Conceptual Framework for Public Policymaking based on System Dynamics and Big Data

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***Abstract*— Public policy is the critical key of the welfare programs. It is also a powerful instrument to achieve a feasible national competitiveness. Unfortunately, many public policy making processes does not utilize an appropriate data and tool in holistic and systematical approach. This research will focus on creating a comprehensive conceptual framework for public policymaking based on data and system approach. In connection with information technology, there are at least two approaches that will be considered for obtaining a more comprehensive public policy. First is utilization of Big Data to extract information. It is believed that if more accurate data are collected and analyzed, then more comprehensive public policy is created. Utilization of data mining will be intensively used to obtain knowledge. The second approach is the system dynamics. The knowledge created in the first approach is useful in modeling the system. The model will be used to simulate the future possibilities of several scenarios. The scenario with the best outcome is selected as an input for public policymaking. At the end of this research, a conceptual framework for public policy making will be created by incorporating Big Data and system dynamics. (*Abstract*)**

***Keywords*— System Dynamics, Big Data, Public Policy**

I. INTRODUCTION

A brief introduction is provided in this section to give explanation about the relationships between Big Data and system dynamics as the foundation of public policymaking. Both approaches, Big Data and system dynamics are able to contribute individually and collaboratively in public policymaking [1,2]. In this paper, it is emphasized to collaborate both of them in one framework for public policymaking.

In some countries, especially in the third countries, process of public policymaking is not done based on data. Decisions are based on group of interest and politics. The Organization for Economic Co-operation and Development (OECD) has recommended their country members to make use of data and information in public policymaking [3]. It means that country members need to know how to store, how to filter, how to analyze, how to display data and information in efficient and effective ways [4].

A holistic approach is needed to see the problem in comprehensive ways. System theory is one of the approaches that identify the problem in holistic ways [5]. System dynamics, based on system theory, will be used to look at the interdependence of its components which contributes in achieving the country's programs. The determination of these components and interrelation are done by using existing data and information extracted from Big Data [1].

In our approach, system dynamics methodology is used in simulating several scenarios holistically to produce the best solution for overcoming public issues or problems. The model is the main entity in this simulation, Some papers have introduced some approach in modeling using big data [1,2,6]. Data and information creates the model of the real system of the public situation. The ideal model has the similar or the same characteristic of the real system. By modeling the real system, public policy makers will be able to simulate several scenarios in a holistic way before implementing into real public policy making. The benefits of simulation are efficient in budget, time and risk. The budget is not significant, because simulation of experiments or scenarios is conducted only in the laboratory. The time will be much shorter because the activity is not performed in the real fields or communities. In simulation, no risk is identified in technical or non-technical tasks. Public policy makers will make improvements by introducing a public policy and its variance, a form of the intervention, into the model and examine the results. Public policy cannot be separated from politics influence [3]. In system dynamics approach, politics or social issues can be accommodated in the simulation.

II. SYSTEM DYNAMICS, BIG DATA & PUBLIC POLICY

There are several techniques and methods used in public policymaking [7]. In this paper, system theory will be the basis of public policymaking. The reason why system theory is chosen has been described in the previous section. In this section, how system dynamics, Big Data and public policy are incorporated to support system theory is explained.

A. System Dynamics

Forrester introduced Industrial Dynamics which is known as System Dynamics now [8]. Basically, he adopted the

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control system theory in engineering into social science. System dynamics is a methodology for studying the properties of a system over time. A system consists of components or subsystems which always interact dynamically among them. Interrelations between these components will affect the states of the overall system [9,10,11]. Since first introduction by Forrester [8], the community of system dynamics has been expanded to all over the world. The books of Urban Dynamics [12] and World Dynamics [13] have been published to show the phenomena in public management.

In system dynamics, the model is the key point. The challenge in creating a model of system dynamics is the identification of components and how they interact in a system [14]. The model can be used to run the simulation of scenarios that are designed to look for the best result. Many techniques have been developed in creating this model [6, 15-20]. System dynamics is essentially based on the system thinking paradigms. Although, it is still debatable about the relationship between system thinking, and system dynamics, but in this paper, it will take the idea of Richmon [21] to put system dynamics as the subset of system thinking.

