Re-Visiting and Re-Entangling Science, Technology and Society (STS): Constructing Inclusive Sustainability

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Abstract

Reflecting social contract and inter relationship between science, technology and society, we have explored society as subsequent form of science and technology and examining the critical issues as well challenges resulted from STS tensions only after the science and technology is being deployed into society. Instead of understanding science and technology in relation with society or from the perspective of society we thoroughly have tried to explain science and technology as something which resulting as an impact on the society and practising a kind of relationship in that context as expressed in the STS literature. Neither society has been considered a centre as of science and technology nor has been attempted to construct whole model of science and technology in order to put society in a kind of relation within the context of it. As resulted, scientific controversies are emerging and STS becoming contested practice which is showing the gape.

A new phase in early 1990 towards the science and society relation was emerged to deal with science and technology associated risks and regulations which further became major concerned issue with emerging science and technology at large both for public and government and gave rise to the concept of citizen science in order to analyze Science, Technology and Society relationship in broader context. As response to controversial scientific practices, the conceptual models of social implications of S&T, trust building, ethics, public engagement with science and technology, inclusive governance and majorly trending responsible research and innovation(RRI) have extended and manifested to the STS. By doing so, we are giving a balancing approach not aiming at inclusive approach.

Another tension in STS, science and technology is exerting largely influence on innovation. On one side, Responsible Research and Innovation and open science are

promoting inclusive and public participatory approach. On other side, IPR settings to encourage innovation in order to protect invention which is against the notion public open domain of S&T. While discussing STS, despite severe efforts the attainment remaining illusive not inclusive. We need to identify the gape at the fundamental notion of domain if we want to overcome the challenges.

The paper will bring an attempt to fill this gap by investigating the roots of STS. This article will empirically give an analogy to the scientific explorations by analysing the science, technology, society and sustainability at the threshold (bottom of the pyramid) equally giving importance to the each intermediate process(from science to sustainability) during the complete process of innovation(empirically investigated).As lagging behind in one of the intermediate process, may lead to the criticality of issues and disputes in the Science, Technology, society and sustainability.

Another gape in STS domain is that sustainability is not a challenge or not something which is to be achieved. It is a practice encompassing together with STS. The paper will also present a conceptual framework where sustainability is incorporated and intertwined with the Science, Technology and Society.

*Keywords***:** Analogy, Scientific Exploration, Inclusive Sustainability,Entanglement.

1. INTRODUCTION

Replicating social contract and inter relationship between science, technology and society, particularly the way it acquired the context, somehow depicts "the widespread imprecision in understanding the STS as a whole domain." Also science and society relationships emerged as limited explorative approach. We argue that lack of understanding in its current form is leading to increasing exclusion while sustainability is not conceptually incorporated in it. The paper endeavours to systematize and directed to incorporate the sustainability through scientific explorations to elucidate in order to support within the settings of Science, technology and Society (STS) which will further accumulate knowledge into the root of STS phenomena.

A persistent transformations in the techno scientific infrastructures of the modern world, STS (Science, Technology and Society), since the last quarter of the 20th century has

become an progressively more vital emerging and developing field and practice. Science and technology are often, among STS literature thought of understanding as having a center–periphery structure. Distinctively, as the older fields of history and philosophy of science, STS has been established how the specialized components of actually practiced science, technology and engineering knowledge in their particular contexts can be configured into broader understanding, through the active collaborations of scientists, technologists and engineers.

Rather than--constructing whole model of science, technology and society in order to put society in a kind of relation within the context of it---only due to the few scientific controversies -----it has been subjected to criticising or repudiating the whole development of S&T----thus, STS becoming contested practice which is showing the gape. The concern is that how can such "border" discussions between disciplines be negotiated efficiently? Despite widespread recognition of the value of Sustainability and its "agendas" more broadly, proponents of achieving Sustainability differ on how to interpret the norm and term of its "goal" As per noted in scientific literature, there is little consensus over what is meant by, or how to practice sustainability in science & technology. For the purposes of this article, it has ever been suggested that any mention of science, technology, society and sustainability assumes the broader interpretation incorporating STSS together.

This paper as a major contribution to the STS, in a broader way is to epitomize the delicate relationships amongst science, technology, and society with integration of sustainability into it by revisiting the conceptualisation of STS how Science, Technology and Society depicts as a set of distinctive elements or mores analyzing the activities termed separately or with any of the blending approach of the foregoing ; following by a brief critique of its current status, how STS become a contested practice in recognition of the tension and how many of the conceptual models have been evolved as response to controversial scientific practices. Further, conceptual model or empirical design with scientific explorations have discussed which incorporating or entwining and entangling Science, Technology, Society and Sustainability together. The paper concludes with a discussion of how STSS could be developed to give a more holistic understanding of the interactions and entwining amongst the four.

