

# Design R&D Program Evaluation Based on the Logic Model Approach: An Example from a Productivity Program in Indonesia

Muhammad Samsuri<sup>1</sup>

---

## Abstract

National R&D programs are under pressure to describe the rationale for how their initiatives will contribute to innovation and to social or economic benefits. What is more, there is an expectation that program planning and evaluation will help make initial decisions on developing a planning framework to describe the plausible program, choosing an evaluation framework to fund, and demonstrating both progress and achievement. Moreover, evaluation has become increasingly important part of reporting R&D program performance. This paper describes a design concept for R&D program evaluation and measuring performance based on the logic model approach, using the example of the “S&T Productivity Program” in Indonesia. This new design concept for R&D program evaluation and performance measurement is also suitable for program managers. Design R&D evaluation should consist of both design R&D program evaluation planning and measurement and R&D program performance. The logical model approach has been utilized to develop both parts of R&D evaluation. This paper describes the resources, outputs and outcomes of the program, as part of this planning design, and provides an outcome indicator and an outline of the likely anticipation impact.

**Keywords:** research and development (R&D), program evaluation, Indonesia, logic model

---

## 1. Introduction

As Indonesia is a developing country with a limited budget for research and development (R&D) investment, national R&D policy primarily emphasizes innovation. This is because with innovation, R&D investment is expected to highly contribute to increasing economic growth while creating a greater social impact. Innovation, whether it involves new products, processes, or business models, is the solution to many of the problems the country faces, especially when it comes to social and economic challenges.

In addition, national R&D programs are under pressure to describe the rationale for how their

initiatives will contribute to innovation and to social or economic benefits. At its simplest, for public R&D programs there is an implicit question: What are we getting for the money we are spending? Stakeholders want to know whether the results proposed by the program are, in fact, the correct results. In other words, they want affirmation that the results address problems appropriate for the program and deemed by the stakeholders to be important to the organizational mission and national needs. There is also the question of how to measure R&D program performance. What is more, there is an expectation that program planning and evaluation will help make initial decisions on developing a planning framework to describe the

---

<sup>1</sup>Ministry of Research and Technology (MoRT), Jakarta, Republic Indonesia  
Email: msyamsuri@ristek.go.id

plausible program, choosing an evaluation framework to fund, and demonstrating both progress and achievement.

The emphasis on accountability and management for results is found in governments as well as in public service organizations such as the Ministry of Research and Technology in Indonesia. It represents a change in the way program managers are required to describe their programs and document program successes. Program managers are not as familiar with describing and measuring outcomes as they are with documenting inputs and processes. Program design is not necessarily explicit, in part because this allows flexibility should stakeholder priorities change.

There is also a burgeoning interest among program managers in continuous improvement and managing for quality. Choosing what to measure and collecting and analyzing the data necessary for improvement measurement is new to many program managers.

The problem is that clear and logically consistent methods have not been readily available to help program managers to make implicit understandings explicit. While tools such as flow charts, risk analysis, systems analysis, are used to plan and describe programs, there is a method developed by program evaluators that more comprehensively addresses the increasing requirements for both outcome measurement and improvement measurement.

The purpose of this paper is to describe a design concept for R&D program evaluation and performance measurement. This design concept might help R&D program managers to better meet new requirements and may also aid evaluators in serving their customers. This article sets out the new design concept for R&D program evaluation and performance measurement, which was elaborated from a basic logic model process. This concept may be useful in guiding R&D evaluation and measuring R&D program performance, especially in evaluation and performance measurement for the National Science and Technology (S&T) Program in Indonesia.

## 2. Literature Review

A logic model is a plausible and sensible model of

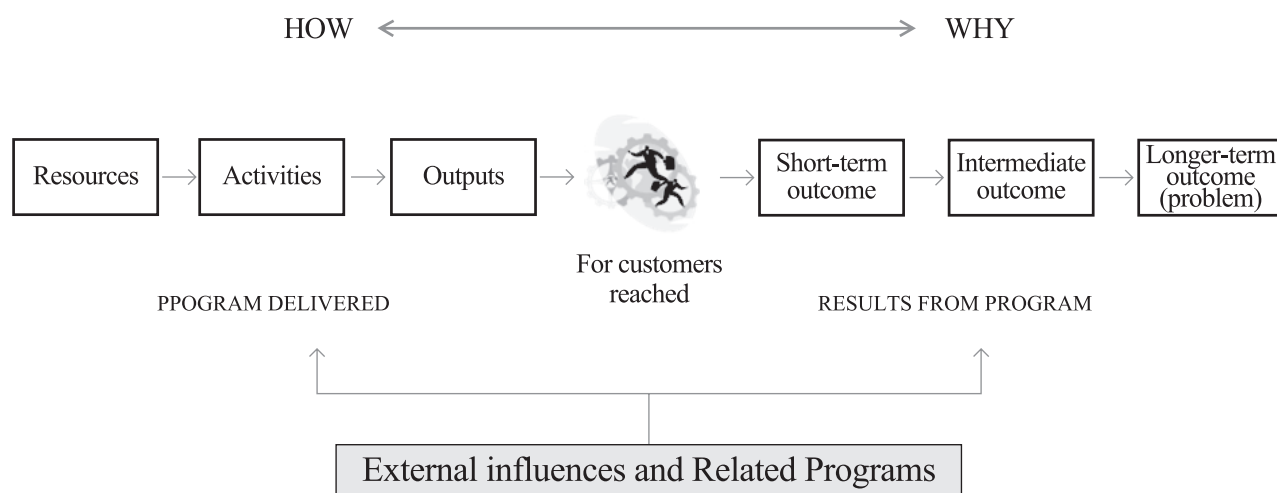
how a program will work under certain environmental conditions to solve identified problems (Bickman, 1987). It can be the basis for a convincing story of the program's expected performance, telling stakeholders and others the problem that the program focuses on and how it is uniquely qualified to address it. The elements of the logic model are resources, activities, customers reached, outputs, and short-, intermediate- and longer-term outcomes (Wholey, 1987).

