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Space Terminology, Space Technology Imperative and Sociocultural Environment Heuristic Model

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***Abstract*— Earth oriented Space missions are valuable for governmental and business ventures in potential areas in developing countries. Various overriding factors hinder developing countries to utilize space technology and its applications to their full potential. To promote the utilization of available space technologies and related resources for the developing countries, a heuristic model is introduced to analyze the significance of space terminology as part of social and technological communication to that end. The push-pull heuristic model illustrates various cause and effect relationships in space technology for development, and assessing the role of a space terminology lexicon in fostering national space activity.**

***Index Terms*—Modelling, Technology Transfer, Social Ramification, Space Terminology, Space Technology Communications, Space Technology Development.**

I. Introduction

Space technology has delivered great benefits for the everyday life of mankind, ranging from: the ready availability of handheld, point-to-point and point to multipoint communications devices; significant enhancements in the methodologies of government administration and new, highly productive business support. Space technology has been one of the significant technologies that has changed the lifestyle and standard of living in various cultures and allowed people in remote areas to reap the associated benefits [1]. Space technology has enabled people across the world to become aware of their individual living conditions and environments and introduced suitable means for providing necessary sustainability. However, there are global gaps that hinder the attainment of optimum benefits for all mankind, and many regions still remain untouched by the benefits potentially offered by space technology. Various factors are responsible for this, among others: cultural, geophysical, geopolitical and economic factors and backgrounds. It is desirable that such gaps be minimized in order that all people can enjoy a reasonable living standard within the progressive and just social values and societal multi-faceted structures that are potentially available. Communications and cooperative interactions can be significant, and various technological niches become relevant. Throughout mankind's history, technology has progressed remarkably due to the untiring efforts of mankind as a species to achieve a better life. At the same time, technology has triggered and stimulated mankind's creativity and productivity, thereby leading to harmony amongst themselves, as well as with nature, the environment and its underpinning that makes up the grand scenario of mankind‘s life across the ages and across the globe. For example, psychological well-being includes a person's overall appraisal of his/her life and affective state, and is considered to be a key aspect of the health of individuals and groups, as elaborated by Stone et al [2]. In this context one may further inquire whether individual people can communicate well outside their cultural habitat. In this context, the local development of a lexicon of space terms can contribute to technological progress, and function to place cultural, social and economic advancement in self-accelerating modes.

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Within a creative-productive socio-cultural setting, modernization of communication technologies can lead to significant personal advancement. This not only involves oral and written communications which are transmitted in physical mode (person-to-person), but also progress in computer technology which facilitates virtual contact in virtual space. A technological-cultural-traditional mix can thereby automatically develop which might well be fostered by proactive governmental initiatives and assistance.

Space, space science and space technology are very intriguing to the public at large since they can represent their dreams, imagination and hopes. In reality, these people already live in the space age, in that space technology and space technology derived products are utilized in their daily lives. Associate with this, through the initiative of the International Academy of Astronautics, a multilingual Space Dictionary Program has been established. Within this program, a number of Bi-and Multi-lingual Space Lexicons have already been published, while foreseeing the ultimate publication of a Multi-lingual Space Dictionary.

In this context, the significance and role of space terminology in Space Technology development is here reviewed and analyzed in the backdrop of sociocultural setting, particularly in developing countries. As a case in point and without loss of generalities, Indonesia is chosen as an example. Space terminology has a special place in foreign-local language dictionaries in Indonesia, as elaborated by Djojodihardjo [3]. Based on the authors' assessment, this can be attributed to the prevailing cultural background, since this background shapes multi-faceted aspects of native socioeconomic and political life. Space, space science and space technology are very intriguing to the public at large since they can represent their dreams, imagination and hopes. These people in reality already live in the space age in that they utilize in their daily lives space technology and space technology derived products. Therefore, in preparing a space technology dictionary, and in particular an English-Indonesian Space Lexicon, a multitude of issues must be considered.

