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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต
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FINANCING FOR TECHNOLOGICAL INNOVATION BUSINESS STARTUP

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A Dissertation Submitted in Partial Fulfillment of the Requirements

for the Degree of

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ขวัญรัฐ ส่วนพงษ์ : การจัดหาเงินทุนสำหรับการจัดตั้งธุรกิจนวัตกรรมทางเทคโนโลยี (FINANCING FOR TECHNOLOGICAL INNOVATION BUSINESS STARTUP) อ.ที่ปรึกษาวิทยานิพนธ์หลัก : รศ.ดร.กมเลศน์ สันติเวชกุล, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม : ศ. กิตติคุณ ดร. อัจฉรา จันทร์ฉาย, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม : ผศ. ดร. ดวงหทัย เพ็ญตระกูล   251   หน้า.

การศึกษานี้มีวัตถุประสงค์ที่จะค้นหาปัจจัยที่มีผลกระทบต่อการตัดสินใจลงทุนของนักลงทุนในธุรกิจจัดตั้งใหม่ที่มีนวัตกรรมทางเทคโนโลยี รวมถึงการสร้างตัวแบบแนวคิด (conceptual model) สร้างตัวแบบการตัดสินใจทางการเงิน (financial decision model) และทำการทดสอบการยอมรับในตัวแบบที่สร้างขึ้น

ผลการวิจัยการตัดสินใจของนักลงทุนด้วยการสัมภาษณ์เชิงลึกแบบกึ่งโครงสร้าง (semi-structured interview) พบว่านักลงทุนให้ความสำคัญปัจจัยความมั่นคงและการเจริญเติบโตจากนวัตกรรมทางเทคโนโลยี นักลงทุนจะให้ค่าธุรกิจจัดตั้งใหม่ที่มีทางเลือกหรือความยืดหยุ่นในด้านเทคโนโลยีหรือตลาดในช่วงวิจัยและพัฒนามากกว่าในช่วงพาณิชย์ โดยการวัดมูลค่าแบบเรียลออพชั่น (real option) มีการยอมรับในกลุ่มที่ทำหน้าที่บริหารเทคโนโลยี/ทรัพย์สินทางปัญญา และผู้บริหารเงินร่วมลงทุน (venture capital) มากกว่ากลุ่มนักลงทุนรายบุคคล

การพัฒนาตัวแบบการตัดสินใจสำหรับธุรกิจจัดตั้งใหม่นี้ใช้ตัวแบบแนวคิดเรียลออพชั่นในการวัดมูลค่าการเติบโตจากนวัตกรรม ส่วนการตัดสินใจของนักลงทุนใช้ตัวแบบแนวคิดความปลอดภัย-ศักยภาพ/ความปรารถนา (security-potential/aspiration) และตัวแบบแนวคิดการขาดทุนที่ยอมรับได้ (affordable loss) ผลการทดสอบการยอมรับพบว่าตัวแบบการตัดสินใจช่วยให้นักลงทุนประเมินการเติบโตและความเสี่ยงที่สอดคล้องกับความปรารถนาและการขาดทุนที่ยอมรับได้

ผลจากกรณีศึกษาธุรกิจใหม่ที่ทำการผลิตไบโอดีเซลในประเทศไทยโดยใช้ตัวแบบการตัดสินใจนี้พบว่าโครงการที่สามารถแยกออกเป็นส่วนๆ (modular) และทำทีละขั้น (stages) สามารถสร้างมูลค่าของทางเลือก (option value) เพิ่มเติมจากมูลค่าโครงการที่เป็นสแตติก (static) โดยที่มูลค่าของทางเลือกสามารถชดเชยการขาดทุนที่ยอมรับได้ (affordable loss) ส่วนผสมของมูลค่าทางเลือกกับปัจจัยด้านความน่าไว้วางใจและความกตัญญูของผู้ประกอบการสามารถช่วยเพิ่มแนวโน้มที่นักลงทุนจะตัดสินใจเข้าลงทุนในธุรกิจจัดตั้งใหม่ได้

สาขาวิชา   ธุรกิจเทคโนโลยีและ   ลายมือชื่อนิสิต
              การจัดการนวัตกรรม   ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก
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                                          ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์ร่วม

KWANRAT SUANPONG: FINANCING FOR TECHNOLOGICAL INNOVATION BUSINESS STARTUP. ADVISOR: ASSOC. PROF. KAMALES SANTIVEJKUL, Ph.D., CO-ADVISOR: PROF. EMERITUS ACHARA CHANDRACHAI, Ph.D., CO-ADVISOR: ASST.PROF. DUANGHATHAI PENTRAKOON, Ph.D.   251   pp.

The objectives of this study aim to explore factors that investors use for decision making to invest in business startups that base their innovation on technology, create conceptual model, develop financial decision model and test acceptance of model.

The study was conducted with investors and related persons using semi-structured interview revealing that investors focus their criteria around security and growth value obtained from technological innovation. The startups that contained options or flexibility in technology or market were perceived more valuable to investors in research and development stages than in commercialization stage. Real option valuation was highly valued by technology/intellectual property licensing officers and venture capitalists but less commonly known among individual investors.

The financial decision model was developed and tested using real option to value startup's growth from innovation, affordable loss to represent startup's security and security-potential/aspiration theory for individual investor decision making. The acceptance test with investors found the decision model to be helpful in assessing growth value and investment risk that match with their aspiration and affordable loss level.

Result from case studies of startup in biodiesel production in Thailand using this decision model showed that splitting a modular project in to stages could create option value in addition to static value of project. One of the major effects of option value on investment decision making was found to be able to compensate the affordable loss. Combination of additional optional value and non-monetary quality of entrepreneur such as trustworthiness and gratitude could help increase propensity of making plunge decision to invest in technological innovation startup.

Field of Study : Technopreneurship and   Student's Signature

Innovation Management   Advisor's Signature

Academic Year : 2011   Co-advisor's Signature

Co-advisor's Signature

ACKNOWLEDGEMENT

CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Business startups accounted for much of innovation creation and new technology commercialization. However, due to capital constrains, they could not exploit potential opportunity as much as they desired. Normal collateral available by mature firms could not be provided by business startups for general financial institution. New technology and innovation in new product development increased risk of startups which widening the funding gap by investors. As a result, lack of funding access was found to be major cause of startups' failure.

Lack of financing for the start-up companies is one of the major obstacles for promoting innovation. Capital constrains have made start-up unable to exploit every potential profitable opportunities (Bollinger, Hope, & Utterback, 1983). In Thailand, the Stock Exchange of Thailand-Market for Alternative Investment (MAI), listed security market for small and medium companies, has set listing requirement only 1 year profit and capital not less than 20 million Baht. However, it took approximately 11 years on average for top-ten market capitalization companies to reach IPO (The Stock Exchange of Thailand, 2012b), while venture capital criteria required to cash out in 5-10 years (MacMillan, Siegel, & Narasimha, 1985). Therefore, the availability of financing support as risk capital for start-up should mitigate obstacles of creation of innovation.

Study on initial funding for business startup showed that they relied on financing from private equity or private investor, either informal risk capital-business angels or formal risk capital-venture capital, before they could obtain public financing from general bank financing or IPO in later stages. Business angel was known to add value in technology development stage by improving quality and reliability of technology assessment. On the other hand, venture capital was known to provide additional value in commercialization stage and growth by adding professional administration and control to shape business startup for further funding from banks and IPO.

Uncertainty in technology development and commercialization of business startup should be reduced if output of one stage could be used as feedback mechanism to reflect learning either success or failure and feed forward as input to guide and form financing need for later stages. As a result, there is opportunity to increase effectiveness of business startup financing process by stripping startup process into stages and linking outcome of earlier stage development to be an input for evaluation possible actions in later stages that will maximize total returns.

This study proposes new conceptual framework for financing technological business startup firms from private capital to public financing. It proposes to split technology development and commercialization into stages and link one stage to later ones using Real Option Reasoning as evaluation tools. The model will increase return on investment by incorporating commercialization strategy and recognize incentive from

government policy. It is also expected to lower risk of investment by stage financing, flexibility with Real Option Reasoning, secure financing by technology collateral, and recognize benefit of clustering. With goal of technology commercialization as maximize profit, Real Option Reasoning will be used as evaluation tools with feedback and feed-forward along stages of commercialization for financing with private funding to public funding or IPO. It is expected to potentially reduce the funding gap for technological business startups and improve effectiveness of investment process of early stage risk capital providers.

1.1 *Background and Importance of Problem*

Innovation process of typical startup of new venture contains huge uncertainty as outcome of innovation during development of firm is hard to forecast in advance. There are various choices of technology to decide and each option carries different value and certainty. Therefore, there is difficulty in providing financing by outsider agents, who are not principal entrepreneur, such as bank, venture capital or business angels.

Venture capital is one of the essential financing agents for business startup. However, key problem of venture capital financing for innovation/technological business startup is the context of financing without solid collateral. This has made venture capital focuses investment to the later stage of venture development such as after completion of prototype and rejects earlier stage of development, especially with radical innovation.

In venture capital industry, there are many available tools which contribute to growth of VC industry. Staging capital is one of financing tools designed to reduce risk of investing in newly startup with radical innovation by splitting investment in trance or stage and ties each stage of investment to condition precedence.

System of innovation concept suggests to have process of financing and process of innovation to co-evolve from the start till finish, providing interaction and learning to actors in each process in order to properly making decision on direction along fuzzy-front-end stage of innovation. By gradually invest in startup firm according to performance of firm in achieving each milestone, a staging capital need to match with outcome developed along innovation process. However, with normal view of innovation product as final complete product and the end of process, there is no profit as price information feedback along innovation process to the earlier stage of financing process. So there is a need for other milestones to be measured for making decision on innovation project during development, other than profit.

Technology commercialization should consider all factors and actors within the value network. Technology commercialization process suggested separating technological product into various technological components of core assets and complimentary assets, depending on type and possibility or channeling to commercial such technology and related technology within value network. It provides visibility of

possible profit generated from each component of assets during the development process and provides options for firm to decide to exercise option to commercialize in each choice or not, depending on total value maximization under consideration of technology commercialization process, until the development reach prototype and final product in the market. Decision making on value of each option to take could utilize framework of Real Option Reasoning to decide on which option provides highest value during the development of technological component, until completion of final product.

In addition to consideration on technology development and technology commercialization, the critical issue is about choosing right strategy for entrepreneurial startup to match financial resources for technological innovation, considering matching of right technology commercialization and technological development.

Innovation is uncertain, because both entrepreneur and customer do not know what they want, and also customer cannot always express their latent needs on future product which they have not yet experienced. Entrepreneur has to make assumptions about product features that would have strong impact to customer demand and stimulus customer to purchase that innovative product. Issues are about impact of such assumptions and level of uncertainty of those assumptions. High probable scenario that such assumptions would become real and affect the business, the entrepreneur has to plan to incorporate these assumptions into its core technological capabilities in order to satisfy the need of customers. However, in order to set a robust strategy, entrepreneur should test their strategies with future scenarios that have high impacts but less chance to occur, as option strategy in addition to core strategy. It is believed that taking option strategy in addition to core strategy should bring additional value valuation of the development of new technological innovation.

Venture capital normally prefers to invest in later stage of venture development, while making business angel contribute to financing in earlier stage of startup. This circumstance exposed business angel to higher risk of uncertainty of technology development. In addition, there is limited or no assets for business startup to use as collateral for unsuccessful case of private equity. As a result, it put burden of high financing cost for business startup which lower success rate of innovation or technological development.

Therefore, there is a gap in the study on financing of technological business startup. It is also explicit that there is a need for tool to help increase investment return and reduce investment risk of private equity, especially for business angel that is at the fuzzy front end of innovation development. This study aims to develop decision model that improve competitiveness and survivability of technological business startup by restructuring its financing model to match with nature of uncertainty of technological development and innovation. It needs to attract private investors with a unified framework that integrate policy, industry condition, and firms levels. It

attempts to find the gap of intersection among studies of entrepreneurship, financing, innovation, technology commercialization, and synthesize potential new process with aim to reduce gap of multidisciplinary integration.

It will explore possibility to synthesize financing contract or instrument to secure the financing by providing assets or claim on each outcome during the development of innovation as collateral for financing. The financing contracts or convertible securities could be formulated between business startup and private equity to provide contingent claim on possible profit generated from innovation of business startup against finance amount invested.

Frameworks expected to be synthesized are 1) staging financing for new venture development, 2) value network and separation of technology as hierarchy of assets, 3) decision framework of Real Option Reasoning to value each technology option, and 4) secured financing by collateralized each asset to each finance tranche.

In summary, outcome at micro level is expected to obtain a synthesized tool as financing contract or instrument for business startup to attract and bind private equity, which also reduces investment risk for private equity by securing technology assets generated along the development of business startup.

Outcome at macro level is expected to establish linkage of such tool with policy on investment incentive and financing support from government and capital market that would increase investment return for private equity. In the end, it is expected that the growth of private equity industry will reduce funding gap of business startup firms during innovation and technology development.

1.2 *Research Objectives*

Therefore, objectives of this study aim to explore issues as follows.

1. Study relationship of business startup's factors on nature of technology, innovation, technology commercialization and financial evaluation that affect investment criteria of private investor.

2. Create conceptual model of financing business startups that match innovation and technology development on

    2.1. Technology and innovation that satisfy investment criteria of investors.

    2.2. Financial return and investment of business startup that match investment preference of private investor.

3. Develop financial decision model for investors to evaluate financial payoff from risk and return of investment invested in business startup.

4. Test of acceptance of model in business startup with private investors

1.3 *Scope of Study*

This study aims to identify financing factors that relates to startup phase of new venture development, with consideration of total value chain of financing from private equity to public or IPO stages. The study focuses on subset of business startup that focuses on technological innovation because it contributed to growth of startup (Shane, 2001b).

1.4 *Key Definition of Terms*

Technological Innovation is the implementation/commercialization of a product or process with improved performance characteristics such as to deliver objectively new or improved products or services to the consumer (EUROSTAT, 1996).

Private Investor is capital provider after owner capital and before public capital. Capital consisted of equity, debt and grant. For equity, sources are from entrepreneurs, private equity, and public equity. Private equity contains business angel and venture capital as they are not general financial institutions that obtain funding from public (Rasila, Seppä, & Hannula, 2002). Public capital contains commercial banks and public security market or IPO. Private investor who invested their own money in entrepreneurial firms is defined as business angel (Freear, Sohl, & Wetzel, 1996).

Sustaining innovation was defined as "innovation that improve performance of established products along the dimensions of performance that mainstream customers in major markets have historically valued" (Christensen, 1997).

Disruptive innovation was defined as "innovation that may initially underperformed established products in mainstream markets, but they have other features that initially a few or new customer value" (Christensen, 1997).

Disruptive innovation contains two types, low-end disruption and new-market disruption. Low-end disruption was defined as innovation that offered performance at good enough level along the traditional metrics of performance to over-served customers at the low end of mainstream market (Christensen & Raynor, 2003).. In this study, low-end disruption and low-end innovation would be used interchangeably.

New-market disruptions was defined as innovation that offered lower performance in traditional attributes, but improved performance in new attributes-typically simplicity and convenience to non-customers who historically lacked the money or skill to buy and use the product (Christensen & Raynor, 2003). In this study, new-market disruption and new-market innovation would be used interchangeably.

Business angel was defined as high networth individuals who provide direct funding to early-stage new business (Berger & Udell, 1998). It was also called as informal risk capital (Haar, Starr, & MacMillan, 1988), angel investors (Lerner, 1998),

informal venture capital (Mason & Harrison, 2000) or informal venture investors (Wiltbank, 2005).

1.5 *Academic Contribution*

The outcome of the study would expect to extend technology commercialization concept of (Teece, 1986) to combine with real option reasoning in order to create option view point in valuation of each commercialization choice. In addition, it was expected to extend real option valuation from valuating technology or project (McGrath & MacMillan, 2000a) to the use of individual for investment in startup by simplifying real option technique.

The outcomes of the study are expected to be as follow.

1. A decision model for funding provider to innovations that structured to incorporate consideration of commercialization ability and financing investment in stage and with options to act on future perceives of risk and return of next investment.

2. Contribution in technology is expected to be in integration of technology commercialization model with financing model and link technology as assets to be used as collateral to support financing during startup.

3. Contribution in innovation is expected to provide a new model of financing innovation for private equity to reduce risk of financing of risky new technology business startup

4. Contribution in management is expected to provide a new decision management process of application of Real Option Reasoning to financing process to foster private equity industry.

1.6 *Practical Contribution*

1. Linking framework of investment from various funding types, both public and private, from breaking investments into different stages, which each type of investors can invest according to their specific risk and return preference of business cycle, technology cycle or financing cycle.

2. Convert the decision model into financing instrument/contract for innovation at each stage of venture development.

3. Stimulate venture capital and business angel in provide funding for new business startup that develop innovation /technological product by having framework that reducing investment risk.

CHAPTER II

LITRATURE REVIEW

2.1 *Innovation System and Environment*

An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (EUROSTAT, 2005). In order to support survival of startup, cluster of capabilities or competencies could be formed or designed as "platform" to create specific competitive advantage from capabilities to improve the success of further innovation. Platform advantage could be viewed as product synergies, control of distribution. Technology platform was referred to cluster of technological capabilities that create technological advantage through creation of standard of forms. Business platform was referred to cluster of business capabilities that capture profitability from providing access to customer base, creating new business, or increase likelihood of market penetration. Technology platform variables that provide higher technical performance product features should match with business platform variables that offer higher value that serve customer satisfaction. Strategies that combine the use of business platform to capture profit from technology platform were keys to managing innovation (Wonglimpiyarat, 2004)

Reference to synthesize of cluster that match technology platform and business platform, cluster of business angels could be effective if matched with cluster of industry that business angel invested. As both entrepreneur and business angel are most likely use to be in the same industry, relationships and prior knowledge between both entrepreneur and business angels are important. Management of networked region that comprised of networks among entrepreneurs, venture capitalists, researchers and others could transform ideas into new commercial innovation (Wonglimpiyarat, 2006a).

The development of cluster in US Silicon Valley was shown as effective economic development model that entrepreneur could drive innovation from support of universities, industry, and venture capital. With framework of Porter's Diamond model, factors of demand conditions, factor input conditions, context for firm strategy and rivalry, and related supporting industries are main attributes that catalyze, support, and self-reinforce development of clusters. The contribution of venture capital and angel capital network are classified under factor (inputs) conditions of cluster indicators (Wonglimpiyarat, 2006b).

As market of business angel and venture capital are complimentary, therefore, the development of clustering of business angels would complimentary promoting the development of venture capital, and vice versa. Therefore, the promotion of business angels should match with promotion of cluster as a whole. It could be implied that cluster should include entrepreneur, business angels and factor of technology commercialization. As a result, cluster creation should match technology platform, business platform, and business angel platform.

Therefore, clustering framework enable to comprehend technology commercialization at firm level into technology platform and business platform at industry level. Clustering with consideration of matching of technological platform, business platform and financing platform could be benefit technology angels for specific industry and technology startup firms.

2.2 *Innovation and Industry Cluster, Private Equity, Venture Capital, and Business Angels in Thailand*

Industry cluster could be designed based on Triple Helix model, the tri-lateral network, to support knowledge generation and industrial development by integration of government, university/research organization, and private sectors (Wonglimpiyarat, 2007). Clustering system was proved to successfully promote commercialization of innovation in US Silicon Valley and Italian textile industry. Venture capital funding took key role in the clustering system by supporting commercialization of innovation and promoting effectiveness of innovation (Wonglimpiyarat, 2009b).

Thailand had implemented cluster development with direction of increase of competitive of nation under Porter's Diamond Model. Under that model, industries development were planned to create competitive advantage through niche creation. Five key industries were defined as keys are in food, fashion, travel, auto, and software. Regional cluster developments planned to be set up were Andaman Silicon Valley and Phu Wiang Silicon Valley, with aim to promote investment from private sector in designed cluster with integration of support from university and government (Wonglimpiyarat, 2010).

To support cluster development, promotion of venture capital should be stimulated in order to perform service of funding as factor (input) condition for firms that have technology strategy in supporting the cluster. Various measures were recommended such as wider access to venture capital, setting up of public venture capital, and creating network among venture capital and business angels. At infrastructure level, tax incentive on investment and income of venture capital and business angels were proposed, including taxing benefit for investors of venture capital and business angel fund, writing-off of fail investment. Promotion of business angels was also very important to the development of innovation from startup companies. It could be in form of setting up angel funds to attract wealthy individual that interest in specific field to jointly invest in the development of cluster. However, proper planning should be focus on broadening area of investment, not to focus on specific field (Wonglimpiyarat, 2010).

Recent study by GEM Thailand 2007 Report on business startup in Thailand found that total entrepreneurial activity increased to 26.9% in 2007. However, most entrepreneurs at 96% did not focus on innovation. They provided product and service that already presented in the market. Approximately 70% of early-stage of Thai entrepreneur did not use new technology in producing their products. As a result, causes of business failure were at 36% from lack of funding access and 21% from unprofitability of business (Virasa & Hunt, 2008).

Report of Venture Capital in Thailand for OSMEP & Thai VC Association 2007 was conducted through survey of 9 major venture capitals from Thai VC Association and 20 business angels from Thai-Chinese Business Association. The study found that venture capital in Thailand were highly educated, significant business experience 13 years in average, with mainly background in finance, and hands-on monitoring in average 50% of time. Fund size was found to be 720million Baht in average, duration 10yesrs in average, and invest 30% in early stage and 70% in growth & mature stage. Business angels in Thailand were found to be highly educated, significant business experience 16 years in average, with mainly background in operations, and very hands-on monitoring in average 70% of time. Fund size was found to be 90million Baht, deal range between 4-50million baht, with no exit strategies, and 47% in early stage and 41% in growth & mature stage (Scheela & Jittrapanun, 2007).

Problem venture capitals faced were difficulties in finding startups with good potential and professionally managed, while good potential startups were not interested in working with venture capital. Firms that preferred to retain control denied request from venture capital to be major shareholder. Problem business angels faced were inefficiency of operations, low quality production, lack professional management. They also faced lack of competitive advantage, high competition, low profitability, and limited distribution channel. Business angels also regarded networking of investors as important in order to obtain reliable business partners (Scheela & Jittrapanun, 2007).

Active government policy could promote venture capital activities of financing innovations. For stimulating the finance of innovation in Thailand, the government should be more of catalytic role rather than just policing. It should set up policy forum to coordinate scope and delivery of incentive for innovation. It should also ease financial support to SME, especially for those in line with government stimulus programs. In addition, government should take full supports for innovation of startups from R&D until commercialization and full support in integration of various incentive policies from tax incentive for financier and firm, relaxing loan-provision of financial institution, and improving R&D grant scheme for more effective of innovation stimulation (Wonglimpiyarat, 2009a).

In addition, government promotion should give the industry a boost from subsidy that would lead to creation of new growth industry. And in that growing industry, it is a business environment that startup companies can easily survive, rather than mature industry that startup firms have to fight with established companies.

Problems stated by venture capital and business angels were potential area of improvement on firms and policy level. Problems stated by entrepreneur could also implied potential service of business angel in addition to financial support. Product differentiation from technology and innovation could benefit increasing rate or innovation and survival of business startup in Thailand. In conclusion, funding and other non-financial service of private equity such as venture capital and business

angels brought to startups could stimulate competitiveness through commercialization of technology for business startup in Thailand (Wonglimpiyarat, 2010).

2.3 *Technological Innovation*

Technological innovation is manifested in the development of new products, processes and techniques such that emerging technologies often substitute for more mature technologies. In short, technological innovation is innovation based on technical knowledge (Utterback, 1971)

2.3.1 *Technology Change*

Technology progress affected changes in set of knowledge in solving problem and direction of changes. In order to master effect of technology advancement, firms should continuously interact between technological factors and market factors (Dosi, 1982). New project in development of high technology or innovation contain various type of uncertainty. There were different methods to manage uncertainty such as assigning probability to possible outcome. Key parameters for decision making on innovation project were probable cost of development, probable future income and probability of success, technically and commercially. The most difficult estimate to be accurate was the probability of market success. As a result, most firms have incentive to avoid radical type of product innovation and only a few small-firm innovators who are ready to make a big gamble or ready to accept a very high degree of uncertainty (Freeman, 1995). As value anticipated from new technology was uncertain, it was therefore uneasy to find solid value of such technology.

Technology change had contributed to change of structure and relationship of firms and market. Without proper anticipation of value from commercialization of technology in such new market, opportunity arise from disruptive technology will be valued as unattractive economic and financial return. As a result, established firms did not allocate proper resource to disruptive product development and commercialization. Technology choices, therefore, should be made by firm to anticipate value to be generated from disruptive technology, which would influence the strategic action of firm (Christensen & Rosenbloom, 1995). Established firms normally find it difficult to associate disruptive technology with customer demand without analysis down to structural level of both technology and market (Christensen & Bower, 2004).

Possible principles that make established firms fail in developing disruptive technologies are i)Allocation resources to satisfying main customer rather than for new market (resource dependent to main customer), ii) small market of disruptive technologies in the beginning does not comply with the need of large establish firms, iii) Ultimate use or applications for disruptive technologies are unknown in the beginning which are too uncertain for rationale manager in established firms to make decision in favor that development, and iv) Technology performance supply may not equal performance of demand and product attributes of disruptive technologies

unattractive to established market are often attractive to emerging market (Christensen, 1997).

Established firms successfully commercialize disruptive technology by 1) Embedding independent organization within an entirely different value network which aligning disruptive technology with right customer to increase customer demand and probability of resource allocation to disruptive projects , let resource dependence pull disruptive technology from specific value network, ii) develop disruptive technologies in small unit to get team excited and explore small opportunities and small wins, iii) Plan to fail early and inexpensively while searching for right market for disruptive technologies, and iv) Develop new market for disruptive technologies that value the attributes of disruptive products, rather than search for technological breakthrough (Christensen, 1997).

As a result, firm should understand nature of technology and develop proper way to handle strategic choice on technology, especially business startup that relied heavily on commercialization of new technology.

Business consideration that able to indicate innovation which disruptive for niche market that has more potential for small and startup to grow and survive and defend existing firms. Business strategy should be the lead for all others parts and should be defined first. Then move to next level of financing and technology.

Technology change created change in product performance. It started at the beginning of product innovation, in the earlier stage of product life cycle. The change would have objective to satisfy technology performance needed, before process innovation takes over to improve other feature such as quality, reliability, ease of use, and price.

2.3.2 *Technology Change, Knowledge Creation and Economic Growth*

Traditional economic growth was explained by knowledge accumulation in the growth process. However, without technological change, capital accumulation will not be sustained (Freeman & Soete, 1997). Assumption of scarce resource was foundation of economic principle of rational choice of agent and goal of profit maximization. However, such rational of allocation of scarce resource could not effectively attribute to economic growth that is based on knowledge creation (Lundvall & Borrás, 2005).

Long term growth of economy was contributed by the rise of science-related technology, the introduction, diffusion and continuous improvement of new products and processes. Technical innovation was accepted to be one of the most important sources of dynamism in capitalist economies (Freeman & Soete, 1997). Technology change could be seen as open-ended and path-dependent process. Theories of interactive learning and evolutionary theories of technological change constitute important origins of System Innovation approaches in institutionalism perspective. Public policy for innovation of demand-side instruments such as public technology

procurement should be focus by having public agency to place order for a product or system, which does not exist at the present time. It will provide price and quantity signal together with promoting interaction and learning process on key technology in catching-up strategy (Edquist & Hommen, 1999).

In national innovation systems, capability to learn tends to become the most important factor behind the economic success of people, organizations, and regions (Lundvall & Johnson, 1994). The concept of national innovation system was developed by explaining that knowledge and learning are main cause of economic growth. Knowledge was stated to be the most important resources in the modern economy and learning is the most important process.

At policy level, building linkage and strengthening absorptive capacity of users are fundamental under interactive concept on innovation. Under strategy of catching-up economy, active role of government was suggested to build national infrastructure for transport people and commodity and institutions for education and training in order to promote the accumulation of mental capital and use it to spur economic development (Freeman, 1995). At firm level, innovation performance of firm is based on interaction and feedback activities, and interactive learning of on-going activities such as in production and sales are fundamental of product innovation (Lundvall & Johnson, 1994).

Applying concept of innovation systems to standard economic has open possibility of new thinking in several existing theories. In theory of firm, the dynamic of competition will move focus from allocation of resources toward adaptation and flexibility due to technological opportunity. Allocation of resources, including financial resources should be allocated based on processes of innovation, which may be referred to venture capital and entrepreneurship. In marketing and commercializing of new product, it should reflect not only production and transaction costs but also attempt to harvest benefits from interactive learning between users and producers (Lundvall & Borrás, 2005).

2.3.3 *Technology Opportunities and New Firm Creation*
To increase probability of firm creation, dimension of technological opportunities about "importance", "radicalness", and "patent scope" are proposed (Shane, 2001a). He argued that technology opportunity was important to decision to establish a new firm by obtaining decision rights over a new technology can influence the mode of commercialization.

Firm creation and entrepreneurship were based on behaviour of pursuing growth through innovation and opportunity exploitation (Stevenson & Jarillo, 1990). For high-tech industries, new ventures have to focus on activities of planning; problem exploration, *k*nowledge exploration, and business plan development. Characteristics of new venture firms on flexible, participative, and adaptive were found to be competency that makes firms successful (Duchesneau & Gartner, 1990). In US during 1990s, new and small firms were found to be responsible for 55% of

innovations and 95% of all radical innovations. However, uncertainty of business startup was high as only about half of all startups were found to last between five and seven years (Kuratko & Hodgetts, 2008).

The attractiveness of such opportunity depends on entrepreneur's ability to recognize market value of a particular technological innovation, which such ability was based on entrepreneur prior knowledge in solving customer problem in related market (Shane, 2000). For entrepreneur to exploit such opportunity further through firm creation, key influential factors were found to be the nature of individual making decision, nature of industry in which opportunity would be exploited, and nature of the opportunity itself. In addition to that, the pace of technological change can also influences the rate of firm formation. Analysis on technological opportunity found that factors that influence probability of firm formation were the importance, radicalness and patented scope of technology. The importance was measured by the magnitude of economic value of invention, radicalness measured by the degree that invention differs from previous invention in such field, and patent scope measured by the scope of intellectual property protection (Shane, 2001a).

New technological opportunity will be commercialized in order to exploit profit from such innovation. In addition to just technology opportunity, the variation in technology lifecycle and appropriability conditions were found to be factors influenced probability of new technology to be commercialized through new firm formation. When technology is in early stage, age of technology is young and market is segmented, exploitation of technology through new firm formation is favored due to low competition from incumbent as market size is limited or unproved. The willingness to exploit an invention depends on ability to appropriate its value, which depending on effective of patent protection and complementary assets, such as distribution system or specialize manufacturing are not in advantage by incumbent firms (Shane, 2001b).

Further analysis was recommended to find the effects of interaction and evolution of technology component within firm to the new firm startup, rather than just at the macro level or technology trends (Park, 2005). In addition, it was suggested that investment in new technology should be treated as links of a chain of interrelated, staged investment decisions (Smit & Trigeorgis, 2007). As a result, investment and financing for technology investment are very important in the context of new firm start up.

2.4 *Capabilities*

Capabilities are underlying assets of firms that create valuable resource. Capabilities such as technology capability, marketing capability, and entrepreneurial capability are also key matrices that investors used to evaluate probability to survive of start-up and propensity to invest in start-up by investors.

2.4.1 _Technology Capabilities_

Technological capability is ability to use technological resources to combine/recombine components, linkages between the components, methods, process and techniques, and underpinning core concepts to offer products (Afuah, 2002). Each technological product can be viewed as bundles of different performance characteristics or attributes. Customer chose product of one firm over others' when that product offers better value or better performance characteristic. Customer value can be comprised of performance characteristics, physical characteristics, and product technology. Performance characteristics of technology are benefit perceived by customer and fit in customer value network or system of activities (Christensen & Bower, 2004). Physical characteristics are functions that create such performance (Afuah, 2002). Product technology consists of components and linkages between them, method, processes and techniques, and core concepts that underpin them.

Technological capabilities can be measured by technological skills which includes skills in applied R&D, transforming R&D into products and manufacturing new product (Zahra, Neubaum, & Larrañeta, 2007). Technological capabilities can also be measured by ability to exploit technological opportunities further through firm creation. However, key influential factors were found to be the nature of individual making decision, nature of industry in which opportunity would be exploited, and nature of the opportunity itself. In addition to that, the pace of technological change can also influences the rate of firm formation. Analysis on technological opportunity found that factors that influence probability of firm formation were the importance, radicalness and patented scope of technology. The importance was measured by the magnitude of economic value of invention, radicalness measured by the degree that invention differs from previous invention in such field, and patent scope measured by the scope of intellectual property protection (Shane, 2001a).

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2.4.2 _Market Capabilities_

In addition to technological capability, market capability is considered as complementary capability required to commercialize technological know-how to create value to customer in the market (Rajagopal, Sexton, Roland-Holst, & Zilberman, 2007). Market capabilities are complex bundles of skills and collective learning, exercised through organizational processes that ensure superior coordination

of functional activities toward market and customers (Day, 1994). Subgroup of market capabilities are market-sensing and customer-linking capabilities. Market-sensing capabilities emphasize ability to learn about customer, competitors and channel members in order to continuously sense and act on events and trends in present and prospective market. Customer linking capabilities is ability to create and manage close customer relationship through continuously exchanging information about needs, problems, and emerging requirement and coordinate activities relating to customers' order (Day, 1994).

2.4.3 *Entrepreneur Capabilities*

Entrepreneur capabilities that focus on capability to withstand intense effort during start-up is the highest weight factor from venture capitalists (MacMillan et al., 1985). Entrepreneurship is associated with growth, innovation and flexibility (Lastovicka, Bettencourt, Hughner, & Kuntze, 1999). The attractiveness of such opportunity depends on entrepreneur's ability to predict market direction, recognize market value of a particular technological innovation, which such ability was based on entrepreneur prior knowledge in solving customer problem in related market (Shane, 2000).

Figure below explained combined effects of technology capabilities, marketing capabilities and entrepreneur capabilities could enhance survival probability of the startup, which could further increase tendency that investors would invest in the startup.
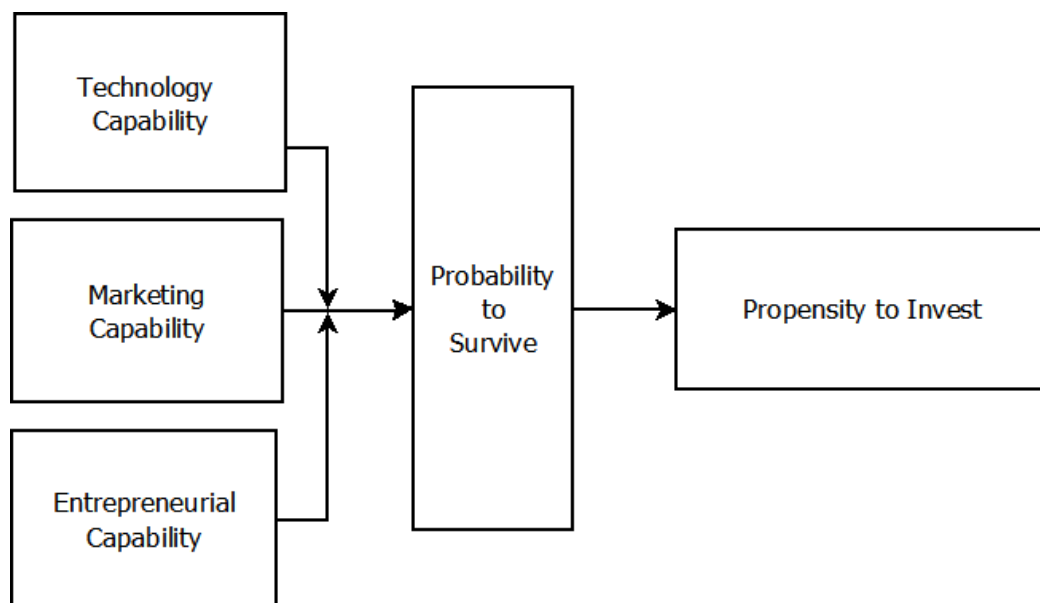
Figure 1 Capabilities of start-up that create survival and propensity to invest

Key questions in the later parts are about how start-up can create disruptive innovation in a way that can capture growth opportunities and how start-up can value such disruptive innovation and growth opportunities in order to communicate financing terms with investors.

2.5 *Disruptive Innovation: Capture Growth Opportunities*

In the study of innovation among large existing companies and small startup companies by Christensen (1997) found that small startup companies that use disruptive innovation could successfully survived and grew against the competition with large existing companies that use sustaining innovation. Large existing or incumbent companies were better positioned to utilize existing capabilities to pursue sustaining innovation or technology that focused on improvement in performance of established product along the dimension of performance that main stream customers in major markets have historically valued. However, new and small startup companies normally had no previous capabilities that they could use or depend on. Therefore, small companies would be in better position to seek to use disruptive innovation that address customer at low-end of value system or low-end disruption or at new-market who was non-consumption group or new-market disruption (Christensen, 1997).

Start-ups that contain disruptive innovation have more chances to achieve potential or target return. The higher the probability to achieve target return of star-up, the higher opportunity perception of investors become, and therefore, there is higher propensity to invest in the start-ups (P. K. Wong, Ho, & Autio, 2004).

Start-up can leverage its capabilities to capture growth opportunities through innovation. Disruptive innovation is one of the strategies that help start-up to create and sustain successful growth (Christensen & Raynor, 2003). Disruptive innovation create new growth business that disrupted the progress of established technologies in mainstream market (Christensen & Rosenbloom, 1995). To create new business that has more chance of success, the start-up should reconfigure existing components available in the market and applies to new market segment, rather than invent the whole new product to new market segment (Schwartz & Trigeorgis, 2004). To create new growth business, the start-up should address user needs in different emerging markets, apart from mainstream market that was dominated by incumbents (Christensen & Rosenbloom, 1995). It could either address low-end segment that focus on overserved customer by providing affordable solution or entry level product, or it could address new-market segment that focus on new on noncustomer or nonconsumption by providing solution that never been available to them before (Christensen & Raynor, 2003).

To create disruptive innovation, the start-up must deliver nonprice value at a cost that incumbents could not match through either from a classic strategic differentiation, a new business model with a different productivity frontier or a new business model that push new productivity frontier outward by key enabling technology (Raynor, 2011). Productivity frontier was defined as maximum value that company can offer product or service at given cost. It constitutes a trade-off between dimension of operation effectiveness and nonprice value. In order to deliver maximum value, firm can improve its operation effectiveness to obtain lowest relative cost position on one dimension, or improve its nonprice value through activities that create variety of product, satisfying various types of needs, and various ways of access to product on the other dimension. Strategic fit among systems of such activities can create

sustainable competitive advantage which implies sustainable of growth of start-up (Porter, 1996).

Technology change had contributed to change of structure and relationship of firms and market. Without proper anticipation of value from commercialization of technology in such new market, opportunity arise from disruptive technology will be valued as unattractive economic and financial return. As a result, established firms did not allocate proper resource to disruptive product development and commercialization. Technology choices, therefore, should be made by firm to anticipate value to be generated from disruptive technology, which would influence the strategic action of firm (Christensen & Rosenbloom, 1995).

Criteria for disruptive innovation are new business model, enabling technology, and new trade-off between price and non-price value (Raynor, 2011). The start-up must have a new business model that defines a different productivity frontier that can be profitable by serving customers that are unattractive to mainstream market incumbents. The start-up must be able to push the new frontier out by a technology or a set of process that enable start-up but difficult for incumbents to adopt it. The start-up must reconfigured product configuration to obtain a new trade-off in price and non-price value that incumbents cannot match, and in the end drive upward to become new dominant or mainstream market (Raynor, 2011). Such reconfiguration of product structure could be done by designing and making product structure to become modular.

2.6 *Modularity: Reconfigured Capabilities to Create Disruptive Innovation*

Modularity is a concept that enable changes in product structure to cope with uncertainty in newness of technology or market (Baldwin & Clark, 2006). In product structure, there are technology components which can be put together or combined into structure of final product from components, parts or assemblies (Arthur, 2007). Baldwin and Clark, (2000) had identified six modular operators to reconfigure product structure as splitting, substitution, exclusion, augmentation, inversion, and porting. The characteristics of real option in modular operators lie in implementation and testing whether the value of the new design after applying modular operator is positive or not. When best outcome of experiment reveals best performance or value, then the option is deemed exercised (Baldwin & Clark, 2000).
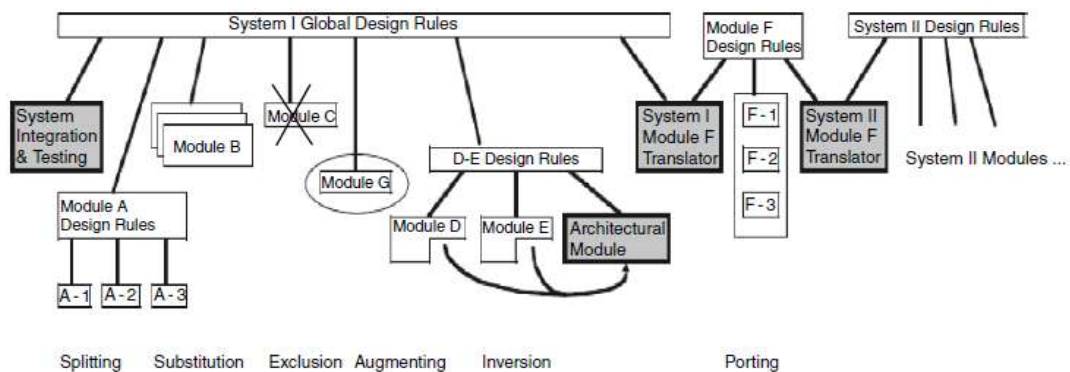
Figure 2 Modular operators (source: Baldwin and Clark 2006)

Splitting operator change single-level design with interdependent parameters and converts into hierarchical structure design with core design and subsidiary modules. Substitution operator compliment splitting by allowing replacing existing module after split with new module that is better in design or performance (Baldwin & Clark, 2000). Splitting and substitution are basis for creating modular structure that contains flexibility to future changes.

Exclusion operator takes out unnecessary modules to create the simplest configuration or minimal system for specific purpose at lowest cost. Augmentation incorporate users requirement by adding new module to give system new type for functionality required by users. Exclusion and Augmentation are basis for reconfiguration, after modularized by splitting and substitution. With strategy of exclude-then-augment, market entry strategy for newly reconfigured product can be started as initial version with minimal system design and then introduce other module augmentation to add new features after core minimal system success in the market. Early sales should serve as establishment of system in the market place, and the payment for addition modules can come at later stage (Baldwin & Clark, 2000).

Inversion operator takes previously hidden modules that commonly used by others and move it up the design hierarchy. By making the modules visible to others, it allows reuse of the inversed modules, therefore reducing component, increase efficiency and lower cost of new design. Porting operator breaks loose the hidden modules and extend to overlap to be used by other system. It also translates information to be used in another module. Both inversion and porting reduce cost of design or redesign by not having to start from the beginning each time there is a need to use such module (Baldwin & Clark, 2000).

2.6.1 *Modularity and Disruptive Innovation*

In investment view, modularity means reduction of investment cost in new product development to only new portion that was reconfigured upon existing product in the market. Modularity at 20% can be simplified to represent 20% portion that is flexible and able to reuse for another project or 20% of product development cost can be reduced. Therefore, modular also means a reduction of investment while return retain the same level, making increase in ROI. As entrepreneur facing problem in raising capital to finance innovation, designing to be modular means less rely on external financing.

To achieve new productivity frontier, the start-up can reconfigure its product or process to make its design become modularity. Modularity, when applies to existing product structure, can transform proprietary product architecture into new structure with common design rules and modules that enable lower cost from component reuse, improve bottleneck performance by substitute with new module, or add specific functions desire by specific niche market users. When product becomes modular, it creates option to design product in new ways that can change market value of previous design of product or process (Baldwin & Clark, 2000).

Technology capabilities with design/modular capabilities can provide exclusion and inversion operators to create low-end disruption by enable firms to deliver lower cost and better performance with technology-positioning option. On the other hand, providing augmenting and porting can enable start-up to deliver new product that suits the need of new market and flexible enough to cope with uncertainty of newness by allowing changing only modular portion.

2.7 Innovation and Financing

2.7.1 *Financing Startup and Early-Stage Investor*

Financing for technological innovation start-up is special due to risk of newness of technology and innovation and risk of failure of new venture. Due to lack of operating history that would enable investor to predict return level and probability to achieve, and partly due to less chance of survival, financing for start-up by external investors such as venture capital or business angel are rare (Damodaran, 2009). To help them select good start-up to invest, they set various criteria categorized into technology capabilities, market capabilities, and entrepreneur capabilities together with expected risk and financial return (MacMillan et al., 1985; Tyebjee & Bruno, 1984; Zacharakis, McMullen, & Shepherd, 2007). At product level, the probability that an invention will be commercialized through firm formation is influenced by its perception importance of opportunity, radicalness of invention, and broad patent scope (Shane, 2001a). In order to obtain financing from investors, the start-up has to show that they possess such capabilities and can leverage such capabilities to create growth and reduce risk of failure.

2.7.2 *Financing for Technological Business Startup*

Access to capital was one of the most important issues for startup. Typical collateral choices required by financial institution for young and small firms with few tangible were found to be personal collateral and guarantee. For firm with more tangible assets, pledge of account receivable and/or inventory against bank credit line were found to be twice as often. After lending, financial institution would control behaviour of borrowers by specifying in covenants that normally ties to financial performance. However, for small firms with no audited financial statement, covenants control could not be effective (Berger & Udell, 1998). Therefore, business startups, with no profit records and lack of tangible assets to place as collateral, would normally have limited access to general bank financing.

Type of financial resources for business startup depends on two factors; the stage of venture development and the scale of venture (Bhide, 2000). Study on initial funding for business startup with high technology or new technology-based firms (NTBFs) indicated that initial funding of venture cannot be based on cash from early sales since there is often no market available for such new product (Tidd, Bessant, & Pavitt, 2005) Therefore they tended to rely on outside equity financing such as venture capitals, angel investors, and corporate investors (Denis, 2004). However, limited the financing from bank, bank financing provided structurally the service of monitoring (Denis, 2004) and selection device (Dosi, 1990) to startup firms.

Startup firms account for much of innovation creation. However, capital constrains made them unable to exploit every potential profitable opportunities (Bollinger et al., 1983). Therefore, availability of financing support for startup should mitigate obstacles of creation of innovation.

2.7.3 *Venture Capital: Formal Risk Capital*

Venture capital could be described as professionally managed pool of capital that invested in equity-linked securities of private ventures (Sahlman, 1990). Typically, venture capital provided funding to firms at early-stage and startup stages (Gompers & Lerner, 1999). As a result, venture capital could also be defined as financial intermediary that provide risk capital to small and young firms operating in high-risk environment with expectation of high reward (Gompers & Lerner, 2001). They took active role in providing mentoring, strategic advice, help in bringing innovative product to market and assistance in recruitment of top manager (Denis, 2004). Main objectives of venture capitals were to be financial intermediary, limit investment to private companies, take active role in monitoring and strategic supports, maximize financial return by exiting through a sale of IPO, and invest for internal growth of companies (Metrick & Yasuda, 2010c). The study by Venture Economics (1988) revealed that one US dollar investment in a firm, holding average period of 4.2 years before goes public, could provide average cash return of $1.95 in excess of initial investment.

There were dramatically growth of venture capital industry in U.S. during 1972 to 1994 due to changes in regulatory allowing pension funds, reduction of capital gains

tax, overall economic growth and increasing expenditure of R&D (Gompers & Lerner, 1999). Their activities affected on patenting and R&D activities which in U.S. during the decade ending 1992, venture capital accounted for 8% of industrial innovation (Kortum & Lerner, 2000). Venture capital financing contributed to the innovation in high-tech start-ups (Hellmann & Puri, 2000). It contributed to the development of new firms by actively involved in strategic activities (Hellmann & Puri, 2002). However, as venture capital tended to be expensive source of financing, the cost must be traded off with benefit venture capital provided (Denis, 2004).

Venture capital had been one of the important forces that transformed innovation process in the US. Venture capitalist who forged important linkages among a variety of organization was important to the success of innovation process. Venture capitalist acted as "technological gatekeeper" that accelerating the process of technological change. It catalyzed technological change and provided research organization a strong incentive for "breakthrough" innovation (Florida & Kenney, 1988)

Venture capital fund obtained capital from limited partners who assigned role of investor in managing investment in firms to general partner (Metrick & Yasuda, 2010c). Therefore, as agent of investor, venture capitals have lower tolerance for novelty than business angels who invest their own fund. Venture capitals are likely to avoid untested business models, inexperienced entrepreneur and preferred investment in later stage of firm. In U.S. 1996, 77% of venture capital funding were three year old or older (Bhide, 2000).

To cope with the risk and uncertainty, venture capital extensively used stage financing and convertible securities. Stage financing was used to provide option for venture capital to be able to change its investment course according to performance of startup firms. Such conditional finance offered could also be called as integrated finance. It benefited small startups firms by reducing uncertainty in financing and cost (Aernoudt, 2005). They could abandon if entrepreneurial firm failed to perform as planned and create incentive for entrepreneur to meet milestone such as prototype or market test (Cornelli & Yosha, 2003).

Convertible securities served as various purposed in entrepreneurial firms. It served as incentive mechanism for entrepreneur to perform well so that venture capitalist will invest other series (Schmidt, 2003). It also served as uncertainty reduction tool on market failure or technology risk as fall back mechanism to allow venture capitalist to diverge and exit firms if the development of firm or market were not as planned. The convertible securities were developed to control cash flow rights in investee firms for the purpose of profit distribution and compensation (Jääskeläinen, Maula, & Murray, 2007) or control exit mechanism (Bascha & Walz, 2001; Hellmann, 2006).

Even though investment in startup firms provides opportunity for huge rewards for venture capital, startup firms contained high risk and uncertainty. At the beginning of firm, it was difficult to predict survival of business. It contained few tangible assets provided to venture capitalists to compensate for high risk environment (Gompers & Lerner, 2001). Most founders did not start out with proprietary ideas or valuable

intellectual property right that investor could assess in advance. Only 6% of founders started firms with unique product and services and only 3% had patents (Bhide, 2001). Together with specific objectives of venture capital, they interested only in innovation that could be made by small companies, which can be a small piece of new technology that could be patented and potentially licensed across a wide range of products (Metrick & Yasuda, 2010b). As a result, only 2% of small companies received funding from VC (Kuratko & Hodgetts, 2008).

2.7.4 *Private Investors*

Small firms had obtained external financing almost exclusively through private investor and debt market, while large firms have access to public market. Due to informational opacity, created by not fully disclose of information, small and startup business cannot issue security for public market (Berger & Udell, 1998)

Private investor provides funding support between business development stage-early stages before it reaches investment stage-listable stage that could obtain funding from public listing or IPO. From the start of business till maturity, the investment status of firm changes from viable, prospective and investable to listable. Funding by entrepreneur at seed stage is solo financing that change investment stage from viable to prospective. Funding by business angel at startup stage changed investment stage from prospective to investable. Venture capital provides funding at growth stage change investment status from investable to listable (Rasila & Okkonen, 1995).

2.7.5 *Business Angel: Individual Informal Risk Capital*

Even though VC proved to be important driver of fast growing startup companies, informal investors were found to be larger source of external financing for entrepreneur. From Global Entrepreneurship Monitor (GEM) (2008), investment in startup by informal investments were valued at $359 billion to 33.5 million companies that classified at Glamorous (or Superstars), while venture capital invested only $32 billion to 12,446 companies that classified as Economic core, constrained, and ambitious (Lumpkin & Eisner, 2003).

Business angels or angel investors are private individual who provide equity investments for seed capital during the early stages of a new venture. Business angels can also be defined as individual venture investor who are (1) networth over US$1million and annual income over US$100 thousand, (2) substantial business and financial experience, (3) capable of evaluating the merits and risks of prospective investments, (4) unaffiliated with portfolio venture, i.e. excludes founders, friends, and relatives, (5) willing to take substantial financial risks to earn substantial returns and (6) willing to commit funds for extended periods to earn substantial returns (Wetzel, 1987).

Business angel typically are private individual who provide risk capital of their own to small and private firms (Prowse, 1998). Source of funding from its own capital is the main characteristic that set business angel apart from venture capital who has to raise capital from investors. Funds invested by business angel were estimated to be as

much as by venture capital (Metrick & Yasuda, 2010b). Business angels are more willing to provide capital ten times as many businesses as venture capitals do (Bhide, 2000). They tended to focus on younger companies and make larger numbers of small investments than venture capitals (Metrick & Yasuda, 2010a).

Business angels often perceived as start up financing in second round after entrepreneur have exhausted all his family and friend's money, but before approach formal venture capital. They vary in degree of actively or passively involve in deal making. Most active angels share same characteristics of using to be ex-business owners who have considerable experience in setting up small companies or managing division of large companies and have high net worth. They often preferred to invest in small companies in startup or infant stage. They search deals from informal network of friends, family and other angels and screed deals using rough rules of thumb rather than systematic process. However, problems business angels faced were time-consuming and informal of deal searching, inadequate skill for picking up investment, and inadequate protection of investment contract (Prowse, 1998).

Behaviors of business angel are quite different from venture capital. Survey by Farrell (1998) found business angels not too keen on exist strategy. The report showed only 17.9% had sold investment and out of the remaining only 4.5% had ever tried to sell its investment. Return was reported to be in range of 20% to 50%. However, almost 37% of informal investor reported to lose their investment through bankruptcy or closure of business. This large number of failure reflected "gamble-like" nature of informal investment (Farrell, 1998).

Business angels were found not to rely on traditional control mechanisms such as board control, staging investment, or strong contractual provisions. Instead, business angels reduced expected agency cost and align interest of entrepreneur with outcome of firm by having entrepreneur to hold larger share proportion. It mitigated risk by investing in close geographic area and syndicate investments with other business angels (A. Wong, Bhatia, & Freeman, 2009). Empirical evidence found less use of convertible securities and preferred securities in business angels, while extensively used in venture capital (Giot & Schwienbacher, 2007).

Business angel who focuses on investment in technology may be called as technology angels. It was found that as they invested in high-technology ventures, they needed to improve quality and reliability of technology assessment to facilitate financing of innovation and its commercialization (Freear, Sohl, & Wetzel, 2002). Technology angels' behaviors were found that their level of involvement was different from others. They invested in firm at earlier stage, with higher involvement, and more deal making. As a result, technology angels exhibited behaviour of "co-founder" or "portfolio entrepreneurs" than other type of angels (Erikson & Sørheim, 2005)

If certain investment from business angel is limited to family relationship, it should not be considered as a market for investment (Mason & Harrison, 1996). Therefore, for investment of business angel that is not restricted to just family relationship, it should constitute a market, "informal venture capital market".

Investment from business angel in the startup or new firm creation, should be for either acquiring resource to develop technological capability that customer wants. (Bone & Saxon, 2000).

2.8 *Options: Capture Uncertainty in Growth Opportunities*

Investment in capabilities that create right to apply to other area without obligation to pursue it would enable start-up to capture growth opportunities. Framing capabilities as option also create balance focus between exploitation of capabilities and exploration of opportunities that match with such capabilities (Kogut & Kulatilaka, 2001). Investment opportunities can also be viewed as options when such investment is irreversible, associate with uncertainty and various choice of timing (Dixit & Pindyck, 1994).

Option-like investment can be categorized as growth options and strategic option, which growth options create possibility of new and profitable revenues, but strategic options create possibility to compete in existing core/mainstream market but in fundamentally different ways (Raynor, 2011). Investment that create growth opportunities can also be viewed as call option (Myers, 1977). McGrath and MacMillan (2000c) categorized options related to opportunities with consideration to different level of technical uncertainty and market uncertainty as core enhancement launches, platform launches, positioning options, scouting options, and stepping-stones options. However, since start-up has no prior product as platform to enhance upon, therefore, the possible options for start-up are positioning options, scouting options, and stepping-stones options. Start-up's capabilities in technology, market, and entrepreneur help creating corresponding options in technology, market and entrepreneur that are source of disruptive innovation and growth potential as in figure 3.
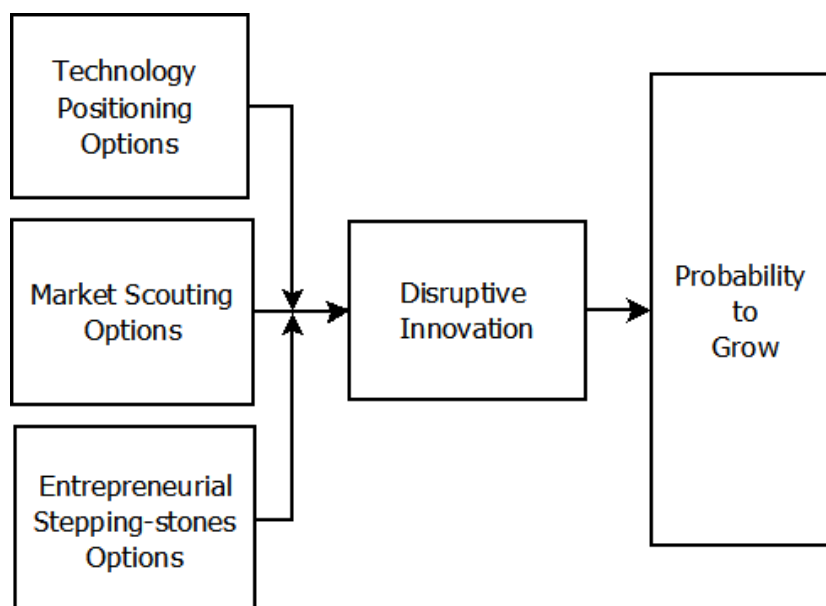
Figure 3 Options that create disruptive innovation and growth opportunities

2.8.1 *Technology Positioning Options*

In the strategic technology assessment review (STAR), McGrath and MacMillan (2000a) described technological capabilities factors that corresponding to technological positioning option value as comprised of value of claim on potential upside less commercialization cost and less development cost. Value of claim on potential upside was a function of positive level of cash flow which were affected by structure of demand, speed of adoption, blocking potential, and a function of sustainability duration of cash flow which were affected by competitive response, ease of imitation, and standard capture. Commercialization cost was a function of investment to access market, investment to build infrastructure, parallel technology cost, and industry development costs. Development cost, or option cost, was a function of firm capabilities, spilled over effects, and potential downside damage (McGrath & MacMillan, 2000a). Such factors were found to be more uncertain in technology category than in market. Therefore, investment that exposes to higher uncertainty of technology than market factors should be best utilized technology positioning options.

Technology positioning options create right to be in a position to wait and ability to exercise investment in technology when opportunities are clear and certain. Investment in technological positioning options is valuable when there expected to be high potential market demand or opportunities but not yet clear which technology will dominate, lacking dominant design or standard, or lack of technology feasibility, or lack of regulatory to support such technology (McGrath, 1997). The key is to make smallest number of positions by investing new technological capability at the lowest cost to hedge against making a wrong position The best course for start-up that invest in new or uncertain technology to benefit from this technological positioning option can be in making small investments in that uncertain technology (McGrath, 1997; McGrath & MacMillan, 2000a, 2000c). The learning and experiment shall be expected to be an improvement in efficiency of technology, cost reduction, and possibility to establish that new technological capability into new platform (Kogut & Kulatilaka, 1994) that enable new product or feature to be added or existing to be removed (Gawer, 2009).

2.8.2 *Market Scouting Options*

In order to create profitable growth, firms should deepening strategic position in making activities more distinctive and valuable to customer by providing more choice of product or service varieties, serving most or all needs of particular group of customers better, and preferred choice of customer access through product and product information (Porter, 1996). Market capabilities with design capabilities can provide augmentation operator to create new-market disruption by enable firms to deliver nonprice factors that added to satisfy customer needs with market scouting option. Property of core competence is that they can be deployed in more than one market (Afuah, 2002). Scouting options, or probing options, extend existing capabilities to new direction that there might be high market opportunities and uncertainties.

2.8.3 *Entrepreneurial Options*

Stepping-stones options comprise of many stages of sequenced of real options, addressing to create new technology capabilities that might satisfy future market opportunities. It contains many small technological positioning options and market scouting options. The start-up can initiate with small experiment in less challenging market niches that entrepreneur knows its customer who can provide feedback to improve technology and market offering, and use the experience gain there as stepping stones to build capabilities in another increasing challenging and attractive market (McGrath & MacMillan, 2000c). When the path of technology and market development are uncertain, there may be a chance that young companies which success in one business or market used it as a stepping-stone to success in other new products or new markets (Damodaran, 2009).