The logic modeling process makes explicit what is often implicit. Also, if done carefully, the process lays out a 'theory of change', highlighting the plausible pathways through which resources translate into outcomes, and identifying mediating factors that can help or hinder success at key points. Much has been written about the logic model forming the basis for good evaluation and performance monitoring, as well as its use in program design and building a shared understanding of what an effort plans to achieve and how it will achieve that (Rogers *et al.*, 2000).

The logic model and these variations are all related to what evaluators call 'Program Theory'. According to Chen (1990), program theory should be both prescriptive and descriptive. That is, a manager has to both explain the elements of the program and present the logic of how the program works. Patton (1997) refers to this kind of program description as an "espoused theory of action"; that is, stakeholder perceptions of how the program will work.

The benefits of using the logic model tool are manifold. Firstly, this model builds a common understanding of the program and expectations for resources, customers reached and results, thus is good for sharing ideas, identifying assumptions, team building and communication. Secondly, the tool is helpful for program design or improvement by identifying projects that are critical to goal attainment, are redundant, or have inconsistent or implausible linkages among program elements. Thirdly, the logic model communicates the place of a program in the organization or problem hierarchy, particularly if there are shared logic charts at various management levels (McLaughlin & Jordan, 1999).

A basic model is shown in Figure 1, although logic models may take many different forms, including



**Figure 1** Basic logic model

narrative and table form. Evaluators can prepare logic models at any time in the life cycle of a program, and they often revise them as more program information is collected.

‘Resources’ include human and financial resources as well as other input required to support the program, such as partnerships. Information on customer needs is an essential resource to the program. ‘Activities’ denotes the action steps necessary to produce program outputs. ‘Outputs’ are the products, goods, and services provided to the program’s direct customers or participants. For example, the reports generated for other researchers and technology developers as a result of the activity of conducting research could be thought of as outputs of the activity.

The feature of ‘customers’ had been dealt with implicitly in logic models until Montague added the concept of “reach” to the performance frameworks. He speaks of the 3Rs of performance: resources, people reached, and results which cannot happen without people (Montague, 1997). The customers served and the partners who work with the program enable actions that will lead to results. Placing customers, the users or receivers of a product or service, explicitly in the middle of the chain of logic helps program staff and stakeholders better think through and explain what actions lead to what results and which population groups the program intends to serve.

‘Outcomes’ refers to benefits resulting from activities

and outputs. Program typically have multiple, sequential outcomes, sometimes called the program’s outcome structure. First, there are short-term outcomes: the changes or benefits that are most closely associated with, or “caused” by, the program’s outputs. Second are intermediate outcomes, which result from the short-term outcomes. Longer-term outcomes or program impact follow from the benefits accrued through the intermediate outcomes.

A critical feature of the performance story is the identification and description of key contextual factors external to the program and not under its control which could influence its success either positively or negatively. It is important to examine the external conditions under which a program is implemented and how those conditions affect outcomes. This explanation helps clarify the program ‘niche’ and the assumptions on which performance expectations are set. Doing this provides an important contribution to program improvement (Weiss, 1997). Explaining the relationship of the problem addressed through the program, the factors that cause the problem, and external factors enables the manager to argue that the program is addressing an important problem in a sensible way.

### 3. Design R&D Evaluation Planning Based on a Logic Model

The detailed guidance provided in this paper

on how to develop a logic model and use it to determine key measurement and evaluation points will clarify how the logic model process has worked for the S&T productivity program in the Ministry of Research and Technology, Indonesia. Based on the basic concept of a logic model Figure 1 this paper proposes a new design in R&D evaluation planning. The entire design concept for the logic model is constructed in the five stages discussed below. Stage 1 involves the collection of relevant information; Stage 2 is a description of the problem the program will solve and its context; Stage 3 involves defining the elements of the logic model in a table; Stage 4 is the construction of the logic model, and Stage 5 is the model verification.

### *3.1 Collecting Relevant Information*

Whether they are designing a new program or describing an existing program, it is essential that managers or work teams collect information relevant to the program from multiple sources. The information will come in the form of program documentation as well as interviews with key stakeholders both internal and external to the program. While strategic plans, annual performance plans, previous program evaluations, pertinent legislation and regulations and the results of targeted interviews should be available to managers before the logic model is constructed, as with any project, this will be an iterative process requiring the ongoing collection of information. Powerful evidence that the program approach selected is correct can be gleaned by conducting a literature review to gain insights into what others have done to solve similar problems and to reveal key contextual factors to consider in designing and implementing the program.

In the case of the S&T Productivity Program in Indonesia, collected information includes been The Midterm National S&T Development Framework (2010-2014), the National S&T Strategic Planning for the Ministry of Research and Technology, the National Research Agenda for 2010-2014, and other literature review related to the development of science and technology.

