

Editorial:

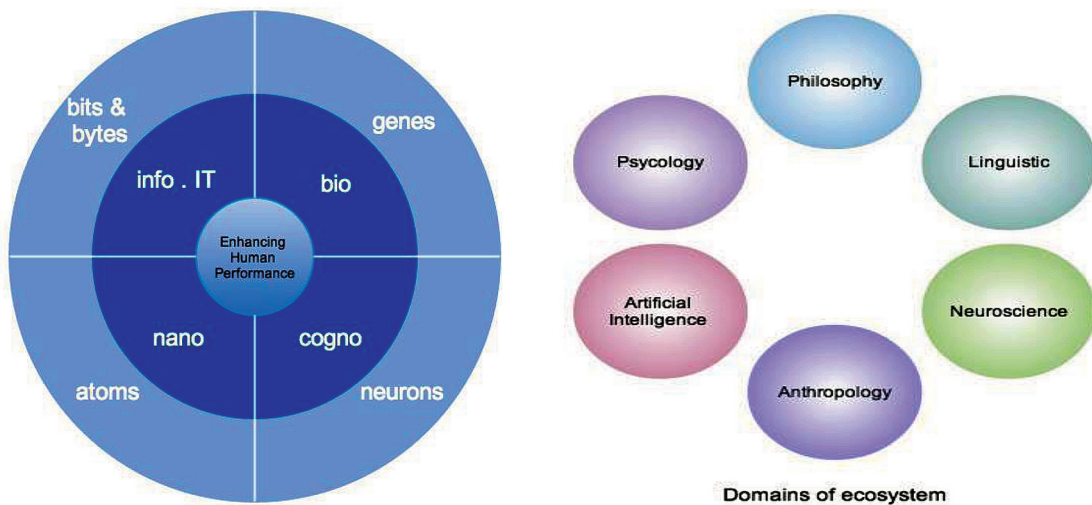
Sustainable Development of Cognitive Science and Technology Ecosystem; an Overview to the “Human Brain Project” as a Functioning Sample

This editorial has the objective to do the analogy between ecosystem distributing and science developing for extracting objective measurement items in order to find out how cognitive science and technologies (CST) can build added value for developing countries economy.

Therefore, we are proposing the natural ecosystem analogy in (CST) developing model. By means of this approach we are intrinsically being able to find measuring factors to reach healthy ecosystem. We are analyzing evidences from developing and business models based on our proposal while the human brain project (HBP) as one of the main large-scale project of European Union in knowledge developing strategy is mapped to our novel landscape.

1.CST Principles

The interdisciplinary Cognitive Science and Technologies (CST) is targeted to explore the secrets of brain, mind and human cognitive functions. Cognitive technologies together with Nanotechnology, Biotechnology and Information technology (NBIC) as shown in figure 1, are established Convergent knowledge, which may result significant development in human life ability, social outcomes, and nation’s productivity. Altogether enables us to promote wealth and welfare in countries. Accordingly, NBICs related subjects considered as an important concern of national science and technology policy making in majority of developed countries and less developing ones such as Iran.



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Figure 1. left side: illustrating the fields that contributed to the birth of cognitive science, including linguistics, neuroscience, artificial Intelligence, philosophy, anthropology, and psychology(Miller 2003). Right side: exhibits NBIC convergence

The main question is how to integrate, align and promote CST as an interdisciplinary field? It is necessary to have a Network of nation-wide Scientistscollaborating from different domains including neuroscience,

psychology, artificial intelligence, linguistics, anthropology, and philosophy of mind in a developing country like Iran;

On the other hand, the big challenge is to connect science, technology, innovation, economy and government. In order to find out a solution in this editorial, initially, science and technology ecosystem were projected to define policies of the CST ecosystem management. CST improvement needs a web which is embodies association of scientists, students, researchers, clinicians, innovators, together with whom is member of universities, institutions, clinics, hospitals, laboratories or enterprises. Furthermore, it can be influenced by legislators, publishers, media, financiers, investors and service provider organizations.