First, to whom will the lexicon be addressed - students, intellectuals, lay persons or decision makers? How familiar are these populations with the terminologies concerned? Will these terminologies be useful to, and assist them, in developing a progressive mentality? Second, since space terminologies will rapidly develop in pace with scientific and technological progress, how can one create terminologies that will remain true to their originally stated meanings while yet being easily understood by those seeking help in communicating ideas that can potentially lead to productive activity? Translators, historians, educators, librarians and others working in a wide variety of fields, including the mass media were associatively foreseen to find the prepared translations of Astronautical terms of interest and value, which now have reached over 3500 terms. The initiatives carried out by Matsukata et al [4] and Ninomiya et al [5, 6] through elaborate technological innovation utilizing computerized coding and structuring of space terminology and utilizing the progress of space technology, is a novel approach to systematize the space terminology lexicon, which attempts to transcend among a large host of different world languages. Space terminology, may have been well founded in the space faring countries, especially with the cultural background of the European based languages. The establishment of space terminology in developing countries, with quite different cultural background and heritage, may require novel approach and stake holders coordinated support.

II. Objectives

With such background, the objectives and focus of the present paper are (1) to identify the benefits of space technology, (2) to be proactive in showing its applications in bringing about sustainable and timely developments that can contribute to mankind's progress, welfare and sustainability, while also advancing world peace, and (3) to elaborate the role of space terminology, no matter how minute, in developing space technology in a multi-faceted socio-economic-cultural setting. In fact, the wealth and mutual understanding of terminology, and to a larger extent, dictionary, is the authority of one's development of many of the basic skills of language [7], thus communications, understanding and cooperation. In this regard various international facilitators, such as UN-COPUOS, UN-ESCAP, and UNESCO etc. have indicated that a conducive environment provides push factors, while social, economic and human capital benefits produce an outcome and pull factors. The entry to interrelationships in language and web-based international communications and cooperation enables holistic (social, economic, scientific, technological, private and governmental) participation, both active and proactive, in technological development that encompasses all social strata. Progress can then be realized in a synchronized, timely, efficient, effective and expeditious manner, oriented towards constructive developments in technology based on global cultural diversity and international cooperation.

Language is a high level cultural component, and a major means of communicating ideas and creativity, as well as socioeconomic and technological developments. The breadth and depth of multi-point communications reflect socio-economic and technological activities and development chains, while also stimulating and triggering these chains. Language is a melting pot of multi-cultural elements, both in the wealth of ideas conveyed and in their structure – a process that has already been globally well observed throughout the ages. However, misuse of language and misinterpretations can hamper multi-sector socio-economic and technological progress, in addition to raising sensitive and relevant domestic and international social and political issues. The synthesis, development and dissemination of a space technology lexicon, in the context of the presence and emergence of multi-modal means of communication, is thus of paramount significance in realizing the lofty intentions inherent in the goals of this activity. An important requirement for progress is the generation of a positive attitude among all stakeholders (including the public at large as well as decision makers). The public and social media as generators of opinion could play a significant role here.

III. Heuristic push-pull model for the inter-relationships of Socio-Cultural Settings and Space Technology Activities

Space-faring Nations and the United Nations Committee on the Peaceful Uses of Outer Space have played a significant role in forging global environmental concerns and environmental standards associated with the application for development of space technology which are of great interest to both Governments and Private Enterprises. International treaties have been instrumental in directly delivering space exploration and its applications for the benefit of mankind in all countries, while also highlighting the urgency of adopting international environmental standards to protect the earth and the space environment itself. Leading experts in space-faring countries and their counterparts in developing countries can communicate better so as to establish, and contribute to, in-depth international understanding that incorporates visionary space imperatives.

Space technology in many Earth related investigative missions (involving for instance remote sensing, communications, and navigation), can and have already provided valuable information and tools for government as well as for business ventures in a number of sectors that include: natural resources monitoring and management; disaster mitigation and efficient and precision agriculture, which have great potential for solving problems in developing countries. However, an unfortunate gap in knowledge exists, due to a general lack of funds, expertise, equipment and awareness, which constrains many developing countries from utilizing space technology to its full potential.

