

Economic Development using an Enabling Environment for Contextualized Innovation: The Case of the "Poverty Reduction Project by Building-up the Innovation Environment Using FabLab", Bohol Province, The Philippines

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1. Background

Since Joseph Schumpeter (Schumpeter 1954) first argued that indigenous elements such as innovation are a key driver of economic development, theorists in economics have thought that the growth model based on the volume of production factor inputs is a thing of the past, and the majority of them have been insisting that growth actually takes place when we are able to find a new combination of inputs of goods and powers enabled by innovations. This idea goes beyond the domain of development cooperation and has been influencing the whole international community.

More recently, Michael Porter's *industrial clusters* (Porter 1992) and Charles Landry's *innovative cities* (Landry 1995) have drawn our attention to the idea of economic development, insisting that an enabling environment for innovations induces indigenous development of the local community. Landry points out the possibility that the notion of innovation covers a range of activities as wide as the "original concept, technology, technique, procedure or process applied, or the implementation and management mechanism adopted", and this indicates a possibility that the project that includes innovations in these contexts stimulates local economy and sustain development.

Innovation-led economic development has long been regarded as a tool available only in the case of big cities in the developed countries. In the rural areas of developing countries, however, innovations have never been fully *utilized* for economic development, rather than being non-existent. Thus, perhaps more reasonably, it has been pointed out that innovation clusters have been monopolized by a limited number of big cities as inter-regional competition becomes more severe in the globalized world. Florida (2005) defines as the *creative class* the social class that has the potential to create innovations. He then describes how this *creative class* has been geographically concentrated in a few big cities.

This poses a big challenge to development cooperation. If innovation is a driver of economic development and it is available only in the big cities in developed countries, how can we make this tool applicable to economic growth in the developing countries? This is why the latest literature proposes some counter-arguments on the monopoly over innovations by a limited number of cities. For example, Mizuno (2005) argues that the past literature on innovative space seems to overemphasize geographical factors, as many of these studies see innovations as an explaining factor in the formation of industrial accumulations. Pratt (2010) reviews the British policy of "Creative Cities" and argues that it is a different type of creative cities than the ones Richard Florida has advocated. In the meantime, Goto (2010) analyzed the accumulation of creative industries in the Netherlands, and concluded that the creative industries do not necessarily accumulate only in big cities.

We may also see some examples of bringing innovation to economic development in rural Japan since the 1990s. The Setouchi Triennale is an international festival of modern art held every three years in the small islands of the Setouchi Inland Sea. Although the venue was scattered in remote islands, the 2nd Setouchi Triennale held in 2013 mobilized more than one million visitors, and brought about positive local economic effects worth JPY 13.2 billion (Development Bank of Japan 2013).

This counter-evidence indicates that innovation-led economic development is not only a tool for economic change in the big cities of the developed countries. It is also applicable to medium and small cities in developed countries, and it could also be effective in the case of rural areas in developing countries, a main target for development cooperation. For example, JICA (2006) reports the experience of the international community in supporting innovation-led ICT cluster development in India, the Solomon Islands, and Nicaragua. These case studies indicate that innovation-led clusters can provide solutions to the challenges local communities face in rural areas.

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The question of whether innovation-led development is limited only to big cities in developed countries, or is universally applicable to any other area, may partly come from the ambiguity in the word "innovation". In order to avoid confusion, I will adopt the wide-ranging view of innovation proposed by Landry (1995) mentioned earlier. I therefore define innovation as implementation through invention, leading to the discovery of new or better approaches or know-how concerning the management to production and sales systems in an economy. This does not have to be solely the research and development of products and services that can be accepted in the global market, but it must contribute to the life improvement of local stakeholders, and the enhancement of the local economy. It may not have a disruptive effect on the way that particular industry operates, or it may not cause the creation of a new place of interest that could attract huge number of tourists from around the world, like the small islands in the Setouchi Inland Sea. Even so, the definition covers the need for key important improvements for the sake of development cooperation. Therefore, it makes sense to use such a definition when discussing innovations.

The technology and institutions I discuss in this paper have the potential to create an enabling environment for innovations to take place in the rural areas of developing countries. To be more specific, I take a close look at those technological factors called digital fabrication technologies, such as 3-D printers and programmable control circuits, and outline corresponding social factors in terms of the human and organizational networks formed around "FabLabs", or fabrication laboratories.

FabLab is a creative network aimed at mutual cooperation for better use of ICT. It has a world-wide network, and there are 555 FabLabs across 77 countries as of August 2015 (Fablabs.io 2015). Equipped with a set of digital fabrication hardware, each FabLab offers an environment for product development, but it is also open to citizens who want to fabricate personalized products utilizing ICT and open-source devices. These participants have been creating innovations around the world, at the grass-roots level to the industrial level, and from 3-D printers to smart houses (Tanaka 2012)



Figure 1: Smart house built at the FabLab in Barcelona (Photo from: <http://www.fablabhouse.com/>)

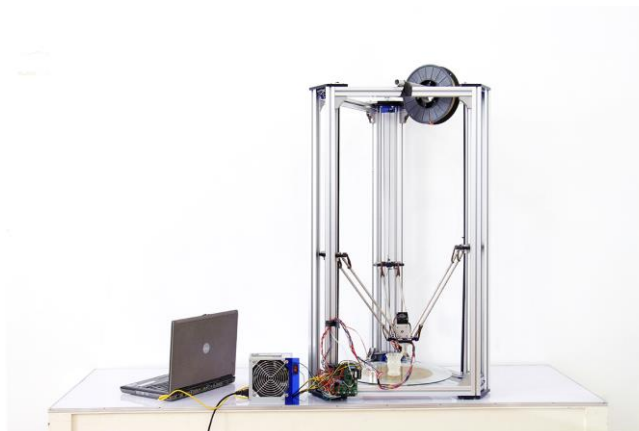


Figure 2: Delta type 3D printer produced at the FabLab Kannai in Japan

There are quite a few cases of FabLab-enabled innovations that may attract the development industry. In Ghana and Kenya, local FabLabs enabled the production of processors for local food ingredients. The FabLab in Afghanistan helped to produce wooden WiFi routers that enable wireless access to the Internet even in hilly remote areas. Other interesting cases are the milk fat sensors and the 100 dollar weather data loggers for local agriculture, developed at the FabLab in Pabal, Pune, India (Gershenfeld 2007). It should be noted that the ones developed in Pabal are innovations born in rural areas, and they clearly provide the evidence that supports the argument in this paper.



Figure 3: Wooden WiFi router "FabFi" produced at the FabLab in Afghanistan

Having these precedents, the development industry has started keeping an eye on the potential that FabLabs have for development. At the 9th International Conference on FabLabs (FAB9) in August 2013, the Japan International Cooperation Agency (JICA) declared that it would seek to exploit the potential of FabLabs for socio-economic development and project formulation in development cooperation programs (JICA 2013). Further, at the 10th conference (FAB10) in July 2014, the World Bank provided a streaming broadcast of the Conference, and published a report on FabLab impact on development (World Bank 2014ab). However, development cooperation providers seem still not sure how they should collaborate with the FabLab movement, and what measures they need to introduce to improve the probability for FabLabs to lead to innovations. This paper is an initial response to these questions.



Figure 4: Presentation of Mr. Arakawa, former Research Advisor of JICA, at FAB9

This paper reports on the case story of the "FabLab Bohol" (IDJ 2014) and the JICA-supported "Poverty Reduction Project by Building-up the Innovation Environment Using FabLab", implemented in the Province of Bohol in the Philippines. In line with the above-mentioned global trend, this project aimed at installing the enabling environment for innovations that lead to economic development. It was a joint project between the Department of Trade and Industry (DTI) of the Philippines, JICA, the Department of Science and Technology (DOST) of the Philippines, and the Bohol Island State University (BISU). The FabLab Bohol was officially launched on May 2, 2014 as the first digital fabrication laboratory in that country.

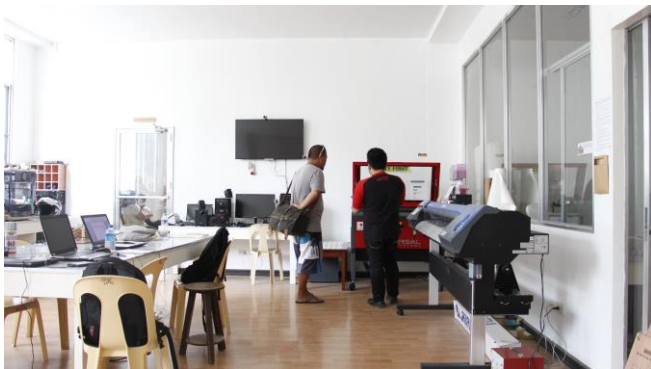


Figure 5: Inside the FabLab Bohol

It takes two hours to fly to the Province of Bohol from the capital Manila, and two hours to reach there by ship from Cebu, the second largest city in the country. The province's capital, Tagbilaran, is a small city with a population of approximately 100,000 (City of Tagbilaran 2010).

Since the opening of the FabLab Bohol, an accumulation of innovations and the emergence of a creative class have been observed. These changes, measured in terms of the number of new innovations created by local micro, small and medium enterprises (MSMEs), and the number of local business start-ups, have successfully met the plan's priorities set by the DTI.

In addition, Benigno S. Aquino III, President of the Philippines, made an observation visit to the FabLab Bohol in May 2014. He appreciated the initiative and expressed his commitment to scale up the FabLab network across the whole country. This was followed by the first joint study

group meeting on FabLabs convened by the Secretary of DTI in December 2014, and an awareness event for citizens in February 2015. This shows that the central government has been looking at the FabLab Bohol as a success story (JICA 2014).



Figure 6: President Benigno Aquino III evaluated this activity highly and announced the expansion of a FabLab network all over the country in front of the FabLab Bohol on May 2, 2014

2. Literature Review and Key Research Questions

In this paper, I set the following key questions: Do FabLab-enabled innovations lead to economic development in the rural areas of developing countries? What are the key factors that affect the effectiveness of this approach? In order to respond to these questions, I review my own experience working as project leader for the FabLab Bohol. I was stationed in Bohol for 26 months to assist the establishment of a new FabLab, and the promotion of local businesses and community development jointly with local counterparts. This is a report on my action research.

Looking at my experience ethnographically, readers will be able to identify the circumstances under which the FabLab Bohol was opened and the processes used, and how it has been creating an impact. Concurrently, I propose a conceptual framework that will help in the application of the same approach to the promotion of economic development in other developing countries.

