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The Art of Crafting Actionable National Innovation Policy: The Case of Sri Lanka

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Abstract

Innovation or S&T policy has become one of the crucial policy domains in almost all the countries during the last three decades. The association between the level of innovation and the socio-economic development of a country has created a considerable national level prominence to work on formulation and implementation of innovation policy which will direct to configure a national level innovation eco-system. This study examines the contribution of National S&T Policy of Sri Lanka published in 2008 together with analysis of the National Science, Technology and Innovation Strategy 2011-2015 presented in 2010 for making recommendations for effective designing and implementation of the innovation policy in the light of rationality model for policy. Document analysis, secondary data sources and in-depth interviews with key personalities were the methods applied to meet study purposes. The design effort of the Policy and the Strategy is appreciated as this was the first attempt in formulation a policy in innovation in Sri Lanka. Nevertheless, incompatibilities that the two documents presented have created inconsistency of the goals and objectives. Loop holes in assigning strategic actions amongst relevant actors, lack of guidance for resource allocation, and ambiguity in coordination and communication are highlighted as weaknesses in these policy initiatives. Overall, it reveals that the gap between stipulated goals and objectives of the Policy and the level of attainment has been widening annually over 10 years of the policy formulation. Therefore, this study recommends that it necessitates the policy to be appropriately adjusted in order to meet with timely needs and crafting actionable strategies accordingly.

Keywords: Innovation, National Innovation Policy, National Innovation Strategy, Rationality Model for Policy

1. Introduction

1.1 Introduction to the Problem

Policies are widely used in many countries for the purpose of appropriation of limited national resources to maximize the achievement of different national priorities. Public policy has been defined as ‘...the series or pattern of government activities or decisions designed to remedy certain social problems, as a purposeful course

of action that an actor or the group of actors follows in dealing with a problem or matter of concern' (Khan and Khandaker, 2016, pp. 539). Accordingly, the issue of public policy is two folded—to set reasonable and attainable goals and objectives for long term in a particular national level concern, and to decide strategies intentionally to reach those goals and objectives effectively.

A policy, having innovation in the label had appeared in the literature from mid 1990s. However, the influence of public policies on innovation had been in existence for centuries with conviction (Edler and Fagerberg, 2017). According to Meissner et al. (2017), the innovation policy has become a popular scientific research domain in knowledge-based societies. The old version of this particular policy domain was 'Science and Technology Policy' and the new version sometimes got renamed as 'Science, Technology and Innovation Policy.' Innovation policy covers all the science, technology, education, economic, industry and political domains that are undertaken by public organizations that influence on innovation for national development needs (Edquist, 2005; Borrás and Edquist, 2013). Hence, whatever the title given in different contexts, this policy domain covers almost all the institutions and functions associated to national level innovation system of a country.

1.2 Explore Importance of the Problem

National Innovation System (NIS) comprises main actors and their interrelationships focused on main functions of a NIS - knowledge generation, knowledge exploitation and dissemination, commercialization of the outcome, training of R&D personnel, managing innovative processes, coordination, legal regulation, mediation, financial support, and other facilitations for innovation. NIS works as the network of public and private sector institutions (NIS actors), whereby the activities and interactions initiate, import, adopt and disseminate new decisions, technologies (Juknevičienė, 2019). Accordingly, the broad framework is required to cover the above national level considerations in the formulation of an effective national innovation policy.

Hence, the innovation policy and the strategy work as the general guiding framework of the country towards establishment of a national level eco-system for promotion of innovation. However, in the same policy domain, some countries implement the policy successfully to gain socio-economic advantages while some countries struggle with difficulties of gaining benefits through successful deployment of the policy. The intellectual dilemma on why do these gaps exist among performance of different countries and how the slow performing countries can work on speeding up innovation performance through formulation and implementation of innovation policy has become important and concurrent in research arena.

The national commitment on this policy domain in Sri Lanka was shown through formulation of S&T Policy in 2008 and developing National Science, Technology and Innovation Strategy 2011-2015. Although the commendable jobs performed by formulating a world-class standard policy, it is discernible that outcomes such as national innovation performance, awareness and enthusiasm on innovation, are still not manifested. Meanwhile, similar slow-performing nations two decades ago, such as Malaysia, Thailand, Vietnam, Taiwan as well as big nations in the region, China, India, Bangladesh and Indonesia, are steadily increasing their innovation performance and capabilities. Therefore, it has become a propitious and important consideration apropos assessing the role of national innovation policy to identify missing elements and ingredients for making recommendations to accelerate innovation for socio-economic development targets of Sri Lanka through strong policy formulation and implementation practices.

