International Journal of Technology (2018) 7: 1469-1479
ISSN 2086-9614 © IJTech 2018

ANALYSIS OF LIFE CYCLE COST AND PUBLIC-PRIVATE PARTNERSHIP IN THE DEVELOPMENT OF WALINI CITY AS TECHNOLOGY PARK

Mohammed Ali Berawi[1*], Asifa Nabila[1], Gunawan[1], Perdana Miraj[2], Hamzah Abdul Rahman[3], Abdur Rohim Boy Berawi[1]

[1]*Department Civil Engineering Department, Faculty of Engineering, Universitas Indonesia, Kampus UI Depok, Depok 16424, Indonesia*
[2]*Department of Civil Engineering, Faculty of Engineering, Universitas Pancasila, DKI Jakarta 12640, Indonesia*
[3]*Department of Quantity Surveying, Faculty of Built Environment, University of Malaya, 50603 Kuala Lumpur, Malaysia*

(Received: July 2018 / Revised: August 2018 / Accepted: December 2018)

ABSTRACT

Walini is an area with potential for development into a technology park based on its population and economic growth. This paper aims to analyse the investment feasibility of the development of Walini Technology Park and its optimum funding scheme. The life-cycle analysis approach is used to evaluate operation and maintenance (OM) costs and the system dynamics technique to generate revenue. The study will focus on examining scenario alternatives to determine an optimum public-private partnership (PPP) scheme. The results show that development of Walini would require an investment cost of 151 trillion rupiahs (US$ 9.97 billion) and OM costs of 353 trillion rupiahs (US$ 23.3 billion). The development would generate a revenue of 75 billion dollars, with a 35-year concession period. 42 scenarios were considered in order to obtain that with optimal Internal Rate of Return (IRR) values. The optimal IRR score is 15.57%, with a private share of around 49.89% of the initial costs, 60.08% of operational and maintenance costs, and 80.06% of revenue.

Keywords: Feasibility analysis; Investment cost; PPP scheme; Technology park

1. INTRODUCTION

Infrastructure and regional development correlate highly with each other in the increasing economic growth of a nation (Berawi & Susantono, 2012; Komarova et al., 2014). They improve connectivity and provide mobility for people in conducting their economic activities. The Indonesian government is attempting to develop a high speed train connecting the capital city with Bandung. The project is expected to increase economic activities and in the long term significantly contribute to the nation’s competitiveness on a global scale.

Previous research has generated the conceptual design of New City Walini. It recommends the adoption of a technology park similar to Silicon Valley in the United States (Berawi et al., 2017a). This concept aligns with the government’s attempt to encourage greater use of technology and industry for the future of Indonesia.

According to Presidential Regulation of the Republic of Indonesia No. 2 year 2015 on the Regional Development Plan (RDP) 2015-2019, the technology park has the potential for

*Corresponding author’s email: maberawi@eng.ui.ac.id, Tel. +62-21-7270029, Fax. +62-21-7270028
Permalink/DOI: https://doi.org/10.14716/ijtech.v9i7.2588

development and to increase Indonesian competitiveness as a center for science, technology and innovation on a global scale. The development of technology is a correlation between industrial growth along with technological development by the university. Universities, R&D institutions and industry should be integrated into the region for instance Walini (Berawi et al., 2017a).

Walini's development requires a fund of 151 trillion rupiahs (Taris, 2016). As such huge amount will heavily burden the state budget, a cooperation scheme between the government and private financing, known as a Public Private Partnership is required to minimize government subsidy into the project. However, its implementation faces several issues, such as the budget, overlapping regulations, resistance from the public, private party guarantees that have not been obtained from the government, and the fact that the proposed projects have not been well prepared (Wibowo et al., 2012).

Moreover, the large funds involved in the development of Walini city will cause a delay in capital return if only a few areas are developed (Taris, 2016). Considering such obstacles, there is a need to re-plan the financing cooperation scheme. Therefore, it is necessary to calculate the life-cycle cost to elaborate the financial feasibility of the proposal.

