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Long Term Indonesian Construction Industry's Aggregate Productivity Simulation Considering Overall Business Environment

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Abstract
Competitiveness of Indonesian Construction Industry is in question. It is necessary to address the problem soonest so that persistence situation can be improved. To find the solution for this problem this research therefore conducted. The research are conducted in two steps, the purpose of the first step is to determine the problem of the Indonesian construction industry, second step is to built a soft system dynamics model through a soft system modelling and structural equation modelling. Data were collected from various sources such as World Bank Institute, Freedom House, International Corruption Watch, UNDP, Indonesian Statistics Office and Bank Indonesia. Primary data was collected from Indonesian Construction Industry Players. This study indicates that: higher educated human resources in construction industry are not effectively support the productivity of the industry; construction industry players tend to consider short term benefit than long term sustainability and growth; strategic planning time horizon consideration contribute significantly in long term productivity. It is suggested that to improve productivity of Indonesian construction industry several step should be taken: marketing orientation should be changed toward more sophisticated project, institution for collaboration in construction industry should be initiated and high governance should be established and maintained.

Keywords:
Productivity, Cluster, Competitiveness

1. Introduction

Indonesia has signed and become a member of World Trade Organization since 1996, and this membership has been ratified by the parliament. Indigenous Indonesian Construction Industry will experience troubles when they are not prepared to face this new situation. And they yet to be ready in facing this free trade and globalization. It is necessary to address the problem soonest so that persistence

situation can be improved. To find the solution for this problem, this research therefore conducted. This paper is presented base on recent studies regarding the aggregate productivity of Indonesian construction industry.

As stated by Michael Porter (Porter 1996), the notion of competitiveness has no meaning unless it is related to productivity. Through productivity competitiveness can clearly be analysed from its roots, which are capital, human resources and labour. It is needed to differentiate between labour and human resources. Labour are the workers who directly transform the raw material into the product, while human resources are the thinking part of the equation. The purpose of this research is trace the problems to their very cause. The intention is to find they way to improve the previously mention problem, through system dynamics simulation model. The study is not intended for forecasting tools, but merely to help policy makers make decisions and see the trend created when certain policies are implemented.

The study started from the Cobb Douglass production function as its core, and the variable are trace back from the strategic decisions by the construction firm's management. The availability of the production factor is determined by these decisions. The input for making this decision are the business environments, direct or indirect. The direct business environments include: perceptions of future market, time frame of the business vision, transaction cost economy, easy entry into the industry, and factors that determine which direction the investment should go (human resources, labour or construction equipment). While the indirect environments are: governance which are represented by political stability, government effectiveness, control of corruption, consistency of implementation of laws and regulation, pro business regulation and voice and accountability (Kaufmann and Kraay 2005); and knowledge economy index: human resources development (education), information infrastructures, innovation and economic performance indicator in this case is Gross Domestic Product (GDP) per capita. Following this way of thinking the availability of production factor is then determined. As production factors of the construction industry are established, eventually the productivity of total human resources can then be calculated. Based on this fact policy required to improve the situation can be then simulated by using a model.

Several statistics method such ordinary least square and structural equation modelling are employed to estimate parameters needed to build the system dynamics model. The research was conducted in two stages. The purpose of the first stage is to identify the problem of the Indonesian construction industry. This was conducted in three steps: the first step is exploratory survey, the second step is a structured survey to support the finding of the first step, and the third step is to find the real problems using correlation analysis based on the cluster analysis as suggested by Michael Porter (1996). The purpose of the second stage is to build a soft system dynamics model through a soft system modelling, with parameters calculated using structural equation modelling. The secondary data used in this research are from International sources such as World Bank Institute, Asian development bank, freedom house and United Nation Development Program, which are available publicly, and from national sources such as Indonesian Statistical Office, Indonesia Central Bank, and National Construction Development Board. The primary data were collected from survey and interview with national construction industry stakeholders.

2. Production and Productivity in Construction.

Cobb Douglass production function is used to approach production and productivity in construction industry. Industry players take the direct and indirect business environment into consideration for their long term strategy. Direct business environment includes transaction cost economy, entry regulations, market, time frame selected. Indirect business environment are governance, knowledge economy Index and economic performance. Available options for main strategy selection are market approach or

resources approach. The industry players' Strategic Investment decision from the rational choices point of view will be directed by these factors.