1.3 Describe Relevant Scholarship

The development and implementation of national innovation policies in knowledge-based, developed countries have become a popular interest of researchers and policymakers (Meissner et al., 2017). According to Borrás and Edquist (2013), this policy domain covers all the related public institutions and their combined actions, which create an impact on the process of innovation of a nation. Innovation policy is identified as public action that influences technical change and other kinds of innovations and it includes elements of research and development (R&D) policy, science and technology policy, infrastructure policy, regional policy, education policy and other related policies. Therefore, this policy is named as science, technology and innovation policy as well (Edler and

Fagerberg, 2017). Innovation policy is a prerequisite to accelerate innovation at both the national and the local levels necessitating interactions and interrelationships of actors to be synchronized in order to make an effective national innovation system with clear responsibilities. Thus it enables control and supervision of the actions of actors for successful implementation of S&T policy (Pülz and Treib, 2006).

The system is defined as the input-process-output model required boosting innovation performance while it highlights the actors as well as their interdependencies with clarifications for their roles and functions. The necessity of adopting transformative change-oriented style of the system is also accepted by the concept of NIS (Hitt et al., 2011). Hence, the policies and strategies need to be developed to promote such changes and adjustments to accommodate the timely emerging necessities. However, complexity associated with the innovation process at the national level due to involvement of multi-actors, ambiguous nature of relationships and interdependencies as well as openness of the innovation process has created difficulties in understanding the boundary of the policy and assessing its effectiveness. It will further affect disruptions in the process of implementation.

In order to minimize the complexity in understanding the innovation policy, Jukneviene (2019) has introduced and used four types of an innovation policy viz: 1) mission-oriented policies, 2) invention-oriented policies, 3) system-oriented policies, and 4) transformative change-oriented policies. This categorization has been presented by analyzing ten research papers of different authors and it defined each category with citation of original works as depicted in Table 1.

Table 1: Types of innovation policies

Type	The core of the type	Requirements
Mission-oriented policies	Policy-makers consider all phases, in broad approach, of the innovation process to design and implement policies aiming at providing new solutions to specific challenges that are on the political agenda.	Solutions should be practiced/ implemented.
Invention-oriented policies	Policy-makers believe in the potential benefits of S&T which will contribute to the society. They concentrate on the R&D, invention phase and leave the possible exploitation and diffusion of the invention to the market. Hence, this is considered as a narrow approach.	Creation of new public organizations, supporting firms and public research organizations of various types for R&D.
System-oriented policies	Concentrate on the system-level features, parts and interaction between different parts of the system; the extent to which some vital component of the system is in need of improvement; or the capabilities of the actors that take part. Policy focuses on building links, clusters and networks and on stimulating learning between elements in the systems and on enabling entrepreneurship.	The creation and development of national innovation system (NIS).
Transformative change-oriented policies	Policy-makers are trying to match S&T policy with social needs and sustainable development of inclusive societies at a more fundamental level or their associated ideologies and practices. This promotes experimentation albeit there is an argument that the Global South does not necessarily need to catch-up the transformation model of the North.	Transformation refers to sociotechnical system change.

Source: Jukneviene (2019)

Although the author has introduced these contents as four types of innovation policies, it is more valid in introducing as functions of innovation policy as there may be combination of two or more orientations in a single national innovation policy. Therefore, this exercise provides a strong basis to understand the constituents of the policy and assess the national level innovation policy.

There are well crafted public policies in all the countries that can guide the sustainable socio-economic development of those nations. However, policies can generate the desired results only if the implementation part is carried out successfully. Policy implementation is the process of translating the goals and objectives of the

policy into actions. The gap between the expectations and the realization of performance creates frustration and it continues mainly due to drawbacks in the implementation process of the policies. Successful policy implementation depends not only on designing effective systems but also on managing implementation with a good execution plan which will connect all stakeholders effectively and assists to obtain their maximum support (Brinkerhoff and Crosby, 2002; Khan and Khandaker, 2016). Therefore, in order to address these implementation necessities, it is necessary to provide significant resource allocation, have expertise skills and pay attention to designing policies.