2. METHODS

In the study, life cycle costs, comprising initial costs, operational and maintenance costs and revenue, and the PPP scheme were used to evaluate the project feasibility (Rahman & Berawi, 2002; Berawi et al., 2016). The operational and maintenance costs were derived from the benchmarking process from countries that have similar technology parks. For the analysis of the revenue results, the capacity analysis and price per unit of each regional function were formulated based on a causal loop diagram and simulated into a dynamic system using Powersim software. The results of the operational and maintenance costs and revenue results became the basis for generating IRR value, financing schemes and institutional schemes between the government and the private sector.

2.1. Life Cycle Cost Analysis

Life Cycle Cost (LCC) is a method to assess the total cost of ownership of a facility and its design with the lowest overall costs, while maintaining its quality and function. The method takes into account all costs, starting from construction costs and operational costs, and including the cost of capital return (Fuller, 2010; Berawi et al., 2017b).

LCC calculates capital and funding costs and operational and maintenance costs, as well as the end-of-life costs associated with certain assets or projects. LCC considers uncertainty, risk and other elements, including the environment. The method can produce an accurate cost comparison when conducted properly (Woodward, 1997). In Value Engineering study, LCC is needed to evaluate several alternative solutions in order to achieve the optimal value of the total costs (Kirk & Dell'isola, 1995).

LCC comprises initial cost, operation and maintenance cost, and revenue. Initial cost in infrastructure projects can be in the form of land acquisition, construction or renovation costs, or procurement of equipment for project operations. Operation and maintenance (OM) cost is usually issued per specified period, expressed in monthly or yearly terms. This cost varies between projects due to different operational schedule and maintenance standards. The costs of taxes, insurance, electricity, gas, utilities, personnel salaries, maintenance, marketing, administration and general costs are commonly included in the scope of OM fees (Fuller, 2010). Revenue is the total income generated by the sale of products or services from an infrastructure.

The calculation of life-cycle cost analysis considers the time value of money based on the NPV value (de Blas, 2006). NPV is the calculation of the cost invested by estimating the value in a particular period. The formula can be expressed as follows:

$$NPV = i: \sum_{t=0}^{T=N} \frac{(B_t - C_t)}{(1+r)^t} \tag{1}$$

Two main variables, Internal Rate of Return (IRR) and Minimum Attractive Rate of Return (MARR), are used to determine the accuracy of the above formula (Karim et al., 2007; Morgan, 1999). IRR is a method commonly used by private parties to determine the feasibility of an investment; the IRR value is one of the considerations of the private sector in predicting project sustainability and risk. MARR is the minimum value from IRR offered by the party providing the project to an individual/company/agency. It can also be defined as the minimum value of the rate of return of the average company for all aspects of a project. The following comparison of IRR and MARR is used as the basis for selection of the PPP scenario.

Table 1 Comparison between IRR and MARR

Condition	Explanation	Conclusion
IRR>MARR	Investments provide benefits to the investor	The project is recommended for implementation
IRR< MARR	Investments do not provide benefits to the investor	The project is not recommended for implementation
IRR = MARR	Investments do not see any profit or loss	The project implementation decision depends on the investor's policy

One way to determine MARR is to calculate the weighted average cost of capital (WACC) of the sector associated with the project investment (Ye & Tiong, 2000); in this case, the construction sector. For Indonesia, the WACC value of the construction sector is 11.1% (Finance 3.1, 2017). Furthermore, the assumed discount rate is 4.75%, with a general inflation rate of 4.33% and property sector inflation of 5.91% (Bank Indonesia, 2017).

2.2. PPP Scheme

PPP is a legally binding contract to manage responsibilities between the government and a private entity in the infrastructure sector. The concept of PPP regulates the resources, risks, responsibilities and rewards planned for implementation by the government in cooperation with the private sector (Asia Pacific Economic Cooperation, 2014). Several types of PPP might be used; for instance, Design-Build-Finance-Operate (DBFO), Design-Build-Operate (DBO), Design-Build-Maintain (DBM) and Build-Operate-Transfer (BOT), depending on condition of the state condition, readiness regulations and other related factors (Asian Development Bank, 2007).

DBFO is the most common form of PPP, integrating all four functions, namely design, build, finance and operate. In this method, the private sector is paid according to the performance standards for the development carried out; this is done so that capital resources can be used optimally. This approach will also transfer financial risk to the private sector. In the DBO model, the public sector provides funding for the planning and development phase, while the operational phase involves the private sector. This model is appropriate for an extended type of project which the private sector cannot finance. Unlike DBM, this model requires the private sector to design, build and carry out maintenance within a certain period of project completion. In BOT, the private sector must bear all development and operational costs and is responsible for project maintenance. As compensation, the private party has the right to receive project revenue within a particular time according to the contract, and subsequently return it to the public/government at a cost or no cost at all, according to the agreement that has been previously agreed (Levy, 2008).