The relation among the business environment can be described as follows (Figure 1), transaction cost economic has causal relation and affected by governance, knowledge economy index (KEI) an economic performance. Governance is affected by political stability, government effectiveness, control of corruption, consistency of implementation of laws and regulation, pro business regulation and voice and accountability. Knowledge economy index is determined by human resources development (education), information infrastructures, and innovation. Economic performance is determined by GDP per capita. For the purpose of this study, a simulation model is built based on Soft System Dynamic Modelling, which is a combination between soft system methodology and system dynamics model (Rodiriguez-Olloa and Parcar-Caceres). Causal relation parameters among variable were estimated using statistical method ordinary least square and structural equation model (Tabachnik and Fidell 2001).

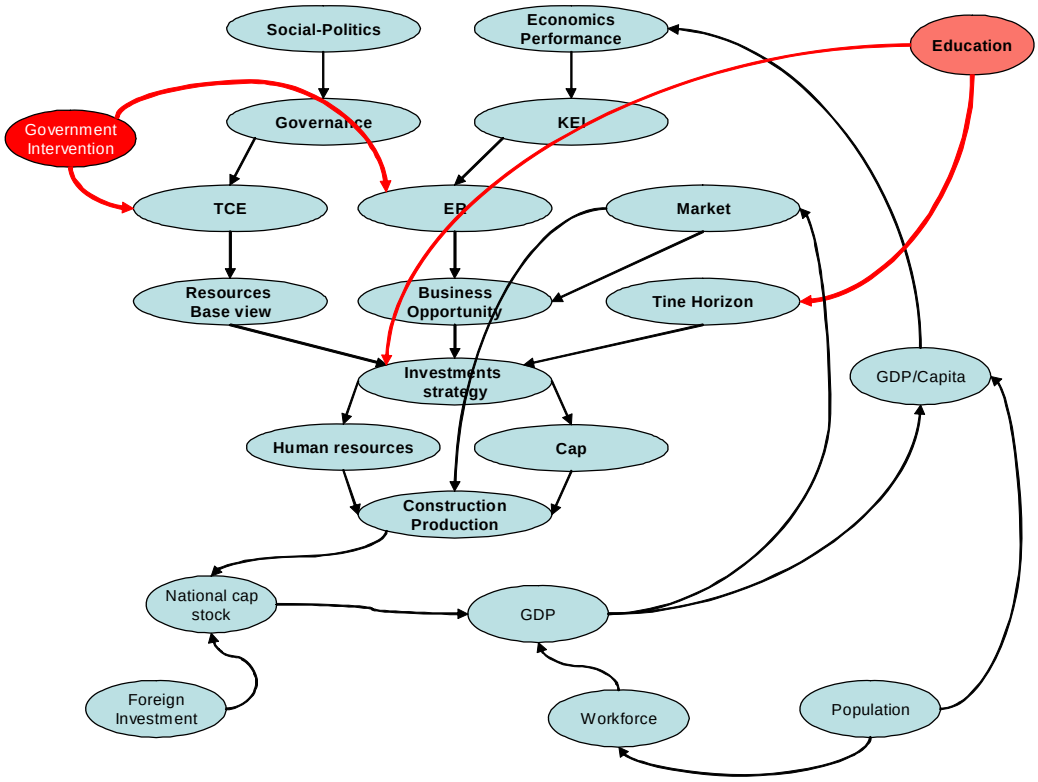

Figure 1: Business Environments Relationship

The number of available workforces and construction capitals are determined by the investment strategy implemented industry players. Investment decision is determined during the course of strategic planning. The decision making options are whether to invest more in human resource (for marketing, engineering, and project management) or in skill labour or in construction equipment. This decision is determined or at least influenced by the business environment i.e. governance, political stability, effectiveness of the government, rules of laws, quality of rules, and control of corruptions. In addition, industry players also consider their perception on market size, the time horizon in which they consider for strategic planning horizon, and severity of competition which is determined by entry regulations. Another factor to be taken into consideration is transaction cost economy.

