

The Schemes Funding Analysis for Technology Commercialization: A Case Study

Wahyudi Sutopo^{1,*}, Rina Wiji Astuti², Yuniaristanto¹

¹ *Department of Industrial Engineering, Sebelas Maret University, Surakarta, Indonesia*

² *Graduate School of Industrial Engineering, Sebelas Maret University, Surakarta, Indonesia*

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Abstract

Funding is an important aspect in doing commercialization of the results of research based technology. Adequate funding is needed to develop successful research. This article is focused on developing a funding strategy for technology commercialization, on the condition where the funds owned by the researcher is not sufficient, the efforts need to do is find the source of funding from the other funding source. This research methodology was conducted by identifying an alternative access to the finance commercialization of technologies that possible and analyzing detail on each scheme by collecting primary data through interviews and support with some secondary data. The data were collected from interviews with the Technology Transfer Office (TTO) of universities in Indonesia; questionnaires and published material from some universities and research centers and Ministry of Science, Technology, and Higher Education of Indonesia. We also made a case study of a comparative analysis between Indonesia and Malaysia. The collected data were transcribed and analyzed with mapping analysis based on the criteria for each funding scheme. Conclusions are drawn from the study findings and recommendation made.

1. INTRODUCTION

Technology commercialization is a conception with inventions, evaluation of the invention, determination and follow-on of the appropriate from of intellectual protection, initial market assessment, further technical analysis, market and competitive analysis, relative value proposition of technology, estimation of the development requirement and time to market, confirmation of commercial interest, establishment of a formal business plan, identification and consideration of appropriate sources of financing and raising such financing (Gardner, 2004). Commercialization system infers many such features as; banking industry, venture capital firms, technology transfer offices, management consulting company, small and medium sized firms, the entrepreneurs and so on (Khin *et al.*, 2010).

Distribution of knowledge was regarded as an important determinant of innovation and it was reported that rate of commercialization has a positive effect on the growth rate of output in all industry (Hisrich *et al.*, 2006; Khin *et al.*, 2010; Ulku, 2007) and upstart entrepreneurs increasingly dominate the nation's economy.

Technology Based Firms during the early development phase are facing funding problems (Hisrich *et al.*, 2006). Identification of the reluctance of traditional lending institutions to invest as a reflection of the problems of distinguishing between good and bad technology businesses and furthermore, the lack of expertise of commercial banks in this sectors, coupled with the limited collateral of entrepreneurial managers (Mason and Harrison, 2010; Moore, 1994). These problems are believed to be mainly as a result of the cyclical nature of both product sales and R & D expenditure associated with these kinds of products (Mason, 2010). To be successful develop a research necessary source of adequate funding .

The funds obtained from the outside willing to participate in finance the project. On the condition where the funds owned for the project is not

*Corresponding author. Sutopo, W.
Email address: wahyudisutopo@staff.uns.ac.id (Sutopo, W.), yuniaristanto@gmail.com (yuniaristanto), rinawijia@gmail.com (Astuti, R.W.)

sufficient research, of course efforts need to do is find the source of funding from the outside or the second.

Universities usually has limited funds to finance a research project that required an active role of the college to find the parties that want to fund the research referred to. These early financing was allocated to interested and willing technology entrepreneurs through dedicated public agencies and some government ministries to provide certain support in technical expertise, training, disseminating information and financing (Siegel *et al.*, 2007). Further evidence was put forward that the fast growth nature and subsequent diminishing of sales over time from an initial new product indicate that the returns from these companies may not be consistent (Mason and Brown, 2011; Mason and Pierrakis, 2011).

The ability of an inventor to find a willing financier determines how quick his innovation can be commercialized (Lerner, 2010). However, there are several challenges faced by technology inventors in commercializing their innovations (Ulku, 2007). There are different types of financing possibilities available to technology based firms. From a strategic perspective, the view proposed that under certain conditions, there is no reason to expect a particular source of funding to be used more frequently by firms – proposes that firm's financing and investment processes are separate (Modigliani & Miller, 1958).

It can be considered as a barrier to the development and commercialization of the innovations as it is very difficult for firm to share risk (Mason and Brown, 2011; DGE, 2009). The funding mechanism also deals with aim (Sutopo *et al.*, 2013).