A combination of two or more components or subsystem is called as a system. They are interconnected for some purpose [22]. Each component in the system is interconnected and interacted positively or negatively to each other. A system means a grouping of parts that operate together for a common purpose [9]. System is a collection of components or subsystems that is consistently organized. Each components or subsystems are interconnected in a pattern or structure that construct a characteristic set of behaviors [23].

A system is consist of several components in which each of them have interrelationship, interconnection, interdependency, interaction and have their own characteristic and behavior, such as: oscillation, overshoot, collapse, stability, delay, feedback and others. System dynamics studies usually are not designed to predict what will happen. It is designed to explore several possibilities if several factors are modified. This is to emphasize that the practice of system dynamics is not similar with a predictor in control theory. System dynamics is used more to learn about the behavior of the system, identified the components and how to optimize the result. System dynamics models explore possible futures and ask "what if" questions [23].

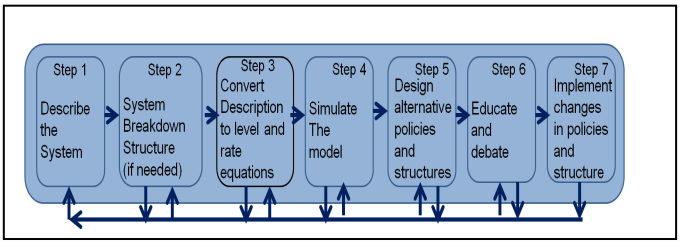

Fig. 1. System Dynamics Framework

The interrelation of component in a system can create a complexity. Without a good method, it will be impossible to understand its behavior. System dynamics is a method to enhance learning in complex systems. The method has been used in many area of knowledge. System dynamics is fundamentally interdisciplinary. A multi discipline expert or a group of experts who work collaboratively to come with the optimized result of certain system dynamics case are needed.

System Dynamics Framework (Figure 1) is created based on modification of Forrester's framework [9]. It consists of 7 steps, which are accommodation of feedback process, mental construct [24] and continual improvement process [25]. Basically, all those steps can be summarized into three steps [26] which are Understanding of Situation/Problem Definition, Model Conceptualization/Model Building, and Running the Simulation Model/Using the Results.

A system is a collection of its subsystems or components. In the framework, system breakdown structure (SBS) may be used to assist in identification of the subsystems or component of the system. This subsystem is also a system which consists of its subsystems. This iterative process continues until the subsystem is undividable. SBS is the method to break down the system into smaller components [1,2,27,28].

B. Big Data

Big Data analysis involves three things: volume, variety and velocity of data. It creates more complexity in data management process. The most difficult part in this Big Data is how to analyze large data with their special characteristics. Davenport and Harris [29] define the analysis as "the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions". According to Lustig [30], there are three phases of analytic in an organization : descriptive analytics, predictive analytics and prescriptive analytics. The last phase, prescriptive analytics is suitable with the simulation stage of system dynamics. Different simulations are run on the model to understand the behavior of system and accomplish the best outcomes before determining the decision. In the simulation, some optimization techniques are introduced to the model. It evaluates and determines a new approach. It is called as reengineering process on the model where balances all obstacles to reach the goal [31].

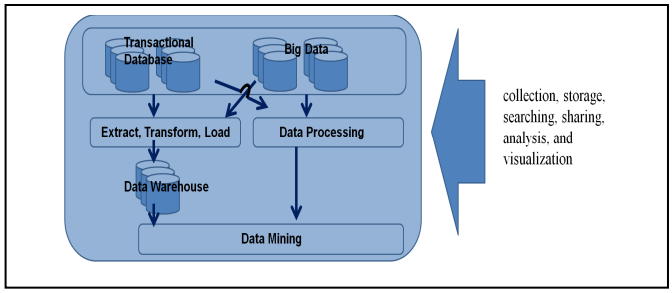

Fig. 2. Data Mining Framework based on Big Data

In this research, the descriptive analytic is a collection of large datasets. In this stage, it is discussed how to collect, store and search data in an efficient way. The predictive analytic becomes the main way to develop the model of system dynamics by identifying the components of the system and how they interact. Once the model is created, it goes to the next stage, prescriptive analytic. Some simulations are run on the model. Some adjustments are introduced on the model