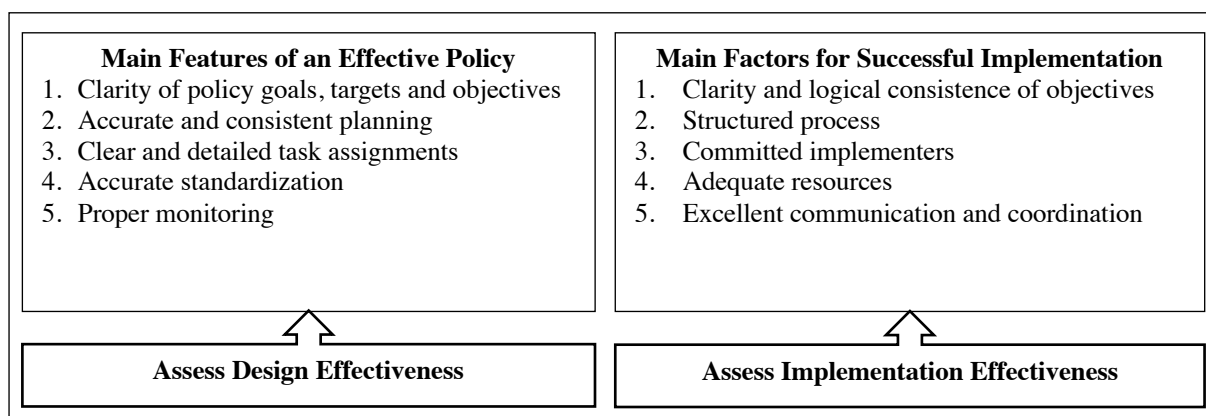
Multiple factors are linked to poor policy performance such as lack of coordination, funding, commitment as well as capabilities among implementers and support from top to bottom in the national governance system. Bitrán (2017) has suggested five main requirements of successful policy implementation viz: clarity and logical consistence of objectives; structured process; committed implementers; adequate resources; excellent communication and coordination. Five theoretical models namely; rational, organizational, political, bureaucratic and management has been summarized (Table 2) by Jukneviene (2019) to guide understanding of the constituents of innovation policy and conditions for successful execution of the policy.

Table 2. Models for the successful policy designing and implementation

	<i>Rational Model</i>	<i>Management Model</i>	<i>Organizational Development Model</i>	<i>Bureaucratic Model</i>	<i>Political Model</i>
<i>Main features in designing</i>	1. Clarity of policy goals, targets and objectives	1. Sufficient and effective use of budget	1. Effective leadership	1. Proper discretion of frontline implementers	1. Avoiding complexity of joint actions
	2. Accurate and consistent planning	2. Right organizational structure	2. Motivation	2. Competency of front-line implementers	2. Capacity for bargaining capacity
	3. Clear and detailed task assignments	3. Effective communication	3. Engagement of people	3. Control of the behavior of front-line implementers	3. Harmony among political actors;
	4. Accurate standardization	4. Involvement of stakeholders	4. Team building	4. Commitment of front-line implementers	4. Active political motivation
	5. Proper monitoring	5. Adequate equipment and appropriate technology	5. Accuracy of decisions		5. Minimizing the influence of pressure politics
<i>Factors affecting implementation</i>	1. The clarity of goals and objectives	1. Organizational structure	1. Leadership capacity	1. The role of members of staff who directly come into contact with people and other stakeholders	1. Outcome of interactions between agents
	2. Details plans and assigning jobs appropriately	2. Personnel and human resources	2. Team building		2. Bargaining power
	3. Effectiveness of evaluation and monitoring	3. The activities of front-line implementers	3. Engagement of the various parties		3. Conflict resolution
	4. comprehensive and efficient operating procedures, techniques required assisting implementers	4. Equipment and technology	4. Participation, motivation, coordination, and commitment		4. External environmental factors (economic, political and social)
		5. Coordination and cooperation			
		6. Exercise of authority			
		7. Location			

Source: Jukneviene (2019)

Many recent researchers have used the five functions introduced in the rationality model as in Table 2, to assess S&T and Innovation policy. This research also applies the same rationality model to assess the content of the policy and to identify the prevailing condition which is affecting the implementation of the policy as summarized in Figure 1.