For start-up, entrepreneur can reconfigure its product offerings and redefine value chain, in order to withstand competition from incumbent (Porter, 1985). Modular operators can be used to reconfigures any product offering to either reduce cost or increase variety to offer to markets. As a result, entrepreneur capabilities can support the use of technology positioning options, market scouting options, or stepping-stone options, depending on level of entrepreneurial intensity that match with level of goal desired by investors.

2.8.4 *Growth Options*

Firm's investment in growth opportunities creates call options which its value depending on future discretionary investment of firm. (Myers, 1977)

Growth options is investment in opportunities (Kogut & Kulatilaka, 1994). For startup, growth options create possibility of new, profitable revenues (Raynor, 2011). Therefore, method to value options could be beneficial to value growth opportunities of startup.

Investment in opportunities are firms' option on future growth (Kester, 1984). Growth options also represent real value for firms that possess them (Kester, 1984). Resource allocation for investment should consider growth options in terms of simple/compound, expiring/deferring, and shared/proprietary growth options. Simple growth option creates value only through cash flows stemming from underlying assets. Compound growth option-like research and development projects create expansion in existing market or entry into new market, leading to new investment opportunities, which affect the value of existing growth options. The shared, compound, and deferrable growth options is important not to overlook even though cash flow analysis may not look promising, because it creates future growth potentials.

Capabilities only explain probability to achieve desired rate of return. Innovation is deployment and leverage capabilities to capture opportunities in market which then create growth for startup. But Innovation is newness that is uncertain by nature. Future growths are uncertain and therefore they need growth options to capture many

scenarios of future technology. They need entrepreneurial options to create flexibility and resilience for growth scenario.

2.8.5 *Platform Options*

When the reconfiguration of product architecture makes certain common modules of product to be reused and shared with others, that module is called platform. In platform architecture some common modules and its interface will be fixed, allowing other modules to evolve according to demand from user over time (Gawer, 2009). Investment to create platform of products can create value from operational flexibility and value growth options (Kogut & Kulatilaka, 1994).

2.9 *Traditional Discounted Cash Flow Valuation*

Traditional discounted cash flow valuation based its concept on valuating intrinsic value of company. The riskier the future cash flow is, the lower the value at present (Damodaran, 2001). Key factor that describe changes in valuation is the use of discount rate that could use to reflect various types of risk, such as risk-free rate, technology risk premium, market risk premium and management (or entrepreneur) risk premium. On the other hand, limitation of traditional discounted cash flow is also at discount rate, which it assumed static decision making and focused on downside risk. Therefore, discounted valuation approach would miss the opportunity to value upside (Damodaran, 2001; Mun, 2006). This issue becomes more important when using traditional valuation to measure value of startup companies which have high risk in various aspects. High perceived risk by investors reflected in higher desired target return or higher discount rate which resulted in lower value of startup expected by investor. All volatilities, either upside or downside were considered as risk. For example, desire rate of return for startup could range from 70% to 100% which gave too low valuation for startup. It caused few deal to get funding at this low valuation. It might also create perception for investors that there were few quality startups for them to invest too.

Discount rate was a risk-adjusted rate which used to represent risk and uncertainty in future expected cash flow on startup side and also used to represent perceived risk in investor viewpoint. Discount rate was powerful in the sense that it could capture and model all type of risk in to single parameter. However, estimation of proper discount rate to use was also another limitation of traditional discounted cash flow. In summary, traditional discounted cash flow had limitation in static valuation and estimating discount rate to represent all risks.

2.10 *Real Options*

2.10.1 *Real Option Reasoning: Flexibility and Value of Waiting*

Not only real option reasoning is beneficial to technology selection stage, but it is also beneficial to business startup as a whole. When business startup focused too much on success, it might create anti-failure bias, which could blind entrepreneur for real

relationship between market and the new product to offer. Real option reasoning proposed to view entrepreneurial initiatives as real options. Rather than avoiding failure, real option reasoning suggested to manage cost of failure by limiting downside risk exposure while maximize opportunity and gain. Once failure occurred, real option reasoning suggested to falling forward upon such failure in early stage of development by recognizing it as learning in order to reduce uncertainty and increase value in the next stage of explore and search (McGrath, 1999). Real option reasoning implied business startups process to be in small stages with feedback of failure as learning to perform better in the later stages.

2.10.2 *Real Options Valuation: Value of Growth Opportunity*

Real options approach is the application of financial option theory to nonfinancial options such as strategic planning (Amram & Kulatilaka, 1999). With uncertainty in technology and market development, the most important job for start-up is entrepreneurial leadership; technology and market insight, allocation resources, planning, and real option reasoning to see opportunity and exploit it (McGrath & MacMillan, 2000c). Real option reasoning is a thought process for firm with entrepreneurial mindset or start-up searching for opportunities (McGrath & MacMillan, 2000c). Real option reasoning was used as assessment tool to value technology positioning options. Value of technology option was proposed to be comprised of value of claim on potential upside less with cost to develop technical capabilities (option price) and cost to commercialize technology to market (McGrath, 1997; McGrath & MacMillan, 2000a). To value real options, binomial lattice model can represent uncertainty by showing evolution and changes of value of underlying asset through risk-neutral probabilities of outcomes as it pass in different stages from beginning until final date as in figure 4 (Amram & Kulatilaka, 1999).
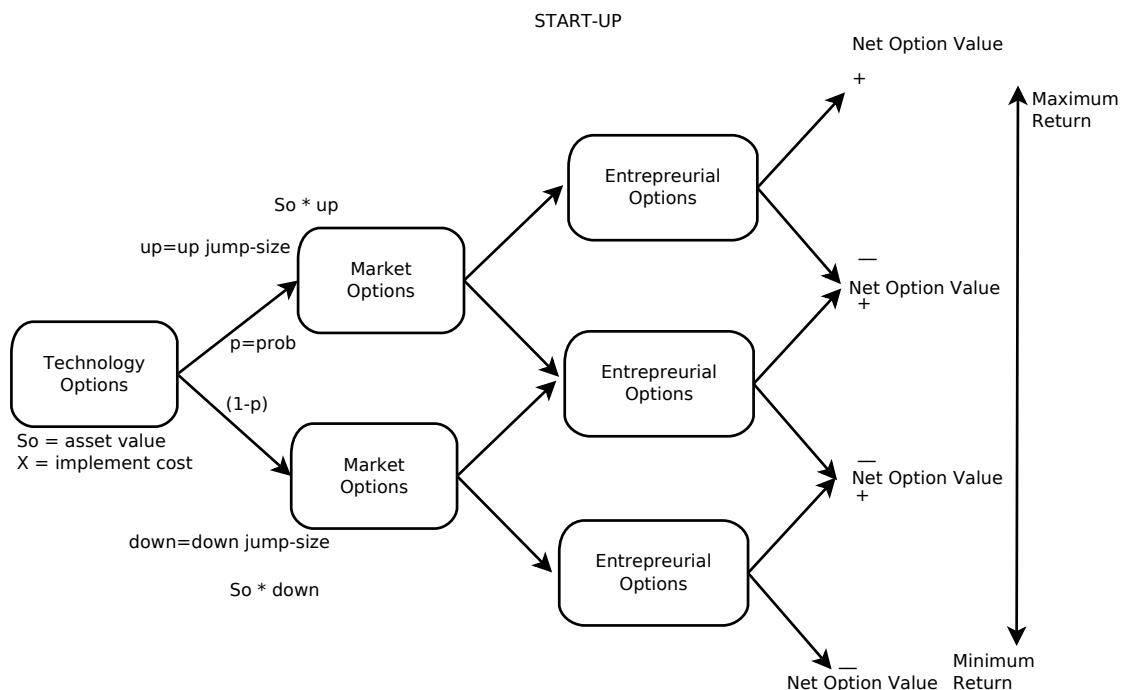
Figure 4 Real option valuation

2.10.3 *Modularity and Real Options*

Modularity can be valued using real option because real options are embedded in designs, technologies, and production processes (Baldwin & Clark, 2000; Gamba & Fusari, 2009). Baldwin and Clark, (2000) had identified six modular operators as splitting (complex system to many modules), substitution (old with new module), exclusion (unwanted modules), augmentation (by add new module), inversion (combine common elements), and porting (create shell to let module works with other modules).

In general, real options have been identified to be valuable in various dimensions and modularity has specified various functional to reconfigure product design to obtain higher option value. For start-up, the entrepreneur needs to explore how to make use of these modular operators to create growth and sustainability. In addition, for investors in start-up, they need to explore how to use real option to value the business and product after applying modular operators.

Investment in market scouting option can be in varying current product feature and bundle different complimentary attribute, peripherals, to test nature of demand, size and growth of future market (McGrath & MacMillan, 2000c).

Design capabilities is capabilities form high level of knowledge of new/enable technology to focus on attribute that customer value and at lower cost (Ulrich & Eppinger, 2008). Product designed in platform system that allow other product to be created on top of its product can create valuable product development option and given them away to other companies. More product developed for the platform, the more valuable the platform as increasing return economies (Arthur, 2007). As a result, product system architecture need to be designed to allow easy rework according to reflect change from actual market needs.

By integrating modularity, real option, and disruptive innovation, we can conclude that augmentation operator can create new-market disruption by enable firms to deliver nonprice factors that added to satisfy customer needs with market scouting option. And exclusion and inversion operators can create low-end disruption by enable firms to deliver lower cost and better performance with technology-positioning option.

In conclusion, start-up has choices to be made for technology development on commercializing such technology to either, in broad category of low-end disruption that likely to require shorter duration of investment, lower amount of investment, lower level of technology and market risk, and medium-to-high return expectation or new-market disruption that likely to require longer duration of investment, higher amount of investment, higher level of technology and market risk, and higher return expectation. Selection on which type of options to choose in some level depends on fit between start-up strategy and capabilities.

2.11   *Investors' Decision Making*

2.11.1 *Prospect Theory*

Prospect theory by Kahneman and Tversky (1979) explained decision making process to consist for framing phase and valuation phase. In framing phase, the decision makers construct a representation of acts, contingencies, and outcomes that relevant to their decision. In valuation phase, the decision makers assess the value of each outcome and choose accordingly. People make decision by perceiving outcomes as gain or loss, with neutral reference point, rather than final stage of wealth or welfare, and value of each outcome is multiplied by decision weight, not probability of occurrence (Kahneman & Tversky, 1979).

2.11.2 *Security-Potential/Aspiration (SP/A)*

Decision making tool that focus on security and potential was proposed by Lopes and Oden (Lopes & Oden, 1999b) as SP/A (security-potential/aspiration) theory which incorporate the analysis of investors seeking for security from its investment, potential of gain and aspiration level in avoiding poverty or seeking wealth. Investors will select the choice options that are evaluated based on their probability of reaching a potential level (or target or goal). This study proposed to use SP/A as dual criteria of security and potential because security level ties to affordable loss and its probability of loss concept of effectuation (Dew, Read, Sarasvathy, & Wiltbank, 2009) and potential level also ties to disruptive innovation. In addition, the use of aspiration level as single parameter to determine whether the start-up could provide outcome higher than aspiration/target/goal or not which such parameter could be used to describe propensity to invest of investors in start-up companies

The preferences for upside potential and limiting downside risk are probably the most important to individual investors when investing in start-up because they cannot diversify the risk out in capital market. Therefore, it is important for start-ups to structure their product structure to be in-line with tools and criteria that investors are using so that they can reflect valuation that match with investors' behaviour in making choice under uncertainty.

2.11.3 *Security-Potential/Aspiration (SP/A) Theory to Evaluate Investment Decision Making*

Consideration of investor preference is very important factor in financing start-up, especially for individual investors such as business angels. The importance of preferences for upside potential and limiting downside risk is considered to be more important to individual investors when investing in start-up because they cannot diversify the risk out in capital market. Therefore, it is important for start-up to structure its product structure to be in-line with tools and criteria that investor is using so that it can reflect valuation that match with investors' behaviour in making choice under uncertainty.

Investors evaluate the start-up and making choice depending on indicative factors that could help predict survival and potential of growth (MacMillan et al., 1985). It is also reasonable for individual to seek to consider there exist catastrophe in investment may become lost and therefore, consideration of investment in safety first is possible (Roy, 1952). In addition, general risk and return derived from mean-variance tools might not fully be comprehended by individual investors who focus their objectives on survival and growth (Shefrin & Statman, 2000). Lopes and Oden (1999a) proposed SP/A (security-potential/aspiration) theory as a dual criterion model for investment choice under uncertainty which incorporate the analysis of investors seeking for security from its investment, potential of gain and aspiration level in avoiding poverty or seeking wealth. Investors will select the choice options that are evaluated based on their probability of reaching a potential level (or target or goal) as in figure 5.
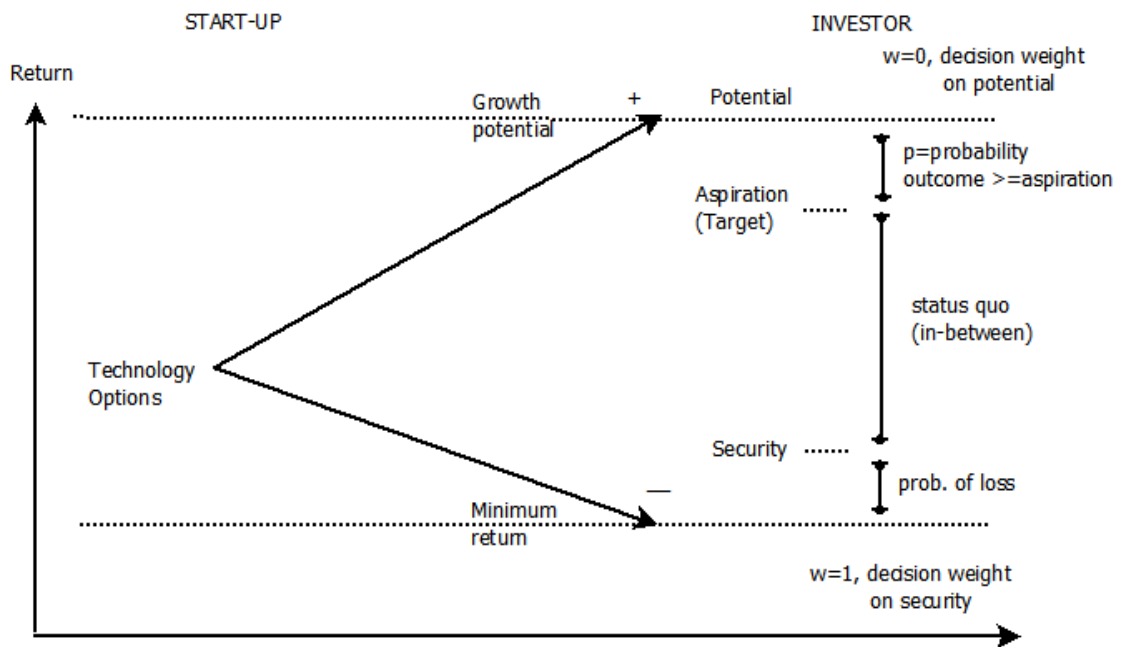
Figure 5 SP/A (security-potential/aspiration) theory

Wang and Johnson (2009) proposed Tri-Reference Point (TRP) as three criterion model that decision maker desire to surpass a goal (or potential or target), stay above security level (or survival) and improve current status quo level. However, in typical cases, it is difficult for start-up to estimate status quo level of investors. In addition, the investment level of business angel in startup and the loss from the investment should not be large enough to affect status quo of business angel. Therefore, in this study with business angel investment, it is proposed to use SP/A as dual criteria of security and potential because security level ties to affordable loss and its probability of loss concept of effectuation and potential level also tie to disruptive innovation. In addition, the use of aspiration level as single parameter to determine whether the start-up could provide outcome higher than aspiration/target/goal or not which such

parameter could be used to describe propensity to invest of investors in start-up companies

2.11.4 *Affordable Loss*

Affordable loss is the factor that influences decision of entrepreneurs and investors to taking plunge into the start-ups. Factors affected affordable loss were 1) preference for taking the plunge, 2) ability to take plunge, and 3) depth of the plunge (Dew, Sarasathy, Read, & Wiltbank, 2009).

Preference for taking the plunge in investment in start-up depended on perception of financial motivation such as upside potential, and non-financial motivation such as psychological reason and socioeconomic factors (Dew, Sarasathy, et al., 2009). Growth potential from disruptive innovation could increase preference of investors through perception of upside profit potential which satisfy their aspiration.

Ability of investors to take plunge in investment in start-up could be from unexpected increase of wealth which lifts mental account set aside for affordable loss, from actions such as inheritance, stock option, and lottery winning (Dew, Sarasathy, et al., 2009).

Depth of the plunge depends on level of commitment to start the business and also pre-commitment to adhere to the level of affordable loss-to back away when it required to quit (Dew, Sarasathy, et al., 2009). Proper strategies of entrepreneurs to structure start-ups to match with investors' preference, ability, and depth of the investments should increase propensity and amount of investment from investors

Affordable loss mindset is important to propensity to invest of individual investors in start-up companies that has technological innovation. From structural interviews with investors who invested in start-up companies in Thailand, the investors' simple decision making rules were the balancing affordable loss and aspiration. By focusing on structuring the start-ups' capabilities to increase level of affordable loss and innovation to increase growth potential, level of aspiration of investors, the start-ups should have more potential to obtain investment from investors. Web-based interactive case study of start-up with various innovation options was presented to investors to test decision making criteria for security, potential and aspiration needs.

Affordable loss was one of the recently found to be key criteria in making decision to invest in start-up by individual investors (Wiltbank, Read, Dew, & Sarasvathy, 2009). To promote innovation and growth in start-up, there is a need for sufficient financing during startup or seed financing.

2.11.5 *Affordable Loss and SP/A*

For Security and Affordable loss, entrepreneur can control, by risk acceptance and loss avoidance on reducing investment. For upside, Potential level may be out of

control, but Aspiration is target within their thought. This Aspiration would induce EN trying to make scenario better in order to increase potential return.

2.11.6 *Entrepreneur Quality*

Various factors could affect level of affordable loss. Quality of entrepreneur could help investors increase their perception of affordable loss level or compensate with lower return or possibility of achieving target return. List of possible quality of entrepreneur that could be possible during startup are proposed as follow.

Integrity was defined as the quality of being honest and having strong moral principles that you refuse to change (Gillard, 2003). Integrity of organization would be self-governance in accordance with set of guiding principle to support ethical and sound behaviour (Paine, 1994).

Honesty was defined as the quality of being truthful or able to be trusted and not likely to steal, cheat or lie (Gillard, 2003). The startup or entrepreneur that had good reputation of being honest was considered as evidence to reduce initial investment risk for investors (Shepherd & Zacharakis, 2001).

Moral was defined as factor relating to standards of good or bad behaviour, fairness, honesty, etc. which each person believes in, rather than to laws (Gillard, 2003). Moral entrepreneur was defined as people who believed good things would come to the people who do what is right and create or enforce moral in process or environment (Becker, 1963).

Trustworthiness was defined as ability to believe or confidence in the honesty, goodness, skill, safety of a person that will not harm or deceive you (Gillard, 2003). Trust was key issues in bonding relationship between entrepreneur and bank (Howorth & Moro, 2006; Welter & Smallbone, 2006).

Gratitude was defined as the feeling or quality of being or expressing thanks especially to another person (Gillard, 2003). Gratitude was mixed effect of empathy and guilt (McCullough, Kilpatrick, Emmons, & Larson, 2001). Gratitude was also defined as attitude toward life that is a source of human strength which enhance one's personal and relational well-being (Emmons & Crumpler, 2000).

Adversity was defined as ability to cope with extreme difficult situation (Gillard, 2003). Adversity was factor that help augmenting or stimulating creativity (Kasof, 1995; Waelsch, 1994).

Attitude was defined as a feeling or opinion about something or someone (Gillard, 2003). Positive attitude toward work was quality of good entrepreneur (Kets de Vries, 1996). Attitude of entrepreneur can be a predictor for strategic growth of startup (Majumdar, 2010) .

Credibility was defined as someone can be believed or trusted (Gillard, 2003).

Credibility of entrepreneur and starup would be examined by venture capital in order to reduce agency risk beforehand during due diligence process (Arthurs & Busenitz, 2003).

Reputation was defined as the opinion that people in general have about someone or something, or how much respect or admiration someone or something receives, based on past behaviour or character. (Gillard, 2003). Reputation is related to past action that affect behaviour (Mouzas & Blois, 2008). Financial institution or investor would consider reputation as proxy of trust in provide financing or capital in the startup (Howorth & Moro, 2006). Reputation is a factor that help reinforcing contractual relationship (Mouzas & Blois, 2008).

Care was defined as process of protecting and looking after someone or something (Gillard, 2003). Successful relationship between entrepreneur and investors depended on entrepreneur care for investors' goal and tried to reduce goal dissonance (Seshadri, 2007).

Fair was defined as treating someone in a way that is right or reasonable, or treating a group of people equally and not allowing personal opinions to influence your judgment (Gillard, 2003). In order for entrepreneur to build trust with investors, they had to convince investors that the procedure in the startup used by entrepreneur were fair and concern key consideration of investors' interests (Shepherd & Zacharakis, 2001).

2.12 *Integration of Modularity, Real Option, Innovation and SP/A Theory*

With modularity, entrepreneur could reconfigure product by split previous design structure into smaller modules through different modular operators that possess options in the way that enable security and potential of growth for investors' need. The integration of entrepreneurs in structuring their products to create disruptive innovation to match with investors' behaviour in making choice under uncertainty are important to bridge demand and supply for financing for innovation. Therefore, this study proposes to integrate real option and modularity to the way start-up and entrepreneur utilize its capabilities, assess technology and market, seek opportunity, and choose between types of disruptive innovation as in figure 6.

However, calculation can be complex and divert away from real issue of managing proper strategy to cope with survival and growth. As a result, the proper tools should allow both investors and entrepreneurs to exercise both precise detail level valuation and also exercise broad view of strategy to enter market. As a result, this study proposes to apply SP/A (security-potential and aspiration) theory with various options and modular operators that security and growth for the start-up.
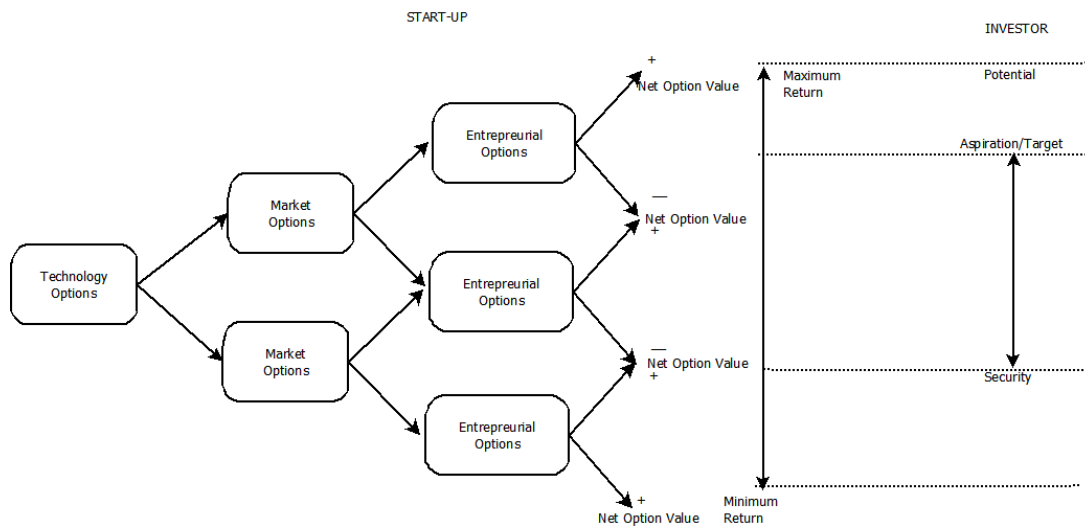
Figure 6 Start-up's valuation with real option and SP/A

2.13 *Research Gap*

Based on literature review, there are strong evidence of contribution of business startup on innovation process and new technology creation. However, there is a gap in proper financing support for activities of business startup by public financing. Lack of understanding on risk and return of innovation process from public market such as financial institutions or capital market, has widening financing gap for business startup. As level of complexity of innovation and technology development of business startup increases, mismatch of risk and return preference of public capital increase. In conclusion, there is no clear synthesis of knowledge in investment evaluation, nature of technology and innovation, and process to commercialize to market, that investors can link such knowledge of each stage to investment.

2.14 *Conceptual Framework*

In creating conceptual framework that attempts to resolve innovation creation gap between business startup and business angel, knowledge creation and national innovation system were considered as policy level framework guiding overall theme to ensure consistency from policy level down to individual level. Business startups typically incorporated into new venture through opportunity created by technology change, but they also face high risk of creating products that fail to satisfy market needs. Therefore, it is suggested that they should overcome that risk by learning to resolve such uncertainty through step by steps evaluation and adjusting their process accordingly to the finding along the development path. The linkage of knowledge from external market into learning of innovation process was considered as a starting point and basis of underlying framework.

Innovation process was known as long and complex. Attempt to enhance success rate of innovation was created through concept of innovation as process. However, during business startup, process of innovation are getting longer and more complex, therefore, tying return of business angel to the final outcome of product after launched

into market may be too long and risky, comparing to rapid of change of technology and market. Rather than waiting until the end result, innovation process and technology creation during startup should be split into sub-process or technological components that linked and chained to deliver value through value chain or value network.

Technology commercialization should therefore be considered as process too. At practical level, technology commercialization framework should explicitly show likelihood of commercially success of business startup activities to business angel. One of technology commercialization process was Profit from Innovation model by Teece (1986) that incorporate viewpoint of factors critical to successful commercialization; dominant design of technology, intellectual property right exploitation, and complimentary assets. The viewpoint that specifically supported consideration of complimentary assets can foster investment from specific business angel network that related to such technology, and as a result foster clustering of business and technological capability.

Financing process of innovation was also support the staging of innovation process. Stage financing techniques has been used by venture capital to formalize investment process for business startup. To design financing instrument for innovation, it should incorporate dimension of flexibility that allow converse to any form with respect to contingent situation faced along innovation development.

Adding value through flexibility of investment decision also reduce uncertainty of innovation development. Venture capital or business angels could utilize option analysis for investment evaluation under uncertainty. Real option analysis was developed to study value from flexibility created by investment that has option embedded in business situation. For widespread use of option thinking for business angel and venture capital on strategic thinking, reduction of sophistication of investment analysis was proposed as real option reasoning to evaluate risk-adjusted return through simple possibility weight of each strategic choice. It values heuristics considerations for business scenario and strategy higher than complex probability analysis. Technology selection and evaluation were incorporated with real option reasoning to consider best possible return on technology each stage of commercialization process.

Once technology can be classified in various components nested in hierarchy, their value or profit generated from commercialization could be anticipated through deduction along the value chain. As a result, value of each component can be used as collateral for such specific investment stage. At investment level, proceed from each sub-technology components can be used as guarantee for worst case as liquidating value if such investment failed to create viable commercial final product in the later stage. Such investor can reduce its investment risk especially for business startup stage.

Investment contract can then be designed synthesize all factors in various platform. It can be designed to finance each stage of technology commercialization and linked

with return of technology in the best case and linked to salvage value of technology as sunk cost in worst case that commercialization fail. Option can be incorporated with investment by allowing conversion of such salvage value to guarantee investment upon investment made. Financial contract can also be designed to incorporate various factors at policy level that aims to promote investment in business startup such as tax incentives to increase business angel return at same level of risk.

This study is based on viewpoint platform of technology, business, and investment. It seeks to study the effect of specific nature of technology, commercialization model that consider dominant design-IP-complimentary asset, and investment in stage, options and collateral. Process of investment during startups that incorporate viewpoints above can be depicted as follow.
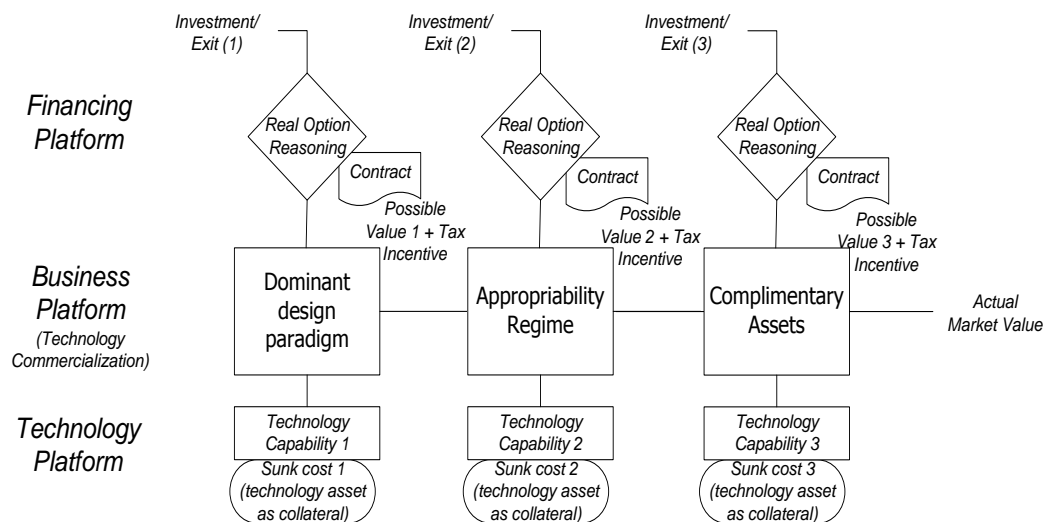
Figure 7 Process of investment decision making in technology innovation startup

2.15   *Research Proposition*

From above conceptual framework, cause and relationship diagram can be developed to test Proposition of interaction between business startups and private equity. Factors of specific nature of technology, commercialization model that consider dominant design-IP-complimentary asset, and investment consideration in stage, options and collateral could be detailed out in diagram as follow.
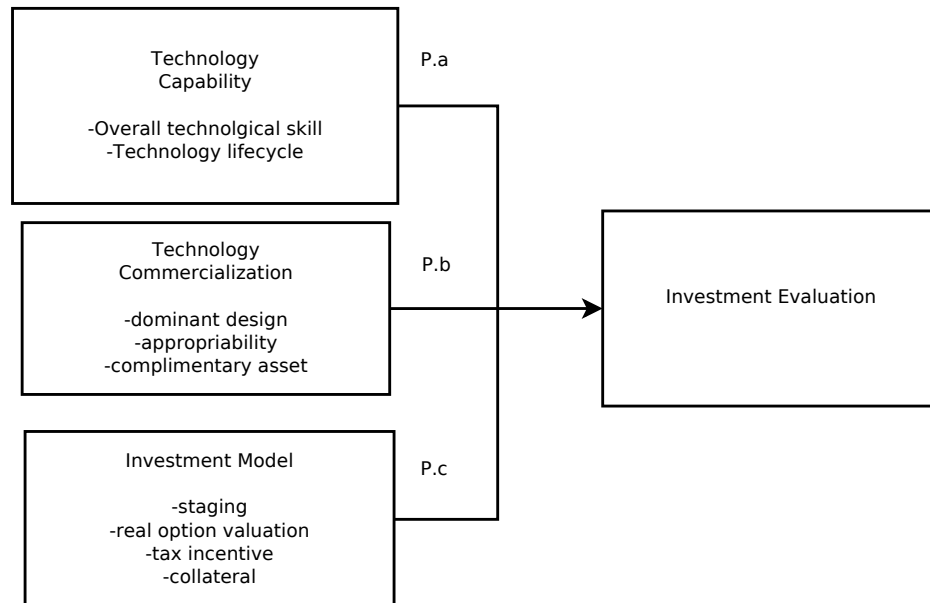
Figure 8 Conceptual framework of investment model

Research Proposition

P.a. Technological Capabilities of business startup have positive impact on evaluation of Private Capital to invest in business startup.

P.b. Technology Commercialization of business startup has positive impact on evaluation of Private Capital to invest in business startup.

P.c. Investment Model of business startup has positive impact on evaluation of Private Capital to invest in business startup.

Variables that reflect relationship between business startups and private equity will be obtained from literature review. They are showed as process of conceptual diagram and as causal relationship as above. They are variables of business startup technological capability, technology commercialization, and investment evaluation.

Technology capability of business startups attracts investment from private equity. Development in new technology or innovation, before commercialization stage, creates option value in such technology because it allows firms to choose in commercialization stage when benefit of technology is clear whether it will pursue commercialization or not.

2.15.1 _Technology Capabilities_

Technology Capabilities

Technology is defined by Oxford English Dictionary as "the scientific study of practical or industrial arts" (Arnold & Thuriaux, 1997). The following terms on technology creation, technology development, were grouped under technology capabilities in this study.

Technology Creation

To manage product development, entrepreneur should create new solutions on their own terms, irrelevant to what current offered in market by any competitors. Technological capabilities consisted of strategic internal element, external elements, and strategic elements (Arnold & Thuriaux, 1997). Internal elements are capabilities for developing and managing intangible and tangible technology bases. External elements are capabilities to access external knowledge that support or complement internal capabilities. Strategic elements are search intelligence for understanding of customer needs and technological opportunities.

Technology Development

Technology development parameters are as follow (Zahra et al., 2007), (Raynor, 2011)

- Skill in conducting applied R&D
- Ability to transform R&D results to products
- Skill to develop new products
- Ability to upgrade existing products that exist in market by removing bottleneck
- Speed of new product development
- Efficiency in developing new products
- Efficiency in manufacturing products
- Skill in manufacturing

Technology Development (Wiltbank, 2005),

- Ability to develop product better when comparing their progress against the development of competitors.

Technology Development (Raynor, 2011)

- Ability to upgrade existing products that exist in market by removing bottleneck through differentiation
- Ability to upgrade existing products that exist in market by removing bottleneck through new product efficiency frontier
- Ability to upgrade existing products that exist in market by removing bottleneck through technology

Technological skills

Technology capabilities cover wide range of skills from R&D to product development and manufacturing. Overall technological skill was used to explain gross effect from ability to applied R&D into new product (Zahra et al., 2007).

Technology lifecycle status

In McGrath (1997), cost of technology development was assigned as option price. Value of technology option was measured by value of return from operations less cost of commercialization and cost of technology development. Business startup

capability or potential to commercialize depended on technology lifecycle status and spillover effects. Early stage in technology lifecycle has greater potential for commercialization.

2.15.2 *Technology Commercialization*

In order to create commercial value of technology to inventors, Teece (1986) proposed three fundamental building blocks for technology commercialization that would create maximum commercial profit if consider dominant design paradigm, the appropriability regime, and the complementary assets.

Dominant design regime
Before dominant design emerged, there are rooms for modification to get market acceptance (Suárez & Utterback, 1995). It shows high possibility or option value to commercialize. After dominant design emerged, the market accepted such design, and competitive factor shifted from design to price (Christensen, Suárez, & Utterback, 1998).

Complimentary asset
The complimentary assets will be key assets that support commercialization with competitive price to market (Teece, 2003). The matching of dominant design and complimentary assets ensure high possibility or option value to commercialize such technology.

For radical R&D project some complimentary components may not yet support the commercial at prototype stage. Innovator may choose to delay radical project in to later stage and implement mainstream product to prepare capability of complimentary asset later. However, it invests early, it may risk that market acceptance may not be fast due to higher cost and lack of easy to use from lack of complimentary asset.

Appropriability Regime
The appropriability regime was referred to strong legal mechanisms of protection such as patents, copyrights, trade secrets (Dechenaux, Goldfarb, Shane, & Thursby, 2008). Tight appropriability regime or strong intellectual property protection implied higher profit from innovation (Teece, 1986). If innovator has weak protection or weak appropriability regime, innovator has to focus on controlling the use of complimentary assets.

2.15.3 *Investment Evaluation*

Investment criteria under real option reasoning will be asked to private investors on investment consideration in technological business startup. The model will be designed to incorporate investment and return in staging, and enable option consideration to pursue next choices depending on future investment, risk, and return characteristics. Evaluation criteria proposed to evaluate the financing each stage of technology commercialization, linked with return of technology in the best case and

linked to salvage value of technology as sunk cost in worst case that commercialization fail.

Real option valuation

Option can be incorporated with investment by allowing conversion of such salvage value to guarantee investment upon investment made. Financial contract can also be designed to incorporate various factors at policy level that aims to promote investment in business startup such as tax incentives to increase private equity return at same level of risk. When options create value for startup, valuation of startup with real options should reflect additional value from option in the startup.

Technology option for investment for disruptive innovation should be taken in to consideration in contrary to customer-focused investment allocation, which may lead firm to allocate resources for existing profitable customer under resource dependence theory, rather than for future business of disruptive innovation (Christensen & Overdorf, 2000).

Staging

Investment staging would help create flexibility in startup when challenged with uncertainty in technology, market or outside competition. During the staging of investment, learning from initial project from experiences or spilled over from other firms may cause firms to utilize developing technology or incremental innovation to first enter modest market with aim to later springboard to radical innovation for other larger market. It may emphasize the disruption of previous technology barriers to open entirely new opportunity space (McGrath, 1997). During the staging, the startup also could benefit from absorptive capacity to verify assumption of disruptive innovation while doing sustaining innovation (Cohen & Levinthal, 1990; Zahra & George, 2002). During early year of experiment, capability of startup in learning from doing and interacting with technology and market could enable them to develop if they have dynamic capability that could prepare them to be ready for new level of innovation (Eisenhardt & Martin, 2000; Teece, 2009).

Tax incentive & Collateral

In addition to factor of option, this study will add factors on tax incentives and collateral for consideration of private equity to add value to each option of investment. Technology collateral should be part of technology development that is recurring benefit that can be used for other technology development.

2.16   *Conclusion*

Financing business startup that based on technology innovation would need to understand technology, innovation and capabilities that enable firms to utilize

technology and leverage to create growth from innovation. The decision making of individual private investors in startup could have been better and less risker if there were simpler decision tool that match investors logical thinking and personal preference. The next section would describe researching to find key parameters of both the startup and investors and creation of decision making tool would be in the following section.

CHAPTER III

METHODOLOGY

3.1 *Research Design*

The research was designed as follow.

Preliminary phase: Establishing conceptual knowledge
Phase I: Exploratory study
Phase II: Concept refinement
Phase III: Concept validation-industry level
Phase IV: Concept validation-individual level
Phase V: Development of financial decision tool
Phase VI: Validation test of decision tool
Phase VII: Acceptance and adoption test of decision tool

3.1.1   *Preliminary Phase*

In preliminary phase, the review of literature in finance of startup, entrepreneur and innovation were studied to find relationship of business startup's factors on nature of technology and innovation, technology commercialization, and financial evaluation for investment that affect investment criteria of business angels. The results of the studied were in chapter II satisfying research objective no.1. The conceptual model was developed from literature review and the proposition was also set for testing.

3.1.2   *Phase I: Exploratory Study*

In phase I, qualitative methodology would be conducted to broaden knowledge from literature review. Individual depth interviewed would be conducted with people related to financing for startup would be conducted to test conceptual model and explore possible factors affecting decision of investors in business startup.

Sampling: In Thailand, there is no public list of investors in startup as formal directory which we could use for this research. Therefore, the individuals would be selected based on purposive sampling, starting with a person who was business angel in technology innovation startup. Then the snowball sampling would be used by asking participant to refer the researcher to other who might be business angel or experience related to investing in startups.

From total 7 interviewees, it could breakdown into 2 groups of occupation and investing roles. Breakdown of occupation and investing role at each phase are as figure below.

All Profile	Occupation				Investing role					
	Entrepreneur	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
1. Exploratory survey	1	5	0	1	1	2	0	0	2	2

Figure 9 Profile of interviewees in exploratory survey

Stakeholders in business startup of 7 people comprised of three business angels who invested in mobile payment, credit card internet payment and smart device startups, one early-stage fund managers who invested in digital marketing, one technology transfer office, one venture capitalist and one private banker in order to obtain various point of views from all stakeholders who related to technology innovation business startup. Their detail profiles were in figure below.

No.	Interviewees	Institution	Position	Description	Occupation	Investing role	Industry Background	Investment Focus	Interview Date	Duration
1	Mr. Janewit Krapraprayoon	True Internet Data Center	General Manager	Management in telecom business. Investor in internet payment	Management	Business angel	ICT	All	09-Sep-11	1.5 hrs
2	Mr. Damrongphan Sanitwongse	UK private bank, Thailand	Ex. Banker	Management in private equity firms. Providing banking service to clients.	Management	Banker	Investment	All	10-Sep-11	2 hrs
3	Dr. Ian Fenwick	Sasin Graduate School	Professor	Professor in digital marketing. Investor in digital marketing	Researcher	Business angel	ICT	ICT	11-Sep-11	1.5 hrs
4	Mr. Douglas Abrams	Expara Investment, Singapore/Thailand	Founder and CEO	Incubator and investor in startup in digital and ICT.	Management	Early-stage fund	Investment	ICT	14-Sep-11	1.5 hrs
5	Mr. Kamarol Rahmana	UKMT Tech Transfer, Malaysia	Entrepreneur-in-Residence	He used to work as VC before jointing technology transfer of UKMT in Malaysia	Management	Early-stage fund	Investment	All	16-Sep-11	1.5 hrs
6	Dr. Jay Jootar	Venture Catalyst	Managing director	He used to work as VC before starting his own company in ICT.	Entrepreneur	Venture captial	ICT	ICT	16-Sep-11	2 hrs
7	Mr. Sopon Boonyarataphan	VNET Capital Thai VC Association	Managing Director of VNET Capital, President of Thai VC association	He used to work as management consultat before becoming VC. VNET invest in company to help business expand.	Management	Venture captial	Investment	All	28-Sep-11	1.5 hrs

Figure 10 Details profile of interviewees in exploratory study

Data Collection: Individual depth interview was conducted individually with various stakeholders related to investing in technological innovation business startup in Thailand were interviewed in order to validate conceptual model and explore possible factors affecting decision of investors in business startup. They were interviewed individually in order accordingly from number 1 to 7.

Telephone interviews were conducted with 2 interviewees. Mr. Janewit Kraprayoon preferred phone interview conducted while he was at home and Mr. Kamarol Rahmana interview was conducted over the phone to Malaysia. The remaining 5 individuals were interviewed face-to-case.

Semi-structured interview was used to collect information from individual related to startup. The detail questionnaire as in Appendix D served as instrument to collect data and as interview guideline. The questionnaire was sent to each individual interviewee prior the interview date and conduct face-to-face or telephone interview separately later. The questionnaire guided the question order, specific ways to ask answer and possible answers. The questions related to criteria for their investment in startup then followed with consideration about technology and evaluation of profitability. The interviewees were asked to relate their personal experiences and investing histories for criteria of investment in startup and describe what would be important factors for them to invest in startup. The interview with each interviewee took about one or two hours in Thai or English according to interviewees. The researcher recorded answers from the interview into each questionnaire and used it as a filed note for further analysis.   Details interview results were shown in Appendix E.

3.1.3 *Phase II: Concept Refinement*

In phase II, data from the interviews with 13 business angels would be used to refine the conceptual model and parameters related to technology, innovation and financing of startups. The revised conceptual model and parameters would be used to validate conceptual model through the following quantitative research and qualitative research with actual business angels and stakeholders in Thailand and international.

3.1.4 *Phase III: Concept Validation-Industry Level*

In phase III, the quantitative research using self-administrated questionnaire survey was conducted with business angels in Thailand and international to validate the conceptual model for industry level.

Sampling: In Thailand, there is no public list of investors in startup as formal directory which we could use for this research. Therefore, we had to use proxy by addressing startups or newly incorporated firms that were invested by business angel and referring back to business angel.

The broad base of newly incorporated firms could be obtained from Department of Business Development, Ministry of Commerce. Number of newly incorporated firms during 2007-2009 was 41,220 firms (Department of Business Development, 2009). Details such as name and contact information of directors and shareholders could be obtained further by database provider such as Business Online or Yellow Pages.

From list of Department of Business Development, we could obtain total numbers of business startup. It could be filtered down to SME and entrepreneurial firms (not corporate venture). Subset of such startup firms that attend program with NIA or OSMEP could represent technological business startups. To enable large population of technological business startups, list of attendance of incubation program from NIA or OSEMP during 2007-2009 (3 years) could be used to compare with business startups not attending the programs.

For business startup that related to new technology or innovation, sample size could be scoped down to the list that attend governmental support program, such as National Innovation Agency (NIA) or Office of Small and Medium Enterprises Promotion (OSMEP). For the case of OSMEP, technology business startup, during 2007-2008, there were 106 SME firms that developed innovation after entered incubation programs with OSMEP. These are list of technology business startups that begin to obtain technological capabilities, but not certain to be investable or listable.

To obtain population of technology innovation startup that passed investable phase into listable phase, companies listed in Stock Exchange of Thailand under Market of Alternative Investment (MAI) contains approximately 80 companies, which can represent business that passed the stage of startup and entering growth stage. It passed the stages of investable and listable already. Information on profit performance and investors could be obtained for at least 3 years back. Due to fully disclosed

information of listed companies, it is expected to be able to clearly monitored and measured.

Investors in MAI can be separated by their investing role into founders, private equity, business angel, venture capital, and public investors. Filtering of investors types to take out founders, family & friends, employee, and public investors out, we could obtain information on private equity investors.

Data Collection:. The survey questionnaire addressed criteria business angels used in their investment decision making about capability, innovation and valuation tools used. In addition, the survey would also ask them to indicate their profile, whether they were founder or outside equity partner (business angel or venture capital).

The questionnaire was jointly developed with one business angel fund manager to address the questions and technical terms in wording that investors could understand. Then the questionnaire was pretested with 5 people before actual submitting to business angels.

For Thailand, self-administered survey was planned to be distributed by mail to business angel who invested jointly with entrepreneur in all listed companies in MAI, 73 companies (The Stock Exchange of Thailand, 2012a).

For international business angels, a web-based self-administered questionnaire survey would be sent to investors who were members of business angel group in Linkedin.com, special groups within professional social network that dedicated to startup entrepreneurs seeking funding and business angels who looking for promising opportunities. For example, an Angel Investor Network group at Linkedin.com has 6,182 members registered (Linkedin Corporation, 2012). The questionnaire was sent to 10 Linkedin.com groups (ABL/SBA Finance Professionals, Angel Investment Network, Angel Investor Group, Angel Investor, Bain Capital Ventures Innovation Center, Financial Plus, Nesta, Private Equity Networking, Startup and Venturepreneur Group) by posting message about the survey and ask the respondent to click the link to the survey pages. The details questions, answer and categories of answers were in Appendix B. The outcome of this phase III was expected to satisfy research objective no. 2.

3.1.5 *Phase IV: Concept Validation-Individual Level*

In Phase IV, the qualitative research methodology would be conducted to validate conceptual model for individual level, especially on any parameters that the quantitative survey at industry level could not capture.

Sampling: The interviews were conducted with 13 individual who were performing role as investors such as business angels, venture capital, business angel fund, or corporate business angel. Selection of sample was based on believe that such people who could provide direct insight to concept about investment in technological business startup. The sample size of approximately 10 samples was considered as

adequate for qualitative survey (McDaniel & Gates, 2005; Sandelowski, 1995). The individuals were selected based on purposive sampling, starting with a person who was business angel in technology innovation startup. Then the snowball sampling would be used by asking participant to refer the researcher to other who might be business angel for further interviews.

From 20 interviewees, 7 were interviewed in exploratory phase and 13 were interviewed in concept validation phase. Breakdown of occupation and investing role at each phase are as figure below.

All Profile	Occupation				Investing role					
	Entrepreneur	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
1. Exploratory survey	1	5	0	1	1	2	0	0	2	2
2. Concept Validation	7	5	1	0	0	5	2	2	2	2

Figure 11 Profile of interviewees in exploratory survey and concept validation

The interviewees comprised of five business angels who invested in nutraceutical, ICT, logistics, entertainment, retail, energy startups, two early-stage fund managers, two corporate business angels, two business angel fund and two venture capitalists.

Including interviewees from both exploratory survey in 3.1.2 and concept validation survey in 3.1.5, there were 20 people, whose nationalities were Thai 15 people and foreign 5 people. The interviewees resided in Thailand 17 people, in Malaysia, 1 in Singapore and 1 in USA. Their detail profiles were in figure below.

	Interviewees	Institution	Position	Description	Occupation	Investing role	Industry Background	Investment Focus	Interview Date	Duration
8	Dr. Nils B. Vogt	Sarsia Seed AS, Norwey	Seed Capital Managing Partner	He started up his company in Thailand. He used to manage startup fund in Norway.	Entrepreneur	Early-stage fund	Chemical	All	09-Jan-12	2 hrs
9	Mr. Troy Henikoff	Exelerate Labs, Chicago	CEO and Co-founder	Seed stage accelerator (incubator and investors)	Management	Early-stage fund	Investment	All	24-Apr-12	1.5 hrs
10	Mr. Bunprasit Tangchaisuk	A-host	Managing director	He began as researcher at IBM. He started up his company A-host as hosting for Oracle application with partial funding from business angel. He invested and manage angel fund for ICT in Thailand.	Entrepreneur	Business angel fund	ICT	All	09-May-12	2 hrs
11	Mr. Chanitr Chanchainarong	MAI stock exchange CFA Society Thailand	President of MAI President of CFA society Thailand	He used to work as venture capitalist in ICT sector before turning to be regulator and professional association.	Regulator	Venture captial	ICT	All	11-May-12	1 hr
12	Mr. Jrarat Pingclasai	Private individual	Private investor	He began as reseacher at IBM. Later he started his company from taking over other listed company. How he becomes business angel.	Entrepreneur	Business angel	ICT	All	17-May-12	1.5 hrs
13	Mr. Charatpong Chotigavanich	Magnate Capital	Partner	He started up with MIT friends to develop CRM software for Pocket PC which got funding from VC in US and went public. He now works as venture capitalist.	Management	Venture captial	ICT	All	20-May-12	1.5 hrs
14	Mr. Dej Bulsuk	McDonalds' Thailand CCC Business Development	ex President McDonalds' Thailand President CCC Business Development	He brought McDonalds' to Thailand. He opened traning center (CCC Business Development) to mentor new generation of leadership. He consult and invest in various startup in retail business and marketing.	Entrepreneur	Business angel	Retail	All	21-May-12	2 hrs

	Interviewees	Institution	Position	Description	Occupation	Investing role	Industry Background	Investment Focus	Interview Date	Duration
15	Mr. Naritsomjarern Sumpaopol	TOT Innovation Institute	Senior Director	He is a reseacher at TOT innovation, managing IP and new product development. He invested privately in his staffs startup company in energy business.	Management	Business angel	ICT	Energy	24-May-12	1.5 hrs
16	Mr. Kungval Kusoltammaratana	International Research PCL.	CEO	He started IRPC and listed successfully. He invested in new startup in ICT that related to his businesses.	Entrepreneur	Corporate business angel	ICT	ICT	25-May-12	2 hrs
17	Ms. Wanee Theinthanoo	Trisara	Management	She is management at one of the most luxurious resort in Phuket. She invested in her friends' startup HR software development.	Management	Business angel	Investment	ICT	27-May-12	1.5 hrs
18	Mr. Krisd Aksornwong	Digipon	Founder	He started up his software digital mobile marketing with partial fund from business angels. He had various experiences in approaching business angel investing. He now becomes business angel in ICT business.	Entrepreneur	Business angel fund	ICT	ICT	28-May-12	1.5 hrs
19	Mr. Somchai Sittichaisrichart	SIS Distribution PCL	Managing director	He startup SIS, one of the largest IT distributor in Thailand and listed in stock exchange. He invested in two IT startup through SIS.	Entrepreneur	Corporate business angel	ICT	ICT	30-May-12	2 hrs
20	Dr. Bhusana Premanoch	Institute of Social and Economic Policy Institute of Biomedical Engineering, UK	Chairman of ISEP Editorial board member of Open Journal of Applied Biosensor	He was management in Total Access Communication. He successfully listed TAC in Singapore stock exchange. He involved in startup company at Imperial College, UK. He invested in startup in telecom, tele-health.	Management	Business angel	ICT	ICT	01-Jun-12	1.5 hrs

Figure 12 Details profile of interviewees in concept validation phase

Data Collection: Individual depth interview was conducted individually with people who were invested in startup to validate conceptual model with expert in the field and explore possible factors affecting decision of investors in business startup. They were interviewed individually in order accordingly from number 8 to 20.

Semi-structured interview was used to collect information from individual related to startup. The detail questionnaire as in Appendix D section 2, Interview guideline II served as instrument to collect data and as interview guideline. The questionnaire was sent to each individual interviewee prior the interview date and conduct face-to-face separately later. The questionnaire guided the question order, specific ways to ask answer but not provide possible answers in order to explore possible answers openly.

The questionnaire in Appendix D section 2 which served as guideline for concept validation of individual was based on questionnaire in Appendix B that was for concept validation of mass population on internet. The questions at this stage, Appendix D section 2, were made shorter and simpler in order for individual business angel investors not to feel uncomfortable. This revision was based on experiences faced at exploratory study which investors did not answer detailed questions fully or tried to map their experienced to answer items. The questions related to criteria for their investment in startup then followed with consideration about technology and evaluation of profitability. The interviewees were asked to relate their personal experiences and investing histories for criteria of investment in startup and describe what would be important factors for them to invest in startup. The interview with each interviewee took about one or two hours in Thai or English according to interviewees. The researcher recorded answers from the interview into each questionnaire and used it as a filed note for further analysis. The interviewees were asked for consent and willingness to tape recording. However, due to sensitive issue about investment matter, the researcher chose not to transcribe the tape recording into words, but use the tape recording as reference to support accuracy of the field note. Details interview

results were shown in Appendix E. The outcome of this phase IV was expected to research objective no. 2.

3.1.6 *Phase V: Development of Financial Decision Tool*

In phase V, opinion and comment from surveys and interview of business startup and private equity were used to develop financial decision model. The model was designed to incorporate investment and return in staging, and enable option consideration to pursue next choices depending on future investment, risk, and return characteristics. The model was created using Excel spread sheet and internal Excel algorithm or conditions to show investment and return for each stages. It is expected to create what-if scenario to show the changing of return if no technology commercialization and investment model in order for private investor to exercise their option thinking during investment. The outcome of this phase V would satisfy research objective no. 3.

3.1.7 *Phase VI: Validation Test of Decision Tool*

The financial model would be tested for its validity in ability to explain or help in judging innovation to invest.

- Sampling: The interviews would be conducted with approximately 20 individual who are both 1) entrepreneur or investors (or potential to become ones) and 2) people who would understand business and financial analysis. Possible sample group are MBA or Executive MBA. The individuals were selected based on purposive sampling.
- Data Collection: A focus group and questionnaire survey would be conducted to participants. The test would set hypothetical business case asking participants to assume being investors and analyzing case then using the tools to value startup. The case studied selection would be explained in section 3.2. The decision model would be shown how to work. In the end, the test would ask about their opinion about usefulness of the tool in judging investment in startup.

3.1.8 *Phase VII: Acceptance and Adoption Test of Decision Tool*

The financial model would be tested for its acceptance and adoption by intended group or proxy of the group. This acceptance and adoption test was intended to explain commercialization ability of the model.

- Sampling: The interviews would be conducted with approximately 20 individual who are both 1) entrepreneur or investors (or potential to become ones) and 2) people who would expose themselves with possible startup companies. Possible sample group would be student of entrepreneurship studies or technology entrepreneurship since most of them would expect starting up new business and some of them would turn to invest in their friends' startup. The individuals were selected based on purposive sampling.
- Data Collection: A focus group and questionnaire survey would be conducted to participants. The test would set hypothetical business case asking

participants to assume being investors and analyzing case then using the tools to value startup. The decision model would be shown how to work. In the end, the test would ask about their opinion about behavioral intention to use the tools. Outcome of this phase VII was expected to satisfy the research objective no. 4.

3.2 *Case Studies Selection*

Actual technologies and hypothetically possible commercialization strategy were planned to use to test the decision making tool to make sure that the tool could capture actual factors in real case. The technology in question should be technology that has potential to grow but there are still unknown factors about certainty either upside possibility of growth or downside of risk. The case should also show various possible innovation or commercialization of such technology in order to see varying scenario of different innovation type.

Biodiesel production from waste vegetable oil was proposed as subject of study because of the technology is evolving fast and considerable uncertainty in commercializing the technology. Biodiesel production also could be commercialized in typical mainstream business by selling to current oil manufacturer, or in low-end value system of biodiesel community, or in new-market value system of biodiesel for jet airplane. Information about actual investment cost, process technologies and output figures were obtained from Biodiesel Technology Operational Guide (C. Tongurai, Waisuwan, & Nikom, 2012) and from Plan Energy (Thailand) (2012).

3.3 *Data Analysis*

For quantitative research methodology as in phase III, VI, and VII, the data from the survey would be entered into a statistical analysis program, IBM SPSS Statistics version 20, in order to find relationship between factors.

For qualitative research methodology as in phase I and IV, the data from the interviews would be coded into content analysis tools, NVivo version 9, in order to group words or quotes expressed by interviewees into categories and to find relationship between categories. In phase I-Exploratory study and phase IV-Individual depth interview, the interviewed from participants that was collected as field note on the interview guideline would be quoted as concepts. Pattern matching was one of the techniques for analyzing case studies (Yin, 2009). Pattern matching could be used to replicate common factors in the case study (Natcha Thawesaengskulthai, 2007).

For detailed qualitative data analysis, Natcha Thawesaengskulthai (2007) used both content analysis and grounded analysis as they both provide common or contradictory theme, patterns and categories from data. Content analysis is used to measure the semantic content or what aspect of message (Cooper & Schindler, 2008) . Grounded theory means theory that was derived from data, systematically gathered and analyzed through the research process (Strauss & Corbin, 1998). As a result, this study follow

Natcha Thawesaengskulthai (2007) by analyzing qualitative data partly by following the grounded theory model and use pattern matching for content analysis in order to match patterns and analyze common factors among different investors for investment evaluation of technology innovation business startup.

Coding involves assigning numbers or other symbols to answers so that the response can be grouped into a limited number of categories. Categories are partitions of a data set of a given variable. Categorization is the process of using rules to partition a body of data (Cooper & Schindler, 2008) . Coding for close question was used mostly for structured question which had pre-quoted questions and answers. For grounded theory that allows new data and new concept to emerge, coding procedures start with (1) open coding, which could be used with content analysis in order to analyze response and capturing emerging categories, (2) Axial coding, which is the process to develop categories by linking sub-categories and relating categories, and (3) selective coding which is the process of integrating and refining theory (Natcha Thawesaengskulthai, 2007; Yin, 2009).

For example, in technology capability category it was pre-code in close questions to contain technology skills and technology lifecycle. However, it was expected to find new concepts from open coding. Then it was also expected that such new concept could be axial code as new sub-category for technology capability category or to other category such as investment evaluation.

Content analysis was processed with NVivo version 9. For example, wordings from interviewee that "He believed internet payment was valuable because everyone will have to use for convenience" would be quoted to concept "valuable". The concept "valuable" would be stored in "valuable node", which would be used to collecting the same concept mentioned by other interviewees. The concept-valuable would be grouped with other concepts (for example rare, imperfectly imitable and non-substitutable) and categorized as "technology capability". However, the word were not simply counted but was considered context of use, therefore, if the conversation was still in the same question and context, the word mentioned about such concept would be counted as one reference only.

Qualitative research analysis process usually started with data reduction, data display and drawing conclusion (Miles & Huberman, 1994). Details analysis process in this study was based partly from Natcha Thawesaengskulthai (2007) by started from semi-structured questionnaire, making field note from interview, listening to interview recording to verify and add any missing data, coding and categorizing, display data, making conclusion and report and use data and conclusion to iterate the interview and making field note until no new conclusion could be obtained.

The individual interview which was in field note was verified with tape recording to verify that the findings were precise and to enhance validity of conclusions. However, it was unable to verify their investment criteria of investors with other sources such as verifying with entrepreneur who receives the funding.