Innovation can constitute a synthesis of technological, organizational and commercial aspects in a dynamic interaction. One can take advantage, despite their limitations of (the more conventional) ***linear technology-push models***, and choose to track evolution by their means, rather than use the more recent and realistic dynamic models of innovation that feature a network of actors, sources and constraints, as elaborated by Tidd [8]**.** In particular it has been shown that a focus on improving the science base and coupling this with novel technological innovation is inadequate because many problems occur during the late stages of the innovation process. For simplicity and clarity, in the present analysis we utilize a conventional linear technology-push models, and synthesize a cultural-technology – push with a combined business, government, and globalization pull-model.

Globalization is a certain outcome, due to progress in technology, information technology, communications, transportation and mankind's increasing demands. In fact, the U.N. Millennium Development Goal as expressed by the U.N. General Assembly's Millennium Declaration [9], largely reflects an existing strong trend toward globalization as well as the ongoing increasing demands of mankind. Globalization can both strengthen existing patterns of social interaction and change these patterns, producing both positive and negative outcomes.

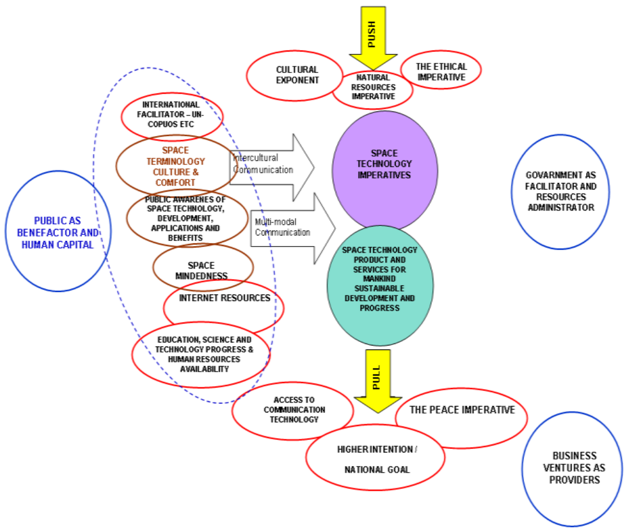

Figure 1: An upstream-downstream (or push-pull) model illustrating the relevance for sustainable development of Space Technology within a local cultural background

This can be analyzed through empirical studies of social practice, as elaborated by Fløysand [10]. Various elements mentioned in the previous section can thereby be identified, including the major players and playing fields. It is within this context that the subsequent discussion will address Cultural Background and Space Development with respect to a Globalization Paradigm and Methodology.

Several elements and factors characterize the efforts of mankind to attain continuous improvement in the quality of life while still maintaining environmental sustainability (subject to local cultural and environmental factors). These elements are referred to as "Push Factors" and "Pull Factors". Space Technology and its Products are identified as contributors to progress.

Figure 1 presents an upstream-downstream (or push-pull) model that illustrates the relevance of Space Technology to sustainable development within a particular local cultural background. The various elements that could assist mankind's efforts to progress are connected by a dotted ellipse. One of the mechanisms to activate the process of achieving progress is communication and, in this context, an important element is linguistic communication. In Figure 1, the central players are identified using blue circles within which the public represent benefactors; human capital and government constitute facilitators (through providing resources) while business ventures assume the role of providers.

IV. Analysis

A. Utilization of the Push-Pull Model in perceiving the Fostering of Space Technology within a Local Cultural Background

The objectives of the present work require us to develop: first, an understanding of the relevance and relationship of sophisticated disciplines, in particular those of space science and technology, to cultural and socio-economic development; second, to investigate the role of oral-literary communications in preparing a smooth playing field for those complex technological, cultural and socio-economic inter-relationships and interaction processes conducive to progressive and synergistic development. It is with such objectives that the Push-Pull model of the relevance of Space Technology Developments within a local cultural background has been synthesized. What follows does not delve in great detail on each item depicted in Figure 1 but rather describes the elements and interactive activities which can be identified to play a role in providing space technology products and services for the sustainable development and progress of mankind.

The concept of Push-Pull model is here introduced and utilized to elaborate a logical relationship between space terminology, space technology development, other socio-cultural factors and other higher intentions in the national development efforts. The higher intentions, as stipulated in many of the UN Global Development Reports [11, 12, 13, 14] are pull-factors that can be effective with better communications with and in the society, thus minimal language barrier; for involvement of highly regarded specific technology, understanding of terminology will be significant.