2. Ecosystem as CST Development Strategy

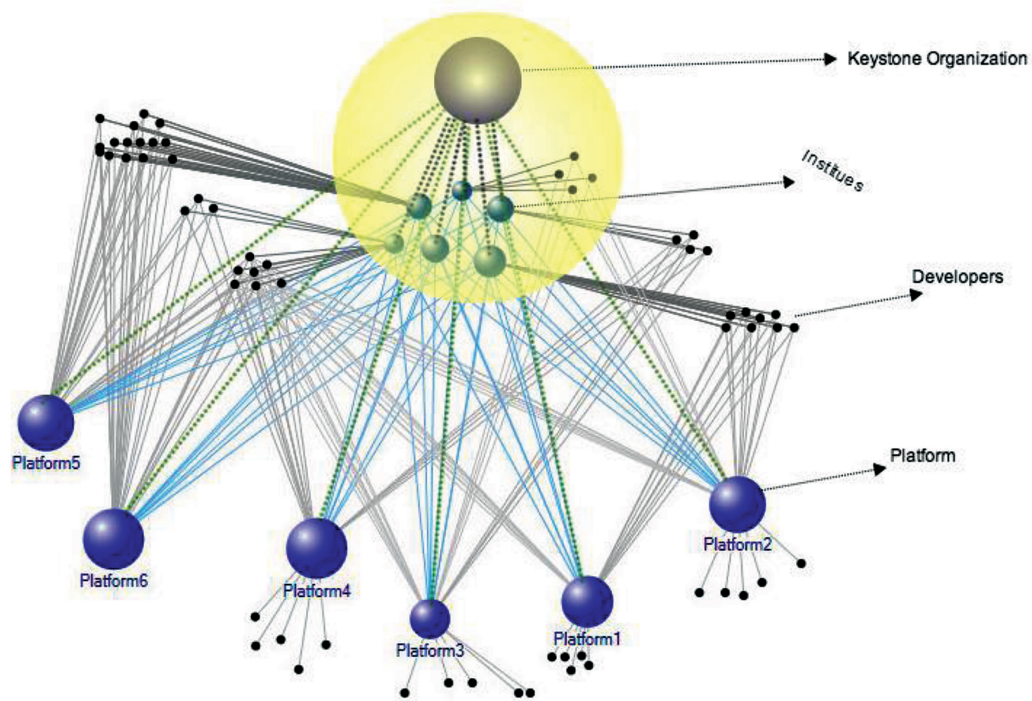
Considering cognitive science as interdisciplinary field that encompasses wide range of knowledge from medical to engineering and philosophy, makes the structure more complex. Better understanding of CST embodiment requires to be revealed in details of network compartments and connections. Main models of science and technology development are demonstrated through the following section, where incorporate with approaches and policies. Recently fundamental innovation concepts are redefined by contemporary science and technology development studies. Traditional Models often pursued linear approaches that fellow science-push or market-pull strategies. The constraint of traditional push-pull models resulted in chain of interactional concepts, combining with system approach led to born a National Innovation System (NIS)(Freeman 2002). Freeman denominated NIS as “the Network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies”(Freeman 1987). On the other hand Lundvall exhibited NIS as: “the elements and relationships which interact in the production, diffusion and use of new, and economically useful knowledge either located within or rooted inside the borders of a nation state.”(Lundvall 2010). Aforementioned NIS explanations emphasize dynamic network of participants in countries level with variety constructive relations to processes of education, research and development, innovation, production and distribution(Freeman 1995).

Policy makers can identify leverage points for enhancing innovating performance to optimize value creation. Policies, which seek to improve networks ability and productivity among main actors, are most useful and valuable. Also healthiness symptoms (productivity [1], robustness [2] and niche creation [3]) of

ecosystems can be studied by evaluating the embodied network and connections. Large-scale research initiatives can provide shared vision for their community. Shared vision aligns full range of participants. It can encourage them to play more effective roles in their cluster, wherein they can receive and share more value streams. Appropriately in shared vision atmosphere, participants earn new capabilities, processes and structures to receive, produce and share related values of correspondence vision. This motivation behaves like facilitator and promotes impressive and robust streams of value, across cluster. NIS approaches to the innovation and technology and also recent models in the field of strategic management, led to interrelation between network of participants that is called “Ecosystem”, where firms coexist and establish interdependent and symbiotic relationships with a complex pattern(Moore 1997, Iyer, Lee et al. 2006). Ecosystems displace “value networks” concepts with “value chain” of traditional linear models(Brandenburger and Nalebuff 1996). Ecosystems are vigorously important, particularly in the Internet and social networks boom years, where service provider organizations encounter with vast associated communities of companies without innovation and operation boundaries(Iansiti and Levien 2004). Consequently, frameworks are desired to figure out current position and modify strategies and policies by circumstances.