3. Indonesian Case of Construction Productivity.

Study by Budiwibowo (2005) indicates that Indonesian construction productivity is considered to be low. This is in accordance with general perception of the construction industry players and supported with secondary data as shown in table 1:

Table 1: Value added/workers in US dollar term:

Country	1997	1998	1999	2000	2001	2002	2003
Japan	68,181.82	68,000.00	63,636.36	64,636,36	62,727.27		
Korea		26,720.00	25,960.00	23,320.00	24,900.00	23,170	
India			1486.85	1,607.22	1,653.97	1,706.39	1,760.47
Hongkong				51,050.26	52,512.80		
Indonesia	2,956.21	1,301.06	1,864.17	1,339.93	1,080.27		

Sources: Asiaconstruct 2000 (Chen and Gajendran 2004; Chiang, Michael Anson et al. 2004; Council 2004; Hirakawa, Tsuchiya et al. 2004; Yoo 2004)

Secondary Data were collected from various trustable international institution resources such as World Bank Institute, Freedom House, United Nation Development Program and from national institution i.e. Indonesian Office of Central Statistic (BPS) (Statistik 2001-2003) and Indonesian Central Bank (BI) (Yudanto, Wicaksono et al. 2005). Primary data were obtained by interview and survey from Indonesian construction Industry players. The survey method used was questioners distributed to participants of a workshop regarding the Indonesian construction industry.

Using the BPS data from 1998 to 2004, national construction industry production function parameters were estimated. Table 2 shows the result of the analysis.

Table 2: Production parameters

Coefficient Estimates			
Variable	**Coefficient**	**std error**	**t-ratio**
Technology	-0.4799	0.1041	-4.6086
Human Resources Development	-0.0015	0.2237	-0.0068
Labour	1.2671	0.3809	3.3261
LNSTO	0.2143	0.1844	1.1619

R2 = 0.9633 R2b = 0.9475

The graph fitting between data and model result is shown on figure 2, based on the following formulation:

Value Added (VA) = e^-4799*HRD^-0,0015*LBR^1,2671*STO^0,2143

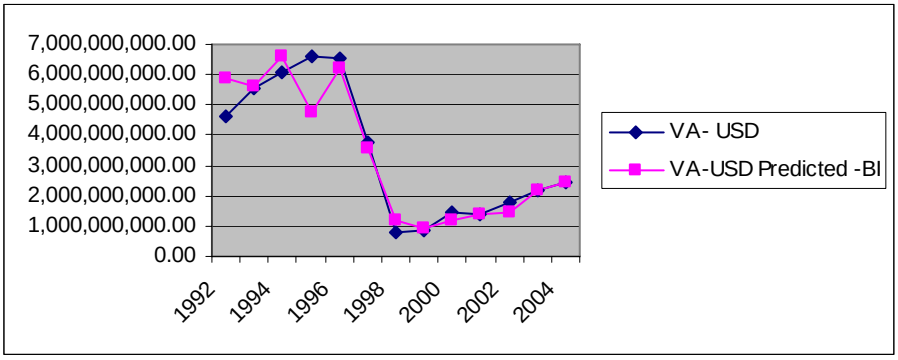

Figure 2: Construction industry value added

4. System Dynamics Indonesian Construction Productivity Simulation Model.

Three models have been built. The first model representing the existing condition simulated from the year 1998 through 2004 and validated and compare with real data. It is used as a reference for the other models. The second model is the problem model, which is used to analyse the problems that persist if the existing condition to continue as is, and to identify which variables cause the persistency. The third model is the solution model, where a sub-model solution is inserted into the reference model then simulated and the result compared with problem model.

Reference Model

Reference model was based on the data from 1998 through 2004 as shown in. figure 3. Comparison between real data and simulation result shows that they are within acceptable range with R2= 0.96 RMSE= 0.086 (Figure 4). Therefore, it can be concluded that this reference model is acceptable for reference purpose.