The major push-factors are those that already are embedded in cultural and socio-economic settings. These comprise: cultural heritage, which defines the behavior and development drive of the community; natural wealth (i.e. natural resources, which can be considered as assets for the collective achieving of defined goals); and ethics, which govern the rule of the game with respect to how specific undertakings are carried out.

The present technology, particularly space technology in the form of products and services for the sustainable development and progress of mankind, has been deliberately singled out. The goal of successful utilization of these products and services within a particular cultural environment is facilitated by public understanding and acceptance of space technology imperatives and so this constitutes an upstream prerequisite for space technology development.

Various generating elements in shaping societal efforts toward constructive and productive ventures in space science and technology are grouped below in a cluster dubbed ***generating elements***. These generating elements are human centered and present technology outputs as products of human culture. Those identified thus far include international facilitators (such as the United Nations Committee on the Peaceful Uses of Outer Space (UN-COPUOS)), as well as other structured international, regional and/or bilateral entities. Also included are societal or cultural elements characterized by their familiarity with, and creativity in using, technological terms in day-to-day parlance; public awareness of space technology development, applications and benefits; availability of technological infrastructure (such as internet resources for virtual communication and information mining); human productivity and creativity infrastructure (such as progressive strata (vertical) and modes (horizontal) of the education system), institutions for both scientific and technological research, both instituted by government as well as formed through business ventures and the quality and quantity of productive and creative human resources as actors (doers) and users. Through complex interactions between these generating elements involving inter-cultural and multi-modal communications, productive and constructive socio-economic processes can bring into being space technology products and services for the sustainable development and progress of mankind.

What are the pull factors? From a logical and moral point of view, the elements with high "gravitational force" exerted through societal impact in a particular culture are: the national government as general facilitator and provider of resource managers and business ventures as profit makers, fund generators and providers. A virtual pull factor, not so apparent without an in depth analysis, is the peace imperative with all its downstream benefits. Within this Push-Pull model of the Relevance of Space Technology Developments [14], space terminology is a minor generating element but, against the background of the globally dominant role of industrialized countries it can be significant in smoothing the 'upstream-downstream' process.

B. Space Terminologies to Facilitate International Communication

The considerations implied by the heading of the present paragraph do not initially seem to have linguistic relevance. However, in practice, these considerations are relevant and this is attributed at a minimum to communication convenience and avoidance of misunderstandings .In this connection, the English-Indonesia space lexicon [15] may contain more than one entry in the translation of particular English terminology: at least one derived from the local vocabulary and cultural background and another from the original language (English) but modified phonetically to produce a more acceptable sound.

Convenience for international communications also implies convenience for local participants in understanding spoken information at international conferences due to their familiarity with local terminologies that have been adopted and adapted from foreign languages. Terminologies with such characteristics thus may facilitate two-way communication (listening and presenting), literature review and search, analysis and data mining and facilitate the Cooperative Development of Space Technologies [14, 16].

As a simple illustration of the role of space terminology, suppose that a particular term assigns to a "thing, action, attribute, property and the like" a certain identity, including "its" "implications" and "consequences". See the representative blue circle in Figure 2. Terminology is part of a language with associated cultural (related to social, environmental, technological and philosophical) identities. This is schematically depicted in Figure 2 by the white oval Q. Society A with its unique cultural setting may interpret the accepted (standardized) terminology translated in its language as indicated by oval R, whereas Society B attains an interpretation indicated by oval S. These ovals may or may not overlap. Language (oral, written and/or otherwise) forms part of the communication tools utilized between individuals or groups.

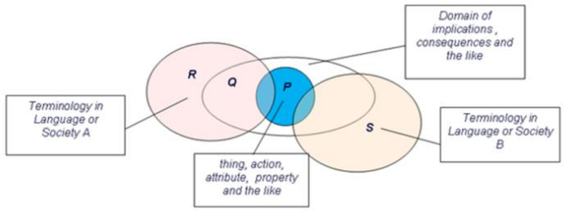

Figure 2: A schematic of terminology (Space) and the establishment of mutual understanding

A message conveyed by an individual in Society A is interpreted by another individual in Society B following a particular pattern. This constitutes a little step and provides a small building block in a much more elaborate communication, interaction, or technological development. With time, further communications, and progress may eventually modify the state of affairs depicted in Figure 2 such that all the circles and ovals eventually coincide.