to identify the optimized outcome, such as in paper written by Nasution and Bazin [27]. Big Data is a good method to analyze all types of data. Transactional data, media online, news, blog, web and others will be the big resources to identify all components of the system and how their interrelations between them [1]. By utilizing few tools, the process will be much faster and accurate [32]. The tools can be open source software such as Apache Nutch, Apache Solr, and Hadoop [33]. The challenges in the Big Data include collection, storage, searching, sharing, analysis, and visualization [34].

C. Public Policy

Lester and Stewart [35] introduce public policy evolutionary approaches which consist of several stages. These stages construct into a cycle which consists of agenda setting, policy formulation, policy implementation, policy evaluation, policy change and policy termination. Below is the public policymaking framework, which is modified to accommodate system theory.

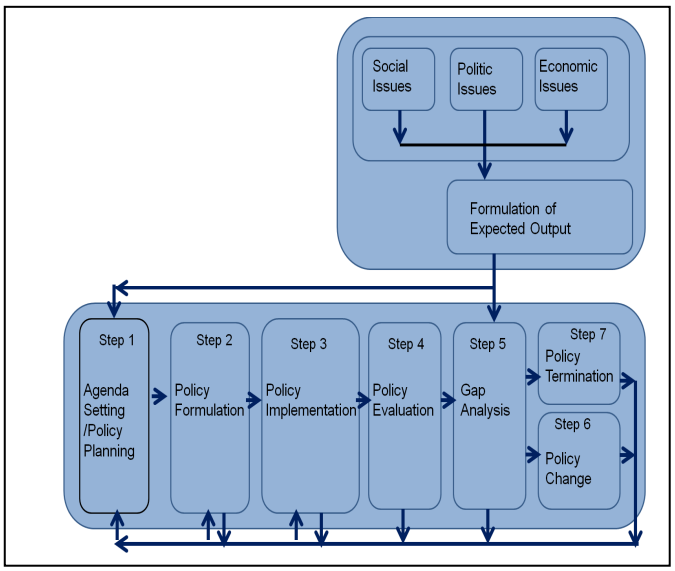

Fig. 3. Public Policymaking Framework

Several experts have given their definitions of public policy. Public policy is a purposive course of action followed by government in dealing with some topic or mater of public concern [36]. Public policy is the authoritative allocation of values for the whole society [37]. Public policy is whatever governments choose to do or not to do [38]. Public policy consists of political decisions for implementing programs to achieve societal goals [39]. Public policy is a set of interrelated decisions taken by a political actor or group of actors concerning the selection of goals and the means of achieving them within a specified situation where those decisions should, in principle, be within the power of those actors to achieve [40]. All are in line with the framework (Figure 3) to achieve output as the expected output or goal.

Policy analysis is done by policy makers to achieve public policy goal efficiently and effectively. In other perspectives, some other experts give their own definition. Policy analysis describes investigations that produce accurate and useful information for decision makers. Policy analysis is an applied social science discipline which uses multiple methods of inquiry and argument to produce and transform policy-relevant information that may be utilized in political setting to resolve policy problems [41]. Policy analysis is a set of techniques and criteria with which to evaluate public policy options and select among them to rationalize the development and implementation of public policy and as the means to greater efficiency and equity in allocation of public resources [42]. In a standalone policy cycle, policy analysis would follow to each stage of policy cycle. But, since it is integrated, most of the analytics is done in the system dynamics and the Big Data processes.

In this modern politics life, the ruling government in every country needs to optimize the use of public policy to transform their promise (expected output) into reality (output of the policy implementation). Public policy is very important because it solves the problems which are also called the gaps between the goal and current society situation. Unfortunately, most of policy makers are not able to find the optimized solution for the problems. Dun [41] identifies few points on this policy problem such as: interdependent, subjective, artificial and dynamic which are related to system theory. Not only Dun [41] who is aligned with system theory, but also Henry [43] and Dror [44] mentioned about system theory in their book or paper.