By the presence of this, this paper will provide funding strategy that is suitable for commercialization of technology result of the research based at the university of with doing mapping to sources of funding that may be in access and composed a recommendation that is appropriate for commercialization.

2.METHODOLOGY

The aim of this study is to find out the financing sources for technology based firm in Indonesia. This particular research reveals that there are many financing opportunities for technology based firm to commercialize their technology in Indonesia. Between technology development and technology commercialization, there is a valley of death (Sutopo *et al.*, 2015). Large investments are naturally extremely risk, and economies of scale often have a central impact on these decisions (Alvarez, 1993; Astuti, 2014).

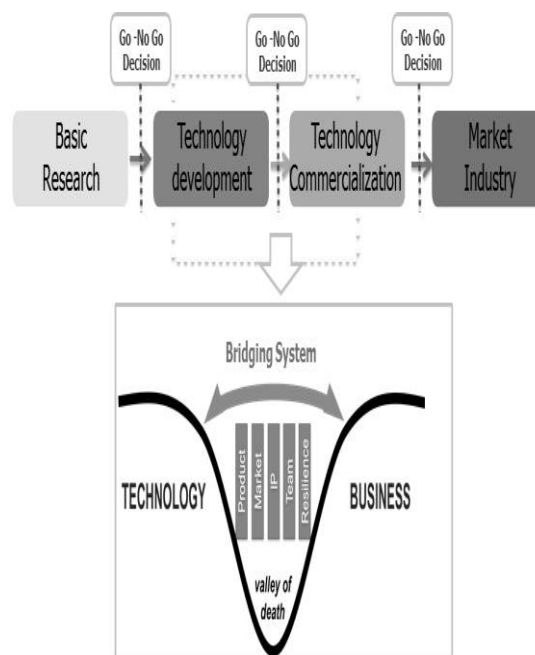


Figure 1. Valley of death. (Source: Sutopo *et al.*, 2015)

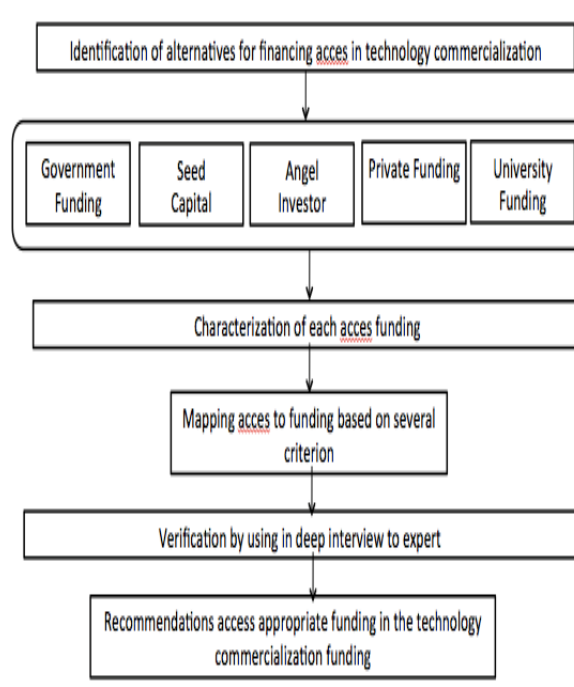


Figure 2. Research methodology.

Commercialization face problems whenever decision is taken on whether the risk are increased and usually public funding will end at creating a risk profile that is also called valley of death (Figure 1). The research methodology described in Figure 2.

The first step that carried out is done by identify an alternative funding access to commercialize of technologies and then explore the

following what was more detail on every access by doing the collection of primary data namely by interview and supported with some data secondary.

The data were collected from interviews with the Technology Transfer Office (TTO) of universities in Indonesia (UNS, ITB, UGM, and UI); questionnaires and published material from some universities and research centers (BPPT, LIPI, LPDP, USU, UPI) and Ministry of Science, Technology, and Higher Education of Indonesia. We also made a case study of a comparative analysis between Indonesia and Malaysia.

The identification obtained some among them are the access the government, seed capital, angel investors, private funding and the funding from the universities. Access to finance will be paid out by identified and performed based on mapping scheme criterion of them possessed of any access, procedures in filing funding, ease of accessing each funding sheme. Mapping was done by the criteria which had been it is stated the next step that is performed validation in arranging funding in strategy to commercialize the technology.