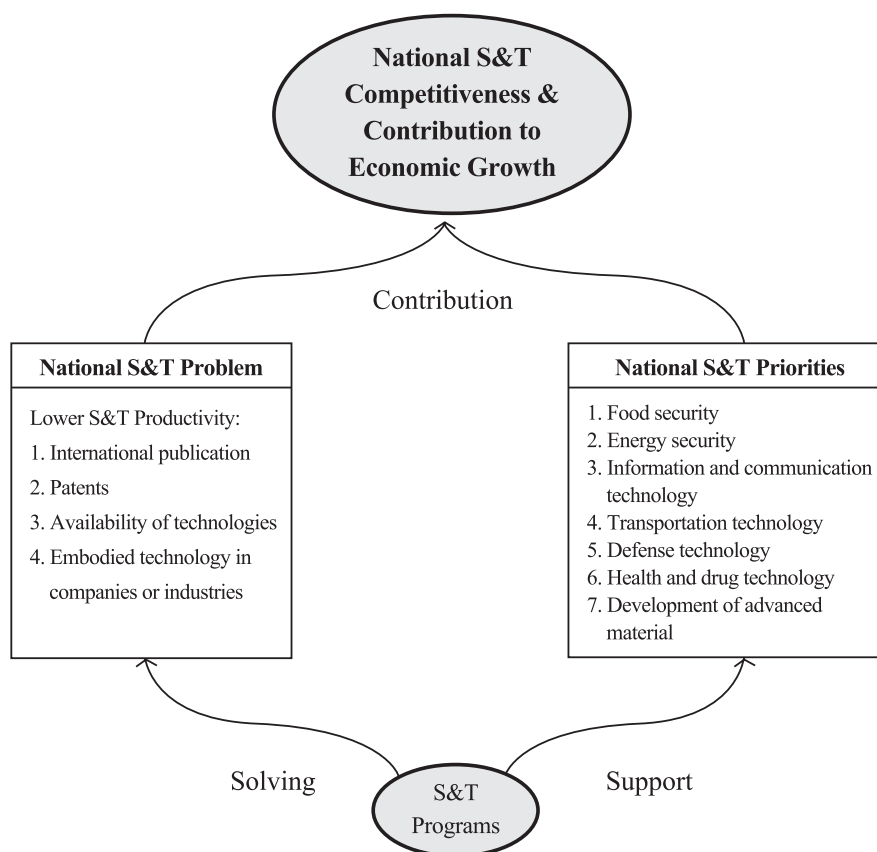
### *3.2 Clearly Defining the Problem and its Context*

Clearly defining the necessity of the program is the basis for all that follows in the development of the logic model. The program should be grounded in an understanding of the problem that drives the need for the program. This understanding includes clear comprehension of the problems customers face and what factors “cause” the problems. It is these factors that the program will address, through customer, to achieve the longer term goal-working to solve the problem. In addition, the program should support national S&T priorities.

The case of Indonesia provides a good example for investigation. There are economic, social and academic challenges related to research, science and technology productivity. R&D productivities are based on several indicators: scientific publications, patents, security and utilization of S&T, the use of technology in companies, and S&T empowerment. In 2009, the number of scientific publications included 560 articles in international journals, 2,718 domestic patents and 19 international patents. The number of international patents was considerably lower than that of Malaysia (168), Singapore (450), the Philippines (22), and Thailand (40). Moreover, in the case of security and utilization of S&T, based on the WEF report, in terms of availability of high technology, Indonesia ranked 54<sup>th</sup> out of 133 countries in 2009, behind Singapore (3<sup>rd</sup>), Malaysia (24<sup>th</sup>), and Thailand (26<sup>th</sup>) but before Vietnam (75<sup>th</sup>) and the Philippine (87<sup>th</sup>). In case of embodiment of technology in companies, Indonesia was ranked 65<sup>th</sup>, after Malaysia (37<sup>th</sup>), Singapore (13<sup>rd</sup>), Thailand (61<sup>st</sup>), Philippine (54<sup>th</sup>) and Vietnam (51<sup>st</sup>) (Ministry of Research and Technology, 2009, 2010).

According to the National Mid-term S&T Development Framework (2010-2014), research enhancement and development and application of science and technology focused on seven areas: food security, energy security, information and communication technology, transportation technology, defense technology, health and drug technology and the development of advanced materials.

To solve the challenges it was necessary to set up the National R&D Program, entitled ‘The Program for



**Figure 2** The concept of the enhancement of national S&T productivity program, to solve national S&T problems and focus on national S&T priorities

The Enhancement of National S&T Productivity”. This program focuses on seven areas as selected from “The Frameworks of National S&T Development in Mid-term National Development Planning (2010-2014)”. Figure 2 illustrates the concept of “The Program for the Enhancement of National S&T Productivity,” designed for the purpose of addressing national S&T problems and supporting areas of national S&T priority.

### 3.3 Defining the Elements of the Logic Model

Building evaluation frameworks base on a logic model usually begins with categorizing the information collected into ‘bins’ or columns in a table. Using the categories discussed above, managers work through the information and tag it as a resource, activity, output, short-term outcome, intermediate outcome, long-

term outcome, or external factor. The most important aspect of building a model is to consider how the program actually works. While not every program detail has to be identified and cataloged, it is crucial to find those that are key to enhancing program staff and stakeholder understanding of how the program works. Figure 3 illustrates some of the elements of the logic model for one of the “S&T Productivity Program” developed by the Ministry of Research and Technology, Indonesia.

As the elements of the logic model are being gathered, the manager and a work group should continually check the accuracy and completeness of the information contained in the table. The checking process is best done by involving representatives of key stakeholder groups to determine if they can understand the logical flow of the program from resources to solving the longer-term problem.