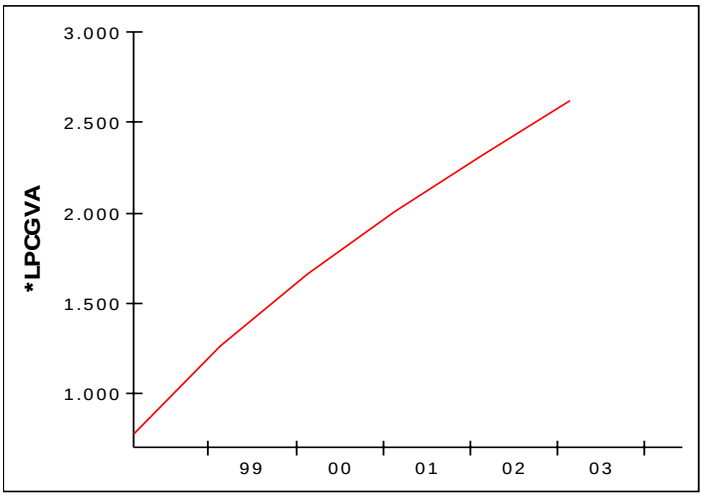

Figure 3: Reference Model

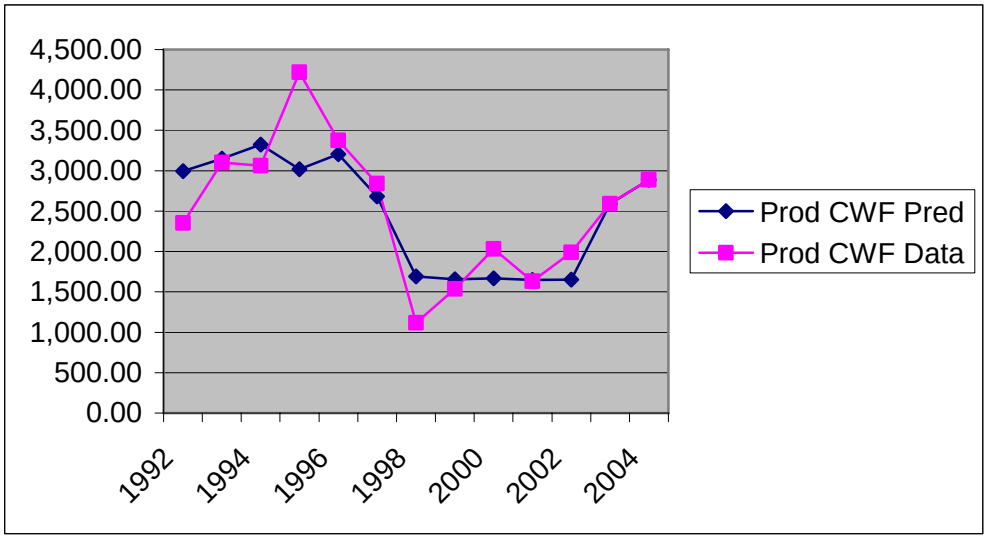

Figure 4: Comparison between real data and model 1 simulation result

Problem Model

Problem model used reference model and extending the simulation time through the years 2025, where the problem can be identified and the persistence problem are revealed (figure 4).

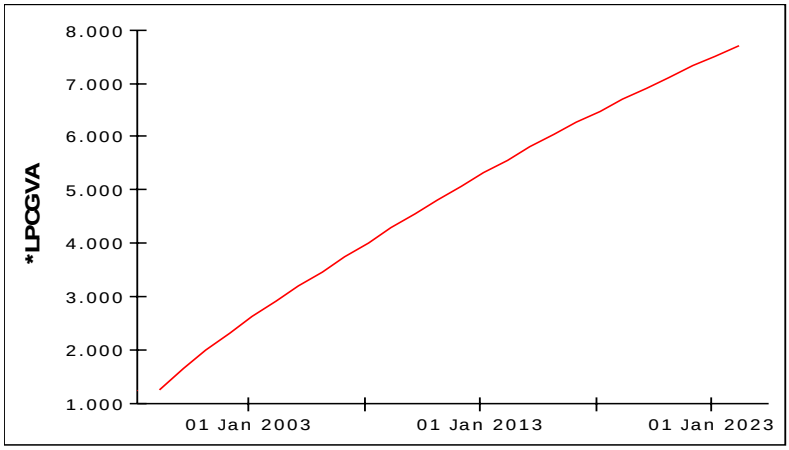

Figure 4: Problem model

Solution Model

Policy sub-model was inserted into the problem model, the level of improvement for several variables was simulated and the result is observed (figure 5 and figure 6).