The validation done by implementing deep in the interview with the expert in order to obtain funding strategy that can be used as a reference in the budget process to commercialization of the results of research based technology and conducted comparison analysis by the other country in this case is Malaysia.

3. RESULTS

A. *Financing Stage For Technology Commercialization*

A technology commercialization presents a higher risk investment than a mature business. The mature business has assets for collateral and a known cash flow that allows investors and lenders to assess business risk. By its nature, the risk profile of a technology commercialization is much more difficult to assess.

The importance of focusing on early stage and expansion stage financing and the various phases within each stage is to understand the unique business and financing characteristics at each of these phases.

The seed phase, also known as the pre-commercialization stage, is the proof-of-concept stage in which a business idea is tested for its viability (Mason and Harrison, 2010). At this stage, the basic research may have been completed, but the commercial capabilities are not yet proven. Generally, a formal business entity has not been formed because the decision of whether to move forward with creating a business has not been decided (Mason and Pierrakis, 2011). The pre-launch phase occurs after the decision has been

made to move forward with the creation of a business. In this phase, the foundation for the business is created. Critical at this time is the development of a detailed business plan explaining how the business will be created and function. During the start-up phase, also known as the launch phase, production is initiated and sales occur (Ismail, 2013). It is characterized by hiring employees and establishing the products in the marketplace.

Tabel 1.
Financing stage for technology commercialization

Stage	Purpose	Instrument
Seed	Strategy & market research Develop Bus. Plan Dev. Beta product (or prove of concept (between \$100k - &1.0 mil)	Equity Convertible (redeemable) loan stock Preferred Stock (low valuation)
First Round – start-up	Complete initial product Build initial team (\$500k-\$5.0 mil)	Per Above
Second Round – Early	Bring product to market Complete team Get customer traction	Per Above + Warrant
Third Round (Expansion)	Expand sales and marketing Significant risk taken out of business	Per Above+ warrant + debt financing
Fourth Round (Mezzanine – Pre-IPO)	Working capital needed for liquidity event	Per Above + debt financing Higher P/E Listing price with discount (high valuation)
Liquidity (M&A or IPO)	M&A, secondary sales or IPO	MNCs, ACE, AIM, Catalyst etc

Source: Musibau, & Kamariah (2013)

Financing for the start-up phase involves bridge financing from the time the pre-launch phase is funded until operations commence, sufficient working capital for the smooth operation of the business, funding of any losses during the start-up phase and contingency funds in case of an unexpected interruption in the start-up process. Funding for the pre-launch stage and the start-up phase may occur at the same time. First-stage financing, also known as the ramp-up phase, is the final phase in early stage financing. It is characterized by ramping up production and sales. Second-stage financing phase follows first-stage financing and provides working capital for the initial expansion of a business that is producing and

shipping product and has growing accounts receivable and inventories (Jeng and Wolls, 2001). Although the company has made progress, there are instances in which it may not yet be profitable. Third-stage or mezzanine financing phases provided for major expansion of a company that has an increasing sales volume and is profitable. These funds are used for further plant expansion, marketing, working capital, or developing an improved product.

B. Government Funding

A combination of regional advantages and historical accidents conspired to produce in Israel the second greatest (after Silicon Valley) "Science Park" in the world (Trajtenberg, 2001). Government program which is a funding given by the government which was set out in the national budget through certain scheme (Siegal et al., 2003). After the data collection obtained some of the scheme owned by Indonesia, they are DIPA, BPPT incubation, LIPI incubation program, LPDP, DIKTI, BLU and research grants.

The budget for experience in the implementation of research and development still rely on state budgets (DIPA). However, in the distribution there are disparities the allocation of funding for the activities of research for produce technology (upstream financing) with activities to commercialize research and development (downstream financing). Information based on respondents, the fund used to finance research was taken from the DIPA budget was very minimal. Magnitude whose the very minimal, aside from the research budget very small, is also caused by an amount received are an brutto ever have to endure in the form of various reduction obligation pay all taxation, employee expenditure and travel as a consequence the use of state budgets.