Resources	Activities	Output	Customer Reached	Outcomes		
				Short term	Intermediate term	Long term
R&D budget, Manager&staff researcher	Perform R&D activities	Progress of R&D activities	Public and private researcher, industries and communities	<ul style="list-style-type: none"> <li>• Lead to: Scientific publications and patents</li> <li>• Prototypes, sample made, new process technology</li> </ul>	<ul style="list-style-type: none"> <li>• Complete on: Scientific publication, patents, prototypes, samples and new process technology</li> </ul>	<ul style="list-style-type: none"> <li>• Availability of advanced technology, utilization embodied R&amp;D results in Industry;</li> <li>• Enhancement national S&amp;T competitiveness;</li> <li>• Contribution to economic growth</li> </ul>
R&D budget, Manager & program staff	Set up and provide R&D incentives	Progress of R&D incentives	Public and private researcher, industries and communities	<ul style="list-style-type: none"> <li>• Lead to: Scientific publications and patents</li> <li>• Prototypes, sample made, new process technology</li> </ul>	<ul style="list-style-type: none"> <li>• Complete in: Scientific publication, patent, prototype, sample and new process technology</li> </ul>	<ul style="list-style-type: none"> <li>• Availability of advanced technology, utilization embodied R&amp;D results in industry;</li> <li>• Enhancement of national S&amp;T competitiveness;</li> <li>• Contribution to economic growth</li> </ul>
R&D budget, Manager & program staff	Set up policy for procurement	R&D Policy progress for procurement	Public and private researcher, Industries and communities	<ul style="list-style-type: none"> <li>• Recommendation of national R&amp;D agenda</li> <li>• Recommendation of national policy support to enhance R&amp;D activities</li> </ul>	<ul style="list-style-type: none"> <li>• Recommendation of national R&amp;D agenda</li> <li>• Recommendation of national policy support to enhance R&amp;D activities</li> </ul>	<ul style="list-style-type: none"> <li>• Availability of high technology, utilization Embodied R&amp;D results in Industry;</li> <li>• Enhancement of national S&amp;T competitiveness;</li> <li>• Contribution to economic growth</li> </ul>



External factors : Stakeholder intervention, Policy intervention, Political intervention

**Figure 3** A table with elements of the logic model for “The program for the of enhancement S&T productivity” in Indonesia

Therefore, the checking process goes beyond determining if all the key elements are identified to confirming that when reading from left to right, there is an obvious sequence or bridge from one column to the next (Patton, 2008)

### 3.4 Drawing the Logic Model

The logic model captures the logical flow and linkages that exist in any performance story. Using the program elements in the table, the logic model organizes the information, enabling the audience to understand and evaluate the hypothesized linkages. Where the resources, activities, and outcomes are listed within their respective columns in the story, they are specifically linked in the model, so that the

audience can see exactly which activities lead to what intermediate outcomes and which intermediate outcomes led to what longer-term outcomes or impacts.

Although there are several ways to present the logic model (Rush & Ogbome, 1991; John A. McLaughlin, 1999), usually the model is set forth as a diagram with columns and rows of boxes, with abbreviated text put in a box and causal linkages shown with connecting one-way arrows. Input or resources to the program are placed in the first column on the left of the model and the longer-term outcomes and problem to be solved on the far right column. In the second column, the major program activities are boxed. In the adjacent columns, the intended outputs and outcomes from each activity are shown, listing



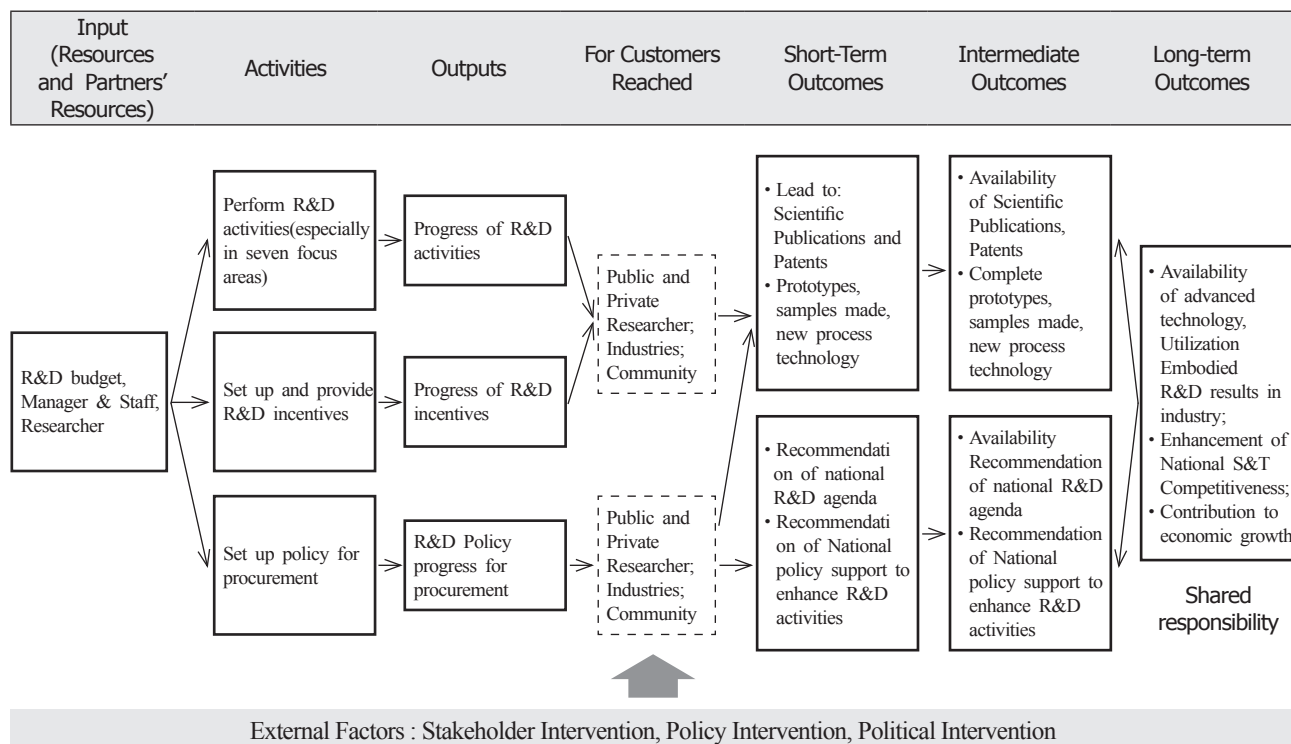
the intended customer for each output or outcome. Another common format is showing the logic from top to bottom rather than from left to right, usually with resources and activities at the top and the goals at the bottom of the page.