2.3. System Dynamics Model

The revenue calculation for the Walini technology park uses the system dynamics model. This model is used because of its superiority, being flexible, closer to the real dynamic world and providing more extensive problem space information (Husin & Berawi, 2015). In the model, a system must be translated into a map of the problem that describes the causal relationship between variables, which is called the causal loop diagram (CLD).

The causal loop diagram of Walini Technology Park representing each function in the area is shown in Figure 1.

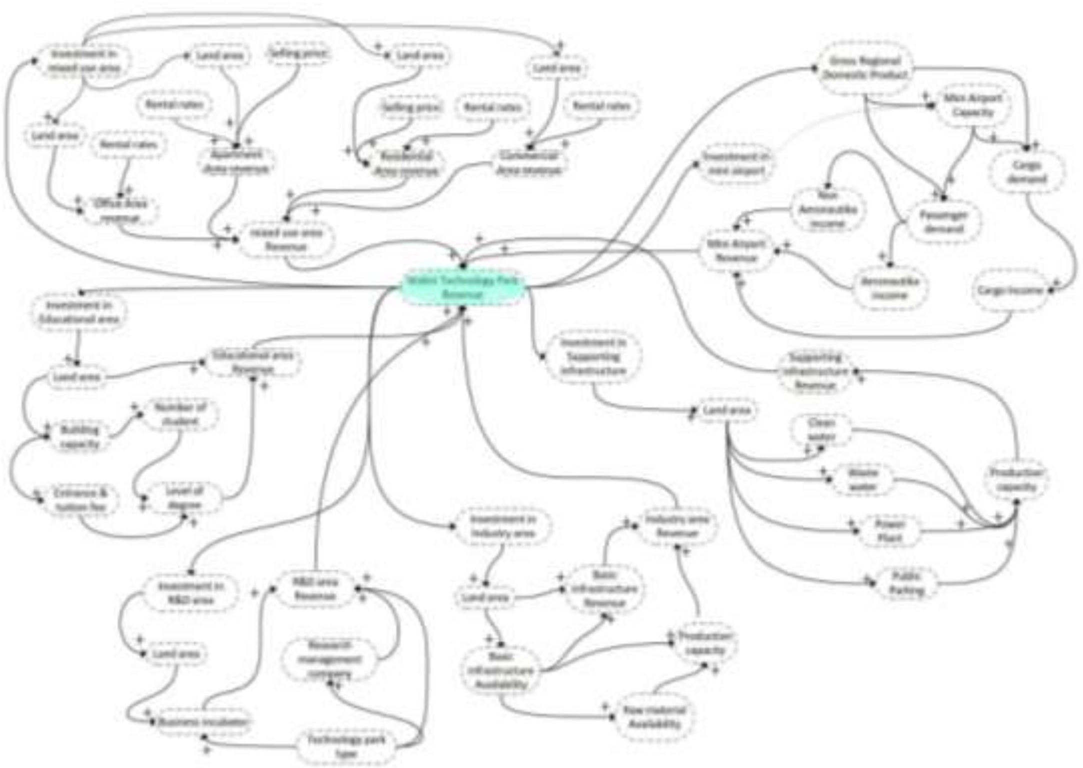

Figure 1 Causal loop diagram of Walini technology park

The CLD illustrates the relationship between the cause and effect variables on the income of the Walini Technology Park area. An arrow symbolizes visualization of the relationship between the variables. The cause variable is located at the beginning of the arrow, and the effect one lies at the end of it. Furthermore, a positive (+) sign on the arrow indicates a relationship that is directly proportional, while a negative (-) sign is inversely proportional.

There are six functions in the CLD model above. The first is a mixed-use area, with the variables being land area, rental and selling prices. The second function is the university area, the forming variables being the number of students, land area, building capacity, entrance fees, and tuition fees. The third function is the research and development area, with the forming variable being the type of technology park to be developed. The fourth function is the industrial area, with production capacity as its forming variable. The fifth function is the supporting infrastructure, with land area and production capacity as the forming variables. The sixth function is the mini airport with the aeronautical, non-aeronautical and cargo sectors as the forming variables.