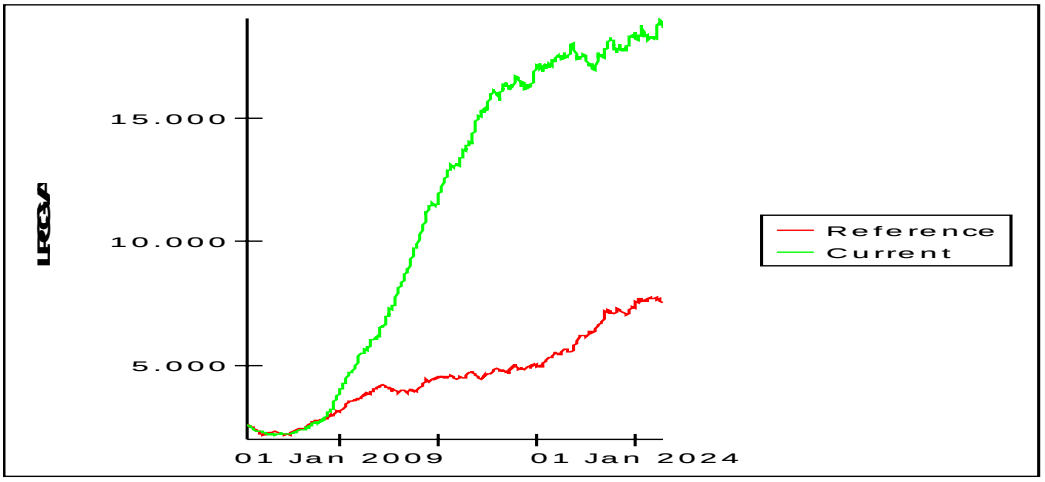

Figure 5: Solution model

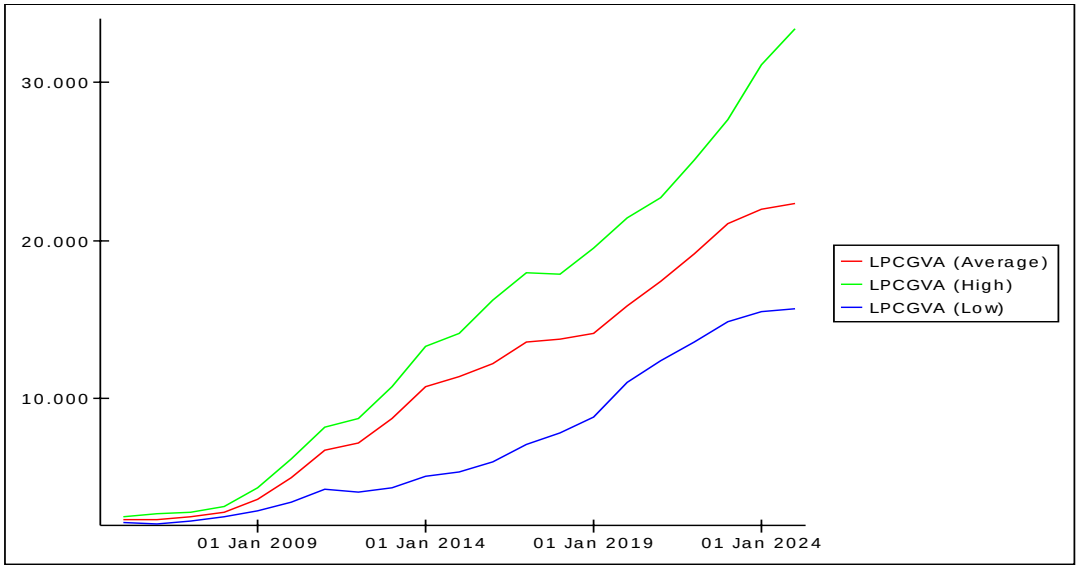

Figure 6: Simulation results of solution modl

Result of Solution model Simulation.

