Functions of innovation systems: A new approach for analyzing technological change

Hekkert et al. (2007) first explain what an innovation system is, criticizes the static approach of national, regional and sectoral innovation systems and then give 7 functions of a Technical Innovation System (or Technology Specific Innovation System) which can be used for a process analysis.

Understanding Innovation Systems can be used to steer innovation. Most analyses of Innovation Systems focus on the social structure of a system, which include e.g. the actors, their relations and institutions, but are therefore very static. There is also less emphasis on the action of an entrepreneur because of this static character. A dynamic analysis would show how the regulations came in place. It would for example show how the renewable energy lobby, opposition, and external events influenced the emergence of renewable energy regulation. By focusing on one technology it is possible to map the activities that take place in the system and result in change of the system. These activities are often called the *functions of innovation system*. Thus it is the individual and collective act that determine the innovation speed. The definition of a TIS is “a network of agents interacting in the economic/industrial area under a particular institutional infrastructure (...) and involved in the generation, diffusion, and utilization of (a) technology.”

Hekkert et al. describe many different functions proposed by others, but eventually come up with their own seven functions.

F1: **Entrepreneurial activities**: Entrepreneurs are essential for a well-functioning innovation system. The role of the entrepreneur is to turn the potential of new knowledge, networks, and markets into concrete actions to generate–and take advantage of–new business opportunities. When there is a problem in entrepreneurial activity, this might be caused by one of the seven other functions.

F2: **Knowledge development**: According to Lundvall: “the most fundamental resource in the modern economy is knowledge and the most important process is learning”.

F3: **Knowledge diffusion through networks**: network activity can be regarded as a precondition to ‘learning by interacting’. When user producer networks are concerned, it can also be regarded as ‘learning by using’.

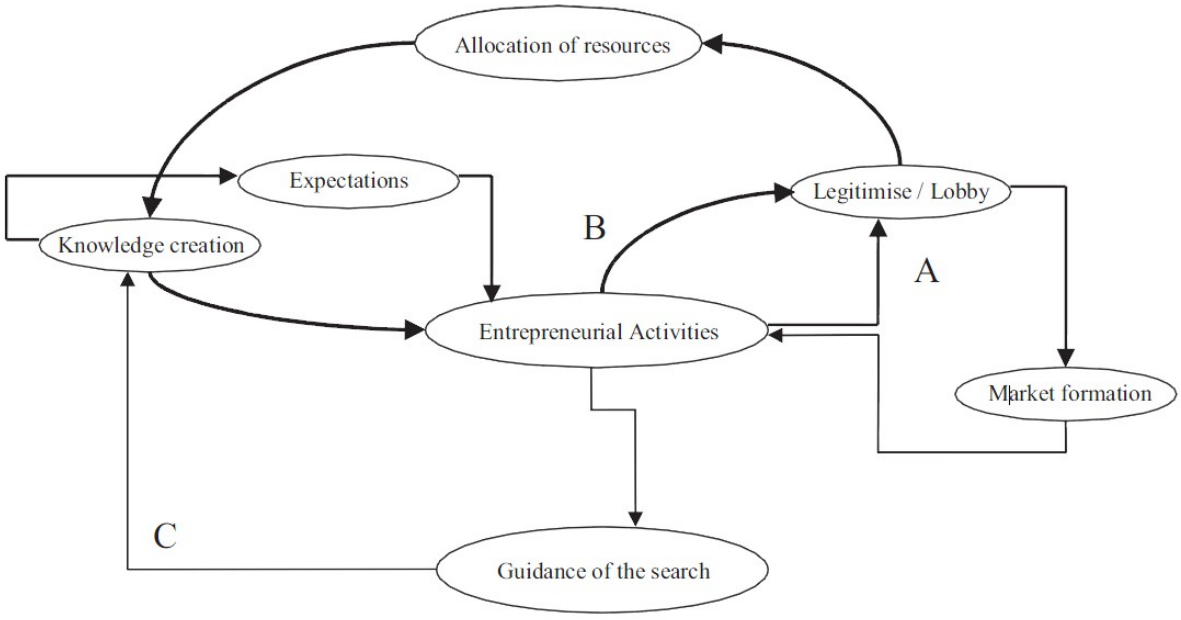
F4: **Guidance of the search:** As resources are limited, there should be a focus for further investments. An example is setting a 10% target of renewables in 2020. This creates legitimation for investments. This also indicates that technological change is not autonomous. ‘Success stories’ can help to create momentum for change.

F5: **Market formation:** Market formation takes several forms. Examples are creating a protected space, favorable tax regimes or a minimal consumption quote. Creating a market stimulates entrepreneurial activities (F1).

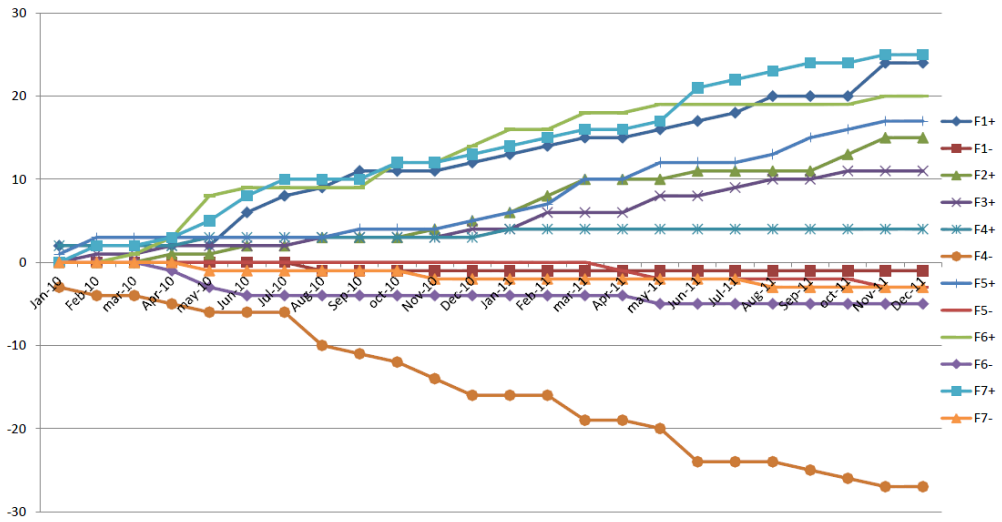
F6: **Resources mobilization:** Of course financial and human capital is needed for all activities.

F7: **Creation of legitimacy/counteract resistance to change:** The incumbent regime might oppose new technologies. Advocacy coalitions can put a new technology on the agenda and create legitimacy. When coalitions grow they may become powerful and 'brisk up the spirit of creative destruction.'

These functions don't work independently from each other, but enforce each other. When one function performs well, it can stimulate other functions, but when one function is damaged, it can damage the whole system. According to Hekkert et al. common triggers of a system are 'guidance of search' and 'legitimization'. These in turn trigger knowledge creation and market formation or allocation of resources (see fig 1).



Newspapers and journals can be crunched for positive and negative events in each function. In this way the functions and the system can be analysed. After counting these events over time (see fig 2), a narrative can be written about how the system is functioning.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