An example of a logic model for the “Program for the Enhancement of National S&T Productivity” in Indonesia is depicted in Figure 4. Notably, all performed R&D activities focus on the seven focus areas, as mandated by National S&T development frameworks, the National R&D Agenda and the National S&T Strategic Planning at the Ministry of Research and Technology, Indonesia.

Thus the logic model delineates what we are going to evaluate in a given program. In investigating the Program for the Enhancement of S&T Productivity, several contributing resources were identified, such as the R&D budget, the manager, the staff, and the researcher. Multiple activities were noted, such as performing R&D activities, organizing and providing R&D incentives and setting up policy for procurement. The progress reports from all activities were identified

as the output of program. All output will lead to the short-term, intermediate-term and long-term outcomes as shown in Figure 4 above.

Although the example given shows the relationship between output and outcome, all of which are of interest to stakeholders and are part of describing the value of the program, activities can be described at many levels of detail. Since models are simplifications, activities that lead to the same outcomes may be grouped to capture the level of detail for a particular audience. Most programs are complex enough that logic models at more than one level of detail are helpful. A logic model more elaborate than the simple one shown in Figure 4 can be used to portray more detail for all or any one of its elements. For example, R&D activities may include conducting literature reviews or methodologies, collecting information from multiple sources, analyzing data, and written reports. These can be grouped and labeled as R&D activities. However, it may be necessary to formulate a more detailed and elaborate description of research sub-activities for those staff members responsible, and to



**Figure 4** Logic chart for a enhancement S&T productivity program in Indonesia

determine if area given area is of specific interest to a stakeholder group.

The final concept may be viewed as a network displaying the interconnections between the major elements of the program's expected performance, from the existence of resources to the solving of an important problem. External factors are entered into the model at the bottom, unless the program has sufficient information to predict the point at which they might occur.

### 3.5 Evaluating the Model

As the logic model process unfolds, the work group responsible for producing the model should continuously evaluate it with respect to its goal of representing the program logic; it should be noted how the program works under what conditions its short-, intermediate-, and long-term aims can be achieved. The verification process should engage appropriate stakeholders in the review process. The work group will use the logic model diagram and the supporting table and text. During this time, the work group can also address the critical information needed in regards to performance, setting the stage for evaluation and measurement plans.

In addition to tackling 'why', 'how', and 'if-then' questions, four evaluation design questions should be addressed in the final verification process:

- Is the level of detail sufficient to create an understanding of the elements and their interrelationships?
- Is the program logic complete? That is, are all the key elements accounted for?
- Is the program logic theoretically sound? Do all the elements fit together logically? Are there other plausible pathways to achieving the program outcomes?
- Have all the relevant external contextual factors been identified and their potential influences described?

A good way to check the logic model is to describe the program logic as hypotheses – a series of 'if-then' statements: given observations of key contextual factors, if resources, then program activities;

if program activities, then outputs for targeted customer groups. If outputs change behavior, first short- and then intermediate-term outcomes occur; if intermediate outcomes, then longer-term outcomes that lead to the problem being solved (Michael Quinn Patton, 2008).

For example, given the problem of lower S&T productivities in Indonesia, the hypothesis might go something like this:

*Under the conditions of lower S&T productivities in Indonesia and strong intervention from stakeholders, the S&T productivities will increase as expected. If the program performs R&D activities in seven focus areas, then it will produce a R&D progress report. If public or private R&D has produced excellent report progress and collaborates with industries, then it will lead to scientific publications, patents, prototypes, new samples and new process technology, and then it will enhance the availability of scientific publications, patents, prototypes, new samples and new process technology. If industry takes this and uses this information and R&D results, then there will be an enhancement of availability for high technology, utilization of embodied R&D results in industry, and there will be enhancement of National S&T Competitiveness, which will be contribute to economical growth through shared responsibilities.*

## 4. The Design Concept for Measuring R&D Program Performance Based on the Logic Model

Evaluation should examine or test the underlying assumptions about how the program works to achieve these outcomes. The verification and checking activities described above apply in that drawing and verifying the logic model involves considering stakeholders to represent the first stages of performance measurement. This process ensures that the program design is logically constructed, that it is complete, and that it captures what program staff and stakeholders believe to be an accurate picture of the program.