3. RESULTS AND DISCUSSION

3.1. Life Cycle Cost Analysis

3.1.1. Initial Costs

Based on calculations from previous research activities (Luthfia, 2016), the total initial cost of building Walini Technology Park is 151 trillion rupiahs, equal to US$ 9.97 billion dollars. This cost was obtained from the results of a benchmarking process with similar projects in Bangladesh and India, adjusted to the unit price of Indonesian materials. The details of the initial cost in developing the city of Walini as a technology park are shown in Table 2.

Table 2 Total initial cost of development of Walini as a technology park

Industry Region	$2,425,670,994.62
Residential Region	$1,686,177,671.56
Education Region	$1,045,742,589.52
Commercial Region	$3,369,251,841.28
Research and Development Region	$960,393,283.80
Supporting Infrastructure	$483,703,401.83
Total	$ 9,970,939,782.61

The cost of land acquisition is the main component of the initial cost, while other costs are adjusted to the functions of each region; for instance, industrial estates including factory buildings and offices, mobile phone industry equipment, component industry, semiconductor industry, software industry, and infrastructure and supporting facilities. In terms of the residential area, this will include low rise and high rise building settlements. The education region will consist of the cost of campus buildings, and academic and public facilities. The commercial area will include office buildings, malls, hospitals, schools, sports buildings, mosques, community centers, entertainment, a railway station and mini airport. The research and development area will consist of office building costs, garden techno-science equipment, bio technoparks, a geopark, art technopark, and industrial park. Finally, the initial cost of the supporting infrastructure includes roads, public parking, power plants, water treatment plants, and wastewater treatment plants.

3.1.2. Operation and maintenance costs

The operation and maintenance costs were ascertained by a benchmarking process that involved each component of the compiler function of each region. Three stages of development will be implemented. In the first stage, the components that will be built consist of roads, clean water treatment, dirty water treatment, power plants, residential areas, education areas, health facilities, worship facilities, public facilities, train stations, science tech parks, and geo-tech parks. The second stage includes the development of a mobile phone industry, semiconductor industry, parking space, medium-rise offices, a mall, and bio technopark. In the final stage, the components industry, software industry, sports facilities, community centers, entertainment and art centers, and an industrial technopark will be developed (Taris, 2016).

The calculation of the operational and maintenance costs was made following the stages of development. The operational and maintenance costs of the mobile phone industry and mini airport area are based on Korean industry equivalents (Samsung, 2013; Zakariah, 2015), while those of the component and software industry are in line with similar industries in Japan (Hanby, 2016; Sharp, 2017). For Research and Development, the countries used for benchmarking were India for the science technopark; Switzerland for the bio technopark; Dubai for the geo technopark; Hamburg for art technopark, and Morocco for the industrial park. The residential areas and education and commercial zones were benchmarked on the existing surrounding areas. From the benchmarking process, the total cost required is around US$ 23.3 billion, as detailed in Table 3.

Table 3 Total OM cost of development of Walini as a technology park

Industry Region	$ 10,207,824,324.31
Residential Region	$ 1,822,847,194.82
Education Region	$ 239,175,213.23
Commercial Region	$ 4,097,858,031.10
Research and Development Region	$ 5,261,658,776.82
Supporting Infrastructure	$ 1,670,151,521.32
Total	$ 23,299,515,061.60

3.1.3. Revenue

Revenue was calculated based on the projections of goods/services produced, selling prices, and market share for each production/service area. Income was then formulated using a causal loop diagram (CLD), and simulated through system dynamics using Powersim software (Sterman, 2000). Based on the simulation, a revenue of US$ 75.491 billion was generated. The details of the revenue for each area development are shown in Table 4.

Table 4 Revenue from development of Walini as a technology park

Industry Region	$	30,722,096,013.06
Residential Region	$	12,431,098,729.98
Education Region	$	299,719,149.76
Commercial Region	$	22,814,281,283.43
Research and Development Region	$	8,941,100,283.98
Supporting Infrastructure	$	283,407,315.71
Total	$	75,491,702,775.92

The assumptions of the selling prices of products and services in calculating the revenue were determined based on the results of the benchmarking approach from various countries and companies. For instance, the selling price of cell phones was obtained from international cellphone brands, at about US$ 132 per unit, and that of semiconductors at US$ 79 per unit. On the other hand, the selling prices of products from the component industries refer to the Taiwan Semiconductor Manufacturing Company (TSMC), estimated at about US$177 per unit, and those of the software industry at US$113 per unit.