Various aspects depicted in Figure 1 are representations of the state of affairs governed by individual, societal, environmental and other factors underlying the development of technology as a whole. In developing countries the prevailing value system, infra-structure and cultural background are still fluid and developing, thereby adding uncertainties and flexibilities to progress.

An alternative way of assessing effectiveness could be on the negative side, i.e. what would happen if no space terminology in the local language exists while there is a need for space technology development promoted by international communication and cooperation? The United Nations Committee for the Peaceful Uses of Outer Space and the United Nations Office for Outer Space Affairs are currently reaching out to many developing countries to make space technology available and affordable for national development, and to invite active participation in the applications of space technology. One of the relevant bridging tools is language. This can be recognized where, for example, exchanges of experts or training courses for local experts to be are made available. *The use of correct terminology contributes in this case to scientific and technological development and is mandatory in order to establish correct mutual understanding*.

V. Cultural Heritage, Infrastructure, Adoption and Development of Technology

Indigenous and endogenous technological development can be influenced by cultural considerations. Many developing countries may lack a strong motivation for technological development, i.e. there is a perspective that technology is a foreign rather than an intrinsic cultural and intellectual property. Public opinion and the decision makers' policy may reflect such a mindset, and influence the priority setting of national developments. Certainly there is a challenge in the context of cultural transformation and behavioral changes. Developing countries with immense undeveloped infrastructure and relatively large rural areas can benefit from space technology when pursuing comprehensive economic development, although many obstacles can exist in providing local support for this activity. Cooperative Development of Space Technologies could have a two-pronged advantage in that regard through providing expeditious entry to the application of a technology that is based on the progressive development of endogenous support. Finding the most effective means of developing relatively new technologies is as important as choosing which technologies to develop. Technological development efforts and responsibility should be given to the right people in order to avoid disappointing outcome. Technological development approach should be well organized, in order to incorporate valuable technologies into the appropriate technological system. Management of technology development and establishment of effective cooperation between industry and universities in adopting appropriate space technologies should be well planned. Some examples can be synthesized from progress in selected countries with various levels of space related technological progress and applications.

A. United States of America

The existing experience of space agencies provides a model that can engender confidence among various stakeholders in developing countries when devising appropriate steps-forward under governmental or business patronage. In the past, many NASA resources were oriented toward operations [17, 18]. New programs tended to be evolutionary rather than revolutionary. Further, technology development was centralized to ensure that the research and technology base essential for, and critical to, the development of the home country was addressed and given budgetary priority. It was in addition perceived that appropriate space applications relevant to national development should be accompanied by proactive and selective synergistic local technology development through effective cooperation between industry, universities and government related technological organizations.

For example, NASA‘s four divisions of space activity [19] are now being examined so as to establish performance requirements for future missions that can only be met by utilizing new technologies. Each division is responsible for acquiring or developing the required technologies. NASA's new Strategic Plan states that “the Agency will focus on re-establishing NASA's role as a research and development agency”.

B. China and India

China and India are two countries that have vision, determination and a policy to develop Space Technology for their national interest and to allow space technology benefits to trickle down to the grass roots population. India has remarkable vision as articulated by Vikram Sarabhai [20] and consistently implements, through its governmental policy, the approach of providing technology leadership to address population needs. The economies of China and India have, in consequence of their approach, progressed remarkably. Of significance, for example, is the early decision in India to utilize satellite technology for addressing the needs of rural people regarding information and medical services, and the establishment of the *Enabled Village Resource Centre* [20]. The Rand document [21] sheds light on the development course taken within these countries to rise from developing country status to powerful economies, as is already currently exhibited and also projected for the future. The Rand document assesses the prospects of India and China through 2025 in four domains: demography, macroeconomics, science and technology, and defense spending and procurement. This paper focuses on three of these domains, namely demography; macroeconomics; science and technology, and attempts to show how the present level of progress was achieved against the backdrop of different cultural backgrounds. The Rand paper also attempts to show how cultural values and leadership successfully transformed these countries as they progressed. In the process, the balance between advantages and disadvantages that China and India are foreseen to display 15 years from now is assessed. Although the focus is on quantitative answers, there are uncertainties in the assessment made due to such qualitative unknowns as: whether or not the same results could be established in some other country with particular regard to the different socio-cultural-geographic-demographic setting involved.

