for informal learning and sharing of skills. Many argue that the skills which this environment can foster - problem-solving, risk taking, creativity and the confidence to experiment - are precisely those required by China's economy today.

5. Makerspaces and an education revolution

Mitch Altman. Licence CC BY SA 2.0.



Children learning how to solder - Beijing Makerspace

Our survey shows that there are now a large number of organisations across China that provide maker education for children: one in five spaces said that the majority of its members are school-aged children. One such organisation is Litchie Lab in Shenzhen. Founded in 2014 by Benjamin James Simpson, an American and his Chinese partner Lit Liao, it organises maker education for children through its 'Make Club.' Makerspaces like Litchie Lab differ from craft clubs in that they provide access to digital tools like 3D printers and open source electronics like Arduino. They are an expression of a desire to bring creativity and hands-on, project-based learning into China's education system.

Schools themselves are also setting up makerspaces. Comprehensive lists are hard to come by, but by the end of 2014 at least 16 schools had set up makerspaces.¹⁹ The first school to set up a makerspace was the Shenzhen International American School. In its makerspaces, children can engage in everything from sewing and jewellery making to electronics and gardening.²⁰

The maker revolution has also extended beyond schools to universities. Over 75 per cent of the makerspaces surveyed said that they have a relationship with China's universities. These relationships are mainly in three areas: hosting joint events, makerspaces working with universities to organise 'maker' courses for their students and makerspaces working with universities to access the more advanced tools and equipment that it would be too expensive for them to buy.

Alongside this, many universities are setting up their own makerspaces. Examples of makerspaces in universities include Fablab Shanghai, based at Tongji University and the i.Center, based at Tsinghua University, which is the largest makerspace in China at 16,500m². Makerspaces tend to be in universities and departments that focus on engineering and electronics. Often, the university already has much of the equipment in place, and sets up makerspaces as a way to provide a focal point for making (see page 31: Blue Island Makerspace case study).

According to Eric Pan, founder of Seeed Studio and Chaihuo Makerspace, there are several drivers behind university interest in makerspaces: *"The government is pushing students to set up startups, so this is the political driver,"* says Pan. Alongside this *"students like making things and hardware innovation,"* meaning there is a large community of would-be makers in universities. Pan thinks there is a lot of value in universities setting up makerspaces: *"they help break down the barriers between different disciplines - engineers and designers."*²¹

6. Challenges

What are the main challenges your makerspace faces?

“Coming up with a sustainable business model for our makerspace.”

Wenzhou Makerspace

“Too many people come to the makerspace just to have a look around – it’s too busy.”

Dalian Makerspace

“Workshop space and funding are both a problem.”

Changzhou Makerspace

“Getting teachers to understand the value of making and persuading them to combine the standard curriculum with a maker education model.”

Blue Island Makerspace, Nanjing

Running a makerspace is challenging, and the challenge for China as a whole is in turning top-down support into a maker movement that is self-sustaining. In our survey, respondents highlighted three main issues: funding, skills and promotion.

Funding: Just over half of makerspaces (52 per cent) said that funding was a problem. Average income was 100,000 RMB but 11 spaces (24 per cent) said they have no income whatsoever. One in five makerspaces has a parent company subsidising it. For example, it could be based within a company, like Ruichuang Makerspace, or it is largely funded directly by a company, like Mushroom Cloud. For spaces that don’t have this type of funding, developing a sustainable business model is a challenge. Fewer than 10 per cent of the makerspaces surveyed receive their main source of funding from membership fees. Other sources of funding include workshops and training, which may become more lucrative as the maker movement grows and interest in increases. Alongside this, local governments across China have recently started to provide support and funding to makers. While funding requirements differ by region, in general it is only available for makerspaces that are focused on commercial aspects of making, for example, hardware incubators. This means that many of the spaces that focus on craft or the hobbyist aspects of making are unable to access government support.