### 4.1 Developing Performance Indicators

A measurement plan will include a small set of

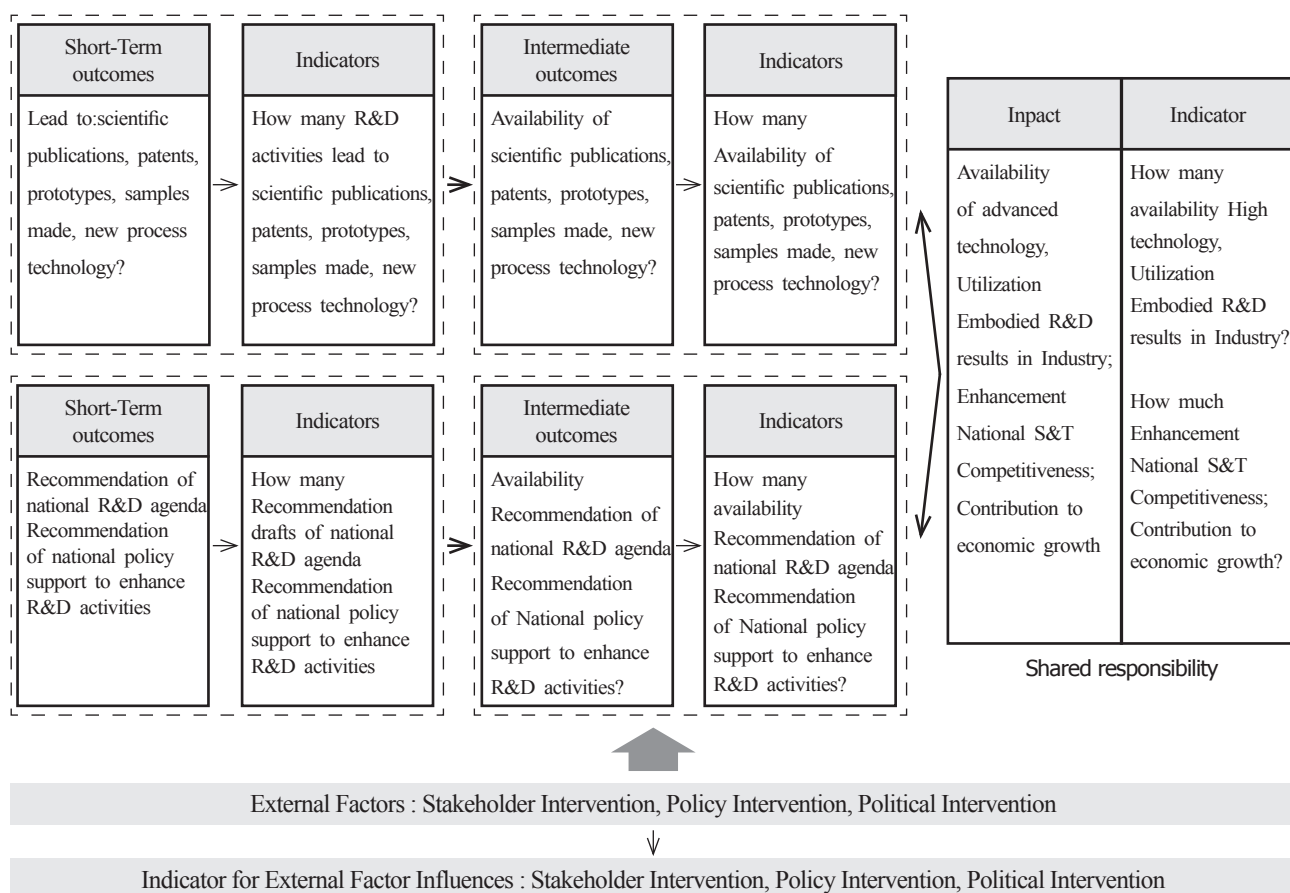


critical measures, balanced across the performance story and indicator of performances. The plan will also include the important indicator performance measurement questions that must be addressed, and will suggest appropriate timing for outcome or impact evaluation. This approach to measurement will enable the program manager and stakeholders to assess how well the program is working to achieve its short term, intermediate and long term aims and to assess those features of the program and external factors that may be influencing program success.

The logic model could be adopted to describe the performance of indicators for short-, intermediate- and long-term outcomes (impact). For example, Figure 5 demonstrates the concept for describing the logic model for indicators developed in the Enhancement of S&T Productivities Program in Indonesia.

Indicator outcomes, especially those for the short- and medium-term should be clear. An example of a short-term outcome would be how many research report activities probably lead to scientific publication, patents, prototypes. An intermediate outcome might be how many scientific publications, patents and prototypes are available. Long-term indicators denote a responsibility shared with other national programs, as a long-term outcome creates a basic change in conditions that has not only been influenced by science and technology programs.

Having a logic model in place at the beginning of the evaluation is important because it serves as an advance organizer or focusing mechanism for the evaluation and the measurement of key variables or performance indicators. Once the evaluator and staff agree on the logic, the evaluation questions and data



**Figure 5** Outcomes indicator for the enhancement of S&T productivities program in Indonesia, based on the logic model approach

collection strategies may be developed. It must be noted, however, that the logic model is merely a draft document that captures the program staff's concept of how the program works. Indeed, it may not work that way at all. Thus, the evaluator needs to test the logic model through an implementation assessment to develop what Patton (1997) has called the theory in practice. If discrepancies are found, the evaluator and program staff should discuss the ramifications of the discrepancies and either redesign the program or increase implementation fidelity to enhance the change for success.

Morell (2010) and Patton (2010) discuss the importance of pattern matching as a tool to study the delivery and impact of a program. The use of the logic model process results in a pattern that can be used in this way. It thus becomes a tool to assess program implementation and program impacts. An iterative procedure may be applied; this procedure first determines the theory in use, followed by either revision in the espoused theory or tightening of the implementation of the espoused theory. Next, the resulting tested pattern can be used to address program impacts.