The development of space technology in China and India, the world‘s two most populous countries, *has been* remarkable. From the viewpoint of economic progress, the ages and compositions of their populations are more significant than their collective size. Many factors influence the balance of demographic advantages and disadvantages; these include the health, education, migration tendencies and gender composition in each population. Perhaps a significant factor that assisted India in attaining scientific and technological progress is the mastery of English exhibited by its population.

The assessment of progress in science and technology (S&T) focuses on several indicators of S&T inputs and two output indicators. The input indicators comprise both financial and human resources. The financial input indicators involve spending on research and development (R&D). These comprise - Gross Expenditures on R&D (GERD) as a percentage of GDP, while taking into account GERD‘s four components: (1) Higher Education R&D spending (HERD); (2) Business R&D spending (BERD); (3) Government R&D (GOVERD) and (4) Private, Non-profit Organizations‘ R&D spending (PNPERD). BERD may have the greatest early effects on productivity. The human resource input indicators comprise the number of doctoral degrees in engineering, life sciences, physical sciences, computer science, mathematics, and agriculture.

As output indicators, the assessment compares (i) publications in refereed scientific journals and (ii) patents(especially triadic patents) produced by authors and inventors from China and from India. These indicators may be incomplete. For example, innovations and improvements in production and management practices often occur that are not reflected in either scientific publications or patents.

Unique aspects that can be considered of advantage in technology mastery and development, in addition to their scientific heritage, can be mentioned for China and India.

Within the domain of socio-cultural setting, China's more or less homogenous mastery of their unique Chinese characters for communication and which have been incorporated in their electronic media, and India's mastery of the English language, can be considered to be of significant advantage in technology development and mastery.

C. Indonesia

Indonesian interest in space science and technology is marked by the establishment of the Indonesian Space Agency, the National Institute of Aeronautics and Space (in Indonesian: *Lembaga Penerbangan dan Antariksa Nasional*/LAPAN) on November 27, 1963. As early as 1976, Indonesia had taken the strategic step of utilizing a Domestic Satellite Communications system which has molded socio-political unity and rendered local economic development effective. However, this venture was not accompanied by a corresponding development in space technology to take advantage of the related momentum potentially available to enhance local creative human capital.

The relatively large gap in socio-cultural acceptability and the driving force for technology push within the scientifically oriented group contribute to slow momentum in technological capacity building and endogenous development. As an example of the current Indonesian integrated socio-political setting and its ramifications with regard to Space Science Efforts and Benefits, Space-based data secured in the disciplines of astronomy, solar physics or solar terrestrial physics which are helpful in allowing scientists from developing countries to participate in space research through the use of these measurements for analysis, are not readily accessible due to lack of observational facilities and accessible data through the internet infrastructure. These are exacerbated by the lack of scientific infrastructure due to priority setting within the government financing mechanism related to national 'down-to-Earth' applications of space technology, as surmised from Djamaluddin [22].

VI. Space Development and Globalization

A. Space Terminology

The few examples outlined above illustrate how countries emerging in space technology need to employ both vision, investment and energy in order to take the best advantage of the spirit of international cooperation presently existing in space faring countries and, thereby, establish win-win co-operation in space technology programs. Space terminology can potentially be a tool in establishing a socio-cultural environment where the multiplying effects on decision making and public support), engender an understanding of space technology that eventually leads to both governmental and private investment. The role of communications and the social media, including science writers, can be instrumental here. Cultural background is relevant and has to be considered in defining space terminologies that follow linguistic rules and facilitate international communication. Relevant factors (such as public acceptance within various social strata and convenience in establishing international communications) are identified and analyzed below. The establishment of a common technological understanding can be assisted by means of a widely disseminated space terminology lexicon. Appropriate choice of the terminologies included not only avoids confusion, but may contribute to information mining and knowledge dissemination. As a simple example, familiarity with space terminology may facilitate effective internet search. All of these aspects are discussed in the light of creating space terminology lexicons that offer enlightening and stimulating examples, to encourage understanding on space technology issues among various cultural backgrounds.