CHAPTER IV

RESULTS

4.1 *Result of Preliminary Phase*

Outcome of preliminary phase was in literature review in Chapter II, which expects the factors that were important to investment decision criteria of investors to be related to technology capability, technology commercialization and investment models. This outcome satisfied research objective no. 1.
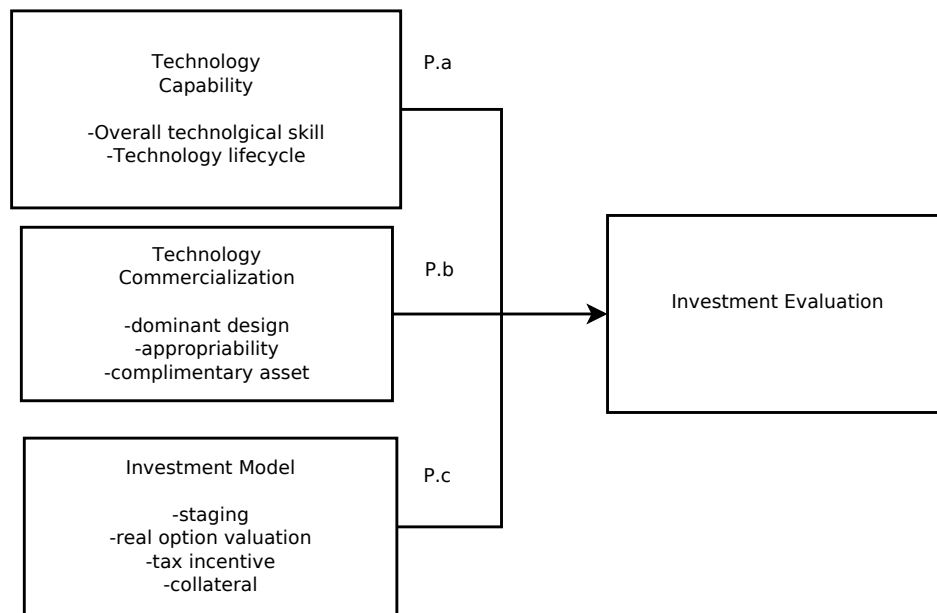
Figure 13 Original conceptual model

4.2 *Result of Phase I: Exploratory Study*

The exploratory interview with 7 people related to investment in startup companies aimed to find the importance of technology capabilities, technology commercialization and investment model of startup. Content analysis using NVivo was conducted based on model of capabilities which was derived from original conceptual framework as figure below.
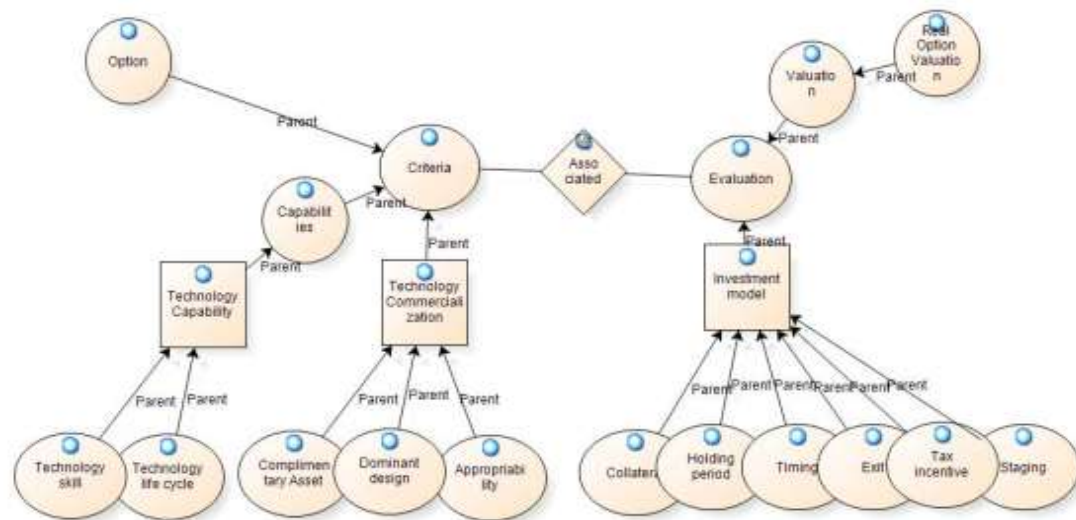
Figure 14 Concept mapping in NVivo-original

4.2.1 *Breakdown of Criteria*

Breakdown of criteria in startup that preferred by investors were as follow.
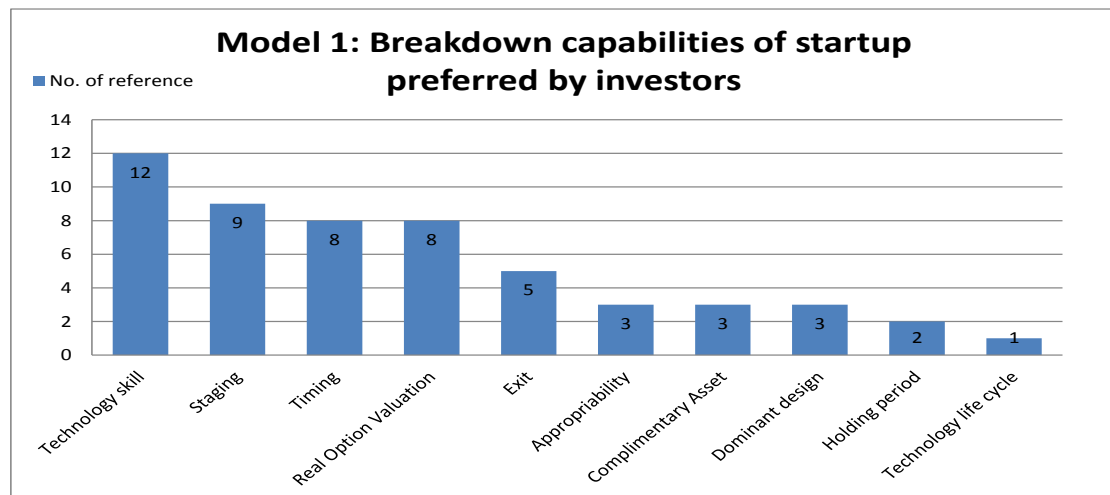
Figure 15 Model 1: Breakdown criteria of startup preferred by investors

4.2.2 *Analysis*

4.2.2.1 Technology Capabilities

The research proposition P.a explored relationship of investment evaluation and technology capabilities, which comprise of overall technological skill and technology lifecycle. Results of content analysis were as follow.

Technology skill: Technological capabilities can be measured by technological skills which includes skills in applied R&D, transforming R&D into products and manufacturing new product (Zahra et al., 2007). It was referred most among interviewees, 12 references. Sample of the quotes are as follow.

"He considered technology capability, especially new technology and new market because of less competition."

"VC invested in stages. First stage to evaluate technology, market, and entrepreneur…"

Technology lifecycle: Value of technology depended on timing of introducing technology in its lifecycle (McGrath, 1997). Cost of technology development was assigned as option price. Value of technology option was measured by value of return from operations less cost of commercialization and cost of technology development. It was less quoted within technology capabilities, 1 reference. Sample of quote is as follow.

"He believed market timing was important, not to invest to early when no acceptance or dominant design emerge or not too late in the lifecycle."

4.2.2.2 Technology Commercialization

Research proposition P.b explored relationship between investment evaluation and technology commercialization, which comprise of dominant design, appropriability and complimentary assets. Results of content analysis were as follow.

Dominant designed, appropriability and complimentary assets were equally weighed by investors, 3 references each. Sample of quotes referred to each parameter are as follow.

Dominant design: Investors should consider to commercialize technology when there was no dominant design emerged before in order to maximize profit because there should be are rooms for modification to get market acceptance (Suárez & Utterback, 1995). Sample of quote from investors about consideration on dominant design was as follow.

"The first stage investment helped to judge whether the entry was too late or too early. If it turned out to be early, he might still invest. However, if it turned out to be too late, no follow on investment and exit because too many competition."

Appropriability: Startup with tight appropriability regime or strong intellectual property protection should have ability to retain higher profit from innovation (Teece, 1986). From sample of quote from investors, they mentioned about consideration to have intellectual property protection in order to invest as follow.

"Paysabuy was the very first company to provide internet payment and was protected under license."

Complimentary asset: Bargaining power from complementary asset owners may reduce profit to technology commercialization of startup and investors (Teece, 2003). For the case of Paysabuy, investors considered it did not depend on complementary assets.

"Paysabuy can run on any internet technology, so it did not depend on complimentary asset."

4.2.2.3 <u>Investment Model</u>

Research proposition P.c explored relationship between investment evaluation and investment model, which comprise of staging, real option, tax incentive and collateral. Results of content analysis were as follow.

Staging: Investment staging would help create flexibility in startup when challenged with uncertainty in technology, market or outside competition (Cornelli & Yosha, 2003). It was the most referred in investment model, 9 references. Sample of quotes referred to each parameter are as follow.

> "He invested in two stages, first stage at lower amount and second stage at higher, for example first stage may be 5M.Bht and follow with second stage at 10M.Bht."

> "He split investment in two stage, development and commercialization. Each industry had different weight to decide where the cut off or gate should be to decide for go or no go for follow on investment."

> "He split project in two phases. The first phase of development product will have option to follow on second phase if market is good and not exercise option if market is not good."

Real option valuation: Real option reasoning is a thought process for firm with entrepreneurial mindset or start-up searching for opportunities (McGrath & MacMillan, 2000c). It was referred in second within investment model group, 8 references. Sample of quotes referred real option are as follow.

> *"In R&D of drug industry, real option valuation is very useful."*

> *"However, people did not use real option in IT industry because process of development was clear or need to be different and be quick to establish in the market. So there is not much time to think about option or act in contingency."*

> *"He found that it would be useful to make real option valuation easier to use, match or reconcile with NPV which already accepted by investor"*

> *"Need to simply the tools in order to promote strategic tool that could identify which research should be exploited into innovation."*

> *"Business angel should understand risk, option they could use, and flexibility that might help mitigate risk. Business angel should use real option concept as discipline structure, as guideline for making decision"*

> *"Entrepreneur should use real option in their NPD process and able to communicate strategy and flexibility with investors."*

> *"He used real option to value startup that is in pre-commercialization stage and use State-Gate to monitor which way technology and market would turn to be. He believed real option valuation is proper to early stage company. He used real option to add as premium to traditional financial value such as NPV."*

Tax Incentive: No reference was made by interviewees about requirement for tax incentive for business startup.

Collateral: No reference was made by interviewees about requirement for collateral from technological components.

4.2.3 *Overall Criteria*

NVivo was used to summarize references quoted by 7 interviewees in to concepts and group number of references up to higher categories of technology capacity, technology commercialization and investment model. Overall criteria that investors preferred in startup were as in Figure 11.
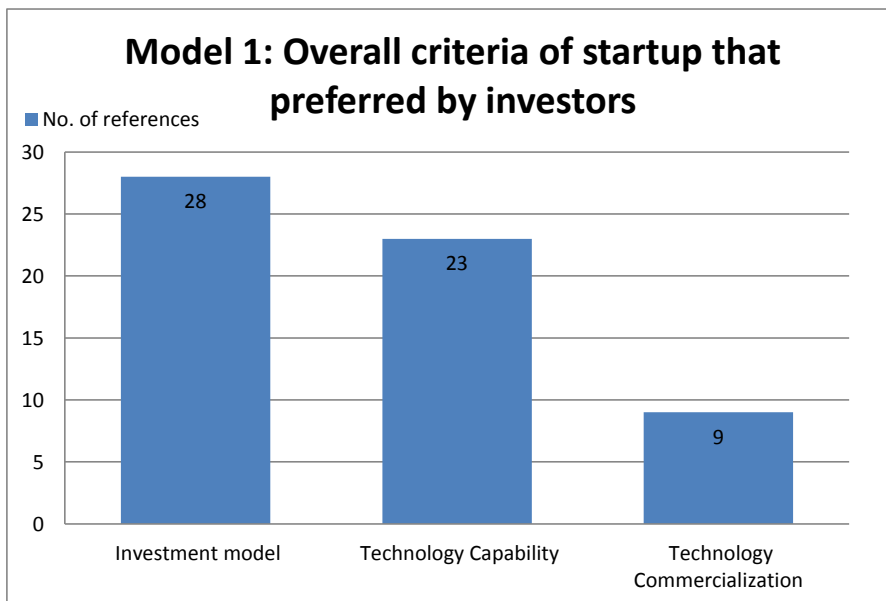
Figure 16 Model 1: Overall criteria of startup preferred by investors

From 7 interviewees, results of research propositions were found as follow.

Research proposition P.a: Technology capability was supported moderately to affect investment evaluation by result of reference count at 23.

Research proposition P.b: Technology commercialization was supported least to affect investment evaluation by result of reference count at 9.

Research proposition P.c: Investment model capability was most supported to affect investment evaluation by result of reference count at 28.

When mapped result of references quoted with conceptual model, the numbers of references which related to corresponding factors were as follow.
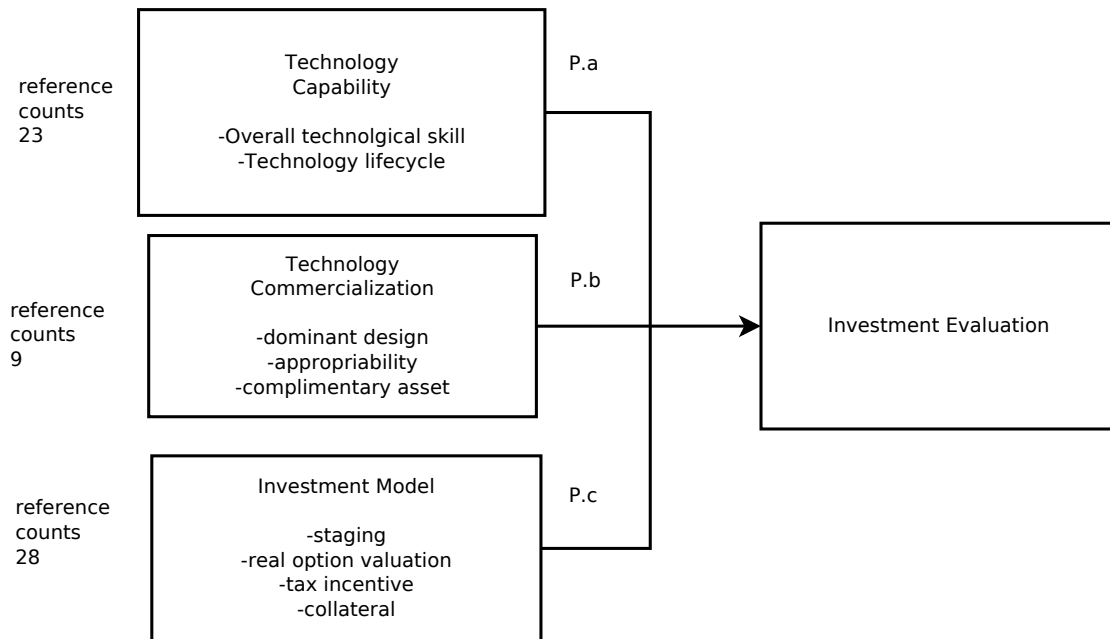
Figure 17 Result of reference mapping with conceptual model 1

4.2.4 *Conclusion*

The result of content analysis and reference counts showed that in the conceptual model 1, investment model had highest effect on investment evaluation, technology capability had lower effect and technology commercialization had least effect. As a result, technology commercialization may need to be modified with other factors that could represent investment evaluation more.

Staging: Business angels tend to make their first start-up investment in later stage of firm development. Start-up that can provide technology protection in terms of patent or exclusive licensing that create barrier of entry for other firm can obtain more investment from business angel and obtain funding in earlier stage than firm that could not provide protection. Then as time and experiences grow, they tend to invest in earlier stage than previous ones.

Low-end Innovation and Technology Protection: For start-up that could not provide technology protection, business model that can show it is disruption that can address new ways of doing things at low-end of the market (or low-end disruptive innovation) to solve current problem cheaper and easier can obtain similar protection against imitation from the view of business angels. With uncertainty in innovation, business angels that invest in the beginning of start-up feel they need time to understand business as it grows, and option-like tools is very helpful for them in order to be able to incorporate flexibility and resilience to learn and explore the new market and adapt to the outcome as it unfolds.

<u>Flexibility/Option</u>: Investments that create option or flexibility were valuable more in the very beginning in the stage of development of start-up-firms than in the later stage such as in the stage of commercialization, while less valuable in the later stage of start-up such as in stage of commercialization. However, option concept was less aware by investors when viewed at successful investments or recently invested. Venture capital or private equity do not think about option because they wanted the start-up to just execute to reach predetermine goal as fast as possible and any deviation from goal considered a failure of execution. On the other hand, business angels don't consider to give value to option because they focus more on gain / loss, their investment valuation did not considered formally in the beginning.

<u>Real Option Valuation</u>: Real option was more useful for investors that invested in pre-commercialization which they set options different according to context of each deal. However, real option valuation was less considered as a valuable tool by venture capital that focused on investment in commercialization phase.

Conclusion on findings and research propositions would be as follow. In model 1, apart from requirement to have strong technology skill, the ability to stage investment and invest at right timing are considered better than having strong IP or strong appropriability.

Research Propositions	Findings
P.a.Technological Capabilities of business startup have positive impact on evaluation of Private Capital to invest in business startup.	<u>Moderately support</u> Technology skill was the most preferred criteria from investors, more than technology lifecycle. However, investors considered technology, market and entrepreneur capabilities at the same time.
P.b.Technology Commercialization of business startup has positive impact on evaluation of Private Capital to invest in business startup.	<u>Least support</u> Dominant design, appropriability and complimentary asset were equally considered by investors, but overall lesser than technology capabilities and investment model.
P.c.Investment Model of business startup has positive impact on evaluation of Private Capital to invest in business startup.	<u>Strongly support</u> Staging was the second most preferred after technology skill. Within investment model, staging was the most considered by investors. Second most preferred was staging, and third preferred was timing of investment and real option equally.
Overall	Research proposition P.c-Investment Model was strongly support by interview results. Research proposition P.a-Technology Capability was moderately support by interview results. Both the investment model and technology capability

	should be used further in concept validation phase. However, research proposition P.b-Technology Commercialization was less supported by interview result. Therefore, conceptual model on technology commercialization should be revised before using in validation phase.

4.3 *Result of Phase II: Concept Refinement*

4.3.1 *Additional Parameters*

Previous model was based on technology capabilities. However, during the interview, new concepts emerged, which the following parameters that added in conceptual model 2nd revision would change from technology view into innovation view. New parameters would combine technology and market to explain growth of startup. This revised model would be used for semi-structure interview were based on the following reviewed.

When comparing the result of the exploratory interview with initial conceptual model, some refinements were proposed as follow.

1) Entrepreneur capability: Most interviewees described their preferred criteria for investment in startup in form of capability of entrepreneurs about technology and marketing. Therefore, the revised model should add other types of capabilities such as marketing capabilities and entrepreneurial capability in addition to technology capability.

2) Market capability was proposed to replace technology commercialization. Most interviewees described their preference for growth in startup through disruptive innovation. Factors related previously to technology commercialization, such as dominant design or complimentary assets were re-categorized under marketing capability.

3) Disruptive Innovation: The revised model should have disruptive innovation as separate factors which could describe growth option of startup in broader term than technology commercialization.

4) Investment model: The revised model should include factor of growth option and modularity was also added as possible causes that create disruptive innovation (Baldwin & Clark, 2000).

   a) Listable: the revised was proposed to group listable to be with exit or option to exit.
   b) Technology component / collaterals: The revised model should exclude the study on technology components or collateral because no one mentioned about this factor.

5) Modular design: The modularity of product components or production represents internal flexibility that could help startup to reconfigure current product architecture in the market to create new one (Baldwin & Clark, 2000). The external modularity of products would allow it to connect to other products or complimentary products into external platform would allow its product to gain more acceptance from current users of existing product or complimentary products in the market(Gawer, 2009) .

6) Behavioral financial decision model was proposed to add to reflect mindset of individual investors. From literature review, model Security-Potential/Aspiration was added as a form of evaluation of returns and probability investors expects to achieve target return, which match with investors' preference on growth options.

7) Market Capabilities: Market capabilities were set in phase II to cover capability of startup in sensing direction of market in future, actual ability to create market, and customer creation.

   a) Market-Creating Capabilities (Wiltbank, 2005)
      i) During develop a marketing approach for product; entrepreneur should imagine possible courses of actions based their prior experience.
      ii) Even with uncertainty of market, the entrepreneur should move forward because their expertise should allow them to influence that uncertainty

   b) Market-Sensing Capabilities (Day, 1994), (Wiltbank, 2005)
      i) During develop a marketing approach for product; entrepreneur should research competitors' approaches.
      ii) Even with uncertainty of market, the entrepreneur should move forward because their actions can create a future with value to company.
      iii) The startup possessed the competence to learn about customers, competitors, and channel members in order to continuously sense and act on events and trends in present and prospective markets.
      iv) The startup possessed the competence to collect and acting on information about customer needs and the influence of technology, competition, and other environmental forces through lead users.
      v) The startup possess the competence to anticipate quite accurately the responses to actions designed to retain or attract customers, improve channel relations, or thwart competition.

   c) Customer-Linking Capabilities (Day, 1994)
      i) The startup was very competent on creating and managing close relationship with customer.
      ii) The startup was very competent in continuously exchanging information about needs, problem, and emerging requirements from lead users.
      iii) The startup was very competent to participate in customer development process , even before the product specifications are established

iv) The startup has mutual commitments with customer to improve product quality and reliability of order and production planning.

d) Differentiation Capabilities (Raynor, 2011)
   i) The business breaks trade-offs that define competition in established market. The company has a different business model that defines a new productivity frontier, to be profitable serving customers that are unattractive to incumbent players even if incumbents chose to try to serve them

8) Entrepreneurial Capabilities

Entrepreneurial capabilities was introduced in phase II to cover consideration weight that investors set on entrepreneurs

a) Entrepreneur's Capabilities (Dew, Read, et al., 2009)
   i) Skills that are have positive impact on your propensity to invest in startup

b) Entrepreneur's personality (MacMillan et al., 1985)
   i) Capable of sustained intense effort
   ii) Able to evaluate and react to risk well
   iii) Articulate in discussing venture
   iv) Attends to detail
   v) Has a personality compatible with mine

c) Entrepreneur's experience (MacMillan et al., 1985)
   i) Thoroughly familiar with the market targeted by venture
   ii) Demonstrated leadership ability in past
   iii) Has a track record relevant to venture
   iv) The entrepreneur was referred to me by a trustworthy source
   v) I am already familiar with the entrepreneur's reputation

d) Entrepreneur's ability to control events (Dew, Read, et al., 2009)
   i) To assemble information during startup entrepreneur should talk to people they know to enlist their support in making this become a reality
   ii) In situation of startup, it is important that entrepreneur base their strategy on what they are capable of, given the means available to them.
   iii) When entrepreneur learns that industry is expected to change, entrepreneur should imagine ways that startup would change aspects of situation the industry is forecasted.

e) Entrepreneur's ability to predict events (Dew, Read, et al., 2009)
   i) To assemble information during startup, entrepreneur should study expert prediction of where the market is "heading".
   ii) In situation of startup, it is important that entrepreneur base their strategy on relevant forecasts and analyses.
   iii) When entrepreneur learns that industry is expected to change, entrepreneur should form updated predictions of likely outcomes for the business.

f) Entrepreneur's ability to create new business model (Raynor, 2011).

i) The company has a different business model that defines a new productivity frontier, to be profitable serving customers that are unattractive to incumbent players even if incumbents chose to try to serve them

4.3.2 *Conceptual Model 2ⁿᵈ Revision*

The 2ⁿᵈ revision conceptual framework was proposed as follow.
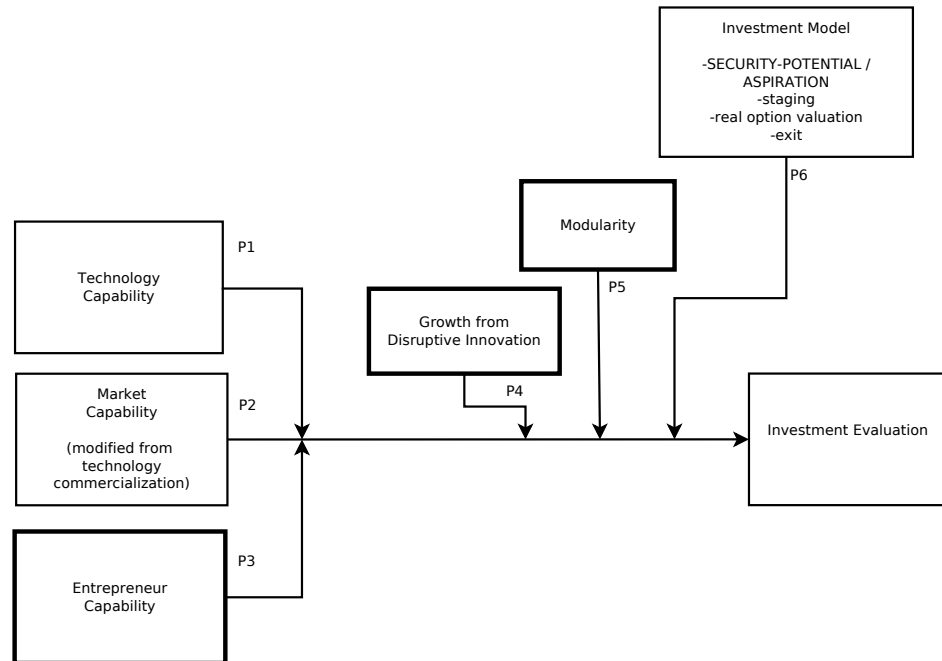
Note: Heavy box or capital letter represented new parameters

Figure 18 Conceptual model 2nd revision

Revised Research Proposition

P1. Technological Capabilities of business startup have positive impact on evaluation of private capital to invest in technological innovation business startup.

P2. Market Capabilities of business startup has positive impact on evaluation of private capital to invest in technological innovation business startup.

P3. Entrepreneur Capabilities of business startup has positive impact on evaluation of private capital to invest in technological innovation business startup.

P4. Disruptive Innovation of business startup has positive impact on evaluation of private capital to invest in technological innovation business startup.

P5. Modularity of business startup has positive impact on evaluation of private capital to invest in technological innovation business startup.

P6. Investment Model of business startup has positive impact on evaluation of private capital to invest in technological innovation business startup.

This conceptual framework would be used to conduct questionnaire survey and individual depth interview in phase III and phase IV.

4.4 *Result of Phase III: Concept Validation-Industry Level*

4.4.1   *Business Startup Firms in MAI*

A self-administrated questionnaire was planned to be mailed to all 80 business startup firms listed in MAI.   It would contain information on nature of technology that business startup used, technology commercialization model, and investment requirements of business startup.   Name and type of private investors would be asked under investment part, which would be used to develop as list of private investors for cross-checking with list of investors obtained from disclosure to MAI market.

4.4.2   *Problems in Identifying Business Angels from Secondary Data*

The search for individual private investors or business angels in MAI listed companies was not possible to create valid data. From the search using SETSMART, SET Market Analysis and Reporting Tool found listed of all shareholders in MAI. First problem was that SETSMART provided information only 5 years back, while some company in MAI startup since more than 10 years ago. When looked at name of shareholders, it was not possible to find query rules to pick business angel who were not family with entrepreneur founder by looking at surname. Therefore, the plan to trace business angels back from listed company to startup was not possible.

4.4.3   *Business Angel in Social Network-Linkedin.com Group*

A self-administrated questionnaire as in Appendix B was sent to business angels who were member of Linkedin.com group. The questionnaire were posted as "discussion" to ten Linkedin.com groups, ABL/SBA Finance Professionals, Angel Investment Network, Angel Investor Group, Angel Investor, Bain Capital Ventures Innovation Center, Financial Plus, NESTA, Private Equity Networking, Startup and Venturepreneur Group. Members in such group acted as entrepreneur, investor or agent posting discussion to common place announcing deal of startup who wanted to raise money and investors who interested in making investments as in Figure 19. For example Angel Investor Network group at Linkedin.com, there were 6,182 members registered as in Figure 20 (Linkedin Corporation, 2012). The discussion in Figure 19 asked the respondents to click the link to another survey containing questionnaire as in Appendix B.

Figure 19 Survey posted in Linkedin.com business angel group

Figure 20 Private equity networking members in Linkedin.com

4.4.4 *Problems in Survey with Business Angels*

Result from survey was in Appendix C that 80 people had viewed, 20 had started survey, but only 1 people had completed. Low response rate to the survey, despite high activities of entrepreneurs and business angels, may due from nature of business angels who may not like to reveal their methodology about investing.

4.5 *Result of phase IV: Concept Validation-Individual Level*

Two quantitative studies in phase III showed that finding information about business angel from secondary market and survey might not give enough information. The qualitative technique-semi-structured individual depth interviewed was conducted with people who used to be or worked with business angels.

The data from interviews were groups into common concepts using NVivo. They were then grouped into categories that related to conceptual model. Number of items which such concept were quote would be grouped and counted as related to the degree that such concept was important to categories in each node in conceptual model.

Content analysis using NVivo was conducted based on model of capabilities which was created based on conceptual model 2nd revision as figure below.

Figure 21 Criteria of investment in startup before interviews-model 2

During interview and coding, the 3rd model was created to accommodate new parameters regarding quality of entrepreneur, affordable loss and support from external ecosystem as follow.

Figure 22 Criteria of investment in startup after interview-model 3-final model

4.5.1 _Additional Parameters_

Apart from the results, before developing interview guideline, addition information from further literature reviews suggested to
1) Add affordable loss. Further literature search found that affordable loss affect decision to plunge or jump into invest in startup.
2) Add indirect return and non-monetary return criteria
3) Add qualitative capability of entrepreneur
4) Add support from large corporate and formal institution

4.5.2 _Conceptual Model 3rd Revision_
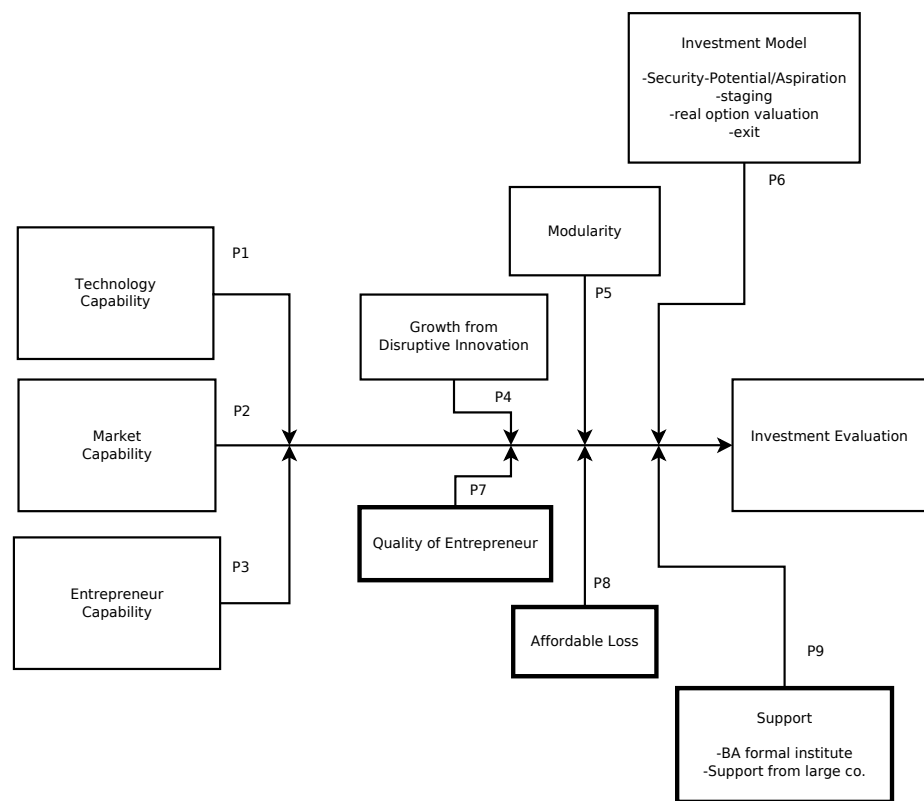
Note: Heavy box represented new parameters

Figure 23 Conceptual model 3rd revision- final model

Revised Research Proposition

P1. Technological capabilities of technological innovation business startup have positive impact on investment evaluation of private capital.

P2. Market capabilities of technological innovation business startup have positive impact on investment evaluation of private capital.

P3. Entrepreneur capabilities of technological innovation business startup have positive impact on investment evaluation of private capital.

P4. Disruptive innovation of technological innovation business startup has positive impact on investment evaluation of private capital.

P5. Modularity of technological innovation business startup has positive impact on investment evaluation of private capital.

P6. Investment models of technological innovation business startup have positive impact on investment evaluation of private capital.

P7. Qualities of entrepreneur in technological innovation business startup have positive impact on investment evaluation of private capital.

P8. Affordable loss has relationship with investment evaluation of private capital in technological innovation business startup

P9. Supports from external ecosystem of technological innovation business startup have positive impact on investment evaluation of private capital.

This conceptual framework would be used to conduct questionnaire survey and individual depth interview in phase III and phase IV.

4.5.3 *Interview Result: Model 3*

4.5.3.1 Capabilities

4.5.3.1.1   Technological Capabilities

Research proposition P1 explored relationship of investment evaluation and technology capabilities. However under model 3, technology capabilities comprised of factors about various applications, ability to transform R&D in to product, recurring income, non-substitutable, reduce cost and rare. The results of content analysis for parameters of revised model conducted by NVivo could be summarized in figure below.
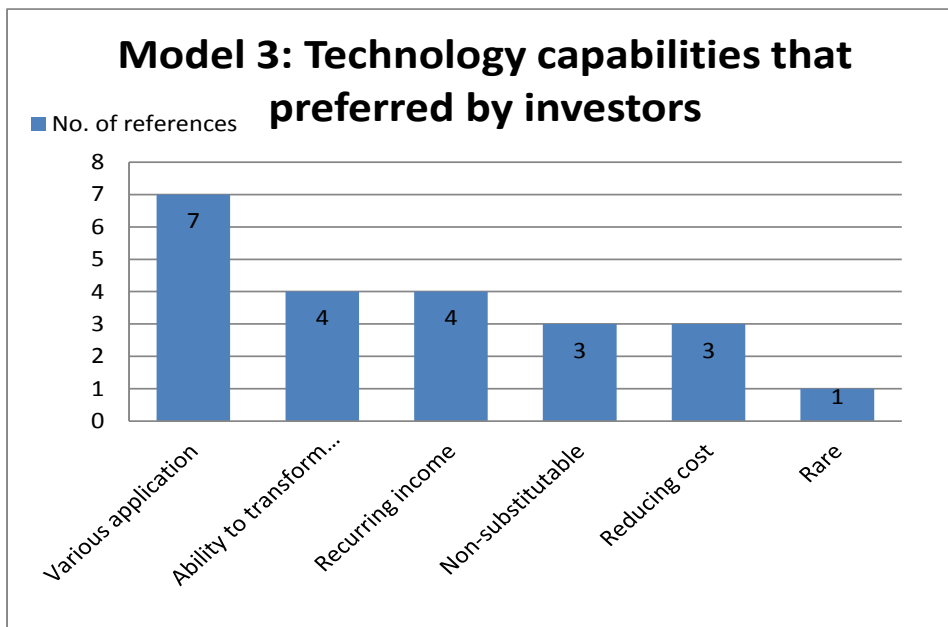
Figure 24 Technology capability of startup preferred by investors – final model

Technological capability is ability to use technological resources to combine/recombine components, linkages between the components, methods, process and techniques, and underpinning core concepts to offer products (Afuah, 2002). Considering all interviewees, they preferred startup to have technology capability that could be applied to various application, ability to transform R&D into product and ability to create recurring income, than technology capability that are rare or non-substitutable or reducing cost.

> *"Investment in technology must be planned to serve many functions and long into the future. Then select middle technology that could cover current application at low cost and have option to go up market in future in modular way."*

Technology that could be applied to various application need to have flexibility or perhaps modularity in product components. Technology that could create recurring income would satisfy the need of entrepreneur and investors about security or survival or sustainability of startup.

Model 3: Techonlogy Capability (reference counts)		Occupation			Investing Role				
	All	Entrepreneur	Management	Regulator	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Total	22	5	12	5	10	1	2	2	7
Various application	7	1	6	0	5	1	0	0	1
Ability to transform R&D in to product	4	0	2	2	1	0	0	0	3
Recurring income	4	2	2	0	2	0	2	0	0
Non-substitutable	3	0	1	2	1	0	0	0	2
Reducing cost	3	2	1	0	1	0	0	2	0
Rare	1	0	0	1	0	0	0	0	1

For management, business angel and business angel fund, they preferred startup to have technology capabilities that could be applied to various applications. For regulator and venture capital, they preferred ability to transform R&D into product. For entrepreneur and corporate business angel, they preferred startup to have technology that could create recurring income.

Technology capability such as technology protection in form of patent or exclusive licensing that create barrier of entry for other firm can obtain more investment from business angel and obtain funding in earlier stage than firm that could not provide protection. Technology capability was perceived by investors as growth potential. For start-ups that could not provide technology protection, they could provide similar protection in form of business model that is disruptive to current value system addressing new ways of doing things to solve current problem cheaper and easier.

The research proposition P1 was supported by this result of technology capability reference count at 22, lowest among other capabilities but still higher than disruptive innovation, affordable loss and support from institute, confirmed with research proposition P1 that technology capability had positive effect on investment evaluation of investors.

4.5.3.1.2   Market Capabilities

Market capabilities are skills that related to market and customers (Day, 1994). Considering all interviewees, they preferred startup to have market capability on both sensing market direction and broad market equally. Quote from investor confirmed their expression for importance of market capabilities was as follow.

> *"Investors consider startup that address market that is growing and has large size, technology that possible, solid business plan, and good entrepreneur and team".*

Research proposition P2 explored relationship between investment evaluation and market capabilities, which comprised of capabilities to address broad market, address growing market, sense market direction and develop new customers. The results of

content analysis for parameters of market capabilities were conducted by NVivo and were summarized as in figure below.
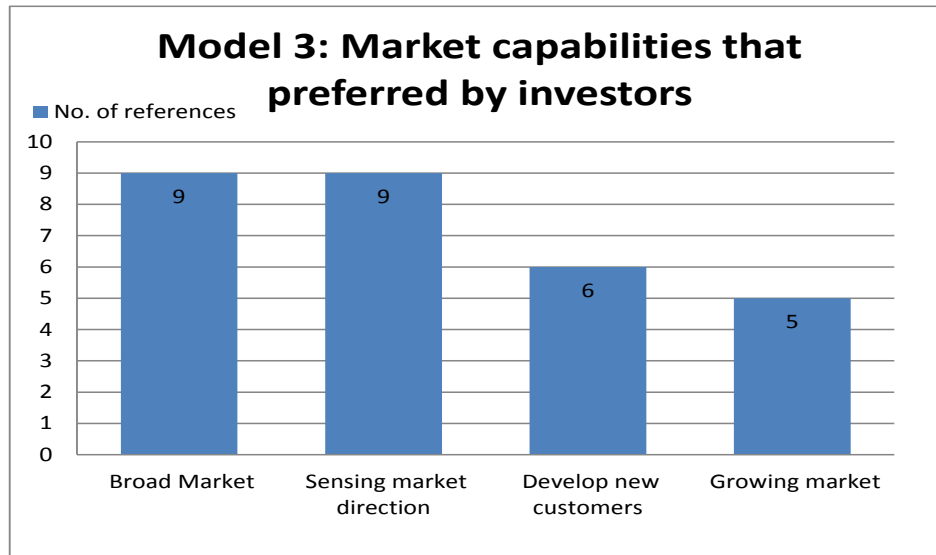
Figure 25 Marketing capabilities that preferred by investors

In general, investors preferred startup that has capability to address broad market (reference count 9) more than capability to address growing market (reference count 5). Investors also preferred ability to sense market direction (reference count 9) more than ability to develop new customer (reference count 6).

Model 3: Market Capability		Occupation			Investing role			
(reference counts)	All	Entrepreneur	Management	Regulator	Business angel	Business angel fund	Corporate business angel	Venture captial
Total	29	7	18	4	9	2	4	14
Broad Market	9	2	7	0	5	2	0	2
Sensing market direction	9	2	5	2	2	0	1	6
Develop new customers	6	3	3	0	1	0	3	2
Growing market	5	0	3	2	1	0	0	4

Management, business angel, and business angel fund preferred startup to address in broad market. Entrepreneur and corporate business angel preferred ability to develop new customer. Venture capital and regulator preferred ability to sense market direction.

Research proposition P2 was supported by this result of market capability reference counts at 29 which is highest among other capabilities, had confirmed with research proposition P2 that marketing capability had positive effect on investment evaluation of investors.

4.5.3.1.3   Entrepreneur Capabilities

Research proposition P3 explored relationship between investment evaluation and entrepreneur capabilities, which comprised of capabilities that related to experience in execution real business, skills in technology and marketing, skills in exploit new opportunities, skill that enhance security and skill that enhance return of startup. The

results of content analysis for parameters of entrepreneur capabilities were conducted by NVivo and were summarized as in figure below.
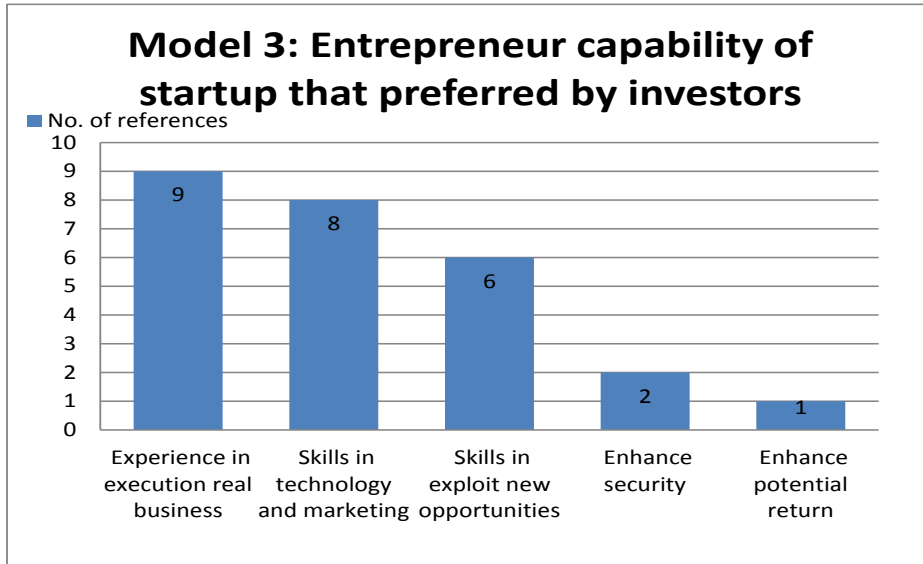
Figure 26 Entrepreneur capabilities that preferred by investors

The attractiveness of opportunity to the firms depends on entrepreneur's ability in solving customer problem in related market (Shane, 2000). Experiences of entrepreneur was considered one of the key criteria by venture capital (MacMillan et al., 1985). Considering all interviewees, they preferred startup to have team which had experience in execution real business before startup new firm.

> *"When he was in VC industry, he evaluated startup with 3E: Exclusive-Technology had to be exclusive, Exponential-Market had to be exponential growth, and Execution-Entrepreneur had to be capable of deliver as plan. If no exclusivity in technology, market is unlikely to be exponential growth. Therefore investor had to look for execution capability of entrepreneur".*

Skill in technology and marketing and skills in exploiting new opportunities were of lesser weight.

Model 3: Entrepreneur Capability (reference counts)	All	Occupation			Investing role				
		Entrepreneur	Management	Regulator	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Total	26	10	13	3	11	5	3	2	5
Experience in execution real business	9	2	5	2	3	1	1	2	2
Skills in technology and marketing	8	2	6	0	4	1	1	0	2
Skills in exploit new opportunities	6	3	2	1	4	1	0	0	1
Enhance security	2	2	0	0	0	1	1	0	0
Enhance potential return	1	1	0	0	0	1	0	0	0

Experiences in execution real business were favor by venture capital, early-stage fund, corporate business angel, business angel fund and regulator. Skill in technology and marketing was preferred by management and business angel. Skill in exploit new opportunities was preferred by entrepreneur.

Research proposition P3 was supported by this result of entrepreneur capability reference count at 26, which was higher than technology capability but lower than market capability, confirmed with research proposition P3 that entrepreneur capability had positive effect on investment evaluation of investors.

4.5.3.2 Innovation Model

Research proposition P4 explored relationship between investment evaluation and innovation model, which comprised of new-market Innovation, differentiation, disruptive Innovation and low-end Innovation. Result of content analysis in form of quote reference counts were as follow.
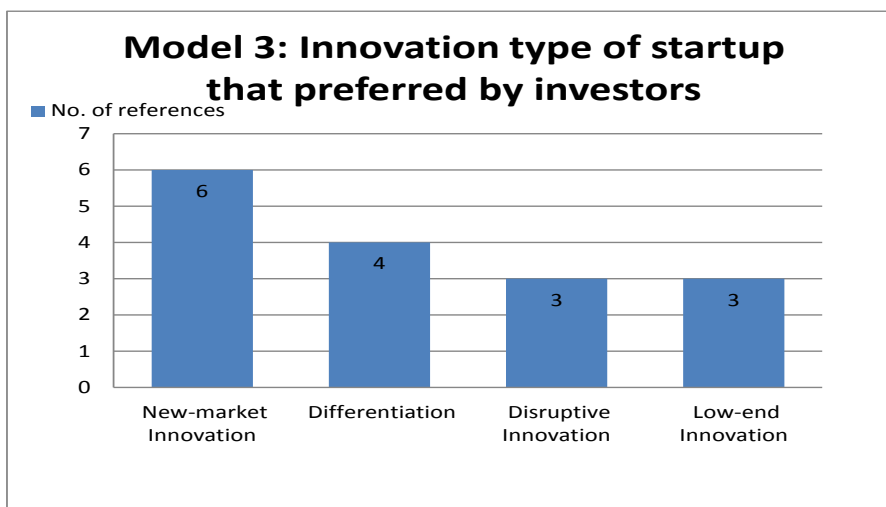
Figure 27 Innovation type of startup that preferred by investors

Small startup companies would be in better position with large incumbent companies when use disruptive innovation that address customer at low-end of value system or low-end disruption or at new-market who was non-consumption group or new-market disruption (Christensen, 1997). Considering all interviewees, most of them preferred startup to have ability in new-market innovation, while none favor radical innovation.

Model 3: Innovation		Occupation		Investing role			
(reference counts)	All	Entrepreneur	Management	Business angel	Business angel fund	Early-stage fund	Venture captial
Total	16	8	8	9	4	2	1
New-market Innovation	6	3	3	3	2	1	0
Differentiation	4	3	1	3	0	1	0
Disruptive Innovation	3	1	2	1	1	0	1
Low-end Innovation	3	1	2	2	1	0	0

Investors agreed that they related disruptive innovation either low-end or new-market with potential of growth of start-ups. They agreed that disruptive innovation was a way to create survival of start-up and create wealth with less competition from incumbents. The only group of investors that preferred disruptive innovation is venture capital.

"[I] only invest in disruptive innovation"

"He believed investment in disruptive innovation could create potential growth, but difficult to judge which one is really a disruptive. He believed if entrepreneur look at customer pain, not focus too much on performance of product, they could create disruptive innovation".

"He believed software developments are mostly disruptive innovation".

They give more weight to start-ups that have plan for innovation as it created growth. But they would consider the start-up to pursue any type of innovation only after start-up could prove to be sustainable and survive.

Some investors with low affordable loss level would considered first to go with low-end disruptive innovation because they could extract or substitute existing components of technologies available in market and reconfigured with new product with less risk. Some investors with higher affordable loss level would consider pursuing new-market disruptive innovation because they believed in their experience in the industries and network of related supplier or customers that could help. Some investors would consider any type of disruptive innovation that match with capability of entrepreneurs and team, the higher the capabilities the more they preferred pursuing new-market disruptive innovation over low-end.

Research proposition P4 was supported by result of reference count of disruptive innovation factor at 16, which was lower than factors in capabilities group, confirmed with research proposition P4 that disruptive innovation had positive effect on investment evaluation but at lower effect than capabilities of startup.

4.5.3.3 Modularity

Research proposition P5 explored relationship between investment evaluation and modularity, which comprised of ability of startup to create internal flexibility for product, process and production and external platform to create connectivity with outside product or complementary products. Result of content analysis in form of quote reference counts were as follow.
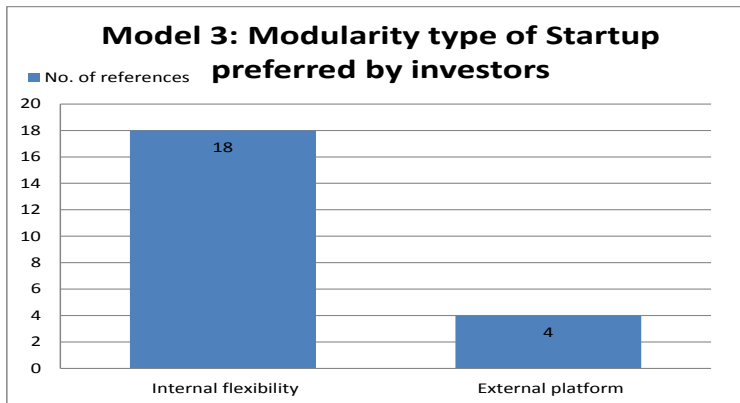
Figure 28 Modularity type of startup that preferred by investors

Considering all interviewees, they preferred startup to have modularity in internal flexibility more than external platform.

Model 3: Modular (reference counts)	All	Occupation		Investing role				
		Entrepreneur	Management	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Total	22	11	11	8	4	1	6	3
Internal flexibility	18	8	10	8	3	1	4	2
External platform	4	3	1	0	1	0	2	1

Modularity could help create option for startup to design product in new ways that can change market value of previous design of product or process (Baldwin & Clark, 2000). Modularity could be for internal product structure or for outside platform to connect product of startup with other platform or product or complimentary assets (Gawer, 2009). From the result of content analysis, management, entrepreneur and business angel considered internal flexibility when applying modularity in the startup.

> *"Startup should smell where the growth of market is and be flexible enough to adapt when situation change".*

> *"He believed modular concept is very helpful for startup, such as reducing cost. He experience modular concept in nutraceutical industry, in addition to computer industry where modular concept was initiated. Modular could be in product structure, operations, or investment".*

> *"Investors would appreciate when entrepreneur told them that the new product was created from 90% out-of-the-self components. Creating new product from existing components could reduce technical risk, market risk of complimentary component, increasing return".*

Modularity and growth
> *"Modularity could help to increase probability that startup to become blockbuster by reducing cost, improve features to satisfy customer in new market, create multifunction product to attract broader market".*

Modularity and survival

> *"Modularity could help to increase probability that startup have more chance to survive if modularity is external allowing to connect with outside complimentary product".*

Modular design is well-known in industry that has visible product structure; computer, electronics, auto industry, but less in non-visible product structure industry such as chemical which investors mention example of adding metal catalyst into plastic to turn it to biodegradable plastics.

Modular concept was viewed to create robustness, flexibility, cost saving, and higher return from lower investment amount. Question to investor about modularity were about opinion on investment to reconfigure existing component available in market place or investment in new component that can be reused in other project and about whether modular could increase probability to of survival, probability to achieve aspiration level, and propensity to invest in start-up.

Under typical evaluation criteria, investors value the start-up form technological, market, and entrepreneurial capabilities. With additional investment in design or modular capabilities, start-up can reconfigure product and process to enable options in technology positioning, market scouting, and entrepreneur stepping-stone option to create upside potential and reduce downside risk that corresponding to either low-end disruption or new-market disruption. Focusing on valuation process that describe capping downside risk and upside potential, the starup funding request should match with investors preference on meeting security need, growth potential needs, and match level of aspiration of wealth of investors with intensity of entrepreneur.

The concern of investor or financier on survival, sustainability and grow of the start-up, under criteria of investment choice under SP/A can be satisfied if new product is developed with option created from corresponding modular operators. It is hypothesized that in order for start-up to survive the competition, it can use modular operators to split and exclude unnecessary module to have option to reduce cost and improve efficiency as low-end disruption. In addition, the start-up may choose to have option to expand its current technology capabilities in different future market by using modular operators to add new modules that correspond to the need of new market as new-market disruption.

At the stage of valuation under real option, investment in capabilities will provide options to enter into each choices either technology or market. However, investment in design capabilities that will create modular structure should be considered as initial investment that will further enable options in technology or market to occur.

Research proposition P5 was supported by result of reference count for modularity factor at 22 confirmed that modularity had positive effect on investment evaluation, but at lesser weight than investment model which (120 counts) but higher weight than disruptive innovation (16 counts).

4.5.3.4 <u>Investment Model</u>

Research proposition P6 explored relationship between investment evaluation and investment model, which comprised of ability of startup to create security, growth potential, probability to achieve target, staging, level of target return, level of aspiration, exit potential, financial valuation, indirect return, non-monetary return, timing of investment and real option valuation. Result of content analysis in form of quote reference counts were as follow.
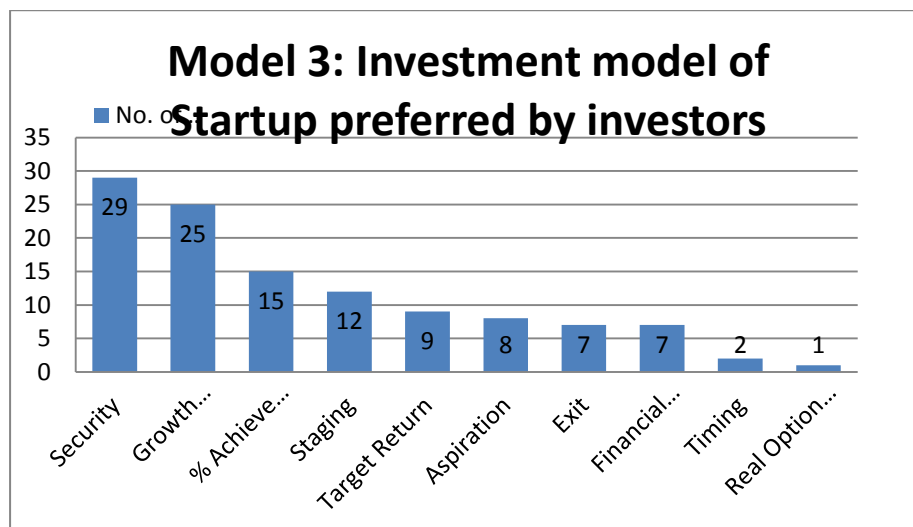
Figure 29 Investment model that preferred by investors

Investment model comprise of SP/A factors, staging, real option and exit potential. Security and growth were factors that investors consider for their investment, rather than average mean or average risk (Lopes & Oden, 1999a). Investors reduce risk in technological investment by investment in many stages and revised future courses accordingly (Kazanjian & Drazin, 1990). Each stage of investment could create option value of either to continue to invest (McGrath, 1997) or exit (Giot & Schwienbacher, 2007) .

Result content analysis showed that of most of investors considered security first for startup then considered growth potential later. Probability to achieve target, staging ability were less preferred.

> "He believed startup should stage in two phases, first was to do what it could do best in order to survive. Second was to select either innovation at core or modular, the third to expand upstream or downstream".

> "He gave value to option that create security and survival more than growth option. Survival is first then growth comes second".

Investment model (reference counts)		Occupation			Investing role				
	All	Entrepreneur	Management	Regulator	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Total	120	64	54	2	62	23	12	9	14
Security	29	15	14	0	16	3	5	2	3
Growth Potential	25	10	14	1	15	1	2	2	5
% Achieve Target	15	10	5	0	8	4	2	0	1
Staging	12	6	5	1	5	4	2	0	1
Target Return	9	5	4	0	3	1	1	2	2
Aspiration	8	4	4	0	6	2	0	0	0
Exit	7	6	1	0	5	1	0	0	1
Financial Valuation	7	2	5	0	2	2	0	2	1
Indirect Return	3	2	1	0	1	2	0	0	0
Non-monetary Return	2	2	0	0	0	2	0	0	0
Timing	2	2	0	0	0	1	0	1	0
Real Option Valuation	1	0	1	0	1	0	0	0	0

Entrepreneur, management, business angel, corporate business angel and early stage fund preferred security in the startup. Venture capital preferred to see growth potential, while business angel fund preferred to see startup that has high probability to achieve target.

In this section of investment evaluation, SP/A was asked to measure level of aspiration (goal or target return), minimum return requirement, and expect probability to achieve aspiration and minimum return (or loss). However, potential level that start-up could achieve was not mention because investor would not stop their aspiration lower than potential that start-up could be. Therefore, level of aspiration of investor and level of potential return from start-up are the same point.

The investors related security criteria to capabilities of entrepreneurs and affordable loss they could assign to specific start-up. They related potential of growth from study the business plan of start-ups with innovation and newness of product of start-up. They also related their decision to take plunge in investing in start-up when conclude that such investment could satisfy their aspiration, both financial motivation (invest with expectation of financial return) and non-financial motivation (invest with expectation to give as inheritance, sport, or reputation).

Research proposition P6 was supported by this result of reference count of investment model at 120, highest among all factors, confirmed with research proposition that investment model had positive effect on investment evaluation of investors.

4.5.3.5 Quality of Entrepreneur

Research proposition P7 explored relationship between investment evaluation and quality of entrepreneur, which comprised of integrity, honesty, moral, trustworthiness, gratitude, ability to withstand adversity, good attitude, credibility, high determination, good reputation, care and fair for investment that investor made in startup. Result of content analysis in form of quote reference counts were as follow.
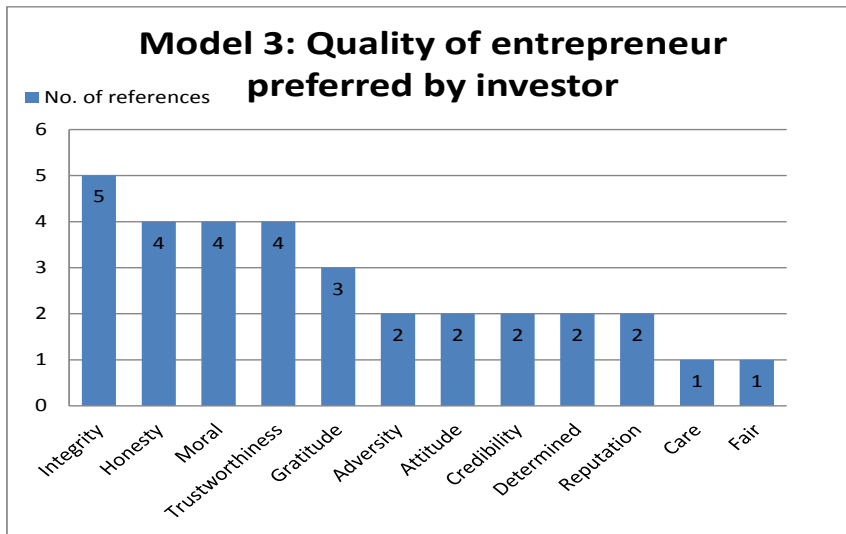
Figure 30 Quality of entrepreneur that preferred by investors

Considering all 13 interviewees, their criteria on quality of entrepreneur for them to invest in startup were integrity, honesty, moral, trustworthiness and gratitude respectively.

Model 3: Quality (reference counts)		Occupation		Investing role			
	All	Entrepreneur	Management	Business angel	Business angel fund	Corporate business angel	Early-stage fund
Total	32	27	5	15	7	9	1
Integrity	5	5	0	4	0	1	0
Honesty	4	4	0	0	0	4	0
Moral	4	4	0	2	1	1	0
Trustworthiness	4	3	1	1	2	1	0
Gratitude	3	3	0	0	3	0	0
Adversity	2	2	0	2	0	0	0
Attitude	2	1	1	1	0	0	1
Credibility	2	0	2	2	0	0	0
Determined	2	1	1	1	0	1	0
Reputation	2	2	0	1	1	0	0
Care	1	1	0	1	0	0	0
Fair	1	1	0	0	0	1	0

Entrepreneurs and business angels are group of investors that put high weight on integrity. Corporate business angel focused on honesty. Business angel fund focused on gratitude. Management focused on credibility. Early-stage fund focused on attitude.

> *"Integrity is number one quality for entrepreneur".*

> *"Investor did not consider financial statement much. They looked at reputation of entrepreneur".*

> *"He focused on integrity of entrepreneur more than business plan or technology".*

> *"He selected startup with good experience, good education and attitude to join incubator. Then he tried to improve by mentorship-learning from others and learning by doing-presentation during 3 months".*

Investors invest in entrepreneurs that have high ethics. They reasoned that they had experienced conflicts on partnering with entrepreneurs mostly when firms started to make profit. When conflict occurred with entrepreneurs, investors give more weight to loss in non-monetary factors, such as reputation than loss of money invested, since they could afford to lose such money. They apparently use criteria of affordable loss in monetary terms together with other affordable loss in non-monetary terms such as time, network, and reputation.

4.5.3.6 *Quality of Entrepreneur and Evaluation of Startup*

Model 3: Quality of EN & Evaluation	Security base			Growth base		
(reference counts)	Affordable Loss	Security	% Achieve Target	Aspiration	Target Return	Growth Potential
Total Quality of Entrepreneur	4	5	4	1	3	1
Credibility	1	1	1	0	0	0
Reputation	1	0	1	0	0	0
Gratitude	1	0	0	0	0	0
Integrity	1	0	0	0	0	0
Trustworthiness	0	1	1	0	0	0
Determined	0	1	0	1	1	1
Honesty	0	1	0	0	1	0
Moral	0	1	0	0	0	0
Care	0	0	1	0	0	0
Fair	0	0	0	0	1	0

In general, investors weighted affordable loss and security more than aspiration or growth potential.