The framework I propose here consists of the following three concepts: (i) *contextualized innovation* that could empower local resources; (ii) *proximity* that is normally used in the discussions on innovation in the economic context; and (iii) *active body* that is frequently referred to in economists' discussions on industrial clusters.

If I may formulate my conclusions in advance, the following case study shows that we can create an enabling environment for innovations even in those rural areas where conditions seem disadvantageous. I argue that we can make this happen under the conditions that: (i) there is a locally active body who could work for discovery of solutions to local problems on their own initiative; (ii) there are tools for digital fabrication that could technically empower local actors such as an active body; and (iii) there is a location-specific lack of access to resources such as innovative ideas and the application of technologies that can be complemented by the network-based proximity taking shape as the worldwide network of FabLabs, not by the geographical proximity of local actors. It makes sense to

utilize the FabLab in a package under these three conditions for the sake of economic development. These conditions are further elaborated below.

2-1. Contextualized Innovation

Toyama (2014) points out that a local economy consisting of the firms closely tied to communities accounts for 70% of GDP and employment in Japan. These firms provide services such as public transport, health and welfare, restaurants, community infrastructure, and product distribution. Toyama further argues that the expansion of the global supply chain, and a horizontal division of labor, makes difficult the vertical connectivity between large global enterprises and local MSMEs.

This vertical connectivity was a typical phenomenon during the time of the rapid economic growth of the 1950s to 60s in Japan. As large enterprises grew up and became more integrated into the global economy, however, the trickle of growth dividend could not easily flow down into the local economy. Consequently, the global economy and the local economy became divided, and now exist in parallel without any interactions between them. As a result of this economic paradigm shift induced in a highly globalized world, policy tools for promoting the global economy do not assure revitalization of the local economy. Toyama therefore concludes that we should target the local and implement policies for promoting local economies (Toyama 2014).

Similar arguments about the global-local divide are given by Strange (1997). She points out that as the world economy becomes more flat and globalized, we can observe the bipolarization of marketed products. The differences between the ones that respond to supranational needs and standards, e.g. Coca Cola, PCs and smart phones, and the ones developed for specific local markets have become obvious.

The discussions on economic development, no matter if they are dealing with the issues of developing countries or developed countries, tend to end up with the conclusion that we need to enable local-based firms to turn global. Also, even in discussions on human resources management, our attention tends to be concentrated on the measures needed to create competitive innovation by shifting home-grown human resources and institutions to the global domain, or the measures required to attract competitive innovators from the global domain to form a new creative class in the local economy.

As mentioned earlier, this paper does not define innovations solely as those able to be competitive enough in the global economy, but rather as those ones that could improve the welfare of a small local area, including their impact on the effectiveness and efficiency of particular institutions or the lives of particular individuals in that particular locality. In case where development cooperation agencies consider measures for economic development, they need to focus on the local people, on community-based institutions, and on local economies. What is needed here is therefore *contextualized innovation* that brings breakthroughs or improvements to the status-quo of each group of local people.

Toyama (2014) points out that the global-local divide exists in the urban area, and that trickle-down from the global economy to the local economy does not occur. The concept of *contextualized innovation* may therefore be applicable not only to rural areas but also to the disadvantaged sectors and situations of many people in the big cities.

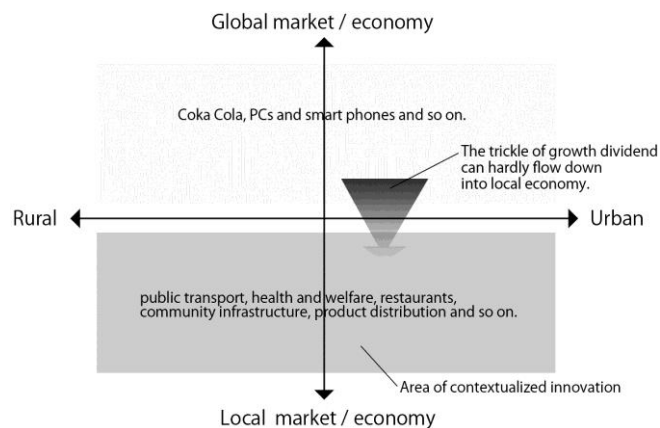


Figure 7: Conceptual diagram of contextualized innovation

In developing countries, it is extremely difficult to develop local human resources to produce the level of innovation required to create a competitive edge in the global market. It is almost impossible to increase the number of innovators to form a creative class in a particular local community and build an environment for the continuous creation of world-class innovations.

However, *contextualized innovation* offers an alternative pathway that can enable local actors to find solutions to their immediate problems. If I take my definition, it is that innovation is implemented through invention, leading to the discovery of new or better approaches or know-hows concerning management, production and sales systems in an economy. If we seek for *contextualized innovation*, we do not always have to be a champion to compete and survive in the global economy, and it is easier to create innovations. This makes it easier to educate local innovators in disadvantaged rural areas.

Thus *contextualized innovation* does not make it difficult to build an enabling environment for the continuous creation of innovations. Development in this way is no longer a difficult challenge. In the case of FabLab Bohol, we focused on the measures needed to create *contextualized innovations* locally, through various FabLab-based economic activities. This has successfully had an impact on the local economy.

2-2. Organizational Proximity vs. Temporary Geographical Proximity

It is not until Torre and Gilly (1999) brought *organizational proximity* into their analysis that the concept of *proximity* increased in importance in the discussion on local innovation in developing countries. Prior to their argument, innovations had been thought to accumulate only in big cities. There had been an implicit assumption that innovations were created out of interactions and

combinations of different ideas and pieces of knowledge and ideas, and what mattered was the population density of creative class and the *geographical proximity* enabled by transport infrastructures and other factors.

Of course, the absolute numbers in the creative class with a high level of knowledge may be too small in developing countries, especially in rural areas, and may be further handicapped by a lack of access to transport and communication infrastructures. Thus, they do have great disadvantages compared with big cities in terms of *proximity*. These unfavorable conditions had been thought to lead to brain drain of the creative class out of the local economy, and to make it difficult to promote economic development in developing countries.

However, Torre and Gilly (1999) went so far as to divide the concept of *proximity* into two: *geographical proximity* and *organizational proximity*. They stated that:

“Organizational proximity is based on two main logics, which are similarity and adherence (economic actors being involved in an organizational proximity relation when they belong to the same relational framework, or when they share the same common knowledge and capacities)”.

They argued that the proximity also refers to interactions, and it is considered that it leads to innovations. *Organizational proximity* thus works like psychological proximity. So, in fact, organizational proximity may neutralize the disadvantages of geographical proximity in developing countries. This indicates that the measures needed to bring about organizational and psychological proximity may be effective in creating innovations even in developing countries.

Torre (2008) further distinguished *temporary geographical proximity* from permanent proximity. This is short- and medium-term proximity formed by interactions taking place at one time, or for a certain period of time. It offers another implication for our approach to innovation in developing countries. The concept of *temporary geographical proximity* implies that a project-type temporary organization formed to serve particular objectives and needs may be suitable for combining different knowledge bases from a wide range of expertise. This may give an advantage in the programs for increasing innovations.

Regardless of whether we are in developing countries, it is possible to host conferences and collaborate with external visitors if this is a short-term program in the project period. In the context of FabLabs, we are able to take a similar approach by organizing international conferences, hosting Make-a-thon type events, and supporting the visit of creative nomads. This will help bring about the condition of high proximity for innovations.

In addition, this paper presents a new concept of *inter-local proximity* as a complement to the two types of proximity mentioned above. *Inter-local proximity* is emerging by connecting local communities through human and institutional networks, enabled by the expansion of the Internet. These networks are trans-local and not confined to a closed area. But they do not overlap the global economy.

Inter-local proximity implies that even if each local community is disconnected from the global economy, inter-linkages between such communities may create an enabling environment for innovations.

The case of FabLab Bohol shows that both *organizational proximity* and *temporary proximity* work as *inter-local proximity* via its networks. This facilitates the combining of a wide range of knowledge and expertise, and accelerates *contextualized innovation*.

2-3. Active Body

Thomas Friedman (2005) lists four conditions for developing countries to make their economic management effective. To paraphrase, these are:

- To prepare a global platform to connect the locality to the world;
- To provide education to enable people to innovate on that platform;
- To establish the governance model that does not hinder but facilitate innovation; and
- To create an environment that attracts innovators.

The countries which have succeeded in meeting these requirements include China, Russia, Mexico and India. Reviewing country experience relating to these reforms, Friedman points out that reforms such as building an enabling environment for innovation require leaders who are visionary and highly committed to getting things done.

Further to the above argument on leadership, the framework of capacity development (CD), which has been mainstreamed among development practitioners as an approach to local indigenous development, also indicates leadership is key element of indigenesness. Hosono et al. (2011) for example, found that strong leadership initiated by local leaders was the most effective driver for project implementation, and for making innovations in most of the regional development projects supported by development cooperation. This study used the word "breakthrough" as being equivalent to innovation.

Sasano (2014) discusses the enabling environment for innovations in local communities from the viewpoint of industrial clusters, and points out that all successful local communities commonly have a local *active body* that voluntarily acts for the sake of their communities. This local active body can persuade other individuals and institutions from different sectors to have a common purpose, keep working and always look for the next step to take. Therefore, Sasano insists that their activities facilitate collaboration between stakeholder organizations and enterprises, and therefore induce innovations and promote business start-ups in the local economy.

All these documents assert that an innovative environment needs an individual or a team of a few people as strong driver. Sasano especially refers to case studies of local innovations in the cities of Oulu, Finland, and Maniwa, Okayama, Japan, whose populations are approximately 140,000 and 50,000 respectively. It can therefore be said that a local *active body* is a prerequisite for local innovation

in cities other than the big ones in developed countries.

FabLab Bohol gives another example. It has been established in the City of Tagbilaran, Bohol Province, the Philippines, population approximately 100,000; and is engaged in the programs that build an enabling environment for innovations. We can identify a few people who became a leader or a key driver and voluntarily led the activities at the FabLab. This shows that there is a local *active body* in Bohol's case.

3. Action Research: Building Innovation Environment in Bohol, the Philippines

Before reviewing this case, the stakeholders and other external and internal environments are described, based on my action research. The stakeholders include the Province of Bohol, the Department of Trade and Industry (DTI), and local micro, small and medium enterprises (MSMEs). This discussion is followed by an ethnographic review of my action research on the activities of the "Poverty Reduction Project by Building-up the Innovation Environment using FabLab". This review includes my initial observations and comments on the programs for economic development based on the newly established FabLab Bohol. Please note, however, that people's names are all pseudonyms except for the author's.

