Assessing technology incubator programs in the science park:
the good, the bad and the ugly

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Abstract

This paper is written to provide an assessment framework of technology incubators in the science park. Based on the past studies, nine sets of criteria are identified and incorporated in the assessment framework: advantages from pooling resources, sharing resources, consulting services, positive effect from higher public image, networking advantages, clustering effect, geographic proximity, cost subsidies and funding support. Using business development data of six technology start-ups in the Hong Kong Science Park, the framework is then applied to examine the effectiveness of incubators from the perspective of venture creation and development process. It is found that the benefits required by technology founders at different stages of development are varied and therefore, the general merits that are claimed by incubators as useful to technology start-ups are debatable. In addition, the analysis of development process of six cases, particularly in the interaction with incubator, reveals some good, bad and ugly things about the incubator program. To meet the needs of technology firms during their stages of development, the paper is concluded with the recommendation that incubators’ services and support should be prioritised in accordance with the development process of the technology firms.

Keywords: Science park; Technology start-ups; Incubator

1. Introduction

One of the objectives of establishing the science park in most countries is to provide an infrastructure of technical, logistic and administrative support that a young firm needs in the process of struggling to gain a foothold in a competitive market (Guy, 1996). It is particularly important to those industrialised economies whereby small high tech firms are encouraged in their start up stage. Therefore, most science parks would accommodate incubator programs leading to the development of technology based firms. It is also widely believed that business incubator can provide a nurturing environment for new business start-up and therefore, leading to later development of growth-oriented firms (Cooper, 1985).

However, the benefits and costs associated with such programs are subject to debate in theory and practice. Studies on the approaches to assessing incubator programs are varied but no single framework is concluded as effective (Mian, 1991). One study method is to compare the performance indicators between incubators within a park and off-incubator firms (Colombo and Delmastro, 2002). In the study of perceived benefits with respect to property needs of independent technology-based firms located on managed science parks and non-managed parks, Westhead and Bastone (1998, 1999) used the similar assessment method. Sherman (1999) conducted a mailed survey to examine the effectiveness of business incubation programs by using macroeconomic analysis, questionnaire and telephone interviews of firm managers, community stakeholders and incubator managers. The performance indicators are related only to job creation, survival and growth rate of start-up firms, the report and the comment from incubator managers and sponsors, which are potentially biased because the survey is of self-reported type. After reviewing and summarising the salient features of four selected approaches to university technology business incubator (UTBI), i.e. goal approach, system resource approach, stakeholder approach and internal process approach, Mian (1997) proposed an integrated framework for the UTBI performance assessment. In this model, three sets of variables are identified based on the related literature: (a) performance outcomes, (b) management policies and their effectiveness, and (c) services and their value-added. A comparative evaluation approach is then used in applying
such model to analyse the comparative characteristics of different UTBI programs in the States. In brief, the framework has been successfully implemented and supported with four exploratory case applications. However, since the model is developed to assess various UTBI programs across the board it is not appropriate to be used in the assessment of a particular incubation program, particularly from the standpoint of the users, i.e. the technology firms within the incubator. A framework that displays a consistent set of criteria for the tenant incubators to be based in the assessment process is more desirable. Moreover, it is also noted that the needs of tenant incubators at different stages of development are also varied. Hence, if the purpose is to assess whether or not a particular incubator program is of value to tenant incubators at different stages of business development, the comparative evaluative approach should be modified so that the effects on technology firms throughout the venture development path could be captured. The paper is therefore, intended to explain how an alternative framework is developed to assess the performance of a particular incubation program from the perspective of the technology firms and describe how the model is applied with six multiple cases joining the incubation program at different period of time. All cases in the study are selected from tenant incubators joining the incubation program under the Hong Kong Science and Technology Park Corporation.

In Section 2, we shall explain how the assessment framework is developed. It is then followed by a brief description of the methods of data collection from tenant incubators. Six case applications are reported in Section 3. Detailed illustration of the development path of each tenant incubator is provided with an attempt to identify the characteristics of incubator program with relation to the venture development process. In Section 5, an analysis on the assessment results is explained.

2. Developing assessment framework for incubators

Since most incubation programs are launched within the framework of ‘Science Park’, we need to explain what science park mean in our study context. The terms, such as science park, research park, technology park, business park and innovation centre, etc. have been used interchangeably in past studies (Currie, 1985; Eul, 1985; Monck et al., 1988). In this study, we define Science Park as an area where allows agglomeration of technological activities, leading to positive externality benefits to individual firms located on the park (Westhead et al., 2000). Practically speaking, according to International Association of Science Parks, a science park is a property based initiative which:

- has formal and operational links with a university or other higher education institution or major centre of research;
- is designed to encourage the formation and growth of knowledge-based businesses and other organisations normally resident on site;
- has a management function which is actively engaged in the transfer of technology and business skills to the organisations on site.

With reference to the above practical definition, one of the important functions of Science Park is to encourage and facilitate the formation and growth of knowledge-based businesses, which is usually categorised as ‘incubator’. The main role of incubator is therefore, to assist entrepreneurs with business start-ups and development, and with possible involvement of the public, private and non-profit sectors (OECD, 1999). In particular, most incubators provide value-added services and contributions for new technology-based firms, rather than traditional business start-ups (Mian, 1996). In this paper, we focus our study in technology incubator within the Science Park and the analysis of target cases in assessing the performance of incubator also falls into technology based firms.

In order to capture the negative and positive effects of incubation programme on the development process of technology firms so as to form the basis of developing the assessment model, we would briefly review the underlying theories that used to explain why incubation programme would be of merit (or demerit) to young technology based firms.

The structural theory, for example, supports the assertion that incubates can gain access to structural elements provided by the science park, e.g. infrastructure and supporting facilities, and therefore synergy between and among high tech firms can be generated (Maillat, 1995; Phillimore, 1999). These services can be generally divided into basic structural support and technology-specific structural support. Typical examples of basic structural support include shared office services, business assistance, rental breaks, business networking, access to capital, legal and accounting aid, and advice on management practices (Mian, 1997; Smilor, 1987; Hisrich and Smilor, 1988; Harwit, 2002). On the other hand, technology-related structural support features the following services: laboratory and workshop facilities (Brown, 1985; Mian, 1997), mainframe computers (Hisrich and Smilor, 1988), research and development activities (Doutriaux, 1987), technology transfer programmes (Smillor, 1987) and advice on intellectual property (OECD, 1999).