Qualities of entrepreneur that contribute to affordable loss were credibility, gratitude, integrity and reputation. Quality of entrepreneur that contribute to security or survival of startup were credibility, determine, honesty and moral. Quality of entrepreneur that contribute to probability of achieve target were care, credibility, reputation and trustworthiness.

> *"Entrepreneur was a trustworthy person would be honest and true in doing business in care of safety of capital invested by business angel and survival of company".*

> *"He gave example about when he met business angel asking for funding. He was introduced by his previous boss to the investor that the entrepreneur was a trustworthy person, who knew best in software development, and his boss guaranteed that he was a person with gratitude. That was how he got funding committed 10 MBaht with just business plan".*

"Entrepreneurs who care for other people and not willing to hurt others feeling by their acts or their words have more chance to get any deal done in win-win situation".

Determine was the quality that contributed to achieve of growth potential, target return and aspiration. Additional of fairness and honesty would contribute to achieve of target return.

Research proposition P7 was supported by the result of reference count of quality of entrepreneur at 32, rank in second after investment model, confirmed with research proposition P7 that quality of entrepreneur had positive effect on investment evaluation of investors.

4.5.3.7 *Affordable Loss*

Research proposition P8 explored relationship between investment evaluation and affordable loss. Result of content analysis in form of quote reference counts were as follow.
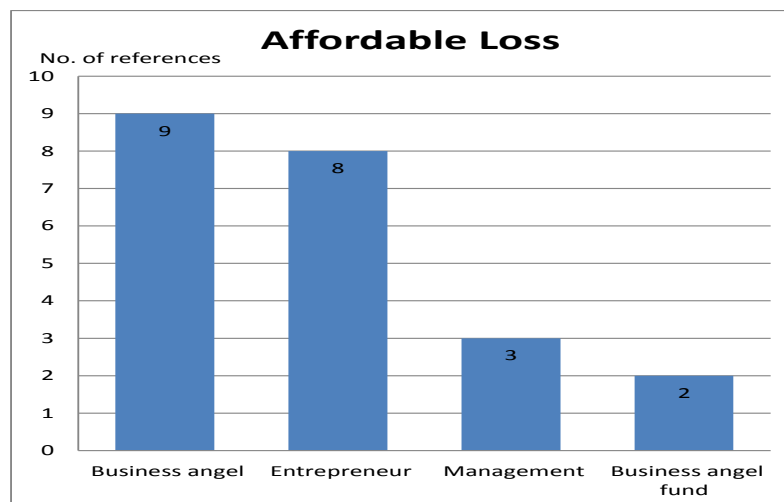
Figure 31 Reference counts for affordable loss

Model 3: Affordable Loss		Occupation		Investing role	
(reference counts)	All	Entrepreneur	Management	Business angel	Business angel fund
Affordable Loss	11	8	3	9	2

Affordable loss was a non-predictive factor that explained behaviour of investors in tanking plunge decision in startup (Dew, Sarasathy, et al., 2009). Result of investment count shown that entrepreneur and business angel agreed that they used criteria of affordable loss to make decision to invest and plunged into start-up, according to request of funding from entrepreneurs. Management and business angel fund considered less about affordable loss.

> *"Entrepreneur was a gratitude person would try to do every way he could to make use of money obtained from business angel"*.

They mentioned about their preference and depth of plunge that related to affordable loss, but not directly mentioned about their ability to take plunge. They confirmed that their affordable loss level on each start-up varied depending on capabilities of entrepreneurs such as their personal preference, commitment, credential, and especially ethic.

> *"Affordable loss depends on entrepreneur and project. Key to obtain funding from business angel was how to make affordable loss in the mind of business angel, which they expect to lose, become unlikely to lose"*

Individual investors who started their business and succeed in which industry tends to invested in start-up in such industry, because they had capabilities, start-up experience, and network that could apply to help them evaluate the start-up. Past experience in specific industry help them reduce complicate rules into simple heuristic such as affordable loss.

Security and Affordable Loss
Matching investor preference with characteristics of start-up is very important in financing start-up, especially for individual investors such as business angels. In general, investors in the start-up evaluate and making decision to invest based on indicative factors that could help predict ability to survive and potential of growth (MacMillan et al., 1985). The ability to survive is a reasonable factor that investors with safety-first in mind would consider due to the fact that there is always a chance that the any investment may become lost (Roy, 1952).

Affordable loss was proposed as one of the major criteria for entrepreneur in making decision to plunged into new venture (Landström, 1998). Informal investors or business angels were similar to entrepreneurs in term of business creation or co-creator (Dew, Sarasathy, et al., 2009). Therefore, affordable loss could be applied to both entrepreneur and business angels as decision making criteria to estimated what they might be able to put at risk and possible to lose in order to plunge in to investment in start-up. In order to increase amount that investors prepare to lose, entrepreneurs should focus to plan to accept risk as inevitable and try to minimize downside loss in order to provide security for invested capital from investors.

Research proposition P8 was supported by the result of reference count of affordable loss at 11 confirming that that affordable loss had positive effect on investment evaluation, but at lesser weight than quality of entrepreneur (32 counts) and support from formal institution (16 counts).

4.5.3.8 *Support for Business Angel*

Research proposition P9 explored relationship between investment evaluation and availability of formal support institution for investors, such as BA formal institution,

startup market for investment, startup mentoring, large corporation that could support financing and large corporation that could support in technology. Result of content analysis in form of quote reference counts were as follow.

Considering all interviewees, they requested for establishment of business angel formal institution to support them.
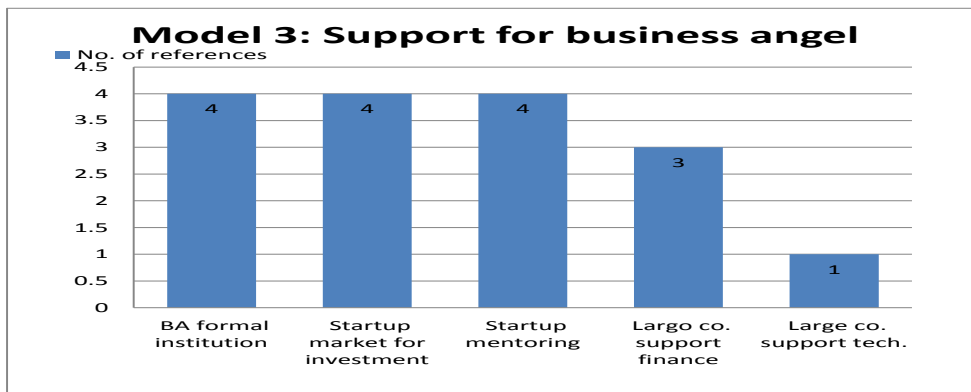
Figure 32 Support for business angel

Model 3: Support (reference counts)		Occupation			Investing role			
	All	Entrepreneur	Management	Regulator	Business angel	Business angel fund	Early-stage fund	Venture captial
Total	16	6	9	1	2	4	6	4
BA formal institution	4	2	1	1	0	2	1	1
Startup market for investment	4	1	3	0	1	0	0	3
Startup mentoring	4	0	4	0	0	0	4	0
Largo co. support finance	3	2	1	0	1	1	1	0
Large co. support tech.	1	1	0	0	0	1	0	0

Industry cluster and networking were important to startup and investors in supporting knowledge generation and industrial development by integration of government, university/research organization and private sectors (Wonglimpiyarat, 2007). Formal institution for business angel was important to promote investment from individual and promote startup growth (Scheela & Jittrapanun, 2012) . Entrepreneur, regulator and business angel fund agreed to the need for business angel formal institution. They mentioned that they need organizer to set rules and expectation of private investment in order to protect investors and promote more startup. Fair rules for contribution from investor or mentor and fair benefit to them should be set in advance so that startup could expect what to get from mentor, incubator or investor and what cost to them.

> *"Between entrepreneur and business angel there was no standard deal that people accepted widely. In Asian culture, like China in the old day, they set moral code for young people to raise themselves, help the one who in need, and give back to the people used to help you".*

> *"The lack of standard and formal institution between business angel and entrepreneur case mismatch of expectation between giver and taker. There should be an institution or society that set standard, code of practices and*

ethics, giving certificate to investors, incubator, or training entrepreneur, the same way as CPA or CFA society. So they could understand what to do and what to expect from shareholder".

"Key to success in work, life and family is on how to balance expectation. Managing expectation of counter party when events turn up and down would help long term relationship which is more important than short term loss or gain".

Management and early-stage fund agreed that the business startup needs mentoring from experienced people. Most interviewees were willing to help as mentor for newly startup. Apart from mentoring, investor also so agreed that large company could help startup by support financing and technology.

"Startup had room to grow more if large corporation supported the development such as joint development, providing its technology platform or labs for startup to use to develop new product".

"Large corporation should help coaching and run startup with entrepreneur. After 3 year, VC could come in for expansion finance. Cooperation between large company, startup and VC should help promote more startup".

Venture capital is the group most wanted for market to support their investment or sales of their shares in startup/small business, then business angel.

Research proposition P9 was supported with reference count for support from formal institution at 16, higher than affordable loss (11 counts) but lower than quality of entrepreneur (32 counts). The result confirmed with research proposition P9 that support from formal institution had positive effect on investment evaluation, especially among factors that focus on security of investment in startup.

4.5.3.9 <u>Non-Financial and Indirect Return</u>
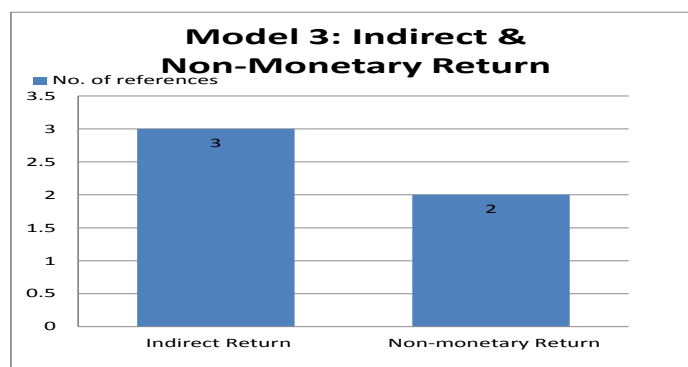
Figure 33 Indirect & non-monetary return from startup

Non-monetary or indirect return are factors that influence decision making of informal investors in startup (Bygrave & Reynolds, 2011). Considering all

interviewees, investors agreed they expected indirect and non-monetary return in their investments. Indirect return was expected more than non-monetary return.

Model 3: Indirect & Non-Monetary (reference counts)	All	Occupation		Investing role	
		Entrepreneur	Management	Business angel	Business angel fund
Total	5	4	1	1	4
Indirect Return	3	2	1	1	2
Non-monetary Return	2	2	0	0	2

Group of investor who expected indirect return from startup were entrepreneur, management, business angel and business angel fund. Those who acted as investors that concern only financial return were banker, corporate business angel, early-stage fund, and venture capital.

"Business angel looked for indirect return such as benefit to existing portfolio more than monetary return".

"Business angel looked for non-monetary return such as excitement in participation at startup more than monetary return".

"She believed other investors who had excess cash would look for not only financial return, but indirect return such as benefit to their portfolio business".

4.5.3.10 Model with Details Criteria
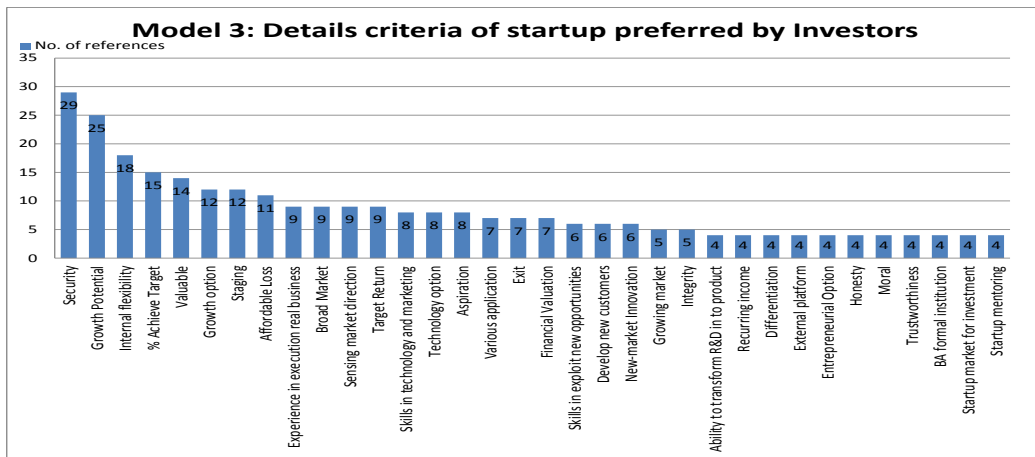
Figure 34 Detail criteria of startup that preferred by investors

Most of investors considered security first for startup, then considered growth potential later. Modularity from internal flexibility of product was also preferred after that. Investors also weight probability to achieve target, technology that was valuable, growth option and staging respectively.

Model 3: Detail Criteria		Occupation			Investing role				
(reference counts)	All	Entrepreneur	Management	Regulator	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
Security	29	15	14	0	16	3	5	2	3
Growth Potential	25	10	14	1	15	1	2	2	5
Internal flexibility	18	8	10	0	8	3	1	4	2
% Achieve Target	15	10	5	0	8	4	2	0	1
Valuable	14	5	8	0	7	1	2	2	1
Growth option	12	5	5	2	5	1	2	0	4
Staging	12	6	5	1	5	4	2	0	1
Affordable Loss	11	8	3	0	9	2	0	0	0
Experience in execution real bus	9	2	5	2	3	1	1	2	2
Broad Market	9	2	7	0	5	2	0	0	2
Sensing market direction	9	2	5	2	2	0	1	0	6
Target Return	9	5	4	0	3	1	1	2	2
Skills in technology and marketi	8	2	6	0	4	1	1	0	2
Technology option	8	2	6	0	3	0	2	0	3
Aspiration	8	4	4	0	6	2	0	0	0
Various application	7	1	6	0	5	1	0	0	1
Exit	7	6	1	0	5	1	0	0	1
Financial Valuation	7	2	5	0	2	2	0	2	1
Skills in exploit new opportunitie	6	3	2	1	4	1	0	0	1
Develop new customers	6	3	3	0	1	0	3	0	2
New-market Innovation	6	3	3	0	3	2	0	1	0
Growing market	5	0	3	2	1	0	0	0	4
Integrity	5	5	0	0	4	0	1	0	0
Ability to transform R&D in to pr	4	0	2	2	1	0	0	0	3
Recurring income	4	2	2	0	2	0	2	0	0
Differentiation	4	3	1	0	3	0	0	1	0
External platform	4	3	1	0	0	1	0	2	1
Entrepreneurial Option	4	1	3	0	2	0	1	0	1
Honesty	4	4	0	0	0	0	4	0	0
Moral	4	4	0	0	2	1	1	0	0
Trustworthiness	4	3	1	0	1	2	1	0	0
BA formal institution	4	2	1	1	0	2	0	1	1
Startup market for investment	4	1	3	0	1	0	0	0	3
Startup mentoring	4	0	4	0	0	0	0	4	0
Non-substitutable	3	0	1	2	1	0	0	0	2
Reducing cost	3	2	1	0	1	0	0	2	0
Disruptive Innovation	3	1	2	0	1	1	0	0	1
Low-end Innovation	3	1	2	0	2	1	0	0	0
Gratitude	3	3	0	0	0	3	0	0	0
Indirect Return	3	2	1	0	1	2	0	0	0
Largo co. support finance	3	2	1	0	1	1	0	1	0
Enhance security	2	2	0	0	0	1	1	0	0
Adversity	2	2	0	0	2	0	0	0	0
Attitude	2	1	1	0	1	0	0	1	0
Credibility	2	0	2	0	2	0	0	0	0
Determined	2	1	1	0	1	0	1	0	0
Reputation	2	2	0	0	1	1	0	0	0
Non-monetary Return	2	2	0	0	0	2	0	0	0
Timing	2	2	0	0	0	1	0	1	0
Enhance potential return	1	1	0	0	0	1	0	0	0
Rare	1	0	0	1	0	0	0	0	1
Market option	1	0	1	0	1	0	0	0	0
Care	1	1	0	0	1	0	0	0	0
Fair	1	1	0	0	0	0	1	0	0
Real Option Valuation	1	0	1	0	1	0	0	0	0
Large co. support tech.	1	1	0	0	0	1	0	0	0

Entrepreneur, management, business angel and corporate business angel preferred security in the startup. Regulator preferred to see growth potential, while business angel fund preferred to see startup that has high probability to achieve target. Early stage fund preferred modularity in internal flexibility and venture capital preferred to see startup that could sense market direction.

4.5.4 *Model Summary*

To create summary of various concepts in to larger category, NVivo would aggregate number of quotes of child concepts up to parent concepts or category.
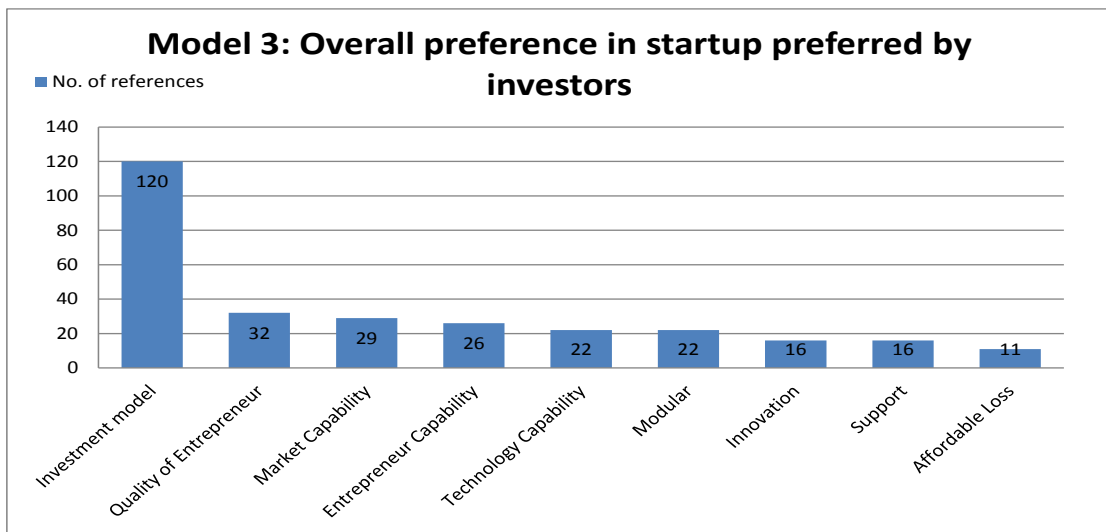
Figure 35 Overall preference in startup

Investors quoted with concept related to investment model most. Quality of entrepreneur was quoted less and following by market capability, entrepreneur capability and technology capability.

Model 3: Overall Criteria		Occupation			Investing role				
(reference counts)	All	Entrepreneur	Management	Regulator	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
Investment model	120	38	30	2	33	14	6	7	10
Quality of Entrepreneur	32	17	5	0	11	6	4	1	0
Market Capability	29	6	12	2	8	2	3	0	7
Entrepreneur Capability	26	7	11	2	9	3	2	2	4
Technology Capability	22	5	11	2	9	1	2	2	4
Modular	22	10	11	0	8	4	1	5	3
Innovation	16	6	7	0	8	3	0	1	1
Support	16	4	7	1	1	3	0	4	4
Affordable Loss	11	8	3	0	9	2	0	0	0

All group of interviewees concerned with investment model in order for investing in business startup.

4.5.5 *Result of Model Summary with Final Conceptual Model*

The final conceptual model was enhanced by the outcome weight of each criteria. Data on reference weight from model summary could be assigned to each node in the conceptual model. When revising the final conceptual model to use line width to represent higher reference count. The drawing was done by program Diaw.exe version 0.97.2 and use line width 1.20cm to represent highest 120 reference counts and line width 0.11cm for lowest 11 reference counts and other lines in the same manners. The new figure of conceptual model with reference counts would be as follow.
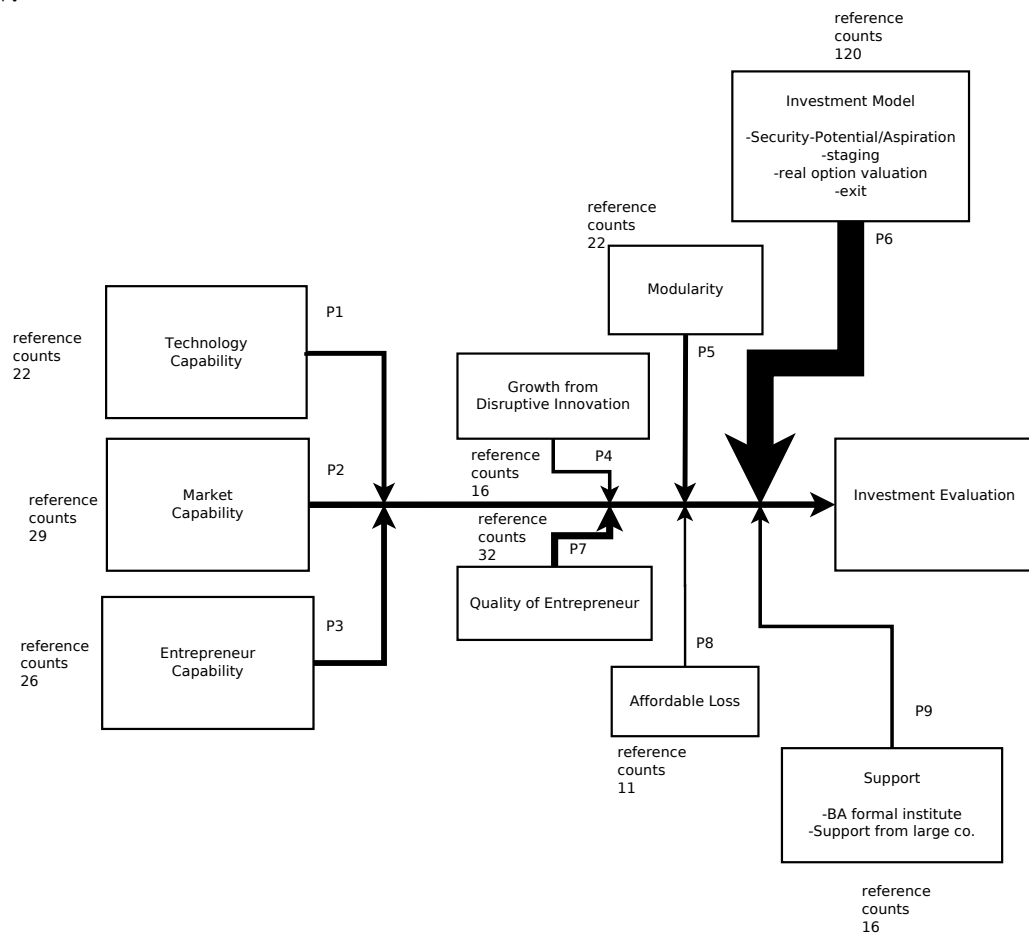
Figure 36 Final conceptual model with reference counts

Investment model was given highest reference weight shown in wider arrow line demonstrating that proposition 6 had been considered as highest weight and considered by all 13 investors. Exploring in detail of investment model, it was shown that investors would give highest weight on security of their investment in startup as first criteria then consider growth and probability to achieve target and staging ability later.

Quality of entrepreneur was assigned with second order weight lower than investment model. However, quality of entrepreneur was considered at higher preference than market capability, entrepreneur capability and technological capability respectively.

4.6 *Conclusion*

For final model, the revised research propositions P1-P6 which were the same for model 2 could be summarized as follow.

Research Propositions	Findings
P1.Technological Capabilities of business startup have positive impact on evaluation of Private Capital to invest in business startup.	Most investors preferred startup to have technology capability that could be applied to various applications, ability to transform R&D into product and ability to create recurring income.
P2.Market Capabilities of business startup has positive impact on evaluation of Private Capital to invest in business startup.	Most investors preferred startup to have market capability on both sensing market direction and broad market equally. Ability to develop new market and targeting growing market were lesser weighed.
P3.Entrepreneur Capabilities of business startup has positive impact on evaluation of Private Capital to invest in business startup.	Most investors preferred startup to have team which had experience in execution real business before startup new firm. Skill in technology and marketing and skills in exploiting new opportunities were of lesser weight.
P4. Disruptive Innovation of business startup has positive impact on evaluation of Private Capital to invest in business startup	Almost all investors preferred startup to have ability in new-market innovation, while few favor radical innovation.
P5. Modularity of business startup has positive impact on evaluation of Private Capital to invest in business startup	Most investors preferred startup to have modularity in internal flexibility in product components or production more than modularity in external platform.
P6. Investment Model of business startup has positive impact on evaluation of Private Capital to invest in business startup	Most of investors considered security first for startup, then considered growth potential later.

The additional research propositions which were added only in model 3 or final model could be summarized as follow.

Research Propositions	Findings
P7.Quality of Entrepreneur of business startup has positive impact on evaluation of Private Capital to invest in business startup.	Most investors preferred that the startup that they would invested in should have entrepreneur that was high in integrity, honesty, moral, trustworthiness and gratitude respectively.
P8.Affordable Loss has relationship with evaluation of Private Capital to invest in business startup.	The entrepreneur and business angel agreed that they used criteria of affordable loss to make decision to invest and plunged into start-up, according to request of funding from entrepreneurs.
P.9 Support from External Ecosystem of business startup has positive impact on evaluation of Private Capital to invest in business startup.	Entrepreneur, regulator and business angel fund agreed to the need for business angel formal institution, market for investment in startup and mentoring startup in equally weight.

Outcome of this chapter was the conceptual model of financing business startups that match innovation and technology development in Model 3 or final model.

The technology and innovation that satisfy investment criteria of investors in startup companies were technology that supported the new-market innovation which could create growth options for investors. Major characteristic of such technology was related to modularity which allows internal flexibility in product components or production process. When startup possess capability in sensing market direction and utilized to new and broad market, startup should have growth potential that satisfy investors criteria.

Growth options and ability to stage investment to create options to pursue such growth market are financial and investment model of business startup that that match investment preference of private investor.

Good quality of entrepreneur contributed more to affordable loss, security and probability to achieve target return. On the contrary, bad quality of entrepreneur would affect security and survival or probability to achieve target return.

> "He would jointly consider the plan of entrepreneur to consider risk and try to reduce risk in technology, market, competition, tax, raw material. Risk of loss was also caused by people. If entrepreneur has high trustworthy, he expected not to lose much, or risk of loss is low".

Outcome of this chapter were conceptual model of financing business acceptance test of model satisfy research objective no. 2.1 and 2.2.

CHAPTER V

DEVELOPMENT OF DECISION MAKING TOOL

5.1 *Financial Decision Model Development*

Opinions and comments from surveys and interviews of business startup and private equity were used to adjust and fine-tune the financial decision model. From such variables, financial decision model will be revised.

The model was designed to incorporate investment and return in staging, and enable option consideration to pursue next choices depending on future investment, risk, and return characteristics. The model was created using Excel spreadsheet to show investment and return for each stages. The model incorporated what-if scenario to show the changing of return if no technology commercialization and investment model in order for private investor to exercise their option thinking during investment.

5.2 *Conceptual Design*

Design of investment decision making tool was taken from parameters mentioned to be important from literature review and interview. Decision making of investor was focused on financial return which also framed into groups of security, potential and aspiration or targeted return rate and probabilities. Technology capabilities, market capabilities and entrepreneur capabilities were grouped into disruptive innovation abilities and presented in financial information of the startup in form of business cases that provide cash flow return from investment. Real option technique was used to measure value created from volatility of innovation, rather than value calculated from traditional finance. Propensity to invest of investor should increase as probability that return from investment above targeted rate of return or aspiration. Decision to plunge to invest in the startup is also depended on probability that affordable loss. The higher probability of security or lower probability of lost will reduce probability of actual lose the affordable loss.

5.3 *Case Studies: Biodiesel from Waste Vegetable Oil*

Case studies of actual technologies were used to test the decision making tool to make sure that the tool could capture actual factors in real case. Biodiesel production from waste vegetable oil was proposed as subject of study because of the technology is evolving fast and considerable uncertainty in commercializing the technology.

Desired innovation project for technological innovation startup was set to produce biodiesel for jet engine (BioJet) as new-market innovation (Daggett, Hendricks, Walther, & Corporan, 2007). Alternative scenarios of commercialization were set into two scenarios of large scale and small scale process to compare with desired innovation project.

Large scale process could produce biodiesel B100 at capacity of 1,200 liter per day cost 870,000Baht to construct. Output from this technology could be marketed to existing commercial vehicle use. This case is proposed as sustaining innovation for mainstream market.

Small scale process could produce biodiesel B100 with different technology using Continuous Deglycerolization-CD Process at capacity of 100 liter per day cost 100,000Baht to construct. This alternative process was claimed to use energy only 60-70% of existing process (C. W. Tongurai, T.; Nikhom, R., 2012). Output from this technology could be marketed to existing commercial vehicle use. This case is proposed as low-end innovation for market at lower value system than current mainstream market.

Information about actual investment cost, process technologies and output figures were obtained from Biodiesel Technology Operational Guide (C. Tongurai et al., 2012) and from Plan Energy (Thailand) (2012).

5.4 *Functional Design*

Major functions of decision making tool were designed to be as input module, valuation module and decision making modules as in figure below.
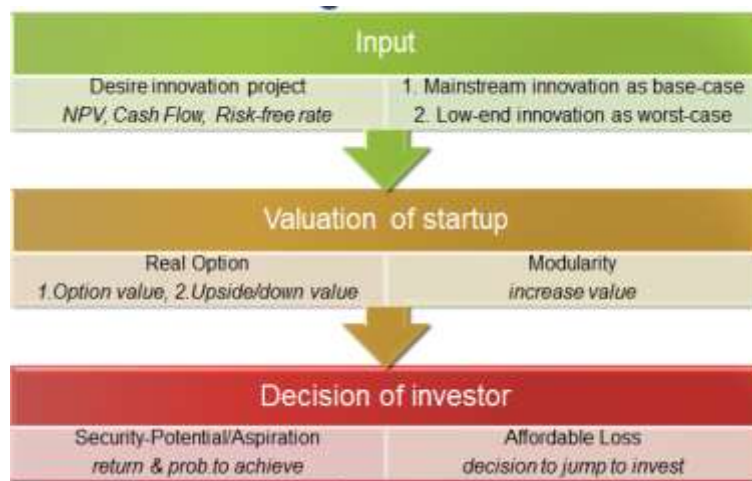
Figure 37 Functional design of decision tool

Detail processes of decision making tools were laid out in figure below and with detail description in section 5.5.
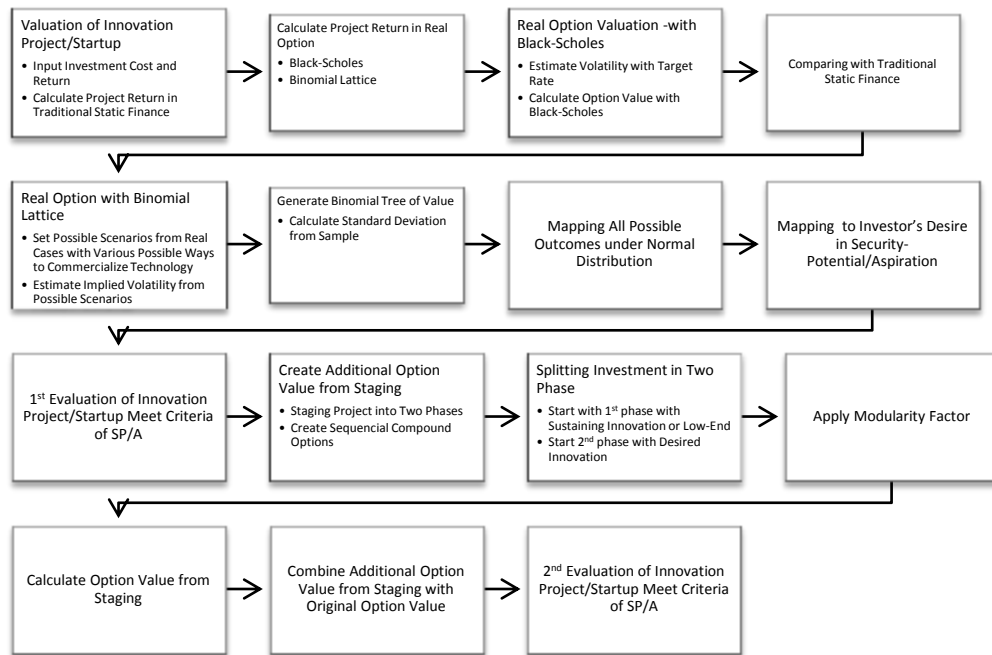
Figure 38 Functional flow of RO-SP/A investment decision making

5.5 *Development of Decision Algorithm*

Detail processes of calculation of value of innovation project under real option are as follow.

5. Valuation of Innovation Project of the Startup
    5.1. Input Investment Cost and Return
        The model asked user to input investment amount, expected cash flow yearly for 5 years and discount rate at risk-free rate.

    5.2. Calculate Project Return in Traditional Financial View
        The model calculated Net Present Value (NPV) from investment cost, cash flow return and discount rate.

    5.3. Calculate Project Return in Real Option
        5.3.1. Real Option Valuation of Project-with Black-Scholes
            Under real option, it use analogy to value real investment project as call option which creates right to receive benefit from investment. Valuation of call option under Black-Scholes is

    Value of call option $= S.N(d_1) - XN(d_2)e^{-rf(T)}$

    Where
    S is value of underlying asset or stock price or value of cash inflow
    X is the strike price or cost of executing the option or investment cost
    rf is the nominal risk-free rate

N is the cumulative standard normal distribution function

σ is annualized volatility of price

T is the time to expiration or economic life of strategic option

$$where \ d_1 \ = \ \frac{\ln\left(\frac{S_0}{X}\right) + (rf + \frac{1}{2}\sigma^2)(T)}{\sigma\sqrt{T}}$$

$$d_2 \ = d_1 \ - \sigma\sqrt{T}$$

5.3.2. Estimate Volatility with Target Rate

Target rate is the required rate of return investor, especially venture capital, for their investment. Target rate of return for company in startup stage of the life cycle is typically about 50%-70% (Damodaran, 2001). The target rate 50% was chosen for starting point and applied to volatility in Black-Scholes model.

5.3.3. Calculate Option Value with Black-Scholes

Calculate option value of investment in each innovation startup with following inputs by linking from input pages.

S = S_0 = Present value of cash inflow during 5 years project, discounting at risk-free rate

X= Investment cost

rf = Nominal risk-free rate at 7.7%

N = Cumulative standard normal distribution function of N(d1) and N(d2)

σ= Annualized volatility of price was estimated at 50%

T = 5 years for time to expiration or economic life of strategic option

5.3.4. Comparing with Traditional Financial NPV

The static valuation of NPV was compared with option valuation for each innovation project that startup wished to pursue. The comparison was shown at each project page.

ผลตอบแทนการลงทุน Finance			ผลตอบแทนการลงทุน Real Option			ผลตอบแทนการลงทุน Real Option		
เงินลงทุน	870,000	บาท	S=PV of cash flow	1,740,000		S=PV of cash flow	1,740,000	
Payback	2.01	ปี	K=Exercise price	870,000		K=Exercise price	870,000	
IRR	12%	ต่อปี	t=life of option	5		t=life of option	5	
Capital ga	1.00	เท่า	s=standard deviation	74%		s=standard deviation	0%	
Yr1	432,354	บาท	r=risk free rate	7.7%		r=risk free rate	0.0%	
Yr2	432,354	บาท	d1	1.48		d1	#########	
1-5yr	2,161,770	บาท	d2	-0.17		d2	#########	
NPV	870,000	บาท	Value of call option	1,362,747	บาท	Value of call option	870,000	บาท

Figure 39 Example of real option valuation and NPV

With traditional finance, sample investment amount 870,000Baht would provide NPV from 5-year investment in hypothetical project at 870,000Baht. When using real option valuation, with no volatility (or standard deviation) and zero risk-free rate, value of call option representing right to invest in such project would yield 870,000Baht, equal to traditional finance. However, when add volatility of cash flow

(or standard deviation) and risk-free rate, real option valuation would give more value to call option as volatility give value to both upside and downside.

5.4. Real Option Valuation of Flexibility with Binomial Lattice

Simpler alternative approach to value option was proposed by Cox, Ross, and Rubinstein (1979) using binomial discrete-time option pricing with expectation to allow broader use of option concept in various fields (Cox, Ross, & Rubinstein, 1979). Under binomial lattice, varying of price of asset over time is termed as volatility of asset price which were represented by up-side price movement (u) and down-side price movement (d). When risk of uncertainty was already represented in volatility, the assumption of binomial model referred to arbitrage-free world that investors could borrow or lend at risk free rate. As a result the risk factor using in binomial model or probability of upside movement is risk-neutral probability (probability with no effect of risk) (p). Risk-neutral probability of downside price movement was therefore 1-p (Mun, 2006). The calculations are as follow.

$$Upside\ factor\ \ u\ \ = e^{\sigma\sqrt{\delta t}}$$

$$Downside\ factor\ \ d\ \ = e^{-\sigma\sqrt{\delta t}}$$

$$Risk-neutral\ prob.\ \ p\ \ = \frac{e^{(rf)(\sigma t)}\ \ -d}{u\ \ -d}$$

Where σ= step wise time to calculate (here using 1 year)

Step 1: Lattice evolution of the underlying		0	1	2	3	4	5
	0	870,000	1,818,266	3,800,106	7,942,075	16,598,629	34,690,491
	1		416,276	870,000	1,818,266	3,800,106	7,942,075
	2		-	199,179	416,276	870,000	1,818,266
	3		-	-	95,303	199,179	416,276
	4		-	-	-	45,600	95,303
	5		-	-	-	-	21,819

Figure 40 Binomial option value

5.4.1. Process of Real Option Valuation

The process to frame the investment problem into real option valuation was applied from Mun (2006) to simplify to match with individual investment, not portfolio construction.

5.4.2. List of Projects and Strategies to Evaluate

Set of possible scenarios to commercialize technology or innovation based on real cases were created. Desired innovation project was set as target of analysis and compare with other possible upside and down side that could happen due to uncertainty. In this example case, the technology about biodiesel production was chosen because there are high potential in the technology and high uncertainty in which forms such technology would become into mainstream market.

RO-SPA: INVESTMENT DECISION IN TECHNOLOGICAL INNOVATION						
using Real Option Valuation and SP/A (Security-Potential/Aspiration)						
https://sites.google.com/site/investmentsurvey						
Type your input in color box	yellow					
Calculation results are in	green					
Warning	pink					
STARTUP PLAN						
Pre-Determine Outcome from New Innovation						
Desire innovation project (not commonly avail. in market)	BioJet-Produce Biodiesel-BioJet Grade from waste vegetable oil					
	Invest (Baht)	CF return 1	CF return 2	CF return 3	CF return 4	CF return 5
Investment/Return	-2,570,000	1,277,184	1,277,184	1,277,184	1,277,184	1,277,184
REFERENCE PLAN: Possible Senarios in Current Market						
	Invest (Baht)	CF return 1	CF return 2	CF return 3	CF return 4	CF return 5
Sustaining Innovation (avail. in current market)	Large Scale B100-Biodiesel-Commercial grade from waste vegetable oil					
Investment/Return	-870,000	432,354	432,354	432,354	432,354	432,354
Low-End Innovation (avail in current lower value system)	Small Scale B100-Biodiesel-Commercial grade-Continuous Deglycerolization from waste vegetable oil					
Investment/Return	-100,000	49,696	49,696	49,696	49,696	49,696
NET PRESENT VALUE						
Discount PV CF at Financial Cost	7.7%					
+ technology cap. risk premium	0.0%	(0% risk premium = high capability)				
+ market capability risk premium	0.0%					
+ entrepreneur cap. risk premium	0.0%					
Total discount rate	7.7%					
	Invest (Baht)	PV 5yrs	NPV	Capital gain		
Desire innovation	-2,570,000	5,140,000	2,570,000	1.00		
Sustaining Innovation	-870,000	1,740,000	870,000	1.00		
Low-End Innovation	-100,000	200,000	100,000	1.00		

Figure 41 Inputs of model

5.4.3. Estimate Implied Volatility from Possible Scenarios

Different in return from technology commercialization in biodiesel B100 commercial grade and biodiesel community grade was used to calculate implied volatility of return from biodiesel technology.

5.4.4. Calculate Standard Deviation from Sample

Implied volatility was applied for standard deviation in normal distribution by assuming returns from technology in various methods are bounded to normal distribution under Central Limit Theorem (Mun, 2006).

5.4.5. Generate Binomial Tree of Value

The model started with static NPV valuation of desire innovation project of biodiesel BioJet in year 0 as S_0. Then the model calculated binomial possible value in year 1 as upside price and another downside price. Upside price in year 1 was calculated by using price at year 0 (S_0), to multiply with upside factor (u). Downside price in year 1 was calculated by using price at year 0 (S_0), to multiply with downside factor (d).

Such upward price was then adjusted with volatility by multiplying risk-neutral probability (p) and downward price by multiplying with 1-p. The Binomial operation continued from year 1 to year 5, creating ranges of possible outcome of value of innovation project.

5.5. Mapping All Possible Outcomes under Normal Distribution

Starting with one static NPV value, the model generated 6 possible outcomes (5 year+1) from binomial tree option valuation. Mean value and standard deviation of such samples were used to map possible outcomes and probability to normal distribution. Aspiration level and security level of capital gain return at year 5 were transformed into outcome at aspiration level and security level. Maximum outcome produced at end of year 5 under binomial lattice could represent potential return from such innovation project of startup.

Potential return, aspiration level, and security level were mapped into normal distribution in order to obtain probability to achieve such return. Probability of loss is opposite to probability of security level which related to chance which affordable loss could really be actual loss.

Target Investment Objective when Group in SP/A				Create project in MODULAR		
	Capital Gain	% expected		Invest in Modular, 1=yes, elso =no		1
Aspiration: Desire/target return from investment - capital gain from 5-yr investment (time)	1	50%		Invest yr 1 for 1=Sustain,2=Low-End		2
Affordable Loss: Amount you afford to lose (Baht)	100,000			% Modular (ratio of investment ph 1 reuse in ph 2)		20%
PREDICTION (RO+SP/A)	Possible Capital Gain	% Achieve			Option value	Possible Capital Gain	% Achieve
Potential: Best case return from investment - capital gain from 5-yr investment	12.50	0.7%	Prob > Potential	114,777	12.54	0.7%
Aspiration: Desire/target return from investment - capital gain from 5-yr investment	1.00	37.7%	Prob > Aspiration	114,777	1.04	37.7%
Security: Worst case return from investment - capital gain from 5-yr investment	0.00	45.0%	Prob > Security	114,777	0.04	45.0%
Affordable Loss: Amount you afford to lose	-100,000	55.0%	Prob of Loss			

Figure 42 Outcome SP/A and affordable loss

5.6. 1st Evaluation of Innovation Project/Startup Meet Criteria of SP/A

Investment objectives such as desire rate of return or aspiration and affordable loss were compared with predicted possible return level at maximum potential, aspiration level, security level and associated probability of achieve such level. The model was planned to provide color and message of warning when any of desired conditions could not be achieved. In such event, the model would recommend to proceed with next step to create additional value from option by staging projects into two phases.

RESULT: Probability of Outcome in View of Investors			
Investment Project 1	-2,570,000		Prob
	Capital gain	PV 5yrs	>=
POTENTIAL	12.50	34,690,491	0.7%
ASPIRATION	1.00	5,140,000	37.7%
SECURITY	0.00	2,570,000	45.0%
Type of investment mindset	Outcome and Probabilities		
Profit/NPV		prob. outcome>=	
Potential---------------> 32,120,491	0.7%	37.7%	45.0%
Aspiration/Target---> 2,570,000			
Security----------> 0			
Loss----------> 100,000			55.0%

* WARNING: Probability to achieve Desired Return may be LOWER than Target. Recommend to create project in MODULAR+implement in 2 stages to create

** VERIFY INDIRECT RETURN: if startup could satisfy your INDIRECT return to other companies in your portfolio.

*** VERIFY NON-MONETARY ASPIRATION: If startup could satisfy your NON-MONETARY Aspiration, such as desire to participate in innovation as co-creator, desire for very long-term investment.

**** VERIFY GRATITUDE quality of startup entrepreneur that whether the gratitude could ensure distributing fair return to investors and compensate for the lower success rate or not.

WARNING: Prob of LOSS is more than Security Level. Your AFFORDABLE LOSS has high chance to be ACTUAL LOSS. Recommend to create project in MODULAR+implement in 2 stages to create OPTION VALUE.

VERIFY TRUSTWORTHINESS quality of startup entrepreneur that whether the benefit of trusworthiness could compensate with prob of loss or not.

Figure 43 Outcome and recommendation of model

5.7. Create Additional Option Value from Staging

Creating additional option value by creating flexibility in the execution of project in a way that small amount of investment in technology can benefit follow on investment later when proving that such technology was commercialize properly. Such initial investment and follow on investment could be viewed under real option as a sequential compound option when project has multiple phases and the latter phases depend on the success of previous phases.

Since the desired innovation project in this case is new technology for new market, the risk of successful implementation of innovation is high. Therefore, initial investment in technology that could reduce risk should be technology that already tested and commercially available such as biodiesel process for large scale or small scale for commercial vehicles. After proof the assumptions of technology acceptance, market condition, or manufacturing technics are in place with enough knowledge and confident, the follow on with second phase investment should be pursued.

5.8. Splitting Investment in Two Phases

After staging investment of desire innovation into two phases, there are choices to make either to invest initial amount in which scenarios. User could exercise their choice of investing the initial amount either sustaining innovation of biodiesel large scale production or invest lower amount in low-end innovation of biodiesel small scale with Continuous Deglycerolization.

5.9. Apply Modularity Factor

If desired innovation is radical innovation that based on new thing to the world without existing available component in the market, the initial investment could not be used in the follow on investment. However, if the desired innovation is architectural innovation that based on existing components available in the market but reconfigured in new way, such initial investment could be used in the follow on investment.

Degree of such investment being able to share with others is defined as degree of modularity. For simplicity of conceptual exercise in this investment decision model, degree of modularity is set as percentage of amount of investment in initial investment that could be used in the follow on investment. For example, degree of modularity at 20% means 20% of investment cost in initial phase could be used to reduce follow on investment cost.

5.10. Calculate Option Value from Staging

Valuation of option in binomial lattice was performed in the same manner as previous case to obtain possible option value of project during 5 years. Then the model would incorporate investment option in year 2 as the follow on investment amount and incorporate investment option in year 1 as initial investment option.

The backward reduction would calculate value of option in year 2 by comparing investment cost the follow on phase with value of asset price in year 2. Value of option would replace at node of year 2 and calculating backward to year 1 and year 0, creating the second binomial lattice of investment option that expired in year 2.

Initial investment option in year 1 would be incorporated in sequence prior of year 2. The backward reduction would calculate value of option in year 1 by comparing investment cost the follow on phase with value of asset price in year 1. Value of option would replace at node of year 1 and calculating backward to year 0, creating the third binomial lattice of investment option that expired in year 1. Both option value from investment in year 1 and year 2 would be combined to create total value of option from staging that also changing from year 1 to year 2. Additional option value from staging would then be added to original option value.

5.11.   2nd Evaluation of Innovation Project/Startup Meet Criteria of SP/A
After creating project in modular and staging, the comparison of investment objectives such as desire rate of return or aspiration and affordable loss would be performed again with predicted possible return level at maximum potential, aspiration level, security level and associated probability of achieve such level.

The limitation of this investment decision model is that it focuses on direct financial matter of project of startup. However, from interview, investors also consider indirect return of new investment to their existing portfolio, non-monetary aspiration to participate in co-creation of startup or long-term investment in socially important venture which could compensate for low financial return.

Affordable Loss is decision factor that related more to investors preference rather than to project characteristic. However, if probability of loss when predicted from real option model is more than probability of security, there is more chance that affordable loss will turn to be actual loss. The model would recommend user to split project into two stages of modular structure to create additional option value.

Qualitative factor of entrepreneur also did not include in the calculation algorithm of model. It could just mention as note for investor to consider when financial returns are lower than targeted. From the interview result, investors also consider quality of entrepreneur such as trustworthiness that could compensate to increase probability of achieving target return.

Investor also consider gratitude quality of entrepreneur as it increases likelihood that investors would get fair share of return once actual achieve. As a result, gratitude could compensate for low probability to achieve aspiration level.

5.6 *Development of User-Interface*
Calculation of real option value and SP/A were done in Excel worksheet. Then the Excel worksheet was uploaded into SkyDrive as Microsoft Excel Web App. The application was then embedded into a newly created web page at Google Sites in order for users to interact through internet. The web application site was maintained at https://sites.google.com/site/investmentsurvey/.

5.7 *Incorporation of Technology, Marketing, Entrepreneur Capabilities in Risk Premium*

From the final conceptual model, there were two groups of parameters that drive value of startup, 1) capabilities group and 2) security-potential group. Capabilities group comprised of technology capability, market capability and entrepreneur capability which drives core value of the startup. In Mun (2006), risk of technology success was modeled in DCF phase that used for calculating mean value, not in real option phase, because it was core to the value, not option. Therefore, changes in all type of capabilities should reflect core value of startup which, therefore, such capabilities factors should be factored in DCF. To reflect such risk in technology, market, entrepreneur capabilities, risk premium of each aspect should be modeled in discount rate of cash flow, in addition to financial cost, as per figure 39. The higher the risk or the lower capabilities in technology, market and entrepreneur, the higher risk premium required to be added in discount rate and the lower NPV of project.

Parameters on innovation, modularity and staging are focused on growth potential, while parameters on quality of entrepreneur, affordable loss and support from institutional are focused on security. These are considered as strategic options, or non-core parameters. The changes in all types of option should reflect in option value through volatility estimate. Result of final model incorporating capabilities and security-potential group are as follow.
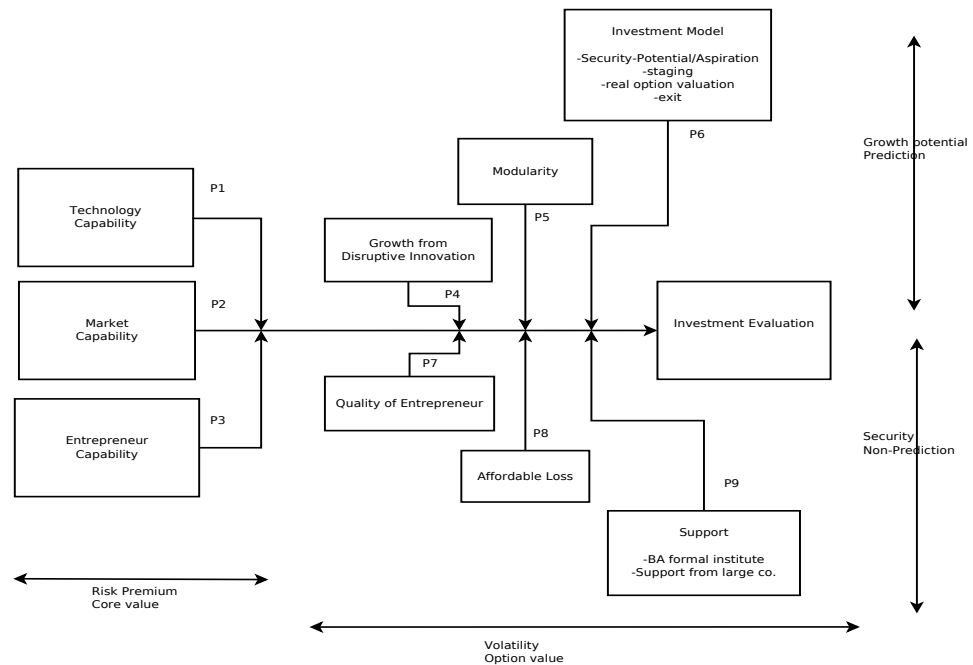
Figure 44 Capability/risk premium & real option/volatility

5.8 *Conclusion*

Input section allowed user to key in desired innovation project of the startup and comparing two possible scenarios in yellow boxes. Cash inflow and outflow of project could be prepared prior in separate in Excel. One benefit of running calculation in Excel is the easiness to transfer between raw data on to the application because most valuations in static finance are prepared in Excel format.

Static valuations of NPV were calculated with adjustable discount rate at risk-free rate. Capital gain of each project was set to equal one for easy to comparison. Investor's target return or aspiration level, expected probability to achieve and affordable loss level were entered here. Outcome from real option calculation of startup and SP/A analysis for investors were at Appendix G showing predicted probability of achieve target return in comparison to desired return.

Outcome of the development of financial decision model for investor to evaluate financial payoff from risk and return of investment in business startup has satisfied research objective no. 3.

CHAPTER VI

VALIDATION AND COMMERCIALIZATION

In order to test the validity of new financial decision model, the model needs to be demonstrated to users who planned to invest in startup. The test should also compare behavior of decision maker between traditional financial decision making tools and this new real option and SP/A tools

6.1 *Validation Test*

The test for validity of decision model was conducted with 29 individuals who were attending Executive MBA class 2012 Chulalongkorn University, because they were entrepreneurs or management in large corporation who were investors or potential to become investors and as MBA students they passed the tested which qualified them for their understanding of business, investment and financial analysis.

The decision making software was demonstrated to the students on web site. The software was tested with hypothetical cases of investing in biodiesel production startup with various options to commercialize as new market for Bio-Jet, existing market for large scale commercial plant, or low end market for small scale commercial plant with new technology. This new decision tool using real option and SP/A was compared with traditional static tools such as NPV, IRR, breakeven, payback period, decision tree and real option-without SP/A. The case, decision tool, and survey were available on internet which were shown to student and also distributed in paper for self-administrative survey. Sample of test case and self-administrative survey are in Appendix H.

The questionnaire asked the respondents for their target investment objectives, their comparison between traditional financial method, decision tree, real option alone and real option-SP/A to validate the ability of model in the following aspects.
1) Ability to measure growth potential of startup
2) Ability to measure security or survival ability of startup
3) Ability to help investors decide on affordable loss for investment in startup
4) Ability to make investment in startup more correct
5) Ability to make investment in startup easier

Result of Validity Test of Decision Model
The test was conducted using SPSS to measure difference of mean between this RO+SP/A tools with other tools which results were in Appendix I.

In general for respondent who did not mention their target return, they believed RO+SPA tools was better than traditional financial indicators, decision tree, or real option analysis alone in explaining growth potential, security or survival ability of the startup, affordable loss, help them making correct investment and help making investment in startup easier.

Comparison of ability of tools in each dimension		Traditional Finance	Decision Tree	Real Option	Real Option + SP/A
Growth Potential	Mean	2.57	2.72	2.79	**3.45**
	N	28	29	29	29
	Std. Deviation	1.069	.960	.978	1.055
Security	Mean	2.21	3.24	3.52	**3.72**
	N	28	29	29	29
	Std. Deviation	.995	.951	.738	.797
Affordable Loss	Mean	2.75	3.41	2.97	**4.00**
	N	28	29	29	29
	Std. Deviation	1.041	.946	1.017	.655
Correctness	Mean	2.96	3.24	3.52	**3.81**
	N	28	29	29	26
	Std. Deviation	1.105	.951	.829	.895
Easiness	Mean	3.21	3.45	3.62	**4.03**
	N	28	29	29	29
	Std. Deviation	1.101	.948	.862	.906

6.2 *Acceptance Test*

Test of Acceptance

In order to test behavioral intention to use this decision making model, the acceptance of this tool was conducted with Technology Acceptance Model (Davis, 1989; Venkatesh, 2000). Due to limitation of access to business angels and their less preference with formal survey tools, the test of decision software was not conducted with such group.

Alternatively, the test was conducted with people who are preparing to be entrepreneurs or entrepreneurs who are preparing to be angels. This software was tested with 43 students who attending Ph.D. program in Technopreneurship and Innovation Management in their first and second years of study. These students entered into this course with aim to enhance their entrepreneurship abilities. Approximately half of them had more than 10 years of working experience, working at managerial or R&D level, invested in security of listed companies and had experience in starting up companies.

The decision making software was demonstrated to the students on web site. The software was tested with hypothetical cases of investing in biodiesel production startup with various options to commercialize as new market for Bio-Jet, existing market for large scale commercial plant, or low end market for small scale commercial plant with new technology. This new decision tool using real option and SP/A was compared with traditional static tools such as NPV, IRR, breakeven, payback period, decision tree and real option-without SP/A. The case, decision tool,

and survey were available on internet shown to student and also distributed in paper for self-administrative survey. Sample of test case was in Appendix H, same case as validity test. However, self-administrative survey for technology acceptance test was in in Appendix J.

The questionnaire asked the respondents for their target investment objectives, their comparison between traditional financial method and real option-SP/A, their profile and their acceptance of new technology.

The behavioral intention to use this new decision tools was asked to measure their prediction and intention to use if they had access to the tool. The perceived ease of used were asked to measure their perception of interaction with tool to be clear, understandable, not required a lot of mental effort, easy to use and help the job done. The perceived usefulness was asked to measure contribution from this tool to improve performance and productivity of their jobs.

The objective of test of technology acceptance were set to study respondents perception with regards to using model RO-SPA on the following;

1. Behavioral intention to use
2. Profile of respondents
3. Perceived usefulness
4. Perceived ease of use
5. Behavioral intention to use and investment objectives
6. Behavioral intention to use and types of experience

Results from Test of Acceptance

1. Behavioral intention to use
   1.1. User with strong (5) and medium-high (4) intention to use are about (32.6+9.3)=41.9% of total.
   1.2. Average level of behavioral intention use was 3.3 out of 5.
   1.3. Respondents 20.9% expressed low intention to use the model.
   1.4. Respondents 37.2% did not express intention to use or not use.
   1.5. Respondents 41.9% intended strongly and medium-strongly to use the model RO+SP/A for their investment (32.6+9.3)

   Range of mean value 1 to 5 could be categorized in level high or low as follow.

Range of mean value	Level of mean value
1.00-1.80	Low
1.81-2.60	Medium-Low
2.61-3.40	Medium
3.41-4.20	Medium-High
4.21-5.00	High

Behavioral Intention to Use

Behavioral Intention to Use RO+SPA 1=lowest, 5=highest	Frequency	Percent	Cumulative Percent
5.00	4	9.3	9.3
4.00	14	32.6	41.9
3.00	16	37.2	79.1
2.00	9	20.9	100.0
1.00	-	-	100.0
Total	43	100.0	

Interviewers for 41.9% that had tried the real option and SP/A tool which developed in this model had strong (5) and medium-high (4) intention to use. Interviewers for 37.2% of total, did not specify intention to use or not to use. However, interviewers for 20.9% of total, expressed lower intention to use this newly developed model.

Technology Acceptance Model: Behavioral Intention to Use

	N	Min	Max	Mean	Std. Dev.	Category of Mean value
Behavioral intention to use	43	2.00	5.00	3.3023	.91378	Medium
Perceived usefulness	43	2.00	5.00	3.4651	.93475	Medium-High
Perceived ease of use	43	2.00	5.00	3.1395	.74263	Medium
Valid N (listwise)	43					

The test of behavioral intention to use showed that interviewees had mean value of perceived usefulness at 3.4651. When mapped with scale of value as table below, perceived usefulness at 3.4651 could be categorized at medium-high perceived usefulness. The perceived ease of use at mean value 3.1395 could be categorized as medium level of perceived ease of use. As a result, behavioral intention to use at mean value 3.3023 could be categorized as medium level of behavioral intention to use.

2. Profile of respondents
    2.1. Respondents 60.4% work in managerial position and research development functions.
    2.2. Respondents 60.5% have less than 5 years of investment experiences.
    2.3. Respondents 51.2% invested in securities of listed companies.
    2.4. Respondents 46.5% have no startup experience.
    2.5. Respondents 27.9% have started up company less than 5 years.
    2.6. Respondents 58.1% have no startup experience.
    2.7. Respondents 16.3% already startup by themselves and now in operational.

3. Perceived usefulness
    3.1. Usefulness of the model in improving performance of their job has linear relationship with their behavioral intention to use.

ANOVA^a

Test of Linear Relationship of Perceived Usefulness and Behavioral Intention to Use

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	15.635	1	15.635	32.984	.000^b
Residual	19.435	41	.474		
Total	35.070	42			

a. Dependent Variable: BIIUSE – Behavioral Intention to Use

b. Predictors: (Constant), UPF – Perceived Usefulness

Ho: Behavioral Intention to Use has no linear relationship with Usefulness in Performance of model

Result: Reject Ho because significance (p-value) < alfa 0.05. Accept H1 that Behavioral Intention to Use has linear relationship with Usefulness in Performance of Model

4. Perceived ease of use
    4.1. Ease of use of the model in improving performance of their job has linear relationship with their behavioral intention to use.