In natural ecosystems major species perform roles of value creation and sharing the value both together which are so called keystone [4] as well as leading organization in business ecosystems (Iansiti and Levien 2004). Keystone organizations can enhance the efficiency of ecosystems by well performing the mentioned acts. Efficient ecosystems absorb and retain more participants (Iansiti and Levien 2004). We believe recognizing keystone organizations and their value networks in the regional, national or international ecosystems is one of the major steps of CST development strategy. But which participants can play the keystone role in CST ecosystem?

The platforms initiation is the main strategy that keystone organization can peruse inside the ecosystems(Iansiti and Levien 2004). Platforms can be physical or intellectual assets. Ecosystems have many participants (or sides) brought together by platform-mediated networks(Rochet and Tirole 2003).



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Figure 2. Keystone organization and its collaborators has shown in the yellow circle (stack holders community) because of their common vision for value creation, the keystone responsible to develop platforms due to make standard communication strategies between ecosystem members to share the value. On the other hand platforms can perform a bridge role between different ecosystems in order to niche creation.

3. Human Brain Project Case Study in CST Ecosystem

We try to establish the ecosystems concepts in Human Brain Project (HBP) blueprints by the purpose of introducing sustainable development pattern in CST, whose outstanding approaches can manifest the policies in country level that. Each concept like keystone organizations, value networks and platforms applies important effects on policy-making strategies, which described before.

The Human Brain Project (HBP) -European large-scale research initiative- funded in late 2013, whose goal is to understand the human brain and develop new treatment for brain disease and ultimately to simulate brain-like intelligence to achieve energy-efficacy computational capabilities- and apply all these created values for desired CST ecosystem.

The HBP network is grounded on various institutes, companies and several collaborators of different countries Aligned organizations by means of HBP vision are engaged in considered ecosystem despite of re-

ceiving fund from HBP or not. All these organizations together demonstrate a consortium that plays the keystone role in whole CST ecosystem. HBP is divided into thirteen sub-projects each one is governing by own leader and co-leader investigators who is member of participants institutes. The vision of the Human Brain Project is to build a completely new information computing technology infrastructure for neuroscience and brain-related research in medicine and computing, catalyzing a global collaborative effort to understand the human brain and its diseases and ultimately to emulate its computational capabilities. This vision gives specific identity to the HBP consortium in CST ecosystem which expect to produce added value by individual actors.

It is restated: “One of the major obstacles to understand the human brain is the fragmentation of brain research and the data it produces. Thus, the most urgent need is a concentrated international effort that uses emerging ICT technologies to integrate the data in a unified picture of the brain as a single multi-level system”.

In HBP, some of the main objectives are distributed to create platforms (European-Commission 2013). The HBP is developing six ICT platforms, dedicated respectively to Neuroinformatics, Brain Simulation, High Performance Computing, Medical Informatics, Neuromorphic Computing and Neurorobotics. As it was mentioned, platforms, as a keystone organization strategy, catalyze and facilitate value creation by other participants in the CST ecosystem. One of the main purposes of the platforms creation in HBP is to make technology accessible to scientists. As it is restated: "In the form of research platforms, they can be used for basic and clinical research, drug discovery and technology development" (European-Commission 2013). These platforms are being built to facilitate collaboration of scientists and organizations. By this way, platforms are required to be create and share value among participants especially in interdisciplinary fields like CST(Rochet and Tirole 2003). It was suggested that many high-tech fields can be considered as "systems of interdependent components, built around and on top of platforms" and are often provided by a complex net-

work of interactive firms, or an "Ecosystem"(Gawer and Henderson 2007).

Making policies for a complex ecosystem must align on several main domains to create value(Iansiti and Levien 2004). It is helpful because each domain has own characteristics, special mission, goal and related value network. The HBP ecosystem was built by connection of three main domains including neuroscience, medicine and computing. It was hard to imagine these domains brought together, until the HBP consortium as keystone grew this community in CST ecosystem and defined a new identity. Each of these domains has its own vision and interests. Their values and structures were different. In ecosystem context, they recognized themselves in the new atmosphere where the keystone organizations has built new structures and vision, and platforms facilitated their value creation and collaborations.