Skills: Makerspaces are often filled with equipment that people will have had little chance to engage with in their schooling or working lives: 3D printers, laser cutters and soldering irons, for example. In one sense, this could be an opportunity for makerspaces to generate income, as they can charge members for attending workshops and training courses. But in another sense it can limit the number of people who are able to take part in making if they can’t afford or are not inclined to pay for training. It also places a burden on the resources of many smaller makerspaces which don’t charge for training but still want to help new members access the tools in the space.

Promotion: Another challenge mentioned by many respondents was the difficulty of promoting the maker movement. Makerspaces are new to China and most people don’t understand them, often mistaking them for incubators because of the media’s focus on the commercial aspect of their operation. Many makerspace founders said that a challenge for them was to promote maker culture, so that more people come to makerspaces who have a genuine interest in making rather than just in starting companies.

7. Case studies

In October 2015 and January 2016 we visited three of China's major cities, Shanghai, Nanjing and Shenzhen to interview makerspace founders and members. Here are the stories of seven of those spaces: XinCheJian and Mushroom Cloud in Shanghai, Nanjing Makerspace, Nanjing Ruichuang Makerspace and Blue Island Makerspace in Nanjing, SZDIY and Chaihuo Makerspace in Shenzhen.



1. XinCheJian

China's first makerspace focuses on those interested in making as a hobby

Location: Shanghai	Founded: 2010
Membership: 120	Fees (RMB): 100/month or 450/six months
Size: 280m²	Employees: One full-time, ten volunteers
Challenges: 1. Space – they recently had to move to a new location and this has disrupted their membership base 2. Their founders believe maker movement in China is too focused on entrepreneurship and undervalues what XinCheJian does	
Website: www.xinchejian.com	

"At XinCheJian we offer space and tools, that's it," says Lionello Lunesu, one of XinCheJian's first members. "In a city like Shanghai, people can't afford to have a garage – this is like the shared version of that. We do for tools what a library does for books."

XinCheJian will look very similar to those that are familiar with the maker scene in the west. It mainly caters to people who want to make things for fun, rather than would-be entrepreneurs, and is full of all the things you would expect to see in a makerspace: 3D printers, a CNC milling machine, workbenches and lots of hand tools and materials. Like many spaces in the UK, most of the members have full-time jobs or are at university, so it is largely empty during the day, filling up only on weekends and the occasional evening.

Founded in 2010 by David Li, Minlin Hsie and Ricky Ng-Adam, the name means 'new workshop'. During its early years the space was mainly used by expats – makerspaces were a western concept that locals weren't that familiar with, and XinCheJian is the earliest import of the idea. Fast-forward to 2015 and around half the members are locals, a testament to how the popularity of makerspaces has grown in China.

While China's makerspaces have evolved a lot in the last few years, XinCheJian has stuck to its roots, resisting the business focus that has come to define other makerspaces in China. Lunesu is typical of many of XinCheJian's members: he used to work at Microsoft, as an engineer, and now spends his days working at his IoT robotics startup, but *"wanted to do something in the evenings that wasn't sitting at a computer. I wanted to make things."* His projects are all about having fun with technology: they include an armchair that you can drive around, and an LED display that reacts to changes in sound.

Education is also a big focus at XinCheJian. Rather than traditional classes run by paid teachers, members share skills with each other. For example, XinCheJian runs a series of workshops: *"Every time we see a member doing something cool we invite them to turn it into a workshop so that others can learn about it."* This kind of informal skills teaching and learning was common across all the spaces we visited.

While fun is the driver of almost all projects at XinCheJian, occasionally they do take on a more commercial focus. One example is STARY, which bills itself as the world's lightest and most affordable electric skateboard. In June 2015 it was successfully funded on Kickstarter to the tune of \$742,000 – more than seven times its goal.²²

Despite this, Lunesu feels that makerspaces are, in general, too focused on commercial outcomes in China. Policymakers mainly see makerspaces as hardware incubators and this, says Lunesu, could have a negative effect on the creativity of makers – stifling the space for making culture grow in China.