Readers will see how the above-mentioned three key concepts, i.e. *contextualized innovation*, *proximity* and *active body* enabled innovations in Bohol.

3-1. Arrival of a JOCV Member in the Duty Station

I arrived in Bohol in August 2012 as a Japan Overseas Cooperation Volunteer (JOCV). Staying in the Province for 26 months, I conducted action research as a development cooperation volunteer. As background, I am male, unmarried, and Japanese. This participant observation task was conducted when I was in my middle 30s. Majoring in product design at a university of arts, I had work experience in R&D at a business venture on computer hardware components, as a freelance web-designer and system engineer, and as a product designer at a medical equipment company, before I became a JOCV member for the Philippines.

Bohol is an island group province located in Central Visayas region in the central part of Philippines. It takes two hours to fly to Bohol from Manila, and two hours to reach there by ship from Cebu. The province is composed of more than 70 small islands, including Bohol Island. There are 3 congressional districts, 47 municipalities and 1 city. It has 1,109 townships called barangays, and the total population of the province is 1,255,128. The provincial capital, Tagbilaran City, has population of approximately 100,000 (Province of Bohol 2015). Bohol is now known as a safe island, but the local economy is still been suffering from under-development due to the after effects of guerrilla activities in the past.

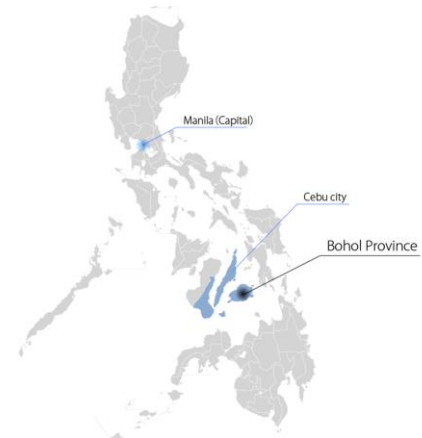


Figure 8: Map of the Philippines and the Province of Bohol

I wanted a volunteer experience in Bohol partly because it was one of the fierce battlefields of the Japanese army during World War II. I wished I could take responsibility for what our ancestors had done to the province by taking time to serve local community development.

3-2. DTI-Bohol

I was assigned to the Provincial Office of the Department of Trade and Industry (DTI). The DTI-Bohol covers the whole province with 26 staff, including 2 foreign volunteers. Under a Provincial Director, there are three operating units: Business Development Division, Consumer Welfare & Business Regulation Division, and Management Support Services Unit.

The mission of the DTI-Bohol is to make the area a preferred destination for investment, talent and innovation that will contribute to economic growth and a better quality of life through job creation, and the creation of a level playing field for both consumers and business. Their expertise in terms of activities lie in hosting trade shows, promoting investments, developing industries and businesses, developing products, providing business information, providing a variety of advice, providing technology-related training, enforcing Fair Trade Laws, supporting consumer advocacy groups, and so on. That is why this office has wide jurisdiction and responsibility, and a wide range of business activities; but it also has limited staff.

The DTI-Bohol occupies the whole of the second floor of a four-storied office building, and there is a branch office of a commercial bank in the same building. All DTI staff members have their own desk and a PC. There is a shared space installed with three laser printers, and a meeting room with a capacity for 20 persons. The meeting room is equipped with a large-screen LCD TV used for presentations. It offers a very clean office environment.



Figure 9: Inside the DTI-Bohol office

I was assigned to the Business Development Division. There were eight staff members including two international volunteers from Japan (JOCV) and Germany (GIZ). Under a Division Chief, the division was divided into three groups, and they worked on the industrial promotion for tourism, food processing and manufacture. They targeted MSMEs with an asset size of 100 million Philippines pesos or less, and aimed at enhancing their competitiveness and business expansion in terms of investment and export.

We were engaged in a wide range of activities: partial funding for MSMEs' capital investment, and procurement of current operating funds; contributions to product planning and product design; organizing workshops for knowledge dissemination and skill enhancement for doing business and product development; hosting seminars for job-seekers; and market-making by organizing trade shows.

As I spent time as a DTI staff, I came to learn that my colleagues were all recruits at the central ministry, and graduates from top-class colleges. They had knowledge of marketing and were excellent public servants. Six Filipino staff members at the Business Development Division had been engaged in product development for more than ten years. They were rich in experience and seemed as hard-working at the office as the colleagues I used to work with in Japan.



Figure 10: The Author and DTI staff

I now overview the manufacturing sector in Bohol and its structural problems. These made me decide to work for the establishment of a FabLab in Bohol, together with my fellow DTI staff members. As described earlier, the Province of Bohol consists of a main island and more than 70 other small remote islands. It is faced with a serious connectivity problem, and product distribution has to rely on marine transport. However, they do not have a good port for large-scale transport, and therefore all product distribution is done at the Port of Cebu as a hub, even though it is located on the other side of Bohol, and it takes two hours to reach Cebu across the inland sea in a high-speed boat.

Almost all freight is in large containers and is first carried to the Port of Cebu for temporary storage in warehouses. It is then divided and repacked into smaller containers so that small carriers can come to pick them up for transport to the smaller Port of Bohol.

Manufacturing requires various materials and consumables and they must almost always be kept in stock. But in Bohol, this is too expensive due to the high cost for shipment and storage. Thus high procurement costs push up production costs, affecting the competitiveness of products from Bohol.

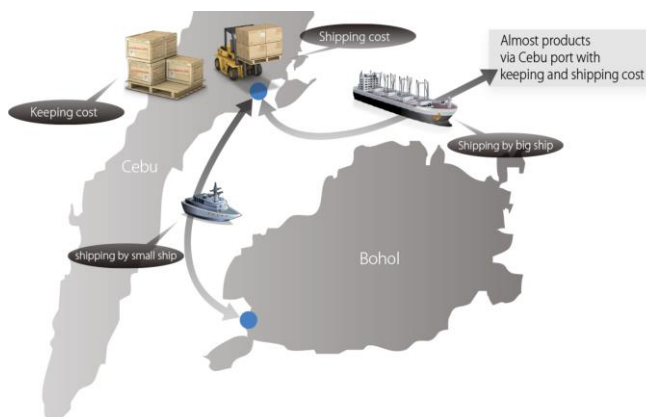


Figure 11: Diagram of Logistics in Bohol

In general, a product market exists no matter if it's high quality that means good design and/or functionality, or not. If quality is poor, lower prices will generally apply. We are always able to create the market value of our product in accordance with its production cost. However, if there is disadvantage in logistics, even if the quality is the same, different prices may apply, and products made in Cebu can be marketed at a competitive price in the same town. But, businesses are not able to market products of Bohol origin at a similarly competitive price in Cebu, and therefore local business cannot be sustained.

If we still aim to promote manufacturing-based local business under these circumstances and make it in a sustainable manner, we would have no choice but to revert to competition in terms of quality. In other words, unless we can make high-quality local products compared to their counterparts outside the Province, we can hardly have them sold in the market and get good results from manufacturing-based local businesses. Therefore MSMEs in the Province of Bohol require highly developed product development and manufacturing capabilities.

The DTI appears to be failing in finding solutions and measures to overcome this logistics problem in Bohol. It has been one of the major problems hanging around for so long.

3-3. MSMEs in Bohol

3-3-1. Initial Observation

The Business Development Division has identified 10 model entrepreneurs out of the whole Province as leaders for the promotion of local industry. The DTI-Bohol has been supporting them in terms of preferential financing

arrangements and technical advice, expecting their immediate impact to trickle down to the whole economy of the Province.

I once asked my counterpart, Brian, how these 10 entrepreneurs were selected. He had already had 20 years of experience in business promotion. He said, "The DTI-Bohol used to randomly advise many local MSMEs. But soon we came to know only a few of them were enthusiastic enough to follow our advice and bring it into their practice. The 10 entrepreneurs we have been providing targeted support have strong passions and high motivation". I also read the activity reports written by my predecessors. Before I was assigned, there were three JOCV members at the DTI-Bohol. According to their reports, they had been working with these 10 leading entrepreneurs. They all seemed to have hard time in providing advisory services to the local MSMEs, and repeatedly wrote in their reports about their struggle, failing in getting the results they had expected.

My counterparts had expected me to succeed my predecessors. However, I wanted to know my counterparts, their activities and the present situation of local industries as well. So I started visiting all the 10 entrepreneurs to observe their practices; only to find out that the situation of MSMEs in the Province is poor.

Almost all of these leading MSMEs were located far away from Tagbilaran, and faced accessibility problems. For example, one entrepreneur crafting wooden accessories in the Loboc municipality had his workshop half-way up a steep hill, and we could not reach there by car. His workshop was built in a small lot surrounded by dense forest. It had log pillars standing at each of the four corners, and they had a simple roof-top cover on them. He had installed a work table equipped with a custom-made table saw machine with a motor and table saw blade. He carved wooden accessories and displayed the finished products in the kitchen of his house, which also looked like a workshop.



Figure 12: Laboratory of an accessories firm in Loboc Municipality

Meanwhile, there was another entrepreneur on Cabilao Island. We had to reach there by boat from Bohol Island, and the workshop was located at the edge of the island. This enterprise had been crafting bags out of *romblon* or *pandan*, a local plant that is a member of the palm tree family, tearing the leaves into strips and weaving them into bags. They and their neighbors were engaged in craftwork in a dark small cabin with a radius of three meters. Electric manufacturing equipment was not installed in the cabin, it

was all manual work.



Figure 13: Laboratory of a bag firm on Cabilao Island

I visited all 10 MSMEs and came to know that they had been engaged in their work without any operational manual or instruction document. As a result, their products had variation in size and shape even if they were the same item. I could find a reference document on quality control (QC) only at one MSME. This QC document was put on the wall and said: "Weave beautifully. If it's not, do it over again." The words used for the message were too ambiguous in definition, and they were hand-written in the local language. The quality of products looked poor, and I thought they were hardly fit for sale. In fact, 80 to 90 percent of the handicrafts sold at souvenir shops in Bohol were made in Cebu.



Figure 14: Reference document on QC found only at one MSME (on the wall)

Another surprise was that almost all the workers could hardly understand the English language, and that caused me difficulties when interviewing them.