1.4 Research Questions

Despite the declared goals of the Policy and the Strategy, the priorities in national strategies, governmental funding, promotion and support, the progress in R&D and innovations in Sri Lanka still remains at a low level. Hence, three specific research questions are drawn to guide this study:

1. What are the main features (presented in Figure 1) have been included in formulations the national S&T policy?
2. How those factors are associated with effective implementation reflected in the Sri Lankan S&T policy?
3. What are the fostering and hindering factors for successful implementation of Sri Lankan S&T policy?

According to the research questions, this study aims at assessing the gap between the level of expectations and level of achievements of the goals and objectives of the Policy and the Strategy. Further, the study suggests practical recommendations for the effective execution of the goals and objectives established in the Policy and the Strategy with special references to the identified barriers.

2. Method

Conceptual model for the study was developed following the rational model which was developed with the contribution of scholars Khan and Khandaker (2016); Bitrán (2017); Singh (2017); and Jukneviene (2019). Accordingly, five features of the formulation stage viz: 1. Clarity of policy goals, targets and objectives, 2. Accurate and consistent planning, 3. Clear and detailed task assignments, 4. Accurate standardization, and 5. Proper monitoring) have been considered to determine design effectiveness while five factors viz: 1. Clarity and logical consistence of objectives, 2. Structured process, 3. Committed implementers, 4. Adequate resources, and 5. Excellent communication and coordination have been traced to assess effectiveness of implementation of Sri Lankan S&T Policy. This study follows the rational model rather than the other four perspective approaches (presented in Table 2). This is a qualitative study which applies document analysis, secondary data analysis, analyzing expert opinions for the summarization and interpretation of the study results. Two main documents that are National Science and Technology Policy (2008) and National Science, Technology and Innovation Strategy 2011-2015 (published in 2010) to elicit meaning, gain understanding, and develop empirical knowledge. Many other national documents available in the public sources such as NASTEC evaluation reports of S&T institutions and Annual reports of S&T institutions were analyzed with the aim to reveal objectives of the study.

Secondary data available for innovation inputs and innovation outputs were analyzed to assess the innovation performance of Sri Lanka. Data sources available at National Intellectual Property Office (NIPO), World Intellectual Property Office (WIPO), World Bank Statistics and specially, reports of Global Innovation Index from 2014 to 2018 was accessed and used in this study. Key officials from representative organizations were interviewed and qualitative data was collected to make clarifications to be certain extent about secondary

documents and secondary data sources to strengthen the understanding of the researchers to make more effective and realistic interpretations.

Methods used in the document analysis and secondary data analysis, were helpful to identify main insights of the empirical research and to explain links between theoretical and empirical findings. National level related documents published from 2008 to 2018 were accessed for analysis in the empirical stage of the study.

3. Results

Sri Lanka is a small island in the South Asian region and located at southern tip of the Indian Mainland of the Indian Ocean. The whole land area including the internal water sources covers 65,610 square kilometers. The population is approximately 21.44 million (World Bank Report, 2017) and it maintains rather a tardy population growth. There was an attractive growth in the Gross Domestic Product with an average of nearly 7 percent per annum till 2015 and in the backdrop in which most other economies are experiencing an economic turbulence caused by recession and political altercations in the world during the same period. The highest growth rate in the country post-independence period, 8.3 percent, was recorded in 2011. As per Dutz and Cornell (2013), it ushered a sustainable optimistic period in the country with the prospects of accelerated economic growth and poverty reduction within the post-war period. Nevertheless, after 2015 the growth has been slowed down again after the regime change that occurred in the country by virtue of presidential election and the general election as well as the recent political instability. The per capita income of the country has been increasing considerably from USD 855 in 2000 to USD 4065 by 2016 (World Bank Report, 2017).

Apropos the compelling necessity of socio-economic development of the country, Sri Lanka has also paid enough attention on innovation as emerging policy domain. Thus, the Ministry of Science, Technology and Research is the dedicated Ministry in Sri Lanka in the matters of administrative functions in innovation. The National Science and Technology Commission (NASTEC) of Sri Lanka initiated for formulation of National Science and Technology Policy of Sri Lanka in 1994 and NASTEC developed a more comprehensive policy for Sri Lanka in 2008. This policy document has presented ten broad objectives that are essentially linked with the prospects of triumphing over into a scientifically and technologically advanced society manifesting a holistic approach to strengthen and develop science and technology in the country.