ANOVA^a

Test of Linear Relationship of Perceived Ease to Use and Behavioral Intention to Use

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.311	1	11.311	19.518	.000^b
Residual	23.759	41	.579		
Total	35.070	42			

a. Dependent Variable: BIIUSE – Behavioral Intention to Use

b. Predictors: (Constant), EOUDO – Perceived Easiness to Use

Ho: Behavioral Intention to Use has no linear relationship with Ease of Use in making decision of model

Result: Reject Ho because significance (p-value) < alfa 0.05

5. Behavioral intention to use and investment objectives
    5.1. Investors' average targeted probability to achieve target return was 48.61%.

Statistics
Investment Objectives and Affordable Loss
and Behavioral Intention to Use

	Target	TargetProb	AL	BIIUSE
Valid	43	36	43	43
Missing	0	7	0	0
Mean		.4861		3.3023

5.2. For 48.9% of investors, they expected to obtain target return at not less than 55% per year or not less than capital gain 8 times of capital for 5 years investment in startup.

Target Return of Investors

	Frequency	Percent	Cumulative Percent
more than 62%, or capital gain 10 time of capital	4	9.3	9.3
not less than 62%, or capital gain 10 time of capital	7	16.3	25.6
not less than 55%, or capital gain 8 time of capital	10	23.3	48.9
not less than 38%, or capital gain 4 time of capital	8	18.6	67.5
not less than 25%, or capital gain 2 time of capital	13	30.2	97.7
not less than 15%, or capital gain 1 time of capital	1	2.3	100.0
Total	43	100.0	

5.3. Investors for 74.5% are willing to accept loss not more than 500,000 Baht
5.4. Investors for 90.8% are willing to accept loss not more than 1,000,000 Baht
5.5. Only 9.3% of investors are willing to accept loss more than 1,000,000 Baht

Affordable Loss

	Frequency	Percent	Cumulative Percent
lower than 100,000 Baht	6	14.0	14.0
between 100,000 Baht to 500,000 Baht	26	60.5	74.5
between 500,000 Baht to 1,00,000 Baht	7	16.3	90.8
more than 1,000,000 Baht	4	9.3	100.0
Total	43	100.0	

5.6. Respondent who would highly intend to use this model desired to get return not less than 15% per year, or 1 time capital gain from 5 years investment, believed or wished 100% to achieve it.
5.7. Respondent who could afford to lose more than 1,000,000Baht in startup believed or wished 80% to achieve it. However, they did not show intention to use the model.
5.8. Respondent who could afford to lose lower than 100,000Baht in startup believe or wished 54% to achieve it. They showed more interest but not strong intention to use.

Target Probability and Behavioral Intention to Use

		TargetProb	BIIUSE
		Mean	Mean
Target	more than 62%, or capital gain 10 time of capital	.38	2.75
	not less than 62%, or capital gain 10 time of capital	.44	2.86
	not less than 55%, or capital gain 8 time of capital	.36	3.70
	not less than 38%, or capital gain 4 time of capital	.49	3.38
	not less than 25%, or capital gain 2 time of capital	.57	3.31
	not less than 15%, or capital gain 1 time of capital	1.00	4.00
Affordable Loss	between 100,000 Baht to 500,000 Baht	.45	3.23
	between 500,000 Baht to 1,00,000 Baht Baht	.48	3.57
	lower than 100,000 Baht	.54	3.50
	more than 1,000,000 Baht	.80	3.00

6. Behavioral intention to use and types of experience
    6.1. Respondents who worked in managerial level and in research development expressed medium-high intention to use (3.46 and 3.62 respectively).
    6.2. Respondents who had working experience more than 20 years expressed medium-high intention to use (3.75).
    6.3. Respondents who had investment experience more than 20 years expressed high intention to use (4).
    6.4. Respondents who invested in startup companies expressed medium-high intention to use (3.5).
    6.5. Respondents who had startup experience between 10-20 years expressed highest intention to use (4.5).
    6.6. Respondents who already startup by themselves and now in operational expressed high intention to use (4).

Type of Experiences and Behavioral Intention to Use

		BIIUSE
		Mean
Working Experiences	Managerial	3.46
	Research Development	3.62
	more than 20 yr	3.75
Investment Experiences	more than 20 yr	4.00
Investment types	Start-up companies	3.50
Startup experiences	between 10-20 yr	4.50
	Already startup by themselves-now still in operational	4.00

Details test result and statistics could be found in Appendix K.

6.3 *Possibility of Commercialization*

Possible ways of commercialization of model are suggested as follow.

- Provide model to business angel fund, corporate business angel, incubator in exchange of profit sharing or retainer fee.

- Provide model to technology licensing office or university research center free of charge and collect network of startups into databases for further stage of incubator or match maker with business angel with brokerage fee charge to business angel.

- Consultancy fee from staging project to create option value to pursue to higher value system.

- Supply to international business angel via web page or social network group free of charge and gain income from advertising

- Supply to international business angel via web page or professional social network group free of charge and gain income from data analysis of startups

6.4 *Conclusion*

On average, respondents did not show strong intention to use this decision model. However, specific group of respondents who have low affordable loss, low desired return with high wish to achieve desired return showed medium-high behavioral intent to use. They were people who are in managerial position or research development field, working experience and investment experience more than 20 years, startup experience between 10-20 years and already startup companies themselves and still in operational.

Outcome of the acceptance test of model satisfy research objective 4.

CHAPTER VII

DISCUSSION AND CONCLUSION

7.1 *Summary of the Research Findings*

In summary, from the final conceptual model, technological innovation business startup that has investment characteristics that focus on security of investment and growth of value could help increase propensity that investor would finance or invest in such startup. Capabilities in technology, marketing and entrepreneur were considered key criteria for investors to invest in startups. However, when consider investment in lens of security-potential/aspiration, additional set of criteria emerged. Disruptive innovation and modularity were found to help increase growth value. However, quality of entrepreneur and support from ecosystem were found to help increase survival of startup and increase security of investment. Development of financial valuation and decision tool using real option valuation that could capture growth value and increase security would make investment in startup easier and increase propensity to invest in startup.

From the result of interviews and analysis, we could summarize the findings to satisfy propositions and research objectives as follow.

Research Objectives	Findings
1. Study relationship of business startup's factors on nature of technology, innovation, technology commercialization and financial evaluation that affect investment criteria private investor.	From literature review in chapter II, factors that could affect propensity or likelihood that investor would invest in startup were technology capabilities of startup, technology commercialization and investment model that consider investment in staging and valuation of startup with real option.

Research Objectives	Findings
2. Create conceptual model of financing business startups that match innovation and technology development.	Conceptual model was derived as per figure 8 in chapter II. In chapter III, quantitative research methodology was not conducted with shareholder in MAI listed company in Thailand due to inability to verify business angel. Survey with international business angels through social network linked in was not responded enough due to secrecy of financial transaction. Qualitative research using individual depth interviewed with 7 people related to startup investment confirmed research proposition about relationship between technology capability, technology commercialization and investment model with evaluation criteria of investors.
2.1 Conceptual model on technology and innovation that satisfy investment criteria of investors.	New parameters about market capabilities, entrepreneur capability, disruptive innovation and modularity were suggested adding from the interviews. The conceptual model revision 2 was used in another individual depth interview with 13 people related to startup investment
2.2 Conceptual model on financial return and investment of business startup that match investment preference of private investor.	The interviewees suggested the benefit of real option valuation in technology based startup, but needed to simplify and communicate with investors. Security-Potential/Aspiration theory was added from further literature reviews on behavioral finance. Investment model was therefore modified to accommodate parameter about security level of investment, potential growth of investment and aspiration or target return level. Affordable loss was added from interview result and literature review to describe decision to plunge into investing. Quality of entrepreneur and support business angel to have formal institution factors were added from the interviews. Conceptual model revision 3 or final model was completed in chapter IV.

Research Objectives	Findings
3. Develop financial decision model for investors to evaluate financial payoff from risk and return of investment invested in business startup.	Chapter V showed process of developing decision model to evaluate investment in startup. The model was developed with consideration to use with case study in order to see actual results. The biodiesel technology was studied because of its commercialization routes were uncertain but it showed new opportunities so large not to join, which could create option value. The model showed one based commercialization route and other two; one upside route and one downside route, replicating simple option payoff. Valuation of outcome and probability to achieve such outcome were framed to match with SP/A theory in order to make the presentation format of startup performance match with psychology of decision making of investors. The decision model accommodated modularity in investment form. The outcome of the model suggested whether the startup financial return could match with target return and security level set forth by investor or not. If not, it would suggest investor to look for non-financial compensation from quality of entrepreneur. The decision model was uploaded on web site allowing investors to test and use. The result of financial decision model was showed in chapter V and Appendix G.

Research Objectives	Findings
4. Test of acceptance of model in business startup with private investors	The model was tested for its validity with 29 potential investors who were Executive MBA student representing management, entrepreneur and wealthy investors in traditional market. The result of validity test shown that the tool that use real option and SP/A could predict growth potential, security and affordable loss for them better than other traditional finance, decision tree or real option alone. The model was also test for acceptance with 43 potential investors who were PhD. Student in Technopreneurship and Innovation Management program, representing entrepreneur and would-be private investors who would expose with many startups in technology and innovation. The result of acceptance test shown the respondents were positive to perceived usefulness and perceived ease of use with the tool and positive to behavioral intention to use the tool. The result of validity test and acceptance showed in chapter VI and Appendix H, I, J and K.

7.2 *Discussion*

7.2.1 *Real Option*

Real option was applied to many areas such as strategic investment (Amram & Kulatilaka, 1999), technology investment (McGrath, 1997) and intellectual property valuation (Chang, Hung, & Tsai, 2005). However useful it is, it requires complex calculation. In this research, real option valuation was applied to help individual investor to value technological innovation startup. In order to match such complex tool for easiness to use of individual investors, real option valuation was integrated with security-potential/aspiration. The strength of real option was in its ability to measure of value of startup in terms of technology capability, market capability, innovation level and turns into ranges of possible value according to evolution of binomial vitality of up and down as project progressed. The strength of security-potential/aspiration was in simplicity that matches with investors' commonsense. This research combined real option and security-potential/aspiration in order to obtain ability to measure startup in simpler way.

Expert Investors found option thinking existed in all decision but believe some investors are aware. Using decision tool with case study found that option would be valuable when small investment in early year could create learning for follow on

investment in growth business. The additional value would be more when those investments were modular structure that the follow on investment could use part of the initial investment. Such increase from option value could help mitigate risk of loss by reducing probability of loss.

7.2.2 *SP/A Theory*

Security-potential/aspiration theory was a developed based on effects of emotion of fear and hope of investors on decision making under risk, expecting outcome to be of security-potential and weight with probability to achieve aspiration (Lopes & Oden, 1999a).

In this study, SP/A was applied to capture fear and hope of investors for security and potential of startup that has innovation based on technology. Risk of technology, market and business model were considered in comparison with probability that investor would obtain return at target rate. Disruptive innovation, in this research, represented hope for growth potential from startup while quality of entrepreneur and support from institution represented factors to reduce fear or increase security of investment in startup.

When applying real option and SP/A together, their functions seemed to complement each other. While SP/A based on emotional factors of investors upon startup, real option based on risk-free rate which concern only project merit. Result of validity test also showed that combination of real option and SP/A making decision tools easier to use than real option alone.

Applying SP/A theory as decision making tools implies that there are further exploration in factors that affect aspiration level, security level which are dependent upon behaviour of both entrepreneurs and investors. On the other hands factors that occurred as biases on perception of goal by entrepreneurs and investors are also worth further studies because both entrepreneur and individual investor are more sensitive to biases than institutional investors.

The decision tools that show security-potential/ aspiration helped reflect investor's expectation with possible outcome from startup. The comparison helped investors adjust their estimation and reduce bias that might exist in the first place.

7.2.3 *Predictive and Non-Predictive*

In predictive mode, entrepreneur and investor calculated their expected return against expected risk (Wiltbank et al., 2009). This mode was also called causation as it predict outcome from the cause (Sarasvathy, 2008). For SP/A, the consideration to weigh between security and potential frame are also under the same prediction mode (Lopes & Oden, 1999a). However, in non-predictive mode, or decision to plunge or jump into investment, entrepreneur or investor considers their affordable loss (Dew, Sarasathy, et al., 2009). This mode was also called effectuation as it focus on controlling action that has effect on outcome rather than cause (Wiltbank, Dew, Read, & Sarasvathy, 2006). In SP/A, the consideration of aspiration is the goal for investor

who consider affordable loss as a mean. In summary, SP/A is a proper tool to use when investor consider both prediction and non-prediction criteria for their investment in startup.

7.2.4 *New-Market Disruptive Innovation and Growth Potential*

From the case of BioJet fuel production, new-market disruptive innovation could create growth potential for investors. From interview, investors did not specify which type of innovation they preferred. However, real option valuation help quantifying expected potential maximum return under binomial lattice until year 5 and their related possibility to achieve such new-market disruptive innovation and possible return for low-end disruptive innovation of B100 from small scale production plant. Investors also preferred innovation type that matched with entrepreneur capabilities. By using SP/A model, investors could simulate which type of innovation project matched with entrepreneur and investors risk and return preference.

7.2.5 *Low-End Disruptive Innovation and Security*

Typically, low-end disruptive innovation addressed from lower end of value system and upward marching to mainstream market. Lower initial investment cost served the need for security-minded investor. When investor use model real option and SP/A to combine security aspect of low initial investment and probability to obtain outcome more than security level, it helped investor with decision to manage their affordable loss level. The higher probability of attaining security level, the safer affordable loss amount and the higher propensity that investor will invest in the startup.

7.2.6 *Disruptive Innovation, Modularity and Real Option*

It is a preference choice for investor who prefers low risk and need for security in its investment. Should such initial investment become modular in structure, it could have more option value to expand into mainstream market or new-market. From the case study, the use of real option valuation and SP/A could prove to help combine thinking about disruptive innovation and modularity to match with risk and return objective of investors. Modular is clearly seen in some industries such as automotive and electronic, but less obvious in chemical industry. Startup that has modularity in product structure is safer to start, lower investment cost, higher return, and higher survival rate due to its flexibility. When moving up market to mainstream market, modularity could help build product platform that are foundation for another sustainable growth.

7.2.7 *Security of Startup and Affordable Loss of Investor*

Focusing on affordable loss as sole investment decision criteria during start-up period might make both entrepreneurs and investors not to give enough weight on what to do when potential success actually happen. Fair treatment to investors who have less inside information than entrepreneurs should reduce potential conflicts when firms success. If no discussion takes place before investment, investors might have less

preference due to risk of loss of financial gain, time, and reputation wasted in arguing about profit retribution to investors.

7.2.8 *Growth Potential of Startup and Aspiration Level of Investor*

In order to set proper expectation about return potential of start-up and proper level of retribution to investors, there is a need to discuss and agree on how to value growth potential. In addition, proper discussion about fair treatment to investors in the beginning of start-up should help reduce such fear and risk of investors and potentially increase actual or perception of affordable loss level.

When growth potential created value from option, such value could be consider to evaluate against affordable loss. For example, let assume the investors put his money in the project at the same amount of his affordable loss level, 100,000Baht. If the real option value turned out to be more than 100,000 Baht, it implied that the investor could overcome the chance of loss his affordable loss amount.

Although investors appreciated that disruptive Innovation could create growth, but they did not differentiate among new-market, low-end or sustaining. They preferred innovation that match with entrepreneur capabilities and would consider innovation and growth after security or sustaining of the start-up.

7.2.9 *Integrated View of Startup and Investors*

This study proposed model that integrate between start-up capabilities, low-end disruption or new-market disruption with simple heuristic criteria of security, potential and aspiration of investors. Focusing on affordable loss help start-up deliver higher survival chances as first stage and deliver at later stage the growth potential from disruptive innovation that suit aspiration need of investors.

For individual investors, framing decision space into SP/A theory had simplified decision making. Various scenarios of start-up business plan that simulate possible outcomes could be a good learning tool for both investors and entrepreneur to exercise various options related to investment in each capabilities. It could be a starting point for discussion and negotiation between entrepreneur in order to better explain the process of value creation and risk reduction.

The proposed model hypothesize the integration between start-up capabilities, modularity design to help transform product and process to enable various options needed for making the business become either low-end disruption or new-market disruption. The modular operators such as splitting and excluding shall enable technology positioning option as required by low-end disruptive innovation in order to improve survival chance of start-up and satisfy security need of investors. Modular operators such as augmentation and inverting shall enable market scouting option required by new-market innovation which improve growth potential of start-up and satisfy potential need of investors.

For individual investors, real option calculation may be complicate, and may be even complicate with SP/A theory. Simulation of value could be a good learning tool for both investors and entrepreneur to exercise various options related to investment in each capabilities. It could be a starting point for discussion and negotiation between entrepreneur as a tool to explain the process of value creation and risk reduction.

The start-up companies that can integrate and apply modularity for its product development, create disruptive innovation, and apply real option to value growth opportunities, can create survival and growth level that satisfy investor preference of security and growth potential under SP/A theory.

7.2.10 *Non-Monetary Loss Consideration*

Investors also confirmed that their weight on loss was higher than on gain, confirming with Prospect Theory (Kahneman & Tversky, 1979). However, they also weight non-monetary loss more than monetary loss. They experienced loss of reputation when start-up failed and entrepreneurs blamed business angels of unfair deal, which cost to them the reputation than monetary loss. They also experienced loss of trust when start-up succeeded but entrepreneur did not distribute fair compensation to them, which cost to them the regret than monetary loss. This consideration of non-monetary loss may help investors by focusing on quality of entrepreneurs in addition to capability to create innovation and growth.

7.2.11 *Quality of Entrepreneur*

These non-monetary risks related to quality of entrepreneurs that had larger effect on propensity to invest in start-up than monetary risk/return. Framing financial return in security, potential and aspiration could explain both in monetary and non-monetary view.

Gratitude quality of entrepreneur could help mitigate risk of not getting fair share of return when start-up succeed and increase perception of adequacy of probability to achieve desired return level. Trustworthiness quality of entrepreneur could help mitigate risk of being blamed when start-up failed and increase level of affordable loss or help increase perception of adequacy of probability of security of their investment. As a result, if entrepreneurs presented their business plan to investors by framing project return and risk in form of security, potential and aspiration, and such entrepreneurs had quality to ensure low risk of financial loss and reputation loss or ensure high potential return and high chance to distribute fairly to investors, it could potentially support or mitigate when innovation appeared to provide low monetary return.

7.2.12 *Formal Institution to Support Business Angel*

Formal institution to support business angels was considered important to help mitigate uncertainty in politics, weak legal and financial support to investors and

inefficient government support (Scheela & Jittrapanun, 2012). However, this research showed the need for support institution at individual level which required standard of practices to set common expectation between startup and business angel.

When there is a lack of formal institution for business angel, there is no clustering of business startup that could support, catalyze or self-reinforce participants in the cluster (Wonglimpiyarat, 2006a). Intermediate agent could play key role to help being middle person between business angel and entrepreneur to help protecting business angel on security side from loss of reputation if the start-failed and on potential side when startup succeed and fair retribution should be provided. Business angels should be only angel, leaving non-angel role to the middle man. It is expected that the more standard of practices have been set and known among community of entrepreneurs and business angels, the clearer expectation would be among each party.

It is expected that activities of business angels would increase on investing in start-up and be visible to entrepreneur seeking funding. On the other hands, in society which no intermediary between business angels and entrepreneurs existed to set standard practices and expectation clear, the activities of business angels were expected to be less and so did the accessibility to them.

7.2.13 *Industry Focus of Investors*

From section 3.1.6, the interviews were conducted for final model with 13 people who were performing role as investors. The interviewees comprised of five business angels who invested in nutraceutical, ICT, logistics, entertainment, retail, energy startups, two early-stage fund managers, two corporate business angels, two business angel fund and two venture capitalists.

Background & Investment	All	Chemical	ICT	Investment	Retail	Energy
Background	0	1	12	6	1	0
Investment	11	0	8	0	0	1

Figure 45 Background of investors and investment

Twelve people had background in ICT and 6 people had background in investment related area (banking, finance, VC). For their investment, only eight people focus their investment in ICT, while eleven people had no restriction on industry. ICT was industry that created most entrepreneur and most investors, because it was a growth. ICT business was most preferred by investor because of low investment comparing to chemical, retail or energy business, fast growth, had many success stories and less uncertainly from regulation or technical risk comparing to chemical or energy business (Premanoch, 2012). In addition, since business angel invested in early stage from their own money, therefore, investment amount was limited. The study by Scheela & Jittrapanun (2012) found that Thai business angels invested at initial round on average at USD 10,000 – 12,500 and follow on investment on average at USD 1.00-1.25 million. As a result, individual early-stage investors were restricted not to some specific industry, but limited to amount of required capital and growth of industry.

7.3 *Contribution to Knowledge*

SP/A tool was originated from psychology field for application in measuring and predicting investment behaviour of people that was not conform to linear utility of preference(Lopes & Oden, 1999a). SP/A theory helped explain behaviour of individual investor that combine preference for gambling together with preference for security. To the knowledge of researcher, this is the first study that applied SP/A theory for investment decision making in startup companies by private individual investors.

Real option valuation had been used to value startup companies in various cases (Hilli & Kallio, 2007; Kogut & Kulatilaka, 1994; McGrath & MacMillan, 2000b). However, no study combined real option valuation of startup together with SP/A decision making of investors. This study had combined viewpoints of both startup and investors into single tools, which it could allow both parties to reach same conclusion about valuation of startup and help increasing activities in financing startup.

This study revealed that theory on psychology of investor such as SP/A was beneficial when using in combination with financial consideration of investment such as real option valuation. SP/A also helped bridge financial consideration of investment in startup together with non-financial consideration about quality of entrepreneurs. The lack of historical record of startup helps quality of entrepreneurs weight more importance in the view of individual investors. This study helped identifying that integrity, trustworthy, and gratitude could help increase propensity to invest in startup or compensate with lower financial return.

The financial decision tools help investors in exercising their expectation from startup with possible return in format that suit their preference in security and potential. The simulation helps de-biasing their expectation of both investors and entrepreneur and help preparing for possible downturn or not achieving aspiration level. It also helped improving possibility to achieve target return and increase optional value by simulating effect of modularity in projects.

7.4 *Conclusion*

The start-up companies that can integrate and apply modularity for its product development, create disruptive innovation, and apply real option to value growth opportunities, can create survival and growth level that satisfy investor preference of security and growth potential under SP/A theory.

When integrating answers of criteria, capabilities, technology and innovation, and investment model, it revealed that investors preferred startup that could provide growth options for their investments through new-market innovation which they expected startup to have capabilities in market and technology in order to create internal flexibility in modularity of product components or production

7.5 *Recommendation*

7.5.1 *Recommendation for Individual Private Investors*

"All investment decisions are basically using option thinking, but less people are aware of that" (Chanitr Charnchainarong, 2012). Investor could use the tool to capture additional value from options, especially for new-market innovation which no one had historical financial data to predict or even no knowledge of what new product would finally turn to be. Like other tools, this real option and SP/A did not promise to be definitely correct at every time. However, it intended to simulate possible scenario that could create value to investors who wanted to participate in new opportunity that was too large not to participate. The tool was embedded with staging investment and modularity which could help reduce risk of loss and let investor control the decision of the next stage according to reflection of actual market or technology revealed from the first investment.

7.5.2 *Recommendation for Entrepreneur*

Although this tool intended for investor, but it might create more benefit to entrepreneurs. Entrepreneurs could use the decision tool to pre-test the starup project to evaluate financial return and possibility of creating additional value from option. They could modify project investment to be in stages, pursuing innovation type that match with them and their investor preference. Should their investor have low affordable loss, they could manage to stage investment in smaller amount and address low-end market to create security of that startup that matched with investor preference. In the later stage they may pursue new-market innovation when they feel they gain knowledge enough to reduce risk. By matching startup nature with investors' psychology, entrepreneur would have more chance to get financing for their technological innovation startup.

7.5.3 *Recommendation for Policy Consideration*

Supporting role from government was studied by Aernoudt (2005) identified seven ways to stimulate business angel investment in international context through co-investment schemes, investor readiness, corporate orientation, business angel networks, business angel academies and the integrated finance concept.

For Thailand, a study Scheela and Jittrapanun (2012) mentioned requests for support from government in forms of reducing political uncertainty, weak legal and increase financial support for investors. With the lack of institutional support, it was found that business angels developed informal institutions by co-investing and networking with family members and government officials.

This study proposed the need for having formal institutional support for business angels in similar manner as above, but from different view point. This result of the research showed that formal institutional support was "job-to-be-done" or needs from actual business angels. Professional association of business angels was requested by business angels for setting up standard or benchmark of expectation between business angel and entrepreneur at the beginning of relationship or in the startup phase. In

growth phase, business angel requested for cooperation scheme between small startup with large existing companies. In the mature stage, business angel requested for market for investment that investor could exit and realize return on their investment. This research recommended policy initiation sequentially from early stage to mature stage of startup and expecting that it could help startup improve readiness each step from start to finish.

The need for formal institutional support was coherently found from international, national, and individual level of studies. It showed as a strong evidence for clear policy for having formal supporting institution and a signal for opportunity to improve performance of startup in Thailand.

7.5.4 *Recommendation for Future Research*
Outcome from this research revealed future areas of studies as follow.

- Adding weight or scale for factor in conceptual such as 1 to 5 in order to create total score for each startup in order to use as weight for decision to invest or not invest.

- Adding weight or scale among factors in conceptual such as 1 to 5 in order to create total score for each startup in order to use as weight for decision to invest or not invest.

- Effect of syndicating investment in startup among many business angels should reduce capital requirement down to match with affordable loss level. Startup could syndicate funding from investors to more than one business angel, such as to two groups as matching fund or to many investors as private placement or crowd-funding.

- Integrating real option valuation with Blue Ocean strategy by addressing option value for different Strategic Canvas.

- Integrating real option valuation with Blue Ocean strategy by addressing option value of pursuing different tier of non-consumers; first tier, second tier or third tier.

- Effect of different type of modularity in option value created. This study simplified modularity in form of investment cost and benefit from reuse of module from phase 1 investment in phase 2. However, future study could focus on specific technology and product structure and try to discover variance or change in product structure in term of modularity and find out option value generate from different type of modularity. It is expected that startup or entrepreneur could modify its product structure to create highest possible option value.

- Applying real option valuation and SP/A for other industry. This study uses the case for biodiesel technology from waste vegetable cooking oil. Different industry might show different characteristic that promote or inhibit value of option.

- Measuring utility of investors under SP/A for larger group of investors. This study had confirmed that the weight investor assigned for security were more than gain. However, mapping investor's utility model was not in scope of this study. Further study could create utility model of some specific group of investors in specific industry.

- Effect of formal business angel institution: Further studies about economic benefit of incorporating business angel institution should help regulator or government bodies evaluate cost and benefit to entrepreneurs or investors in broader measures such as promoting new companies, reducing unemployment in compensating to some tax benefit provided to startup or investors.

- Effect of quality of entrepreneurs specifically on growth potential or affordable loss. From the interview, gratitude was considered to increase affordable loss of investors in entrepreneur who has gratitude. However, the reference quoted was not significantly distinct due to small number of participants. In addition, gratitude was a subset quality of credibility. Further studies may try to address clearer semantic of different quality and their effect on affordable loss.

7.5.5 *Limitation of Real Option Approach*

Real options approached focused on dynamic of future cash flow which allow future decision making so that manager could have flexibility to adapt their strategy according uncertainty or changes in competitive environment (Mun, 2006).

Real option valuation would not create value if the project did not have flexibility to create option. Modular thinking either in product component or production or process could create option value by itself. In order to create option valuation in project, modularity should be considered in tandem with real option.

In order to be flexible in exploiting value of future options, it must have capability to learn and change course of action from such learning (Damodaran, 2001). It must leverage outcome from its investment in early stage, either success or failure, to use as feedback to adjust behaviour in order to discover what required to continue to be on growth track (McGrath & MacMillan, 2009). In order to make real option valuation more convincing to potential users, startup should have strong capability to create differentiation or exclusivity from investment in option and fundamental benefit of creating modularity of investment in stages to capture learning from early investment.

Real option valuation would not create value if project duration was too short to create option, for example, project in ICT industry especially in software business. In software business that platform has already been established such as iTunes or Androids, starup could develop new software and launch to such platform within 6 months and able to generate income. In software business, cost of development was only human resource expense, not much investment was required. In that short period, fast development and execution were more important than option or flexibility.

7.5.6 *Limitation of Real Option Valuation*

Real option valuation based approach in risk is different from discounted cash flow. Instead of discounting future expected cash flow with discount rate or risk-adjusted rate, real option valuation use volatility to drive risk-neutral probability to represent chance of occurrence of upside or downside. This is the key issue that makes real option valuation able to capture upside of growth that investment early stage could help investment in following stage more valuable.

Estimation of volatility could be done in different ways. Logarithmic cash flow returns, logarithmic present value returns and Generalized Autoregressive Conditional Heteroskedasticity were good for financial assets but required many data points and needed to further simulate using Monte Carlo simulation when use with real assets. Market proxy is easier to use as long as comparable market, sector, industry data are available, which might be difficult to compare for innovation project that never happen before. Management assumptions were easiest but may not justify complex investors (Damodaran, 2001).

Management assumption was simply select any specific number of volatility that management believe could represent our desired innovation project, such as select 5% as probability that our desired innovation project would be success full. Management assumptions was easier to explain concept of volatility to management (Amram & Kulatilaka, 1999) and there is more benefit in using simpler valuation that could intuitively exercise in strategic planning (Mun, 2006).

Real options valuation relies on statistical assumptions about normal probability of commercialization of same technology which also based on standard deviation of outcome from innovation project that used as reference scenarios of base case and worst case. The more scenarios of technology commercialization available in the markets used as reference, the more accuracy the standard deviation used in predicting future outcome from innovation project. However, as innovation is naturally based on uncertainty of newness, the prediction in some case that contains many uncontrollable factors may make prediction by real options not correct. The use of real option valuation should be used in combination with real option thinking or modular or staging that allows investment in project to be tested in small portion first in order to verify assumptions of technology and market, then modified future action of second stage according to outcome on first stage. Some industry has special distribution such as power-law distribution that fit world-wide-web rather than normal distribution (Barabási & Albert, 1999).

7.5.7 *Limitation of New Model (Real Option & SP/A)*

This study has developed new financial decision model based on real option and SP/A based on problem of traditional discounted cash flow valuation. Therefore, most limitations on real option valuation and real option approaches are valid for this newly developed model too.

In order to enhance accuracy and relevance of volatility estimate with management assumption method, this newly developed financial decision model added reference

with innovation base-case and worst case in estimating volatility. In order to estimate volatility of desired innovation project against mean value of asset, the volatility of difference in return of the base-case or sustaining innovation project was added and compare volatility of return with another worst-case or low-end innovation project, as proxy of volatility of desire project. It was assumed that return from various commercialization options from single technology, either new-market innovation, sustaining innovation or low-end innovation were normally distributed.

In industry that has dominant design emerged, we could use cash flow from sustaining innovation project as base-case representing proxy of mean value of technology commercialization. In addition, in industry that modular design or platform occurred, we could use cash flow from low-end innovation project as worst-case representing proxy of downward value of technology commercialization. However, these proxies of sustaining innovation or low-end innovation may not represent actual volatility of desire project. In addition, desire innovation project, which may be new-market innovation, may not fit normal distribution. In practice, the use of volatility should consider distribution of commercialize option as it may not be normally distributed.

In this model, SP/A model for decision making was added to group distribution of return outcome from real option valuation into comprehensible category perceived by investors. This SP/A was then mapped with normal distribution of real option value. However, in practice, utility of investor (or preference weight) for security and potential was not in straight line or normal distributed, but mild convex (Lopes & Oden, 1999a). Therefore, precise estimation of utility in future study should lead to more precise preference for security or potential of each specific investor or investor group.

In addition, the outputs of newly developed model were various possible returns according to security, potential and aspiration, together with probability to occur, which would assist investors in deciding whether the startup return and probability match with their SP/A characteristic or not. This model did not attempt to make decision on behalf of investors because investment decision of each individual investor should depend on risk and return preference or bias of each specific individual whether the output from the model meet their preference or not. However, further study for specific group of investors with specific industry of startup may result in decision model that could make decision on behalf of investors.

7.5.8 *Limitation on Sampling*
Information on venture capital is expected to obtain through venture capital association and in-depth interview of fund manager. However, information on some private equity investors, such as business angels may not be easy to obtain. Due to nature of business angel that prefers to be low profile, contact name of business angels might not be disclosed by business startup. As a result, it is expecting that when contacting business angel, they may not respond in high proportion to questionnaire. Therefore, non-responding bias is expected to be found during the survey and higher than other type of sample. This could represent potential bias in validity of cause and effect of business angels, but not on venture capitals.

7.5.9 *Limitation of Case Studies*

Case studies of biodiesel in this study showed possible value from various commercialization routes. However, energy project are based on many uncertainty which entrepreneurs or investors could not control perfectly, such as oligopoly competition, regulation that may protect large producers, or process risk. As a result, the case studies of biodiesel was for hypothetical only which actual project might be more complicate, even though the researcher tried at best to bring most relevant for consideration.

7.5.10 *Limitation of Qualitative Research with Business Angels*

Research methodology and data collection from business angels in this study was based on interviews with narrow population with purposive sampling.   Different background of the investors such as previous experiences, industry focus, or age may affect different results.

7.5.11 *Limitation to Causal Relationship among Factors*

This individual depth interviews were conducted by asking interviewees for factor that affect or criteria they used in their investment in technological innovation business startup and NVivo was used to group concept mentioned into larger categories according to the final conceptual model. However, this study did not seek to find causal relationship among factors which may exists for some factors such as entrepreneurial capability and quality of entrepreneur. Further study may focus in clarifying causal relationship among factors.

7.5.12 *Limitation to Context of Thailand*

The interviewed with business angels in this study was conducted mainly in Thailand 19 cases and 1 in US, which they were 15 Thai investors and 5 foreign investors. Due to small samples and nationality of interviewees were mainly Thai, this research result and conceptual model would be valid only in Thai context and hence it may not be able to generalize in to global context. Therefore, it is recommended to extend the interviews further to broaden the samples, such as conducting survey with investors' group at Linkedin.com which consisted of many varieties of investors types and from various geographic.

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APPENDICES

APPENDIX A CONTENT ANALYSIS MODEL 1

Model 1-Relationships of parameters about technology capability, technology commercialization and investment model
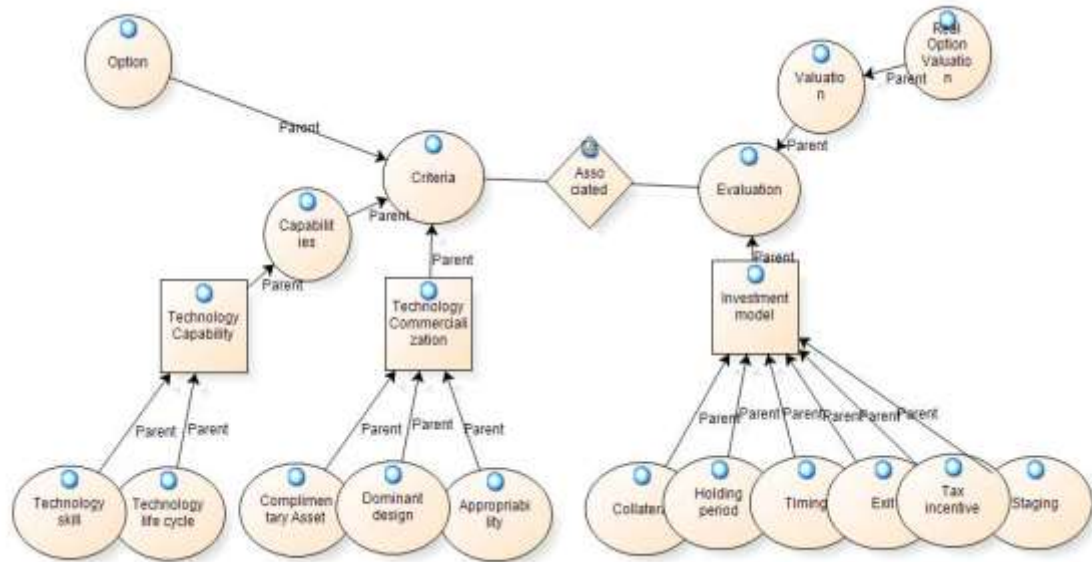
Model 1: Tcap.TC.Inv.Aggregate	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
Investment model	28	0	0	26	0	2	1	6	0	0	14	7
Technology Capability	23	3	0	14	0	1	2	6	0	0	6	4
Technology Commercialization	9	0	0	6	0	3	0	5	0	0	4	0
Model 1: Tcap.TC.Inv.Aggregate	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
	28	3	0	26	0	3	2	6	0	0	14	7
	7	4	N/A	7	N/A	0	4	7	N/A	N/A	7	7

Model 1: Overall criteria of startup that preferred by investors
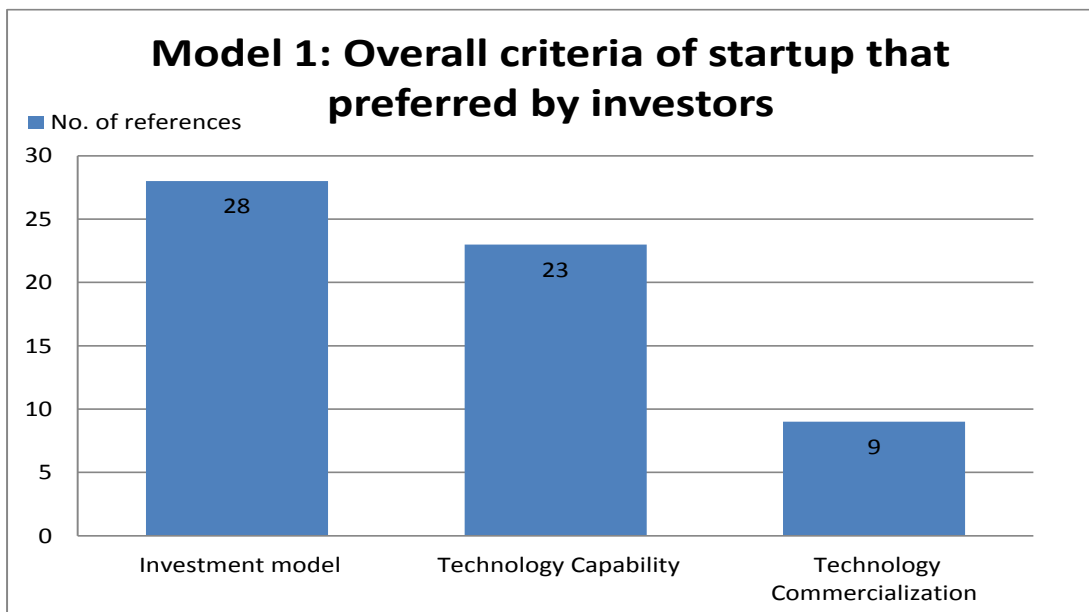
Model 1: Details of criteria in startup preferred by investors

Model 1: Details	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
Technology skill	12	3	0	9	0	0	2	3	0	0	3	4
Staging	9	0	0	9	0	0	0	0	0	0	7	2
Timing	8	0	0	7	0	1	0	2	0	0	4	2
Real Option Valuation	8	0	0	8	0	0	0	0	0	0	8	0
Exit	5	0	0	5	0	0	0	1	0	0	3	1
Appropriability	3	0	0	2	0	1	0	2	0	0	1	0
Complimentary Asset	3	0	0	2	0	1	0	2	0	0	1	0
Dominant design	3	0	0	2	0	1	0	1	0	0	2	0
Holding period	2	0	0	1	0	1	0	2	0	0	0	0
Technology life cycle	1	0	0	1	0	0	0	0	0	0	1	0
Criteria	0	0	0	0	0	0	0	0	0	0	0	0
Technology Capability	0	0	0	0	0	0	0	0	0	0	0	0
Technology Commercialization	0	0	0	0	0	0	0	0	0	0	0	0
Evaluation	0	0	0	0	0	0	0	0	0	0	0	0
Investment model	0	0	0	0	0	0	0	0	0	0	0	0
Collateral	0	0	0	0	0	0	0	0	0	0	0	0
Indirect Return	0	0	0	0	0	0	0	0	0	0	0	0
Non-monetary Return	0	0	0	0	0	0	0	0	0	0	0	0
Tax incentive	0	0	0	0	0	0	0	0	0	0	0	0
Valuation	0	0	0	0	0	0	0	0	0	0	0	0

Model 1: Details	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	12	3	0	9	0	1	2	3	0	0	8	4
	Technology skill	Technology skill	N/A	Technology skill	N/A	Timing	Technology skill	Technology skill	N/A	N/A	Real Option Valuation	Technology skill

Model 1: Breakdown capabilities of startup preferred by investors
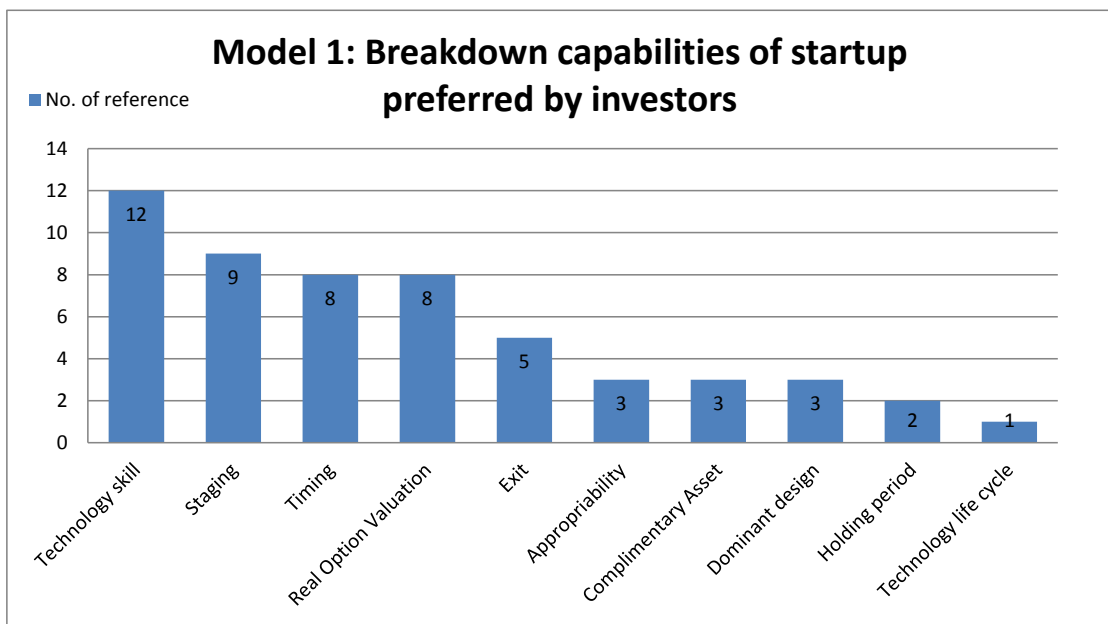
APPENDIX B ONLINE SURVEY

QUESTIONNAIRE TO BUSINESS ANGEL GROUP IN LINKEDIN SOCIAL NETWORK

QUESTIONNAIRE INVESTMENT IN START-UP COMPANIES WITH TECHNOLOGICAL INNOVATION

Please answer questionnaire from your experiences of actual investments in start-up companies which already exited. If still not exit, please answer from your expected assumptions. Please focus on the latest investments within past 5 years. For the purpose of this study, start-ups (or startups)are new firms at very first stage of development when they start business and develop their products and services, but before they could sell and distribute products/services to markets.

1. Investment Criteria
1.1 Characteristics: Which of the followings could describe you best in relations to the investments in startup companies(Select all that apply)
    1. Business Angel: I invest my own money in startup company that majority owned by other entrepreneurs
    2. Venture Capitalists-VC: I raised money from other investors and manage to invest in startup companies that majority owned by other entrepreneurs, expecting investment return.
    3. Private Equity: I raised money from selected group of investors and manage to invest in some specific type of startup companies that majority owned by other entrepreneurs, expecting investment return.
    4. Corporate VC: I invest in startup companies on behalf of a company that I work for expecting business synergism to my company in addition to investment return
    5. Business Incubators: I did not invest money in startup companies, but I help them by providing advice, training, resources and facilities needed during startup period.
    6. No, I have never invested in startup companies, but I have experience in new product/business development.
    7. No, I have never invested in startup companies, but I have experiences in other type of investments.
    8. Other
    _____
    _

1.2 Please rank in order (1-3) the following industries in order of your interest (1=most important, 3=least important)
  • Biotechnology/Pharmaceuticals/Nutraceuticals _____
  • Business Products and Services _____
  • Computers and Peripherals _____
  • Consumer Products and Services _____
  • Electronics/Instrumentation _____
  • Financial Services _____
  • Healthcare Services _____
  • Industrial/Energy _____
  • IT Services _____
  • Media and Entertainment _____
  • Medical Devices and Equipment _____
  • Networking and Equipment _____
  • Retailing/Distribution _____
  • Semiconductors _____
  • Software _____
  • Telecommunications _____

1.3 Total Invested Amount: Please indicate total investment amount that you allocate for investment in single startup (Please select only one).
1. lower than 10,000 USD
2. between 10,000 USD to 49,999 USD
3. between 50,000 USD to 99,999 USD
4. between 100,000 USD to 499,999 USD
5. more than 500,000 USD

1.4 1st Tranche Invested Amount: Please indicate typical 1st tranche in absolute amount and, if possible, in percentage that you allocate for investment in single startup (Please select only one).
1. lower than 10,000 USD
2. between 10,000 USD to 49,999 USD
3. between 50,000 USD to 99,999 USD
4. between 100,000 USD to 499,999 USD
5. more than 500,000 USD

Or, as % of total amount (if possible)
1. 0
2. 10%
3. 20%
4. 30%
5. 40%
6. 50%
7. 60%
8. 70%
9. 80%
10. 90%
11. 100%

1.5 Depending on your choice of industry in question no. 1.2, could you define typical critical milestone for you to move from 1st round to 2nd round investment?
1. Business/financial analysis: A financial or business analysis leading to a go/no-go decision prior to product development
2. Product development:The actual design and development of the product, resulting in, e.g., a prototype or sample product
3. In-house product testing: Testing the product in-house: in the labor under controlled conditions (as opposed to in the field or with customers)
4. Customer tests of product: Testing the product under real-life conditions, e.g., with customers and/or in the field
5. Test market/trial sell: A test market or trial sell of the product—trying to sell the product but to a limited or test set of customers
6. Trial production: A trial production run to test the production facilities
7. Pre-commercialization business analysis: A financial or business analysis, following product development but prior to full-scale launch
8. Production start-up (The start-up of full-scale or commercial production)
9. Market launch: The launch of the product, on a full-scale and/or commercial basis: an identifiable set of marketing activities specific to this product

1.6 a) What is your typically requirement on minimum percentage of ownership for your investment? (Please select only one)
1. No requirement
2. 10%
3. 20%
4. 30%

5. 40%
6. 50%
7. >50%
8. Other

1.6 b) What consideration is this % of ownership selected in 1.6a based upon ? Please rank (1-3) of the following:
- In percentage enough to control significant investment _____
- In percentage enough to control board of directors decision making _____
- In relations to expected total capital required to reach final product in the market _____
- In relations to expected total capital required to reach industry sale (sell share to other firms in related industry) _____
- In relations to expected total capital required to reach IPO _____

1.7 Investment Holding Period: What is your criteria about expected maximum number of years you need to hold your investment before able to exit (years)?
1. No requirement
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8
10. 9
11. 10
12. >10
13. No plan to exit

1.8 Investment Goal: For investment period selected in 1.7, what is your investment criteria about target or desired return from investment in forms of capital gain multiple (or annual return ROI %)?

Capital gain multiple (times)
1. >10
2. 10
3. 9
4. 8
5. 7
6. 6
7. 5
8. 4
9. 3
10. 2
11. 1
Or
Annual Return ROI%
1. >100%
2. 100%
3. 90%
4. 80%
5. 70%
6. 60%
7. 50%
8. 40%
9. 30%
10. 20%

11. 10%
12. <10%

1.9 a) Do you have criteria about Minimum Requirement, expected return of investment in the worst case?
    1. Yes (if yes, continue to 1.9 b)
    2. No (if no, skip to 1.10)

1.9 b) Minimum Requirement: For investment period selected in 1.7, what is your investment criteria about minimum return, which the investment should not fall lower than that, in forms of capital gain multiple (or annual return ROI %)?

Capital gain multiple (times)
    1. >10
    2. 10
    3. 9
    4. 8
    5. 7
    6. 6
    7. 5
    8. 4
    9. 3
    10. 2
    11. 1
    12. 0 (no gain from investment)

Or
Annual Return ROI%
    1. >100%
    2. 100%
    3. 90%
    4. 80%
    5. 70%
    6. 60%
    7. 50%
    8. 40%
    9. 30%
    10. 20%
    11. 10%
    12. <10%

1.10 Affordable Loss: Considering potential downside risk that your investment in startup business might provide return lower than Minimum Requirement, what is your limit to loss that you can afford to lose in the single startup. (Please select only one)
    1. lower than 1,000 USD
    2. between   1,000 USD to 9,999 USD
    3. between   10,000 USD to 49,999 USD
    4. between   50,000 USD to 99,999 USD
    5. between   100,000 USD to 499,999 USD
    6. more than 500,000 USD

2. Investment in Technological Innovation Startup

Technological Innovation Start-up is a start-up firm that bases its new products/services on technology. Please answer questionnaire from your experiences of actual investments in Technological Innovation Startup either already exit or under investment. If still not exit, please answer from your expected assumptions.

For technological innovation startup that you have invested:2.1 Capabilities: Please rate the following factors that you considered to be important for technological innovation startup to achieve Investment Goal.

	1 Unimportant	2	3	4 Indifference	5	6	7 Very important
Technological Capability: Skill in R&D, new product development and manufacturing							
Marketing Capability: Skills in sensing market direction, develop new customers and linking customer with distribution channel							
Entrepreneurial Capability: Skills in exploit new opportunities by leveraging available resources and teams.							

For technological innovation startup that you have invested:2.2 Innovation: Please rate the following factors that technological innovation startup focused their capabilities on in order to achieve Investment Goal.

	1 Unimportant	2	3	4 Indifference	5	6	7 Very important
High-end: New product/service to address highest or most demanding customer in the mainstream market, who are willing to pay for improved performance in attributed most valued (either incremental or radical innovation, expecting high-end to expand and become new mainstream market							
Low-end: New product/service to address low-end or least demanding of mainstream market, who are willing to pay for lower performance but at lower price by providing lower price at good-enough performance, expecting low-end to grow up and become new mainstream market							
New-market: New product/service to address new market (non-consumer, who historically not buy or use product by providing product that are more affordable, simpler or convenient to use, expecting new market to grow and become new mainstream market							

For technological innovation startup that you have invested and exited:

2.3 Please rank in order (1-3) the following exit methods in order of importance:

- Flotation in stock market _____
- Trade sale (sale to another company) _____
- Sale of shares to existing shareholders _____
- Sale of shares to new investor _____

For technological innovation startup that you have invested and exited:

2.4 Probability of success: Please indicate probability of actual return from your investments, related to capabilities and innovation chosen in previous questions 2.1 and 2.2.
- Success: Actual return was higher than Investment goal (Investment Goal Actual Return) _____
- Low-Return: Actual return was lower than Investment Goal, but still higher than Minimum Requirement (Minimum Requirement Actual Return Investment Goal) _____
- Fail: Actual return was lower than Minimum Requirement (Actual return Minimum Requirement) _____

For technological innovation startup that you have invested and exited:

2.5 Reasons of Low-Return: For investment exited with actual return lower than Investment Goal but still higher than Minimum Requirement, please rank (1-3) the following causes in order of importance.
- High-end market was too small/not broad enough _____
- High-end technology required too high investment for startup to compete with existing companies _____
- High-end products performance was not differentiate enough from competitors _____
- Low-end market was too small/not broad enough _____
- Low-end technology was easy for competition to imitate/follow _____
- Low-end product produce too low margin _____
- New-market was too small/not broad enough _____
- New-market customers do not know what technology they want _____

For technological innovation startup that you have invested and exited:

2.6 Reasons of Fail: For investment exited with actual return lower than Minimum Requirement, please rank (1-3) the following causes in order of importance:
- High-end market was too small/not broad enough _____
- High-end technology required too high investment for startup to compete with existing companies _____
- High-end products performance was not differentiate enough from competitors _____
- Low-end market was too small/not broad enough _____
- Low-end technology was easy for competition to imitate/follow _____
- Low-end product produce too low margin _____
- New-market was too small/not broad enough _____
- New-market customers do not know what technology they want _____

3. Improve Returns & Probabilities of Returns

For investment in technological innovation startup that you exited with lower return than Investment Goal:

3.1 Adding Growth Options: Assume there were other alternatives in technology, market, and entrepreneur's actions available as follows for startup, in addition to what it had already performed and fail in the past, please rate the following options in order (1-3) on degree of importance which could have made the investment success.
- Technology Growth Options: Need to have more flexible or broader scope in technology because there were high potential market demand for new high potential technologies, but at that time it was not yet clear which technology would be successful and become dominant design.

Additional investment should have been allocated for other possible technologies that might satisfy such market demand. _____

- Market Growth Options: Need flexible or broader scope of marketing because the startup had strong existing capabilities that could be deployed for new high potential market, but at that time it was not yet clear which market will be successful and become new mainstream. Additional investment should have been allocated for other possible markets that might exploit such technical capabilities. _____

- Entrepreneurial Growth Options: Need flexible in applying resources to validate opportunities because the new opportunities that the startup pursued were too prominent not to participate, but at that time there were highly uncertain in market directions and highly uncertain in technologies that required the startup to create new set of capabilities. Additional investment should have been staged to reduce uncertainty in discovery of fit between new technology and new market.
_____

3.2 Increase Probability of Success: For the options chosen in previous question no. 3.1, please rank the following actions in order (1-3) in relations to degree of ability to increase probability of success
- Increase expected return from opportunities, but stage attempts to reduce loss _____
- Reduce possible loss and manage under affordable loss _____
- Increase competitive advantages, but sequentially discover new competence _____
- Make strategic alliance, to create co-operation rather than competition _____
- Exploit pre-existing knowledge, but adapt when actual differ from metrics _____
- Exploit of contingencies by being patience learn from new market before fully commit the whole investment amount _____
- Predict of uncertain outcomes, but constantly looking for indicators that major opportunities is opening up _____
- Control of an unpredictable of new market/technology by getting stakeholders co-create new technology/new applications that serve them _____

3.3 Reduce Probability of Loss: For the options chosen in previous question no. 3.1, please rank the following actions in order (1-3) in relations to degree of ability to reduce probability of loss beyond your Acceptable Loss limit.
- Increase expected return from opportunities, but stage attempts to reduce loss _____
- Reduce possible loss and manage under affordable loss _____
- Increase competitive advantages, but sequentially discover new competence _____
- Make strategic alliance, to create co-operation rather than competition _____
- Exploit pre-existing knowledge, but adapt when actual differ from metrics _____
- Exploit of contingencies by being patience learn from new market before fully commit the whole investment amount _____
- Predict of uncertain outcomes, but constantly looking for indicators that major opportunities is opening up _____
- Control of an unpredictable of new market/technology by getting stakeholders co-create new technology/new applications that serve them _____

Modular Design

Modular design could simplify complex product into simple block of function, similar to Lego blocks, which accommodate future uncertainty by allowing consumers to mix and match elements to come up with a final product that suits their taste and needs.

Modular design concept is currently available in software, electronic, computer, but it is also put in knock-down furniture, car industry, and pharmaceutical.

3.4 When you look at the investment in technological innovation startup, do you consider about technology, product, and application in term of modularity?
1. yes
2. no

Modular can be internal or external. With internal modularity, we mean making product so that part/piece of product can be interchangeable allowing adding new features and excluding unwanted/unvalued features. External modularity (or platform), means that by changing the configuration of elements that connect with product that connect with others element, the same technology or product can be used in different / several applications (they may also be some internal modularity)3.5 Please rate the following actions you found to be important to create modularity in product/service of technological innovation startup that you have invested.

	1 Very Unimportant	2	3	4 Indifference	5	6	7 Very Important
Substitute: Replace inferior modules with new better performance or lower cost modules;							
Augmenting: Add new module to system, to provide new features demanded from new market, improving performance;							
Excluding: Cut dissatisfying, tolerable, or neutral modules that customer did not value, lowering cost;							
Inverting: Combine common modules into new modules, lowering cost and reducing implementation time;							
Porting: Connect internal module to another system, lowering cost by reusing components.							

4. Investment Value from Modularity and Options

4.1 Modular and Growth Options: In relations to adding growth options in question no. 3.1, please rate the importance of modularity to the creation of growth options.

	1 Unimportant	2	3	4 Indifference	5	6	7 Very important
Importance of Modularity to Growth Options							

4.2 Valuation: Please rate the following methods on their ability to capture value of technological innovation startup.

	1 Unimportant	2	3	4 Indifference	5	6	7 Very important
Expected value of Investment Goal x probability to achieve							
Expected value of Investment Goal x probability to achieve, adjusting with expected value of Minimum Return Requirement x probability to achieve							
Not rely on expected value of gain, but focus on increasing probability of survival (probability of actual return higher than Minimum Return							

Requirement) by pursuing opportunities that are certain to achieve through pre-commitment from customers and resources in hands						
Not rely on expected value of gain, but focus on minimizing probability of not survive (probability of actual return lower than Minimum Return Requirement) and set loss level that is affordable						

4.3 Propensity to Invest: If a product/service of startup shows to be modular in some way or another in order to achieve Investment Goal, should it increase your propensity to invest in the startup?

	1 Strongly Disagree	2	3	4 Neither Agree nor Disagree	5	6	7 Strongly Agree
Increase of Propensity to Invest from Modular Design							

End of survey

APPENDIX C RESULT OF ONLINE SURVEY

Report Link : http://questonpro.com/s/1-1901- Report Sharing is OFF (turn on) Settings

Online Options ~ Download Options ~

20 Started the survey, 1 Completed »

Completed, 1
Drop Out, 19

VIEWED
80

STARTED
20

COMPLETED
1

5% Completion Rate

APPENDIX D INTERVIEW GUIDELINE

1. For Exploratory Survey in Phase I

Introduction
This research is conducted as part of Ph.D study under Technopreneurship and Innovation Management Program of Chulalongkorn University. The focus is on the sources of funding that start-up firm use in addition to owner capital and funding from family and friends. We believe "Private Investors" are very important sources for new firm creations especially in technology area, before they can get funding from public investors or commercial banks.

This interview is the starting point to obtain opinion of industry experts in the fields in order to further develop proper questionnaire survey. In the end, the researcher wishes to create decision model that would help private investors and technology start-up companies in the process of investment during new product development and start-up phases.

Procedures
The interviewer will ask about your investment of private investment in technology start-up companies. Private investments are the investor who invest in the start-up firms, but has no family relationship with the founders/entrepreneurs. You will be asked about the following topics.
- **Investor characteristics**: Identify that you are private investors, with family relationship with founders/entrepreneurs or no relationship with founders/entrepreneurs.
- **Investment preference**: Risk and return on the investment in newly created firms, your attitude about opportunity and especially opportunity arise from new technology, stage of startup such as "development" or "commercialization".
- **Pre-investment**: Criteria that you used to evaluate investment in start-up, investment amount, stage of investments, expectation of return, and duration of investment. Your perception about capabilities, resources, and process that new firm tries to enter in the market with its new technology and new value proposed to customer. Your methods or tools to help you reduce risk.
- **Market Entry Strategy**: Effects of strategy of market entry such as level technology, type of innovation, new market or new value, on the risk and return of investors. Does start-up have core strategy to enter market and contingent strategy if not go as plan? And whether you split your investment to core and contingent to match with startup strategy?
- **Monitoring (Post Investment)**: Evaluation of your investments, your satisfaction with return, or chance of loss.
- **What-If/Option**: You will be asked what-if analysis, whether there were options or flexibilities in strategy or actions during the development of start-up that could be change when reality of start-up was not the same as plan?

Would that flexibility or option, add the value and lower risk to your investment?

- **Core and Growth Option**: Would it benefit you if startup structured to separate core value as firm forward commitment and growth option value (as contingent claim for better or worse than expect case)?