Policy implementation is another critical factor for achieving the original goal of public policy. But unfortunately, implementation is not always as planned. It is almost the same happened in system dynamic which the outcome is sometimes not as expected or becomes unpredictable. Policy makers sometimes experience an unexpected output. The real system can give many things to learn but there is still another big and complex system hidden by layman. To become a capable person in managing a system, a layman must transform into someone who has capability to study the system's behavior or characteristic and interrelation. Being a capable person, it means that he or she could overcome, eliminate or reduce unexpected output of the system. The system is better understood by doing analysis iteratively. Each step of iteration will bring us closer to the optimized solution.

III. Conceptual Framework Creation

It is obviously explained that system dynamics, Big Data and public policy are related to each other in system perspective. It is possible to incorporate them together in one framework. On this occasion, development of the framework that is capable of integrating the processes carried out by system dynamics and big data for public policy-making is created. It is based on system theory. The characteristic of a system is to have a subsystem or component and interrelation between them. The manipulation issues or problems of the system's condition are commonly referred to as intervention by using the policy. Figure 4 is the design of conceptual framework.

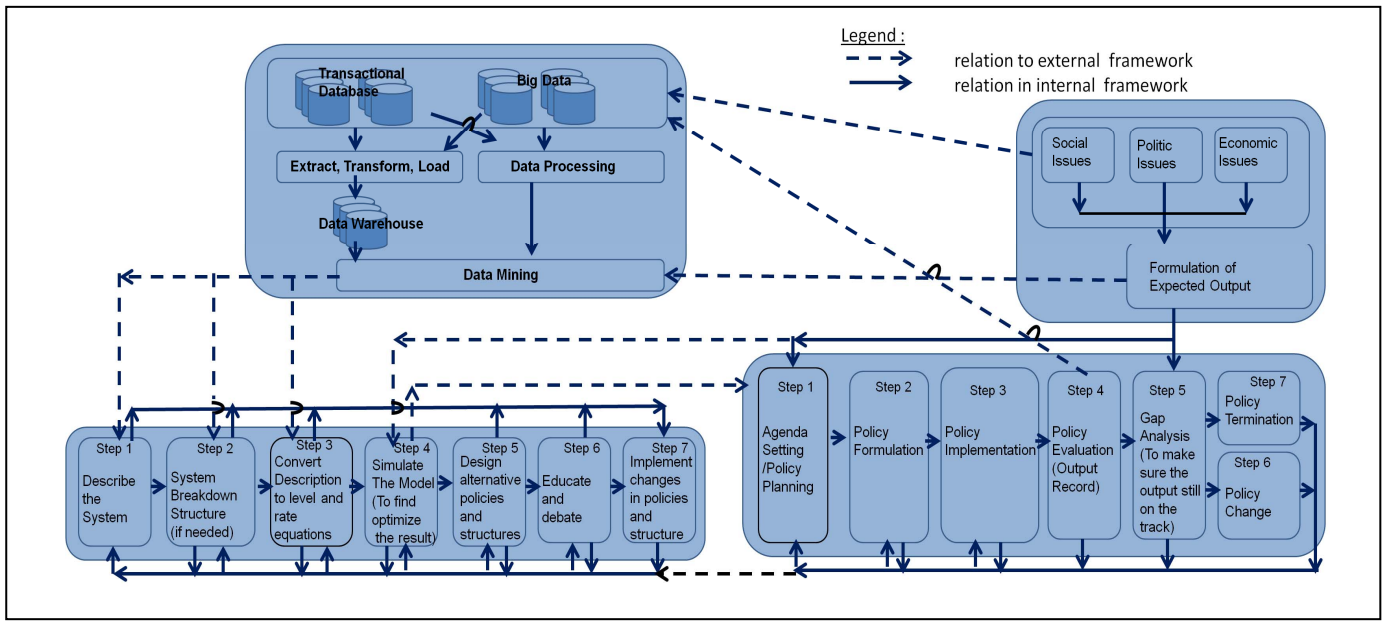

Fig. 4. Conceptual Framework for Public Policymaking based on System Dynamics and Big Data

The process starts from the identification of social, political and economical issues or problems in real life. The policy makers set a goal or the expected output before formulating the intervention or public policy to overcome the issues or problems. Expected output will be the ultimate achievement and as reference after implementing the public policy. The expected output or reference will become the input to the data mining process. This process will help the policy makers to create the model to mimic the real system. In our case, it will identify the components and interrelation of the social, political and economical system where the issues or problems are located.