Subsequently, there was an initiation of a strategic plan preparation for the purpose of effective transformation of the S&T Policy, more action-oriented. Thus, the Ministry of Science, Technology and Research prepared 'Science, Technology and Innovation Strategy for Sri Lanka 2011-2015' published in 2010 with four main broad goals. This document was presented along with suitable measures and time-frames in order to facilitate the implementation and to evaluate the performance of the initiations. More importantly, this strategy has emphasized the need of establishing a world-class national research and innovation eco-system by requesting the attention to be paid on NIS of Sri Lanka with the concurrent consideration of the concept of NIS. It has been emphasized that NIS is the core of the strategy.

It is hard to present detailed and complete analysis based on these two large documents with the relevant data and information herewith. Therefore, the summary of the analysis on design effectiveness of the policy has been presented based on five areas in the rationality model as in Figure 1.

3.1 Policy Design

3.1.1 Clarity of policy goals, targets and objectives

Both the National Science and Technology Policy (2008) and Science, Technology and Innovation Strategy (2010), here-after referred to as 'the Policy' and 'the Strategy,' documents have emphasized the deficiency of effective and efficient national system for innovation and forwarded suggestions for the effective and efficient eco-system for innovation. On the whole, the Policy, as well as the Strategy provides a broader mission towards formulation of a world-class national innovation system for Sri Lanka. □

In order to meet the mission prescribed above, ten policy objectives have been derived in the Policy viz: 1) Creating Conducive Science, Technology and Innovation Culture, 2) Building Capability in Science and Technology, 3) Developing S&T Human Resource Base, 4) Promoting a Research Culture, 5) Developing and Acquiring New Knowledge and Technologies, 6) Ensuring Sustainable Use of Natural Resources, 7) Encouraging Development and Use of Indigenous Technologies, 8) Ensuring the Protection of Intellectual Property Rights, 9) Assuring Quality and Performance of S&T Institutions, and 10) Encouraging Applications of S&T for Human and National Security. It seems that there is a broad range of considerations covered in this policy document to lead to the aforementioned mission. It is a good analysis of the present situation of each sector covered in all the ten objectives and more importantly, a large number of strategic actions are suggested with concise measurements for the achievement of the mission and objectives that lead to configuration of a world-class national innovation system.

Meanwhile, the Strategy has presented four main broad goals viz: 1) Science, technology and innovation for economic development, 2) A world-class national research and innovation eco-system, 3) An effective framework to prepare the people of Sri Lanka for a knowledge society, and 4) Ensuring sustainability. This indicates little contradiction compared with objectives of the Policy. Goals are generally broader than objectives. Generally, it is imperative that the strategy be more action-oriented and follows the policy as a guiding document for the strategy. However, that contradiction and deficiency could be minimized if initiation is made to match the two documents. Anyway, the document period has now expired and it needs to work out the next strategic plan to meet the objectives.

The Policy and the Strategy documents are separately providing clear guidance with clear mission, goals, objectives and strategic actions but creating confusion is inevitable when the users try to match both. Hence, this weakness is critical in analyzing design effectiveness of the innovation policy of Sri Lanka. The compatibility of this policy with other related public policies such as industry policy, education policy, trade and investment policy, and financial policy is also a critical consideration, in addition. However, there is little information about consideration of those policies while formulating this policy.

3.1.2 Accurate and consistent planning

These two documents separately depict the accurate process in aligning policy objectives from top to bottom and bottom to top in order to reach the broad aspiration of configuration of world-class NIS. Policy designing effectiveness concerning the accurate formulation of individual documents is highlighted. However, to ensure the consistency in the planning the strategy definitely should follow the policy as a predecessor of the planning process. Such a deficiency would remain as a main drawback and would cause a huge negative impact in assessing the consistency of the planning process.

3.1.3 Clear and detailed task assignments

Tasks or strategic actions are derived for aligning with the mission and broad goals as discussed in the previous two sections. However, assigning task to responsible parties has continued as it is another drawback in this policy formulation process. A strategic apex body has been newly suggested viz: National Science, Technology and Innovation Council to work as a national level linking and coordinating mechanism. This has addressed the complex nature of this public policy domain which is linked with many national-level considerations. Nevertheless, there are no clear role assignments for most of specific strategic actions suggested in both documents. Hence, in order to ascertain who are the responsible parties to carry out the suggested actions have not been sufficiently mentioned.