Benefit

There is no direct benefit of the researcher in this interview research other than academic. There is also no direct benefit provided for participants of this interview. However, it is hoped that through your participation, the result of the interview research could provide more insight for both entrepreneur who start-up the company and the investors about how to successfully fund the start-up with less risk, higher chance of success and higher return for investors. If the participants wish to receive result of this interview research, please kindly provide email address.

Confidentiality

All data obtained from participants will be treated as STRICTLY CONFIDENTIAL. The result will only be reported in aggregate or combined format and never reported as individual results.

Questions about the Research

The researcher wishes to thank the participants for the information and time providing for taking this survey. If you have questions regarding this study, you may contact the researcher, Mr.Kwanrat Suanpong, at 081-646-6652, or kwanrats@gmail.com or 50878172@student.netserv.chula.ac.th.

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1) **INVESTORS CHARACTERISTICS**
   a) Screening for private equity. This questionnaire aim to study investment/financing behaviour of private investor who is not founder entrepreneur from startup to listed in stock market
   b) You are individual investors in the company who are
      i) Founder or entrepreneur
      ii) Largest shareholders
      iii) Not largest shareholder
         (1) Related to founders, and have same family name
         (2) Not related to founder, but has same family name
         (3) Not related to founder, not has same family name
      iv) Others
   c) You are investors on behalf of others that are
      i) Parent company
      ii) Management
      iii) Business partner
      iv) Private equity
      v) Venture capital

vi) Others (please specify)
d) How did you know entrepreneurs?
   i)   Referred by Relatives
   ii) Referred by person you trust
   iii) Colleagues in previous work place
   iv) As suppliers or customers in previous work place
   v) Others (please specify)
e) Past Experience and Skill
   i)   Investment Experience
       (1) Saving , fixed account, insurance
       (2) Marketable (Gold, Mutual fund, Listed company securities)
       (3) Non marketable (Property, Non listed company securities)
   ii) Industry Experience
       (1) Biotechnology
       (2) Business Products and Services
       (3) Computers and Peripherals
       (4) Consumer Products and Services
       (5) Electronics/Instrumentation
       (6) Financial Services
       (7) Healthcare Services
       (8) Industrial/Energy
       (9) IT Services
       (10) Media and Entertainment
       (11) Medical Devices and Equipment
       (12) Networking and Equipment
       (13) Retailing/Distribution
       (14) Semiconductors
       (15) Software
       (16) Telecommunications
       (17) Others (please specify)
   iii) Work Experience
       (1) Managerial
       (2) Sales and Marketing
       (3) Manufacturing
       (4) Finance
       (5) Business development
       (6) Research
       (7) Others (please specify)
   iv) Startup (Entrepreneurial) Experiences
       (1) Not startup by myself
       (2) Startup but not yet exit
       (3) Startup and successfully exit
       (4) Startup but already abandon

2) **INVESTMENT CRITERIA**
a) Industry choice
   i)   A field in which I have some technical competence
   ii) Fields in which I am sufficiently experienced to permit evaluation

iii) Related to my background in specific industries
iv) Industry that I know it has potential of growth
v) Limited to what I know and understand myself, especially about the marketplace, or can get trustworthy opinions on

b) Investment Amount
   i) Amount of investment
   ii) % of ownership on total shares/ Controlling interest
   iii) Price of investment
       (1) Above par value
       (2) At par value
       (3) Under par value
   iv) Management activities
       (1) Shareholder meeting
       (2) Board meeting
       (3) Investment approval and monitoring

c) Weight/rank criteria in investment in startup, which one is the most important?
   i) Relationship
   ii) Financial return
   iii) Non-financial return
   iv) Indirect Financial Return
   v) Support existing business

d) Tools to evaluate investment
   i) Discounted Cash Flow
   ii) Payback period/ Breakeven time
   iii) ROI
   iv) SWOT analysis, Porter's Five Forces industry analysis
   v) Option pricing or Expected Value

e) Holding period (Length of time you expect to hold a venture investment)
   i) Less than 3 years
   ii) 3 to 6 years
   iii) 7 to 10 years
   iv) Over 10 years
   v) Not important

f) Risk Perception *: ("Perception on downside risk") (after the investment proposal meet your investment criteria regarding, size, industry, location, and management qualification at the time of investment, how many of ten portfolios would probably turn out to be "losers" (eventful loss exceed 50% of original investment)*
   i) Technology-based investors
   ii) "Start-up firms"
   iii) "Infant firms" about one year old and approaching break-even operations
   iv) "Young firms" less than five years old and entering a rapid growth stage
   v) "Established firms" growing too fast to finance from retained earning

g) Expected return on investment (ROI) for 5 year holding, compare startup and established
   i) for all except established firm ROI ___%per year, and capital gain multiple ___ times

      ii) for established firm   ROI ___%per year, and capital gain multiple ___ times

  h) Expected return on investment (ROI) for 5 year holding, and stage of startup
      i) inventor/startup: ROI ___%per year, and capital gain multiple ___ times
      ii) infant firm: ROI ___%per year, and capital gain multiple ___ times
      iii) young firms   ROI ___%per year, and capital gain multiple ___ times
      iv) established firms: ROI ___%per year, and capital gain multiple ___ times

  i) How did startup firms manage its process to make sure it can provide return level you expected
      i) Financial projection with frequently feedback to adjust according to key assumptions about cost and major obstacle
      ii) Sensitivity analysis to find what factors has most influence on profitability and try to manage that factors.
      iii) Using check points (Stage Gate) at each milestone of New Product Development to decide go/no-go.
      iv) Set ROI and net profit target and work backward to get key assumptions about cost and major obstacle to achieve unit sale level or cost that startup has to achieve.

  j) Reason of rejection for investment proposal
      i) Unsatisfactory risk/reward ratio (Risk / reward ratio was not adequate, Unable to agree on price)
      ii) Unsatisfied with entrepreneur capability (Entrepreneur's team are not totally dedicated or commit)
      iii) Absent of well-defined business plan (Too much wishful thinking (on technology, market))
      iv) Investor's unfamiliarity with products, process, or market

3) STAGE OF STARTUP
  a) Stage of **Financing** (Please express your interest in the following type of financing, and reasons)
      i) Seed
      ii) Start-up (Discovery, Exploration, 1st stage financing)
      iii) Early-stage expansion (Development, Exploitation, 2nd stage financing)
      iv) Expansion financing (Expansion, 3rd stage financing)
      v) Later Stage
  b) Stage of **Firm Growth** (Which stage of startup that you prefer to invest in?)
      i) Existence (Conception and Development)
      ii) Product development
         (1) securing adequate financial backing
         (2) identification of market opportunity
         (3) Product prototyping
         (4) Selling ideas to investors
         (5) Prototype finished
      iii) Commercialization

       (1) Commercialize product
       (2) Acquiring adequate facilities
       (3) Establishing a vendor network
       (4) Developing product support capability
   iv) Survival
   v) Success
   vi) Take-Off (Growth)
       (1) High growth in both sales and employee
       (2) Produce, sell and distribute the product in volume while attaining profitability
   vii) Resource Maturity (Stability)
       (1) Growth rate of firm slows to level consistent with market growth
       (2) Maintain growth momentum and market position
       (3) Introduction of second generation product for acquiring new opportunities
       (4) Expansion of business into new geographic territories and market

c) Stage of **New Product Development**: Activities that are important milestone in Development Phases ("New Product Development" process activities)
   i) **Initial screening** (The initial go/no-go decision where it was first decided to allocate funds to the proposed New product idea)
   ii) **Preliminary market assessment** (An initial, preliminary, but nonscientific, market assessment; a first and quick look at the market.)
   iii) **Preliminary technical assessment** (An initial, preliminary appraisal of the technical merits and difficulties of the project)
   iv) **Detailed market study/market research** (Marketing research, involving a reasonable sample of respondents, a formal design, and a consistent data collection procedure.)
   v) **Business/financial analysis** (A financial or business analysis leading to a go/no-go decision prior to product development.)
   vi) **Product development** (The actual design and development of the product, resulting in, e.g., a prototype or sample product.)
   vii) **In-house product testing** (Testing the product in-house: in the labor under controlled conditions (as opposed to in the field or with customers).)
   viii) **Customer tests of product** (Testing the product under real-life conditions, e.g., with customers and/or in the field.)
   ix) **Test market/trial sell** (A test market or trial sell of the product—trying to sell the product but to a limited or test set of customers)
   x) **Trial production** (A trial production run to test the production facilities)
   xi) **Pre-commercialization business analysis** (A financial or business analysis, following product development but prior to full-scale launch.)
   xii) **Production start-up** (The start-up of full-scale or commercial production)
   xiii) **Market launch** (The launch of the product, on a full-scale and/or commercial basis: an identifiable set of marketing activities specific to this product)

d) Does Stage of investment relates to NPD process
   i) Would RISK reduced when startup firms complete more steps?

ii) Which stages are viewed as MOST importance to survival of business startup?

e) Would there be MAJOR milestone that you considered proving investment assumptions and qualifying for further stage of investment from you?

4) **INNOVATION**

a) **Innovation type** (Which type of innovation of product that startup firms try to develop (by change of technology on product components and linkage among component), that you prefer to invest/match with your risk and return profile?)

i) **Incremental innovation:** Incremental innovation refines and extends an established design. Improvement occurs in individual components, but the underlying core design concepts, and the links between them, remain the same. Incremental innovation reinforces the competitive positions of established firms, since it builds on their core competencies. It implies: Low investment, low return, low technology risk, low market risk, but high competition

ii) **Architecture innovation**: Architecture innovation is innovation that changes a product's architecture but leaves the components, and the core design concepts that they embody, unchanged. It implies: medium investment, medium return, low tech risk, high market risk

iii) **Modular innovation**: Modular innovation is innovation that changes only the core design concepts of a technology, such as the replacement of analog with digital telephones. To the degree that one can simply replace an analog dialing device with a digital one, it is an innovation that changes a core design concept without changing the product's architecture. It implies: medium investment, medium return, high market risk, low technology risk

iv) **Radical innovation**: Radical innovation establishes a new dominant design and, hence, a new set of core design concepts embodied in components that are linked together in a new architecture. It implies: High investment, highest return, high market and technology risk

b) **Market-Technology entry strategy:** (startup firms that use initial product-market approach was characterized according to whether it used new or proven component technology in its first products and whether these products were targeted at emerging or established markets)

i) **New-market/Proven-technology components** entry strategy. Startup that develops new product based proven component technologies with architectures targeted at new market applications (New Market Disruption)

ii) **New-market/New-technology components** entry strategy

iii) **Established-market/proven-technology components** entry strategy. Startup that develops new product based on proven technology component and target to established markets. (Sustaining Innovation)

iv) **Established-market/New-technology components** entry strategy

5) **TECHNOLOGY CAPABILITY**

a) **Capability**: Abnormal rent can be obtained from resources or capabilities of startup possess to the extent that they are valuable and difficult to create

i) **Valuable** *(when they enable a firm to conceive or implement strategies that improve its efficiency or its effectiveness)*

ii) **Rare** *(Valuable firm resources possessed by large numbers of competing firms cannot be sources of either a competitive advantage or a sustainable competitive advantage)*

iii) **Imperfectly Imitable** *(because of a combination of 3 reasons: unique historical conditions, causally ambiguous, social complex)*

iv) **Non-Substitutable** *(there must not be strategically equivalent valuable resources that are themselves either not rare or imitable)*

6) **MARKET COMMERCIALIZATION**

a) In order to commercialize by bringing product to market, innovator needs to capture profit from innovation and not allow imitator, followers, suppliers, or customers to gain more benefit from its know-how.

   i) **Dominant design**: Dominant design is a single product architecture that established dominance over other product or class. Before dominant design of product become accepted, technical performance is critical factor for product acceptance, but complimentary assets are not as critical. In dominant design, costs, support, quality, and reliability (product, process, and delivery) are keys to competitiveness.

   ii) **Complimentary Asset**: Complimentary assets are assets that innovation needs to bring product to market. Complementary assets are assets, infrastructure or capabilities needed to support the successful commercialization and marketing of a technological innovation. Some complimentary assets are "specialized" that it needs to build over long periods of time and are sources of competitive advantage. Innovator gains more profit from innovation if its innovation (know-how) can be commercialized through generic complementary assets, but that it improves if the new technology can be commercialized through specialized complementary assets.

   iii) **Know-how protection** (Regime of Appropriability): Easy or difficult of imitability that is a function of both legal impediments (patents, copyrights, trade secrets, trade marks) and the inherent replicability of the technology, which depends in part on whether the know-how is tacit (difficult to learn/transfer) or codified.

b) **Commercialize strategy**

   i) If 1.Dominant design has NOT occurred, 2.STRONG appropriability (through legal protection or difficulty of technical know-how), and 3. Complimentary assets are available in-house, firm will have better positioned against imitator and it is more profitable to "commercial right away".

   ii) If 1.Dominant design has occurred and 2.STRONG appropriability (through legal protection or difficulty of technical know-how), firm can CONTRACT for complimentary asset in order to have better positioned against imitator.

   iii) If 1.Dominant design has occurred and 2. But WEAK appropriability (know-how is easy to imitate), firm should ACQUIRE specialized complimentary asset in order to have better positioned against imitator.

7) **WHAT IF / REAL OPTON**
   a) Flexibility and option that startup provides to investors during product development.
      i) Did entrepreneur break down investment requests in stages for your investments?
      ii) Did entrepreneur break down investment in stages for you to evaluate before making another commitment to further investing?
      iii) Did entrepreneur provide plan with dominant/main strategy and also provide back up plan/option strategy in case future outcome of technology development and market development do not happen as plan?
      iv) What kind of back up/option plan entrepreneur provide to you?
         (1) Option to grow
         (2) Option to delay
         (3) Option to expand
         (4) Option to extend
         (5) Option to abandon
         (6) Option to shrink
         (7) Option to switch
         (8) Option to exit
      v) If EN give option for core and growth choice for investors, will it help to increase funding amount, lower required rate, or extend duration?

   b) OPTION TO DELAY: Disruptive innovation is uncertain in unproven performance of new technology or unproven response from new market. Therefore, you set aside cost or investment to develop prototype, test in small market, and cost for product modification with new technology, before committing in permanent capital infrastructure for alternative technology and new market, in addition to core technology and mainstream market
      i) Did EN spend time to test market? Even though it means delay in product launch.
      ii) Did EN use that market test result to modify technology performance or modify key assumptions about market?
      iii) Did startup use that market test result to increase or decrease investment request from investors?
      iv) Did you use that test result to modify valuation of startup and adjust amount of your investment?

   c) OPTION TO GROW: Disruptive innovation supposes to give you growth in new technology or new market. Therefore, you set aside or incorporate investment for alternative technology and new market, in addition to core technology and mainstream market, hoping to gain upside if uncertainty in technology and market turn out to be differ from your core technology.

   d) For each option, what instrument did you use
      i) Contract
      ii) Convertible share
      iii) Conditional license agreement
      iv) Collateral
      v) Did EN specify which technology components

vi) Did EN give that right and benefit of new component acquired by financing fund to investors as

2. INTERVIEW GUILDELINE II. For Qualitative Research Methodology in Phase III

เรื่อง ขอสัมภาษณ์เกี่ยวกับเกณฑ์ในการตัดสินใจของนักลงทุนส่วนบุคคล (business angel/seed investor) ในการลงทุนในหุ้นของธุรกิจตั้งใหม่ (startup) (ของผู้ประกอบการคนอื่น)ที่มีนวัตกรรมบนพื้นฐานของเทคโนโลยี

เรียน _____ที่เคารพ

ผม นายขวัญรัฐ ส่วนพงษ์ ปัจจุบันเป็นนิสิตปริญญาเอก หลักสูตรTechnopreneurship and Innovation Management จุฬาลงกรณ์มหาวิทยาลัยขออนุญาตเข้าพบเพื่อสัมภาษณ์เกี่ยวกับเกณฑ์ในการตัดสินใจของนักลงทุนส่วนบุคคล(business angel/seed investor) ในการลงทุนในหุ้นของธุรกิจตั้งใหม่(startup) (ของผู้ประกอบการคนอื่น) ที่มีนวัตกรรมบนพื้นฐานของเทคโนโลยีซึ่งการสัมภาษณ์นี้เป็นส่วนหนึ่งของงานวิจัยในการเรียนปริญญาเอกของผมครับ โดยในการวิจัยนั้นผมศึกษาด้วยการสัมภาษณ์นักลงทุนที่เคยเป็นผู้ประกอบการแล้วบริหารงานให้ประสบความสำเร็จจากการบริษัทที่จดทะเบียนในตลาดหลักทรัพย์ซึ่งจะเป็นนักลงทุนที่มีแนวโน้มที่จะลงทุนในธุรกิจตั้งใหม่(ในนามตนเองหรือผ่านบริษัท) เพราะเชื่อในการสร้างมูลค่าจากการริเริ่มธุรกิจใหม่ๆ

จากการศึกษาเบื้องต้นของผมพบว่าในบริษัทตั้งใหม่นั้น ผู้ที่มักจะให้เงินทุนหรือลงหุ้นนั้นเป็นนักลงทุนรายบุคคล (business angel) ในช่วงที่กำลังพัฒนาสินค้าในขณะที่ VC จะตามมาภายหลังจากที่สินค้าเริ่มขาย และผมพบว่าการตัดสินใจลงทุนของนักลงทุนส่วนใหญ่ต้องการความปลอดภัยของเงินต้นและการเติบโตของกำไร ดังนั้นผมจึงเสนอในงานวิจัยว่าบริษัทตั้งใหม่ควรที่จะตอบสนองความต้องการผู้ลงทุนด้วยสร้างนวัตกรรมจากเทคโนโลยีเพื่อให้มีการเติบโต และมีการบริหารงานที่ลดความเสี่ยงที่ธุรกิจจะไม่เป็นตามเป้าหมายจึงจะมีโอกาสที่จะได้รับเงินทุนจากนักลงทุน ซึ่งผมคาดหวังว่างานวิจัยของผมจะมีประโยชน์ช่วยให้ผู้ก่อตั้งบริษัทใหม่ประสบความสำเร็จในการทำธุรกิจโดยได้รับเงินทุนที่ต้องการจากนักลงทุนภายนอก และในขณะเดียวกันนักลงทุนจะสามารถลดความเสี่ยงจากการลงทุนและได้รับผลตอบแทนจากการเติบโตของธุรกิจ

ผมจึงเรียนมาเพื่อขอเข้าพบเพื่อสัมภาษณ์เกี่ยวกับประสบการณ์/แนวคิดของท่านในการตัดสินใจลงทุนในบริษัทตั้งใหม่ โดยมีประเด็นที่สำคัญดังนี้

ในการตัดสินใจลงทุนในบริษัทใหม่ โดยที่ท่านไม่ใช่เจ้าของ/ผู้ก่อตั้งแต่เป็นผู้ที่ร่วมลงทุนให้บริษัทนั้น
1.เกณฑ์การตัดสินใจ
- เป้าหมายของผลตอบแทนที่ตั้งไว้เป็นอย่างไร เช่น ผลตอบแทนจากการลงทุน 5 ปี ต้องได้ ROI เฉลี่ยน 30% ต่อปี หรือได้กำไรตอน exit 2 เท่า
- ความน่าจะเป็น: นักลงทุนได้ประมาณว่าโอกาสที่จะได้รับผลตอบแทนตามที่ตั้งไว้อย่างน้อยเท่าไร เช่นมีโอกาส 70% ที่จะเติบโตและทำได้ตามเป้า 30% ที่จะล้มเหลว

- เกณฑ์การเติบโต: พิจารณาเกี่ยวกับเทคโนโลยี/การตลาด/ลักษณะตัวผู้ประกอบการ/นวัตกรรม ที่
ทำให้บริษัทเติมโตและมีโอกาสทำได้ตามเป้า หรือไม่
- เกณฑ์การล้มเหลว:พิจารณาจำนวนเงินที่ลงอย่างไร เช่น ไม่เกิน 50% ในหุ้นของบริษัท หรืออิง
กับระดับความพอใจของนักลงทุนเช่นจำนวนที่สามารถให้เปล่าโดยไม่มีผลตอบแทน (affordable
loss)
- สัดส่วน หรือการให้น้ำหนักในการตัดสินใจสำหรับด้านความสามารถในการเติบโต และความ
มั่นคง

เพื่อสร้างการเติบโตในบริษัทตั้งใหม่ที่นักลงทุนจะลงทุนนั้น
2. มีนวัตกรรมหรือสินค้า/บริการ ใหม่ ที่เกิดจากความสามารถในการใช้เทคโนโลยีหรือไม่
 - นวัตกรรมนั้นเหมาะสมกับบริษัทตั้งใหม่ หรือไม่ เช่นเป็นสินค้าที่สมรรถนะสูงกว่าปัจจุบันมาก
และมุ่งไปที่ตลาด niche ที่มีขนาดเล็ก-ที่ไม่คุ้มที่บริษัทใหญ่จะแข่ง หรือเป็นสินค้าที่ตัดฟังก์ชันที่
ไม่จำเป็นออก/ยุบรวมระบบให้สั้นเพื่อลดต้นทุนทำให้ตั้งราคาได้ถูกมุ่งไปที่ตลาดล่าง-ที่ไม่คุ้มที่
บริษัทใหญ่จะแข่ง
- บริษัทควรเลือกที่จะสร้างสินค้าใหม่นั้นให้มีรูปแบบเฉพาะที่ไม่เปิดให้คนอื่นเชื่อมต่อได้ หรือ
เลือกที่จะนำส่วนที่มีอยู่ในตลาดแล้วมาเชื่อมต่อกันแล้วเพิ่มด้วยส่วนเฉพาะที่ทำขึ้นใหม่ที่ตลาดให้
มูลค่ากับงานนั้น

3. ในการสร้างสินค้า/ซอฟท์แวร์/บริการ ที่แข่งได้กับคู่แข่งและทำให้ตลาดเติบโตนั้น มีการ
พิจารณาโครงสร้างสินค้าที่เป็น module หรือไม่ เช่น
 - มีการสร้างสินค้าใหม่จากการปรับปรุงโครงสร้างเดิมของสินค้าที่มีอยู่แล้วในตลาดให้ดีขึ้นด้วย
การ แบ่งโครงสร้างเป็นส่วนๆที่จะทำให้การปรับเปลี่ยนตามลูกค้านั้นสามารถทำได้โดยไม่ต้อง
เปลี่ยนทั้งโครงสร้างสินค้าหรือไม่
 - มีการปรับเพิ่มส่วนที่ล้าสมัยและนำส่วนที่ทันสมัยเข้าไปหรือไม่
 - มีการตัดเฉพาะส่วนที่ลูกค้าไม่ให้คุณค่าออกแล้วทำให้ต้นทุนสินค้าต่ำลงได้หรือไม่
 - มีการยุบรวมส่วนที่ทำงานเชื่อมต่อภายในซ้ำๆกันเข้าเป็นส่วนเดียวกันเพื่อลดขั้นตอนในการ
ทำงานหรือไม่
 - มีการสร้างตัวเชื่อมต่อระบบภายใน เข้ากับระบบภายนอก เพื่อให้สินค้า/ระบบใหม่ของเรา
สามารถทำงานร่วมกับสินค้า/ระบบอื่นๆภายนอกหรือไม่ ซึ่งจะทำให้สินค้าใหม่มีขนาดเล็กเพราะ
ไม่ต้องนำระบบงานภายนอกเข้าไปรวมด้วย

4. ในแผนธุรกิจหรือประมาณมูลค่าหุ้นที่ผู้ประกอบการเสนอเพื่อขอเงินทุนนั้น มีการสร้างทางเลือก
(option) เพื่อลดความเสี่ยง (uncertainty) ในกรณีที่
 - สถานการณ์ไม่เป็นตามที่คาดไว้หรือไม่
 - เป็นทางเลือกที่จะใช้ technology ที่ต่างจากที่เป็นอยู่ในแผนหลักหรือไม่ ในกรณีที่อาจมี
เทคโนโลยีใหม่ที่ทำให้เทคโนโลยีของเราล้าสมัย
 - เป็นทางเลือกที่จะมุ่งไป market segment อื่นที่ต่างจากที่อยู่ในแผนหลักหรือไม่ ในกรณีที่อาจมี
ตลาดอื่นที่เติบโตมากว่าตลาดที่เรามุ่งไป

- มีการตั้งประมาณการผลตอบแทน/มูลค่าหุ้นในกรณีที่ธุรกิจประสบความสำเร็จหรือไม่ครับ
มีการประมาณเป็นช่วงเช่น best case, most likely, worst case หรือไม่ครับ
- ถ้ามีการสร้างทางเลือกดังกล่าวแล้ว ควรที่จะใช้แนวคิดการ "วัดมูลค่า" บริษัทตั้งใหม่ด้วย Real
Option ที่เป็นการวัดมูลค่าทางเลือกต่างๆ แล้วปรับด้วยความน่าจะเป็น/ความเสี่ยงของทางเลือก
นั้นๆ เพื่อใช้ในการวัดมูลค่าของกิจการที่อยู่ระหว่างการเติบโต (growth potential) เป็นการเสริม
เพิ่มจากวิธี DCF หรือไม่ แล้วกรณีของ DCF นั้น มีการใช้ discount factor กระแสเงินสดของ
กิจการในอนาคตมากเกินไปหรือไม่

เพื่อลดโอกาสล้มเหลว
5. บริษัทควรที่จะลดโอกาสเสียเงินลงทุนส่วนที่เป็น affordable loss ด้วยการ
- ทยอยลงทุนเป็นขั้นๆ ตามเวลา โดยมีจุดวัดที่ถ้าพัฒนาเทคโลยี/ทดลองตลาดได้ตามเป้าแล้ว จึง
ควรจะลงทุนเพิ่ม ถ้าไม่ได้ควรจะหยุดเพื่อลดโอกาสเสียเงินทั้งหมด
- ทยอยลงทุนเป็นชิ้นๆ ตามโครงสร้างสินค้า โดยลงทุนใน core component ที่ตอบสนองตลาด
โดยทั่วไป จากการนำสินค้าที่มีในตลาดแล้ว integrate แล้วจึงลงทุนสร้างเพิ่มส่วนที่ตลาด niche
ต้องการเฉพาะ ซึ่งหากส่วนตลาด niche นั้นล้มเหลว จะยังสามารถลงทุนสร้างส่วน niche 2 มาต่อ
บนเงินลงทุนส่วน core component ซึ่งจะทำให้ไม่เสียเงินไปทั้งหมดหากตลาดล้มเหลว

6. บริษัทตั้งใหม่ที่มีการสร้างความเติบโตจากนวัตกรรมและลดโอกาสล้มเหลว จะมีโอกาสที่จะให้
ผลตอบแทนตามเป้าที่นักลงทุนตั้งไว้ เพิ่มกว่าบริษัทตั้งใหม่อื่นๆ หรือไม่ หรือจะมีโอกาสได้รับเงิน
ลงทุนจากนักลงทุนเพิ่มขึ้นหรือไม่

จึงเรียนมาเพื่อขออนุญาติปรึกษาในประเด็นข้างต้นนั้นว่าเหมาะสมในความเห็นของท่านหรือไม่
และควรที่จะต้องปรับปรุงเช่นไรจากประสบการณ์ทางธุรกิจของท่าน ผมขอรบกวนเข้าไปพบในวัน
และเวลาที่ท่านสะดวกครับ ขอขอบพระคุณล่วงหน้ามา ณ ที่นี้

ขอแสดงความนับถือ

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APPENDIX E INTERVIEW RESULTS

Category	Category	1
Name		Mr. Janewit Kraprayoon
Date		09-Sep-11
Company		True Internet Data Center
Model		1 TC&RO
Investment	Profile	Management, Business Angel
Investment	Background	Mr. Janewit invested in PaySabuy. He did not know entrepreneur before. Entrepreneur at PaySabuy proposed to sell share in company in order to get funding to expand to next stage. Paysabuy proposed True at that time, but it did not match with True policy. Mr. Janewit was working with True, so he knew opportunities from entrepreneur presentation. So he invested as new majority shareholder (51 %) in PaySabuy by paying new money. This was first investment he made as business angel. As business angel, he helped in planning, BoD meeting (many times in a quarter).
Criteria	Criteria	He considered technology capability, especially new technology and new market because of less competition.
Criteria	Timing	He preferred to invest when company already had product and already commercialize, but lack money to do marketing or market expansion.
Criteria	Holding period	He did not set criteria of holding period. He intended to hold in long term. However, he could sell his investment within 2 years.
Criteria	Exit preference	Option that previous entrepreneur sell share to him. Option that he could sell share to new investor.
Evaluation	Propensity to invest	Single most important factor to invest is entrepreneur quality that could give trust to deliver as promise and honesty.
Evaluation	Growth Potential	He believed market for online payment would grow exponentially.

Evaluation	Target Return	Much higher than average
Evaluation	Security	He believed the investment was low risk because Paysabuy at that time had product and customer already, but it needed more funding to grow, and the business was regulated which Paysabuy obtained licensed already and later the authority did not open for license.
Valuation	Finance Valuation	He used financial tools to make investment decision such as DCF, ROI and Porter's Forces model.
Tech.Capability	Valuable	He believed internet payment was valuable because everyone will have to use for convenience.
Tech.Capability	Rare	Paysabuy also obtained licensed already and later the authority did not open for license (EXCLUSIVITY)
Tech.Capability	Imperfectly Imitable	He believed internet payment comprise of internal algorithm and VISA algorithm which could not be easily imitated.
Tech.Capability	Non-substitutable	He believed internet payment was imperfectly imitable because it was a new technology on top of internet technology.
Mkt. Capability	Dominant design	No dominant design established for personal money transfer in Thai yet. Dominant design of internet payment established in USA already.
Mkt. Capability	Complimentary Asset	Paysabuy can run on any internet technology so it did not depend on complimentary asset.
Mkt. Capability	Know-how protection	Paysabuy did internet payment as very first company and was protected under license.
Mkt. Capability	Sensing market direction	Paysabuy did internet payment as very first company and was protected under license.
Mkt. Capability	Develop new customers	Paysabuy at that time had product and customer already.
Ent. Capability	Skills in technology and marketing	He checked from sources in industry to confirm that the entrepreneur is a good and capable person which excel in technology

Ent. Capability	Skills in exploit new opportunities	Entrepreneurs at Paysabuy managed to develop product and obtained license as very first person in Thailand.
Option	Growth Option	Exit after 2 years because startup did not grow as planned. He was afraid regulator would issue more licenses which would cause more competition and if selling share at that time, selling would be low. When company did not grow much, it was not fun.
Option	Technology Option	At the beginning, no need option if technology is strong and no need option if technology is protected by regulation. However, after 2 years, technology needed to be updated and there was risk to continue and needed more money.
Option	Market Option	No need option if marketing is strong. After 2 years, market was still growing strong.
Innovation	Radical Innovation	He preferred radical innovation that is new in Thailand.
Innovation	New-Market Innovation	He believe Paysabuy was new internet payment gateway in Thailand that is separate own, not part of large company. Advantage is that market is larger because of neutral position.
Modular	Internal Flexibility	When business started it was difficult to chance course or plan. If not success, it was difficult to continue funding expecting to turn up. If still have money, investor preferred to invest in new and promising one than continue with failing.
Support	Large corporation support technology	Startup had room to grow more if large corporation supporting the development such as join development, providing its technology platform or labs for startup to use to develop new product.
Support	Large corporation support finance	Large corporation should support funding to startup that had good idea
Support	Large corporation support incubating	Large corporation should help coaching and run startup with entrepreneur. After 3 year, VC could come in for expansion finance. Cooperation between large company+startup+VC should help promote more startup.

Category	Category	2
Name		Mr. Damrongphan Sanitwongse
Date		10-Sep-11
Model		1 TC&RO
Investment	Profile	Banker
Investment	Background	Private bank manage investment for large and wealthy clients in various project that clients interested. Clients rarely invested in startup. Startup that private bank help client to invest are mostly large and high investment such as natural resources project.
Criteria	Criteria	Consider technology, market, entrepreneur in details. They even consulted industry specialist to provide key information to help investing for clients. Networking is very important in private banking service for their clients.
Evaluation	Propensity to invest	Private banker gave high weight on entrepreneur that has good reputation.
Evaluation	Growth Potential	Global or international market was very important growth for startup. However, currency risk also very important which startup rarely managed well.
Evaluation	Security	Risk management is very important consideration for private bank on client deal. They had to control all aspects of risk that could possible happen to the projects because high amount of investment of clients and high reputation cost that private banking had to uphold. Risks needed to be considered in technology, market, and finance.
Valuation	Finance Valuation	They use traditional finance NPV, IRR and scenario analysis.
Option	Growth Option	Private bankers had to explore all options available to serve their clients in all field, finance, technology, market.

Option	Technology Option	To reduce risk, technology should be flexible enough to adapt if intended plan did not success. He gave example of firm intended to manufacture coffee cup. But when market did not turn out well, it could turn to produce can. Technology or production had to be planned in advance to cope with flexibility in marketing or produce changes.

Category	Category	3
Name		Dr. Ian Fenwick
Date		11-Sep-11
Company		Sasin
Model		1 TC&RO
Investment	Profile	Researcher, Business Angel
Investment	Background	Professor in digital marketing who also invest in student projects or startup by his student related to internet.
Criteria	Criteria	Only invest in disruptive innovation
Criteria	Timing	Business angel wanted to invest early in product development in order to understand the company. Some business angels also came in later stage buy provide large funding in order to own and control.
Criteria	Holding period	Business angel did not concern on exit
Evaluation	Target Return	Business angels did not interest in break even, payback period or ROI. But business angels concerned whether their investment could become enormous in the end or not. Some investors need high profit and can accept high risk. They wanted to invest early but at small amount.
Evaluation	Security	Some investors need high profit and can accept high risk. They wanted to invest early but at small amount. They wanted to diversity to many investments
Tech.Capability	Valuable	Making product cheap could address lower end of value system.
Tech.Capability	Rare	Startup in digital should stay under radar of large company. It should develop product that large company is not willing to copy. Business model of startup that priced very low, competitor would not copy because it was not worth to do it.
Mkt. Capability	Dominant design	Business angel wanted to invest in new things with hope that someday it could become enormous
Mkt. Capability	Complimentary Asset	Digital is co-specialized asset which have to be mutually developed with non-digital product.
Mkt. Capability	Know-how protection	If the product was cheap, there is no need to protect competitor from copying because it

		was not worth it.
Mkt. Capability	Sensing market direction	Startup in digital should stay under radar of large company.
Mkt. Capability	Develop new customers	Develop new market under radar-low value system.
Ent. Capability	Skills in exploit new opportunities	Startup in digital should find Blue Ocean which found the job-to-be done in the value system by developing new way to solve problem.
Option	Growth Option	Startup should smell where the growth of market is and be flexible enough to adapt when situation change.
Innovation	Disruptive Innovation	Only invest in disruptive innovation
Innovation	Low-End Innovation	Business model of startup that price very low, competitor will not copy. Stay under radar of large company. Startup could do the job cheaper by Blue Ocean, doing in different ways than others.
Modular	Internal Flexibility	Startup should smell where the growth of market is and be flexible enough to adapt when situation change.

Category	Category	4
Name		Mr. Douglas Abrams
Date		14-Sep-11
Company		Expara
Model		1 TC&RO
Investment	Profile	Incubator, Early-stage Fund
Investment	Background	Expara is early stage venture capital invested in startup companies, operating same way like Early-stage venture fund or Innosight Venture.
Criteria	Criteria	Expara is an early-stage VC which raised fund from investor before investing in firm. He invested in two stages, first stage at lower amount and second stage at higher, for example first stage may be 5M.Bht and follow worth second stage at 10M.Bht. But different investors invested in different round. Different proportion is for first and second investments and they are valued differently according to risk. From his experience, sophisticate angel (smart angel) look at fact of business as decision criteria. They are willing to invest in product development phase. They invest in two stages.
Criteria	Timing	He invested in early stage of product development. But with the risk of product development, he split investment in two stage, development and commercialization. Each industry had different criteria to decide where would be the cut off or gate to decide for go or no go for follow on investment.

Criteria	Staging investment	He split project in two phases. The first phase of development product will have option to follow on second phase if market is good and not exercise option if market is not good. Critical stages that he would focus decision go/no-go were as follow.1.Technology risk: Can it develop working product? 2.Scalable Risk: Can its manufacturing capability develop commercial product?3. Financing risk: Can it get financing to fund itself to reach commercial scale? If not, it needs 2nd funding tranche. 4. Marketing risk: Can market demand be materialize? Does it miscalculate customer pain? 5.Competition risk: Can someone do it better than us?
Criteria	Exit preference	From investment in early-stage or startup, he aimed to exit by tradesale 80% and 20% by IPO. If unable to scale or grow as planned, they would sell to someone else at 2 times or 6 times capital gain. The method of sell could be sell equity, know-how, license, or management team, or for strategic reason.
Evaluation	Security	If first round of investment turned out bad, second round would be lower than plan or even cancelled. If first round proved technology and market were good, second round may be higher in order to accelerate faster growth. They prefer to put more on winner and exit on lose. No option for more money if you spent it all. He used scenarios to see various type of risks and used discount at 80% for worst case scenario.
Valuation	Finance Valuation	He used financial tools such as NPV, IRR and developing in different scenario and discount 50%.
Valuation	Real Option Valuation	In R&D of drug industry, real option valuation is very useful. However, people did not use real option in IT industry because process of development was clear or need to be different and be quick to establish in the market. So there is not much time to think about option or act in contingency.

Mkt. Capability	Dominant design	He believed market timing was important, not to invest to early when no acceptance or dominant design emerge or not too late in the lifecycle. The first stage investment helped to judge whether the entry was too late or too early. If it turned out to be early, he might still invest. However, if it turned out to be too late, no follow on investment and exit because too many competition.
Mkt. Capability	Sensing market direction	He believed if entrepreneur look at customer pain (MARKET), not focus too much on performance of product (TECHNOLOGY), they could create disruptive innovation.
Ent. Capability	Skills in exploit new opportunities	He believed if entrepreneur look at customer pain (MARKET), not focus too much on performance of product (TECHNOLOGY), they could create disruptive innovation.
Option	Growth Option	He used various scenarios to predict what future would be. But he uses discount rate at 80% on future risk.
Option	Technology Option	He used option thinking in technology development that if in the first phase technology development turned out good, he would invest more to accelerate investment. But if technology turned out bad, no expansion and no second phase investment.
Option	Market Option	There is option thinking about marketing too. There may be more investment in second phase if the outcome was bad from wrong marketing strategy or wrong execution. But there would be no option to invest second phase if over estimating demand / market size or timing was not good (MARKET OPTION).
Innovation	Disruptive Innovation	He believed investment in disruptive innovation could create potential growth, but difficult to judge which one is really a disruptive. He believed if entrepreneur look at customer pain (MARKET), not focus too much on performance of product (TECHNOLOGY), they could create disruptive innovation.

Category	Category	5
Name		Mr. Kamarol Rahmana
Date		16-Sep-11
Company		UKMT Tech Transfer Company
Model		1 TC&RO
Investment	Profile	Incubator, Early-stage Fund
Investment	Background	Mr. Kamarol used to work as venture capital section of commercial bank before. Now he worked at technology transfer company for UKMT to invest in pre-commercialization startup. He had been using real option just one and a half year.
Criteria	Criteria	If business angel was from food industry, they would invest in food industry in earlier stage.
Criteria	Timing	He incubated and invested in product development stage.
Criteria	Exit preference	He needed to talk to potential investor while doing due diligence to find their preference and check for consistency.
Evaluation	Target Return	Target rate of return for UKMT is 20% IRR per year in general, but varies among industry.

Valuation	Real Option Valuation	He found that it would be useful to make real option valuation easier to use, match or reconcile with NPV which already accepted by investor.Need to simply the tools in order to promote strategic tool that could identify which research should be exploited into innovation.Business angel should understand risk, option they could use, and flexibility that might help mitigate risk. Business angel should use real option concept as discipline structure, as guideline for making decision.Entrepreneur should use real option in their NPD process and able to communicate strategy and flexibility with investors.He used real option to value the startup that are in pre-commercialization stage including with State-Gate to monitor which way the technology and market would turn to be. He believed real option valuation is proper to early stage company. He used real option to add as premium to traditional financial value such as NPV.He believed real option is useful tool to value the startup that are in pre-commercialization stage including with State-Gate to monitor which way the technology and market would turn to be.He needed to talk to potential investor about their interest, in case of exit in future.
Tech.Capability	Rare	There were many IP in university. He found that from 500 IPs there were about 33 IPs that has potential for commercialization.
Ent. Capability	Skills in technology and marketing	He needed to evaluate (due diligence) - management team: can they carry out the work? - technology: need 3rd party to verify technology. - marketing: need to conduct market survey
Option	Market Option	Market option helped to mitigate risk. He needed to conduct market survey to find market gap and meet market player to predict what would happen in next 2 years. Real option for market flexibility could help along the way by delay or change strategy according to change in market.

Category	Category	6
Name		Dr. Jay Jootar
Date		16-Sep-11
Company		Venture Catalyst
Model		1 TC&RO
Investment	Profile	Entrepreneur, Venture Capital, Business Angel, Incubator
Investment	Background	Dr.Jay started new companies to produce software for telecom companies in Thailand which was an innovation initiated by customer. He also started another company to do smart device which was an innovation initiated by supplier. Software developments are mostly disruptive innovation.
Tech.Capability	Valuable	Technology skill is enough to work since secondary school.
Ent. Capability	Skills in exploit new opportunities	Entrepreneurship should be taught in university for technology based student to help them leverage technical knowledge to go beyond made to order, product new product with high quality, production that scalable, and product base that expandable (MODULAR, EXPONENTIAL GROWTH)
Option	Growth Option	In Thailand, businesses that have high scalability are retail business and international export.
Option	Market Option	Both retail business and international export also have various market options to scale geographically large.
Option	Ent. Option	Entrepreneur could help to consider various options to enter both uncertain technology and market which the change could be done on employee side or customer side.
Innovation	Disruptive Innovation	He believed software developments are mostly disruptive innovation.
Innovation	New-Market Innovation	Dr.Jay helped large corporation to spin off new company and initiate concept of using existing wireless router to become meshed network.

Innovation	Low-End Innovation	Phython is software development tool that could be disruptive innovation by itself due to new way to do thing effectively. However, such tool could help programmer to create software smaller and cheaper which could become low-end disruptive innovation.
Support	Startup education	Technology skill is enough to work since secondary school. As a result, university should teach entrepreneurship on top for technology based student.
Support	Startup mentoring	When entrepreneur trained their staff to be more entrepreneurial, some would leave to start their own business, becoming entrepreneur. A good boss would encourage them to leave. And a good boss would help him by becoming business angel to invest in newly startup firm of their employee.
Support	Business angel institution	1. Business angel may come from people who used to be entrepreneur, had earned wealth in form of financial gain from starting up business and desired to invest such wealth in creating more wealth from the same manner. 2. Business angel may be potential client of such startup because they are the one who benefit from the use of product from startup. 3. Business angel may be supplier of such startup because they wanted to diversity to get closer to customer in supply chain in order to get growth option.

Category	Category	7
Name		Mr. Sopon Boonyarataphan
Date		28-Sep-11
Company		VNET Capital, Thai VC Association
Model		1 TC&RO
Investment	Profile	Incubator, Venture Capital
Investment	Background	Venture capital invested in the company to help business expand. Relationship, networking or referring by credible people help the deal done easily.
Criteria	Criteria	VC evaluation process is the start of setting rules to live together with new firm. Each side has to adapt to each other. The decision making has to be done together between entrepreneur and VC. Both sides has to communicate with openness. Each side has to adapt to rely less on emotion and making long-term relationship. VC evaluated investment by business plan and ability to perform according to plan. Ability to perform according to plan depended on 1.Entrepreneur quality. VC looked at entrepreneur before business (E>T/M). 2.Experienced in related field. 3.Ability to execute plan. VC needed to make sure when they invested they could exit.
Criteria	Timing	Venture capitalist did not invest in just research. VC invested in firm that already had product in commercialization, in stage of startup or pre-commercialization phase. VC invested in growth phase.
Criteria	Exit preference	VC aimed to exit in IPO- 80% and by trade sale 20% which VC would sell to industry as trade sale the same time it sell to private placement, before entering IPO.

Evaluation	Propensity to invest	VC looked for quality of trustworthiness, transparency and honesty in entrepreneur. (TRUSTWORTHINESS, TRANSPARANCEY, HONESTY) VC looked at quality of entrepreneur by reference check their credibility from trusted sources, such as customer, previous boss, friends and network. (CREDIBILITY)
Evaluation	Growth Potential	Market acceptance of new product is more important than level of innovation. Niche market is not growing fast enough for VC.
Evaluation	Target Return	VC expected target return on investment in infant firm (started for 1 year) at 100% or about 16 time of capital gain from 5-year investment.VC expected target return on investment in young firm (started less than 5 year) at 50% or about 7.5 time of capital gain from 5-year investment.
Evaluation	Security	From his VC experience in Thailand, he predicted that from 30 deals he invested only 3 deal or 10% would be star, 10% would be just good, 40% become lost, and 40% not know what would turn to.
Mkt. Capability	Sensing market direction	Market acceptance of new product is more important than level of technology or innovation (MARKET>TECHNOLOGY). VC looked for growing market or large size of international market. Selling to Thai market was too small. Most VC invested in 1. Export business 2. Retail business, dealing with mass customer.
Mkt. Capability	Develop new customers	Ability of entrepreneur to see opportunity or predict future, especially profitable with new market is very important. He believed such ability was from vast and diverse experience of entrepreneur.
Ent. Capability	Skills in technology and marketing	VC needed to confirm that entrepreneur had related experience.

Ent. Capability	Skills in exploit new opportunities	VC looked at entrepreneur capability when presenting plans to evaluate ability to sell and manage firm. VC looked for ability to predict future, foresight in domestic, customer segmentation, trend changing. He gave example of condominium business that expanded because of change in domestic, trends, communication. He believed ability to see opportunity/predict future/predict new market was from vast and diverse experience of entrepreneur. Success of the business is from ability to look far into future.
Option	Growth Option	VC did not consider value for upside beyond predicted in the plan. VC invested in stages. First stage to evaluate technology, market, and entrepreneur. If market is as planned, VC will invest 2nd stage. If market turn out well more than plan, there is no change in plan or additional valuation surplus. But if market did not go well, VC might advise entrepreneur to change plan and valuation would reduce. There would be no 2nd phase investment.
Option	Technology Option	To create value from flexibility, firm had to pre-plan ahead in developing technology. Because some change in production could not be reverse.
Option	Market Option	Some marketing execution could be changed if implemented in wrong segment through changing of advertising campaign. However, if enter to market too early, there is no option to change.
Option	Ent. Option	Flexibility is capability of entrepreneur to cope with change.
Innovation	Radical Innovation	Some innovation came too early. He gave example of Black Building Group which started the very first fast food chain in Thailand but did not success. He mentioned e-commerce which came too early and did not grow because lack of infrastructure of cheap internet.
Innovation	New-Market Innovation	Ability of entrepreneur to see opportunity or predict future, especially profitable with new market is very important. He believed such ability was from vast and diverse experience of entrepreneur.

| Support | Startup market for investment | He said in US, the alternative market (like MAI in Thailand) had become accepted asset class that institutional investor who manage investment for clients could invest. But in Thailand there was not enough statistics to predict expected return and enough liquidity to ensure with institutional investors. Therefore, the creation of more market for small company like SME market should help created broader formal market for startup to obtain funding. |

Category	Category	8
Name		Dr. Nil B.Vogt
Date		09-Jan-12
Model		2. DI+MODULAR & RO+SP/A
Investment	Profile	Researcher, Management, Entrepreneur, Early-stage Fund
Investment	Background	He used to teach entrepreneurship at University of Burgen, CEO of listed nutraceutical company, and management of startup fund in Norway.
Criteria	Criteria	He believed modular concept is very helpful for startup, such as reducing cost. He experience modular concept in nutraceutical industry, in addition to computer industry where modular concept was initiated. Modular could be in product structure, operations, or investment.
Criteria	Timing	Staging of investment depends on staging of product development critical milestone that defined in each industry differently. In electronic industry it could be working product or prototype, while in nutraceutical is finding the active ingredient.
Evaluation	Growth Potential	Modularity could help to increase probability that startup to become blockbuster by reducing cost, improve features to satisfy customer in new market, create multifunction product to attract broader market.
Evaluation	Target Return	From his experience, he believed investors did not aware of effect of modularity on investment and return on investment.
Evaluation	Security	Modularity could help to increase probability that startup have more chance to survive if modularity is external allowing to connect with outside complimentary product.
Modular	Internal Flexibility	He believed modular concept is very helpful for startup, such as reducing cost. He experience modular concept in chemical industry, in addition to computer industry where modular concept was initiated. Modular for internal of startup could be in product structure, operations, or investment.
Modular	External Platform	Modularity could be external which allow our product to connect with other peripheral easily.

Category	Category	9
Name		Mr. Troy Henikoff
Date		24-Apr-12
Company		Excelerate Labs
Model		2. DI+MODULAR & RO+SP/A
Investment	Profile	Incubator, Early-stage Fund
Investment	Background	He invested his seed money in more than 15 companies. He set up Excelerate Labs to be incubator and startup fund dedicate for startups with helps from individual investors and VC in Chicago area.
Criteria	Criteria	His incubator was strong in providing network of mentors and investors. Incubation: During 3 months incubation, mentor and potential business angels in each functional area and industry would come to meet entrepreneur to give advice. Demo day. Startup need to present his idea, business plan, key metric on stage for 500 investor's network. Investors would comment and advice on problem areas that entrepreneur should focus on and help shape into real potential startup. After demo day, potential business angel may actually invest because they saw development of startup from day 1. In order to make entrepreneur create new product in 3 months, he had to focus on startup that develop new software.
Evaluation	Growth Potential	It implied that startup was valued approx. $416,000. He expected valuation of company should increase at least 2 times with his help. Typical industry people believe his help should increase value of startup by 10 times.

Valuation	Finance Valuation	He did not believe DCF for startup was correct, especially startup in internet, social network.He did not value startup but he provided service to improve value after the incubation. Any startup that was selected to be in Excelerate Labs, the fund will invest US$25,000 in exchange for 6% equity. Incubator also provided free service of office, website, marketing, and mentorship.
Support	Startup mentoring	The mentorship in his model is important to help groom young entrepreneur into the world. He explained learning in 4 types. 1. Lean from book: How to read financial statement. 2. Lean from others: How he worked at problem? 3. Learn by doing: Presentation skill 4. Cannot learn: Thing that you cannot change in yourself, your attitude, your appetite to risk. He selected startup with good experience, good education and attitude to join incubator. Then he tried to improve by mentorship-learning from others and learning by doing-presentation during 3 months.
Support	Business angel institution	His incubator is not-for-profit organization that aims to help Chicago become great. He did not get paid for running incubator. All facility was donated from entrepreneurs in related field. He set a tiny startup fund by obtaining money contribution from 30 individuals and VC 500,000/year who commit to put money in and put time to mentor startup. 50% went into startup company US$25,000 each startup in exchange the fund got 6% equity and 50% was for operations expense of the incubator facility. He managed to get couple successful startup sold to larger company. The gain from the sale was put back to the fund.

Category	Category	10
Name		Mr. Bunprasit Tangchaisuk
Date		09-May-12
Company		Application Hosting
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Entrepreneur, Business Angel Fund
Investment	Background	He helped start angel fund for close group in IT business.
Criteria	Criteria	Investor did not consider financial statement much. They looked at reputation of entrepreneur.
Criteria	Staging investment	Staging is a method to reduce risk of loss for seed investor. Setting milestone to verify business and decide go/no-go help set formal evaluation of business startup, reduce bias of both entrepreneur and investors.
Evaluation	Propensity to invest	Between entrepreneur and business angel there was no standard deal that people accepted widely. In Asian culture, like China in the old day, they set moral code for young people to raise themselves, help the one who in need, and give back to the people used to help you. He gave example about when he met business angel asking for funding. He was introduced by his previous boss to the investor that the entrepreneur was a trustworthy person, who knew best in software development, and his boss guaranteed that he was a person with gratitude. That was how he got funding committed 10 MBaht with just business plan.
Evaluation	Security	Risk of loss or probability of security of startup could be mitigated by phasing project
Evaluation	Affordable Loss	Affordable loss depends on entrepreneur and project. Key to obtain funding from business angel was how to make affordable loss in the mind of business angel, which they expect to lose, become unlikely to lose. (MANAGE EXPECTATION ABOUT LOSS) If business angel believed entrepreneur is a gratitude person, which he believed entrepreneur would appreciate his kindness in providing investment and return or attempt to return business

		angel in future someway or somehow, the level of affordable loss would be higher and propensity that business angel to invest would be higher. Business angel who provide investment to startup would not consider much when investment amount requested for small amount like just 10%.
Evaluation	Indirect Return	Business angel looked for indirect return such as benefit to existing portfolio more than monetary return
Evaluation	Non-monetary	Business angel looked for non-monetary return such as excitement in participation at startup more than monetary return.
Ent. Capability	Enhance Potential Return	Entrepreneur was a gratitude person would try to do every way he could to make use of money obtained from business angel.
Ent. Capability	Enhance Security	Entrepreneur was a trustworthy person would be honest and true in doing business in care of safety of capital invested by business angel and survival of company.
Modular	Internal Flexibility	Modularity is close to phasing in the view that it could help reduce risk of project.
Support	Business angel institution	The lack of standard and formal institution between business angel and entrepreneur case mismatch of expectation between giver and taker. There should be an institution or society that set standard, Code of practices and ethics, giving certificate to investors, incubator, or training entrepreneur, the same way as CPA or CFA society. So they could understand what to do and what to expect from shareholder.

Category	Category	11
Name		Mr. Chanitr Charnchainarong
Date		11-May-12
Company		MAI
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Venture Capital, Regulator
Investment	Background	He was working as VNET, venture capital firm, looking after technology sector because he used to work at Seagate Technology.
Criteria	Criteria	When he was in VC industry, he evaluated startup with 3E: Exclusive-Technology had to be exclusive, Exponential-Market had to be exponential growth, and Execution-Entrepreneur had to be capable of deliver as plan. If no exclusivity in technology, market is unlikely to be exponential growth. So investor had to look for execution or capability of entrepreneur.
Criteria	Staging investment	Investment in stage one is an option to follow on in the next stage whether the business would be interesting enough for second stage or not.
Ent. Capability	Skills in technology and marketing	Investor had to look for execution ability of entrepreneur in compensation with lack of exclusivity in technology and exponential growth of market.
Option	Growth Option	Every investment decision is embedded with option, but less people aware of it.
Support	Business angel institution	He believed it was difficult to set formal institution from policy level top down due to culture of Thai people. Promoting tax incentive for investment in startup like in UK would be difficult due to concern from Revenue Department. We should leave to free market to decide. Now MAI, MAI Association and Bangkok University are in cooperation to incubate startup or SME to become listed company in MAI. If innovation is good, large corporation will do it and with greater magnitude of result than small business.

Category	Category	12
Name		Mr. Jrarat Pingclasai
Date		17-May-12
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Entrepreneur, Business Angel
Investment	Background	He invested in various IT businesses and linked startup with large company in industry for possible trade sale.
Criteria	Criteria	He invested in portfolio with combination of short term gain, long term gain, and very long term investment as heritage for his kids. He separated his investments in three categories. 1. ICT business: He understood the business, could invest majority 80-90%, planned to invest long term to give as heritage to son. (ASPIRATION) 2. Infrastructure: He invested in cement logistics with long-term contract. He believed there was low chance that he could lose money from this business. (SECURITY) 3. TV: He invested 25% in VERY TV with option to increase up to 40%. He invested for fun and expect it to grow and not likely to lose money. (POTENTIAL) He gave high valuation to startup that could enter in stock market as it could raise fund easily in order to fuel growth from new investment.
Criteria	Exit preference	Exit option has value when it is possible to exit in IPO. Value from exit option could compensate for low return from low growth and low risk business.
Evaluation	Target Return	He did not set target return or probability to achieve it formally. He could estimate and compare it from his experience if such startup was in IT industry that he knew.
Evaluation	Security	He did not expected startup not to lose at all, just not lose more than he invested. (Affordable Loss)
Evaluation	Affordable Loss	When investment turned bad, he believed the best way was to end it, cut loss and accept loss occurred.

Option	Growth Option	He confirmed that he looked for options in his investment to mitigate risk. Growth option comes with cost. If startup could enter into IPO market, it created growth option as it could raise fund to invest in emerging business.
Support	Large corporation support finance	He said back-door listing was the same as trade sale of startup's share to larger company. However, in the case that existing company was not performing well and acquiring company performed better and with higher growth, it caused acquired company to become major shareholder of existing firm. He believed trade-sale or back door create value to existing corporation.

Category	Category	13
Name		Mr. Charatpong Chotigavanich,
Date		20-May-12
Company		Magnate Capital
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Entrepreneur, Venture Capital
Investment	Background	Worked at Magnate Capital, venture capital, investing in early stage firm. He used to be entrepreneur since studying at MIT. He joined with MIT friends to develop CRM software for pocket pc. They managed to get funding from VC in US and made company go public in 1999.
Criteria	Criteria	Market of investing in startup in Thailand was not well developed like in US, due to nature of too conservative. Therefore market for startup would not develop much, comparing to market for private equity or late-stage startup. Investors consider startup that address market that is growing and has large size, technology that possible, solid business plan, and good entrepreneur and team.
Criteria	Exit preference	In US, the market accept valuation more than PE 20 times for startup in technology, but not in Thailand. This made market for private equity or venture capital not interesting to international investors. In US, investor aimed to exit from their investment in startup 90% from IPO and at PE around 20 times.
Evaluation	Target Return	In US, investing in startup could provide return up to 70-80 times in success case.
Evaluation	Security	Investor in Thailand give weight to risk of loss more than in US.
Valuation	Finance Valuation	Startup needed to prepare business plan and financial model, which also use as negotiation basis about what price the company worth. Thai investor preferred to invest up 30%, and at par value. US investor was willing to pay premium to lock management team.

Ent. Capability	Skills in technology and marketing	He preferred startup that had team of grade A-idea of grade B, over team of grade B-idea grade A.
Option	Growth Option	Growth option is limited in Thailand because Thai market is small, low volume, difficult to scale. They looked for innovation that could scale to international market. The preferred large market size and clear benefit of new technology.
Option	Technology Option	Investor preferred startup to focus on technology that served target market only, without looking for other options that could serve other market. Investor believed that if technology could be used for other new products, it was expected to come with additional R&D cost, except technology which was flexible in itself without involving other products. Some product was developed for specific market such as VMware for Unix emulation, but now turned into cloud business. That could not counted as option value because it was not planned before since at that time no complimentary asset such as high performance hardware was available. Technology can have option value if it was set as roadmap with clear development path before.
Innovation	Disruptive Innovation	Innovation in Thailand would follow trend in US. Therefore, investing in technology innovation in Thailand is not difficult as much as in US.
Modular	Internal Flexibility	Investors would appreciate when entrepreneur told them that the new product was created from 90% out-of-the-shelf components. Creating new product from existing components reduce technical risk, market risk of complimentary component, increasing return.

Modular	External Platform	If technology is developed to become platform that allow other technology product to build on top, need to look at user based and address specific niche market. For example, Mac OS addressed graphic market or IPhones for game market. Creating platform needed to create sample software or out-of-the-box which let developer see example of what they could further develop it. Platform must focus on how to increase user to level of critical mass that create network effect, which after such level the market would grow by itself.

Category	Category	14
Name		Mr. Dej Bulsuk
Date		21-May-12
Company		McDonalds Thailand
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Entrepreneur, Business Angel
Investment	Background	After brought McDonalds into Thailand and exit the investment, Mr. Dej helped consulting large corporation and new startup companies, especially in retail business and marketing.
Criteria	Criteria	He focused on integrity of entrepreneur more than business plan or technology.
Evaluation	Propensity to invest	Integrity is number one quality for entrepreneur. Moral quotient: Sense of urgency, Self-creation Adversity quotient: Ability to adapt to different scenario which build and collect from experience. Entrepreneurs who care for other people and not willing to hurt others feeling by their acts or their words have more chance to get any deal done in win-win situation. Doing good deeds help create confidence. He saw analogy between doing good deeds and wearing underwear. It gives confidence when you do it. You lack confident when you do not do it. And doing good deeds will be valuable to your contentment most when you keep it to yourself, without showing to others.
Evaluation	Target Return	He focused on how to balance affordable loss and growth in startup.
Evaluation	Security	Key to success in work, life and family is on how to balance expectation. Managing expectation of counter party when events turn up and down would help long term relationship which is more important than short term loss or gain.