C. Seed Capital

Seed capital is funds invested to support new and young companies without fully established commercial operations, launch new products, or continue research and product development (Shaver and Scott, 1991). Seed funds are professionally managed investment partnerships, or limited liability companies (LLCs), that invest in very young, seed-stage companies. Seed capital has always been considered a part of venture capital, specifically directed to early-stage ventures. In the early years, all venture capital was seed capital, supporting the launch of high-risk, technology-based concepts such as computer networks (e.g., Wang) and, later, personal computers (e.g., Apple) (Pike and Neale, 2003). Over time, venture investors discovered they could apply the techniques of private seed investing to more mature companies, particularly those positioned to grow extremely rapidly. Such companies could profitably use very

large amounts of money, making it practical for investors to assemble much larger investment funds (Atkinson, 1998).

Most seed investors look at hundreds of proposals before selecting a handful for investment. Seed capital is needed at the time of creation of the spinout company (Williamson and Markets, 1993). It should be sufficient to fund the company at least through the period needed to produce the proof of concept of its invention or business idea. The duration of this period may vary between two and five years depending on the type of the underlying funding needs.

D. Angel Investor

Define Business angels may therefore play a key role in addressing the equity gap, being more willing to risk investment in early-stage companies. Business angels possess the necessary industry and management experience, to review and invest in promising technology transfer projects. Furthermore, the amounts invested by business angels tend to be far smaller than investments by venture capitalists and hence more suitable for early stage financing (Abel and Deitz, 2011; Arthurs and Busenitz, 2003; Chemmanur, 2010; Levie, 2014; Mustar, 1995; Ontario, 2004; Peneder, 2010; Shaver and Scott, 1991; Siegal et al., 2003; Trajtenberg, 2001; Van, 2002). Business angels have the expertise to help to review technologies and to advice on the commercial potential of technologies, which increases the likelihood of start-up enterprises surviving. This also gives business angels an opportunity to keep themselves updated on university technologies and thus possible investment targets. Some academic institutions in Europe have developed particular relations with certain business angels (Abel and Deitz, 2011; Arthurs and Busenitz, 2003; Klepper, 2002; Levie, 2014; Mustar, 1995; Ontario, 2004; Peneder, 2010; Shaver and Scott, 1991; Siegal et al., 2003; Trajtenberg, 2001; Van, 2002).

E. University Funding

Colleges and universities can help raise a region's human capital levels not only by supplying local graduates, but also by conducting research activities (Abel and Deitz, 2011). Much of the academic work has been focusing on technology transfer from research organizations or universities to the incumbent industry (Mustar, 1995). Conversely, much less is known about creating new ventures as a way to commercialize research and technology. This does not mean, however, that creating spin offs for technology transfer purposes, is an entirely new phenomenon (Levie, 2014).

Tabel 2.
Funding Scheme Characterization

			Funding Capacity	Focus
Government Funding	Technology Policy Assessment, Agency for Assessment And Application of Technology (BPPT)	Incubation Program	Based on the type of product to be commercialized	Technology, software, food
	Indonesian Institute of Science (LIPI)	Incubation program	Based on the type of product to be commercialized	Technology , Software , food
	Indonesia Endowment Fund for Education (LPDP)	RISPRO-Commercial	\$100.000/ year	Food , Energy , Health and medicine , defense and security , transpor Commercialization of
	Public Service Agency (BLU)	ITB, IPB, UI, UGM, USU, UPI Pilot project, competition	Based on university budget \$1500- \$50.000	research results of universities Technology , Software system
Seed Capital	University Grant		Based on the ability of networking	Funding
Angel Investor	Owner, family, business partner individuals who have substantial funds that invest to grow the business early stages (startup)	Loan with no interest rate		
Bank	A financial intermediary that creates credit by lending money to a borrower	Loan	\$3000- \$9000	Funding , mentoring , networking , business consulting Use of collateral , for all businesses
Ventura Capital	An independently managed, dedicated pools of capital that focus on equity and equity linked investments in privately held, high growth firm.	Bank Loan	Based on collateral	Indirectly involved in the aspect - the aspect of management , administration , marketing
University Funding	PPKWU	Chosen proposal	\$ 3000	
			\$ 100 - \$1000	

A better option for intrepid entrepreneur is technology incubator (Musibau, 2013). As well as technopreneur, it also needs a technology incubator to accelerate the invention to commercialize. Incubator address the most challenging aspects of building a successful new technology company: access to early capital and expert mentoring to turn ideas into tangible business models (Ontario, 2004).