In addition to testing theory and logic, evaluation and measurement also serve the purpose of measuring the degree to which the program achieves specified performance objectives. Evaluation is the systematic investigation of the merit or worth of an object for the purpose of reducing uncertainty in decision making about that object. Evaluators often use the terms *merit* and *worth* synonymously. However, it is useful to contrast the two to focus the intent of evaluation more broadly. *Merit* focuses more on the effectiveness of the program to achieve its aims, while *worth* focuses on the broader impact of the program. A key question to consider is whether achieving its aims adds value to the community. The logic model helps the evaluator and project staff members focus the evaluation on questions of both merit and worth. Worth might be assessed from the standpoint of the degree of achievement of the long-term impacts on which the program focuses, while merit is addressed on the basis of the degree to which short-term and intermediate-term outcomes have been achieved. The program

sphere of influence usually stops at the intermediate-term outcomes. Longer-term outcomes typically require the formation of performance partnerships because so many intervening variables cause variation in these strategic indicators of success.

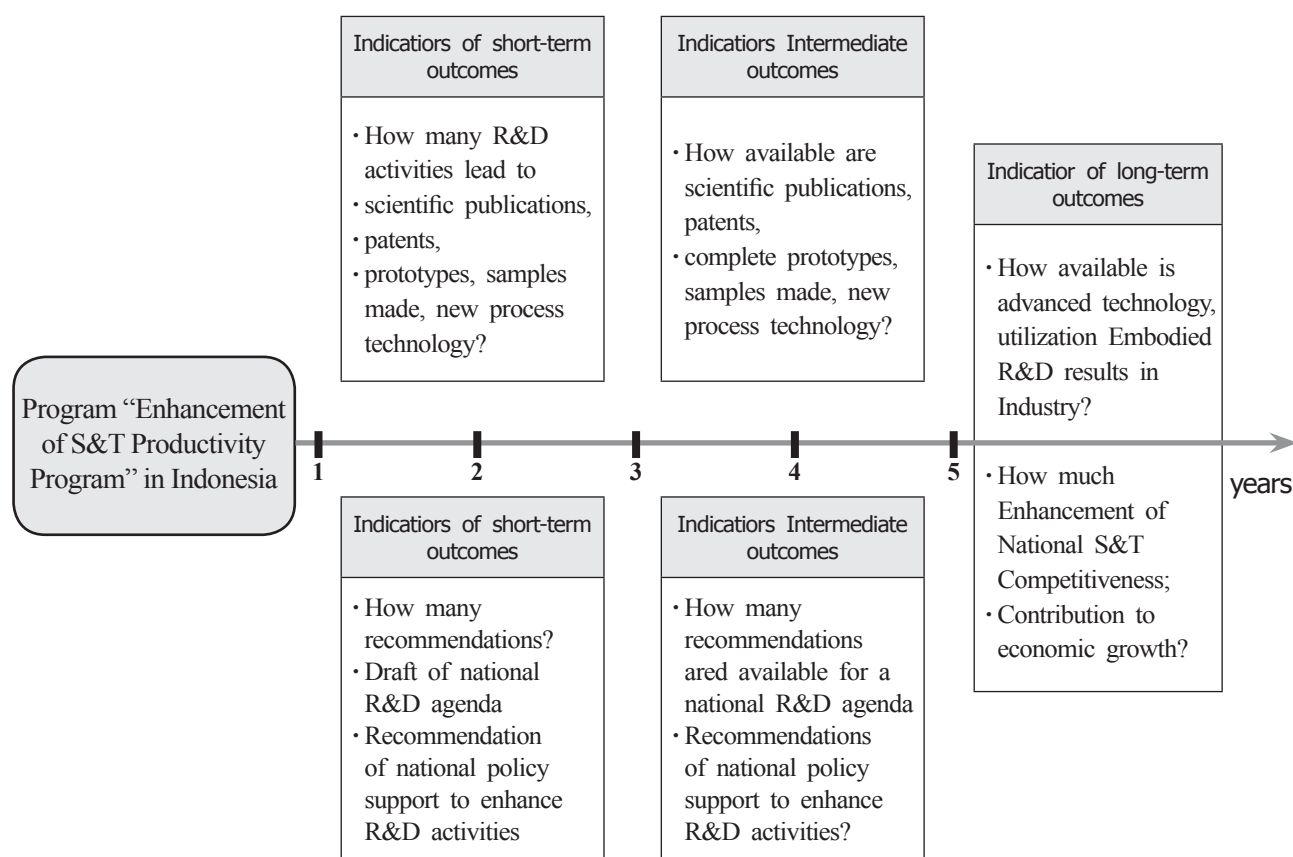
#### *4.2 Develop the Program's Anticipated Timeline of Impact*

Programs aim to bring about change, and change usually takes time. The problem is the frequent lack of explicit clarity on the timeframe of change associated with a program. Furthermore, it is necessary to develop the program's anticipated timeline of impact. Along with these issues, each outcome in the short, intermediate, or long term could be predicted as well. Figure 6 describes the anticipated timeline impact for the Enhancement of S&T Productivity Program at the Ministry of Research and Technology, Indonesia. This approach was elaborated from the model developed by Sridharan et al (2006, 2008, 2010).

In much of the literature, the anticipated timeline of impact for R&D development programs can be measured within one to three years for short-term outcome indicators and three to four years for intermediate outcome indicators. Long-term outcomes indicator can be measured after five years (Cooksy et al, 1997). However, some references mention the measurement of long-term indicators after seven years (Carden, 2007).

Likewise in the case of the S&T Productivity Program, the short-term outcomes indicator can be measured within one to three years and four to five years for the medium-term outcome indicator. Meanwhile the long-term outcomes indicator could be measured after five years after the program was running.