Evaluation	Affordable Loss	He believed that integrity of entrepreneur help increase level of affordable loss when considering invest in startup. Quality of entrepreneur could help increase affordable loss. Entrepreneur could help focus on how to manage startup in the way that investor would not lose capital, investor would not lose profit if success and investor would not lose reputation if invested in entrepreneur.
Ent. Capability	Skills in exploit new opportunities	Adversity is similar to creativity and common sense. Aor-Chor-Ror-Tor (in Thai word อ-ช-ร-ท) Aor: DesireChor: Confident Ror: Self creationTor: Attitude (turn weak point into strong point)Ability to differentiate is key for innovation.
Innovation	Differentiation	Ability to differentiate is key for innovation. He mentioned McDonalds business model that changed practices of food business, by collecting cash before deliver food, made to order with few inventory.

Category	Category	15
Name		Mr. Naritsomjarern Sumpaopol
Date		24-May-12
Company		TOT Innovation Institute
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Researcher, Management, Business Angel
Investment	Background	He is a researcher, managing IP at TOT Innovation Institute. When his staff resigned for starting business, he became business angel.
Criteria	Criteria	He considered investing at entrepreneur who had strong determination, quality, capital needed and marketing strategy.
Criteria	Staging	He believed startup should stage in two phases, first do what it could do best in order to survive. (SECURITY), second to select either innovation at core or modular, the third to expand upstream or downstream. (POTENTIAL)
Evaluation	Propensity to invest	Credibility of entrepreneur that made him investing in startup.
Evaluation	Security	He would jointly consider the plan of entrepreneur to consider risk and try to reduce risk in technology, market, competition, tax, raw material. Risk of loss also caused by people. If entrepreneur has high trustworthy, he expected not to lose much, or risk of loss is low.
Evaluation	Affordable Loss	He invested in startup considering affordable loss in relation to credit of entrepreneur. When entrepreneur asked for funding, if he believed objective not clear or high competition, he would back away and might invest only 20% of what asked.
Option	Growth Option	He gave value to option that create security and survival more than growth option. Survival is first, then grow comes second.
Option	Technology Option	Investment in technology must be planned to serve many functions and long into the future. Then select middle technology that could cover current application at low cost and have option to go up market in future in modular way.

Option	Ent. Option	Even there are many opportunity, he would chose the one that is most secure and match with cash flow. He preferred startup to go step by step and move only when ready.
Innovation	Disruptive Innovation	He did not concern about innovation type. He believed innovation type should match with what entrepreneur really know and not rely on others.

Category	Category	16
Name		Mr. Kungval Kusoltammaratana
Date		25-May-12
Company		IRPC
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Entrepreneur, Corporate Business Angel
Investment	Background	His staff had completed the project and there was no more work to support. So the teams spun off to start their own company. He supported by bringing in more projects and helped get credit with supplier.
Criteria	Criteria	He would invest in startup that had experienced team, had pipeline in market, helped reduce time to develop, and trustworthy and sincere team. He would invested in technology that could create recurring income. (SECURITY) (SUSTAINABILITY),
Criteria	Staging	He preferred to start and survive already, then pursue growth business.
Evaluation	Propensity to invest	He would consider to invest in startup that entrepreneur is honest and high determination. Team must jointly share investment, cost and success. Along the way, return should be distributed fairly and reduce risk gradually. There should be meeting point to evaluate outcome and decide go/no go.
Evaluation	Security	He would study customer, market in order to reduce risk of loss. He would find partners that have high virtue and honest.
Mkt. Capability	linking customer with distribution channel	Startup need to study market and close to customer. Startup need to get recurring income from customer.
Ent. Capability	Enhance Security	He would like entrepreneur and its customer to have high integrity and honesty.
Option	Growth Option	He preferred startup to survive first, then develop growth option or modular structure.
Option	Technology Option	Startup need to develop technology together with partner. It could have option to outsource to focus on its core.
Option	Ent. Option	Startup should reduce risk of technology and market little by little.

Category	Category	17
Name		Ms. Wanee Theinthanoo,
Date		27-May-12
Company		Trisara
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Management, Business Angel
Investment	Background	She invested in her friend's startup HR software development. She invested in initial rounds, but not follow-on later stages.
Criteria	Criteria	She invested in entrepreneur who started the business that really matched with their capability and character.
Evaluation	Growth Potential	She believed that everyone need to use software and market could grow in future.
Evaluation	Target Return	She did not expect much return, around 10% was enough for startup business in the short term. She understood that it took time for new company to earn money. She expected new business to be stable when reach 10 years. She believed profit could be made higher depending on entrepreneur to create.
Evaluation	Security	Highest risk in project was the cash flow risk during R&D.

Evaluation	Affordable Loss	For normal startup that she could find historical data to estimate return, she would adjust her affordable loss for high return. She expected to have high propensity to invest. 1.Experiences of entrepreneur in same field.2.Technology that is flexible3.Market that is broad.But for startup with new technology or new market that she could not find enough financial information to estimate return, her investment criteria would depend solely on Entrepreneur. She would invest only 5-10% of her affordable loss.She related her affordable loss on investment in startup depended on her1. Current wealth2. Ability to Earn from Current Job. At that time she invested, she did not afraid about loss because she was still young and could earn money to cover such loss.
Evaluation	Indirect Return	She believed other investors who had excess cash would look for not only financial return, but indirect return such as benefit to their portfolio business.
Valuation	Finance Valuation	She did not value formally on her investment but she believed in potential of business.
Tech.Capability	Valuable	In software development, technology is key that startup had to develop first, then market activities later.
Tech.Capability	Recurring Income	Cost of software development was huge in the beginning, comparing to hotel business. After all investment was made, it provided very long earning period.
Ent. Capability	Skills in exploit new opportunities	Ability of entrepreneur to create, think out of the box.
Option	Growth Option	She would consider growth option after thinking about1. Affordable loss for initial investment that is a must and unavoidable.2. Survive: Startup need to use that initial investment from affordable loss wisely and carefully to create technology and sell to market as fast as possible in order to create profit to support on-going business.3. Growth option: depending on level of earned profit, customer base, future expansion with current customer.

Option	Technology Option	She would prefer choice that could made technology standardized which she expected to manage to get technology cost down.
Option	Market Option	In software development, there was not much profit from selling software or selling customized work. But profit came in second year from maintenance service.
Innovation	Differentiation	When technology was standard and modular, it allowed customization and reconfiguration to match with customer need easier and cheaper.
Modular	Internal Flexibility	She would preferred choice that could made technology in standardized and modular which she expected to manage to develop new features on top of existing feature easier. When technology is standard (CORE) and modular (COMPONENT), the cost to customize would reduce and market would be broader.
Modular	Internal Flexibility	When technology was developed in standard and module could add on. During maintenance period, there is also possibility for upgrade if startup performed well with customer.

Category	Category	18
Name		Mr. Krisd Aksornwong,
Date		28-May-12
Company		DIGIPON
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Entrepreneur, Business Angel Fund
Investment	Background	He started his software company and obtained funding from business angel to support his business plan. He met about 60 business angels during 5 years for his own startup and arranging for other startups.
Criteria	Criteria	Most of business angel he met had no formal predefined financial goal. They wanted to participate in business creation. They did not require startup to grow too fast. Range of % shareholding varied depended to angel's aspiration. Some wanted control and participate in management as number 2 person. They preferred to engage in customer visit, to see participate and see development of entrepreneur each stage to increase their confidence before/after investment. BA did not use financial information to do due diligence, but the compensate risk by close monitoring operations in details. BA value entrepreneur capability more than technology or market. BA had very close relationship more than VC.
Criteria	Timing	Some BA invested in just business plan, if proposed by entrepreneur with good credential. However, for software business, investors preferred to see beta product, because it was easy to develop.
Criteria	Staging investment	Most business angels in software business did not stage investment because investment was small amount.

Criteria	Exit preference	They did not looked for IPO, but look for buyout (trade sale) as exit route. Only 1-2 from 10 wanted IPO.
Evaluation	% Achieve Target Return	Some angels invested when he expected probability of success only 50%, but some need to make sure 100% success before invest. Some did not concern about probability of success, just effort by entrepreneur to show determination to do business was also enough.
Evaluation	Affordable Loss	Business angels expected failure, but they could afford to lose. Investments in US$100-200K are in range that business angel could afford to lose. Another reason that business angel from foreign country could invest in startup in Thailand because they invested in very small scale of their money comparing to size of business in Thailand. Size of affordable loss also depend on business model of startup whether entrepreneur could mitigate risk down in what way or business model to earn money.
Valuation	Finance Valuation	Angels in western gave value to IP. They preferred technology that could be commercialized to broad market.
Option	Growth Option	Growth option was considering in choosing core business or technology during feasibility study plan, but when on implementation, they would focus on only one technology first.
Innovation	Disruptive Innovation	80% of investor preferred new things or innovation, really new IT concept, but start small first. But 20% did not concern.
Innovation	New-Market Innovation	They believed in creating new market by starting small first.
Innovation	Low-End Innovation	He believed in creating low-end innovation to attack mass customer. He saw example in simple and very easy to use allow your product to enter into market broader, then use modular concept to add on features.
Modular	Internal Flexibility	In order to create innovation, modularity help create new things faster. However, it was more convenient in software to create modular than in hardware business.

Modular	External Platform	He preferred software that developed platform to attract many users and create network effect. Startup that has users in their platform has some value to large company which they may want to buy the startup to obtain user base.

Category	Category	19
Name		Mr.Somchai Sittichaisrichart,
Date		30-May-12
Company		SIS Distribution Thailand PCL.
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Entrepreneur, Corporate Business Angel
Investment	Background	He started up one of the largest IT distributor in Thailand. He invested in two IT startups through his company. He said he could not invest personally because it would be conflict of interest with his position in listed company.
Criteria	Criteria	He would invest in startup that 1. Related business that he did not want to do himself or no skill to do it; 2. Contribution: Business, financial, channel. He could contribute opportunity, capital or retail channel. In this way, his investment in startup could be more success, less risk, solve his internal problem; 3. People: Credible, capability, comfortable to work with. 4. Industry: ICT/Mobile industry or Retail which is his downstream customer 5. Low investment
Criteria	Staging investment	He invested one time, no staging, because the investment is small amount.
Evaluation	Target Return	He did not set financial target for startup, not even ROE.
Evaluation	% Achieve Target Return	He believed if large company help startup in the same business as partner to help give opportunity, it should increase chance of success.
Evaluation	Security	He believed if large company help startup in the same business as partner it should reduce risk of loss, increase chance of survival.

Evaluation	Affordable Loss	He looked at affordable loss as risk the need to accept in order to generate growth from investment in startup. Normally, he set about 50% of profit reserved for affordable loss for reinvestment in growth business.
Evaluation	Indirect Return	He expected investment in startup should help diversify competition risk in technology.
Ent. Capability	Skills in technology and marketing	Startup that request outside funding should be very experienced in that field.
Option	Technology Option	Startup should have backup plan in case their business did not become as plan. Considering various option in technology in advance help to mitigate risk.
Option	Ent. Option	But some changes of technology and marketing that required changing in staff's capability may not be possible or carried out very fast. To be able to prepare staff for change, need to move in to new technology or market step-by-step.
Innovation	Disruptive Innovation	He did not focus on type of innovation. Any business that has growth potential would satisfy his investment criteria.
Modular	Internal Flexibility	He did not consider modular structure of product as key issue to affect investment risk/return.
Support	Large corporation support technology	He could help the startup in related business by bundling new software of startup together with hardware he was selling.

Support	Large corporation support finance	He was willing to fund young company through large listed company, but due to integrity and duty to shareholder, he had to restricted to only related business. The bad pitfall of listed company in startup was on accounting. It need to consolidate every quarter, while accounting system of startup was not up to standard. If investment was at loss, the management needed to explain. He believed if listed company diverted some of CSR fund that did not have clear measurement of effectiveness to the development of startup that focus on social benefit. This CSR money is already set as affordable loss. If CSR fund was directed for social startup, it helped listed company, startup, and society in the same time.
Support	Large corporation support incubating	He was willing to incubating young company through large listed company, but due to integrity and duty to shareholder, he had to restricted to only related business.
Support	Business angel institution	He was willing to support institution for business angel. If it was not related business, he could not contribute funding or business publicly when he is responsible as management or director of listed company. But he when he retired and remain as shareholder, he could help being mentor, incubator, or investor to young startup firms. There is a need for common frameworkClear role: Mentor, Incubator, Investor, and Entrepreneur.Rules that is fair for each party to promote contribution.Compensation to investor may increase if startup success.Example of compensation and contribution-Mentor: contribute time, get 1% equity-Investor: 100,000Baht for 5% equity-Mentor + Investor for 8% equity.For the terms that some party or entrepreneur believed unfair to them, middleman or intermediary agent, should come and solve it. It should leave investor clean from bad reputation.For the terms that some party or entrepreneur accepted as fair, try to find way to motivate people to contribute more on top.

Category	Category	20
Name		Dr. Bhusana Premanoch
Date		01-Jun-12
Company		ISEP
Model		3. DI+MODULAR+RO+SP/A+AL
Investment	Profile	Management, Researcher, Business Angel
Investment	Background	He was a success top management of listed company. He involved in startup company at Imperial College in UK. He invested in startup in ICT.
Criteria	Criteria	His criteria of investment are 1.Technology: R&D is strong in benefit (EXCLUSIVITY), related to commercial application (COMMERCIAL) and compliment with existing platform (MODULAR) 2. Market: Broad or growing 3. Experience: Management that had experience in startup and listed in exchange. Industry: ICT-He preferred investment in ICT -Easy to commercialize, low barrier to commercialize - Many success stories - Startup in software can build on top of existing platform, free or open sources.(MODULAR) Bioenergy: He would not prefer to invest - Risk in process: There are many unknown factor - Risk in government policy: Hard to mitigate.
Valuation	Finance Valuation	He believed there was no perfect valuation model for general business because each industry is different. There was no value during research which no output was known to judge benefit. At this stage, value is derived from experience of people in R&D, Sales, Listing experience.

APPENDIX F CONTENT ANALYSIS FINAL MODEL (MODEL 3)

Model 3-Relationships of parameters about capabilities

Technology capability of startup preferred by investors-Final model

Model 3: Techonlogy Capability	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Various application	7	1	0	6	0	0	0	5	1	0	0	1
Ability to transform R&D in t	4	0	0	2	2	0	0	1	0	0	0	3
Recurring income	4	2	0	2	0	0	0	2	0	2	0	0
Non-substitutable	3	0	0	1	2	0	0	1	0	0	0	2
Reducing cost	3	2	0	1	0	0	0	1	0	0	2	0
Rare	1	0	0	0	1	0	0	0	0	0	0	1
Technology Capability	0	0	0	0	0	0	0	0	0	0	0	0
Imperfectly Imitable	0	0	0	0	0	0	0	0	0	0	0	0
Technology life cycle	0	0	0	0	0	0	0	0	0	0	0	0
Technology skill	0	0	0	0	0	0	0	0	0	0	0	0
Valuable	0	0	0	0	0	0	0	0	0	0	0	0
Model 3: Techonlogy Capability	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	7	2	0	6	2	0	0	5	1	2	2	3
	Various application	Recurring income	N/A	Various application	Ability to transform R&D in to product	N/A	N/A	Various application	Various application	Recurring income	Reducing cost	Ability to transform R&D in to product

Model 3: Technology capabilities that preferred by investors
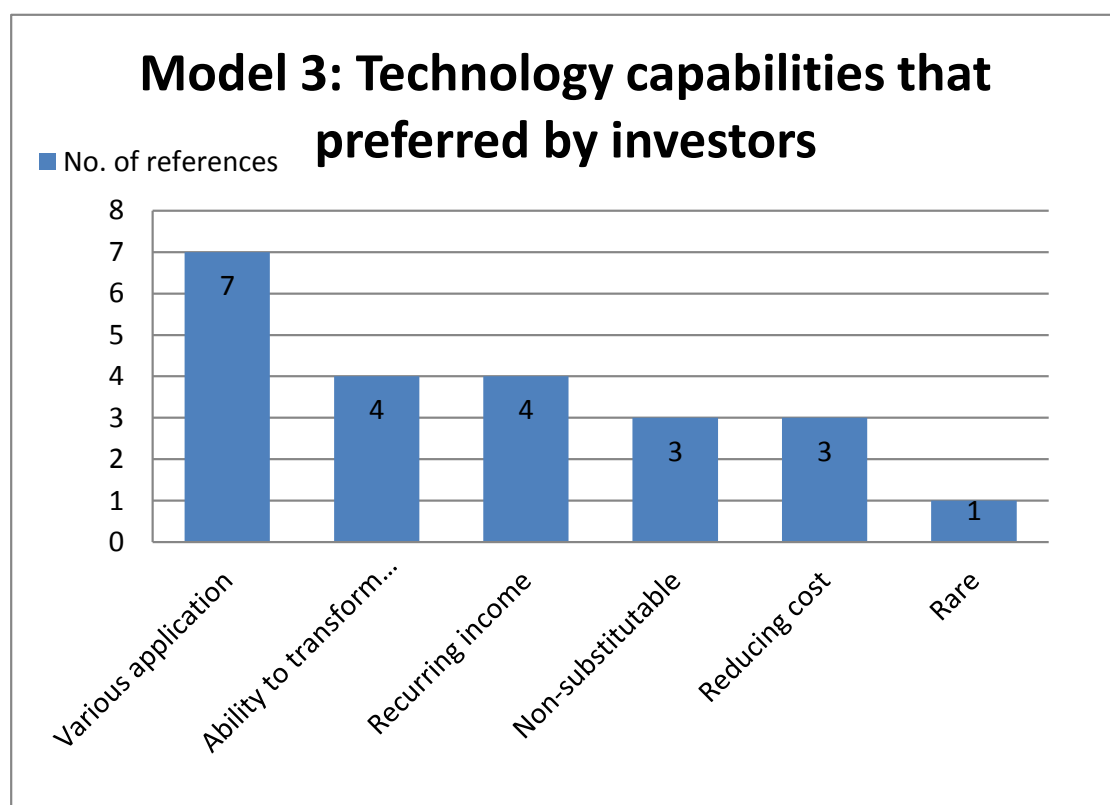
Market capability of startup preferred by investors-Final model

Model 3: Market Capability	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Broad Market	9	2	0	7	0	0	0	5	2	0	0	2
Sensing market direction	9	2	0	5	2	0	0	2	0	1	0	6
Develop new customers	6	3	0	3	0	0	0	1	0	3	0	2
Growing market	5	0	0	3	2	0	0	1	0	0	0	4
Market Capability	0	0	0	0	0	0	0	0	0	0	0	0
Know-how protection	0	0	0	0	0	0	0	0	0	0	0	0
Model 3: Techonlogy Capability	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	9	3	0	7	2	0	0	5	2	3	0	6
	Broad Market	Develop new customers	N/A	Broad Market	Sensing market direction	N/A	N/A	Broad Market	Broad Market	Develop new customers	N/A	Sensing market direction

Model 3: Market capabilities that preferred by investors
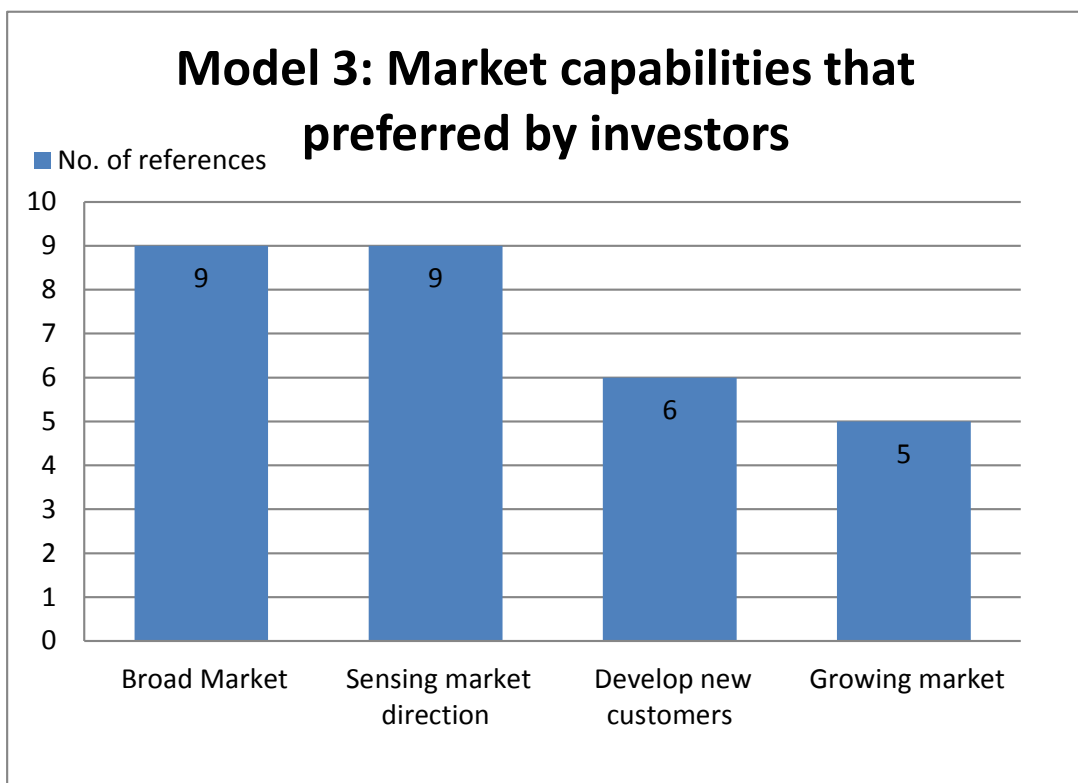
Entrepreneur capability of startup preferred by investors-Final model

Model 3: Entrepreneur Capa	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Experience in execution rea	9	2	0	5	2	0	0	3	1	1	2	2
Skills in technology and ma	8	2	0	6	0	0	0	4	1	1	0	2
Skills in exploit new opportu	6	3	0	2	1	0	0	4	1	0	0	1
Enhance security	2	2	0	0	0	0	0	0	1	1	0	0
Enhance potential return	1	1	0	0	0	0	0	0	1	0	0	0
Entrepreneur Capability	0	0	0	0	0	0	0	0	0	0	0	0

Model 3: Entrepreneur Capability	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	9	3	0	6	2	0	0	4	1	1	2	2
	Experience in execution real business	Skills in exploit new opportunities	N/A	Skills in technology and marketing	Experience in execution real business	N/A	N/A	Skills in technology and marketing	Experience in execution real business	Experience in execution real business	Experience in execution real business	Experience in execution real business
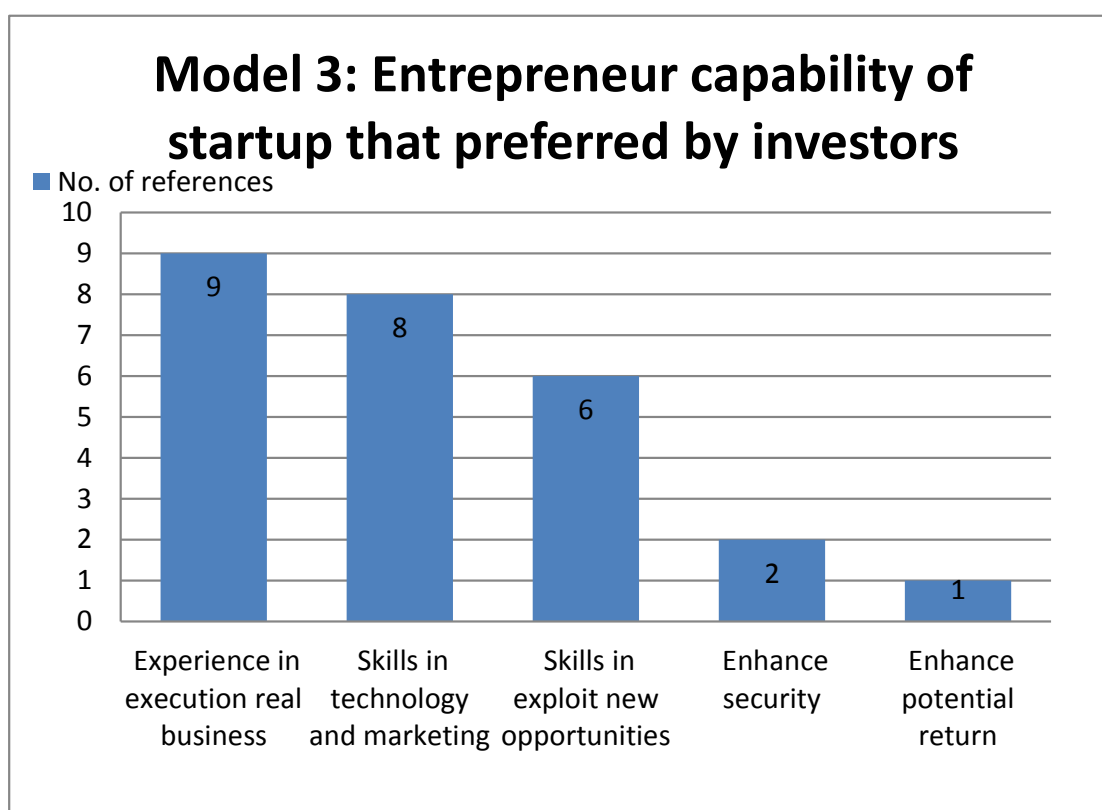
Innovation type of startup preferred by investors-Final model

Model 3: Innovation	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
New-market Innovation	6	3	0	3	0	0	0	3	2	0	1	0
Differentiation	4	3	0	1	0	0	0	3	0	0	1	0
Disruptive Innovation	3	1	0	2	0	0	0	1	1	0	0	1
Low-end Innovation	3	1	0	2	0	0	0	2	1	0	0	0
Innovation	0	0	0	0	0	0	0	0	0	0	0	0
Radical Innovation	0	0	0	0	0	0	0	0	0	0	0	0
Model 3: Innovation	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	6	3	0	3	0	0	0	3	2	0	1	1
	New-market Innovation	New-market Innovation	N/A	New-market Innovation	N/A	N/A	N/A	New-market Innovation	New-market Innovation	N/A	New-market Innovation	Disruptive Innovation

Model 3: Innovation type of startup that preferred by investors
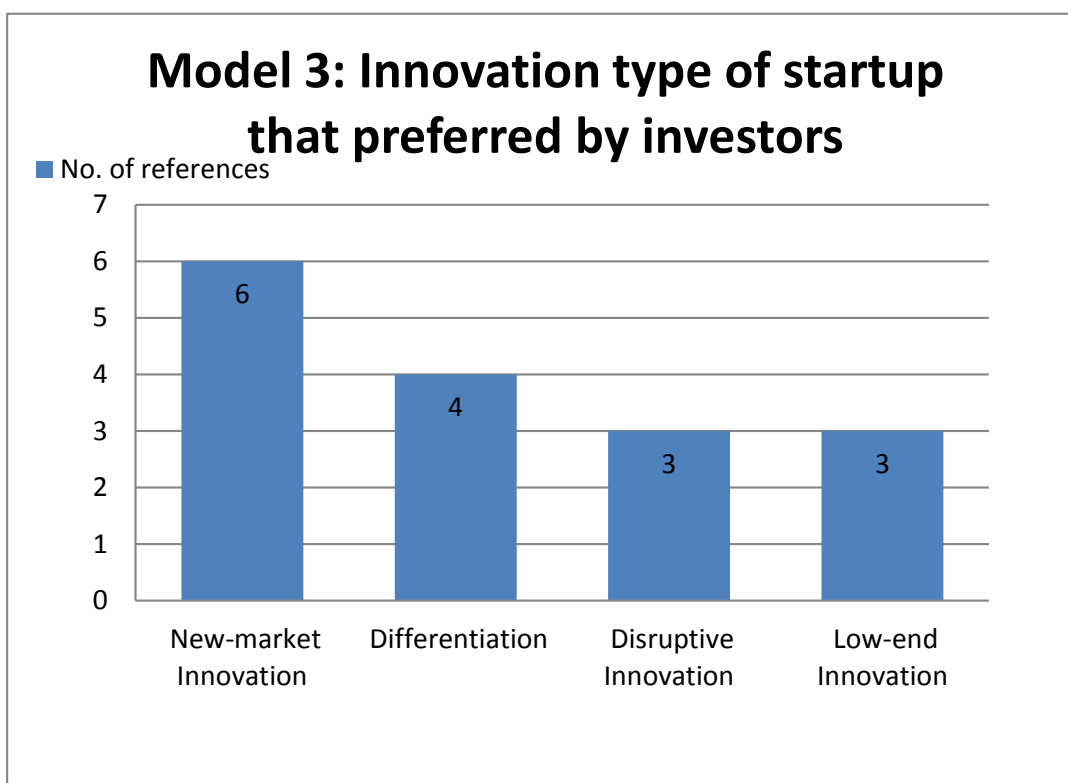
Modularity type of startup preferred by investors-Final model

Model 3: Modular	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Internal flexibility	18	8	0	10	0	0	0	8	3	1	4	2
External platform	4	3	0	1	0	0	0	0	1	0	2	1

Model 3: Modular	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	18	8	0	10	0	0	0	8	3	1	4	2
	Internal flexibility	Internal flexibility	N/A	Internal flexibility	N/A	N/A	N/A	Internal flexibility	Internal flexibility	Internal flexibility	Internal flexibility	Internal flexibility

Investment model of startup preferred by investors-Final model

Investment model	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Security	29	15	0	14	0	0	0	16	3	5	2	3
Growth Potential	25	10	0	14	1	0	0	15	1	2	2	5
% Achieve Target	15	10	0	5	0	0	0	8	4	2	0	1
Staging	12	6	0	5	1	0	0	5	4	2	0	1
Target Return	9	5	0	4	0	0	0	3	1	1	2	2
Aspiration	8	4	0	4	0	0	0	6	2	0	0	0
Exit	7	6	0	1	0	0	0	5	1	0	0	1
Financial Valuation	7	2	0	5	0	0	0	2	2	0	2	1
Timing	2	2	0	0	0	0	0	0	1	0	1	0
Real Option Valuation	1	0	0	1	0	0	0	1	0	0	0	0

Investment model	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	29	15	0	14	1	0	0	16	4	5	2	5
	Security	Security	N/A	Security	Growth Potential	N/A	N/A	Security	% Achieve Target	Security	Security	Growth Potential

Model 3: Investment model of Startup preferred by investors
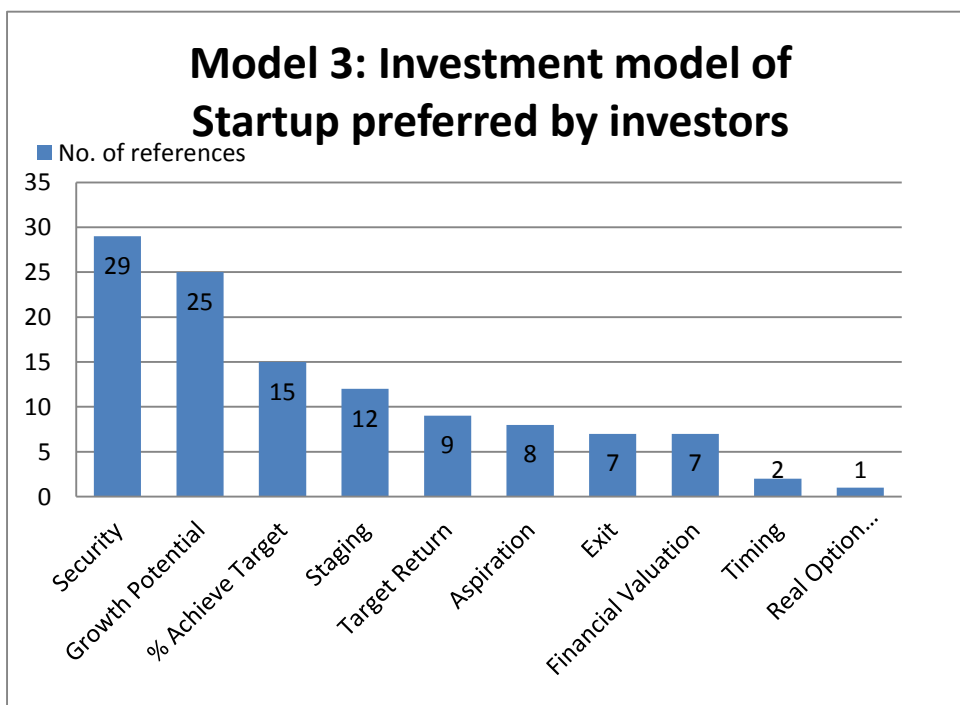
Quality of entrepreneur that preferred by investors-Final model

Model 3: Quality	Occupation					Investing role					
	All	Entrepreneur	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
Integrity	5	5	0	0	0	0	4	0	1	0	0
Honesty	4	4	0	0	0	0	0	0	4	0	0
Moral	4	4	0	0	0	0	2	1	1	0	0
Trustworthiness	4	3	1	0	0	0	1	2	1	0	0
Gratitude	3	3	0	0	0	0	0	3	0	0	0
Adversity	2	2	0	0	0	0	2	0	0	0	0
Attitude	2	1	1	0	0	0	1	0	0	1	0
Credibility	2	0	2	0	0	0	2	0	0	0	0
Determined	2	1	1	0	0	0	1	0	1	0	0
Reputation	2	2	0	0	0	0	1	1	0	0	0
Care	1	1	0	0	0	0	1	0	0	0	0
Fair	1	1	0	0	0	0	0	0	1	0	0
Quality of Entrepreneur	0	0	0	0	0	0	0	0	0	0	0
Transparency	0	0	0	0	0	0	0	0	0	0	0
Model 3: Quality	All	Entrepreneur	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	5	5	2	0	0	0	4	3	4	1	0
	Integrity	Integrity	Credibility	N/A	N/A	N/A	Integrity	Gratitude	Honesty	Attitude	N/A
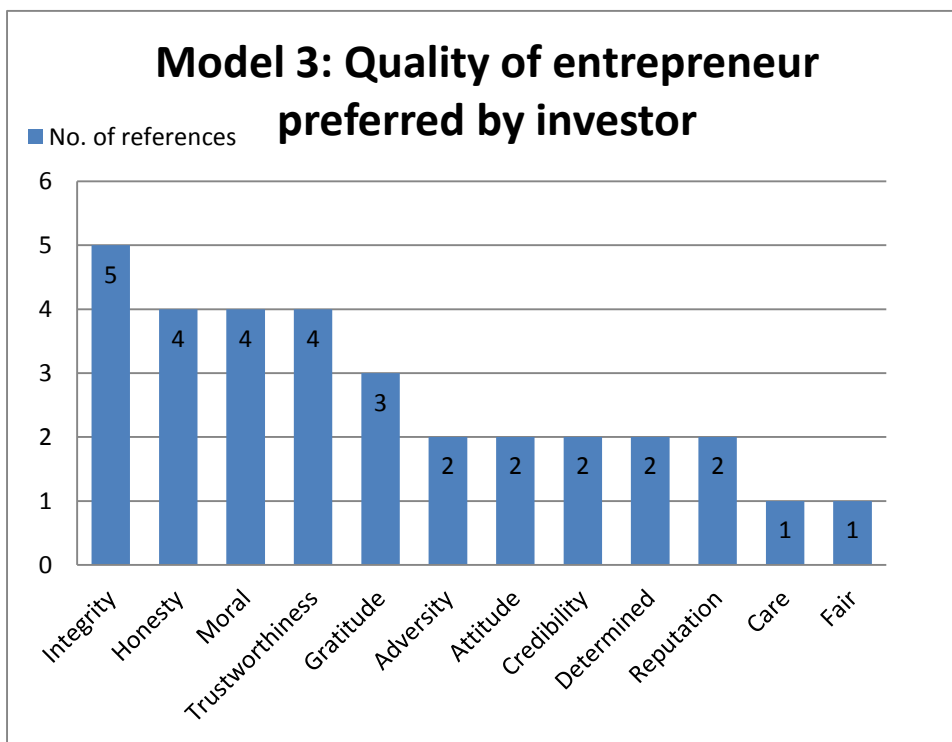
Model 3: Quality of EN & Evaluation	Affordable Loss	Security	% Achieve Target	Aspiration	Target Return	Growth Potential
Quality of Entrepreneur	4	4	4	1	1	1
Adversity	0	0	0	0	0	0
Attitude	0	0	0	0	0	0
Care	0	0	1	0	0	0
Credibility	1	1	1	0	0	0
Determined	0	1	0	1	1	1
Fair	0	0	0	0	1	0
Gratitude	1	0	0	0	0	0
Honesty	0	1	0	0	1	0
Integrity	1	0	0	0	0	0
Moral	0	1	0	0	0	0
Reputation	1	0	1	0	0	0
Transparency	0	0	0	0	0	0
Trustworthiness	0	1	1	0	0	0

Support for business angel and startup –Final model

Model 3: Support	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
BA formal institution	4	2	0	1	1	0	0	0	2	0	1	1
Startup market for investment	4	1	0	3	0	0	0	1	0	0	0	3
Startup mentoring	4	0	0	4	0	0	0	0	0	0	4	0
Largo co. support finance	3	2	0	1	0	0	0	1	1	0	1	0
Large co. support tech.	1	1	0	0	0	0	0	0	1	0	0	0
Support	0	0	0	0	0	0	0	0	0	0	0	0
Large co. support incubate	0	0	0	0	0	0	0	0	0	0	0	0
Startup education	0	0	0	0	0	0	0	0	0	0	0	0

Model 3: Support	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	4	2	0	4	1	0	0	1	2	0	4	3
	BA formal institution	BA formal institution	N/A	Startup mentoring	BA formal institution	N/A	N/A	Startup market for investment	BA formal institution	N/A	Startup mentoring	Startup market for investment

Model 3: Support for business angel
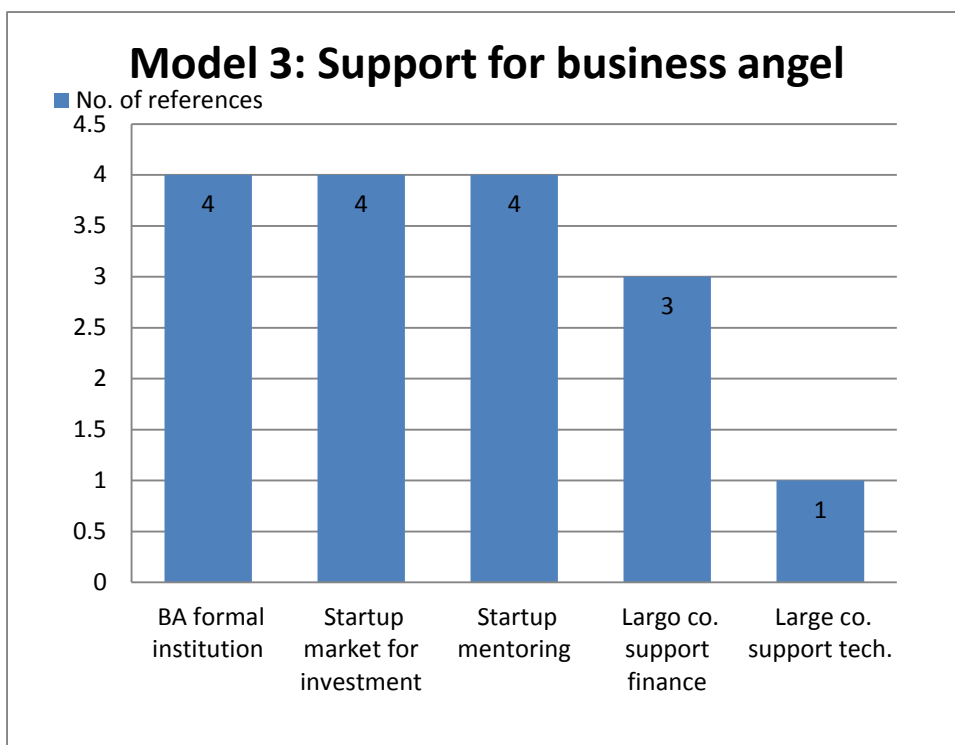
Indirect return and non-monetary return from startup –Final model

Model 3: Indirect & Non-Moneta	Occupation						Investing role		
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund
Indirect Return	3	2	0	1	0	0	0	1	2
Non-monetary Return	2	2	0	0	0	0	0	0	2
Model 3: Indirect & Non-Moneta	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund
	3	2	0	1	0	0	0	1	2
	Indirect Return	Indirect Return	N/A	Indirect Return	N/A	N/A	N/A	Indirect Return	Indirect Return
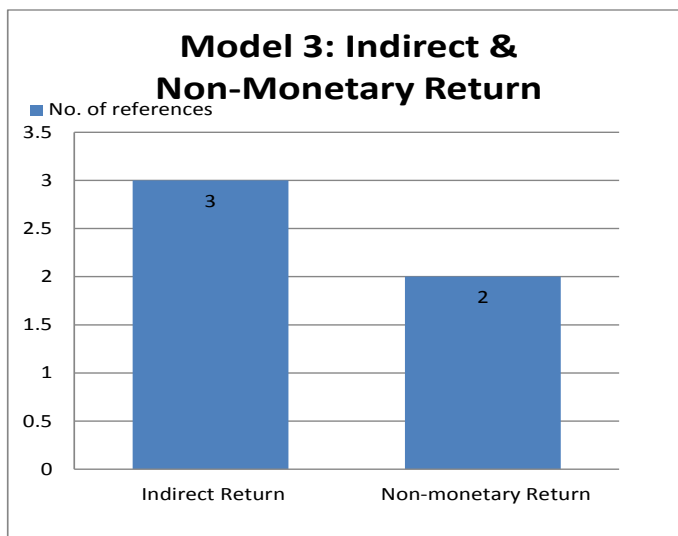
Affordable loss considered by investors in startup -Model 3

Model 3: Affordable Loss	Occupation						Investing role				
Person	All	Business angel	Entrepreneur	Management	Business angel fund	Incubator	Regulator	Researcher	Banker	Corporate business angel	Early-stage fund	Venture captial
Affordable Loss	11	9	8	3	2	0	0	0	0	0	0	0

Detail criteria preferred by investors in startup –Final model

Model 3: Detail Criteria	Occupation						Investing role					
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
Security	29	15	0	14	0	0	0	16	3	5	2	3
Growth Potential	25	10	0	14	1	0	0	15	1	2	2	5
Internal flexibility	18	8	0	10	0	0	0	8	3	1	4	2
% Achieve Target	15	10	0	5	0	0	0	8	4	2	0	1
Valuable	14	5	0	8	0	0	0	7	1	2	2	1
Growth option	12	5	0	5	2	0	0	5	1	2	0	4
Staging	12	6	0	5	1	0	0	5	4	2	0	1
Affordable Loss	11	8	0	3	0	0	0	9	2	0	0	0
Experience in execution real bus	9	2	0	5	2	0	0	3	1	1	2	2
Broad Market	9	2	0	7	0	0	0	5	2	0	0	2
Sensing market direction	9	2	0	5	2	0	0	2	0	1	0	6
Target Return	9	5	0	4	0	0	0	3	1	1	2	2
Skills in technology and marketi	8	2	0	6	0	0	0	4	1	1	0	2
Technology option	8	2	0	6	0	0	0	3	0	2	0	3
Aspiration	8	4	0	4	0	0	0	6	2	0	0	0
Various application	7	1	0	6	0	0	0	5	1	0	0	1
Exit	7	6	0	1	0	0	0	5	1	0	0	1
Financial Valuation	7	2	0	5	0	0	0	2	2	0	2	1
Skills in exploit new opportunitie	6	3	0	2	1	0	0	4	1	0	0	1
Develop new customers	6	3	0	3	0	0	0	1	0	3	0	2
New-market Innovation	6	3	0	3	0	0	0	3	2	0	1	0
Growing market	5	0	0	3	2	0	0	1	0	0	0	4
Integrity	5	5	0	0	0	0	0	4	0	1	0	0
Ability to transform R&D in to pr	4	0	0	2	2	0	0	1	0	0	0	3
Recurring income	4	2	0	2	0	0	0	2	0	2	0	0
Differentiation	4	3	0	1	0	0	0	3	0	0	1	0
External platform	4	3	0	1	0	0	0	0	1	0	2	1
Entrepreneurial Option	4	1	0	3	0	0	0	2	0	1	0	1
Honesty	4	4	0	0	0	0	0	0	0	4	0	0
Moral	4	4	0	0	0	0	0	2	1	1	0	0
Trustworthiness	4	3	0	1	0	0	0	1	2	1	0	0
BA formal institution	4	2	0	1	1	0	0	0	2	0	1	1
Startup market for investment	4	1	0	3	0	0	0	1	0	0	0	3
Startup mentoring	4	0	0	4	0	0	0	0	0	0	4	0
Non-substitutable	3	0	0	1	2	0	0	1	0	0	0	2
Reducing cost	3	2	0	1	0	0	0	1	0	0	2	0
Disruptive Innovation	3	1	0	2	0	0	0	1	1	0	0	1
Low-end Innovation	3	1	0	2	0	0	0	2	1	0	0	0
Gratitude	3	3	0	0	0	0	0	0	3	0	0	0
Indirect Return	3	2	0	1	0	0	0	1	2	0	0	0
Largo co. support finance	3	2	0	1	0	0	0	1	1	0	1	0
Enhance security	2	2	0	0	0	0	0	0	1	1	0	0
Adversity	2	2	0	0	0	0	0	2	0	0	0	0
Attitude	2	1	0	1	0	0	0	1	0	0	1	0
Credibility	2	0	0	2	0	0	0	2	0	0	0	0
Determined	2	1	0	1	0	0	0	1	0	1	0	0
Reputation	2	2	0	0	0	0	0	1	1	0	0	0
Non-monetary Return	2	2	0	0	0	0	0	0	2	0	0	0
Timing	2	2	0	0	0	0	0	0	1	0	1	0
Enhance potential return	1	1	0	0	0	0	0	0	1	0	0	0
Rare	1	0	0	0	1	0	0	0	0	0	0	1
Market option	1	0	0	1	0	0	0	1	0	0	0	0
Care	1	1	0	0	0	0	0	1	0	0	0	0
Fair	1	1	0	0	0	0	0	0	0	1	0	0
Real Option Valuation	1	0	0	1	0	0	0	1	0	0	0	0
Large co. support tech.	1	1	0	0	0	0	0	0	1	0	0	0

Detail criteria preferred by investors in startup –Final model

Model 3: Detail Criteria	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
	29	15	0	14	2	0	0	16	4	5	4	6
	Security	Security	N/A	Security	Growth option	N/A	N/A	Security	% Achieve Target	Security	Internal flexibility	Sensing market direction

Model 3: Details criteria of startup preferred by Investors

No. of references

Criteria	No. of references
Security	29
Growth Potential	25
Internal flexibility	18
% Achieve Target	15
Valuable	14
Growth option	12
Staging	12
Affordable Loss	11
Experience in execution real business	9
Broad Market	9
Sensing market direction	9
Target Return	9
Skills in technology and marketing	8
Technology option	8
Aspiration	8
Various application	7
Exit	7
Financial Valuation	7
Skills in exploit new opportunities	6
Develop new customers	6
New-market innovation	6
Growing market	5
Integrity	5
Ability to transform R&D in to product	4
Recurring income	4
Differentiation	4
External platform	4
Entrepreneurial Option	4
Honesty	4
Moral	4
Trustworthiness	4
BA formal institution	4
Startup market for investment	4
Startup mentoring	4

Overall criteria preferred by investor in startup –Final model

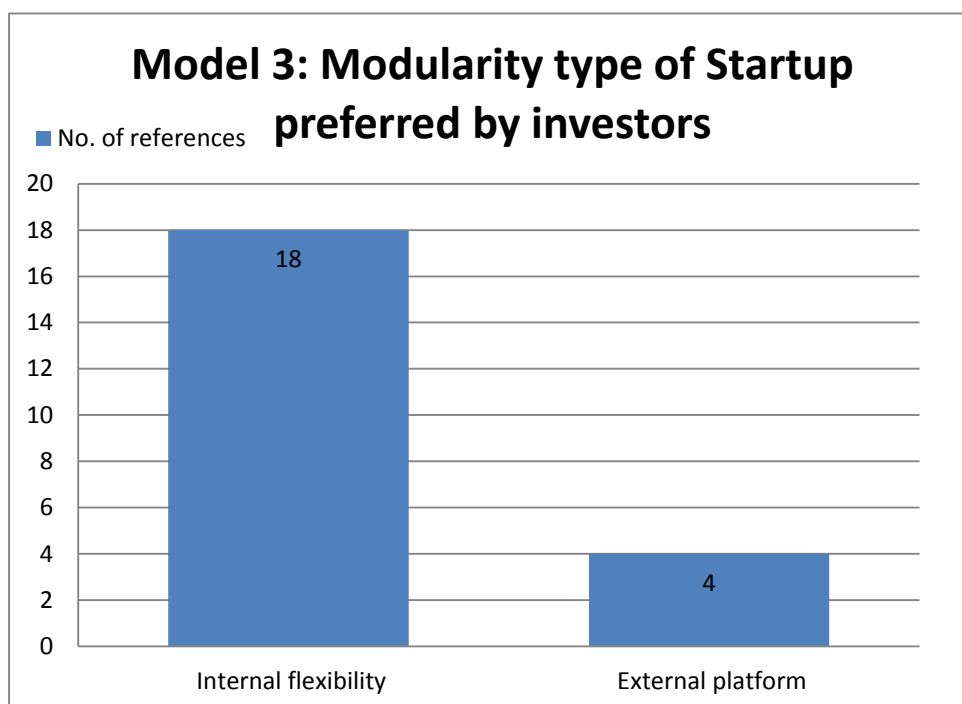| Model 3: Overall Criteria	Occupation						Investing role				
	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture capital
Investment model	120	38	0	30	2	0	0	33	14	6	7	10
Quality of Entrepreneur	32	17	0	5	0	0	0	11	6	4	1	0
Market Capability	29	6	0	12	2	0	0	8	2	3	0	7
Entrepreneur Capability	26	7	0	11	2	0	0	9	3	2	2	4
Technology Capability	22	5	0	11	2	0	0	9	1	2	2	4
Modular	22	10	0	11	0	0	0	8	4	1	5	3
Innovation	16	6	0	7	0	0	0	8	3	0	1	1
Support	16	4	0	7	1	0	0	1	3	0	4	4
Affordable Loss	11	8	0	3	0	0	0	9	2	0	0	0

Model 3: Overall Criteria	All	Entrepreneur	Incubator	Management	Regulator	Researcher	Banker	Business angel	Business angel fund	Corporate business angel	Early-stage fund	Venture captial
	120	38	0	30	2	0	0	33	14	6	7	10
	Investment model	Investment model	N/A	Investment model	Investment model	N/A	N/A	Investment model	Investment model	Investment model	Investment model	Investment model

Model 3: Overall preference in startup preferred by investors
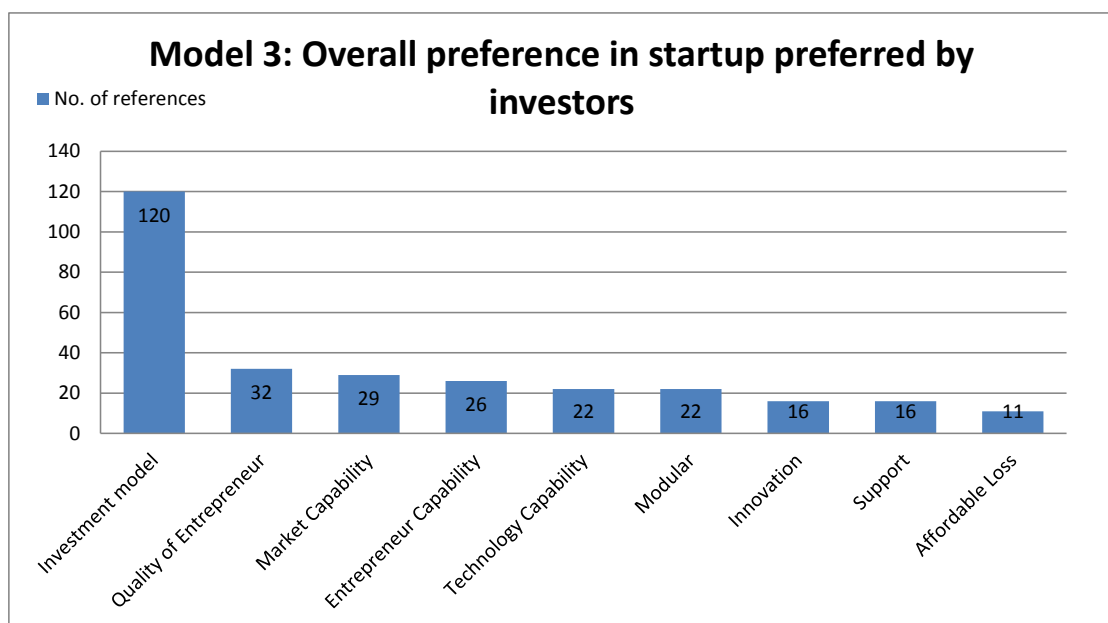
APPENDIX G RESULT OF DECISION MODEL

RO-SPA: INVESTMENT DECISION IN TECHNOLOGICAL INNOVATION					
using Real Option Valuation and SP/A (Security-Potential/Aspiration)					
https://sites.google.com/site/investmentsurvey					
Type your input in color box	yellow				
Calculation results are in	green				
Warning	pink				
STARTUP PLAN					
Pre-Determine Outcome from New Innovation					
Desire innovation project (not commonly avail. in market)	BioJet-Produce Biodiesel-BioJet Grade from waste vegetable oil				
	Invest (Baht)	CF return 1	CF return 2	CF return 3	CF return 4	CF return 5
Investment/Return	-2,570,000	1,277,184	1,277,184	1,277,184	1,277,184	1,277,184

REFERENCE PLAN: Possible Senarios in Current Market					
	Invest (Baht)	CF return 1	CF return 2	CF return 3	CF return 4	CF return 5
Sustaining Innovation (avail. in current market)	Large Scale B100-Biodiesel-Commercial grade from waste vegetable oil				
Investment/Return	-870,000	432,354	432,354	432,354	432,354	432,354
Low-End Innovation (avail in current lower value system)	Small Scale B100-Biodiesel-Commercial grade-Continuous Deglycerolization from waste vegetable oil				
Investment/Return	-100,000	49,696	49,696	49,696	49,696	49,696

NET PRESENT VALUE				
Discount PV CF at Financial Cost	7.7%			
	Invest (Baht)	PV 5yrs	NPV	Capital gain
Desire innovation	-2,570,000	5,140,000	2,570,000	1.00
Sustaining Innovation	-870,000	1,740,000	870,000	1.00
Low-End Innovation	-100,000	200,000	100,000	1.00

Target Investment Objective when Group in SP/A				Create project in MODULAR	
	Capital Gain	% expected		Invest in Modular, 1=yes, elso =no	1
Aspiration: Desire/target return from investment - capital gain from 5-yr investment (time)	1	50%		Invest yr 1 for 1=Sustain,2=Low-End	2
Affordable Loss: Amount you afford to lose (Baht)	100,000			% Modular (ratio of investment ph 1 reuse in ph 2)	20%

PREDICTION (RO+SP/A)	Possible Capital Gain	% Achieve			Option value	Possible Capital Gain	% Achieve
Potential: Best case return from investment - capital gain from 5-yr investment	12.50	0.7%	Prob > Potential		114,777	12.54	0.7%
Aspiration: Desire/target return from investment - capital gain from 5-yr investment	1.00	37.7%	Prob > Aspiration		114,777	1.04	37.7%
Security: Worst case return from investment - capital gain from 5-yr investment	0.00	45.0%	Prob > Security		114,777	0.04	45.0%
Affordable Loss: Amount you afford to lose	-100,000	55.0%	Prob of Loss				

<table>
<tr><td>* WARNING: Probability to achieve Desired Return may be LOWER than Target. Recommend to create project in MODULAR+implement in 2 stages to create</td></tr>
<tr><td>** VERIFY INDIRECT RETURN: if startup could satisfy your INDIRECT return to other companies in your portfolio.</td></tr>
<tr><td>*** VERIFY NON-MONETARY ASPIRATION: If startup could satisfy your NON-MONETARY Aspiration, such as desire to participate in innovation as co-creator, desire for very long-term investment.</td></tr>
<tr><td>**** VERIFY GRATITUDE quality of startup entrepreneur that whether the gratitude could ensure distributing fair return to investors and compensate for the lower success rate or not.</td></tr>
<tr><td># WARNING: Prob of LOSS is more than Security Level. Your AFFORDABLE LOSS has high chance to be ACTUAL LOSS. Recommend to create project in MODULAR+implement in 2 stages to create OPTION VALUE.</td></tr>
<tr><td>## VERIFY TRUSTWORTHINESS quality of startup entrepreneur that whether the benefit of trusworthiness could compensate with prob of loss or not.</td></tr>
</table>

RESULT: Probability of Outcome in View of Investors

Investment Project 1	-2,570,000		Prob
	Capital gain	PV 5yrs	>=
POTENTIAL	12.50	34,690,491	0.7%
ASPIRATION	1.00	5,140,000	37.7%
SECURITY	0.00	2,570,000	45.0%

Type of investment mindset	Outcome and Probabilities	
Profit/NPV		prob. outcome>=
Potential--------------> 32,120,491	0.7%	
		37.7%
Aspiration/Target---> 2,570,000		45.0%
Security----------> 0		
Loss----------> 100,000		55.0%

Calculate Volatility			
Sustaining Innovation	equate base case model		
Low-End Innovation	equate worst case model		
Probability to volatility (Compare Base-case with Worst-case scenario)			
Expected NPV of project	870,000		
Alternate Worst-case scenario NPV	100,000	0.885057471	
Percentile of worst-case scenario	11%	=Worst case/Expected	
% that outcome below worst case	11%		
Implied volatility estimate		equal Votality of Price	
= [$Percentile-$Mean]	-770,000	**74%**	
[Inverse Percentile x $Mean]	-1,044,570		
Step 1: Create Binomial Lattice Evolution of the Underlying Project			
$u = e^{\sigma}$; $d = e^{-\sigma}$			
p = risk-neutral probability = $(e^r - d) / (u - d)$, u=1/d			
Data Input			
T = time duration		1	year
r = risk free rate		7.7%	per year
σ = volatility (uncertainty of value)		74%	per year
A = amount under normal case		870,000	Bht
Calculated input			
p= $(e^r-d)/(u-d)$= Risk-neutral Probability (up)		0.3733	
(1-p)= Risk-neutral Probability (down)		0.6267	
u = e^{σ} = Size of up (increase) in next step		2.0900	
d = 1/u = Size of down (decrease) in next step		0.4785	
INVESTMENT EVALUATION (using Real Option)			
1. MAPPING POSSIBLE OUTCOME INTO NORMAL DISTRIBUTION			
2. ESTIMATE PROBABILITY OF EACH OUTCOME UNDER NORMAL CURVE			
Starting value	870,000		
Std.Dev.Sample	13,658,200		
POSSIBLE VALUE Y1-6	outcome	Cum.Ndist	Inv.Ndist
	34,690,491	99.3%	0.7%
	7,942,075	69.8%	30.2%
	1,818,266	52.8%	47.2%
	416,276	48.7%	51.3%
	95,303	47.7%	52.3%
	21,819	47.5%	52.5%

POSSIBLE PROJECT VALUE Y1-5	0	1	2	3	4	5
0	870,000	1,818,266	3,800,106	7,942,075	16,598,629	34,690,491
1		416,276	870,000	1,818,266	3,800,106	7,942,075
2		-	199,179	416,276	870,000	1,818,266
3		-	-	95,303	199,179	416,276
4		-	-	-	45,600	95,303
5		-	-	-	-	21,819

RO-SPA: INVESTMENT DECISION IN TECHNOLOGICAL INNOVATION

Create Option by Staging Project and Create Modularity

สร้างมูลค่าของทางเลือกด้วยการแบ่งเฟสการลงทุน-stagng โดยที่การลงทุนเฟส2สามารถต่อยอดได้
จากเฟส1-modularity และวัดมูลค่าด้วย REAL OPTION + SP/A

Invest yr 1 with smaller project	choose 1or2		2	Small Scale	870,000	select 1
				Large Scale	100,000	select 2
Invest yr 2 with desire innovation						
Large Scale B100-Biodiesel-Commercial grade from waste					100,000	
Desire innovation project (not					2,570,000	
Assume modular project (% invested in phase1 that can be used in phase2)					20%	
Result: Staging Modular project into 2 phases create option value =					114,777	
			NPV	Option value	e.NPV	
Expanded NPV (e.NPV) become			870,000	114,777	984,777	

	Normal project		2-stage project		
Starting value= Mean =	870,000		984,777		
Std.Dev.Sample	13,658,200		13,658,200		
Possible NPV	Cum.Ndist	Opt.Value	exp. NPV	Cum.Ndist	
34,690,491	99.3%	114,777	34,805,268	99.3%	
7,942,075	69.8%	114,777	8,056,852	69.8%	
1,818,266	52.8%	114,777	1,933,044	52.8%	
416,276	48.7%	114,777	531,053	48.7%	
95,303	47.7%	114,777	210,080	47.7%	
21,819	47.5%	114,777	136,596	47.5%	