Moreover, technology firms can also derive externalities from the central pooling of resources in the science park,
which results in lower overhead costs as well as higher efficiency. Organising support activities for the firms in the science park is only possible and desirable when resources are pooled together and the number of participants reaches the critical mass. Examples of this kind include the provision of staff training and development, organising marketing events, networking events, informal social gathering, and press conference, etc.

The cluster theory extends the argument further that high tech firms of similar characteristics and within the value chain would be attracted to cluster together in the science park and therefore, gradually emerge as a strong allied group complementary to each other. Yet another supporting argument can be viewed from the network perspective. It is found that firms located in science parks are more likely to have links with local universities (Colombo and Delmastro, 2002; Lofsten and Lindelof, 2001) and develop some kinds of organisational relationship with each other because of geographical proximity (Jou and Chen, 2001). The agglomeration effect gives rise to the formation of an innovative milieu (Aydalot and Keeble, 1988). As a result, not only were synergic links created between university (research centre) and technology firms located in a science park, but also the synergies were developed among firms (Phillimore, 1999). Knowledge sharing of technology firms in the same field is another advantage that each firm in the incubator could gain. It is also noted that knowledge dissemination is faster among firms clustered in a location like the science park. In case of technology firms engaging in various part of the value chain, they will get better chance of either upstream or downstream alliance because science park provides them with a good matching platform to work together.

However, critics argued, on the contrary, that science parks are unlikely to produce synergies of any significant kind (MacDonald, 1987; Massey et al., 1992; Castells and Hall, 1994). It was pointed out that the interaction of incubator companies, i.e. technology firms, with the local university and other on-park companies was rather limited (Bakouros et al., 2002). They were usually restricted in commercial transactions and social interaction. Quintas et al. (1992) noted that geographical proximity between a university and a science park only contributed a little in promoting technology transfer and therefore, proximity is not a driving force for university-science park (Vedovello, 1997). According to Westhead and Storey (1995), the link between universities and science parks was weak. Some even commented that science parks were considered as ‘high tech fantasies’ (Massey et al., 1992).

The above brief review of literature offers no conclusive hint on the value of establishing science parks as an appropriate vehicle to help promote and facilitate the development of technology firms within the incubation programmes. Arguments from either side, for or against, seem to indicate that its merit depends on the context of establishment and the implementation process of the incubator programmes. In order to assess its effectiveness, we develop the following framework comprising a number of criteria based on the literature and then test its applicability with reference to six incubating companies in Hong Kong Science Park. The Table 1 below shows the summary of the assessment framework.

### 3. Application of the assessment framework

#### 3.1. Method of data collection

To test how the above assessment framework is applied in technology incubator, we conducted a multiple case study research in Hong Kong and collected data from incubating companies which joined the incubator programme at different periods of time. Based on the retrospective in-depth interviews with the founders/entrepreneurs, we trace their development path with particular reference to their evaluation on the incubator programme based on the assessment criteria that are developed in the previous section. The use of case study approach for incubator evaluation has been confirmed effective and appropriate in past studies (Campbell et al., 1988; Mian, 1997). In order to make the assessment more representative, we carefully select the target technology firms in our study by: (a) the duration of joining the incubation programme (ranging from 5 months to 3 years graduating from the programme and to 5 years after graduation), (b) the nature of business (from IT/IS to electronics to environmental), (c) the location of

### Table 1

| Assessment framework for technology incubators |
|---|---|
| **Assessment criteria** | **Examples of specific indicators** |
| Pooling resources | Organising staff training and development activities, marketing events, exhibitions, press conference |
| Sharing resources | Sharing laboratory facilities, office equipment, testing equipment, administrative support (e.g. meeting room, library, reception area) |
| Consulting/counselling services | Provision of legal, accounting, business, technical advice at low cost (or free-of-charge) |
| Public image | Image of the Science Park/University/Government |
| Networking | Access to clients/suppliers/subcontractors, partnership opportunity with other technology firms within the incubator, knowledge sharing/dissemination |
| Clustering | Development of a pool of skill labour, externalities from logistics arrangement, externalities from supporting network (e.g. emergence of complementary industry) |
| Geographic proximity | Access to market, research centre, universities |
| Costing | Rental subsidies, subsidies on telecom/computer network access, other subsidies related to cost reduction |
| Funding | Access to venture capital (VC) funding, banking facilities, other funding sources |
the firms (within university campus vs. on-park). The background of the target tenant firms are summarised in Table 2.

In-depth interviews are then conducted, tape recorded and transcribed verbatim. The cases are then written to reflect the actual development path and interpretations are made with particular relevance to the assessment of incubators. It is hoped that the process analysis (Langley, 1999) could provide useful reference as to how the assessment framework is applied and how effective incubation programme would contribute to the development and growth of technology start-ups.

3.2. Multiple cases analysis

The following section is intended to describe and interpret the development process of six company cases, which have joined the incubation programme and gone through different stages of development. Two have graduated successfully from the programme; two is in the middle of the programme and two are new technology firms. With regard to the nature of business, three are in IT business and one in IS development; another one is in electronics and the new firm is in environmental industry. All belong to technology firms. To capture the effect of location on their development process, they fall into two categories: three of them are in the Science Park while the other three are located within the university campus. The sample is therefore quite representative as it covers technology firms from various background.

3.2.1. Company A: IS-Platform

IS-Platform\(^2\) is a high tech venture developing and selling online education platform for schools. The main business purpose is to help schools automate their teaching programmes and administration work. Mr. Chow is the founder and CEO of the company. He graduated from the Hong Kong University of Science and Technology (UST) in Computing Engineering and at the time of preparing his final year project, he and his study team got the sponsorship from the Hong Kong Education Foundation Fund, which supported the promotion campaign of IT application in school education, IT training for teachers and the production of CD-ROM for schools. The project was further extended to the period when he was pursuing his Master programme in UST.

After completing the Master programme in 1999, Mr. Chow formed a company specialising in IT consulting. However, the company was operated for only 9 months and due to unsatisfactory performance he closed it. The failure business experience does not discourage him to set up another venture to realise his vision of getting things automated and connected. In 2000, he invited two professors and a few classmates from UST to form a project team and apply to join the incubator programme under the Science Park Scheme by the government. Actually, his conscientious business motive was not without reason. First, he is born and brought up in a family of running business. Secondly, he has an ideal to promote people connectivity and work automation in the world. He wants to change the world enabling people to get connected faster by designing some sort of programmes while, when internet is developed, he has a firm belief that more can be achieved than what he originally thinks of. Thirdly, he receives a lot of encouragement and support from two university professors, who later become part of the venture team, providing valuable technical advices on business operation.