After process of identification, model is created. Policy maker will run several test or scenario on the model to learn the behavior of each component. The most suitable scenario will be chosen for the next step in public policymaking process. At certain stage in public policymaking, there will be an evaluation on the policy and its impact to the system. Current situation of the real system compares with the expected output. The new data and information of the current situation will be stored in the data system for future data mining process. Adjustment or change on the policy can be done as the feedback process. Expected output is formulated by studying the current issue in social, political and economical situation in society. Definitely, if there is a gap between the current situation and the expected output, the policy makers are responsible to remove or minimize this gap. Data and information about the current situation as the time series data are stored in the data mining system. It will become the input for the data mining process. It could be in several type of data, such as transactional data, comments in media social, news or media online, bloggers, website and others.

Few things are emphasized in system dynamics process, such as to describe the system, to run System Breakdown Structure (SBS) [1,2,27,28], to convert description to level and rate equations, to simulate the model, to design alternative policies and structures, to educate and debate, and to implement changes in policies and structure. The best scenario will become the input to public policymaking process.

Preparation in policy making process is conducted in Policy Planning. In Policy Formulation, it will develop the policy based on the result of processes in data mining and system dynamics. After implementing and enforcing policy into society, the evaluation and record all existing status and situation and observe the impact of a policy. The data and information of the current situation (after policy implementation) are kept in Data Mining System. In Gap Analysis, it compares the current situation based on policy evaluation with the expected output. This will give a good feedback to the policy makers what the next action is. Policy Termination Process is for the policy has achieved its target and the policy is not needed anymore. Policy Change Process if for the policy needs to be modified after the evaluation.

IV. Result and Discussion

In this chapter, the creation of public policy for palm oil industry is created based on this framework. Data and information are collected from some papers [1,2,27,28]. Basically, crude oil and natural gas are the main source of petrochemical industry, and CPO is the main source of oleochemical industry [45]. Both of them are able to contribute significantly to Indonesia's GDP. At this moment, Indonesia's GDP is about US$ 888.5 billion, but the contribution from oleo- and petrochemical industry is still low. At this stage, government needs to create the public policy to achieve the expected output, such as to increase the GDP contribution, to optimize the usage of energy resources, and to minimize the pollution. The availability of raw material and growth of market is the key for oleo- and petrochemical industry. Indonesia has those opportunities [46-48].

Source of data is from government web site, NGO and others by interrelated with the other information [1]. After several processes, the components are identified as in [2]. In this process, it follows very close with the system dynamics process, especially such as defining the system, system breakdown structure (SBS) and creation of equation. The system dynamics model is created based on the paper [2] and the model was run with several scenarios. Case one, the baseline is created. Case two, renewable energy is forced to 20% in three years. Case 2a is that renewable energy percentage for electricity increase. Case 2b is that renewable energy percentage for energy fossil increase. Case 2c and Case 2c-1 are where local refinery capacity increase 2 times and 3 times. Case three, the suitable market share are adjusted for oleo- and petrochemical industry for positive export. Case 3a and Case 3a-1 are where oleochemical business increases 1 time and 3 times. Case 3b is increase in petrochemical business. Figure 5 is the model before SBS [2].