B. The Role of Space Development in Globalization

Following Vedda [23], the contributions of technological development towards globalization are

"*the closer integration of the countries and peoples of the world which has been brought about by enormous reductions in the costs of transportation and communications, and the breaking down of artificial barriers to the flows of goods, services, capital, knowledge, and (to a lesser extent) people across borders*".

In modern literature satellite communications, which constitute a component in the recent revolution in telecommunications, is acknowledged to having made the current era of globalization possible. Associated developments in microelectronics, information technology and computers have virtually and practically established direct and instantaneous worldwide links which, when combined with the technologies of the telephone, television and various available space technology applications like GPS have dramatically altered the nature of political communications, governments and lifestyles [24].

The following could be set as a global standard. In the U.S. in addition to being always a key supporter of the infrastructure of projects, the U.S. government became the nation's primary patron of science and engineering. An effort to sustain this relationship was spearheaded by President Franklin Roosevelt's director of scientific research and development, Vannevar Bush [18], which resulted in a "social contract" with science that portrays the pursuit of scientific knowledge as intrinsically good and useful.

"*As long as the nation maintains its input into the reservoir of knowledge, the system is working as it should, and application of that knowledge will take care of itself. Institutions created in this image, such as the National Science Foundation and NASA, persist to this day, as does the dominance of government funding in certain fields, such as medical research".*

Large science budgets will be increasingly difficult to justify if a scientific enterprise, or at least some part of it, is perceived to be isolated from societal needs. The output of the government's partnership with science was the eventual widespread availability of desirable technologies in the era prior to globalization, such as technologies that allowed more rapid movement of people, goods, and information.

C. Cultural Background, Space Technology and Space Terminology

Cultural background embraces more than local vocabulary. Without loss of generalities, the present example addressing the Indonesian case could be chosen to represent typical case in point. Indonesian language is a modern language, synthesized from the Malay language as a *Lingua Franca* and which was nationally declared to be the language of unity within the Indonesian Archipelago since the historical "Pledge of the Youth" in 1928. It has been continuously and consistently developed by numerous linguists (and is now supervised by the National Institute of Indonesian Language). It incorporates various roots, such as Sanskrit (an Indo-European language that is the ancestor of most of the languages of northern South Asia and of Sri Lanka) and Old-Javanese, and is enriched by many Indonesian regional (local) languages (such as Javanese, Sundanese, Betawi, Palembang, etc.) as well as modern languages such as English, Dutch, Portuguese, Spanish, Arabic, Persian and Chinese, even Greek and Latin. Influences are not limited to the use of words, but also enrich the prefixes and suffixes. As a general rule, the Indonesian language may adopt a foreign word that has an acceptable sound as the root of an "Indonesianized" word in the form of a noun. Other words may then be formed, by the addition of prefixes or suffixes, as necessary, and become an accepted Indonesian word. This has been applied in the English-Indonesian Space Lexicon.

In the area of space (or in a wider context, aerospace), translation of terminologies may also be related to common words utilized in ancient legend or mythology. For example, the English word "Space" in space terminology is translated as "*antariksa*", which has a root in Sanskrit and in the Indian mythological epics "Ramayana" and "Mahabharata", which were well known **among** older generations and transformed into local and modern versions as a function of space and time. On the other hand, the English word "space" in day-to-day parlance is well known as "*ruang*". By the same token, the English word "vehicle" (in aerospace vehicle) is translated as "*wahana*" (in *wahana antariksa*) rather than the day-to-day translation "*kendaraan*", such as in the translation of "my vehicle is a bicycle" which is then translated as "*kendaraan* saya sepeda".

In addition, other culturally based drivers may touch upon considerations such as metaphorical or literal, positive or negative effects, and avoid common translations that have degenerated into uninspiring colloquial ones, while seeking other translations that stimulate imagination and appreciation. New terminologies should embrace all of these considerations, through being forward looking, and realistic.