In preparing the incubation proposal two business propositions come to his mind: IT application in medical or in education. Because of prior experience in conducting similar education project, he and his project team eventually choose to enter the IT application in education. Application was approved and the company was formally set up in January 2000 at UST campus. At the initial stage, the venture team spends most of the time in product development. They enhance features in existing education platforms, e.g. linguistic, voice recognition, sound compression and wireless technology, which distinguish the company’s IT products from existing vendors and add competitive edge to the company in education technology market.

As no income was generated in the start-up stage, the venture relied completely from the funding provided by the UST innovation fund. At the same time, incubator programme of the Science Park also provides free-lease office in the first year, which is a great help to company start-up because it is extremely difficult to obtain banker’s

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\(^2\) All company names are disguised to protect confidentiality.
financial support without business records. Office environment, including facilities (e.g. office equipment, computer, office furniture, etc.) clerical and secretarial support, is adequate enough to support the efficient operation. Team members are satisfied with the quiet and comfortable environment in the University campus as they can concentrate their effort in product research and development. In addition, the workplace is convenient to be accessible too. When facing technical difficulties in the product development process, Mr. Chow claims that they can consult expertise easily around the campus and most importantly, all valuable advises are free. The technical network can be extended to IT practitioners who have intensive experience in the area. With regards to general consultation, company can also seek help from the R and D Corporation of UST. Their services cover not only technical aspects, but also legal advice, accounting and auditing, and marketing and sales. Sometimes, referrals to outside professionals will be arranged. For example, the company has asked the R & D Corporation to help to search an outside lawyer to go through the business contract and the charges are lower than the market rate. With the resources pooled together to service 30 business start-ups in the campus, and with the understanding that these are start-up companies without good financial standing, the professional fees are usually levied at a subsidised level.

Entering the second year of incubator programme, IS-Platform has to pay more effort in pushing the education software products in the market so as to generate sale incomes. According to the policy, company joining incubator programme is no longer entitled to have free lease office but required to pay half of the full fee in the second year. Fortunately, the company’s customer target is school principals, administrators and IT teachers who constantly pay visit to UST and therefore have chance to talk to the company on the adoption of education software products. The exhibition and visit tour organised by the University is extremely useful to the company. Mr. Chow also mentions that the information centre at UST helps them a lot in building up client data base. Hence, without waiting for long, the company starts making profit in the middle of second year and throughout the third year of the incubator programme.

With regards to networking, the company seems not benefited from upstream, downstream or horizontal learning. Even though over 30 companies joining the incubation programme are located in the same building, it is found that companies seldom contact each other. In the whole venturing process, companies’ interaction rarely takes place. Most joint seminars and workshops are either for training or for social function. It is pretty far away from integration, collaboration and shared learning activities. Companies are described as discrete and operations of each company are independent.

Different from other incubating companies, IS-Platform has a shared ownership, in which UST is one of them. After graduating from the incubation programme for 3 years, they have to resolve the issue of whether or not they should continue to stay in the campus. However, the change of status implies that they receive the same treatment as other tenants, i.e. paying the lease at market rate and giving other fees as required. They will enjoy no privilege and subsidy like the one they did before graduating. To facilitate product selling, management of the company prefers to move to the office location near the town centre. The advantage is the enhancement of company high tech image without additional lease cost but moving out of University campus will imply the split up of the ownership between Mr. Chow (and his team) and UST, and as a result, losing all the previous benefits arising from its attachment with University. One alternative that the company is now considering is to move to Hong Kong Tech Centre, one of the constituent units of the Science Park, at Kowloon Tong, where the office is closer to the town centre while at the same time the company maintains its high tech image attaching to the Science Park.

IS-Platform is a successful model of incubator programme under the Hong Kong Science Park project. The 3 years’ programme has gone and it will become an independent company soon. At present, the company enters the right market, develops a strong competitive edge in its software products over its suppliers, grasps substantial benefits from the incubator programme, and expands from a management team of four members to a company of over 12 staff. Sustaining continuing success is a great challenge to Mr. Chow, particularly when it is no longer under the umbrella of the incubator programme.

3.2.2. Company B: Am-Tron

Am-Tron is a high tech venture joining the government incubator programme in August 2002. It starts operation in Hong Kong Technology Centre, one of the three constituting institutions of Science Park. The founder and CEO, Mr. Wan, pursued the PhD degree at the Hong Kong Polytechnic University after completing his Master programme in electronic engineering at Australia. After obtaining the PhD he continued the post doctoral in the same area, i.e. photonics research. At the beginning of 2002, because he just completed the project as required and at the same time, the government invited application for funding on incubator programme, he tried to make a change of his career, i.e. from an academic to a businessman. However, his business idea does not fall exactly into the same research area that he has been doing. Technically speaking, his field is more towards the theoretical side while the business venture that he is planning to do is more on the application of high tech, particularly on the use of precision equipment in the manufacturing process of professional hi-fi for the high end market. He also admits that there is only a little relevance to his previous studies.

Besides the incubator fund, Am-Tron also obtains another research assistant fund, which sponsors
the company to hire a research assistant to perform R & D. So, in view of funding support, Mr Wan said he is extremely satisfied with what the government has done to help the new venture start-up. According to the incubator programme, new venture is exempted from the first year rental. To Am-Tron, this is a great help, especially when the company does not have any earning ability. It also takes time to drive a new market. The rental is slightly below the market in the second and third year of the incubation programme. Other basic expenses, e.g., air-conditioning, water, electricity, etc. are also paid by the Science Park. Supporting facilities, e.g., photocopying, reception area, and meeting room, etc., are shared among tenants.

Mr Wan also stresses that product development and research is the priority in the first year so he and his colleague do not have time to promote the product in the market. In addition, they are also given a fixed lump sum of money to do office renovation and furniture replacement when moving into the office building. In the incubation programme, a 75% salary subsidy is provided to the technology firm like Am-Tron for hiring a university student helper to perform research and development project, which mutually benefits the student as part of the study and the company.