	Capital gain	e.NPV	>=	
POTENTIAL	12.54	34,805,268	0.7%	
ASPIRATION	2.04	7,824,777	30.8%	
SECURITY	0.04	2,684,777	45.0%	

Type of investment mindset	Outcome and Probabilities	
Profit/NPV		prob. outcome>=
Potential-------------->	0.7%	
34,805,268		30.8%
_34,690,491_		
Aspiration/Target--->		
7,824,777		45.0%
_7,710,000_		
Security----------->		
2,684,777		
_2,570,000_		
Loss----------->		55.0%
_-100,000_		

REAL OPTION VALUATION: 2 STAGE PROJECTS AS SEQUENTIAL COMPOUND OPTIONS					
STAGING PROJECT INTO 2 PHASES: 1ST PHASE CREATE OPTION TO ENTER INTO 2ND PHASE IF 1ST PHASE HAS POSITIVE OUTCOME					
Binomial approach					
1st phase one-year expiration-cost		100,000			
2nd phase 2-year expiration-cost		2,550,000			
Implied volatility		74%			
Risk-free rate next 2 years		7.70%			
Static valuation of future					
prob.using dcf		870,000			
Step 1: Lattice evolution of the underlying					
$u = e^{\sigma}$; $d = e^{-\sigma}$					
p = risk-neutral probability = $(e^r - d) / (u - d)$, $u=1/d$					
Data Input					
T = time duration		1	year		
r = risk free rate		7.70%	per year		
σ = volatility (uncertainty of value)		74%	per year		
A = amount under normal case		870,000	Bht		
Calculated input					
p= $(e^r$-d)/(u-d)= Risk-neutral Probability (up)		0.3733			
(1-p)= Risk-neutral Probability (down)		0.6267			
$u = e^{\sigma}$ = Size of up (increase) in next step		2.0900			
d = 1/u = Size of down (decrease) in next step		0.4785			
Step 2: Option Valuation: 2nd yr Investment Option					
Option cost = X, Option value = max [X-S2,0]					
Data Input					
T = time duration		1	year		
r = risk free rate		7.70%	per year		
σ = volatility (uncertainty of value)		74%	per year		
Calculated input					
p= $(e^r$-d)/(u-d)= Risk-neutral Probability (up)		0.3733			
(1-p)= Risk-neutral Probability (down)		0.6267			
$u = e^{\sigma}$ = Size of up (increase) in next step		2.0900			
d = 1/u = Size of down (decrease) in next step		0.4785			
Investment cost Y2 for Market					
Commercialization=		2,550,000			
Option value =		149,341			
Step 3: Option valuation: 1st yr Investment Option					
Option cost = X, Option value = max [X-S1,0]					
Data Input					
T = time duration		1	year		
r = risk free rate		7.70%	per year		
σ = volatility (uncertainty of value)		74%	per year		
Calculated input					
p= $(e^r$-d)/(u-d)= Risk-neutral Probability (up)		0.3733			
(1-p)= Risk-neutral Probability (down)		0.6267			
$u = e^{\sigma}$ = Size of up (increase) in next step		2.0900			
d = 1/u = Size of down (decrease) in next step		0.4785			
Investment cost Y1 for technology					
R&D =		100,000			
Option value =		114,777			

Step 1: Lattice evolution of the underlying	0	1	2	3	4	5
0	870,000	1,818,266	3,800,106	7,942,075	16,598,629	34,690,491
1		416,276	870,000	1,818,266	3,800,106	7,942,075
2		-	199,179	416,276	870,000	1,818,266
3		-	-	95,303	199,179	416,276
4		-	-	-	45,600	95,303
5		-	-	-	-	21,819

Roll back from T to T-1

Step 2: Option Valuation: 2nd yr Investment Option	0	1	2	3	4	5
0	149,341	432,078	1,250,106			
1	-	-	-			
2	-	-	-			
3	-	-	-			
4	-	-	-			
5	-	-	-			

Roll back from T to T-1

Step 3: Option valuation: 1st yr Investment option	0	1	2	3	4	5
0	114,777	332,078				
1	-	-				
2	-	-				
3	-	-				
4	-	-				
5	-	-				

Step 4: Combined Option Valuation Lattice	0	1	2	3	4	5
		invest yr1	invest yr2			
0		114,777	332,078	1,250,106			
1			-	-			
2				-			
3				-			
4							
5							

APPENDIX H TEST OF VALIDITY OF MODEL

CASE & QUESTIONNAIRE

INVESTMENT DECISION IN TECHNOLOGICAL INNOVATION
การตัดสินใจลงทุนในบริษัทตั้งใหม่ที่ใช้เทคโนโลยี/นวัตกรรม
https://sites.google.com/site/investmentsurvey/home
Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน
Project 2: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-เพื่อขายให้โรงกลั่นน้ำมัน
Project 3: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-ผลิตเพื่อใช้ในชุมชน, โรงงาน

Target Investment Objective	
A-1: ระดับผลตอบแทน-capital gain ปีที่5 ที่คุณต้องการคือเท่าไร(เท่า-ของเงินลงทุน)	
A-2: ระดับความน่าจะเป็น-probability ที่คุณจะได้รับผลตอบแทนสูงกว่าที่คุณต้องการคือเท่าไร (จากระยะเวลาที่ลงทุน5ปี) (%)	
A-3: ระดับเงินลงทุนที่ยอมเสียได้-affordable loss ในการร่วมลงทุนในบริษัทจัดตั้งใหม่ (บาท)	

Method 1. FINANCIAL RETURN มูลค่าทางการเงินของโครงการ			
สมมติฐาน **การประมาณค่า**	**ความเสี่ยงของโครงการสามารถแทนด้วยอัตราคิดลด discount rate** **1.Discount rate แต่ละโครงการ**		
Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน	เงินลงทุน	2,570,000	บาท
เครื่องจักร: แบบต่อเนื่อง (continuous process) + Cracker/Isomer	Cap.Gain Y5	0.54	เท่า
ผลผลิต: B100 (Bio-Kerosene) เพื่อใช้แทนน้ำมันเครื่องบิน (Jet A-1 or JP-5)	NPV @7.7%	1,397,999	บาท
เทคโนโลยี: ใหม่/นวัตกรรม (new technology / innovation)	IRR	27%	ต่อปี
ตลาด: ใหม่/นวัตกรรม (new-market)	Payback	2.61	ปี
	Outcome y1	985,966	บาท
	Outcome 1-5	4,929,828	บาท
Project 2: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-เพื่อขายให้โรงกลั่นน้ำมัน	เงินลงทุน	870,000	บาท
เครื่องจักร: แบบต่อเนื่อง(continuous process)	Cap.Gain Y5	0.82	เท่า
ผลผลิต: ไบโอดีเซล B100 ไบโอดีเซลเมธิลเอสเตอร์ สำหรับรถยนต์พาณิชย์	NPV @7.7%	717,530	บาท
เทคโนโลยี: ปัจจุบัน (current commercial mainstream technology)	IRR	12%	ต่อปี
ตลาด: ปัจจุบัน (existing market)	Payback	2.21	ปี
	Outcome y1	394,468	บาท
	Outcome 1-5	1,972,342	บาท
Project 3: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-ผลิตเพื่อใช้ในชุมชน, โรงงาน	เงินลงทุน	100,000	บาท
เครื่องจักร: แบบผลิตเป็นครั้ง (batch process)	Cap.Gain Y5	0.34	เท่า
ผลผลิต: ไบโอดีเซลชุมชน < B100 ใช้ในเครื่องจักร การเกษตร รถยนต์ดีเซล	NPV @7.7%	34,156	บาท
เทคโนโลยี: ใหม่/ง่าย (new simpler technology / low-end innovation)	IRR	20%	ต่อปี
ตลาด: ใหม่/นวัตกรรม (new-market)	Payback	3.00	ปี
	Outcome y1	33,335	บาท
	Outcome 1-5	166,675	บาท

Method 2. DECISION TREE ด้วยการวัด expected value ที่คำนวนจากการประมาณค่าของความ ความเสี่ยงของโครงการสามารถแทน ด้วยอัตราคิดลด discount rate		
สมมติฐาน	1.Discount rate แต่ละโครงการ	
การประมาณค่า	2.ความน่าจะเป็นของสำเร็จ/ล้มเหลว สมมติโดยใช้หลัก-pareto 80/20	

Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน

	เงินลงทุน	2,570,000 บาท
	Cap.Gain Y5	0.54 เท่า
	NPV @7.7%	1,397,999 บาท
	IRR	27% ต่อปี
	Payback	2.61 ปี
	Outcome y1	985,966 บาท
	Outcome 1-5	4,929,828 บาท
ประมาณความน่าจะเป็นที่จะ สำเร็จ-20 /ล้มเหลว-80		
	Prob.Success	Outcome yr1-5
	20%	4,929,828
	80%	-2,570,000
	Prob.Fail	
	Expected Value -1,070,034	

Project 2: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-เพื่อขายให้โรงกลั่นน้ำมัน

	เงินลงทุน	870,000 บาท
	Cap.Gain Y5	0.82 เท่า
	NPV @7.7%	717,530 บาท
	IRR	12% ต่อปี
	Payback	2.21 ปี
	Outcome y1	394,468 บาท
	Outcome 1-5	1,972,342 บาท
ประมาณความน่าจะเป็นที่จะ สำเร็จ 50 /ล้มเหลว 50		
	Prob.Success	Outcome yr1-5
	50%	1,972,342
	50%	-870,000
	Prob.Fail	
	Expected Value 551,171	

Project 3: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-ผลิตเพื่อใช้ในชุมชน, โรงงาน

	เงินลงทุน	100,000 บาท
	Cap.Gain Y5	0.34 เท่า
	NPV @7.7%	34,156 บาท
	IRR	20% ต่อปี
	Payback	3.00 ปี
	Outcome y1	33,335 บาท
	Outcome 1-5	166,675 บาท
ประมาณความน่าจะเป็นที่จะ สำเร็จ-80 /ล้มเหลว-20		
	Prob.Success	Outcome yr1-5
	80%	166,675
	20%	-100,000
	Prob.Fail	
	Expected Value 113,340	

Method 3. REAL OPTION ด้วยการวัด-option value ของทางเลือก โดยอิงกับการกระจายตัวของผลลัพท์ของนวัตกรรมภายใต้ normal curve			
สมมติฐาน	ค่าผลตอบแทนจากเทคโนโลยีในการทำธุรกิจจะกระจายตัวแบบ normal distribution		
การประมาณค่า	ผลตอบแทนจากเทคโนโลยีในตลาดปัจจุบันเป็น-base case, เทคโนโลยีใหม่/นวัตกรรมที่ให้ผลตอบแทนสูง-best case, นวัตกรรมที่ง่าย/ลงทุนต่ำ/ให้ผลตอบแทนต่ำ-worst case		

วิธีการคำนวน

1. มองเทคโนโลยีว่ามีทางเลือก-option ที่จะใช้ได้หลายระดับของเทคโนโลยี-technology และหลายตลาด-market

2. จัดผลตอบแทน-outcome ของ 3 กรณี ให้เป็นในรูปของ normal distribution โดยสมมติฐานว่าส่วนกรณีที่เป็นเทคโนโลยีใหม่ new-market เป็นส่วนของ best-case และกรณีที่เป็นเทคโนโลยีที่

3. คำนวนหาค่า-mean และstandard deviation ของทางเลือกที่เทคโนโลยีสามารถสร้างเป็นธุรกิจได้ (commercialize)

4. คำนวนหาค่าผลตอบแทนแต่ละปีที่อาจเกิดขึ้นโดยคำนวนจากอัตราความเปลี่ยนแปลง-volatility ที่ทำให้

5. คำนวนหาค่าความน่าจะเป็นของผลตอบแทน-outcome ที่ต้องการที่ปรับให้อยู่ภายใต้ normal-curve

	Investment	Outcome 1-5	I
Best-case scenario: Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน	2,570,000	4,929,828	III
Base-case scenario: Project 2: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-เพื่อขายให้โรงกลั่นน้ำมัน	870,000	1,972,342	IIIII
Worst-case scenario: Project 3: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-ผลิตเพื่อใช้ในชุมชน, โรงงาน	100,000	166,675	III
			I

Project 1: ไบโอดีเซลสำหรับเครื่องบิน-จากน้ำมันพืชใช้แล้ว			
Outcome Yr1-5	4,929,828		
Prob. Outcome >= target	42.5%		
Investment	-2,570,000		
Profit	2,359,828		

Method 4. REAL OPTION + SP/A (SECURITY-POTENTIAL/ASPIRATION) การวัดมูลค่าที่ให้ค่ากับทางเลือก+เปรียบเทียบในด้านความต้องการของนักลงทุน เรื่องความปลอดภัย-การเติบโต/เป้าหมายที่นักลงทุนต้องการ		
สมมติฐาน	ค่าผลตอบแทนจากเทคโนโลยีในการทำธุรกิจจะกระจายตัวแบบ normal distribution	
การประมาณค่า	ผลตอบแทนจากเทคโนโลยีในตลาดปัจจุบันเป็น-base case, เทคโนโลยีใหม่/นวัตกรรมที่ให้ผลตอบแทนสูง-best case, นวัตกรรมที่ง่าย/ลงทุนต่ำ/ให้ผลตอบแทนต่ำ-worst case	

วิธีการคำนวน

1. ใช้ Real Option ในการหามูลค่าที่เป็นไปได้-possible outcome และโอกาสที่เป็นไปได้-possibility ตาม normal distribution จากทั้ง 3 ของโครงการ

2. จัดกลุ่มเป้าหมายการลงทุนของนักลงทุนให้แบ่งเป็น security-ความต้องการด้านความปลอดภัย potential-การเติบโต และaspiration-เป้าหมายที่ต้องการ

3. คำนวนหาความน่าจะเป็น-probability ที่โครงการจะให้ผลตอบแทนสูงกว่าที่ต้องการ หรือต่ำกว่าจุดปลอดภัย

4. นักลงทุนประเมินโครงการด้วยการเปรียบเทียบผลตอบแทนและความน่าจะเป็นในแต่ละกรณี

Compare Project Outcomes

	Investment	Outcome 1-5	Prob. >=
Best-case scenario: Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน	2,570,000	4,929,828	43%
Base-case scenario: Project 2: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-เพื่อขายให้โรงกลั่นน้ำมัน	870,000	1,972,342	48%
Worst-case scenario: Project 3: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-ผลิตเพื่อใช้ในชุมชน, โรงงาน	100,000	166,675	51%

Compare Investor's Profit Objectives

Investment Project 1	-2,570,000		Prob
	Capital gain	Outcome 1-5	>=
POTENTIAL-การเติบโตที่เป็นไปได้	10.00	28,270,000	11.0%
ASPIRATION-ผลตอบแทนที่ต้องการ	2.00	7,710,000	37.8%
SECURITY-ระดับที่ปลอดภัย	0.00	2,570,000	46.7%

ประเภทความต้องการของนักลงทุน	Prob. ผลตอบแทนที่อาจเกิดขึ้น	
Profit	prob. outcome>=	
Potential----------------> 25,700,000	11.0%	
Aspiration/Target---> 5,140,000	37.8%	46.7%
Security------------> 0		

วิธีเพิ่มมูลค่าด้วยการสร้างทางเลือก-Option ด้วยการแยกเฟสการลงทุน+แนวคิดการต่อยอด-Modular และวัดค่าด้วย Real Option และ SP/A

Case 1: ลงทุนใน project 1 ที่เป็นinnovative project อย่างเดียว

	Investment	Outcome Yr1-5		
Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน	2,570,000	4,929,828		
	Prob.Success	Outcome Yr1-5		
{	20%	4,929,828		
	80%	-2,570,000		
	Prob.Fail			
		Expected Value		
		-1,070,034		

กรณีที่1 สร้างมูลค่าของทางเลือกด้วยการแบ่งเฟสการลงทุน-staging โดยที่การลงทุนเฟส2สามารถต่อยอดได้จากเฟส 1-modularity และวัดมูลค่าด้วยDECISION TREE

Case 2: Two Stage: เริ่มลงทุนเฟส1ด้วยเทคโนโลยีปัจจุบัน-existing แล้วหากมีโอกาสต่อยอดไปเฟส2ด้วยinnovation project

	Investment	Outcome y1		Outcome Yr2-5
Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน	2,570,000	985,966		3,943,862
Project 2: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-เพื่อขายให้โรงกลั่นน้ำมัน	870,000	394,468		133,340
	Total Investment			Total outcome
Split Project 2 to be 2 phases	2,570,000			3,943,862
Phase 1: Yr 1 - Technology R&D	Invest Yr1	Outcome y1		
	870,000	394,468		
Phase 2: Yr 2-5 : Market Comm.			Invest Yr2	Outcome Yr2-5
Assume modular project (% invested in phase1 that can be used in phase2)	100%		1,700,000	3,549,394

Decision Tree - Two Stage: Start with sustaining, then innovation project	Technology	Market		
Yr1 test technology, then yr2 investment in innovation project	R & D	Commercial		
	Yr 1	Yr 2	Prob	Yr 2-5
		Outcome y1	Good	Outcome Y2-5
	Prob.Success		80%	3,943,862
	20%	394,468	20%	-1,700,000
			Prob. Bad	
	80%	-870,000		
	Prob. Fail			EV2=
	Expected value			2,815,090
	-54,088			

Case 3: Two Stage: เริ่มลงทุนเฟส1ด้วยเทคโนโลยีง่าย-LOW-END แล้วหากมีโอกาสต่อยอดไปเฟส2ด้วยinnovation project

	Investment	Outcome y1		Outcome Y2-5
Project 1: ไบโอดีเซลสำหรับเครื่องบิน-จากน้ำมันพืชใช้แล้ว	2,570,000	985,966		3,943,862
Project 3: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-ผลิตเพื่อใช้ในชุมชน, โรงงาน	100,000	33,335		133,340
	Total Investment			Total outcome
Split Project 2 to be 2 phases	2,570,000			3,943,862
Phase 1: Yr 1 - Technology R&D	Investment yr1	Outcome y1		
	100,000	33,335		
Phase 2: Yr 2-5 : Market Comm.			Investment yr2	Outcome Yr2-5
Assume modular project (% invested in phase1 that can be used in phase2)	100%		2,470,000	3,910,527

Decision Tree - Two Stage: Start with LOW-END, then innovation project	Technology	Market		
Yr1 test technology, then yr2 investment in LOW-END innovation project	R & D	Commercial		
	Yr 1	Yr 2	Prob	Yr 2-5
		Outcome y1	Good	Outcome Y2-5
	Prob.Success		80%	3,910,527
	20%	33,335	20%	-2,470,000
			Prob. Bad	
	80%	-100,000		
	Prob. Fail			EV2=
	Expected value			2,634,422
	453,551			

กรณีที่2: สร้างมูลค่าของทางเลือกด้วยการแบ่งเฟสการลงทุน-stagng โดยที่การลงทุนเฟส2สามารถต่อยอดได้จากเฟส 1-modularity และวัดมูลค่าด้วย REAL OPTION + SP/A

Start invest yr 1 with smaller project

Start invest yr 2 with full innovation project

1. ใช้ Real Option ในการหามูลค่าที่เป็นไปได้-possible outcome และโอกาสที่เป็นไปได้-possibility ตาม normal distribution จากทางเลือกทั้ง 3 ของโครงการ

2. ตั้งเป้าหมายการลงทุนของนักลงทุน ให้แบ่งเป็น security-ความต้องการด้านความปลอดภัย potential-ความต้องการด้านการเติบโต และ aspiration-เป้าหมายที่ต้องการ

3. คำนวณหาความน่าจะเป็นที่โครงการจะให้ผลตอบแทนสูงว่าที่ต้องการ หรือต่ำกว่าจุดปลอดภัย

4. นักลงทุนประเมินโครงการด้วยการเปรียบเทียบผลตอบแทนและความน่าจะเป็นในแต่ละกรณี และตัดสินใจลงทุน

เฟส1 ลงทุนใน Project 3: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-ผลิตเพื่อใช้ในชุมชน, โรงงาน	-100,000	
เฟส2 ลงทุนใน Project 1: ไบโอดีเซลจากน้ำมันพืชใช้แล้ว-สำหรับเครื่องบิน	-2,570,000	
ผล: การลงทุนในเฟส1 ก่อนเฟส2 ทำให้เกิดมูลค่าทางเลือกเพิ่ม	46,627	

	Normal project		Option value from Staging	
Starting value= Mean =	717,530		764,157	
Std.Dev.Sample	22,421,355		22,421,355	
Possible NPV	Cum.Norm.Dist	Option value	expanded NPV	Cum.Norm.Dist
60,828,586	99.6%	46,627	60,875,212	99.6%
13,846,879	72.1%	46,627	13,893,505	72.1%
3,152,071	54.3%	46,627	3,198,698	54.3%
717,530	50.0%	46,627	764,157	50.0%
163,337	49.0%	46,627	209,964	49.0%
37,182	48.8%	46,627	83,808	48.8%
8,464	48.7%	46,627	55,091	48.7%

	Capital gain	Outcome Yr1-5	Prob. >=
POTENTIAL-ระดับการเติบโตที่เป็นไปได้	10.02	28,316,627	11.0%
ASPIRATION-ผลตอบแทนที่ต้องการ	2.02	7,756,627	37.8%
SECURITY-ระดับที่ปลอดภัย	0.02	2,616,627	46.7%

ผลของการเพิ่มขึ้นของ option value จากการ stage โครงการให้เป็น 2 phases

<u>ประเภทความต้องการของนักลงทุน</u>

	Prob. ผลตอบแทนที่อาจเกิดขึ้น	
Profit	prob. outcome>=	
Potential-------------->	11.0%	
25,746,627		
25,700,000		
	37.8%	
Aspiration/Target--->		
5,186,627		
5,140,000		46.7%
Security----------->		
46,627		
0		

REAL OPTION VALUATION METHOD: SINGLE STAGE PROJECT				
VOLATILITY ESTIMATE (with management assumption approach)				
Probability to volatility (best-case scenario)				
Expected NPV of project	717,530			
Alternate Best-case scenario NPV	1,397,999			
Percentile of best-case scenario	90%			
Probability that outcome above best case	10%			
Implied volatility estimate				
= [$Percentile-$Mean]	680,468	74%		
[Inverse Percentile x $Mean]	919,552			
Probability to volatility (worst-case scenario)				
Expected NPV of project	717,530			
Alternate Worst-case scenario NPV	34,156			
Percentile of worst-case scenario	10%			
Probability that outcome below worst case	10%			
Implied volatility estimate				
= [$Percentile-$Mean]	-683,374	74%		
[Inverse Percentile x $Mean]	-919,552			
Assumptions				
- Underlying distribution of asset fluctuation is normal (Central Limit Theorem, distribution becomes normally				
distributed when number of trials increases)				
- Standard deviation is the same as volatility				
- Use standard-normal distribution to calculate volatility				
- Normalize volatility to be in percentage by dividing with Mean				
(Ref: Mun, Real option analysis, 2nd 2006, page 210)				
Step 1: Lattice evolution of the underlying				
$u = e^{\sigma}$; $d = e^{-\sigma}$				
p = risk-neutral probability = $(e^{r} - d) / (u - d)$, $u=1/d$				
Data Input				
T = time duration	1	year		
r = risk free rate	7.7%	per year		
σ = volatility (uncertainty of value)	74%	per year		
A = amount under normal case	717,530	Bht		
Calculated input				
p= $(e^{r}-d)/(u-d)$= Risk-neutral Probability (up)	0.3724			
(1-p)= Risk-neutral Probability (down)	0.6276			
$u = e^{\sigma}$ = Size of up (increase) in next step	2.0959			
d = 1/u = Size of down (decrease) in next step	0.4771			
INVESTMENT EVALUATION (using Real Option)				
1. MAPPING POSSIBLE OUTCOME INTO NORMAL DISTRIBUTION				
2. ESTIMATE PROBABILITY OF EACH OUTCOME UNDER NORMAL CURVE				
Starting value	717,530			
Std.Dev.Sample	22,421,355			
	Possible outcor	Cum.Norm.Dist	Inv.Norm.Dist	
	60,828,586	99.6%	0.4%	
	13,846,879	72.1%	27.9%	
	3,152,071	54.3%	45.7%	
	717,530	50.0%	50.0%	
	163,337	49.0%	51.0%	
	37,182	48.8%	51.2%	
	8,464	48.7%	51.3%	

REAL OPTION VALUATION: 2 STAGE PROJECTS					

STAGING PROJECT INTO 2 PHASES: 1ST PHASE CREATE OPTION TO ENTER INTO 2ND PHASE IF 1ST PHASE HAS POSITIVE OUTCOME					
Binomial approach					
1st phase one-year expiration-cost		100,000			
Assume modular project (% invested in phase1 that can be used in phase2)	100%				
2nd phase 2-year expiration-cost		2,470,000			
Implied volatility		74%			
Risk-free rate next 2 years		7.7%			
Static valuation of future prob.using dcf		717,530			
Step 1: Lattice evolution of the underlying					
$u = e^\sigma$; $d = e^{-\sigma}$					
p = risk-neutral probability = $(e^r - d) / (u - d)$, u=1/d					
Data Input					
T = time duration	1	year			
r = risk free rate	7.70%	per year			
σ = volatility (uncertainty of value)	74%	per year			
A = amount under normal case	717,530	Bht			
Calculated input					
p= $(e^r-d)/(u-d)$= Risk-neutral Probability (up)	0.3724				
(1-p)= Risk-neutral Probability (down)	0.6276				
u = e^σ = Size of up (increase) in next step	2.0959				
d = 1/u = Size of down (decrease) in next step	0.4771				
Step 2: Equity Lattice: Two-year Investment Option					
Option cost = X, Option value = max [X-S2,0]					
Data Input					
T = time duration	1	year			
r = risk free rate	7.70%	per year			
σ = volatility (uncertainty of value)	74%	per year			
Calculated input					
p= $(e^r-d)/(u-d)$= Risk-neutral Probability (up)	0.3724				
(1-p)= Risk-neutral Probability (down)	0.6276				
u = e^σ = Size of up (increase) in next step	2.0959				
d = 1/u = Size of down (decrease) in next step	0.4771				
Investment cost Y2 for Market Commercialization=	2,470,000				
Option value =	81,111				
Step 3: Option valuation lattice - One-year investment option					
Option cost = X, Option value = max [X-S1,0]					
Data Input					
T = time duration	1	year			
r = risk free rate	7.70%	per year			
σ = volatility (uncertainty of value)	74%	per year			
Calculated input					
p= $(e^r-d)/(u-d)$= Risk-neutral Probability (up)	0.3724				
(1-p)= Risk-neutral Probability (down)	0.6276				
u = e^σ = Size of up (increase) in next step	2.0959				
d = 1/u = Size of down (decrease) in next step	0.4771				
Investment cost Y1 for technology R&D =	100,000				
Option value =	46,627				

Step 4: Combined Option Valuation Lattice					
		First option	2nd Option		
	0	1	2	3	
		invest yr1	invest yr2		
0	46,627	135,210	682,071		
1		-	-		
2			-		
3			-		

**QUESTIONNAIRE-THAI POTENTIAL INVESTORS
FOR VALIDITY OF MODEL**

สมมติท่านเป็นนักลงทุน ที่มีผู้ประกอบการมาเสนอให้ร่วมลงทุนในธุรกิจจัดตั้งใหม่ ที่มุ่งจะทำ
ธุรกิจผลิตไบโอดีเซล ตามกรณีศึกษาใน https://sites.google.com/site/investmentsurvey/home
กรุณาตอบคำถามดังต่อไปนี้

A. Target Investment Objective
A-1: Investor's Target Return *ระดับผลตอบแทน-capital gain ปีที่5 ที่คุณต้องการคือเท่าไร(เท่า)
For you to invest in startup, what are your investment criteria about target return level from
5 years holding. (Please select only one)

not less than 15%, or capital gain 1 time of capital
not less than 25%, or capital gain 2 time of capital
not less than 38%, or capital gain 4 time of capital
not less than 55%, or capital gain 8 time of capital
not less than 62%, or capital gain 10 time of capital
more than 62%, or capital gain 10 time of capital

A-2 Possibility of Target Returns: For you to invest in that startup, what should the estimated
probability of the startup to deliver target return. *ระดับความน่าจะเป็น-probability ที่คุณจะได้รับ
ผลตอบแทนสูงกว่าที่คุณต้องการคือเท่าไร(จากระยะเวลาที่ลงทุน5ปี) (%)
_____ % (ระหว่าง 0-100%)

A-3: Affordable Loss *ระดับเงินลงทุนที่ยอมเสียได้-affordable loss ในการร่วมลงทุนในบริษัทจัดตั้ง
ใหม่ (บาท) Please indicate amount of investment that you can afford to loose

น้อยกว่า 100,000บาท
ระหว่าง 100,000-500,000 บาท
ระหว่าง 500,000-1,000,000 บาท
มากกว่า 1,000,000บาท

B. การเปรียบเทียบวิธีพิจารณาตัดสินใจการลงทุน
กรุณาเปรียบเทียบเครื่องมือต่อไปนี้ตามความสามารถในการช่วยนักลงทุนตัดสินใจลงทุนในบริษัทจัดตั้ง
ใหม่
Method 1: FINANCIAL วัดด้วยตัวเลขผลตอบแทนทางการเงิน เช่น payback, breakeven, NPV, IRR
Method 2. DECISION TREE ด้วยการวัด expected value ที่คำนวณจากการประมาณค่าของความน่าจะ
เป็นที่จะสำเร็จ/ล้มเหลว
Method 3. REAL OPTION ด้วยการวัด-option value ของทางเลือก โดยอิงกับการกระจายตัวของ
ผลลัพธ์ของนวัตกรรมภายใต้ normal curve
Method 4. REAL OPTION + SP/A (SECURITY-POTENTIAL/ASPIRATION) การวัดมูลค่าที่ให้ค่ากับ
ทางเลือก+เปรียบเทียบในด้านความต้องการของนักลงทุน เรื่องความปลอดภัย-การเติบโต/เป้าหมายที่
นักลงทุนต้องการ

B-1: การวัดความสามารถในการเติบโต Growth Potential *กรุณาจัดอันดับวิธีที่ช่วยในการวัดค่าบริษัท
ตั้งใหม่ว่าจะเติบโตหรือไม่ (จัดตามลำดับจาก 1 ดีมากที่สุด - 4 ดีน้อยที่สุด)

	1	2	3	4
วิธีวัดโดยใช้ข้อมูลการเงิน				
วิธีวัดโดยใช้ decision tree				
วิธีวัดโดยใช้ real option				
วิธีวัดโดยใช้ real option และ SP/A				

B-2: การวัดความสามารถในการอยู่รอด/ไม่ล้มเหลว (Security/survival) *กรุณาจัดอันดับวิธีที่ช่วยในการ
วัดค่าบริษัทตั้งใหม่ว่าจะอยู่รอดหรือไม่ (จัดตามลำดับจาก 1 ดีมากที่สุด - 4 ดีน้อยที่สุด)

	1	2	3	4

	1	2	3	4
วิธีวัดโดยใช้ข้อมูลการเงิน				
วิธีวัดโดยใช้ decision tree				
วิธีวัดโดยใช้ real option				
วิธีวัดโดยใช้ real option และ SP/A				

B-3: การวัดความสามารถในการตัดสินเงินที่จะลงทุนโดยไม่หวังจะได้คืน (Affordable loss) *กรุณาจัด
อันดับวิธีที่ช่วยในการที่ผู้ลงทุนจะตัดสินใจในจำนวนเงินลงทุนโดยไม่หวังจะได้คืน (จัดตามลำดับจาก 1 ดี
มากที่สุด - 4 ดีน้อยที่สุด)

	1	2	3	4
วิธีวัดโดยใช้ข้อมูลการเงิน				
วิธีวัดโดยใช้ decision tree				
วิธีวัดโดยใช้ real option				
วิธีวัดโดยใช้ real option และ SP/A				

B-4: การตัดสินใจลงทุนได้-ถูกต้อง *กรุณาจัดอันดับวิธีที่ช่วยในการที่ผู้ลงทุนจะตัดสินใจในลงทุนได้-
ถูกต้อง (จัดตามลำดับจาก 1 ดีมากที่สุด - 4 ดีน้อยที่สุด)

	1	2	3	4
วิธีวัดโดยใช้ข้อมูลการเงิน				
วิธีวัดโดยใช้ decision tree				
วิธีวัดโดยใช้ real option				
วิธีวัดโดยใช้ real option และ SP/A				

B-5: การตัดสินใจลงทุนได้-ง่ายขึ้น *กรุณาจัดอันดับวิธีที่ช่วยในการที่ผู้ลงทุนจะตัดสินใจการลงทุนได้-
ง่ายขึ้น (จัดตามลำดับจาก 1 ดีมากที่สุด - 4 ดีน้อยที่สุด)

	1	2	3	4
วิธีวัดโดยใช้ข้อมูลการเงิน				
วิธีวัดโดยใช้ decision tree				
วิธีวัดโดยใช้ real option				
วิธีวัดโดยใช้ real option และ SP/A				

C. PROFILE

C-1: Duration of Work Experience *กรุณาระบุระยะเวลาในการทำงานของท่านที่ผ่านมา

น้อยกว่า 5 ปี
ระหว่าง 6-10 ปี
ระหว่าง 10-20 ปี
มากกว่า 20ปี

C-2: Work Experience (ประสบการณ์ในการทำงาน) *กรุณาระบุประสบการณ์ในการทำงานของท่าน (เลือกได้ทุกข้อ)

Managerial (การจัดการ/การบริหารงาน)
Sales & Marketing (การขายและการตลาด)
Manufacturing (การผลิต)
Accounting & Finance (การบัญชี/การเงิน)
Business Development (พัฒนาธุรกิจ)
Research Development (วิจัยและพัฒนา)
Investment related (VC, Fund manager)
อื่นๆ โปรดระบุ

C-3: Duration of Investment Experience *กรุณาระบุระยะเวลาที่ท่านได้เริ่มลงทุนจนถึงปัจจุบัน

น้อยกว่า 5 ปี
ระหว่าง 6-10 ปี
ระหว่าง 10-20 ปี
มากกว่า 20ปี

C-4: Investment Experience *กรุณาระบุประสบการณ์ในการลงทุนของท่าน (เลือกได้ทุกข้อ)

Saving , fixed account, bond, insurance (เงินฝาก เงินฝากประจำ พันธบัตร ประกันชีวิต)
Gold, Mutual fund, Listed company securities (ทอง กองทุน หุ้นบริษัทจดทะเบียน)
Company (existing business) (บริษัท ห้างหุ้นส่วน องค์กรธุรกิจ ที่จัดตั้งอยู่ก่อนแล้ว)
Start-up companies (บริษัทตั้งใหม่)
อื่นๆ โปรดระบุ

C-5: Duration of Startup Experience *กรุณาระบุระยะเวลาที่ท่านได้เริ่มตั้งบริษัทจนถึงปัจจุบัน หรือจนถึงหยุดมีส่วนร่วม

ไม่เคยมีประสบการณ์
น้อยกว่า 5 ปี
ระหว่าง 6-10 ปี
ระหว่าง 10-20 ปี
มากกว่า 20ปี

C-6: Startup Experience (ประสบการณ์ในการตั้งบริษัทใหม่) *กรุณาระบุประสบการณ์ในการจัดตั้งบริษัทใหม่/มีส่วนร่วมเป็นหุ้นส่วนในการจัดตั้งบริษัทใหม่ (เลือกได้ทุกข้อ)

ยังไม่มีประสบการณ์ ไม่เคยร่วมตั้งบริษัทใหม่
รับช่วงบริหารงานบริษัทจากครอบครัว
เริ่มตั้งบริษัทด้วยตนเอง ปัจจุบันดำเนินการอยู่
เริ่มตั้งบริษัทด้วยตนเอง ปัจจุบันได้ขายหุ้นออกไปแล้ว
เริ่มตั้งบริษัทด้วยตนเอง ปัจจุบันไม่ได้ดำเนินการแล้ว

**QUESTIONNAIRE-THAI POTENTIAL INVESTORS
FOR TECHNOLOGY ACCEPTANCE**

สมมติท่านเป็นนักลงทุน ที่มีผู้ประกอบการมาเสนอให้ร่วมลงทุนในธุรกิจจัดตั้งใหม่ กรุณาตอบ
คำถามดังต่อไปนี้ เกี่ยวกับการนำเครื่องมือช่วยในการตัดสินใจลงทุนไปใช้ ตาม
https://sites.google.com/site/investmentsurvey/home

Technology Acceptance (การยอมรับเทคโนโลยีและนำไปใช้ประโยชน์)

1: Perceived Usefulness (ความมีประโยชน์ของเครื่องมือ) *

	1-ไม่เห็นด้วยอย่างยิ่ง - 5-เห็นด้วยอย่างยิ่ง				
เครื่องมือนี้ช่วยเพิ่มสมรรถนะความสามารถในการ ทำงานของฉัน (Using this tool improves my performance in my job)	1	2	3	4	5
การใช้เครื่องมือนี้ในงานของฉันช่วยเพิ่มผลงาน ของฉัน (Using this tool in my job increase my productivity)	1	2	3	4	5

2: Perceived Ease of Use (ความง่ายในการใช้เครื่องมือ) *

	1-ไม่เห็นด้วยอย่างยิ่ง - 5-เห็นด้วยอย่างยิ่ง				
เครื่องมือนี้มีวิธีใช้ที่ชัดเจนและเข้าใจง่าย (My interaction with this tool is clear and understandable)	1	2	3	4	5
การใช้เครื่องมือนี้ไม่จำเป็นต้องมีความรู้ที่สูง (Interacting with this tool does not require a lot of my mental effort)	1	2	3	4	5
ฉันพบว่าเครื่องมือนี้ใช้งานง่าย (I find this tool to be easy to use)	1	2	3	4	5
ฉันพบว่าเครื่องมือนี้ช่วยให้ฉันทำงานได้ตามที่ ต้องการ (I find it easy to get this tool to do what I want it to do)	1	2	3	4	5

3: Behavioral Intention to Use (ความตั้งใจที่จะนำไปใช้จริง) *

	1-ไม่เห็นด้วยอย่างยิ่ง - 5-เห็นด้วยอย่างยิ่ง				
สมมติว่าฉันสามารถเข้าใช้เครื่องมือนี้ได้ ฉันตั้งใจที่ จะใช้เครื่องมือนี้ (Assuming I had access to this tool, I intend to use it)	1	2	3	4	5
ถ้าฉันสามารถเข้าใช้เครื่องมือนี้ได้ ฉันคาดการณ์ว่า ฉันจะใช้เครื่องมือนี้) Given that I had access to the system, I predict that I would use it	1	2	3	4	5

APPENDIX I   STATISTICS ON TEST OF VALIDATY OF MODEL

Objective of Research: To validate the ability of RO+SP/A tools in
1. Explain growth potential of startup
2. Explain security or survival ability of startup
3. Help in decide affordable loss for investment in startup
4. Making investment in startup more correct
5. Making investment in startup easier

GROWTH POTENTIAL: Ability of RO+SP/A Tools to Explain Growth Potential of Startup

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
GPFN * Target	28	68.3%	13	31.7%	41	100.0%
GPDT * Target	29	70.7%	12	29.3%	41	100.0%
GPRO * Target	29	70.7%	12	29.3%	41	100.0%
GPROSPA * Target	29	70.7%	12	29.3%	41	100.0%

Report

Target		GPFN	GPDT	GPRO	GPROSPA
	Mean	2.75	2.86	3.00	**3.62**
NA	N	20	21	21	21
	Std. Deviation	1.070	1.062	1.000	1.024
not less than 15%, or capital gain 1 time of capital	Mean	1.50	2.00	2.00	**2.50**
	N	2	2	2	2
	Std. Deviation	.707	.000	1.414	2.121
not less than 25%, or capital gain 2 time of capital	Mean	2.25	2.25	2.25	**3.25**
	N	4	4	4	4
	Std. Deviation	1.258	.500	.500	.500
3 times	Mean	2.00	3.00	2.00	2.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
not less than 55%, or capital gain 8 time of capital	Mean	3.00	3.00	3.00	**4.00**
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Total	Mean	2.57	2.72	2.79	**3.45**
	N	28	29	29	29
	Std. Deviation	1.069	.960	.978	1.055

In general for respondent who did not mention their target return, they believed RO+SPA tools could explain growth potential of the startup better than other traditional financial, decision tree, or real option alone.

For respondent who preferred higher target return rate, the higher the target, the higher value respondent believed RO+SPA tools could explain growth potential of the startup better than other tools.

SECURITY: Ability of RO+SP/A Tools to Explain Security or Survival of Startup

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
SEFN * Target	28	68.3%	13	31.7%	41	100.0%
SEDT * Target	29	70.7%	12	29.3%	41	100.0%
SERO * Target	29	70.7%	12	29.3%	41	100.0%
SEROSPA * Target	29	70.7%	12	29.3%	41	100.0%

Report

Target		SEFN	SEDT	SERO	**SEROSPA**
	Mean	2.30	3.43	3.67	**3.71**
NA	N	20	21	21	21
	Std. Deviation	1.031	.926	.796	.784
not less than 15%, or capital gain 1 time of capital	Mean	1.00	2.00	3.00	**4.00**
	N	2	2	2	2
	Std. Deviation	.000	.000	.000	.000
not less than 25%, or capital gain 2 time of capital	Mean	2.25	3.00	3.00	**4.00**
	N	4	4	4	4
	Std. Deviation	.957	.816	.000	.816
3 times	Mean	2.00	2.00	3.00	2.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
not less than 55%, or capital gain 8 time of capital	Mean	3.00	4.00	4.00	**4.00**
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Total	Mean	2.21	3.24	3.52	**3.72**
	N	28	29	29	29
	Std. Deviation	.995	.951	.738	.797

In general for respondent who did not mention their target return, they believed RO+SPA tools could explain security or survival ability of the startup better than other traditional financial, decision tree, or real option alone.

For respondent who preferred higher target return rate, it could not conclude that RO+SPA explained security or survival ability better than other tools.

AFFORDABLE LOSS: Ability of RO+SP/A Tools to Explain Affordable Loss of Investor in Startup

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
ALFN * Target	28	68.3%	13	31.7%	41	100.0%
ALDT * Target	29	70.7%	12	29.3%	41	100.0%
ALRO * Target	29	70.7%	12	29.3%	41	100.0%
ALROSPA * Target	29	70.7%	12	29.3%	41	100.0%

Report

Target		ALFN	ALDT	ALRO	ALROSPA
NA	Mean	2.85	3.62	3.14	**4.00**
	N	20	21	21	21
	Std. Deviation	.988	.865	1.108	.707
not less than 15%, or capital gain 1 time of capital	Mean	2.50	2.00	3.00	**4.00**
	N	2	2	2	2
	Std. Deviation	2.121	1.414	.000	.000
not less than 25%, or capital gain 2 time of capital	Mean	2.50	3.00	2.25	**4.25**
	N	4	4	4	4
	Std. Deviation	1.291	.816	.500	.500
3 times	Mean	3.00	4.00	2.00	3.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
not less than 55%, or capital gain 8 time of capital	Mean	2.00	3.00	3.00	**4.00**
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Total	Mean	2.75	3.41	2.97	**4.00**
	N	28	29	29	29
	Std. Deviation	1.041	.946	1.017	.655

In general for respondent who did not mention their target return, they believed RO+SPA tools could explain affordable loss of investor in the startup better than other traditional financial, decision tree, or real option alone.

For respondent who preferred higher target return rate, the higher the target, the higher value respondent believed RO+SPA tools could explain affordable loss of investor in the startup better than other tools.

CORRECTNESS: Ability of RO+SP/A Tools to Help Invest Correctly in Startup

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
CORFN * Target	28	68.3%	13	31.7%	41	100.0%
CORDT * Target	29	70.7%	12	29.3%	41	100.0%
CORRO * Target	29	70.7%	12	29.3%	41	100.0%
CORROSPA * Target	26	63.4%	15	36.6%	41	100.0%

Report

Target		CORFN	CORDT	CORRO	CORROSPA
NA	Mean	3.15	3.48	3.76	**3.94**
	N	20	21	21	18
	Std. Deviation	1.089	.873	.700	.725
not less than 15%, or capital gain 1 time of capital	Mean	3.00	2.00	3.00	**4.50**
	N	2	2	2	2
	Std. Deviation	.000	1.414	1.414	.707
not less than 25%, or capital gain 2 time of capital	Mean	1.75	2.75	2.75	**3.00**
	N	4	4	4	4
	Std. Deviation	.957	.500	.500	.816
3 times	Mean	3.00	2.00	2.00	2.00
	N	1	1	1	1

		EAFN	EADT	EARO	EAROSPA
	Std. Deviation	.	.	.	.
not less than 55%, or capital gain 8 time of capital	Mean	4.00	4.00	4.00	**5.00**
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Total	Mean	2.96	3.24	3.52	**3.81**
	N	28	29	29	26
	Std. Deviation	1.105	.951	.829	.895

In general for respondent who did not mention their target return, they believed RO+SPA tools could help them invest correctly better than other traditional financial, decision tree, or real option alone.

For respondent who preferred higher target return rate, the higher the target, the higher value respondent believed RO+SPA tools could help them invest correctly in the startup better than other tools.

EASY TO MAKE DECISION: Ability of RO+SP/A Tools to Help Making It Easier to Invest in Startup

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
EAFN * Target	28	68.3%	13	31.7%	41	100.0%
EADT * Target	29	70.7%	12	29.3%	41	100.0%
EARO * Target	29	70.7%	12	29.3%	41	100.0%
EAROSPA * Target	29	70.7%	12	29.3%	41	100.0%

Report

Target		EAFN	EADT	EARO	EAROSPA
	Mean	3.50	3.71	3.76	**4.14**
NA	N	20	21	21	21
	Std. Deviation	1.000	.845	.831	.910
not less than 15%, or capital gain 1 time of capital	Mean	3.00	2.00	3.50	**4.00**
	N	2	2	2	2
	Std. Deviation	.000	1.414	.707	.000
not less than 25%, or capital gain 2 time of capital	Mean	2.25	3.00	2.75	**3.75**
	N	4	4	4	4
	Std. Deviation	1.500	.816	.500	.500
3 times	Mean	2.00	3.00	3.00	2.00
	N	1	1	1	1
	Std. Deviation	.	.	.	.
not less than 55%, or capital gain 8 time of capital	Mean	3.00	3.00	**5.00**	**5.00**
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Total	Mean	3.21	3.45	3.62	4.03
	N	28	29	29	29
	Std. Deviation	1.101	.948	.862	.906

In general for respondent who did not mention their target return, they believed RO+SPA tools could help them making decision to invest in startup easier than other traditional financial, decision tree, or real option alone. The higher the target, the higher value respondent believed RO+SPA tools could help them making decision to invest in startup easier than other tools.

APPENDIX J TEST OF TECHNOLOGY ACCEPTANCE

Technology Acceptance and Adoption (การยอมรับเทคโนโลยีและนำไปใช้ประโยชน์)

1: Perceived Usefulness (ความมีประโยชน์ของเครื่องมือ) *

	1-ไม่เห็นด้วยอย่างยิ่ง - 5-เห็นด้วยอย่างยิ่ง				
เครื่องมือนี้ช่วยเพิ่มสมรรถนะความสามารถในการทำงานของฉัน (Using this tool improves my performance in my job)	1	2	3	4	5
การใช้เครื่องมือนี้ในงานของฉันช่วยเพิ่มผลงานของฉัน (Using this tool in my job increase my productivity)	1	2	3	4	5

2: Perceived Ease of Use (ความง่ายในการใช้เครื่องมือ) *

	1-ไม่เห็นด้วยอย่างยิ่ง - 5-เห็นด้วยอย่างยิ่ง				
เครื่องมือนี้มีวิธีใช้ที่ชัดเจนและเข้าใจง่าย (My interaction with this tool is clear and understandable)	1	2	3	4	5
การใช้เครื่องมือนี้ไม่จำเป็นต้องมีความรู้ที่สูง (Interacting with this tool does not require a lot of my mental effort)	1	2	3	4	5
ฉันพบว่าเครื่องมือนี้ใช้งานง่าย (I find this tool to be easy to use)	1	2	3	4	5
ฉันพบว่าเครื่องมือนี้ช่วยให้ฉันทำงานได้ตามที่ต้องการ (I find it easy to get this tool to do what I want it to do)	1	2	3	4	5

3: Behavioral Intention to Use (ความตั้งใจที่จะนำไปใช้จริง) *

	1-ไม่เห็นด้วยอย่างยิ่ง - 5-เห็นด้วยอย่างยิ่ง				
สมมติว่าฉันสามารถเข้าใช้เครื่องมือนี้ได้ ฉันตั้งใจที่จะใช้เครื่องมือนี้ (Assuming I had access to this tool, I intend to use it)	1	2	3	4	5
ถ้าฉันสามารถเข้าใช้เครื่องมือนี้ได้ ฉันคาดการณ์ว่าฉันจะใช้เครื่องมือนี้) Given that I had access to the system, I predict that I would use it	1	2	3	4	5

Objective of Research: To study
1. Behavioral intention to use model RO-SP/A
2. Characteristic of user who intend to use model RO-SP/A
3. Perceived usefulness of model RO-SP/A
4. Perceived ease of use of model RO-SP/A

0. Test of Normality of Behavioral Intention to Use

[DataSet1] D:\1.Thesis_Ton_18Aug11\Thesis Data\TAM-BC.sav

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
BIIUSE	43	100.0%	0	0.0%	43	100.0%

Descriptives

			Statistic	Std. Error
BIIUSE	Mean		3.3023	.13935
	95% Confidence Interval for Mean	Lower Bound	3.0211	
		Upper Bound	3.5835	
	5% Trimmed Mean		3.2804	
	Median		3.0000	
	Variance		.835	
	Std. Deviation		.91378	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		.131	.361
	Kurtosis		-.762	.709

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
BIIUSE	.211	43	.000	.877	43	.000

a. Lilliefors Significance Correction

Test of normality of BIIUSE (behavioral intention to use) for normal distribution
Ho: Behavioral intention to use is normal distribution with confident level 95%

-Kolmogorov-smirnov: p-value < 0.05, therefore, reject Ho, concluding that is not normal distribution.
-Kurtosis = -0.762/+0.709 are still within -3/+3, concluding that this is close to normal distribution.

BIIUSE

BIIUSE Stem-and-Leaf Plot

Frequency   Stem & Leaf

```
  9.00     2 .  000000000
   .00     2 .
 16.00     3 .  0000000000000000
   .00     3 .
 14.00     4 .  00000000000000
   .00     4 .
  4.00     5 .  0000
```

Stem width: 1.00
Each leaf: 1 case(s)

Normal Q-Q Plot of BIIUSE

Detrended Normal Q-Q Plot of BIIUSE
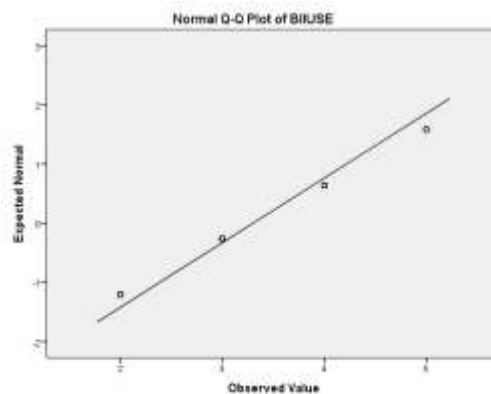
Test normality of Behavioral Intention to Use

Descriptives

Value of Q-Q plot is near expected value, concluding that value is close to normal distribution
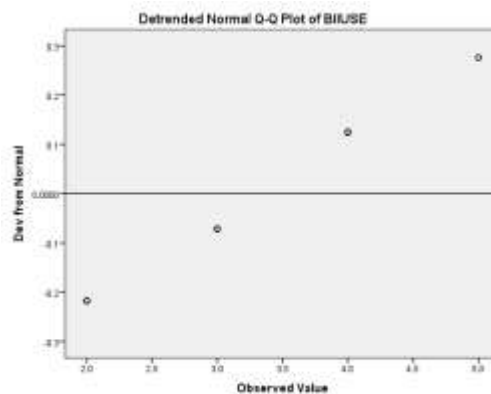
2. Characteristic of user who intend to use model RO-SP/A

Statistics

		BIIUSE	WXPYR	WXPTYPE	IXPYR	IXPTYPE	SXPYR	SXPTYPE
N	Valid	43	43	43	43	43	43	43
	Missing	0	0	0	0	0	0	0
Mean		3.3023						

Frequency Table

BIIUSE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	9	20.9	20.9	20.9
	3.00	16	37.2	37.2	58.1
	4.00	14	32.6	32.6	90.7
	5.00	4	9.3	9.3	100.0
	Total	43	100.0	100.0	

User with strong (5) and medium-high (4) intention to use are about (32.6+9.3)=41.9% of total.

WXPYR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	between 10-20 yr	12	27.9	27.9	27.9
	between 6-10 yr	12	27.9	27.9	55.8
	less than 5 yr	11	25.6	25.6	81.4
	more than 20 yr	8	18.6	18.6	100.0
	Total	43	100.0	100.0	

WXPTYPE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accounting & Finance/ Investment	4	9.3	9.3	9.3
	Business Development	3	7.0	7.0	16.3
	Managerial	13	30.2	30.2	46.5
	Manufacturing	2	4.7	4.7	51.2
	Research Development	13	30.2	30.2	81.4
	Sales & Marketing	8	18.6	18.6	100.0
	Total	43	100.0	100.0	

IXPYR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	between 10-20 yr	2	4.7	4.7	4.7
	between 6-10 yr	13	30.2	30.2	34.9
	less than 5 yr	26	60.5	60.5	95.3
	more than 20 yr	2	4.7	4.7	100.0
	Total	43	100.0	100.0	

IXPTYPE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Company (existing business)	6	14.0	14.0	14.0
	Listed company securities	22	51.2	51.2	65.1
	Saving , fixed account, bond, insurance	13	30.2	30.2	95.3
	Start-up companies	2	4.7	4.7	100.0
	Total	43	100.0	100.0	

SXPYR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	between 10-20 yr	2	4.7	4.7	4.7
	between 6-10 yr	7	16.3	16.3	20.9
	less than 5 yr	12	27.9	27.9	48.8
	more than 20 yr	2	4.7	4.7	53.5
	No startup experience	20	46.5	46.5	100.0
	Total	43	100.0	100.0	

SXPTYPE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Already startup by themselves-now still in operational	7	16.3	16.3	16.3
	Already startup-but already sold equity	2	4.7	4.7	20.9
	Already startup, but no longer in operation	3	7.0	7.0	27.9
	Manage family co. that started in previous generations	6	14.0	14.0	41.9
	No experience in starting up new company	25	58.1	58.1	100.0
	Total	43	100.0	100.0	

1. Behavioral Intention to Use and Target Return amount, %, Affordable Loss

Statistics

		Target	TargetProb	AL	BIIUSE
N	Valid	43	36	43	43
	Missing	0	7	0	0
Mean			.4861		3.3023

Frequency Table

Target

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	more than 62%, or capital gain 10 time of capital	4	9.3	9.3	9.3
	not less than 15%, or capital gain 1 time of capital	1	2.3	2.3	11.6
	not less than 25%, or capital gain 2 time of capital	13	30.2	30.2	41.9
	not less than 38%, or capital gain 4 time of capital	8	18.6	18.6	60.5
	not less than 55%, or capital gain 8 time of capital	10	23.3	23.3	83.7
	not less than 62%, or capital gain 10 time of capital	7	16.3	16.3	100.0
	Total	43	100.0	100.0	

Investors 60.5% desire to get return not less than 38% per year or capital gain 4 time of capital.

TargetProb

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	2.3	2.8	2.8
	.10	2	4.7	5.6	8.3
	.20	6	14.0	16.7	25.0
	.25	3	7.0	8.3	33.3
	.30	3	7.0	8.3	41.7
	.40	3	7.0	8.3	50.0
	.45	1	2.3	2.8	52.8
	.50	3	7.0	8.3	61.1
	.60	3	7.0	8.3	69.4
	.70	2	4.7	5.6	75.0
	.80	4	9.3	11.1	86.1
	.90	1	2.3	2.8	88.9
	1.00	4	9.3	11.1	100.0
	Total	36	83.7	100.0	
Missing	System	7	16.3		
Total		43	100.0		

Investors 61.1% expected to probability at 50% to achieve their target return rate.

AL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	between 100,000 Baht to 500,000 Baht	26	60.5	60.5	60.5
	between 500,000 Baht to1,00,000 Baht	7	16.3	16.3	76.7
	lower than 100,000 Baht	6	14.0	14.0	90.7
	more than 1,000,000 Baht	4	9.3	9.3	100.0
	Total	43	100.0	100.0	

Investors 64.5% willing to accept loss from investment amount when invested lower than 500,000Baht (50.5%+14%)

BIIUSE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	9	20.9	20.9	20.9
	3.00	16	37.2	37.2	58.1
	4.00	14	32.6	32.6	90.7
	Strongly Agree	4	9.3	9.3	100.0
	Total	43	100.0	100.0	

Investors 41.9% strongly and medium-strongly intended to use the model RO+SP/A for their investment (32.6+9.3)

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Behavioral intention to use	43	2.00	5.00	3.3023	.91378
Perceived usefulness – performance	43	2.00	5.00	3.4651	.93475
Perceived ease of use-do	43	2.00	5.00	3.1395	.74263
Valid N (listwise)	43				

Profile and Behavioral Intention to Use

		BIIUSE
		Mean
WXPTYPE	Accounting & Finance/ Investment	2.25
	Business Development	3.00
	Managerial	**3.46**
	Manufacturing	2.50
	Research Development	**3.62**
	Sales & Marketing	3.38
WXPYR	less than 5 yr	3.18
	between 6-10 yr	3.25
	between 10-20 yr	3.17
	more than 20 yr	**3.75**
IXPYR	less than 5 yr	3.42
	between 6-10 yr	3.08
	between 10-20 yr	2.50
	more than 20 yr	**4.00**
IXPTYPE	Company (existing business)	3.33
	Listed company securities	3.23
	Saving , fixed account, bond, insurance	3.38
	Start-up companies	**3.50**
	No startup experience	3.20
SXPYR	less than 5 yr	3.42
	between 6-10 yr	3.00
	between 10-20 yr	**4.50**
	more than 20 yr	3.50
	No experience in starting up new company	3.20
SXPTYPE	Manage family co. that started in previous generations	2.83
	Already startup by themselves-now still in operational	**4.00**
	Already startup-but already sold equity	3.50
	Already startup, but no longer in operation	3.33

Regression: UPF-usefulness in performance & BIIUSE Behavioral Intention to use

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	UPF[b]	.	Enter

a. Dependent Variable: BIIUSE
b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.668[a]	.446	.432	.68849

a. Predictors: (Constant), UPF

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.635	1	15.635	32.984	.000[b]
	Residual	19.435	41	.474		
	Total	35.070	42			

a. Dependent Variable: BIIUSE
b. Predictors: (Constant), UPF

Ho: Behavioral Intention to Use has no linear relationship with Usefulness in Performance of model
Result: Reject Ho because significant (p-value) < alfa 0.05
Accept H1 that Behavioral Intention to Use has linear relationship with Usefulness in Performance of Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.041	.408		2.553	.014
	UPF	.653	.114	.668	5.743	.000

a. Dependent Variable: BIIUSE

Regression: Ease of Use in Doing Decision Making & BIIUSE Behavioral Intention to use

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	EOUDO[b]	.	Enter

a. Dependent Variable: BIIUSE
b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.568[a]	.323	.306	.76124

a. Predictors: (Constant), EOUDO

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.311	1	11.311	19.518	.000[b]
	Residual	23.759	41	.579		
	Total	35.070	42			

a. Dependent Variable: BIIUSE
b. Predictors: (Constant), EOUDO

Ho: Behavioral Intention to Use has no linear relationship with Ease of Use in Doing decision making of model
Result: Reject Ho because significance (p-value) < alfa 0.05
Accept H1 that Behavioral Intention to Use has linear relationship with Ease of Use in Doing decision making of model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.108	.510		2.174	.036
	EOUDO	.699	.158	.568	4.418	.000

a. Dependent Variable: BIIUSE

BIOGRAPHY

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Conference Paper: Financing for Technological Innovation Business Start-up: Real Option and Product Modularity
(POMS 23rd Annual Conference, Chicago, Illinois, USA., 025-1235, April 20 to April 23, 2012)

Journal Paper: Innovation and Individual Investor's Decision making under Affordable Loss
(The International Journal of the Computer, the Internet and Management, submitted, May 31, 2012)

Financing for Technological Innovation Business Start-up: Real Option, Modularity and SP/A Theory
(Management Research Review, submitted MRR-Jun-2012-0133, waiting for review).