2. Mushroom Cloud

A makerspace in Shanghai used mainly by professional engineers with advanced skills

Location: Shanghai	Founded: 2012
Membership: 110	Fees (RMB): 70/month
Size: 100m²	Employees: Two full-time, three part-time, three volunteers
Challenges: 1. The need to constantly cultivate the creativity of its members 2. The difficulty of maintaining and growing its community of members	
Website: www.dfrobot.com.cn/community/forum-98-1.html	

A musical device that works by “*making the air around it explode*” is perhaps not the kind of thing that the Chinese government is thinking about in its drive to support the maker movement. But this impractical and highly dangerous object was the first project we were shown when we visited the Mushroom Cloud stand at Shanghai Maker Carnival in 2015. Asked about the purpose of the device, the member said he was just doing it for fun.

As the name suggests, Mushroom Cloud is a bit different from your average makerspace. Based in Shanghai’s high-tech park and founded by DFRobot, a company that manufactures and sells open-source hardware, its members are mainly IT and engineering professionals who work for multinational companies. As a result, members have unusually advanced engineering and electronics skills and often take on highly ambitious projects.

It is these skills and ambitions which are the major difference between makerspaces in China and the west, one member told us: “*Because engineering and science courses are so popular in China, people who go to makerspaces tend to have advanced engineering and electronics skills. So the projects we take on are often much more advanced than those you would see in a western makerspace.*”

Mushroom Cloud’s members can, if they choose, turn their hand to more commercial endeavours. Asked in our survey about the makerspace’s greatest success story, we were told: “*taking a person who doesn’t know anything about making and helping them create a product themselves and get it on an international crowdfunding website.*”

Beyond tinkering away in Shanghai, members travel around the country to take part in maker competitions, and given their advanced skills, they often win. As a result, it is perhaps unsurprising that Mushroom Cloud is making a bit of a name for itself and is coming to the attention of businesses and local governments across China. For example, local governments regularly invite members of Mushroom Cloud to take part in hackathons which are designed to improve the products of local companies.

With all the government and media interest in making, lots of people now come to Mushroom Cloud asking for help to create hardware startups. Here they act a bit like an incubator, assessing the merits of an idea and team before they allow them to use the makerspace’s facilities and offer help and advice.

The growing commercial focus is a welcome source of income for Mushroom Cloud and its members. Monetary prizes for winning hackathons go to individual members, but they usually give a large proportion of their winnings back to the makerspace. As one member told us: “*We have well-paid jobs so we aren’t in it for the money.*”

3. Chaihuo Makerspace

One of China's earliest and most well known makerspaces, it is the organiser of Shenzhen Maker Faire and plays an important role promoting maker culture

Location: Shenzhen	Founded: 2011
Membership: Over 3,600	Fees (RMB): 200-5,000/month
Size: 60m²	Employees: Three full-time, one part-time
Challenges: <ol style="list-style-type: none"> Too many visits, which disturbed the makers who were actually making things Lacking a sustainable operation model People are too focused on entrepreneurship, making it difficult for them to really enjoy making 	
Website: www.chaihuo.org/	

When Chinese Premier Li Keqiang set out the country's agenda for home-grown innovation at the beginning of 2015, he did so with a well-publicised visit to Chaihuo, a makerspace in Shenzhen, the global capital of manufacturing, on his first workday of the year. Held up as exemplar for the maker movement in China, the coverage has since propelled the space and its founder, Eric Pan, to great reputation and has inspired many to follow in his stead.

Chaihuo grew out of Eric Pan's Seed studio, a company which he set up in 2008 to support makers: *"I saw makers making lots of interesting things, but I also saw that they needed lots of support, from equipment to training to services."* Similar to Adafruit in the US, Seed makes most of its income from kits it sells to makers around the world. But Seed is also a unique kind of facilitator to the maker community, providing not just open-source hardware to makers but also helping with everything from schematic design and components and small-batch manufacturing to supply chain management and shipping, thanks to its being located right at the heart of the global manufacturing ecosystem.

