# Activating National System of Innovation: introducing the concept of innovation circle in the enterprise innovation system

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*The National System of Innovation (NSI) is a powerful concept that has significantly influenced the science and technology policy for the last four decades. The present article re-examines the concept of NSI and suggests that it has no internal dynamics that activate NSI. With reference to the disconnect between the production system and the innovation support system in Indian NSI (as underscored in the Indian National Innovation Survey), the article suggests that the trigger that can activate NSI is demand from the enterprises. The focus, therefore, should be on the Enterprise System of Innovation, a micro replica of NSI. This article introduces the concept of the innovation circle as a mode of inculcating the culture of innovation within an enterprise, thereby stimulating demand and activating NSI.*

**Keywords:** Culture of innovation, enterprise, innovation circle, science and technology.

FAGERBERG and Sapprasert[1] observed a trend break in the late 1980s and early 1990s in the literature on innovation with a change in focus from firm as a unit of analysis to 'stronger emphasis on the interdependencies between the actors, organizations and institutions that influence the innovation and – above all – was much more focused on policy', that is, the National System of Innovation (NSI).

NSI is a powerful concept that reveals the importance of a 'system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies'[2]. In order to promote innovation, the different innovative actors must have strong linkages with each other based on a strong level of trust. Governments should promote and activate trust among the different innovation actors[3]. Furthermore, the success factors of NSI have been seen by many scholars in the creation of supportive institutions and organizations (with a key role of education) and collaboration linkages bridging scales in innovation policies throughout the various elements that constitute the NSI[4]. Several studies have helped open the black box of innovation, the understanding of which had earlier remained a linear flow from research and development (R&D)[5–8]. NSI reveals that innovation results out of a set of institutions whose interactions determine the innovative performance of national firms[5]. In a study on India's Health Biotechnology Innovation System, Arora[9] reaffirmed that national and international linkages are equally important. The technological capability of an innovative firm evolves through internal efforts while learning from international best practices and augmented by the emerging public–private partnership.

It is to be noted that NSI, as propounded by Freeman[6], Lundvall[7], and Nelson[5], begins with the innovation end of the problem, or, in other words, investigation traces institutional interactions that make innovations happen. The opposite of it, however, is not obvious. Since there is no benchmark of nature, extent and intensity of interactions among institutions, we do not know the ideal types of institutions and interactions among them that would ensure innovations.

The fallacy embedded in the formulation of the NSI is that any type or intensity of interactions and types of institutions are good if they are related to successful innovation. It is, therefore, a post-facto understanding of innovation dynamics. Questions remain regarding what, who and how such interactions are triggered. The relevance of the question emanates from one of the major findings of the National Innovation Survey on India[10].

The Survey suggests that there is a wide range of institutions as part of the innovation support system, but there is a discernible disconnect between the innovation support system and the production system. The interactions among different institutions are largely absent in the Indian scenario. From this perspective, the question arises – what triggers or activates close interactions, and resulting learning and actions of a wide range of national institutions? We propose that the trigger is inside the enterprise where

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innovation happens. In an innovation-active firm, there would be a need/demand for various types of support to be sourced internally and from external agencies. Let us name this process as 'innovation circle'. We propose that making innovation happen is making/activating the 'innovation circle' in a firm. We see innovation as an ongoing activity within a firm. The innovation circle is a construct that gives a body to interactions and actions that result in innovation. To this end, we revisit the 'firm', which is regarded as a 'coordinator'. As coordinator, innovation is activated in a firm through a set of coordinated actions and functions. We identify the innovation circle in an innovative firm as the defining dynamics of innovation that create demand on the innovation support system.

## Innovation-active firms

By innovation-active firms we mean firms in pursuit of technological competition as opposed to price competition. While technological innovation is a way to strengthen market power, the debate on conditions that make a firm invest in activities fostering technological innovation has generated important insights into the theory of firms.