3.1.4 Accurate standardization

Standardization is generally associated with measures in specific considerations. There is inherent difficulty in standardization of vague and broad national policy domains. Therefore, standardization cannot be assured to a large extent. However, there is a number of measurements presented in both documents comparing with world standards, regional measures, and current status of the particular concerns in order to understand requisite states of the standards. Allocation for R&D expenditure as a percentage of GDP, number of scientists per million of the population, number of patents has been considered in the policy initiatives that are some good examples to prove that the standardization has been considered. Further, these are good denotative actions suggested for standardization of procedures of the national innovation system through the Policy and the Strategy initiatives. Therefore, it can be concluded that the attempts for standardization of the design stage of the policy as commendable.

3.1.5 Proper monitoring

It is appreciated that producing measurement indicators, as discussed in section 3.1.4 above, facilitates monitoring of the progress of the actions in the policy formation process. Although a number of key performance indicators have been produced to facilitate the monitoring of the progress it continues unclear who will engage in the monitoring the progress at different levels. Hence, identical matters as in many public policy domains, the monitoring part of the policy have not been sufficient cause for concern in this policy context too.

□

Overall, the attempts of formulating National S&T Policy with the contribution of different experts can be appreciated as it is the first such initiative to move the country forward by dint of a systematic approach for national-level innovation. □

3.2 Policy Implementation

The process of the implementation of the Policy and the Strategy is also clearly documented. Government has realized the importance of policy intervention in the field and attempted to create a strategic framework with target-oriented actions although implementation has been abandoned. However, the broad acceptance and meeting a commitment to the lack of implementation of the policy are not depicted in the actions and performance of the key actors of the NIS yet.

The Science, Technology and Innovation Strategy has been prepared with an evaluation of extant science, technology and innovation outcomes, inputs and capabilities by establishing performance targets for the period of 2011-2015. Those performance targets included progress-oriented features and were aligned with the requisites of effective NISs in the world. The strategy indicated an improved friendly-eco-system of national research and innovation for Sri Lanka by the year 2015 with the implementation of the strategies suggested. As data presented in Global Innovation Index 2016 and 2017, it was not proven that the performance targets set in the Strategy document had realized until 2017. There exists a considerable gap between the expected targets in the strategy and the actual performance achieved. For example, it was expected to progressively increase the investment for S&T up to 1.5 percent of GDP by the year 2016, with a public spending of at least 1 percent. Nevertheless, it still remains far below that level, when compared to all the other regional countries (GERD 0.11 percent from GDP in 2015) as summarized in Table 3.

Table 3. R&D Allocation as Percentage of GDP over Time

Country	R&D % GDP in				
	1996	2000	2004	2011	2014
South Korea	2.24	2.18	2.53	3.75	4.28
Singapore	1.32	1.82	2.10	2.15	2.20
China	0.56	0.90	1.21	1.78	2.02
India	0.63	0.74	0.74	0.83	0.63 (2015)

Pakistan	0.16 (1997)	0.13	0.44 (2005)	0.33	0.25 (2015)
Thailand	0.12	0.24	0.24	0.36	0.48
Malaysia	0.22	0.47	0.60	1.03	1.26
Sri Lanka	0.18	0.14	0.18	0.14 *(2010)	0.106 *(2015)

Source: UNESCO Institute for Statistics 2017, available at: <https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS>

*National Science Foundation, 2018

Notwithstanding many measurable outcomes that lag behind the expectation of the strategy, the intuitional initiative and the governing framework suggested by the policy, the strategy necessitates being established successfully. These institutions require working with the assigned tasks and their performance should effectively be monitored by NASTEC according to the mandate assigned to it. Therefore, it requires to investigate how the five factors mentioned in the rational model (Figure 1) have been contributed to the implementation of national innovation policy of Sri Lanka, *viz:*

5.2.1 Clarity and logical consistence of objectives

It discussed the incompatibility of the Policy and the Strategy in the assessment of the design effectiveness of the policy. Thus, it remains as the major inconsistency as explained in the previous section. It requires to pay attention to remove this incompatibility to make a clear chain of goals and objectives from top to bottom and vice versa. Existing two documents have created confusion among the stakeholders of this policy domain in making decisions relevant in the implementation stage. This should be dealt with in future initiatives of the national innovation policy formulation.