Chaihuo Makerspace is part of Pan's ongoing effort to support and promote the maker movement in China. In 2011, Pan decided to set up a makerspace after witnessing the makerspace phenomenon firsthand in the US and spotting an opportunity at home. In Shenzhen he connected with a collective of makers called SZDIY, a community without a space to work out of. *"They needed a space so I offered them one."*

SZDIY moved and set up on its own in 2015 as a result of the growing media and government attention - including almost daily visits to the makerspace - which made working in Chaihuo impractical. The original Chaihuo makerspace, housed in an arts and cultural centre in the west of the city, popular with creative businesses and up-market, artsy shops, is small and unremarkable in a way that belies its reputation. It looks like many community workshops in the west and is now mainly used for visitors including the media, western makers and government delegations, who want to learn about making. The plan is to move to a much larger space in 2016, which can accommodate both visitors and makers.

"For Chaihuo, it's about focusing on innovators - it's a lot about openness and sharing," explains Pan. The space was established for people to learn about and play with technology, but its founders also know that some people hope to turn their ideas into companies, and that increasingly many come to them with that ambition. As a result, in 2015 Chaihuo started Chaihuo VIP, a spillover space for nascent startups that emerge from Chaihuo, in the same building complex.

Pan describes this as *"a real space where people can make things"*. Acting as something in between a makerspace and an incubator, companies receive the space for free, in return for a cut of the business. On our visit, two companies occupied the space: Halo, which is building

7. Case studies

a heads-up display for cars, and Dorabot, which is developing a robotic arm for warehouse order fulfilment. In each case, the founders met each other at Chaihuo proper, initially using the space for their hobby before developing an idea that they thought had commercial potential. After moving into Chaihuo VIP and setting up a company, they are now looking for venture capital funding.

Rather than the Chaihuo to Chaihuo VIP graduation being a planned one, the space has popped up organically after the success of these two impromptu companies, none of whose founders particularly intended to start businesses.

Alongside providing physical space for makers, Chaihuo plays a major role in promoting the maker movement in China and creating links with makerspaces around the world. For example, since 2012 Chaihuo has organised the annual Shenzhen Maker Faire. The event, hosted over three days, has hundreds of exhibits and sees tens of thousands of visitors. A large number of western makers attend the event, making it an important channel for international maker collaboration.

“If China wants the next wave of entrepreneurs, they all should like Eric Pan,” says David Li. Son of two teachers in a small city outside of Shenzhen, Pan, and his entrepreneurial record, is a made-in-China success story. Having been educated fully in China, Pan worked at Intel after university, but decided, against his parents’ wish, that Chinese business had more to offer than a big western company, and quit to try his luck at startups. “Eric actually rode a bike from Beijing to Shenzhen, checked into a small apartment, with a friend, and started Seeed Studio from his living room. And he’s now grown it to an internationally respected brand. Without Eric there might not be the political will, as he is the political poster boy for the whole thing.”

Looking to the future, Pan, who is a bit overwhelmed by the constant media coverage over the past year, hopes that Chaihuo can start to focus on social problems: *“It’s good to be famous”* he says of Chaihuo, *“people now know innovation is possible for everyone. It’s a great starting point, but now we need to use that platform to focus on social problems.”* As an example, he mentions the environment: *“Many Chinese people now care about the environment and we will give people a space to work with technology on problems like air and water pollution.”*

Alongside this, Pan wants to do something much more basic and perhaps also more urgent: *“We want to come back to the fundamentals and work out how to make a makerspace that is sustainable. We want to develop a business model that people can copy from.”*

4. Nanjing Makerspace

Turning a community of amateur electronics tinkerers into an open-source research and development talent pool

Location: Nanjing	Founded: 2012
Membership: Over 3,100	Fees (RMB): Doesn't charge membership fees
Size: 5,000m² across five locations	Employees: Four full-time, five part-time, 36 volunteers
Challenges: <ol style="list-style-type: none"> 1. Finding resources to expand, particularly workshop space and equipment 2. Difficulty of getting to the workshops (they are mostly in the suburbs, as city centre space is too expensive) 3. Issues finding competent managers for each of the spaces 	
Website: www.do-idea.org/	

At Nanjing Makerspace on the east coast of China, large crates arrive every day containing things you might never expect to see in a makerspace – fridge-freezers and other white goods, solar panels, bathtubs. These and other consumer products are sent to Nanjing Makerspace by companies in the hope that members of the makerspace might be able to improve their design or solve a tricky problem.