The residential area was forecast to sell 85% of its total capacity, with the remaining 15% leased. Selling and leasing prices refer to property prices in West Bandung regency. Low rise building rental prices are US$ 16 per square meter per month, high rise building about US$ 24 per square meter per month, low rise building sales prices are US$ 274 per square meter, and high rise building sales are US$ 413 per square meter.

The revenues from education are from entry fees and tuition fees and refer to similar fees implemented in West Java province. Entrance fees for master's and doctoral students are US$ 40, while tuition fees for each semester for undergraduate, master and doctoral students are US$ 660, US$ 890 and US$990 respectively.

Commercial income is obtained from leasing the office buildings, mall stores, and commercial land. In determining the prices, benchmarking was conducted on the average cost of rental of commercial and contract buildings in Bandung and were based on data from Colliers International for the fourth quarter of 2016 (Colliers International, 2016). From the benchmarking process, the cost of office building rental is US$ 430 per square meter, and the rental price of commercial land is US$ 485 per square meter. For mall store rentals, the cost is US$ 1,676 per square meter, which includes security and cleaning costs.

Research and Development revenue is derived from the costs of research management company and leasing business incubator services. The details of the research management fees and business incubator rental are explained as follows. The science technopark adopts a similar concept to that used in Pune, India, which cost US$ 71,774 per unit of service and US$ 598 per square meter. On the other hand, the bio technopark refers to a similar project in Schlieren, Zürich, Switzerland, at US$ 78,697 per unit of service and US$ 656 per square meter. In addition, the geo technopark refers to the concept in Dubai, at about US$ 73,322 per unit of service and US$ 611 per square meter. The art technopark is based on a project in Hamburg, Hit-Art, equal to US$ 79,860 per unit of service and US$ 590 per square meter. Finally, the industrial technopark refers to Casablanca, Morocco, at US$ 71,745 per unit of service and US$ 598 per square meter.

Supporting infrastructure income is obtained from clean water supply services, wastewater management, electricity and public parking. The price for providing the services is based on the JABABEKA Indonesia industrial area for clean water and wastewater, at US$ 0.36 per cubic meter and US$ 0.42 per cubic meter respectively. Electricity refers to the price charged by the State Electricity Company (PLN) of US$ 0.16 per kilowatt hour, while public parking refers to prices in West Bandung Regency of US$ 0.07 per hour for motorcycles and US$ 0.14 per hour for cars.

3.2. Financing Scheme

The simulation to generate optimum IRR values was conducted through four types of financing schemes between the government and the private sector:

- The initial cost-sharing scenario.
- The operation and maintenance cost-sharing scenario.
- The initial cost and operation & maintenance cost-sharing scenario.
- The initial cost, operational & maintenance cost and revenue sharing cost-sharing scenario.

The distribution scenario of investment costs between the government and private sector follows three subsidy scenarios: 40%, 50% and 60%. The assumption is analyzed using logic by considering the ability of private and government involvement to bear the initial investment cost, with figures of 40% and 60% obtained. The private sector will subsidize 40% if the government bears an initial investment cost of 60% of the Walini city development plan, and vice versa: the private sector will subsidize 60% if the government bears an initial investment cost of 40%. The percentage assumption using a combination of 40%, 50% and 60% is used in determining the share of operational costs and maintenance of the construction.

The revenue scenario between the government and private sector uses a range of 60%, 70% and 80%. The four schemes therefore produced 42 scenarios. In the first scheme, the government and private sector only share the initial costs, while the operations and maintenance costs and income are in the hands of the private sector. In the second scheme, the government and the private sector share operation and maintenance costs, meaning the initial costs and revenues are in the private sector.

In the third scheme, the government and the private sector share the initial costs and operating and maintenance costs, but overall project revenue is retained by the private sector, whereas in the fourth scheme, the government and the private sector share the initial costs, operating and maintenance costs and income. The percentage of initial cost and operating and maintenance costs ranges from 40% to 60%, based on Minister of Finance Regulation Number 223/PMK.01/2012, while the percentage of revenue sharing ranges from 60% to 80% for the private sector, based on an analysis of private investment interest in development projects. Table 5 shows the advantages and disadvantages of each scheme.