At present, Am-Tron’s office size is around 500 square feet, which is not big enough to perform hardware electronic test. So, Mr Wan has planned to expand in the next 2 years. Only two staff is hired to help at the start but now one more partner would like to join with three new employees in the coming months. All staff is in the technical field performing product development while one will spend time in marketing. Since the product that the company develops is of high precision equipment, specifically tailored for the use of high class hi-fi testing, the market is pretty focused. It is sold at high price and high profit margin. The product needs good support of R & D and design, which is largely conducted in Hong Kong while some machine parts are made in Shenzhen. The final critical process: integration and assembling, is carried out in Hong Kong office. Apart from overall administration of the new venture, Mr Wan constantly identifies commercial applications of the product, analyses clients’ needs and performs product promotion job. At the moment, the company has gained some orders, mostly through Internet promotion.

In the development process, Am-Tron does not gain too much benefit from networking programmes organised by the Technology Centre, e.g., tea party, social meeting, informal contact with other technology start-ups and well-known tenants within the office building, whose products are complementary to Am-Tron. However, Mr Wan says he learns a lot from an outside mentor appointed by the incubator programme. The mentoring system requires the constant contact between the technology firm and the mentor, building good relationship, sharing experience in the business development process, providing advices on solving problems they face during the incubation process. Another benefit that Mr Wan believes to be of great value to the company is various training courses organised by the coordinator of the incubation programme. The staff of Am-Tron, for example, has participated in the courses related to business and law in the past few months. In addition, the company also subcontracts to the Polytechnic University at the early stage of product development in the form of part-time consultancy project as no equipment in the Technology Centre can perform such testing work.

Am-Tron is now in good progress and Mr Wan has great confidence to meet the prescribed milestones towards the end of half year’s review period. Mr Wan appreciates the financial and administrative support of the incubation programme and acknowledges that he might also start up the business without such support but would be more difficult.

3.2.3. Company C: Encument

Encument is a new venture with only half a year’s set up under the incubator programme. Its core business is to provide environmental engineering service and technology with particular reference to water pollution and water treatment business. Under the parent company called Medi-health, Encument is set up in the form of a joint venture with the Hong Kong Polytechnic University, one of the eight universities in Hong Kong, which is well known for its application research and engineering development. The company joins the government incubator programme under Science and Technology Park scheme while its management and control office is located within the campus of the Polytechnic University. By and large, Encument follows the development path of its parent company, Medi-Health, and is engaged in environmental related business. Medi-Health, for example, has been involved in providing environmental products/services to improve the health of people and in one occasion, the company’s CEO meets with a professor in the civil and structural engineering department of the Hong Kong Polytechnic University, who is also interested in the field of environmental engineering, in particular, the water treatment. Both then form a JV to pursue such initiative. At present, a senior staff from Medi-Health is assigned to take up the CEO position of the incubating company and one professor is assigned to represent the University to serve as the partner and chief of the technical office.

Without doubt, the new venture gains substantial cost benefit at the start under the incubator scheme as they pay zero rental for the office at the campus, which is a central location in Hong Kong. The 3 years’ rental subsidies will be of great help to them, particularly when no sales revenue could be generated at the beginning of start-up. In terms of operation and development, Encument also finds it convenient to seek for technical support and advice from professors in the campus, which offer high quality human back up as well as physical facilities at arm’s length distance. Encument also gains marketing benefit from the dispersed incubating model, in which tenants can set up
offices at university campus but at the same time is attached with Science Park. For example, using the office of the University as a meeting point and the place to talk to clients does bring about the image advantage to Encument. The participation of Polytechnic University as a partner in actual operation adds another merit in selling the service as the name itself can increase public confidence.

With regard to administrative support, as only five staff is employed in Encument at the start up stage, office space is not a critical problem. The general office facilities, e.g. photocopying, stationary, function room, meeting room and, etc. is more than good enough to serve the existing purpose. While Encument is the only incubator located in the Polytechnic University campus, the company does not have a reception area to entertain clients. Incubators in other locations, e.g. Hong Kong Technology Centre, are provided with a common reception area that is more appealing to outside guests, clients, suppliers, etc. Furthermore, the company has very little chance to join the central pooling activities, e.g. joint promotion, press conference, public functions, etc. Occasionally, senior staff of the company might participate in some networking events, marketing events and some training seminars organised by the Science Park. At the moment, Encument is not entitled to enjoy the services as prescribed in the aid-package of incubator programme.

Sharing information with other companies in the same industry on technology and product development is one of the essential parts in the venture development process. It is of particular relevance to incubators at the initial stage of development because all incubators are eager to know whether or not there is any parallel or complementary development in technology so that they can avoid duplication of any kind and prevent from waste of resources and time in their development projects. This objective can be achieved if incubators are clustered in the same business area and have opportunity to meet and talk with each others. Unfortunately, in the case of Hong Kong’s incubator programme, the majority focuses on the theme of electronics, IC and software and only two new ventures are found in environment related business. Moreover, they are located in the Technology Centre, which is not close to Encument’s office. The CEO of Encument said that it is a pity that the three incubators in environmental business do not know each other and have no opportunity to share experience and information in the field. They just learn by words-of-mouth that the other two incubators are engaged in environmental business different from Encument, which is more technology-oriented and solution based in dealing with pollution problems.

By far, Encument plans its business development and makes good progress in meeting the milestone as required in the incubation programme. Its success lies on the huge potential market for environmental protection and the company’s advantage of wide network of expertise through technical advisers and university professors within the campus. In addition to financial subsidies in terms of office rentals and other logistic and administrative support, joint venture with Hong Kong Polytechnic University is a great asset to the company’s future development. With regards to the issue of whether or not the university academics will actively play a partnership role in Encument, i.e. becoming academic entrepreneurs, the CEO cannot preclude such a possibility. It is further pointed out that the company might have to be re-located to the Hong Kong Technology Centre or other locations of the Science Park when the existing agreement between Science Park and Hong Kong Polytechnic University expires within the 3 years’ graduation period for incubation programme.

3.2.4. Company D: Sun-Tech

Miss Helen Lai started the company called Sun-Tech in 1997 when she came back from the States with little savings. She graduated at Canada Waterloo and finished his Master in computing in the US. After working 5 years for AT & T in the area of computer programming, she set up a company in the US for 2 years, mainly engaged in system integration projects and software development. In this respect, Helen highly commended that the bidding process in the US was fair and project was awarded with reference to objective criteria, rather than the prestige and size of the company. On the contrary, personal trust in Hong Kong is the major factor for winning government projects. She indicates that the sponsor/client, i.e. the government, simply does not trust such a small tender as her company, particularly in the early stage of incubating programme.