Whenever I visited local entrepreneurs, I tried to take time for an interview with the employees actually working at their workshops. When I asked a simple question like "What are you making?" they would answer in a couple of words. But when I went further and asked the next questions, or when I tried to give them advice, they could not understand and communicate with me. As I went through these trial and error situations, I came to know they didn't understand my points. It turned out that they just presumed what I meant in

my question, and therefore vaguely answered to that.

For example, when I interviewed the villagers working with wooden accessories in Loboc, I once advised: "It's dangerous to take a position facing the table saw blade just in front of you. You had better take an oblique stance against the blade." Then the informant seemed to have mistaken my advice as a question and repeatedly explained, "This is a table saw", and "We made it out of coconut tree." I couldn't make myself understood by the informants. With a worried expression on their faces, they looked around to search for a help from an interpreter.

Of course this was also partly due to my poor English pronunciation and lack of vocabulary. But the on-ground reality was that even using such simple words as left or right, up or down, or "like this", we could not communicate with each other. I once tried to make conversation in writing, only to find they could not read English. But that was not all. It turned out that quite a few workers were illiterate on units of length, and didn't know how to measure with a ruler. As a result, I soon gave up verbal or handwritten communication in English, and shifted to conversation in the local language.

3-3-2. Workshops

Their knowledge of basic level skills often discouraged and troubled me. One day, I visited one lead entrepreneur at the village in Bien Unido municipality. I could reach the village in three hours from Tagbilaran city by car. This entrepreneur had also been crafting bags out of *rombulon or pandan leaves*. I had planned to organize a local training workshop on bag production.

I had already seen their products displayed at the souvenir shop in a local hotel, and knew their design and production capacity. I thought I knew which level of design I could expect from them, to some extent. Before I visited the village in Bien Unido municipality, I had designed four types of bags and small articles to be produced by local entrepreneurs. I made the design as simple as possible, and prepared hand-written design sketches, production manuals, paper for patterns to cut out, and paper mock-ups to show the 3-D shape of the products.

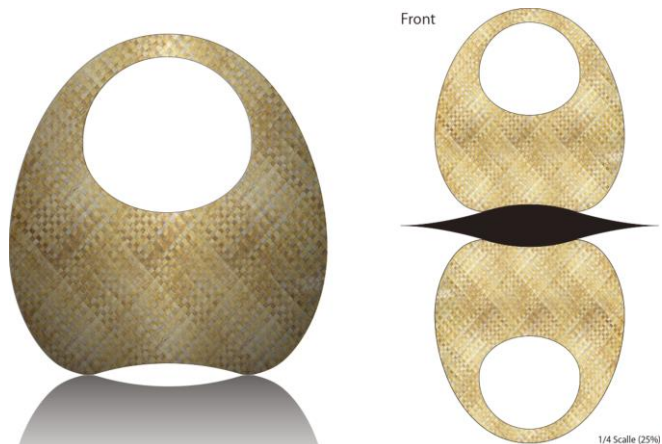


Figure 5: Design sketch and paper for patterns I prepared for the workshop at the village in Bien Unido municipality



Figure 16: Paper mock-ups to show the 3-D shape of the products I prepared for the workshop at the village in Bien Unido municipality

The venue for the workshop was a basketball gym. It was large for the size of the town, but shoddily built of cement and reinforcing iron bars. There was no table or chairs. Instead we spread out patterns and materials on a table tennis table. A sewing machine was put on the floor beside the table. Outside we saw half-naked farmers pulling *carabaos*, water buffaloes, to work in the paddy fields. It was a very peaceful sight.



Figure 17: Farmer pulling carabaos beside the venue for the workshop

The participants did not speak English and I decided to facilitate the workshop in my poor local language, with the help of my fellow DTI staff, Louis. I demonstrated the use of scissors and paper patterns, and explained some production basics, such as:

- When you cut fabric with scissors, keep moving the blades and avoid them being closed. Then you can cut it straight;
- You can achieve product uniformity if you use paper patterns to cut cloth; and

- You should treat the patterns carefully as you are supposed to use them often.

The workshop was disrupted from time to time as participants left the site without prior notice. Starting in the early morning, the workshop had advanced to a sewing session after noon. It was close to the evening when I referred to a key important message that once they draw a reference line with a pattern paper, they should not miss it in sewing the cloths.



Figure 18: The author lecturing on how to produce bags at the workshop

We had to close the workshop in the evening. Although the participants proceeded to sewing machine operation, I stopped them, saying, "If you operate a sewing machine as explained in the production manual, you can produce uniform bags according to the paper mock-ups. Louis will come and pick up the products next week."

I left the village. I was too exhausted from heavy exposure to unfamiliar local language, and I was so shocked at the on-the-ground reality that I couldn't say even a few words in the car on our way back home. Two weeks later, I thought it's time that the bags were finished and ready for pick-up. I asked Louis if he had brought them from the village. With a forced smile, he took the bags from under a desk and silently passed them to me. What I saw was bags different from the ones I had expected. They lacked uniformity of size and shape, and had limited design properties. They must have been produced in a different way from my advice. Clearly, I could see that the pattern papers had never been used for their production even though it was one of my key messages at the workshop. I thought that the local people must have not read the production manual at all even though I spent much time preparing it.

This is the reality of Bohol, I thought. The people I worked with were the lead local entrepreneurs who, in Brian's words, "were so enthusiastic as to follow our advice and bring it into their practice."



Figure 19: Bag produced at the village in Bien Unido Municipality

I organized this workshop three months after my assignment to Bohol. Since then, I have asked myself if it was too inefficient to give technical advice directly to local people, and if this approach to economic development was inappropriate. There are job-seekers hanging around in the country-side of the Philippines; people who needed empowerment. And there are local entrepreneurs working on craftwork in villages. But soon I came to learn that the majority of the job-seekers were school drop-outs, and they have a hard time in getting a job all the more for the fact that they have not completed even the basic education curriculum. Otherwise, they would have found a job, or have migrated to the provincial capital Tagbilaran, or to neighboring Cebu city. There were some diligent workers who could work without completing a basic education. But those people were busy on the farms.

There were a lot of earlier technical assistance efforts provided by international donors. Although these efforts achieved so much according to their reports, most of these efforts did not seem to have sustainable effect. The previous advisors had made desperate efforts in quality control, dyeing, and design. Most of these, however, had been dismissed a few years after donors and advisors left the Province, and the production system returned back to where it was before they came to town. It seemed clear to me that, if I took the same approach and spent time in providing technical assistance to MSMEs for the coming two years, my efforts would be forgotten in the next few years and end up in vain.

The story might be more or less the same with the DTI's numerous efforts of technical assistance. As mentioned earlier DTI staffs are all well-educated and knowledgeable. They frequently participate in the training programs at DTI Central and regional headquarters, eager to learn new technical skills, new methodology and new ideas. As a result they are capable of guiding the local MSMEs. However, I couldn't find only a few evidences of enough knowledge accumulation among the local MSMEs, attributable to the efforts of the DTI.

3-4. External and Internal Environment in Bohol: Temporary Summary

This section gives a temporary summary of the local

industry before the "Project for Poverty Reduction by Building-up the Innovation Environment Using FabLab" was launched, and on the present situation of the Business Development Division of the DTI-Bohol.

According to my observations in the first few months, the unit staff of the DTI-Bohol had enough knowledge on product marketing and product development. They had good administrative capacity and I could even say they were as competent as local civil servants from developed countries. They had past experience to implement several projects for promotion of local industries. They organized workshops that intended to enhance the capacity of local MSMEs. They had never been self-complacent in designing their programs. They always tried to disseminate what they had learned at the seminars hosted by the DTI Central, or invited lecturers from the big cities of Manila and Cebu. Thus, I could hardly find any defect in the way they had delivered these public services.

However, once their activities were combined with the geographical disadvantage in logistics, and the poor learning capacity of the local MSMEs, the DTI's efforts turned out to be a failure, creating no clear results. This vicious circle has been affecting the Province for almost 10 years. There seems to have been no steady growth in the manufacturing sector, and Bohol is still heavily dependent on primary industries.

If I describe the situation in terms of the PDCA (Plan, Do, Check, Act) cycle, it could be said that the DTI could plan, do, and check (their plans). But they could not implement them, and this situation seemed to have been going round and round for the last 10 years in the same place.

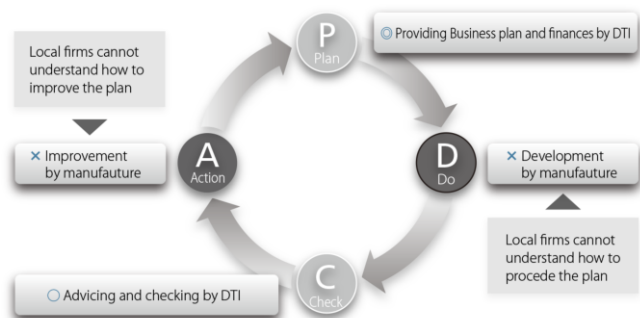


Figure 20: Model diagram of problems in Bohol expressed in terms of the PDCA cycle

3-5. The Project for Poverty Reduction by building up the Innovation Environment using FabLab

3-5-1. Concept

As discussed in the preceding sections, we had to overcome the following two constraints, in order to find a solution to the problems affecting the local industries and hence promote economic activities in Bohol:

- The difficulty in improving technological capabilities, due to the low level of education of local workers who belong to MSMEs; and
- The geographic disadvantage affecting logistics, which makes it extremely difficult for local products to be

competitive in the market.

After a few months of struggle, I finally gave up on the conventional step-by-step approach of enhancing the entire technical capacity of the local people as a whole, and decided to shift to a new approach of targeting a few people to provide innovators' education. This would be promoting industrial development with innovation policy; the latter having been recognized as the mainstream in modern economic thought.

In the former holistic step-by-step approach, product quality might remain low and fail to make full performance, unless local producers break the constraints and make products better in quality than in Cebu. This seemed to be a very cost ineffective development cooperation when we calculated the discounted cash flow into and out of investments.

On the other hand, if we could concentrate our scattered resources into investment in innovators' education, we could better utilize the resources and bring about many *contextualized innovations* in local industries, enabling the adoption of better methodologies and knowhow in all the value creation processes in the management to production system. These innovations would promote the local economy, and at the end of the day benefit all MSMEs through very cost-efficient development cooperation.