The literature on a firm's technological innovation is a direct off-shoot of the Schumpeterian description of capitalism and its dynamics. Technological innovation is a way to build technological capability that enables a firm to beat price competition with technological competition. Firms that have market power and are resource-rich can afford to opt for technological competition. Nath[11] has detailed the above postulates as the Schumpeterian sufficient condition (market power and the economic rent accruing from it is the Schumpeterian condition for a firm investing in technological innovations) and Galbraith[12] as the necessary condition for a firm investing in technological innovations (Present-day technological innovations require large resources. Only large firms can mobilize large resources for technological innovation.). These conditions are about market power and availability of resources that enable large firms to opt for technological competition as opposed to price competition. Arrow[13] added the incentive aspect to innovation to suggest that if monopoly is defined as a barrier to entry, 'incentive to invent is less under monopolistic than under competitive conditions but even in the latter case it will be less than socially desirable'. He also suggested that appropriability is the only argument in favour of monopoly power as a sufficient/necessary condition for innovation. A monopolist is likely to be the 'first-second' innovator[14]. Even in a competitive market condition, according to Arrow[13], inventions would be essentially cost-reducing as opposed to radical innovations. Focusing on market structure, Philips[15] suggested that in a market dominated by a few large firms coexisting with a number of small firms, higher market concentration might inhibit technology competition through tacit market-sharing among large firms. On the other hand, small firms in the same market operating in a competitive condition might be more innovative in creating their own market niche.

As such, therefore, there are no apparent incentives for firms undertaking radical innovations. Arrow[13] suggested institutional intervention for creating incentives and conducive conditions for radical innovations leading to technological competitiveness. NSI, as discussed above, highlights this aspect of institutional arrangements for innovation. The question, however, remains about the dynamics between market and firm that nurture the transformation from price competition to technological competition.

## Drivers of innovation-active firms

We ask the same classical question: 'What is a firm?' A firm may be seen as a black box 'consisting of a set of production activities or even a presumed production function with a finite set of inputs to be adjusted so-as-to generate a set of outputs corresponding to a maximal level of profits or some other measure of owner utility. The inputs controlled by the firm are then assumed to be put to their most efficient use without having a look "inside" the firm or "outside" in the relations with other economic agents, except for competition with other firms'[16].

Coase[17] observed that firms and markets are alternative institutions. He pointed out that in addition to production costs of the usual sort, one must also consider transaction costs inside and outside the firm in explaining institutions such as a firm. He also focused on the comparative transaction costs of alternative organizational structures, such as firms and markets. Markets may fail to provide the right inputs at the right time and place; they may not offer the most desired and efficient use of the inputs. The resulting uncertainty is managed through an alternative form of institution called 'firm'. A firm makes effort to keep inputs under control for efficient use in the production system. In the process, firms incur costs, which are known as transaction costs. Williamson[18] argued that market failure is the source of transaction cost. This was later extended to be known as the transaction cost economics or, more broadly, the economics of an organization[19]. The firm is, therefore, treated as an organization. Because of asset specificity and bounded rationality (limited cognitive ability), certain transactions must be executed away from the market. This is the beginning of an organization. Transaction cost is the cost incurred for avoiding the market and operating in a network mode. According to Williamson[18], it is the undesirable evil of the modern market system.

Lazonick[20] has given it an interesting twist. He postulates that acting within an organization and acting away from the market are intended acts of value-creating capitalist firms. He has distinguished between an 'adaptive' enterprise and a 'value creating' enterprise. According to Lazonick[20], a capitalist enterprise is a value-creating enterprise, the

basic dynamics of which is to create competitive advantage by developing enterprise-specific assets – both physical and human. Transaction cost, therefore, is not an undesirable evil. On the contrary, it is incurred as an intended act for developing asset specificity. Lazonick[20] brands a Williamson-type firm as an adaptive enterprise. Further, he distinguishes between 'market-coordinated' and 'organization-coordinated' enterprises. According to Lazonick[20], a value-creating enterprise is necessarily 'organization-coordinated', since its basic dynamics is to create asset specificity. On the other hand, an adaptive enterprise is market-coordinated, where transaction cost is a fait accompli – the evil of market failure.

So, the evil of Williamson's asset specificity and bounded rationality that subject the firms to undesirable transaction costs becomes the basic dynamics of a value-creating firm in Lazonick. The firm creates asset specificity to gain a competitive advantage and brings in human resources to mitigate the limitations associated with bounded rationality.

Once enterprise-specific assets are created by an enterprise, those assets do not remain specific to the enterprise for all future time to come. The advantage created by an enterprise is emulated or imitated by others in the business. A diffusion process begins. Over a time period, the specificity will not remain an advantage to the initiator enterprise. It has to look for new specificity and create new advantages. What happens to the assets that have become a common advantage of the industry? Instead of going for endless accumulation of assets of different vintages, the enterprise would externalize activities associated with those assets and would adopt market-coordinated transactions for them. Every enterprise will, therefore, have both organization-coordinated and market-coordinated transactions. This process of moving from organization-coordinated to market-coordinated transactions is associated with the creation of asset specificity and gradual termination of the same over a period of extractable competitive advantage from asset specificity. We, therefore, can describe the dynamics of Lazonick's value-creating enterprise as a process of creation and termination of asset specificity. Innovation, therefore, can be seen as a firm-specific asset embodied in physical and human assets.