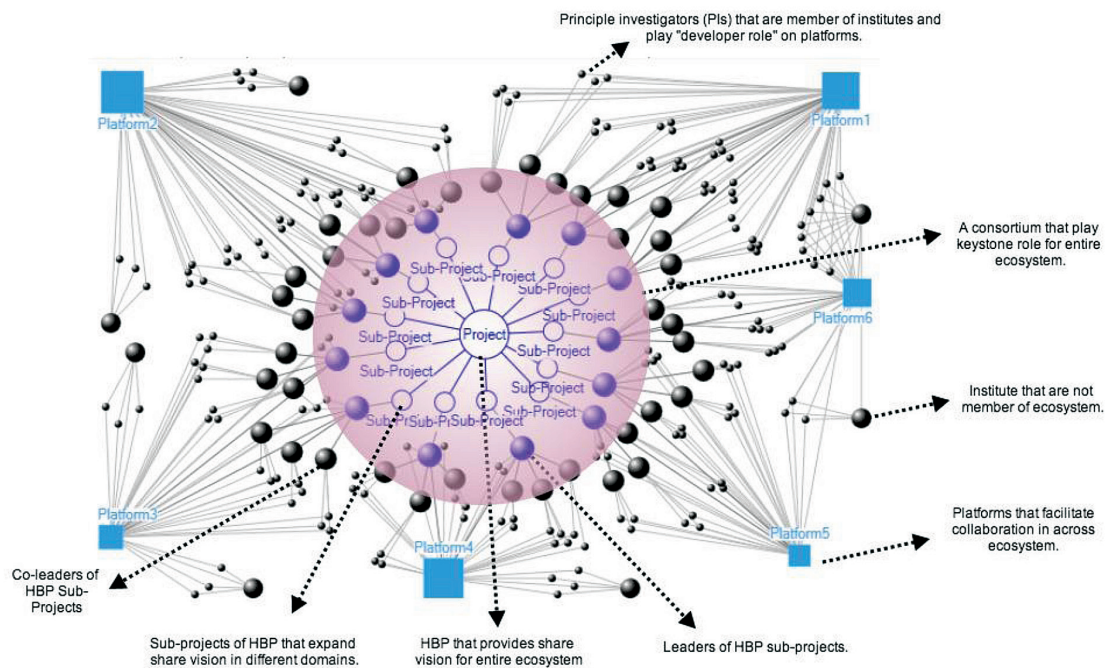
The mentioned analogy is summarized in Table.1:

Table 1. The analogy among natural, business and CST ecosystems

Cognitive Science And Technology (CST) Ecosystem	Business Ecosystem	Software Ecosystem	coastal ecosystem of the Pacific Northwest
HBP Consortium	Keystone Organization	Microsoft Co.	Key Stone Species (Jaguar)
HBP Structure (Relations Among Leaders and Co-leaders of Sub-Projects)	Value Networks	Relations Among Service Providers and Users	Food Chain
ICT Platforms	Platforms	Windows	Habitat
Principle Investigators	Developers	App Developers	Species
	Value Exclusivity	IBM at 1985	Dominator Species (Weed)
Research Innovators	Player Aims to Develop Specialized Capabilities		Niche Species
Partners and Collaborators	Participant Organizations	Software Service Provider Organizations	Species
HBP Initiates and Maintains by Large-Scale National Initiatives	Ecosystem Initiates and Maintains by Market Mechanisms		Natural Mechanism

Ecosystem approach provides applied context in strategic assessment like network visualization and foresight across ecosystem, For instance the mapping of ecosystem by means of graphs, enables policy makers to better analysis of alliances and relationships of participants(Basole and Karla 2011). This provides visual perception and insight into policy making and

implementation(Iyer, Lee et al. 2006). Visualization helps researchers to recognize hidden information inside data and enables humans to overcome their cognitive limitation(Moore 1997). For example, we can visualize relations among Principle Investigators (PI), institutes and platforms in HBP ecosystem shown in figure 3.



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Figure 3. Visualization of HBP analogy in CST ecosystem

On the other hand, one of the main objectives of HBP is to provide a foresight for the main trends. As they declared: “The HBP foresight lab studies the views, attitudes and strategies of participant in CST ecosystem. With methods from the empirical social sciences involving interviews, focus groups and other assessment methods”(European-Commission 2013). Analyzing multiple possible future realities is an important function of strategic foresight(Mojica 2010).

Accordance to analogy of business ecosystem “The HBP Competitive Calls Program will allow researchers from outside the HBP Consortium to propose research and applications development projects using the HBP platforms and to receive funding from the HBP”. This approach encourages researchers for innovation and acting new role in niches existing in the ecosystem. Then the ability and healthiness of ecosystem will be improved.