But this shift couldn't be completed in a day. Before we introduced the new approach of innovation-led economic development, we first had to install a mechanism that would enable us to initiate innovators' education, and have different knowledge and ideas connected to and amalgamated with innovations.

3-5-2. Planning

Soon I came up with an idea of establishing a digital fabrication laboratory, or FabLab in short, to build the enabling environment for innovations in Bohol. It was six months after my assignment to the region. I prepared a presentation on my idea and explained it to Brian, my immediate counterpart, and to Marcia, Division Chief for Business Development. I said:

"When you want to make a bag, you first develop the design in digital data. Then you have the fabric cut by a laser cutter in accordance with the data. Even if the local fabric is made of hard natural fiber like *romblon* or *pandan*, a laser cutter could make holes for a needle before stitching and you can stitch straight by hand. No need for a sewing machine."

and

"If we could raise just one person as a *guru* of digital fabrication equipment, he could help others to make uniform products in size and shape. The local producers could make many beautiful bags of excellent design that the local MSMEs in Cebu could hardly imitate."

and

"The digital data for those beautiful bags are open and accessible on the Internet. You just go and look for

them. In case you can't understand the recipe or have difficulty in customizing the products by using locally available materials, you can consult with other FabLab users around world via the FabLab network and ask for their advice. Therefore, the local producers don't have to learn to use pattern papers to draw a reference line."



Figure 21: One scene of the explanation of the project concept

I also added:

"In case you want to make wooden accessories for example, a CNC (computerized numerical control) milling machine will help you to cut the local wood. If one knowledgeable and skillful FabLab *guru* is available there, he could help you to develop the 3-D data for the local design. Then the CNC milling machine will help you to carve the local design with great accuracy on the wooden accessory. It's a new combination of, technology and local traditional design and local products."

and

"You don't have to develop the whole design by yourself. For the basic design and shape, you can access shared data on the Internet or the 3-D data available in the FabLab network."

and

"Once you download the data and add a new flavor of Bohol specific culture to the open design, you can develop a new accessory that is a product of Bohol origin but assures the same product quality as the major accessories sold in the global market. No producer in Manila or Cebu could make it. It's the original of Bohol and the local people must be proud of the product."

I still remember the moment that the sunny smile of Brian and Marcia suddenly turned to a serious face watching my presentation. But the moment I proposed a new project as the first thing to do with FabLab, they changed their whole attitude:

"In Bohol we see plastic wastes everywhere thrown away by the roadside. The situation gets worse and we can see more wastes as we go away from the state

capitol. But we do not see any steel wastes. Because they are easy to process and recycle at the local steel mills, scavengers collect and bring them to local mills for cash. If we could make plastic wastes easier to process as well, and if there are facilities to reprocess them as a new material for production, plastic wastes will disappear from the streets".

Having said that, I took out from under the desk a toolkit I had made for my presentation. It was a customized glue gun with an attached device that reprocesses the plastic bags to the form of long strings. Also, I brought a fabric hand-loomed with the plastic strings as wool and local natural fibers called *raffia* as warp. *Raffia* is made of *buri*.



Figure 22: Material from reprocessing the plastic bags to the form of long strings (upper), fabric hand-loomed with the plastic strings as wrap and wool as woof (lower left), and fabric hand-loomed with the plastic strings as wrap, and local natural fibers called raffia as woof. Raffia is made of buri (lower right)

"Plastic becomes soft as we heat it, and we can reprocess it to a recyclable material like this string. It's not difficult to build the facility by ourselves. However, if we want to improve the quality and make this string salable at the market, we need to cut aluminum parts more precisely. But this can be possible with the digital fabrication facility installed in the FabLab."

"Once we have a FabLab, we can multiply this toolkit. If there are many similar toolkits, we can create a new industry, as scavengers collect plastic wastes and local recycling processors make plastic strings out of the wastes. Then the existing local MSMEs could weave a new fabric of Bohol origin using the reprocessed strings. Local bag producers could make a new eco-friendly bag from the new fabric. This could make a project that could achieve at the same time, beautiful Bohol, create a new local industry, and be seen as a strong brand of *Made in Bohol*."

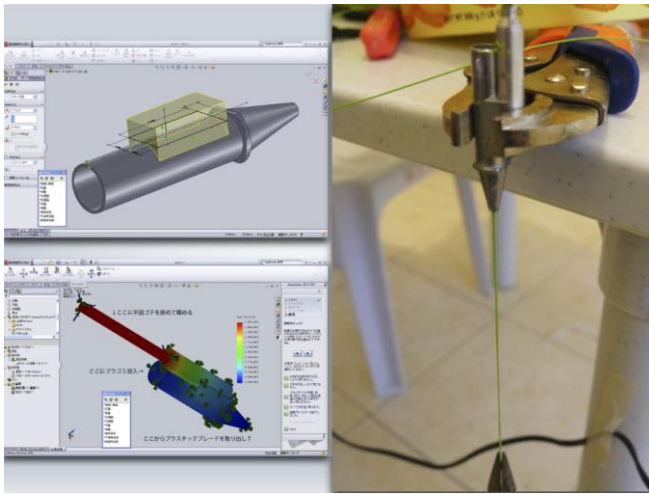


Figure 23: Slides of the presentation to explain a project for recycling plastics

Brian got excited and said: "This is the one I have been looking for. Let's get the budget. We can do this." He looked as if he couldn't wait until I finished my presentation. He was joined by Marcia who said, "Brian, do you know when Natalia, (Director, DTI-Bohol) will be back in office? Yutaka, let's discuss it with Natalia. Everything goes well." She also looked as if she did not want to let me finish.

However, this was not the first time that I had talked about FabLab to them. Since I first came up with this idea, I had asked myself again and again for almost a month if I could really proceed with this idea in Bohol. I was not so sure, and I had asked for their reaction from time to time by showing web-pages of the FabLabs around the world, and photos taken on the innovations created at the Labs. But they had been unresponsive, almost as if they were not interested.

In developing countries, especially in the underdeveloped areas, government offices capable of getting things done are much sought after by development cooperation agencies as a local implementing body, or a counterpart of their projects. The DTI-Bohol had also been involved in the GIZ-funded environmental upgrading project and USAID-funded local governance improvement project. It had also been the executing agency of a JICA-funded yen loan project. The DTI staffs seemed to be busy with implementing the projects so that they could meet the accountability requirements agreed with each donor.

Under these circumstances, it was quite natural that the DTI staff did not have a positive attitude toward bearing new responsibility. They are too busy with their own tasks and have no time to try a new project, especially one proposed by a young Japanese volunteer who had been there for just six months.

Even so they jumped at FabLab excitedly and thought they should try it, even if that might slow down their other programs. I suppose that was because they could easily imagine how the FabLab project could lead to *contextualized innovations* that could offer a solution to the problems they had been facing, and meet their primary goal of empowering the local economy.

International donors have repeatedly provided funding to local development projects. But they had been supply-driven,

and were not attractive to the recipient government staff any more. Instead, what mattered to them were ideas for improving the profitability of local weavers who had been suffering from severe competition with their neighboring weavers in Cebu, even after they installed a new powerloom as recommended by those officers. The ideas became more attractive if they could also address the issues on solid waste management at the same time.

The primary merit of *contextualized innovation* is that it can motivate local actors to take action. It helps them to know what the most important issue is, and to clearly imagine what benefit they could expect from the project. If we aim at *contextualized innovation* that is targeting a small local economy and is embodied in such small devices as described above, we don't have to aim at survival in the global economy. All we should do is to make products only for the local economy and this will lower the difficulty of creating innovations. If the scale of innovations gets smaller, the required standards for education of the local innovators could be lower as well, and this makes it easier to design education curricula in the rural areas of developing countries.

This is due to the fact that *contextualized innovation* does not require high technical knowledge and skills. Also, it is partly because the local people have better knowledge about their community and the problems they are facing. They are thought to be richer in ideas as a fountain of innovations, and that also lowers the threshold for creating innovations. With these requirements, it is easier to ensure the long-term sustainability of the impact and the development of mechanisms to bring about innovations continuously.

Furthermore, *contextualized innovation* does not require large investments in state-of-the-art facilities to compete with the world, and it's easy to build the enabling environment for innovations. We can implement the project while we have local actors keep a high sense of ownership and maintain motivation for innovations.

In the case of the FabLab Bohol, selection of hardware was initiated by the DTI-Bohol, and the inputs from JICA were made in terms of assignment of a JOCV member like myself as a facilitator, and the partial installation of equipment and expendables. Most of the inputs were made available at the cost of the local government and the Bohol Island State University (BISU).

3-5-3. Initial Stage: Project Preparation

There are some options on the package of hardware to be installed in the innovation facilities. Even if we narrow down the scope to digital fabrication laboratories that require only small investments, we have TechShops, Hackerspaces and Makerspaces as an option besides FabLabs.

We also have an option to create innovations without belonging to any network. With selected equipment for digital fabrication, we could make full use of open data on the Internet for *contextualized innovation*.

In developing countries, however, especially in the case of rural area, we always face with the issue of project

sustainability if we plan to install facilities in a large lot. They may soon break down and be left unfixed. Whereas FabLab *guru* may leave the project after they complete their training program and no one is able to operate the machines there. Local actors have to avoid the risk of the facilities becoming a white elephant.

In a country like the Philippines which has a long history as aid recipient, there is accumulated experience in success and failure in development, and we can see “white elephants” in almost all the provinces. Immediate response from the field staff like Brian and Marcia was welcome. But once we started trying to get the funds, the chief concerns that Directors expressed were about project sustainability.

In order to mitigate the risk of being a white elephant, we should receive support easily whenever the facilities are not running well or have even broken down. Also there should be a system under which we could easily take a training program on facility management as frequently as possible, and an atmosphere in which we could freely consult with others whenever we came up with a question.

The reason that Bohol chose FabLab as a package for innovation facilities was that it could offer the environment that would help us to minimize the risk of being underutilized or even useless. FabLab is explained as “There are a few collaborative projects within the community, and a number of initiatives to exchange designs and experience between the Labs. Similar to the Hack-a-thons, but occurring more regularly and systematically, all the Labs around the world can contact each other through a common video conferencing system hosted at the MIT which is used for ad-hoc meetings” by Troxler (2011). And international conference for FabLab member is held every year. If members participate in it, gathering support and help from other participants are easy. Therefore, FabLab has been supported by a more cohesive and more active community.