Recently, says co-founder Jin Xiaofei, Haier came to Nanjing Makerspace with a specific problem plaguing its washing machines: with routine use, dirt was clogging up the area outside the drum, shortening the appliances' life. One maker came up with the idea of placing a ball outside the drum, which would roll around the machine absorbing dirt. Haier ran with the idea, which worked perfectly, and within three months created a new product with the design a core feature.

Nanjing Makerspace is one of the most established makerspaces in China. Founded in 2012 as a hobbyist club for robotics enthusiasts, the collective has since expanded to five workshops across the city. The organisation also acts as the secretariat of the nationwide China Makerspace Association, helping makerspaces across the country develop ties with industry. They have also set up a website where makers can list their inventions. If a company is interested in commercialising the invention, Nanjing Makerspace helps the maker negotiate with the company, to ensure that they get a good deal.

What makes Nanjing Makerspace particularly notable, however, is its relationship with industry. Having developed a strong community of innovators in the city, with considerable experience in electronics, the group has begun offering up its collective expertise to major consumer electronics and appliance firms, of which Haier is just one. For companies like Haier, which gave a cash prize to the maker who came up with the 'smart ball' idea, the motivation for working with makers is the promise of tapping into a talent pool for open innovation: the ability to draw upon a wide variety of skills outside the corporate groove.

Beyond Nanjing, provincial governments, most recently Guangdong, have started inviting Nanjing Makerspace to visit local companies. The hope is that Nanjing Makerspace can help these companies address some of their innovation challenges. Alongside this, companies from across the country, not just Haier, send their products to Nanjing Makerspace for their members to tinker with, and hold joint hackathons to problem-solve or develop new product ideas. The money that the organisation makes from these activities helps subsidise its core purpose: *"Providing a space for amateur enthusiasts to tinker on electronics and hardware projects in whatever way they like, with equipment they otherwise wouldn't have access to, and with the opportunity to meet and collaborate with like-minded people to improve their skills and develop their ideas,"* says Jin Xiaofei.

5. Ruichuang Makerspace

Using making as an education tool, to help the company's employees become more creative, confident and independent

Location: Nanjing	Founded: 2013
Membership: 200 per programme	Fees (RMB): None
Size: 5,000m² across five locations	Employees: 20
Challenges: 1. As it is part of a state-owned company engaged in military R&D, it is difficult for it to collaborate with other makerspaces and makers 2. Difficulties promoting an entrepreneurial mindset - it hopes its members will create spin out companies but young engineers mostly want a secure career in a big company	
Website: www.glarun.com (parent company)	

Visiting a makerspace in a defence research and development institute, one might plausibly hope to see grassroots innovation of the military kind: DIY rocket launchers, open-source 'killer robots', or hacked and modified armoured vehicles. If that's the case, Ruichuang Makerspace might disappoint: projects we were shown on our visit included a DIY 'smart' door lock that can be controlled by a smart phone and a keyboard for children where the keys light up when they should be played. Why would a military research institute set up a makerspace for its engineers to get involved in amateur electronics?

Owing to the spike in government and media interest in makerspaces over the last few years, many organisations have set up their own in-house spaces. Nanjing Ruichuang Makerspace is one of the more curious examples. Set up by China Electronics Technology Group (CETC) which is mainly involved in defence R&D, it claims to be the first of its kind to be set up by a state-owned enterprise.

For Ruichuang Makerspace, it's all about creativity and innovation – spurring more entrepreneurial and creative thinking amongst its engineers. With this in mind, in 2013 the founder set up a three-month maker programme for new recruits to the company. Around 200 employees come to the makerspace each week to work on their ideas, often with the help of technicians. They have found that recruits who go through the programme are able to develop their own ideas much faster than those who don't.