F. Bank and Capital Venture (Privat Funding)

In bank based systems, on other hand, bank loans are an important source of external finance, implying that this results in a system that encourages strategies with a longer term perspective, emphasizing relational banking and firm specific understanding

which increases the likelihood of debts being repaid to the bank (Kreinsen, 2011).

Venture Capital has been recognized globally as being among the most important financing mechanism for Technology Based Firms (TBFs) assisting Research and Development (R & D) activities, from encouragement of rudimentary scientific research to technology development and commercialization (Anokhin et al., 2011; Aakub et al., 2011; Mason and Pierrakis, 2011). Venture capital plays a minor role in funding basic innovation; in 1997 only about 6 percent of the \$10 billion VCs invested went to start-ups (Arthurs and 2003).

Table 3.
The Advantages and Disadvantages Of Each Funding Scheme

Scheme	Advantages	Disadvantages
Government Funding	Strongly supports the commercialization of research results to the academic community of a university	Limited funds
Seed Capital	Seed capital often comes from the company founders' personal assets or from friends and family	Fund depends on the ability of networking, The amount of fund is usually relatively small because the business is still in the idea or conceptual stage.
Angel Investor	The opportunity to be given access to the knowledge , experience , and network of the Angel , which is the business leaders in Indonesia were successful	No business mentoring facility
Private (Venture Capital)	Investment decision is based on economic considerations, VC fund managers are much more exposed in terms of investment experience	Exposed in terms of investment
University Funding	Filing procedures easier	Limited funding , lack of good management

Table 4.
Fund Managed by MTDC

Name	BSF	CRDF	BGF	TAF
Fund size	RM 125 million.	RM 180 million.	RM 150 million.	RM12 million
Source of fund	Ministry of Finance (MoF)	Ministry of Science, Technology and Innovation (MOSTI)	Ministry of Finance (MoF)	Ministry of Science, Technology and Innovation (MOSTI)
Fund tenure period	Budget 2011-2012.	10 th MP	10 th MP	10 th MP
Fund objectives	To support and encourage entrepreneurship and creation of new strategic businesses that are important, and potentially scalable; and the funding of supporting companies within a technology eco-system.	To promote the commercialisation of locally developed technologies (from public and private universities, Government's Research Institutions and companies) undertaken by Malaysian owned company.	To support successful grant recipient companies until they can generate sufficient commercial value to attract VC financing and other forms of financing.	To facilitate eligible Malaysian companies in the acquisition of foreign technologies for immediate incorporation into the company's manufacturing activity.
Focus sectors	Technology companies.	Locally-developed high technology, except ICT.	High technology companies.	Technology companies.
Subscription instrument	Loan with convertible option to equity.	Partial, matching grant.	Hybrid – a combination of grant and equity.	Partial, matching grant.

Source: Malaysian Technology Development Corporation, 2015

Venture Capital is defined as an independently managed, dedicated pools of capital that focus on equity and equity linked investments in privately held, high-growth firms (Lerner, 2011). They play a key role in the emergence of new industries by establishing and assisting technology firms which later dominate these industries. While there is an emphasis that VC investments accelerates the growth of firms, enabling them to transform ideas quickly into marketable products and become industry leaders through first-mover advantages (Mason, 2011)

Venture Capital raise their finance predominantly from large financial institutions such as pension funds, insurance companies, banks and have a duty of care when investing this money (Ismail, 2013). So their investment decision is based on economic considerations (Cooper, 2011; Ismail, 2013; Megginson; 2012). They are also more concerned about exit routes and investment stage. They decide on the worth of a potential investment as principals, rather than as agents or employee (Jeng and Wells, 2011; Macmillan et al., 1989). VC fund managers in terms of their investment capacity. They have deeper pockets and are able to provide further rounds of funding necessary for growth (Ismail et al., 2011). And this puts them in a more comfortable position as equity owners of the business because of their capacity to negotiate for stakes in the investee companies.

4. DISCUSSION

This research finds that VCFs also source their capital under management from a variety of sources. The capital is channeled to support TBFs grow their innovations from the early stage through concept formation to commercialization for mass marketing, licensing to spin off, licensing to established companies or possibly IPO as the case may be. Fund managers can manage risks related to asymmetric information in a number of ways and this can be maintained assuming that three control mechanisms are common to almost all VC investments; The use of financial contracting, most commonly used by financing through convertible securities, syndication of investments, incremental financing.