Figure 24: Participants exchanging designs and experiences at a workshop during the international conference held once a year by persons concerned with FabLab (Fab9 in 2013)

Looking back at its history, FabLab was first installed by the MIT’s FabLab to empower rural India. Meanwhile another FabLab was established in Indonesia with the Dutch FabLab’s support. We can see quite a few cases of the Labs in developed countries supporting their counterparts in developing countries. Besides, there is an annual international conference organized by the fabbers who are

FabLab operators and users around the world. Once you go there and are connected to other fabbers, you can receive support from other Labs or ask for advice. To sum up, FabLab is a package that offers a high degree of organizational and psychological proximity that creates an atmosphere in which you can ask anything freely.

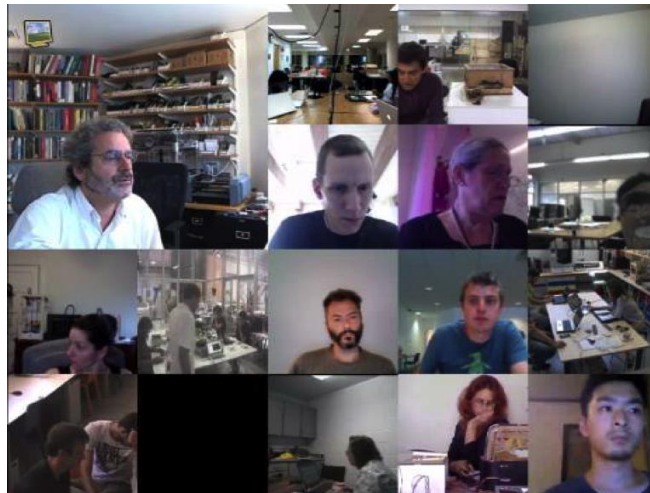


Figure 25: Persons concerned with contacting one another through a common video conferencing system hosted at the MIT (Photo from: <http://www.fab9jp.com/>)

This high organizational proximity of the FabLab community brought about a secondary effect that I had never expected at the initial stage of the project. In order to implement a “Poverty Reduction Project by Building-up the Innovation Environment Using FabLab” in Bohol, our team had to visit and make a presentation so many times at the DTI, DOST, JICA and BISU, both at their central/regional offices and Bohol branch offices.

Innovation-led economic development and digital fabrication were new concepts in the Philippines. Presentation to the key players at those stakeholder institutions was essential in securing budget allocation for the project.

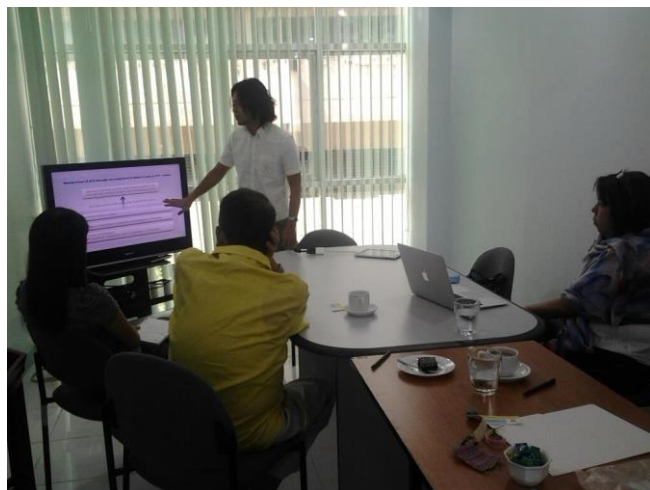


Figure 26: The Author giving a presentation to secure budget allocation for the project at DOST’s local office

While they were preparing the presentation, my fellow DTI staffs were getting so nervous. They were worried about the worst-case scenario that they could not answer if the

audience asked them technical questions on innovation and digital fabrication. They first wanted me to accompany them or if I was not available, they even wanted to postpone the presentation. They were so slow at the initial stage of the project.

But as they repeated the presentation many times, they have learned how to respond to those technical questions. They said, "I don't have enough knowledge about technical aspects, but engineers in the FabLab network could answer your question. If you wait for a while, I can get back to you with an answer." And, "We can overcome the maintenance issues as we can ask for help or advice from the FabLab community."

The more experience they had, the less frequently I had to accompany them to presentations. That helped us to accelerate our project preparation. If I had been the only DTI staff who could make an effective presentation at this initial stage, we would not have undergone such a number of presentations on so many different occasions. It was due to the organizational proximity of the FabLab community that the DTI staff became confident enough to be ready for any kinds of questions.

3-5-4. Second Stage: Preparing for Project Launch

When we could see there was hope for winning the budget, the high fever about the FabLab project cooled down to normal at the DTI-Bohol by late May 2013. I had been thinking that the next step would be just calmly proceeding with preparation, concentrating on the paperwork. However, Brian, officer in-charge for the new project, seemed at a loss, failing to start any concrete action including the one I had asked him to do.

That was quite natural. Brian knew the outline of FabLab, *contextualized innovation*, and essential package of hardware and materials, but he had learnt it from me or from information available on the Internet, and had never visited a FabLab, or seen any digital fabrication machine there. Since he didn't have hands-on experience with the hardware, he didn't seem to have full understanding of FabLab, *contextualized innovation*, and the essential package.

For example, he was at a loss what to start with and how to proceed even in the shortlisting of laser cutters to be procured for our new FabLab. A laser cutter had been familiar to me since I was a university student. Also I used to be engaged in prototyping as a product designer, frequently operating a CNC milling machine. Even though I had never visited a FabLab either, I had thought the task would be just simply picking a few digital fabrication machines from a catalogue. Brian's response taught me that there is a huge perception gap between the people who had touched and operated the machines before, and those who had never seen any digital tools.

What could we do to break through this deadlock? I consulted with a Senior Representative at the JICA Philippines office who had been my great mentor since my first day in the Philippines. He kindly advised me to give them a FabLab experience in the neighboring country. With the help of the JICA network, I identified HonFabLab in

Jogjakarta city, Indonesia as our place to visit. I contacted the Director of HonFabLab. Briefing him about our background and constraints, I asked him to receive four visitors from Bohol. He kindly accepted my request, saying "It's good to have a new FabLab friend in our neighborhood." In late June 2013, four members visited HonFabLab for a training session for 3.5 days. The participants were Brian from DTI, the Provincial Director for DOST, the Campus Director of BISU, and myself.

There is an inventory of hardware and materials to be deployed in a FabLab. It includes at a minimum six basic items: laser cutter; large CNC milling machine; mini CNC milling machine; electronics workbench to make circuits with a soldering iron, DC power source, test equipment; a vinyl cutter; and Internet access and a video-conferencing facility (FABWIKI 2015). HonFabLab had all these six items, and we could learn efficiently how to operate them. The Fab Director and Fab Manager gave us lectures on the management of FabLab, which was followed by discussions on how to manage a new FabLab in the Philippines.



Figure 27: Training at HonFabLab in Indonesia

The participants were confident in their knowledge after all the programs in Indonesia. Brian said, "Now it is all clear. There is nothing I don't know." This is good evidence of *organizational proximity* functioning as key fundamental element for successful project implementation.

There was another episode of high *organizational proximity* during the project implementation with regards to the relation with the neighboring FabLab. The Manager of the HonFabLab kindly expressed his willingness to cooperate with the FabLab Bohol. He said, "In case something is wrong with the hardware, you can reach me on skype and discuss how to fix it. If you need materials unavailable in the Philippines, I can make the shipment from Indonesia." He also suggested, "Let's think about a collaboration project between the two FabLabs, and campaign for the makers' movement in Southeast Asia."

Brian responded to this suggestion by requesting the HonFabLab to have a brotherly relationship with the FabLab Bohol. As a result, they took a formal pledge of brotherhood with each other.



Figure 28: Member of the HonFabLab and the FabLab Bohol having a brotherly relationship

When he was back in the office, Brian hosted a debriefing session and referred to the pledge with the HonFabLab, saying, "We are connected to the FabLab network. Whenever we have problems, we can move on with the support from the network."

Since this observation visit, Brian has come to show strong leadership in the implementation of the project. He became very active, making full use of connectivity to the FabLab network. One day he said to me, "The laser cutter in the HonFabLab was made in China. Don't you think that it easily breaks down? If you have no idea, I will ask them directly." This doesn't mean that Brian then had enough knowledge on laser cutters. As he felt strong psychological proximity to the FabLab network, however, he came to show strong ownership on the project.

A similar event took place in December 2013. We had identified Edward, an instructor at the Faculty of Industrial Design, BISU, as potential candidate for FabLab manager. But one day, he suddenly exclaimed, "I am not capable of becoming a manager for such a high-tech lab. Please find someone else." I tried to persuade him by saying that the digital fabrication tools were not so difficult to handle. The bottom line is that you are able to design products digitally, using 2-D and 3-D drawing software such as Adobe Illustrator and AutoCAD. That's what you have been teaching your students at university, isn't it? You don't need knowledge and skills on computer-assisted engineering. Even so, he never turned positive.

I contacted the FabLab Japan Network and made arrangements for Edward, his supervisor and myself to fly to Japan for a four-day training course on the use of lab equipment at the Super FabLab of the Keio University, as well as to attend lectures on lab management at the Fab Space at the Tama Art University, and the privately-run FabLab Kamakura. This was in January 2014.

Just like Brian's experience with the HonFabLab, Edward received a warm welcome from the FabLab Japan Network members. The Super FabLab members at the Keio University agreed to be the elder brother, and promised to advise them via skype on whatever questions might come up. Each of the labs expressed that they were ready to support our new lab.



Figure 29: Training at the Keio University

Edward has been corresponding with his counterparts in the Keio University and the FabLab Kamakura since he came back to the Philippines. He was empowered by the human network and determined to assume responsibility for the management of the new FabLab. He has come to undertake presentations on the outline of the lab as representative of the FabLab Bohol. He says, "Even though I am just a designer, it doesn't matter. We are part of the FabLab network and we could deal with any problems with the help of the network members."

As these stories of Brian and Edward show, *organizational proximity* in the rural areas of developing countries can be achieved through inter-local connectivity based on the cohesive network of FabLabs. Also, this connectivity between remote local communities is enabled by the Internet access via videoconference, skype and email. Thus organizational proximity works as *inter-local proximity* achieved by the Internet access, and it could be the prerequisite for successful project implementation.