5.2.2 Structured process

The Policy document has not been aligned with the introduction of the structured process for the implementation and has abandoned the suggestion of a structured process for implementation (Table 4). The responsibility has been transferred to the Strategy making process and the Strategy has contributed to making a detailed process for implementation of the Policy despite that the mismatch of goals and objectives still remains. The planned configuration of the NIS of Sri Lanka would become a more realistic if it had been worked during the last ten-year period. □

Table 4. Supportive mechanisms suggested in the Strategy

Suggested Mechanism	Description
National Center of Excellence Letters	This has been suggested to be established with partnership of the state research institutes, universities and the private sector. The main aim of this setting up is to centralize human and physical resources required for research and innovation in the domain of critical science and technology. This center is to be self-reliant with proper systems and procedures to work in critical technologies such as biotechnology, nanotechnology and IT that cut across many core technologies as suggested in the Strategy.
Science Parks	Science parks were proposed to setup at deferent levels and network with those to facilitate research and innovation from grass-root levels to a higher level of the economy. The basic village level centers (through Vidatha Centres) are suggested to address techno-entrepreneurial capabilities at grass-root level while a Minipolis is established at the district level by connecting village level centers. Technopolis at regional level has been proposed to establish connecting with several Minipolises. Megapolis is suggested as the central hub which facilitates advanced research and innovation while coordinating with all other centers.

Sri Lanka Institute of Technology and A National Cadre of Researchers (NCR)	It has suggested initiating Sri Lanka Institute of Technology collaborating with international institutions such as IIT in India, MIT in US, AIT in Thailand for the purposes of training and development of the human capital stipulation. Establishment of a National Cadre of Researchers is suggested herein in order to secure the maximum contribution of knowledge workers. The Strategy document has proposed that S&T personnel should be considered as a special group of employees in the National Carder in order to motivate and retain them to derive the maximum contribution from their work to the development of the country. Recruitment of S&T personnel with international exposure as well as expatriate personnel are also aimed at through the establishment of NCR. Both of these suggested establishments can be considered as sine qua non for the development of science and technology outcome through refined and highly and motivated S&T personnel. Therefore, there arises the necessity of identifying the implementation barriers carefully in the current policy and strategy-making the process. □
National Research and Technology Fund (NRTF):	It suggests to establish the NRFT managed by the National Science, Innovation and Technology Council. Operation flexibility and efficiency in fund allocation and utilization for R&D activities both locally and abroad are expected. Government allocation from the annual budgets, funds from local and international donors, government special taxes on R&D purposes, entering into R&D contracts with different parties and industrial contribution for R&D are expected as the contribution for the fund. However, it has not expected to impose restriction or discourage access to different funding by individual institutions and universities for the R&D and innovation activities through the establishment of NRTF.

5.2.3 Committed implementers

This remains unclear and less dealt with in the policy preparation as a result of inability to assign the responsibilities to existing authorities clearly. Instead, most of responsibilities are assigned to proposed authorities which will be new institutional formulations. Most of suggested entities are still not established and coordination among existing partners to guide them and motivate towards the implementation is yet lacking.

5.2.4 Adequate resources

This is one of main factors affecting the achievement of the set goals and objectives in the Policy. Resource allocations as well as dedication to allocate resources have recorded one of the weakest aspects. Hence, most of the goals still remain below the level of expectation. It has created a big challenge to develop a retained human capital, the requisite innovation facilitators and infrastructure which is a necessity for a world class NIS and other capability development for R&D and innovation.

5.2.5 Excellent communication and coordination

There are a large number of institutions working on the formulation and implementation of the national S&T policy and strategies. According to the findings of this study, it is difficult to find a strong coordination mechanism to connect different institutions to a strategic apex body. Although NASTEC has been established for this purpose initially, the main role of NASTEC is limited to creation of an evaluation mechanism and carrying out evaluations. It was restricted to engagement of post-evaluation activities due to the fact that no clear mandate exists in order to govern other S&T institutions. The suggested Council was also not yet established.