Thereby, development of CST in the present complicated world, like other domain of science and technology, needs compatible approaches reflected not only in our articles, but also in our policies, strategies and planning, where decision makers set priorities for budgeting. By the ecosystem approach we discussed in this article, priorities must be defined around formation of keystone consortiums and making platforms to facili-

tate collaboration. These collaborations will increase healthiness of CST ecosystem to ensure its natural life and development.

4. Conclusion

We applied conceptual analogy method between natural ecosystems and CST environment resulted in theoretical sustainable development framework of CST which is in agreement with “project management body of knowledge” (PMBOK) standard concepts.

PMBOK breaks any project to five distinguishable stages as initiation, planning, execution, monitoring and closing the project.

Foremost Policy makers are illustrating the ambitious vision by means of a valid and up to date information from current known ecosystems. Through the initiation stage keystone (consortium) is demonstrated and intellectual property sharing with consortium participants are being defined. It is following by planning stage in which large scale project will break down to sub domains and small projects. Additional at this stage leaders of each subproject is identified by resources such as collaborator and participants are being specified based on assets and tasks. By the end of this phase we have time sheet to run the project and measurable item to evaluate the project

development. The parameters to evaluate the ecosystem healthiness can generate continuous monitoring of productivity, robustness and niche creation of ecosystem. In executing stage the platforms are startup in order to facilitate the principles investigators. Monitoring must be done in both issues of project progress and ecosystem healthiness to define a feedbacks to optimize the executive plan. Furthermore at monitoring stage the task based intellectual sharing will be evaluated again in order to ing optimization. By achieving golden goals or obtain the finished products, the project will be finalized in a healthy ecosystem.

5. Open Questions

What is the developing criterion of interdisciplinary cognitive science and technologies (CST)? In Iran, as an example, the most acceptable general idea is based on the amount of papers index in high tech journals can show the progress rate of that knowledge, such as CST and Nanotechnology, however we believe, not only this factor is inappropriate measure assessment of developing growth rate in any field but also it can provide wrong illustration of real world which enhances the noise of information system and results in non-healthy progress strategy, which it is tangible in high granted knowledge areas in last decays.

Which infrastructure is required to obtain sustainable development in CST? Which roles can be better perform by governments and private sectors? What kind of pilot study can help to find out urgent act in initiating and planning stage? The flow of information how to motivate the system or at last but not the least how we would be able to apply the effect on legislator and policy makers?

Hossein Farrokhi, BSc
*System, Strategies & Evaluation Dept.
Cognitive Sciences & Technologies Council (CSTC) of Iran.*

Iman GhodratiToostani, MSc
*Research & Development Dept.
Fanavaran Gostaresh Salamat Cooperative (FGSco) of Iran.*

Maghsoud Farasatkah, PhD
*System, Strategies & Evaluation Dept.
Cognitive Sciences & Technologies Council (CSTC) of Iran.*

Hamed Ekhtiari, MD
*Education, Promotion and Human Resources Dept.
Cognitive Sciences & Technologies Council (CSTC) of Iran
h_ekhtiari@razi.tums.ac.ir*

End Notes

[1]. "Productivity" is the ability of transforming technologies and raw materials of innovation into reducing price and new production which can be measured by return on invested capital.

[2]. "Robustness" is the potential of surviving disruption like unpredictable technology change. It can be measured by survival rates of ecosystem members, over the time or either in associate with comparable ecosystem(Iansiti and Levien 2004).

[3]. "Niche creation" is ability to attract the extrinsic shocks and exchange it to productive production. On the other hand in business ecosystem context represents capacity of enhance significant diversity as a consequence of valuable new functions or niche creation. It can be measured by inspecting at the extent to what emerging technologies are actually being applied as a variety of new business and product(Iansiti and Levien 2004).

[4]. Modern business networks and biological ecosystems also are characterized by the presence of crucial hubs that assume the keystone function of regulating ecosystem health. Like keystones in business networks, sea otters represent only a small part of the bio- mass of their community but exert tremendous influence. Note, too, that, as in business ecosystems, some individual members of the community suffer as a result of the keystone's behavior, but the community as a whole benefits. The biological counterparts of the two other primary roles we have identified in business ecosystems – the dominator and the niche player – are more obvious. And most species in nature, like most companies in the business world, are niche players, with a specialized function that contributes to the functioning of their ecosystems. Inputs like technology in business ecosystems are constantly changing.

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