Another benefit of the programme is its effect on the confidence of young graduates, the founder of Ruichuang Makerspace told us: *"We give the students a space for their characters to grow. This is not something you get in the normal Chinese education system. It helps people develop their confidence, especially when they feel they are making successful products. It also improves their problem-solving skills and makes them think more creatively."*

Ruichuang Makerspace is only open to company employees at the moment, as the parent company deals with state secrets. However, the founder of the makerspace is keen to develop a more open model. As well as taking members of the makerspace to compete in hackathons around the country, he also plans to set up a charity to teach making and spread maker skills throughout society.

6. SZDIY

A hardcore hobbyist makers happily coexisting with professional makers

Location: Shenzhen	Founded: Originally 2009 - became a makerspace after 2010
Membership: 30	Fees (RMB): A voluntary payments system - members usually pay between 200-500/month
Size: 120m²	Employees: Three part-time staff
Challenges: 1. Whether or not to accept government support - members have mixed views on this 2. Funding - the organisation is mainly run on membership fees and donations	
Website: www.szdiy.org/	

SZDIY (Shenzhen DIY) is a vibrant community of hackers and hardware geeks in Shenzhen, whose mission in life is simply to 'make cool things', using open software and open hardware. The things they make here are suitably geeky: examples include the Polascii – a camera that produces pictures of people in ASCII computer code. It has a strong reputation in Shenzhen and beyond for being a 'hardcore' hackerspace, and many of its members are uninterested in the commercial direction that Chinese makerspaces are taking. And yet, SZDIY's story is a bit more complicated than that, and shows how makerspaces engage in a broad spectrum of activities, and the contradictions that arise when next steps are discussed.

SZDIY grew out of the free software movement – its founding members were Linux User Group members – and wanted to take the same spirit into hardware. They initially used Chaihuo Makerspace (see case study on page 26) for their meetings, moving out in 2015. The new workshop is hard to find; expensive rents have driven it into a so-called 'urban village' – an area of the city where a lack of building regulations have created a jumble of tightly-packed apartment blocks, warehouses and factories. The space itself looks like a western hackerspace: an industrially shabby workshop with a mishmash of tools and equipment, mainly electronics, spare parts and half-completed projects spilling out electronic guts and sprouting wires, surrounding a large workbench.

Providing space for hobbyists isn't the only motivation for SZDIY. For Ryan Liang, a freelance design engineer and one of the more active members of the makerspace, his interest is the freedom that it gives him to produce creative designs: *"Companies design products then come to me and ask me to make them work,"* he says of his day job. *"I would often have ideas for improvements, but the customers always said no to them. So I was having a lot of ideas but no way to implement them. At SZDIY I work with other members to create open-source designs that improve existing products. I recently did this for a dehumidifier and were accepted onto the Hax accelerator programme."*

The more professional and hobbyist versions of making seem to co-exist relatively happily at SZDIY. Liang is equally enthusiastic about making as a hobby and making as a way to improve product design, for commercial ends. *"We just come together and make things. We enjoy it. Sometimes that might result in ideas for products which we might want to sell, which is great. But if not, we still get to make cool stuff."*

Looking to the future, a big question for SZDIY is whether to accept government support. With government interest in makerspaces at such a high point in China at the moment, even SZDIY, a space which mainly focuses on hobbyists, has been offered government support – a free workspace and modest levels of funding. Put to a vote, the members of SZDIY recently chose to reject this, believing that it would have a negative influence on their independence. However, Liang hopes that members will soon change their minds. Looking around at the members of the space, who combine great enthusiasm with advanced technical skills, it's difficult not to wonder what they could achieve if they were given the proper resources.

7. Blue Island Makerspace, Nanjing Institute of Mechatronic Technology

A makerspace exploring the role of innovation and entrepreneurship in tertiary education

Location: Nanjing	Founded: 2015
Membership: 815	Fees (RMB): None
Size: 10,000m²	Employees: Three full-time, 60 volunteers
Challenges: 1. Getting teachers to understand the value of making and persuading them to combine the standard curriculum with a maker education model	
Website: www.nimt.cn (university website)	

What happens when you set up a makerspace inside a technical university, with access to a range of cutting edge equipment, highly skilled instructors and connections to some of China's biggest tech companies? That's what the Nanjing Institute of Mechatronic Technology is trying to find out with its Blue Island Makerspace.