A question to consider is where such a timeline should come from in the absence of a detailed theory. One approach to developing a timeline of impact is to involve key stakeholders – those most directly involved in the planning, implementation and delivery of a program (Sridharan et al., 2006, 2010). Much of the evaluation literature recommends an active involvement of program stakeholders because these are



**Figure 6** Anticipation timeline of impact for outcomes indicator for the Enhancement of S&T productivities program in Indonesia (elaborated from Sridharan et al, 2011)

the people most familiar with the program.

Further, different groups, such as funders, evaluators, and program staff, can have different views of the underlying theories of impact (Connell et al, 1995) and the timelines associated with the program. Understanding differences in expectations of timelines may have implications for integrating diverse viewpoints that affect the planning, implementation, and evaluation of programs. Additionally, based on multiple evaluations of community programs, stakeholders in community settings often have a more realistic understanding of the difficulties of community change processes than academic experts or funding agents. Tapping such experience is especially important in evaluations of complex initiatives. Finally, it is important to remember the importance of the stakeholder in describing and deciding the program’s anticipated timely impact.

## 5. Conclusions

This paper has described a way to design R&D program evaluation and measure performance based on the logic model approach, as developed by the S&T Productivity Program in Indonesia. This model proposes a new design concept for R&D program evaluation and performance measurement, suitable for use by program managers.

Design R&D evaluation should consist both of design R&D program evaluation planning and the measurement of R&D Program performance. A logic model has been used as an approach to develop both R&D design and evaluation. Designing R&D program evaluation planning based on a logic model describes the program that will be evaluated. A description of resources, outputs and outcomes of the program are part of this design of R&D program evaluation

planning.

Findings from the Enhancement of S&T Productivity Program, several resources identified as program contributors, such as R&D budget, the manager, the staff, and the researcher. Several activities were also noted, such as performing R&D activities, implementing and providing R&D incentives, and setting up a policy for procurement. The progress reports from all activities were identified as outputs of the program. Each output will lead to short-, intermediate-, or long-term outcome. Examples of a short-term outcome include development leading to scientific publications, patents, and prototypes. The availability of scientific publication, patents, or prototypes has been described as an example of an intermediate-term outcome. Shared responsibility of national competitiveness serves as an example of long-term outcome.

The logic model developed here also set out to design a measurement of R&D program performance. Included in this is information about outcome indicators and the timely anticipation impact. Some indicators such as how many R&D results lead to scientific publication, the availability scientific publications, and the number of shares in economic growth have been set out as outcome indicators of the Enhancement of S&T Productivity Program in Indonesia. For a timely anticipation impact, the short-term outcomes indicator can be measured within one to years, while the intermediate-term indicator would denote a four to five-year span. The long-term outcome indicator could be measured once a program has been running for five years.

## References

- Bickman, L. (1987), The functions of program theory. In L. Bickman (Ed), Using program theor in evaluation. New Directions for program Evaluation, No.33. Sam Fransisco: Jossey-Bass.
- Chen, H.T. (1990), Theory -driven evaluations. Newbury Park, CA; Sage.
- Connell, J., Kubisch, A., Schorr, L., & Weiss, C. (Eds.). (1995), New approaches to evaluating community initiatives: Concepts, methods and contexts. Washington, DC: Aspen Institute.
- Jordan, G.B & Mortensen, J. (1997), Measuring the performance of research and technology programs: a balanced scoreca.
- Mclaughlin, J.A, Jordan, G.B (1999), Logic models: tool for telling your program's performance story, Evaluation and Program Planning, 22: 65-72.
- Ministry of National Development Planning (2010), Middle Term of National Development Planning 2010-2014, Ministry of National Development Planning. (in Indonesian)
- Ministry of Research and Technology (2010), Strategic Planning of Science and Technology 2010-2014, Ministry of Research and Technology. (in Indonesian)
- Ministry of Research and Technology (2009), Knowledge based Economy; Ministry of Research and Technology. (in Indonesian)
- Montague, S. (1997), The three Rs of performance, Ottawa, Canada: Performance Management Network, Inc. September.
- Morell, J.A (2010), Evaluation in the face of uncertainty: Anticipating surprise and responding to the inevitable. New York, NY: Guilford Publications.
- Patton, M.Q (1997), Utilization-focused evaluation: the new century text, Thousand Oaks: sage, pp.221-223.
- Patton, M.Q (2008), Utilization-focused evaluation (4th edition), Sage publication, Printed in USA.
- Patton, M.Q (2010), Development evaluation, New York, NY: Guilford Press.
- Rogers, P J, A Petroschino, T A Huebner and T A Hacsí (2000), Program Theory Evaluation: Practice, and Problems. New Directions for Evaluation, no. 87. San Francisco: Jossey-Bass.
- Rush, B., & Ogborne, A. (1991), Program logic model: expanding their role and structure for program planning and evaluation. Canadian Journal of Program Evaluation, 6: 2.
- Sridharan, S., Campbell, B., & Zinzow, H. (2006), Developing a stakeholder-driven timeline of change for evaluations of social programs, American Journal of Evaluation, 27(2): 148–162.
- Sridharan, S. (2008), Making Evaluations Work, American Journal of Evaluation, 29(4): 516–519.
- Sridharan, S., & De Silva, S. (2010), On Ambition, learning, and co-evolution: Building evaluation as a field, American Journal of Evaluation, 31(2): 246–325.
- Weiss, C (1997), Theory based evaluation: past, present and future. In D. Rog&D. Founier (Eds), Progress and future direction in evaluation: perspectives on theory, practice, and methods, New directions for program evaluation, no. 76. San Francisco: Jossey-Bass.