On this occasion we also do a case study of a comparative analysis between Indonesia and Malaysia through Malaysian Technology Development Corporations (MTDC). Role of MTDC is to identify, finance and develop potential companies in strategic technology areas, to focus on commercialisation of public sector research results, to identify and transfer emerging and strategic technologies for adoption by industries. MTDC services are grant management, soft loan and hybrid fund programmes, advisory and value added service and incubation management that shown at Table 3.

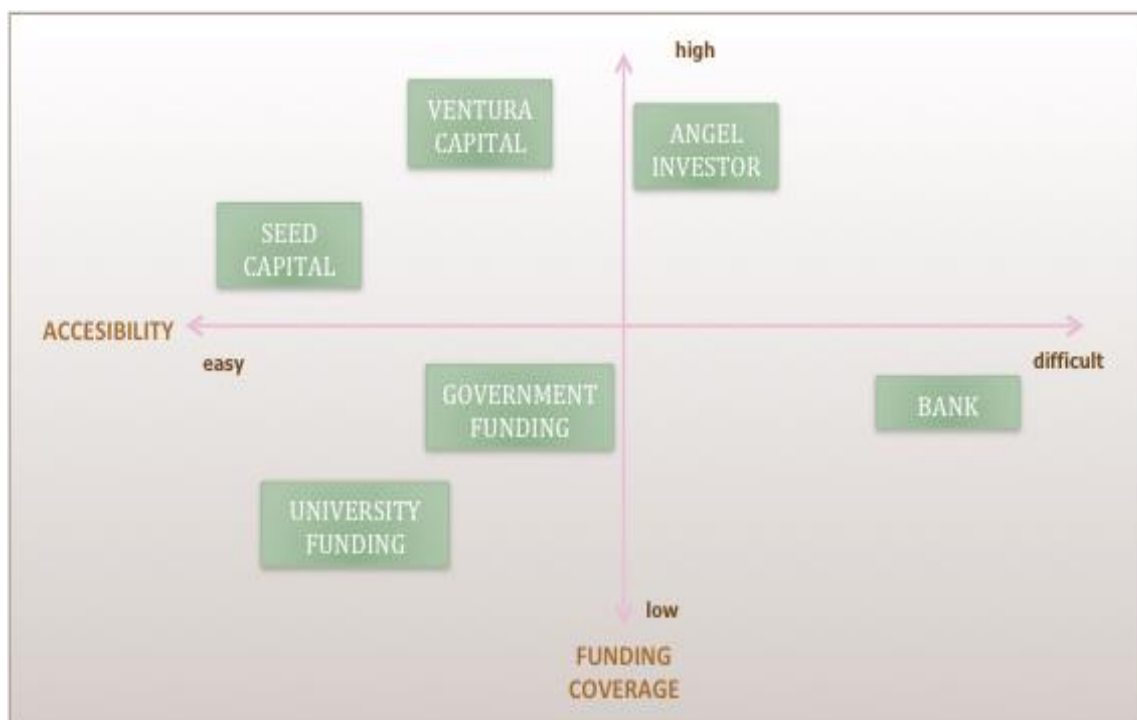


Figure 3.
General Mapping of Funding Source

Table 5.
Funding Scheme Comparison

Stage	Indonesia	Malaysia
Seed (Research Basic)	V	V
First Round – start-up	Limited	V
Second Round – Early	Limited	V
Third Round (Expansion)	V	V
Fourth Round (Mezzanine – Pre-IPO)	V	V
Liquidity	V	V

From Table 5 known that Indonesia still have obstacles on funding for start-up stage and early stage. Furthermore the amount of funding that used in Indonesia is smaller than Malaysia.

5. CONCLUSION

The findings from this study finds that there are many funding sources that available to support the growth of technology commercialization in university. For technology commercialization we recommend to access a government funding for RnD stage and venture capital to start up the company that produce by technology commercialization in university. University are also highly funded to ensure that they engage in R & D that is aimed at generating innovative products that could develop to global companies and hence boost job and wealth creation for the economy. So that policy strategies are needed at every stage of the funding.

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