In the start up phase, Sun-Tech joins the incubation programme under the Industrial Technology Centre. The initial capital is just a few thousands Hong Kong dollars. It is a great help to her because the market rental for offices are HK$15 per feet while it is only HK$10 per feet in the incubator programme. Furthermore, the company is provided with internet support, saving up another several thousands. As internet service to her company is necessary in developing software products, the financial benefits on rental of office and internet are extremely helpful according to what Miss Lai said. However, the internet service is not without problem. At that time, she had to share the service with other incubators so the speed is low, which affects adversely the efficiency of software development. After 2 years and before the three years’ period of graduation requirement, Sun-Tech moves out of the Science Park office and stays in an office outside with a lower rent. In other words, the rentals set at the Science Park are not flexible enough (or fast enough) to reflect the market level.

In fact, Sun-Tech completes the 3 years’ incubator programme in 2 years with an award in high tech development. The main reason for early graduation is the company’s excellent achievement in business development and Helen’s determination to move out to other work place with lower rental cost and at the same time, she prefers to stay in an office closer to her living place. Helen said...
the rental at Technology Centre has been raised to HK$15 per square feet at that time while her present office at Sheung Wan near the Central District is only HK$10 per square feet. In addition, many clients are also located in Central District and it will be more convenient for them to come over to talk about business at her office, or vice versa.

However, Helen mentions that she does not regard the administrative and logistic support from the programme as important to her business development. Marketing facilities and exhibition, for example, are not organised to help them out. Joining those functions is a waste of time as most customers who are attracted to come to promotion events consider office decoration, company background and scale as most important. Incubators are just other companies in the street and people usually pass the booth without giving notice in the exhibition. ‘I don’t gain much from it’, concluded Helen. Attending one to two training programmes is the only benefit that she feels might be a little help.

Recognising the importance of networking in new venture development process, Helen has a high hope when joining the incubation programme that she might have a chance to meet other similar software firms in the same field so that learning can take place among incubators in the cluster. But to her surprise, many incubators moving in are not high tech small and medium size enterprises (SMEs) but sale agents working as representative of foreign software brands. They receive subsidies from the government to compete with local high tech SMEs, like Sun-Tech. Throughout the 2 years’ stay in the Industrial Technology Centre (one of the constituting institutions in the Science Park), she seldom shares information and experience with other incubators in the same field, and never uses the training room and other office facilities. On the other hand, Helen is opined that the government is subsidising foreign agents in the incubation programme to sell well-known foreign brands of software, which are in direct competition with local high tech incubators who are in the process of developing this software. The original purpose of helping local SMEs to grow is therefore, self-defeating. With regards to the interaction with big companies that are leased tenants mixing with incubators and staying in the same building, Helen says that it is very minimal. She even points out that some big companies are not high tech while others are just servicing companies. As far as client network is concerned, Sun-Tech has to establish its own from the scratch. ‘We are not expecting the Science Park can introduce clients for us but they should have helped to provide us the contact because they have had a good database of possible network.’

There is a review process to monitor the effective progress of incubators joining the programme. First, all incubators have to satisfy the milestones mutually agreed and established by the Science Park and the founder of the company. However, Helen said this is more related to the discussion of some performance indicators and it is advisory in nature. It seems no serious consequence is imposed no matter the milestones are met or not. Both parties like to get through such hurdle in an informal way. Secondly, a review meeting with the director of incubator programme is conducted once every half a year but according to Helen’s comment, the session is just another bureaucracy meeting, which is used to fulfill the need of the mechanism. Questions like ‘how much profit has been made’, ‘what kind of accomplishments the company has achieved’ ‘how many clients have been generated,’ ‘how much sale revenue/incomes have been raised’ are asked while no constructive suggestion is made during the meeting. It is not simply the monitoring system itself that is criticised not effective in practice. In the development process, Sun-Tech receives only negative comments from the evaluators of the Science Park. ‘They are not helpful towards small companies and unfamiliar with the operating environment of small business in Hong Kong. How can they perform and advise us what to improve?’ commented Helen.

Sun-Tech has gone through the difficult time during the incubation period. At first, she can afford to hire two staff to help and now it is increased to five. The company concentrates in product development and struggles to survive without incomes for the first year. The product, a search engine with Chinese-language version, is eventually developed successfully and is given the best web technology award by the Radio Hong Kong and the Gold Medal of the IT Excellence Award in year 2003. The next to do is ‘marketing and publicity’. Finding a partner who can provide marketing network is Helen’s top priority as she sees a huge demand for search engines in both China and Asian market but it must be quick as piracy is a serious problem in China.

3.2.5. Company E: Pen-Tech Ltd

After graduating from the teacher training school, Mr Tang has been teaching science subjects in the secondary school for 6 years. He then furthers his study in the States and eventually completes his PhD at the UST in Hong Kong. He starts his academic life during his PhD research and gradually builds an interest in education and computation with the application of recognition technology.

In 1999, he obtained a start-up funding in innovation technology sponsored by the government and the university. In this funding model, university provides free office, government pays monthly salary of HK$20,000 to the founder and a lump sum grants of HK$30,000 for buying basic equipment, e.g. computers and printers, etc. The funding period is about one and half year and the main purpose is to encourage the development of high tech business in Hong Kong. The company Pen-Tech. is founded with such initial financial and rental assistance. Mr Tang then changes to incubator programme under the Science Park while maintaining its office in Hong Kong UST. The company is now entitled to have rental subsidies, e.g. free rental in the first year, half rental in the second year and full
rental in the third year. It also enjoys all benefits that other incubators do. The only difference: Pen-Tech is located in UST campus, which is a bit isolated in geographical sense. Mr Tang also admits that he does not join the functions, formal and informal, very often as most are held in the office building of Technology Centre, in which the travelling time is relatively longer. On the other hand, Mr Tang is also happy with the isolated but comfortable working environment in the University campus because he can concentrate in developing the product.