3-5-5. Final Stage: the FabLab Asia Network Conference

As described earlier, *organizational proximity* based on the FabLab networks played a key role in the earlier stage of activities for the set-up of the FabLab Bohol. With regards to proximity, however, we should also highlight *temporary geographical proximity* as key element leading to larger empowerment and impact on the local community. In order to describe the role played by temporary geographical proximity, this section discusses FAN1, the 1st International Conference of the FabLab Asia Network. This was a regional conference for Asia, held for six days in early May 2014, in the island of Bohol. What kind of empowerment did this event bring to the local community?

With the FabLab Bohol as a main site, FAN1 consisted of conferences at three different sites and field work on the island. The FabLab Asia Network and DTI were the main organizers, and it was cohosted by DOST, BISU, JICA and Keio University, Japan. The Province of Bohol, City of Tagbilaran, GIZ, NicoNico Gakkai β, hardware suppliers in the Philippines, craftsmen's cooperatives and designers' cooperatives in the Central Visayas region also supported the event. It became the "largest conference in Bohol's history" in Brian's words.



Figure 30: Banner advertisements put up all over Tagbilaran city before and after FANI

Nominated as host and chief organizer of the event, I set the key message of FANI as "Weave Asian Fabbers!!", aiming at building a Fabbers' community like the strong fabric woven of FabLab operators, users and digital fabricators in Asia. But the hidden agenda for the catch copy was to strengthen the proximity between the Province of Bohol, the FabLab Bohol and the FabLab network, to promote innovations for economic development in Bohol.

There were participants from Japan, Korea, Taiwan, the Philippines, India, Indonesia, Timor-Leste and Israel. The launching event and opening ceremony gathered more than 200 people while the plenary sessions mobilized 150 people. International participants were operators of FabLabs, Lab users, and other designers' and makers' organizations. Participants from inside the Philippines included university/college professors and lecturers from Manila, Cebu and Bohol, officials and technicians from central ministries or local governments, craft producers, designers' and craftsmen's cooperatives, and students of engineering or design.

FANI offered an opportunity for each Lab representative to make an introductory presentation. It also organized a competition on product design to address the issue of "disasters and reconstruction" as cross-cutting issue across the whole Asian region. The design competition lasted six days, and participants were divided into a few groups and engaged in joint work to develop new products. This facilitated communication among the participants and as the program came close to the end, even the local participants from DTI, DOST and BISU came to talk over their product design with the foreign participants as if they were old friends.

Besides these formal conference events, I often witnessed the local participants showing their proposals or products and consulting with the international Fabbers. They even proceeded to joint work to make a prototype.



Figure 31: Participants from local areas showing to fabbers in other countries their new products and prototypes

Digital fabrication hardware for FabLab is computer-assisted and it requires a certain level of knowledge and skills with computers. So there had been some concerns about the number of potential users who could come and operate the machines at the lab. However, because the local participants were given an opportunity to interact with the knowledgeable world Fabbers, and touch digital fabrication equipment with their help, they learned that even the latest machines had high operability and were not difficult to operate, and that the members of the world FabLab network were so friendly and supportive that they could learn from them anytime they wanted. The earlier concerns were cleared. The *temporary proximity* embodied by FANI has empowered the FabLab Bohol and the project, facilitating education for local users.



Figure 32: Participants from Japan lecturing on programmable electronic circuit



Figure 33: Participants from Indonesia lecturing on large CNC machine

In order to discuss the impact of *temporary geographical proximity* on the creation of *contextualized innovation*, it is better to refer to the innovations presented in the final

session of the design competition. Those innovations were the ones that could be introduced to the recovery and reconstruction phases after disasters. Each team collaborated with the local participants and created 16 innovations which were unique and specific to the local contexts. They included: chairs made of fibers of banana trunks broken down by typhoons; trays for distributing foods at shelters; and dome shelters with no supporting pillars.

Chairs made of banana fibers had a sequel. The Mayor of Tagbilaran and his administrative staff were deeply impressed by the chairs at FAN1 and agreed to extend financial and technical support from their city to develop them further to practical use. The project for popularizing banana chair production was designed as supplement to a project for recycling plastics. Our project had worked on the measures to reprocess plastic bags, and had developed a micro facility later jointly with the FabLab Kannai, Yokohama, Japan. Previously, recycling had been only possible with a large reprocessing plant. But the introduction of micro or small facilities would succeed in localizing reprocessing and recycling plastics.

With these facilities, we could also fabricate new materials from locally available banana fibers. The new banana chair project was aimed at *contextualized innovation* for strengthening production-consumption linkage inside the local community. The City of Tagbilaran is planning to install fifteen micro facilities in each of their fifteen districts.



Figure 34: Chairs made of fibers of banana trunks broken down by typhoons and recycling plastics

Research and development on the micro and small reprocessing facilities is on-going between the FabLabs in Bohol and Kannai. The staff of the FabLab Kannai participated in the dissemination workshops in Bohol and explained the operation and maintenance of the new facilities.



Figure 35: Micro recycling facility developed jointly by FabLab Kannai and FabLab Bohol

FAN1 also facilitated another case of *contextualized innovation*, aimed at low-cost construction of public buildings, combining Asian traditional joint structure and digital fabrication technology. The designing of the buildings was first initiated at the Keio University, who proposed a new project to apply this new design to new building construction via the FabLab Bohol, as their response to the earthquake disaster which hit Bohol in October 2013. Their proposal drew attention from the officials of the Provincial Government of Bohol, and the Keio University reached an agreement to cooperate in the construction.



Figure 36: Outside (Upper) and Inside (Lower) views of the low-cost construction of public office buildings built

with digital fabrication facilities designed by the Keio University

These projects on banana chairs and low-cost building construction were both identified and prepared only because the officials of the province and municipal governments had attended the FAN1, and interacted with the world Fabbers at the FabLab Bohol. Both the FAN1 and the FabLab Bohol provided a platform for different ideas, and the opportunities to meet to bring about innovations. These cases show that even *temporary geographical proximity* could play an important role in *contextualized innovation*.

In these cases, we can see that *temporary geographical proximity* worked as *inter-local proximity* between the FabLab Bohol and the FabLab Kannai and the Keio University, and formed a strong driving force in the project. It should also be noted that, as observable here, such temporary geographical proximity might work as inter-local proximity, and thereby facilitate *contextualized innovation*. For most of the international participants from developed areas like Japan, Taiwan, Korea and Israel, it was the first-ever exposure to the atmosphere of developing countries. They were attracted by the environment surrounding the FabLab Bohol, and said it appealed to their creativity.

They were usually playing the role of creating *contextualized innovations* as FabLab managers, to cope with the problems specific to each local community. However, in most cases, they were having a hard time to identify local problems to be solved in developed countries. They rarely brought about innovations that would offer a real solution to the problems of local economy and community. One Fabber who participated in the FAN1 from Japan excitedly said, "I am so jealous that you could stay here much longer." To the Fabbers of developed countries, the local settings in developing countries looked like a gold mine of contextualized innovations.

The above-mentioned design competition seemed to have stimulated their enthusiasm to create new products that would address the issue of recovery and reconstruction after earthquake disaster. If the subject had been "global innovation to beat Silicon Valley," they would not have brought about sixteen such unique innovations.

According to the past discussions on *temporary geographical proximity*, we focused on a few advantages to make innovations: whether that innovation was more relevant to objectives and needs than others, and whether it was more flexible than others. But through my experience with the FAN1, I came to understand that temporary geographical proximity in developing countries might contribute more effectively to innovations through the empowerment of the innovators from developed countries. This secondary effect on innovations indicates that there is an alternative channel to create *contextualized innovations*.

3-5-6. The Use of FabLab

Before I describe how the FabLab Bohol has been used since the FAN1, and what kind of innovations have been created so far, I review the activities of the DTI-Bohol and myself as one of the local actors. This project was first

initiated by the suggestion I made as an international volunteer, and it started from scratch. There were very few precedents of international donors investing in digital fabrication facilities. I couldn't find any success story or model case in the literature.

The management of the project was assumed by the team from the DTI-Bohol, comprised mainly of Natalia (Provincial Director), Marcia (Division chief), Brian, and me. We implemented the project through trial and error. The key driving force for the successful implementation of the project was the enthusiasm of the stakeholders involved. Besides the core team, a few more DTI staff devoted their time to the FabLab, in some cases on a voluntary basis. I bore the travel expenses for Edward to visit Japan. Brian worked hard to negotiate with influential people in the constituency for the success of the first international conference, the largest in Bohol history. Natalia tried every possible channel to invite President Benigno Aquino III to the FAN1.

The strong ownership and dedicated efforts by each of the local actors were praised as "incredible" by the officials of the JICA Philippines office, and the FabLab Asia Network. Unless these local actors had taken such strong ownership during the course of project, from the preparatory stage to FAN1, the FabLab Bohol would not have been set up and begun operations.

Their ownership continues to play an important role even after the opening. Natalia identified two prominent local students of design major out of all the participants to the FAN1 and hired them as new staff for the DTI Bohol. They will be working to create innovation in local industries. As it is unusual for central ministries to hire designers, it must have been extremely difficult for small local offices to hire local university graduates as a designer. This is in itself one of the most innovative events in the history of local economic development in the Philippines.

These two young staff have led the increasing sophistication of the package design of local handicrafts and processed food products. They have also facilitated contextualized innovation by producing molds for the mass-production of local foods and soaps.



Figure 37: Package of coconut oil provided for a local firm



Figure 38: Molds for mass-production produced with a 3D printer provided for a local soap firm

Natalia says:

"If we hire designers for innovations, they should be natives of Bohol, and young people. There remain quite a few things for us to learn from the FabLab network. But if they are young, they will not hesitate to ask for advice, and the predecessors would feel free to teach them. Young people are more flexible and open to new ideas".

This clearly shows that Natalia understands the importance of focusing on *contextualized innovation* and achieving proximity, and that she is trying to deal with these factors by promoting the project activities as a key driver. As for the other impacts, the project preparation for recycling plastic wastes was coordinated by Natalia, and the low-cost building construction was launched by the initiative taken by Brian. They are among the few cases of their dedicated activities contributing to the creation of *contextualized innovations*.

If I may add one more symbolic case, Natalia once noticed one activity initiated by a local student. He was studying industrial design at the BISU and participated in the FAN1. He designed a coin case made of coconut skin. This material used to be considered waste only for open dumping. But he attached new value to the waste, and started the production with the local people who lost their jobs due to the earthquake disaster. Natalia noticed his activity and introduced it to the city government of Tagbilaran as good practice enabled by the FabLab. That led to additional financing from the municipal financing facility for poverty reduction for scaling up the production. Natalia's proactive behavior motivated university students who were aiming to become local innovators, as well as vitalizing local youth who were looking for an opportunity for business start-ups.