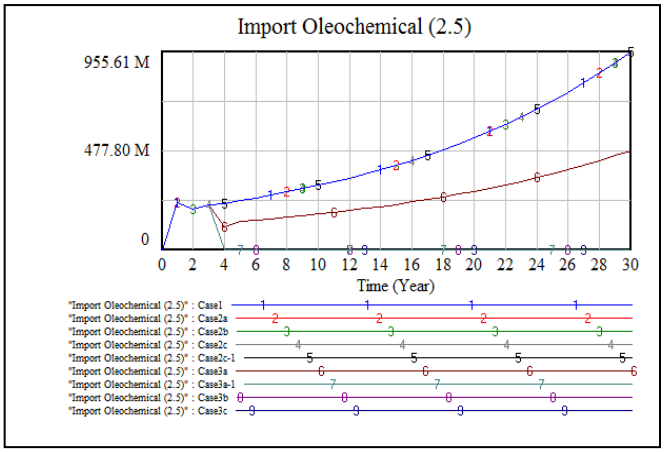

Fig. 5. Import Oleochemical - System Dynamics Model

The outcome of the simulations are based on the expected output: The growth of oleochemical industry will impact the export quantity of CPO. The loss revenue from the dropping of CPO export and the gain revenue from decreasing oleochemical import (Figure 5), is very significant. It is about four times. It is understood that by selling value added product, this will contribute to increase national GDP. In the next cases which are case 2a and 2b, the renewable energy is able to achieve 20% in three years. the simulation shows that the total consumption of fossil energy for the non-electricity usage such as for transportation and residential is higher than the electricity. Pollution is reduced because of minimizing fossil energy and maximizing the renewable energy.

Fortunately, although Indonesia Government does not use our method in formulating the policy, but they has identified the need to increase the GDP by promoting at least two regulation. First, Indonesia Government Regulation No. 24 Year 2015 about Raising Plantation Fund. Second, Indonesia Minister of Energy and Resources Mineral Regulation No. 40 Year 2016 about Gas Price for Specific Industry. Both of these regulations give impact indirectly to promote oleo- and petrochemical industry. The first regulation No. 24 Year 2015 resists export of crude palm oil (CPO) by increasing the tax. Indirectly, it increases the supply in local to supports downstream industry, such as oleochemical. The second regulation is to give incentive and better price of natural gas for certain industry. This helps for petrochemical industry as well.

Unfortunately, policy evaluation comes with not a good results, such as that the oleo and petrochemical industry is not growing as expected. No more space in the industrial estate and bureaucratic process to get the government incentive. Another one is implementation of gas price is not as expected. Based on our survey that competitive gas price cannot be implemented because of the expensive gas infrastructure project. The natural gas has been fully allocated by the government and gas operator. At this moment, it is very hard to get the new allocation without a new gas block finding, especially with competitive gas price. Based on the policy evaluation, the data and information will be fed into the Data Mining system. Definitely, it will create a new component into the system dynamic model to consider. Then the process will start from beginning again. But this will take more budget, time and cost. It is very different if the government utilizes system dynamics and Big Data before implementing the policy.

V. CONCLUSIONS

System theory is useful to integrate system dynamics, Big Data and public policymaking in one framework. It is based on feedback mechanisms, mental construct, system breakdown structure and continual improvement process to create model based on the data mining process. The model imitates the real system, such as oleo and petrochemical industry. Before introducing the public policy into the real system, policy makers will run simulation on the model and identify the best scenario as the best candidate for the public policy. By using system dynamics, public policy making needs to use the data and information in Big Data. On the other way, policy implementation and evaluation in public policy making process provides data and information to Big Data system. It is two ways interactions.

System dynamics is the methodology for creating public policy in holistic and systematic way. It uses data and information in creating the model before running simulation, which can make the policy implementation more efficient and effective. Public policy makers can do several tests with different scenarios on the model before running the policy implementation in real system. More researches are needed to make a better tools and integration of the system dynamics, Big Data and public policymaking seamlessly. Government and research Institution collaboration are needed to realize it.

References

[1] F.B.B. Nasution, N.E.N. Bazin, Daliyusmanto, and A. Zulfikar, "Big Data's Tools for Internet Data Analytics: Modelling of System Dynamics," International Journal on Advanced Science Engineering Information Technology (IJASEIT), in press.

[2] F.B.B. Nasution, N.E.N. Bazin, P. Prayudhi, and Y. Affandy, "Public policy of hydrocarbon productivity optimization for oleo- and petrochemical industry: system dynamics approach (Case Study : Hydrocarbon Consumption in Riau Province, Indonesia)," International

Conference on Oleo- and PetroChemical Engineering 2015 (ICOOPChe 2015), 2015.