With regards to the product innovation, Mr Tang has already developed a prototype. The main idea of this software product is to use pen-write computation instead of conventional press button computation, based on the theory that he develops out of his PhD Thesis. It is first experimented in workstation and then PC. After a long time effort, it is now applied in Window CE and Palm. From idea formation stage to product development stage, it has already taken him 4 years. But before launching, he still has to make sure the product to be perfect. Therefore, he keeps conducting tests and making improvement. It is anticipated to be commercialised after half a year. At present, he has no time to think of any market applications and has no idea of what kinds of customers should/will use it. In 2000, he was invited by one company to joint effort to develop and launch the product. He was asked to use the product to do the job of recognition but eventually it is only a venture trap. Mr Tang says he would not trust any form of partnership with other companies since the incident.

Since Pen-Tech is a new venture mainly engaging in product development, the company structure is simple. Mr Tang is the only staff conducting all technical tests. Other stockholders include his PhD supervisor, R & D. Corporation of UST, and the government Innovation Technology Enterprise (ITE) which provides funding support to Mr Tang before joining the incubator programme. No full time staff is hired to help in the office except some supporting staff provided by UST under incubation programme. Employing a staff, part-time or full time, is not a bad idea to speed up the timeframe of product development but Mr Tang is worry that it will take a lot of time to train him/her up before he/she can contribute to the product development. Intellectual protection is another consideration when employing outside staff at this stage.

The next thing to do for Pen-Tech is to identify the target customers, and design an appropriate approach to promote and sell the product. In other words, marketing would be his next important job. Mr Tang is not impressive with the training courses organised by the incubator scheme but appreciates the referral system recommending some expertise to give advices to incubators on various kinds of problems, e.g. legal service, financial audit and accounting, etc. at cost or at charges below the market. Locating at UST campus is also another advantage that can help enhancing the company’s image. Mr Tang agrees that location is an invisible asset to Pen-Tech, as many clients show better respect to companies with university link.

Talking about the future development of the company, Mr Tang says he is determined to go by himself. He does not consider the participation of venture capitalist or partners of any kind. He has a promotion plan: direct internet release, contact with palm to install his pen-based recognition version, and contact with other vendors. License fee will be the main source of incomes. For further product development, there are also three directions. First is the palm-based calculator. The next is computer system and the last is the technology on input method. All these developments must depend on the initial success of launching the first generation of educational calculators with pen-based recognition system.

3.2.6. Company F: Tele-cone

Tele-cone was officially set up in 1995 under the incubation scheme. However, the company actually started operation in September, 1994 within the City University of Hong Kong. The CEO and founder, Mr Chiu, is a lecturer in Electronic Engineering teaching at the City University of Hong Kong. He has a product idea and therefore initiates to talk to the University about setting up a company to develop this product and sell to the market. With the help of two colleagues and two research graduates, Mr Chiu forms a new venture called Tele-cone, which is run separately from the University to avoid the conflict of interest. For example, all facilities and office used by the company must be paid to the University at market rate. Since the company is later accepted to the incubation scheme it is no longer attached to the University while it is still one of the stockholders.

Tele-cone completes the three years’ incubation programme successfully and continues to stay at the Technology Centre, paying market rentals and necessary expenses as other tenants. It is obvious that the company is benefited from lower office rentals at the first 2 years of incubation programme. However, Mr Chiu explains that this is not the case. He points out that the rentals for the first year is HK$5 per square feet, which is below the market but adding the management fee of HK$5 per square feet, the total rentals become HK$10 per square feet, is comparable to those offices at similar locations. According to the scheme, the rentals are adjusted to HK$10 per square feet, excluding management fee, which is more expensive than the market. So in terms of rental subsidies, Mr Chiu concludes that the scheme is not attractive at all.

The most important advantage of joining the incubation programme is the resource support in organising training, marketing events (e.g. exhibitions, product launch, public relation (PR), press release, poster design for promotion, etc.) and networking events that most SMEs cannot afford to do, particularly in a professional way. In terms of promoting image to the public and clients, Mr Chiu admits that the centralised function is a great help to incubators. With respect to technical support such as product development
and technology development, it basically rests on individual incubator while the central function of the incubation programme offers no help at all. Like many other technology incubators, Tele-cone has its own technical expertise before start-up so it doesn’t expect to receive any technical assistance from the incubation programme. In addition, social gatherings are organised for incubators from time to time but Mr Chiu says these are only for informal chatting and sharing of ideas. Usually, the ideas are related to suggestions on improving clerical or administrative aspects of the office and work place. In the initial stage of venture development, these become the useful and practical feedback for Technology Centre.

Since Tele-cone is close to the campus of City University and the shareholders are academics working in the same university, the link between the company and the university is very close. The company is in a favourable geographical location, whereby the university resources, including human support and physical facilities, are easily accessible. Tenants are big companies from various industries doing various businesses while incubators are actually engaged in various technologies. It is therefore difficult to stimulate complementary effects among firms in the building. Hence, for Tele-Conce, networking is taken place within the university campus but not the Technology Centre.

After completing the incubation programme, Tele-Cone has successfully developed its remote video system and launched into the market with good response. At the beginning, Mr Chiu and his team intend to commercialise a new product which combines modem with voice box but due to the deficiency of appropriate distribution network it is not successful. They therefore, conclude that in the past the company spend too much effort on research and development and ignore the importance of marketing in developing business. Now they would pay equal attention to both marketing and R & D. in their future development process. Technology Centre can help in making their marketing activities more professional as their people have more business sense and better network in the business world.

Apart from marketing and R & D, Tele-Conce is not involved in manufacturing of video products. All production process is contracted out to Hong Kong manufacturers while Tele-Cone maintains quality control and acquisition of core supplies. The design of key components is critical in the process so they would not trust sub-contractors to purchase from other unreliable sources. On the other hand, Mr Chiu believes the company’s added value is in the R & D, design, purchasing and marketing network, not production, so he and his team do the best they can in these areas and let other manufacturers contribute the most value in production. Mr Chiu says even though the company does not obtain any direct benefits in any of the above functions during the three years’ period in the incubator programme, he still appreciates that the incubation programme provides him and his staff a good working environment so that the company can concentrate in product development, design and marketing. Without the help and administrative support, the company might not be so smooth in getting the funding support from the banks and gaining the customer recognition in such a short period. At present, Tele-Conce has been listed on the growth enterprise market of the Hong Kong Stock Exchange and it is moving fast to globalise the company in the world market.