The founders had a diverse range of motivations for setting up the space, which opened in March 2015. Partly, it was about experimenting with teaching methods. According to Diao Aijun, who is on the board of the makerspace: *"We wanted to explore what a method of education that involved merging vocational education and maker education would look like."*

What this looks like in practice is an open space where students can access a mixture of workshops, tool inductions and technical support. Membership is free for students enrolled at the university and they have a materials shop on site where students can purchase materials. It is possible to become a member of the space even if you aren't a student at the university, although in practice nearly all of the members are students.

Because it is a technical university, the equipment they have in their makerspace is very advanced, allowing students can work on some very high-tech projects. But the university has always had the equipment, what Blue Island Makerspace provides is a network of makers: *"Before, if you wanted to be a maker you didn't have anywhere you could go to sign up. Now there is this organisation which promotes making across the university,"* said a student we talked to at Shanghai Maker Carnival in October 2015.

Students can make whatever they want in the space, they just need to come with an idea and try things out: *"I'm building an electronic door lock that can be opened with a smartphone",* the student we interviewed told us. His motivations are a mix of wanting to do something fun and wanting to solve a practical challenge: *"At our university dormitory the main door is opened with a key. Sometimes you forget your key and have to shout for someone to let you in. The university could install smartphone enabled locks, but they are very expensive. So my idea is to create a much cheaper version of a smartphone lock."*

What happens to these projects is up to the student: *"You might just want to create a great project for your school work or just do something for fun, but if you have a good idea, the university can help by providing technicians to help out on the more advanced machines and also resources to scale up your prototypes."* For students with commercial aspirations, the university can help by offering introductions to large Chinese companies such as Huawei, which can help students commercialise their products.

8. The future of making in China

What is the future of making in China?

“A lot of big makerspaces will close down...when the current heat cools down. The public will realise the most valuable thing a makerspace can provide to the community is education about creativity, critical thinking and freedom to try on a project one really likes.”

Litchee Lab

“Half of China’s GDP will be generated by makers in the future!”

Wuhan Fab Lab

“Every child in Lanzhou will be able to take part in maker-type education and also STEAM.”

LXT Makerspace, Lanzhou

“The internet, open-source hardware and digital fabrication will allow anyone to take part in the age of invention.”

SEG makerspace, Shenzhen

China’s ‘maker movement’ is only five years old and yet in that time it has evolved rapidly to suit the needs of the Chinese economy and society. Interest from government, businesses, schools and universities will all help shape the maker movement over the next five years. Below, we discuss the role that makerspaces could play in each of these sectors.

- **Government:** For the Chinese government, makerspaces are about supporting innovation and entrepreneurship. This support has grown stronger over the last five years, with local governments across the country offering space, grants and policy support to makerspaces. Yet in 2016, minor grumbles are emerging – the idea that government is wasting its money by investing in organisations that are little more than co-working spaces, for example.²³ Over the next few years, local governments will likely reassess their support for makerspaces. One outcome could be that they decide to stop offering funding and support. Another, more desirable outcome would be that the central and local governments come to take a broader view of makerspaces, not just seeing them as hardware incubators and accelerators, but instead appreciating the range of benefits they potentially offer, from a more holistic model of education to the ability to promote innovation within companies.
- **Business:** In 2016, the relationship between businesses and makerspaces in China is still in a highly experimental phase. Companies across China are just beginning to explore what makerspaces can do for them. These experiments will gather pace over the next couple of years, with more companies opening in-house makerspaces, working with independent makerspaces to organise maker education for their employees and organising hackathons as a way to open up their product R&D to a wider community of innovators. Manufacturing companies will also increasingly open up their services to makers, with small batch production, for example. It is impossible to say what the result of all this experimentation will be, but it will certainly go a long way to creating a uniquely Chinese maker movement.