2. LITERATURE REVIEW

Although the intellectual lineages in STS literature are varied, but current approaches to science-technology-society (STS) focus primarily on the controversial socio-scientific issues that arise from the application of science in modern technology. (Lee, 2010) Although understanding STS must be describing as comparative perspective to make assumptions more accountable, especially, if there any, in the disjunctions and differences which seems to be taken for granted such as of clinical trials, of patent protection and intellectual property rights that inevitably arise in attempts as global concerns. (Fischer, 2007)

The entwining attempt of 'integration' in STS must recognize not only the effort to reconnect the different fields and disciplines such as of science, engineering, humanities, arts, social sciences but also both to balance and counter the specialization, among subfields of science and components of big engineering projects, conducting the approaches of public discussion, and inequitable constraint of access to the hierarchies of power and knowledge. STS as a domain must responsible for contributing to the creation of multilayered institutional abilities to negotiate and recognize among the differing knowledge as per the needs of societies and social strata.

Within the extensive literature, Science, Technology and Society are deceptively inclusive words which tends to refer to a variety of distinct though interrelated items. They are commonly used to denote a set of distinctive elements with their individual characteristics and mores analyzing the activities termed separately or with any of the combination of the foregoing. STS in this vision must figuring out how our techno-scientific worlds together with the principals such as scientists, engineers, technologists, bureaucrats, entrepreneurs, community organizations and other professionals, people from civil society and public space should operate with what sorts of regulatory structures and accountabilities.

Relatively and more willingly than analyzing STS approach as integrative process across disciplines, whether technically and scientifically capable they are, reverberating culturally, and cross-culturally conscientious they are or not. The insight and perspectives of science and technology remained concerned around examining the impact of science and technology on society and vice versa. Instead of concerned in a preliminary approach

with the integral structure of science, technology and society that is only with one limited aspect of STS being evolved.

In other words, the concern always been limited in which this institution of science deliberately being discussed as how it has changed as a result of various forces acting and influencing it. The term science is being used here in a rather broader sense of understanding of science as social system and its influence on society by its application. Society have been explored as subsequent form of science and technology and critical issues as well challenges examined only after the science and technology is being deployed into society.

2.1 Limited Co-existing Understanding

Enormous relevance could have been co- existed phenomenal approach in STS .After an evaluative review of range of STS literature, different perspective underlying the notion in detail. As shown, still not an agreed and explicit conceptualization or STS might be based on rather limited conceptualization of it. Above serious conceptions of the problem presuppose some form of the thesis that notions are (ir)responsible of (Below analyzed terms are based on extensive STS literature) limited conceptualizations.

1.   Addressing the issues of social inclusion.

2.   Major Science and Technology Problematic. The immense impact of science and technology on our society almost inevitably raises issues and problems. (Bugliarello, 1995).

3.   Negative impact on society.

4.   S&T for sustainable growth.

5.   S&T associated risks.

6.   Impacting S&T for/on/across Society/Industry.

7.   S&T Fostering Inclusive Societal Development and Science & Society: Bridging the Gap Through Innovations.

3. PRESENT STS (Science, Technology and Society) STRUCTURE: MISSING STSS STRUCTURE

Without revisiting the roots, efforts are further elaborated still growing continuously. As response to controversial scientific practices, such as the conceptual models of ---social implications of S&T, trust building, ethics, public engagement with science and technology, inclusive governance and majorly trending responsible research and innovation(RRI) have extended and manifested to the STS. For instance, as reviewing the literature, there are still barriers as well lack of clarity around what that means, what public engagement might mean be there?

Before going and growing further into the centre of this article, we must ask few questions to ourselves which certainly will give a kind of thought that we are heading into the negative direction.

- Why there was a need to explore and analyze science and society relations or changing relations in-between ?(since mid-twentieth century)

- Why couldn't we able to build Science, Technology and Society and of course sustainability together?

- Does society have no responsibility for Sustainability? For every negativity only S&T system is responsible?

- The inception of Science, Technology, Society and Sustainability (Still not incorporated) seems to be conceptualized as unguided/misinterpreted formalization of above four notions or least adequately understood phenomena.
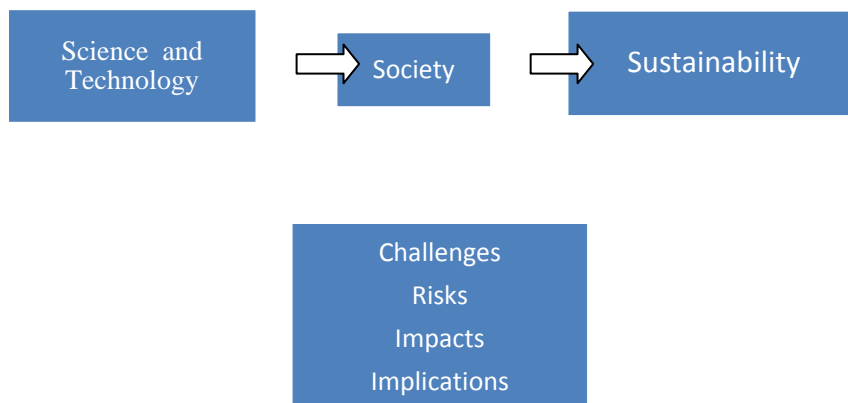