A value-creating enterprise may, therefore, be called an innovative enterprise. If innovation is defined as new knowledge being used by an enterprise, and knowledge is considered an asset embodied in physical and human assets, such an enterprise will create enterprise-specific knowledge. This is the Enterprise System of Innovation (ESI). The innovation circle is the way ESI gets activated within.

## Inside an innovation-active firm

A firm produces an artefact. The artefact is a reflection of the technological knowledge it possesses. So, we mention that the firm has the technological knowledge to produce an artefact. Pavitt[21] has suggested '… distinctions between the artefacts (products, etc.) that the firm develops and produces, the firm-specific technological knowledge that underlies its ability to do so, and the organizational forms and procedures that it uses to transform one into the other' should be used for analysing the innovating firm. Following Nelson[22], Pavitt[21] identified two complementary elements in firm-specific knowledge; 'body of understanding' and 'body of practice'. He has quoted from a study by Iansiti and Clark[23] to illustrate the distinction between the two forms of knowledge.

We shall use the same illustration of body panels of automobiles to develop our argument on the deconstruction of knowledge. Let us digress here for clarification on the deconstruction of knowledge by an enterprise.

In a deconstructed form, this knowledge includes, for example, '… knowledge of techniques of die design, die modelling, die testing and finishing. Additionally, knowledge can take the form of the skill of die designers in anticipating processing problems, customised software that allows for rapid and effective testing, patterns of communication and informal interaction between die designers and manufacturing engineers that allow for early identification of potential problems, an attitude of co-operation that facilitates coordinated action between die designers and the tool makers that will build the dies. These elements (and many others) define an organizational capability for die design and development'[23]. This knowledge is embodied in various types of physical and human assets, and they are made to function in a defined fashion through an appropriate organizational arrangement. This organizational arrangement of vertical diffusion of knowledge can be named an innovation circle. Knowledge is accumulated and stored within this structure, and many related innovations occur. Such innovations are, following Rosenberg[24], incremental improvements on existing innovations based on past experience.

Any firm acquiring technology without the above-mentioned organizational structure (let us call it innovation circle) in place will, at best, lead to attaining some 'production capability' and not 'technological capability', as distinguished by Bell and Pavitt[25,26]. This attainment of production capability (which may be called horizontal diffusion of technology), without the innovation circle, does not make a firm innovation-active. Following Coase[16], we mention that if a firm is seen as a coordinator, the innovation circle activates that role – the flow of information and generation of knowledge through processing information within the firm. Hayek[27] emphasized the role of information in the coordination of economic activities. According to Casson[28], 'the essence of coordination is decision making', and he suggested an information theory of firms. Choo[29] suggested that information for decision-making is a traditional perspective of the use of information. According to him an organization is a sense-making body that performs its job by accessing and processing information for knowledge creation. A modern firm is no longer a stand-alone producing entity. It operates in a network mode, networked

with hundreds of globally distributed nodes for accessing and processing information for knowledge creation. Nonaka and Takeuchi[30] prefer to describe it as a knowledge-creating firm.

## Conclusion

ESI, following NSI, can be constructed as a system of interactions and coordination among different units of an enterprise. In a formal structure, information gathered through such interactions must be well-coordinated and processed for decision-making. Let us call an organizational structure inside an enterprise performing this job the innovation circle. This is conceptualized as a mode of intra-organizational communication network among interdependent work units relevant to building technological capability and also associated with both national and global networks towards attaining higher levels of technological capability, competitive advantage and growth.

The findings of Department of Science and Technology Reports on NSI and other related studies, when seen in the light of the above discussion, suggest that the disconnect between the production system and innovation support system can be explained by the fact that Indian firms in those studies were generally 'adaptive', 'market-coordinated' and geared to attaining 'production capability' in contradistinction to the firms that are 'organization coordinated', 'value creating' and geared to attaining 'technological capability'.

We suggest that, in light of the recent push towards expanding the global presence of Indian businesses through the promotion of technological innovations, adopting an innovation circle approach can foster a culture of innovation that keeps enterprises on a continuous path of value creation.


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