[3] OECD (2013). EXPLORING DATA-DRIVEN INNOVATION AS A NEW SOURCE OF GROWTH - Mapping the Policy Issues Raised by "Big Data". Retrieved Apr 7, 2017, from http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP(2012)9/FINAL&docLanguage=En

[4] S.K. Pal and P. Mitra, "Pattern Recognition Algorithms for Data Mining," Boca Raton, FL:A CRC Press Company, 2004.

[5] P.B. Checkland and J. Scholes, "Soft Systems Methodology in Action," Chichester: John Wiley & Sons, 1990.

[6] E. Pruyt, S. Cunningham, J.H. Kwakkel, and J.A. De Bruijn, "From Data-Poor to Data-Rich: System Dynamics in Era of Big Data", Proceedings of the 32nd International Conference of the System Dynamics Society, 2014.

[7] G.E. Shambaugh IV and P.J. Weinstein, "The Art of Policymaking; Tools, Techniques and Processes in the Modern Executive Branch Second Edition 2nd Edition, Washington: CQ Press, 2016.

[8] J.W. Forrester," Industrial Dynamics. Cambridge," Massachusetts: The MIT Press, 1961.

[9] J.W. Forrester," Principles of Systems," MA: Wright-Allen Press, Inc., 1968.

[10] J.D. Sterman ," Business Dynamics - System Thinking and Modeling for a Complex World," Boston, MA: Irwin McGraw-Hill, 2000.

[11] P.M. Senge, "The Fifth Discipline - the Art and Practice of the Learning Organization," New York: Currency Doubieday, 1990.

[12] J.W. Forrester," Urban Dynamics," Waltham, MA: Pegasus Communications, Inc., 1969.

[13] J.W. Forrester," World Dynamics," MA: Wright-Allen Press, Inc., 1971.

[14] G.P. Richardson," Problems for the future of system dynamics. System Dynamics Review," vol. 12 (2), pp. 141-157, 1996.

[15] J. Houghton, M. Siegel, A. Wirsch, A. Moulton, S. Madnick, and D. Goldsmith, "A Survey of Method for Data Inclusion in System Dynamics Models: Methods, Tools and Applications," Retrieved on April 5, 2017, from web.mit.edu/smadnick/www/wp/2014-03.pdf

[16] C. Sücüllü and G. Yücel," Behavior Analysis and Testing Software (BATS)," Proceedings of the 32nd International Conference of the System Dynamics Society. 20-24 July. Delft, Netherlands, 2014

[17] M. Mediavilla, L.J. Miguel, P. Retortillo, and L.F. Blázquez, " Application of fuzzy tools to the automatic analysis of system dynamics models: an example of World3," The 19th World Congress The International Federation of Automatic Control. 24-29 Aug. Cape Town, South Africa, 8983-8988, 2014

[18] S. Sumari, R. Ibrahim, and N.H. Zakaria ," Qualitative Analysis in System Dynamics for Health Care System," Journal Of Information Systems Research and Innovation . pp. 8 – 16, 2014

[19] N. Hajiheydari, S.B. Khakbaz, and A.A. Ojaki," Developing responsive marketing system concept: Applying system dynamics approach," Science Journal of Business and Management. vol. 2(3), pp. 91-96, 2014

[20] J.P.C. Kleijnen," Sensitivity Analysis of System Dynamics Models: Regression Analysis and Statistical Design," System Dynamics Review. vol. 11(4), pp. 275-288, 1995

[21] B. Richmon,"System Dynamics/System Thinking: Let's Just Get On With," System Dynamics Review, vol. 10(2-3), pp. 135-157, 1994

[22] A. Ford," Modeling the Environment - An Introduction to System Dynamics Models of Environmental Systems," Washington DC: Island Press, 1999

[23] D.H. Meadows," Thinking in Systems - a Primer," UK: Earthscan, 2009.

[24] P. Checkland," Systems Thinking, Systems Practice: Includes a 30 Year Retrospective'" Chichester: John Wiley & Sons, 1981

[25] ASQ (American Society for Quality), "Continuous Improvement," Retrieved Apr 7, 2017, from http://asq.org/learn-about-quality/continuous-improvement/overview/overview.html.