In addition, the rules of a language (also called grammar), should be taken into account in synthesizing or finding an appropriate lexicon and hence enriching the language. These rules include **phonology**, the sound system, **morphology**, the structure of words, **syntax**, **semantics**, the combination of words into sentences, the ways in which sounds and meanings are related, and the **lexicon** – or mental dictionary of words.

The particular terminology should acquire some characteristics of the language, or in some way be related to the rules applicable to the language, or to words already accepted in that language, i.e. sound units that are related to specific meanings. However, the sounds and meanings of words are arbitrary. It may well be that there exists no apparent relationship between the written form or pronunciation of a word and its meaning. Knowing a language implies knowing that particular language system, with **competence.** This is different from behavior, or the **performance** of the language [25]. The spoken terminologies should bear some relationship to the knowledge of the language. As a relative new national language within the background of many local regional languages, Indonesian language as scientific language needs to adopt foreign terminologies related to space technology.

D. Cooperation and Development of Space Technologies

UN-COPUOS (Committee for Peaceful Uses of Outer Space) and the UN-OOSA (Office of Outer Space Affairs) are of the opinion that finding the most effective means of developing new technologies is as important as choosing which technologies to develop [14, 16, 26]. If technology development is not carried out by the right people, disappointing outcome may result. Valuable technologies could be overlooked rather than incorporated, if the approach in introducing technology is not well organized. Current management of 'Space Technology Cooperation and Development' requires relevant local and international agencies to work effectively with industries and universities to develop advanced space technologies. Communication in the Cooperation and Development of Space Technologies involves not only institutions, but expertise and workers at large. The latter may benefit from the presence of accepted space technology related terminologies, which in turn will contribute to accessing space application tools for sustainable development through capacity building in basic space technology. The existence of local space terminology may assist countries to ensure adherence to the relevant regulatory frameworks and promote the use of standards.

The emergence of a global knowledge economy has created new challenges and opportunities for business in developing countries, and established trends in the convergence of information communications technology (ICT) and space technology. Therefore, the UNESCAP-E63-16E document provides an overview of ICT applications for small and medium-sized enterprises that are required in order to meet such challenges [13]. Further, the document discusses the importance of knowledge networking, which would facilitate knowledge-sharing among stakeholders. It also briefly reviews the current status of the information communications technology service sector and opportunities for its expansion.

Guidance provided to the community by UN-ESCAP can assist member states to appropriately manage globalization through the application of ICT and space technology. Advances in space technology have been observed to be a significant tool in developing the "information society". Geo-spatial data services have consequently become a significant pillar of the information society. Global navigation satellite system services used for positioning, search and rescue, mapping and aviation support are developing into widespread practice [16, 26].

Governments should work with all stakeholders to create an enabling environment and develop appropriate policies to foster ICT penetration among SMEs through overcoming existing obstacles.

VII. Concluding Remarks

Establishment of systematic and culturally well-based terminologies with widespread public acceptance, which may be initiated within science and technology related activities and circles, and the dissemination of these terminologies through the social media in a responsible manner, could contribute to the long term development of a scientifically oriented culture, characterized by technological and industrial creativity and productivity.

The use of information and communications technology (ICT) by the business sector, such as SMEs and the ICT service industry, to support the establishment of sustainable community e-centers and knowledge networking for socioeconomic development should also be implemented as this would be effective in providing pull factors in a well rooted development of scientifically oriented culture. The contribution in addition of SMEs and the ICT service industry to government, universities and international organizations, through exercising their objective oriented role as push factors, can establish a roadmap for holistic societal participation and creative contributions to the application and development of advanced space technology, In this way, national sustainable development in an environment of globalization and global networking can be provided.

Space terminology is considered to be relevant and significant with regard to local efforts to embark upon space related affairs and, in that way, develop a space technology related culture. Principles underlying the mastery and dissemination of widely accepted space terminology will transcend various socio-cultural aspects. These range from the cultural background itself to a visionary goal to contribute to the development of space technology through capacity building efforts and proactive attitude generation against a general background of ever expanding global international cooperation.

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