4. Assessment of incubation programme in the incubators’ development process

Six case description and analysis presented in the above section provides a clear illustration of how technology start-ups go through their development stage and how each of them (a) draw relevant services from incubator; (b) interact with incubator; and (c) assess and comment on incubators. Interpretations have been made throughout each case analysis. Table 3 below summarises the ranking on each criteria of the assessment model as revealed and perceived by six tenant firms.

From the development process of six technology firms described in the above section, it is generally believed that cost consideration is of paramount importance at the beginning of start-ups. Specifically, all technology founders mentioned that rental subsidies are the major advantages of joining the incubation programme. It is also the main attraction for them to think about applying to join the programme. As evidenced from the case description, technology start-ups usually focus most of their effort

| Assessment ranking of technology incubator in Hong Kong |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|
| Pooling resource            | IS-Platform | Am-Tron     | Encument    | Sun-Tech    | Pen-Tech    | Tele-Cone   |
| Sharing resources           | Medium      | Medium      | Medium      | Low         | Low         | High        |
| Consulting/counselling service | High       | Low         | High        | Low         | High        | Low         |
| Public image                | High        | Low         | Medium      | Low         | Medium      | High        |
| Networking                  | Low         | Low         | High        | Low         | Low         | Low         |
| Clustering                  | Low         | Low         | Low         | Low         | Low         | Low         |
| Geographic proximity        | Medium      | Low         | Low         | Low         | Medium      | Medium      |
| Costing                     | High        | Medium      | High        | High        | High        | Medium      |
| Funding                     | Medium      | High        | Low         | Medium      | High        | Low         |
and time on product development in the first year of venture development while little attention is given to sales and marketing so it is almost impossible to generate incomes to support office cost. Therefore, free rental, as most incubation programme would offer in the first year, becomes a great help for start-up firms to survive. The exceptional cases in our study are Tele-Cone and Am-Tron. They have actually gone through the embryonic stage when they apply to join the incubator. Tele-Cone, for example, was set up at the University campus with the support of City University, which is one of the shareholders at inception period, and other professors, who have already developed the prototype and started a prior test for market commercialisation. Am-Tron provides another interesting high tech example, which uses niche strategy for high-end and tailor made customers. Their business model is to undertake both product development and marketing at the same time. They sell to specific customers who pay for specific product so there is always cash income to back up product development. In that case, office rental subsidy to them is not a great help. However, there is a general negative comment on the level of office rental for tenants, all six technology start-up firms in our study indicate that after the rental subsidies in the first and second years, they have to pay in the third year office rental equivalent and even higher than the market rate. The net benefit from joining incubator programme is therefore overestimated.

Better utilisation of central pool of resources provided by the incubator programme is claimed to be the main attraction for technology firms to join together in the science park. The case study does confirm this belief. Five out of six tenant firms mentioned the merits of training programmes. They actually participate in the programmes acknowledge their practical value. Business related programmes are of particularly useful because the founders of tenant firms are all technology entrepreneurs without business background. Encument is the only firm in the study that seems not exciting about in using incubator’s central resources partly because they are too young to gain such benefit (joining for only 6 months) and partly because the company’s location is at the university campus that makes them difficult to use the central pool of resources. However, with respect to other functions organised with central resources, e.g. marketing events, press conference, etc. the tenant firms are generally not impressed at all. Most of them pointed out those activities were not relevant to their business development. Both Sun-Tech and Pen-Tech have a strong view that it is a waste of resource serving only for government PR purpose. Tele-Cone shared the same opinion but has the feeling that if pooling resource can help to organise promotional activities in a more professional way, the long term image of Science Park could be enhanced and as a result, it will also indirectly benefit all tenant firms. In brief, the theory of better use of resources by central pooling in incubator programme is only partly true in practice.

In the venture development process, all six technology start-ups in our study have been using such facilities as office equipment, meeting room, library, reception room, etc. The majority also seeks technical support on performing R & D function, e.g. testing laboratory and computer hardware but they are restricted to those firms located near university campus. So, the advantages of geographical proximity are closely related to where the tenants are located. In out study, Pen-Tech, Encument and IS-Platform are located within university campus, while Tele-Cone has good relationship with the staff of City University. Hence, in the product development process, it is not surprising to note that they derive maximum benefit from the technical support of research and testing facilities. Due to previous close work contact with professors, Am-Tron also contracts out some consultancy work to Polytechnic University at the beginning but, given the relatively longer geographic distance between the company and the university, such contractual relationship is gradually weakened as the company finds better sources of alternative testing laboratory. Among all cases, Sun-Tech is the one benefited the least in getting technical support from central resources. They have no connection with local universities so they rely on their own in product development.

The advantage of obtaining consulting/counselling services from incubator is generally considered as an important part of intellectual human support for technology firms. Analysing the development pattern of six cases, three companies constantly seek such advices, in which they use for guiding their operation as well as for defining their strategic direction. Not surprisingly, they are the companies with close link to universities and with their offices in university campus. With reference to the nature of consulting service, it is apparent from the case analysis that technology firms need both technical and business related services. Mr Wan of Am-Tron indicates that all technology founders should have already formed some product ideas in their own disciplines, so he likes to choose a non-technology mentor to guide the company as to how to run the business. Mr Tang of Pen-Tech, for example, considers himself the best in product development so what he needs is the advice on how to draft legal contract with clients and how to deal with accounting matters during the company development process.

Public image of Science Park is usually claimed to be the intangible advantage that would bring about marketing as well as partnership benefits for tenants. It is also an important selling point for incubator to argue that the office in the science park should comprise a higher rent (or a rent at least equal to the market). However, the case analysis suggests that five out of six technology founders, with the exception of Mr Chow of IS-Platform, perceive that public image is not as important as other administrative support and rental subsidies. In the first three years of development during the incubation period, there are many practical things the tenants should be of more concern. Many believe that
public image is too far-reaching, high-profile but not down-to-earth, window dressing gimmick and rather political. Some speculate that this function is used as a means to polish the senior official. It is also a function used to justify the value of science parks and their incubation programme. On the other hand, when Tele-Cone undertook IPO in the Hong Kong Stock Exchange after graduating from incubator programme, the CEO Mr Chiu agreed its success relies on the good public image of Science Park.