[26] R. Rodriguez-Ulloa and A. Paucar-Caceres," Soft System Dynamics Methodology (SSDM): A Combination of Soft Systems Methodology (SSM) and System Dynamics (SD)," Retrieved on April 6, 2017 , from http://www.systemdynamics.org/conferences/2004/SDS_2004/PAPERS/163PAUCA.pdf

[27] F.B.B. Nasution and N.E.N. Bazin," Adjusting ICT Capacity Planning by Minimizing Cyber Crime Effects in Urban Area: A System Dynamics Approach," International Journal of Electrical and Computer Engineering. vol. 4(5), pp. 668-678, 2014.

[28] F.B.B. Nasution and N.E.N. Bazin," Creating Model with System Breakdown Structure (SBS) for System Dynamics Approach", Indonesian Journal of Electrical Engineering and Computer Science (IJEECS), in press.

[29] T. Davenport and J. Harris," Competing on Analytics: The New Science of Winning," Harvard Business Review Press, 2007.

[30] I. Lustig, B. Dietrich, C. Johnson, and C. Dziekan," The Analytics Journey - An IBM view of the structured data analysis landscape: descriptive, predictive and prescriptive analytics," Analytics Magazine, November/December 2010, pp. 11-18, 2010

[31] G.C. Deka and P. Raj," Handbook of Research on Cloud Infrastructures for Big Data Analytics," IGI Global, 2014.

[32] T. Garcia and T. Wang," Analysis of Big Data Technologies and Methods," 2013 IEEE Seventh International Conference on Semantic Computing. 16-18 Sep. Hyatt Regency Irvine, USA, 2013.

[33] Z. Laliwala and A. Shaikh," Web Crawling and Data Mining with Apache Nutch," Birmingham, Mumbai:Packet Publishing, 2013

[34] A. Pentland," Big Data: Balancing the Risks and Rewards of Data-Driven Public Policy," Retrieved Apr 6, 2017, from http://www3.weforum.org/docs/GITR/2014/GITR_Chapter1.4_2014.pdf

[35] J.P. Lester and J. Stewart," Public Policy: and Evolutionary Approach 2nd Edition," Belmont, CA: Wadsworth, 2000.

[36] J. Anderson," Public Policy Making 2nd Edition," New York: Holt, Rinehart and Winston, 1969.

[37] D. Easton," The Political System: An Inquiry into the State of Political Science," New York: Knopf, 1953

[38] T. Dye," Understanding Public Policy 2nd Edition. Englewood Cliffs,N.J.:Prentice Hall, 1975.

[39] C.L. Chochran and E.F. Malone," Public Policy: Perspectives and Choices," California: McGraw-Hill Higher Education, 1995

[40] W. Jenkins," Policy Analysis: A Political and Organisation Perspective," London: Martin Robertson, 1978.

[41] W.N Dunn," Public Policy Analysis: An Introduction. Englewood Cliffs: Prentice- Hall, 1981.

[42] H. Jenkins-Smith," Democratic Politics and Policy Analysis," CA: Brooks/Cole Publishing Company, 1990.

[43] N. Henry," Public Administration and Public Affairs," New York: Prentice Hall Inc, 1980.

[44] Y. Dror," Policy Analysis : A Theoretic Framework and Some Basic Concepts," Retrieved on April 22, 2014, from www.rand.org/pubs/papers/2008/P4156.pdf

[45] S. Matar and L.F Hatch," Chemistry of Petrochemical Process, Gulf Publishing Company, Houston, Texas, 2000.

[46] M.H. Hasana, T.M.I. Mahliaa, and H. Nur," A review on energy scenario and sustainable energy in Indonesia," Renewable and Sustainable Energy Reviews, vol. 16, pp. 2316 – 2328, 2012

[47] B. Rianto," *Palm Oil Plantation*, PricewaterhouseCoopers Indonesia," 2010.

[48] W. Caroko, H. Komarudin, K. Obidzinski, and P. Gunarso," Policy and institutional frameworks for the development of palm oil–based biodiesel in Indonesia," CIFOR, Bogor, Indonesia, 2011.