Table 5 Advantages and disadvantages of the four schemes

	Advantages	Disadvantages
Scheme 1	• The government only participates in the initial investment cost sharing, so no further processing system is required, such as area revenue. • Generates a maximum Net Present Value (NPV) of 15.5%.	• No revenue for the government. • Minimum involvement from the government in Walini city development; no control from the government that allows for a monopoly.
Scheme 2	• The government only participates in operational and maintenance costs, so no further processing system is required. • Generates a maximum NPV of 11.52%.	• No revenue for the government. • Lack of interest from private parties due to minimum IRR value.
Scheme 3	• The government participates more systematically in the development of the city. • Generates a maximum NPV of 18.30%.	• The government needs to develop a further processing system for the operational and maintenance costs that will be incurred. • No revenue for the government.
Scheme 4	• The government participates more systematically in the development of the city. • The government obtains revenue from the development. • Generates a maximum NPV of 18.30%.	• The government needs to develop a further processing system for the operational and maintenance costs that will be incurred.

Based on Table 5, the fourth scheme is the optimal one. Its advantage is the optimal IRR value, with the more systematic involvement of the government in the development of the city of Walini. The fourth scheme, used with the optimal IRR value and the distribution of the private sector, amounts to 50.29% of the initial cost of the investment, 59.80% of operational and maintenance costs, and 80.06% of revenue. The use of the scheme results in an IRR of 14.63%. The resulting NPV derives from each life cycle cost component. In this scheme, the private sector will be involved in a particular area; the investment is summarized in Table 6.

Table 6 Private financing

IC Private	OM Private	R Private
	RnD Area	
• Construction of science technopark. • Construction of bio techno park.	• O&M of science techno park. • O&M bio techno park.	• Revenue from science technopark. • Revenue from bio technopark.
	Industry Area	
• Develop of semi-conductor industry. • Construction of mobile phone industry. • Construction of software industry.	• O&M of semi-conductor industry. • O&M of mobile phone industry. • O&M of software industry.	• Revenue from semi-conductor industry. • Revenue from mobile phone industry. • Revenue from software industry.
	Mixed-Use Area	

IC Private	OM Private	R Private
• Construction of high rise buildings. • Construction of medium rise buildings. • Construction of mall. • Construction of community center. • Construction of entertainment centers. • Construction of mini airport.	• O&M of high rise buildings. • O&M of medium rise buildings. • O&M of mall. • O&M of community center. • O&M of entertainment centers. • O&M of mini airport.	• Revenue from high rise buildings. • Revenue from medium rise buildings. • Revenue from mall. • Revenue from community center. • Revenue from entertainment centers. • Revenue from mini airport.

From the above financing scheme, the research has produced an institutional scheme for the development of Walini city. The proposed scheme involves five main parties, namely the planners, the providers of capital, the service providers, the government and the service users. The planners consist of planning consultants; the providers of capital consist of PT SMI, investors and bank; and the third party service providers consist of contractors, operational and project maintenance providers. The study proposes a special purpose vehicle (SPV) to manage the development, from the initial stage up to operation and maintenance. The institutional scheme is shown in Figure 2.