8. The future of making in China

- **Schools and universities:** In 2015, schools and universities across China began to open in-house makerspaces. As the Chinese economy changes, requiring employees who are more creative, independent and good at problem solving, makerspaces and 'maker education' - hands on, project-based learning - will come to play an increasingly important role in the education system. As more schools and universities set up in-house makerspaces, as well as increase their collaboration with independent makerspaces to set up maker-education courses, the role that makerspaces can play in education will develop and evolve and should be watched closely by western educators.

Annexe

a. About the authors

Tom Saunders is Senior Researcher – International Innovation at Nesta. His work focuses on helping governments learn from innovations around the world, with particularly the use of digital technologies to address urban challenges. Tom also leads on Nesta's research and engagement with China and is co-author of *China's Absorptive State: Research, innovation and the prospects for China-UK collaboration*.

Jeremy Kingsley is Assistant Editor of *The Long+Short*, Nesta's magazine of innovation. He is a Contributing Editor at *WIRED*, and as a journalist and researcher has covered technology, economics and innovation for, amongst others, *The Economist*, *Slate*, The Economist Intelligence Unit and the Future Laboratory.

b. Makerspaces visited

- | | |
|--|------------------------------------|
| i. Shenzhen Open Innovation Lab (SZOIL) | vii. Nanjing Makerspace |
| ii. Huaqiangbei International Maker Center | viii. Nanjing Ruichuang Makerspace |
| iii. Chaihuo makerspace | ix. XinCheJian |
| iv. Chaihuo VIP | x. Mushroom cloud |
| v. Make Mountain | xi. SZDIY |
| vi. Litchee Lab | xii. Blue Island Makerspace |

Endnotes

1. <http://www.ibtimes.com/china-manufacturing-10-things-chinese-make-more-anyone-else-world-infographic-1369727>
2. Ninety-three spaces responded to our survey but we are aware of several spaces that didn't complete the survey and believe there are just over 100 makerspaces in China.
3. <http://tieba.baidu.com/p/3848347305>
4. Note that open-access doesn't necessarily mean open to the public. Makerspaces in universities, for example, are open to their students but not members of the public and makerspaces within companies are regularly open to any employee, but not the public.
5. http://online.wsj.com/public/resources/documents/NPC2016_NDRC_English.pdf
6. Hewitt, D. (2010) 'Getting rich first: Life in a changing China.'
7. http://www.nesta.org.uk/sites/default/files/open_dataset_of_uk_makerspaces_users_guide.pdf
8. <http://knowledge.ckgsb.edu.cn/2015/09/02/technology/made-in-china-2025-a-new-era-for-chinese-manufacturing/>
9. Author interview, 15/10/2015.
10. <http://www.bloomberg.com/news/articles/2015-07-02/dreams-collide-with-china-slowdown-for-job-seeking-graduates>
11. Author interview 15/10/2015.
12. http://www.chinadaily.com.cn/china/2015twosession/2015-03/09/content_19760292.htm
13. http://english.gov.cn/policies/latest_releases/2015/03/11/content_281475069667730.htm
14. http://www.czs.gov.cn/czj/12867/12875/content_607371.html
15. <http://www.economist.com/news/special-report/21593590-why-southern-china-best-place-world-hardware-innovator-be-hacking>
16. Makerspace located in the heart of Huaqiangbei, the centre of Shenzhen's electronics markets area. Occupies office area owned by Shenzhen Huaqiang Industry Co Ltd, which also owns most of properties in the area. Focus is on incubation and innovation. Established in circa 2012-2013.
17. For more on Huaqiangbei see: 'An Insider's Guide to Shenzhen Manufacturing' published in Make Magazine.
18. <http://tieba.baidu.com/p/384347305>
19. http://blog.sina.com.cn/s/blog_661ddcf0102v7qt.html
20. <http://creativeconomy.britishcouncil.org/blog/15/11/22/fiona-livingtheresearch-week-two/>
21. Author interview: 24/02/16.
22. <https://www.kickstarter.com/projects/staryboards/stary-worlds-best-electric-skateboard-get-yours-fo>
23. http://www.china.com.cn/lianghui/news/2016-03/03/content_37926218.htm [Mandarin]

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