The findings of the study indicates that production of construction industry can be calculated from the production function coined by Cobb Douglass, which comprises of the number of the workforce and capital, and appropriate value shared for each variables. The study also indicates that higher educated human resources in construction industry are not effectively support the productivity of the industry, Indonesian construction Industry players tend to consider short term benefit than long term sustainability and growth; contractors more involve in simple construction activities than the sophisticated one. Therefore it is suggested that to improve productivity of Indonesian construction industry several step should be taken. First, vision of industry players toward future orientation should be improved, marketing to aim at the more sophisticated project should be done, and educated human resources should be used more effective use. Then, formation of institution for collaboration in construction industry should be initiated and materialised, and better governance should be established and maintained. Productivity of construction industry in year 2025, when following the current condition, would approximately within the range of 6,000 to 7,000 US$ per worker. When effort exerted on improvement by educating industry players to consider long term sustainability and competitiveness, as well as improving transaction and entry regulations, the model simulation shows that Indonesian construction industry productivity could

dramatically increase up to the level of 18,000 US$ per construction-workers, provided that the construction market increases following the increase of economic performance as shown in figure 5 and figure 6.

5. Conclusions

The time vision of construction industry players is important factor for construction industry improvement. It encourages players to invest in company assets, whether it is human capital, intellectual capital or physical capital. With the availability of production factors increase construction production capacity would subsequently increase. When the number of educated human resources increase, technology exchange and innovation became more effective. This would improve technical progress as part of the production equation, and subsequently would increase production and productivity significantly. When opportunities for doing more sophisticated projects grow, the roles for educated human resources intensify. This condition would improve production and productivity further. The Solution model has successfully shows these phenomena.

Furthermore, when better policies implemented to provide more effective governance and facilitate establishment of institution for collaboration, direct business would improved. Such institution could improve transaction process between parties involved, which would reduce transaction costs. It could also facilitate and encourage businesses and professionals entering construction industry, which would improve competition within the industry. Good governance, high knowledge economy index and economic performance will increase project opportunities, which would lead to increased productivity. The WTO agreement will be effective in the year 2020, therefore it is imperative to take improvement policies and action to make Indonesian construction industry more competitive

6. References

Budiwibowo, A. (2005). Cluster Konstruksi Indonesia. Bidang kekhususan Manajemen Konstruksi, Program Pascasarjana Bidang Ilmu Teknik. Jakarta, Universitas Indonesia. **Magister Ilmu Teknik**.

Chen, S. E. and T. Gajendran (2004). Asiaconstruct Country Report 2004 Australia. Newcastle Center for infrastructure and property, University of Newcastle.

Chiang, Michael Anson, et al. (2004). The Construction Sector in Asian Economies. London, Spon Press.

Council, C. I. D. (2004). Asiaconstruct Country Report 2004-India. New Delhi.

Hirakawa, I., K. Tsuchiya, et al. (2004). Asiaconstruct Country Report 2004 Japan Tokyo, Research Institute of Construction and Economy.

Kaufmann, D. and A. Kraay (2005). Measuring Government Using Cross Country Perception data, Worl Bank Institute.

Porter, M. (1996). On Competition, A Harvard Business Review BBook.

Rodiriguez-Olloa, R. and A. Parcar-Caceres Soft System Dynamics Methodology (SSDM): A Combination of system methodology and system dynamics. Lima, Peru, Andean Institute of System.

Statistik, B. P. (2001-2003). Statistik Konstruksi Indonesia. Jakarta, Biro Pusat Statistik.

Tabachnik, B. G. and L. S. Fidell (2001). Using MultiVariate Statictics, Allyn and Bacon.

Yoo, J.-Y. (2004). Asiaconstruct Country Report 2004 Korea, Korean Cosntruction Economy and Industry.

Yudanto, N., G. Wicaksono, et al. (2005). "Captal Stock in Indonesia: measurement and validity test." IFC Bulletin **20**.