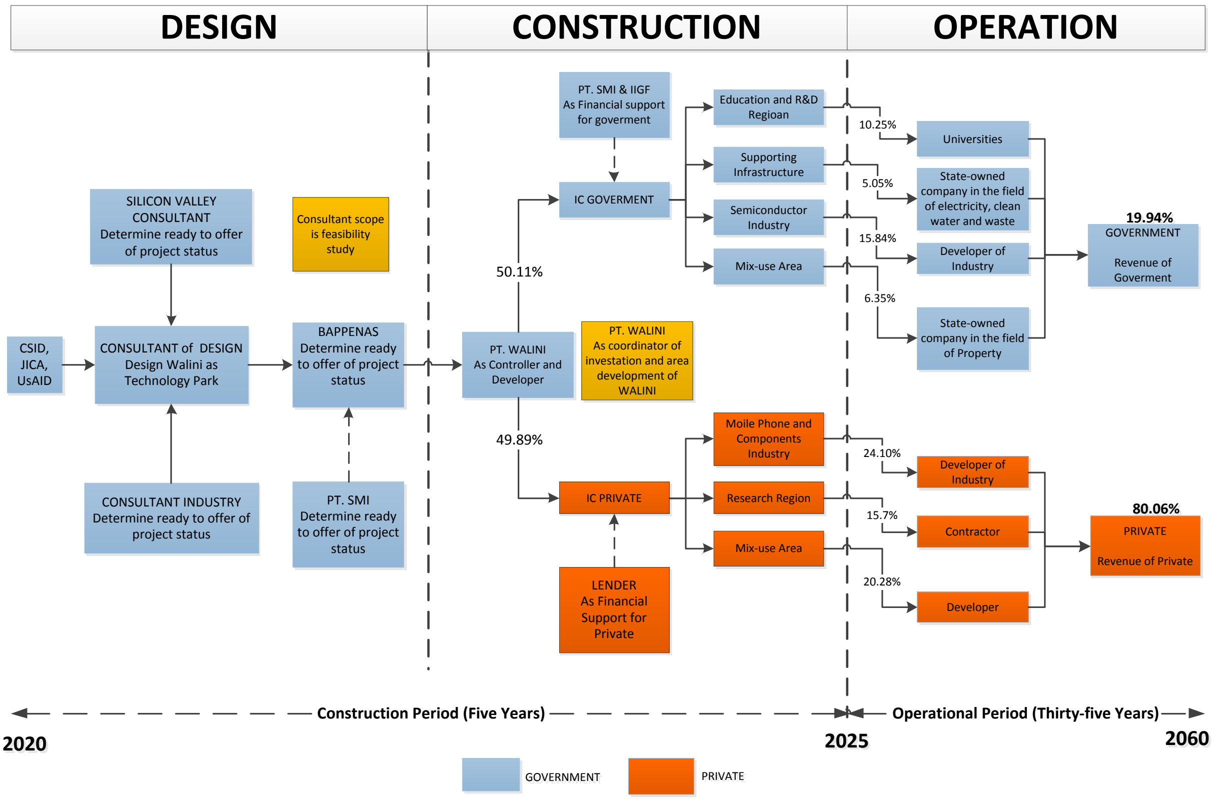

Figure 2 Optimum PPP scheme for development of Walini as a Technology Park

4. CONCLUSION

The development of Walini as a technopark is expected to contribute 25% of revenue to the operator, which consists of two level of tax on construction development amounting to US $ 451 million and Rp. 7 trillion of tax value if the area is operational. Five main areas will be developed in the City of Walini, namely industrial zones, residential areas, education zones, commercial zones and research and development zones. The development of the city will require an investment of US $ 9.97 billion, with OM costs of US $ 23.3 billion, and will generate revenues of US $ 75 billion over 35 years.

Walini city development is planned to use PPP for its financial scheme, with four main schemes possible. The fourth scheme was chosen, as it can produce an optimal IRR value, with more systematic government involvement in the development of the city. The optimal IRR value in the development of Walini city as a technology park, based on the government scheme and private cooperation, is 15.57%. The scheme uses the division of IC + OM Cost + R Sharing. In the scheme, the private sector accounts for 49.89% of the initial investment costs, and 60.08% of the operational and maintenance costs.

5. ACKNOWLEDGEMENT

This research is supported by a grant from the Ministry of Research and Higher Education, Republic of Indonesia, No 413/UN2.R3.1/HKP05.00/2018.

6. REFERENCES

Abdul-Rahman, H., Berawi, M.A., 2002. Managing Change in Construction Contracting. *Contract Management*, Volume 42, pp. 10–16

Asia Pacific Economic Cooperation, 2014. Infrastructure Public Private Partnership Case Studies of APEC Member Economies, Autoroute 25- Montreal, Quebec, Canada, 26. 21st Finance Ministers' Meeting, Beijing, China.