Networking, together with clustering, is espoused in theory that would bring about the fast development and growth of technology firms in incubators. However, from the users’ perspective, this is completely contrary to our belief. The results of the case study reveal that both networking and clustering are ranked the lowest according to the value that would contribute to the business development process. For example, the so-called networking events, social party, facilities for tenants to meet and talk, informal or formal gatherings, etc. cannot serve the linking function. All technology firms shut the door, work alone and never chat on product, market and business related topics despite that they often see each other on corridor and say Hello. The simple reason is that they have nothing in common. Sun-Tech even pointed out that the incubator admits tenants serving to compete with, rather than to complement each other. In analysing the development process, it is found that there is no partnership opportunity, no externality in whatever aspects, no complementary synergy, no client/supplier/manufacturer network, and no knowledge sharing.

In the assessment model of incubator, funding is the last criteria in the list. The question that we address is whether or not technology start-ups joining incubator programme would be in a better position to obtain funding support and therefore facilitate their development and growth. Two companies in our study do obtain strong funding support in their product development stage. Am-Tron received from government on sponsoring the hiring of research assistant to undertake R and D project, which is a great help to the company in the start up stage. Pen-Tech is sponsored by the innovation and technology fund, which is used to buy equipment and hardware facilities to back up the company’s development of pen-write recognition technology. Other funding support is also available in the incubation programme but its ultimate aim is to help the company develop high tech product. However, since most technology start-ups are young and small firms, and their product ideas are usually not the big ones, some argue that if funding support is only provided in the direction of high tech product development it would be too limited in scope and too biased in function. Suggestions are thus made to include funding of other areas, e.g. marketing, human resource and etc.

To summarise the above assessment by the development perspective of technology start-ups, we place the core development activities of the technology firms alongside with their associated needs derived from incubators and then check out what deficiencies are found so that incubator manager/policy makers can draw useful references for improvement. The figure below presents the highlights (Fig. 1).

5. Conclusion

Technology incubator within Science Park has been developing as a means to facilitate the development of technology based start-ups. Evidence on its effectiveness is not conclusive. Therefore, issue of developing an appropriate assessment model and applying the model in any particular incubator is of great concern for researchers and policy makers. In this paper, we summarise the models and the methods used in the past and develop an alternative assessment model with reference to the theories underlying the rationale of technology incubator. The model is then applied in the Hong Kong Science and Technology Park. Using the development perspective of technology start-ups that participate in the incubator programme at different time periods, we collect data of six cases and describe how these start-ups develop, with particular reference to its interaction with incubators. Interpretations are also made in the six case analyses, based on the criteria we develop in the assessment model. In brief, our study finds that:

1. Cost advantage in the form of rental subsidies and other expenses is found the most important benefit that technology tenants derive from incubator programme. It is particularly critical for those tenants whose product technology is still in pre-mature stage or requires longer time to develop.
2. The claim that pooling resources together in the science park so as to reach the critical mass to enable organising central functions like training, networking events, etc. for the young start-ups is found partly
true. The merit of central functions to each tenant is varied depending on the need of firms at different stages of business development.

(3) It is also found in our study that sharing basic structural resources, e.g. administrative support, office equipment, etc. are generally applied to all technology firms within the incubator programme. However, sharing technical resources among firms is found not valid in our study as technology-related resources are varied from tenant to tenant unless science park is set up with a main theme of technology, e.g. software development, IC design or biotechnology, etc. Geographic proximity to universities is found in our case study to be a determinant affecting the use of shared technical resources like laboratory, workshop facilities, etc. by technology firms.

(4) It is found in our study seeking consulting advices on product development is not the main concern of technology start-ups. The reasons are of twofold. First, technology founders are usually the experts in their own field. Consultants appointed or recommended by Science Park might not be of direct relevance. Secondly, most founders express their concern in our fieldwork interviews that they are afraid that the product technology would be stolen by outsiders if they talk to consultants about this. On the other hand, our study reveals that in the venture development process, technology founders are usually keen to seek business advice as it is the area that they do not know. In addition, it is of immediate and practical use in every day operation. Once again, geographic proximity is also found to be related to how often technology founders seek consulting help from incubator.

(5) Moreover, it is also found in our study that technology start-ups do not gain any benefits from networking and clustering. Such theories in support of the value of science parks in fostering rapid growth of small technology start-ups is not confirmed in the study. Strong views are presented by some young tenants in the study stating that the argument is more of a political show to justify government’s investment in establishing science parks and incubators. In the case analyses of the above sections, no evidence is found on networking advantage and clustering effect on technology firms in their development process. Perhaps the theories are over emphasised or the application is subject to specific contexts, e.g. western model of science parks. The terms of condition in the implementation process might be another factor that affects the effectiveness of incubator with respect to these theories.

(6) Another similar perspective that emerges from our case study is that the positive effect of good public image of science parks on technology tenants is minimal. To some firms, there is no help at all in their business dealings with clients, suppliers, contractors, etc. It is found that public image benefit is only an illusion for young start-ups but it is politically a good selling point for other tenants who lease offices in the Science Park as they can take advantage of the ‘reputation’ to make deals with business parties.

(7) The university-technology start-ups relationship is found more useful than the science park-technology start-ups relationship with regards to the product development process. The reason is obviously due to the fact that university can provide technology start-ups with both software support, i.e. consulting advices on product, and hardware support, i.e. laboratory equipment and facilities. So the ideal model of incubator is to bring three parties together in the structure: science park, university and technology start-ups.

In summary, given the premise that incubator models within the science park has been so common but its effectiveness is still unclear, this paper is an attempt to develop an assessment framework based on the related literature and, from the development perspective of technology start-ups, we apply the framework to analyse six cases in Hong Kong Science Park. It is believed that the assessment framework and its subsequent application offer an alternative perspective in the analysis of technology incubators. Furthermore, in the process of applying the framework, a number of issues concerning the good, the bad and the ugly aspects of incubators are found and presented in the conclusion section. They are worth of further attention and revisit in the future when incubator programme needs to be designed and improved.

Due to the exploratory method we use in collecting data that must be rich enough to warrant the description and interpretation of the development process of technology start-ups, there are only six cases selected in the study. Hence, the results are constrained by this method and generalisation is difficult to be made. Another limitation that cautions our analyses in the study is its application in Hong Kong context. Though incubator models in all economies follow more or less similar policies and rules in their set up, it is still important to qualify some results with reference to their unique features. It is therefore desirable to extend our study to examine incubators of other economies and to find out more information on their development process so as to understand better how incubator programme can be assessed from the development perspective.

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