~~Key findings are presented herewith aligning with the rationality model for innovation policy. The section presented the features to determine the design effectiveness and factors associated with effective implementation referring to innovation policy of Sri Lanka. Next section presents concussions and recommendations based on these findings. □~~

4. Discussion

This study aimed at investigating the policy initiatives on national innovation from the rationality perspectives for policy analysis. Main documents relating to national innovation policy initiatives and secondary data sources were used in the empirical stage of the study while experts in the field were interviewed to collect their opinions and get clarifications for unclear areas. Features of effective policy design and factors affecting the effective implementation were investigated with the theoretical support of rationality model to draw conclusion about effectiveness of policy designing and implementation.

On the whole, the 'Policy' as well as the 'Strategy' provides a broad range of strategic goals objectives and initiatives for the formulation of world-class national innovation system for Sri Lanka. The process of the implementation of the Policy and the Strategy is also separately documented to meet main features of clarity, accuracy, standardization and ability of monitoring which are presented in the rationality model to decide designing effectiveness. However, the major weakness is arising with the consistency and compatibility with the two documents. The Strategy is not based on the Policy document which should be all the strategic actions to meet national innovation goals. The strategy document has surpassed the content of the policy regarding some points being broader than the contents in the Policy. Hence, this alignment if strongly recommended in the next policy initiative on national level innovation needs revision. Broadening scope is even possible by revising the Policy. Anyway, this revision has to be effected before the formulation of the Strategy and the Strategy should follow the Policy.

In addition to the incompatibility in the design stage, role assignment among the actors of the innovation policy is also not clear enough. Furthermore, it suggests several new institutions and mechanisms instead of assigning roles to the already existing national-level bodies by duplicating functions and requesting more resources for the establishment of such entities. Setting up new establishments is not an easy task within the resource-constrained conditions faced by the government subsequent to the long term internal war situation. Therefore, understanding the existing large number of institutions which are mostly underutilized, examining roles and functions of those institutes and obtaining their maximum contribution through effective management and coordination mechanism are strongly recommended in this study.

The factors affecting the effective implementation of the innovation were investigated in this study to address second research question. According to the factors suggested by rationality model, viz: 1. Clarity of setting goals and objectives and 2. Introducing structured process for the implementation are positive factors associated with innovation policy of Sri Lanka. However, the other three, viz: 3. Commitment for implementation, 4. Adequate resource allocation, and 5. Excellent Coordination and communication are the missing factors revealed in this study. The next policy initiative on innovation should take these missing areas into consideration. Institutional support and contribution for the implementation assigning responsibility and accountability to meet goals and objectives, sufficient funding allocation with national-level commitment as well as clear and unidirectional coordination mechanism with proper communication are recommended actions to be included in the next policy formulation initiative.

Albeit, the government has realized the importance of policy intervention in the field and attempted to create a strategic framework with target-oriented actions it can be concluded that implementation part has been abandoned based on the investigations of this study. Hence, the achievement of the set goals and objectives in the Policy and the Strategy still remain below the level of expectation. Resource allocations as well as dedication to allocate resources were recorded as one of the weakest aspects in addition to lack of focused attention on all related national-level initiatives. □

There are a large number of intuitions working on the formulation and implementation of the national innovation policy and strategies. According to the findings of this study, it is difficult to find a strong coordination mechanism to connect different institutions to a strategic apex body. Although NASTEC has been established for this purpose, the main role of NASTEC is limited to creation of an evaluation mechanism and carrying out evaluations. It was restricted to engagement of post-evaluation activities due to the fact that no clear mandate exists in order to govern other S&T institutions. Meanwhile, it was observed that the Coordinating Secretariat for Science, Technology and Innovation (COSTI) had been established in 2013, aiming at coordination and

monitoring of Science, Technology and Innovation activities. This was a one strategic action presented in the Strategy document and initiative to address the coordination and communication function of the policy. However, it is too early to present opinions on its functioning as there is still no proper assessment on the role played by COSTI yet.

It is of paramount importance to draw prompt attention of policy makers, strategists, government and other related institutions apropos of this policy. Absence of commitment, resource allocation, coordination and communication mechanism, following up process and mechanism for overseeing the different roles played by S&T institutions have created repetition of the functions, resource misappropriation as well as underutilization of resources and funds in this fragmented innovation system of Sri Lanka. Hence, a follow-up process is a compulsory requirement to ensure the achievements of the policy goals and objectives. This follow-up process should be facilitated with a national-level data collection and processing system to make timely statistics and information required to make timely decisions on the innovation system. Lack of such data collection and processing mechanisms creates an obstacle for researchers in conducting comprehensive studies in this policy domain.

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