Figure 39: Activity, started by locals, of the production of coin cases by the local people who lost their jobs due to the earthquake disaster

This is a brilliant reflection on the actors, and has the potential to drive many college students and local youth to rise up as a creative class in Bohol, and further stimulate the innovative environment for economic development.

The DTI-Bohol has also come to host a digital fabrication workshop every week at the FabLab. It is open to local citizens, from six-year-old children to sixty-year-old retired people. This workshop has been functioning as a platform for state-wide *contextualized innovations* and clusters of the creative class. Out of the workshop participants in the early years, one local youth came to look for a new business start-up to helping others with 3-D printing. Another young entrepreneur started seeking a business opportunity with a smartphone app that controls lighting systems.



Figure 40: The product of an entrepreneur aiming at starting a business in controllable lightning system with a smartphone app

Reviewing the earlier impacts that the FabLab has been bringing to the local community, the active body is indispensable driver for the creation of an enabling environment for FabLab-led innovations.

4. Conclusions

Since the opening of the FabLab Bohol, we have seen the formation of an innovation cluster and the emergence of a creative class. This was seen during the implementation of the Project for "Poverty Reduction by Building-up Innovation Environment Using FabLab". The economic promotion initiated by the DTI has enabled new innovations to emerge from among local MSMEs, with the help of

digital fabrication machines available at the FabLab Bohol. In addition, it has enabled quite a number of local business start-ups.

Tagbilaran is a small city with population of approximately 100,000. The case of the FabLab Bohol indicates that innovation-led economic development is applicable not only to major cities, but is also important to small cities in developing countries. This can be achieved by creating an enabling environment for innovations with FabLabs.

In the creation of a FabLab-based enabling environment, the initial stage of concept development, project design, and the launch, is helped in critical way by a focus on *contextualized innovation*, especially in team building and the approach to each stakeholder. At the second stage of the case study project, *organizational proximity* gained more relevance among the different types of proximity. It raised psychological proximity, and contributed to the empowerment of the staff at the implementing agency.

Then at the final stage until the launching of the FabLab Bohol, *temporary geographical proximity* raised by the hosting of the FAN1 directly contributed to the creation of *contextualized innovations* and caused a huge impact. We found that *organizational proximity* and temporary proximity were combined and were functioning as *inter-local proximity* through the FabLab network.

As we advanced from the initial phase of the project to the phase of promoting economic activities based on the FabLab, the ownership of local actors and their voluntary but very energetic activities became a strong and sustainable driver for the project. This summary implies that if we could take an approach that fully addresses all the three elements of *contextualized innovation*, *proximity*, and *active body*, the use of innovations for economic development would be effective in developing countries, especially in rural areas.

What the Province of Bohol has achieved in the project was to break down the constraints stemming from the low education standard of local entrepreneurs, and the Province's geographical disadvantage in logistics. These had been thought to be unbreakable for a long time.

The project was also a departure from the conventional approach of development cooperation, as it aimed at enhancing the entire technical capacity of the local people as a whole by providing training programs step-by-step. Instead, they decided to take a new approach to economic development. That is, to target a few educated people, provide innovator education, and hence promote industrial development with innovations.

No matter whether it is Bohol or any other rural area in developing countries, development cooperation projects have usually faced a huge educational gap between the project counterparts and other local people due to barriers arising from different languages, manners and customs, and cultures. Similarly, disadvantages in logistics have harmed the geographically remote areas of small island states, hills and deserts. They have been placed in a cost disadvantage with respect to neighboring better-placed cities. In such situations, even if technical assistance seems to succeed in smoothly transferring technical knowledge to local

counterparts, this might not be further disseminated to local people, resulting in underachievement in terms of impacts on the local economy. This is what we call a pitfall of aid programs, and the risk of being caught in the pitfall has long been affecting development cooperation. The case of Bohol has shown that in the new approach to development cooperation that fully utilizes *contextualized innovations* in rural areas, the risk of being caught in the pitfall can be hedged in one way or another.

Similar stories of innovation-led economic development in rural areas in developing countries have not been found in the past literature. The case of Bohol implies as a possibility the applicability of a similar approach to the economic development in almost any rural area. However, it is still a possibility and we need to verify the impacts by further scrutiny. However, the findings reported here may have the potential to dramatically change the approach to economic development and poverty reduction in the rural area of developing countries. International donors should exploit this potential, and link the new approach to their development cooperation programs. That could enhance program efficiency and further accelerate the transformation of such areas. In order to make this happen, we need further research on innovation-led economic development.

5. Challenges and Prospects for the Future

In this paper, I have argued that the application of *contextualized innovation* to economic development in developing countries requires FabLab-enabled access to technology, enhanced *proximity* to be realized by social networks, and an *active body* who could utilize the access and proximity. But my argument is still based on just one case, my observations in Bohol, and further research is needed to develop a new methodology applicable to other areas. This model is based on the above three concepts as a requirement. But it is still subject to further scrutiny as to whether we should add a few more requirements to make them sufficient conditions.

For example, it would be beneficial to our journey towards the sufficient condition if we could develop a methodology for project appraisal in development cooperation: what is the *contextualized innovation* that the project target area wants; and what the local economy would look like as the result of the innovations. In addition, development cooperation could be more effective if we develop a guidebook for business start-ups, in which readers could find answers to their questions, such as what are the machine items required for investment in a FabLab besides the six basic items mentioned above.

Also, with regards to the project implementation, it may be a key requirement that we have better understanding on the *active body* who could promote the project and come up with the answers to the questions on the number of required actors and the role for each actor to play. In the case of Bohol, I was involved in the project as one actor, and played an important role as a driver for successful project implementation. Hosono et al (2010) referred to *external actors* as an essential element for capacity development. I worked as an external actor in Bohol. Even so, we still need a better understanding of what essential elements external

actors should have. If we could undertake a thorough literature survey and find an ideal solution on the combination of key actors, development cooperation could be more effective.

Besides the discussions on *active body*, methodology for education and training for local actors and innovators should be another subject for further research. In Bohol, we fully utilized different types of proximity, and introduced Project-Based Learning (PBL) to facilitate the learning process of the project staffs and the beneficiary local innovators. If we could modularize the learning program to be adaptable to any other area, this could also enhance the effectiveness of development cooperation.

Another subject for further research would be on the use of *open-source devices* for creating *contextualized innovation* at the FabLab. The use of open-source devices, such as the programmable control circuit *Arduino*, is becoming a common practice in FabLab-based contextualized innovation. In the case of the above-mentioned customized glue gun to reprocess plastic wastes into strings, Arduino was installed as the Thermostat. The use of low-cost open-source devices like Arduino has made it unnecessary to research and develop complicated controlled circuits and specialized IC circuit boards. It has replaced high-tech, high-cost R&D elements with ready-made technology, and dramatically lowers the difficulty and costs of creating innovations.

Arduino clearly indicates that the use of open-source devices is an essential element for *contextualized innovation*. However, the impact of open-source devices on development has not been paid much attention in past research. How can open-source devices contribute to contextualized innovation and development cooperation? What kinds of open-source devices are wanted, and can be developed in the future? These questions should be further explored as a future research agenda.

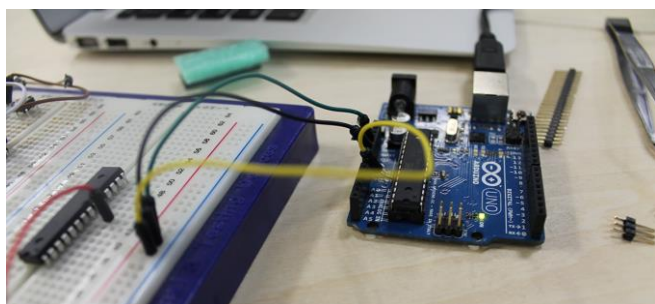


Figure 41: Producing electronic circuits as a test with Arduino

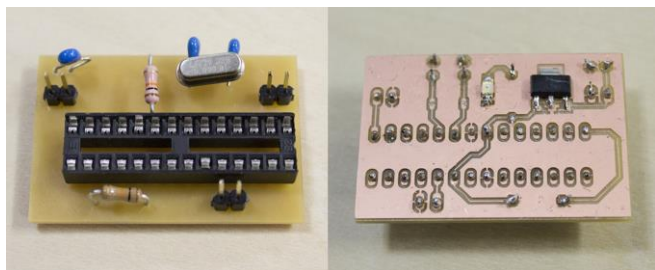


Figure 42: Arduino substrate produced as a test with a small CNC machine in FabLab

Logistical barriers impeding low-cost procurement of materials for innovation is still an issue we cannot overlook. The FabLab users in the underdeveloped areas like Bohol are poor people who are making a living on no more than USD 1.25 a day. They cannot afford to purchase even simple materials like thin wooden boards and make prototypes. That inhibits innovation activities.

That leads to another research agenda on the use of locally procurable materials, including recycling, for digital fabrication, and on the financing mechanism of identifying and mobilizing local venture capitalists as key stakeholders who invest in contextualized innovations in rural areas.

Development cooperation aiming at the FabLab-based innovation has still been at an initial stage, and we still have a lot to do to standardize the new approach. However, as a new concept of *inclusive partnership* emerges at various international fora such as the Global Partnership for Effective Development Cooperation (GPEDC), and the Post-2015 Development Agenda, the FabLab-based economic development model has been becoming more relevant to sustainable development because of its potential to diversify the channels for development cooperation. The FabLab Asia Network International Conference (FAN1) has repeatedly referred to *co-creation* as a key message, and the second conference (FAN2), held in Taiwan in May 2015, also facilitated collaboration between the participants from developed and developing countries. As it serves the national interests of both aid providers and receivers, the FabLab-based development cooperation model has the potential to emerge as a new and innovative aid modality.

This is a departure from traditional North-South development cooperation. It leads to a new type of development cooperation for the providers and recipients to work towards development as equal partners. Amartya Sen and UNDP introduced a new concept of *human development* in the 1990s, as an alternative to the conventional approach to development that required huge capital investment in infrastructure. This concept focused on the capabilities of the humans, and aimed at facilitating the indigenous process of human capacity enhancement. Similarly, FabLabs have the potential to bring about a revolutionary change in the global trend in the thinking of development cooperation.

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