Figure-1: Existing STS Structure

4.   ANALOGY TO THE SCIENTIFIC EXPLORATION: EMPIRICAL CONCEPTUAL DESIGN

This section provides a concise illustration more on an understanding to constructing the inception of STSS instating with the formalisation of work under considering a chemical reaction A ⟶ B (we can understand in the context of STSS as a process)

Where, A is a reactant and B is the product or next segment of process . The rate this reaction is defined by 'the increase in the concentration of B per unit time.'

$$\text{Rate (k)} = \frac{\textit{increment of the concentration of B}}{\textit{Time}}$$

Now if this reaction occurs through some intermediate products or process C and D, like

A ⟶ C ⟶ D ⟶ E ⟶ B

Where, we will initialize as given

rate (A to C) = k1 ;

rate (C to D) = k ;

rate (D to E) = k3;

rate (E to B) = k4 , such that k1 > k2 < k3> k4.

In our context of STSS, assuming all the elements or the processes as

A → C initialize 'Science' to 'Innovation' as k1;

C → D initialize 'Innovation' to 'Technology' as k2;

D → E initialize 'Technology' to 'Society' as k3;

E → B initialize 'Society' to 'Sustainability' as k4

Following the process:

Then the rate of the whole reaction i.e rate (A to B) = k, will be equal to the k2(the rate of production of D) which is the lowest among k1, k2 and k3. This means the rate of overall process is governed by the rate of slowest intermediate process.

In other words, any of the intermediate process being slow can slow down the rate of overall process. Similarly if the process of our concern goes like
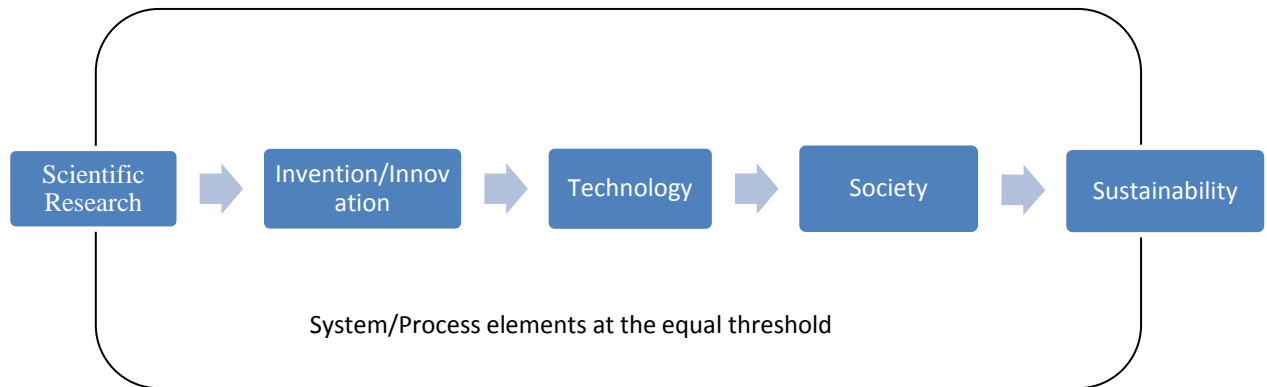

Figure 2: Conceptual Science-Technology-Society-Sustainability(S-T-S-S) Framework

Then, the developments of all these aspects are equally important. As lagging in one field will affect the overall development. As in a chemical reaction, slow production of any intermediate compound slows down overall reaction, each of the above aspects is equally important to emphasize on for better results.

4.1. Conceptual Science-Technology-Society-Sustainability Framework

The core of STSS practice along with the unifying vision is knowledge and understanding which needed to design and evaluate practices within a variety of social contexts, of course as a system may have unintended as well as intended consequences. Practices, systems and the social context exist in a symbiotic relationship where the system is purposefully needed to design and re-design both to change the social context and to address the changing needs of the social context.

5. CONCLUSION

The primary explanatory objective of this article as a part of STS literature, and to the domain and field is to give thoughtful reflection of a precise, empirical, account of the construction and understanding of knowledge about entwining of sustainability as a practice encompasses together into it. The paper is an initial effort of understanding with

extended to little shifting the paradigm Science, Technology and Society under which society operates along with Science and Technology.

In addition, It must be given strong emphasize to re-explore and re-analyze the conceptualizations of STS through its roots otherwise design and intertwining sustainability wouldn't be incorporated or practiced. Following as the course of action, Interdisciplinary scholarly approach should be take out. It is further required well-articulated theoretical understanding of how S-T-S-S research and practice will influence, shapes, or informs to policy and innovation processes. And, thus of how to structuring S-T-S-S researching processes appropriately, more effort should be devoted to develop a niche with a clear strategy and balancing approach more effectively. On government part, if any of the intermediate proportion reflecting the direct negative results, immediately decision should be initiated.

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