Asian Development Bank., 2007. *Public Private Partnership Handbook*. Philippines: Metro Manila

Bank Indonesia, 2017. Kenaikan Harga Barang Properti Residensial (*Increase in Residential Property Prices*). Jakarta: Bank Indonesia

Berawi, M.A., Miraj, P., Berawi, A.R.B., Agdhitya, R., 2017a. Increasing Added Value for the New City of Walini through Infrastructure Project Development. *International Journal of Technology*, Volume 8(6), pp. 1141–1149

Berawi, M.A., Miraj, P., Berawi, A.R.B., Akbar, F., 2017b. A Benchmark Study for Indonesia's High Speed Train Considering Technology Selection. *Advanced Science Letters*, Volume 23(7), pp. 6343–6346

Berawi, M.A., Miraj, P., Berawi, A.R.B., Silvia, Darmawan, F., 2016. Towards Self-sufficient Demand in 2030: Analysis of Life-cycle Cost for Indonesian Energy Infrastructure. *International Journal of Technology*, Volume 7(8), pp. 1444–1453

Berawi, M.A., Susantono, B., 2012. Developing Conceptual Design of Mega Infrastructure Project: Creating Innovation and Added Value. *Value World*, Volume 35(1), pp. 12–20

Colliers International., 2016. Jakarta Property Market Report. Jakarta: Colliers International

De Blas, B., 2006. Net Present Value. Monticello: University of Arkansas Monticello

Fuller, S., 2010. *Life-cycle Cost Analysis (LCCA).* Whole Building Design Guide

Finance 3.1., 2017. WACC Indonesia, Construction and Materials Sector. Retrieved from WACC Expert. Available Online at http://www.waccexpert.com/, Accessed on January 07, 2017

Hanby, J., 2016. Software Maintenance: Understanding and Estimating Cost. Available Online at http://blog.lookfar.com/blog/2016/10/21/software-maintenance-understanding-and-estimating-costs

Husin, A.E., Berawi, M.A., 2015. Forecasting Demand on Mega Infrastructure Projects: Increasing Financial Feasibility. *International Journal of Technology*, Volume 6(1), pp. 73–83

Karim, S.B.A., Rahman, H.A., Berawi, M.A., Jaapar, A., 2007. A Review on the Issues and Strategies of Stakeholder Management in the Construction Industry. *In:* Meeting and Conference on Management in Construction and Researchers Association (MICRA)

Kirk, S.J., Dell'Isola, A.J., 1995. Life Cycle Costing for Design Professionals. New York: McGraw-Hill Companies

Komarova, V.N., Zjablova, O.V., Denmukhametov, R.R., 2014. An Infrastructure Factor in Regional Competitiveness. *Mediterranean Journal of Social Sciences*, Volume 5(18), pp. 355–359

Levy, S.M., 2008. Public-Private Partnership in Infrastructure. *Leadership and Management in Engineering*, Volume 8(4), pp. 217–230

Luthfia, N., 2016. Analisa Pengembangan Wilayah dan Biaya Investasi Kota Baru Walini Sebagai Technology Park (*Regional Development Analysis and New City Investment Costs for Walini as Technology Park*). Undergraduate Thesis, Universitas Indonesia

Morgan, M., 1999. *Life Cycle Cost Analysis Handbook.* 1st Edition. State of Alaska: Department of Education & Early Development

Samsung, 2013. Samsung Electronics Annual Report

Sharp, 2017. Sharp Components Annual Report

Sterman, J.D., 2000. Business Dynamics – System Thinking and Modeling for a Complex Word. Boston, Irwin/McGraw-Hill

Taris, N.L., 2016. Analisis Pengembangan Wilayah dan Biaya Investasi Kota Baru Walini Sebagai Technology Park (*Regional Development Analysis and Initial Cost Calculation of Walini*) Undergraduate Thesis, Universitas Indonesia

Wibowo, A., Permana, A., Kochendörfer, B., Kiong, R.T.L., Jacob, D., Neunzhen, D., 2012. Modeling Contingent Liabilities Arising from Government Guarantees in Indonesian BOT/PPP Toll Roads. *Journal of Construction Engineering and Management*, Volume 138(12), pp. 1403–1410

Woodward, D.G., 1997. Life Cycle Costing—theory, Information Acquisition and Application. *International Journal of Project Management*, Volume 15(6), pp. 335–344

Ye, S., Tiong, R.L.K., 2000. NPV-at-Risk Method in Infrastructure Project Investment Evaluation. *Journal of Construction Engineering and Management*, Volume 126(3), pp. 227–233

Zakariah, T.H., 2015. Airport Business. Malaysia: KLIA Professional & Management College