

## The Development of Technology Intelligence in the National Innovation Ecosystem; The Case of Fuel Cell Technology

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**Abstract:** Policy makers at the national level and decision makers in firms generally need to have appropriate and opportune information in various technological fields and innovation situations to make timely and effectively decisions. Lack of this information has irreparable consequences for organizations. The term “technology intelligence” is a generic solution for dealing with such a challenge. It is especially important in fields where technological development is rapid and where changes are likely to occur more rapidly. The purpose of technology intelligence is to gain a technology based competitive advantage. This paper suggests a conceptual model for the development of technology intelligence in the national innovation ecosystem by using an empirical study in the fuel cell technology ecosystem. This model has six crucial items at its top level including performance and needed guidance, search and acquisition, processing, organizing and storing, analyzing and documenting and disseminating. According to this model developing technology intelligence in the national innovation ecosystem can improve efficiency and increase wisdom in the ecosystem.

**Key words:** Technology intelligence system, fuel cell, functional architecture, intelligence needs, technology

### INTRODUCTION

Technology policy makers are always faced with the problem of decision-making and choices. Important factors in decision-making are accuracy, time and cost which are often opposing dynamics. In other words, the decision maker must be able to establish an equilibrium between time, cost and accuracy to obtain the best result. Advances in information and communication science are some of the events that dramatically impact these three factors in decision making. These phenomena constitute a serious threat as they increase competitor intelligence which consequently increases science and technology growth rate which causes a shorter technology life cycle. This results in the time factor becoming more important in decision-making. On the other hand, this progress provides the decision maker access to a large volume of information. The inability of the decision maker to process and analyze this data can cause confusion and reduce accuracy. Therefore, rapid advances in science and technology can result in shorter life cycles for technology, increases uncertainty and risk in decision making and gives access to a large volume of data which cannot be processed and analyzed by traditional methods. These kinds of factors show the necessity of a structured system for increasing the power of decision making.

Such a system has been introduced under various names in the literature in recent years, including Technology Intelligence (TI), Technical Intelligence (TI),

Competitive Technical Intelligence (CTI), a Competitive Technological Intelligence (Vatcha, 1993; Safdari Ranjbar and Tavakoli, 2015) or scientific competitive intelligence (Bryant *et al.*, 1993). Implementation and deployment of these systems increase the power of accurate and timely decisions in technological fields (Porter, 2005). The importance and necessity of such systems can also be studied from the view point of the development platform of technology. Technology development is often dependent on the creativity of technology professionals and product designers. Since, discovery of new opportunities and innovation in developing new technologies is necessary, innovative ideas are the basis for the successful development of technology (Arai, 2006; Yang and Liu, 2006). Creativity can be identified as the ability to detect new communications, testing subjects from a new aspect and forming new concepts from current concept (Couger, 1995; Evans, 1990). Researchers have found that creativity is more dependent on a necessary infrastructure for growing ideas than the genius of the individual (Gatignon *et al.*, 2002). Therefore, it is necessary to increase innovative work by methods that facilitate the idea generation process and provide valuable information (Yoon, 2008). This is one of the main goals of technology intelligence systems.

Today we know that there are three active ecosystems. First, business ecosystems focus on present customer value creation and large companies are typical key players within them. Second, knowledge

ecosystems focus on the generation of new knowledge and research institutes and innovators such as technology entrepreneurs, play a central role in these ecosystems. Third, innovation ecosystems occur as an integrating mechanism between the exploration of new knowledge and its exploitation for value co-creation in business ecosystems. The relationships and the dynamics between overlapping ecosystems is an important research theme and we need to create tools to enable crossing borders between the ecosystems (Valkokari, 2015). Technical Intelligence systems are one of the processes that focus on how actors can decision make in multi relationships and multi functions in their related ecosystems.

Based on these factors, the necessity of deploying and developing these kinds of systems are obviously understandable, particularly in countries like Iran where internal companies need to increase the level of professional expertise and science and knowledge in order to compete with foreign companies at the international level. Technology intelligence systems could provide valuable assistance at the national and regulatory levels. Therefore, this study aimed to concentrate on the conceptual design of technology intelligence systems in national level. But given that the design of this system is based on technology's innate characteristics the interests of beneficiaries associated with that technology and hence their variable needs should also be considered, intelligent system for advanced fuel cell technology was designed technology intelligence system is suggested for organizations or areas that have special circumstances such as the following.

Operate in technologically dynamic industry environments where the pace of change is rapid or new technologies are likely to surface.

Emphasize technology-intensive products where technology is a differentiating factor, product introduction rate is fast, market entry timing is important, regulatory approval of new products is complex. Manage a significant R and D portfolio.

Expect a high share of near-term business revenue growth from new products. For such companies, technology is a basic determinant of a company's competitive position and is the source of future growth (Ashton and Klavans, 1997). Accordingly, the establishment of a technology intelligence system for advanced fuel cell technology which embodies all these of features would be advantageous at a national level.

**Literature review**

**Intelligence:** When we want to talk about intelligence concept it is unavoidable to face with other concepts such as data, information and knowledge which are strongly related to each other and we cannot analyze it

without them. However, some of editors believe that making differences between these concepts is useless. For example, we can mention to Mass which says: "data, words, records or whatever it is called remains information and the term information encompasses all the others" (Mass, 1982) or the idea which denies the differences between data and information by reasoning that information is simply the physical representation of knowledge or its surrogate (Farradane, 1979). However, the fact that there is a conceptual difference between data, information, knowledge and intelligence has been confirmed by many authors that their comments are summarized in Table 1.

In summary the above definitions can be stated that data is simple facts or a scattered bit which after restructure will change to information. This information, along with the meaning and concept is equal to intelligence. And finally, data, information or intelligence along with experience is equal to knowledge. These definitions are shown in Fig. 1.

Table 1: Summarizing the literature of data, information, intelligence, knowledge

Concept	Definition
Data	Simple and naive facts (Courseault, 2004) A string of symbols, facts, measurements, statistics (Castillo <i>et al.</i> , 2008)
Information	Scattered bits of knowledge (Herring, 1998) The structured data (Adams, 2002) Given context and framework (Courseault, 2004) The data with relations (Arai, 2006) A piece of knowledge that can be encoded and stored (Yang and Liu, 2006)
Intelligence	Physical representation of knowledge (Couger, 1995) Composition of the particles (Herring, 1998) Form of information (Castillo <i>et al.</i> , 2008) Analyzed data (Adams, 2002) Inference analysis (Herring, 1998) Ability to understand and apply knowledge (Yang and Liu, 2006)
Knowledge	Data/information, opinions (Evans, 1990) Information with high reliability and certainty (Castillo <i>et al.</i> , 2008) Information sharing (Castillo <i>et al.</i> , 2008) Experienced data (Eysenck, 1995) Structured internal data (Yang and Liu, 2006) Knowing mode (Yang and Liu, 2006)

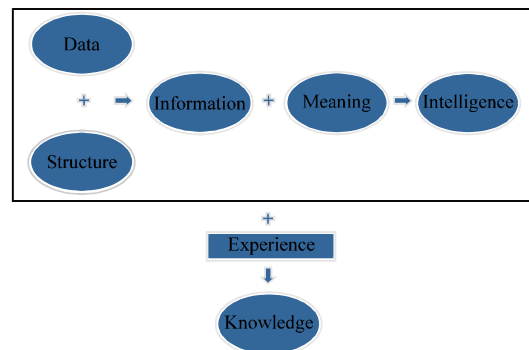


Fig. 1: Relation between data, information, intelligence and knowledge

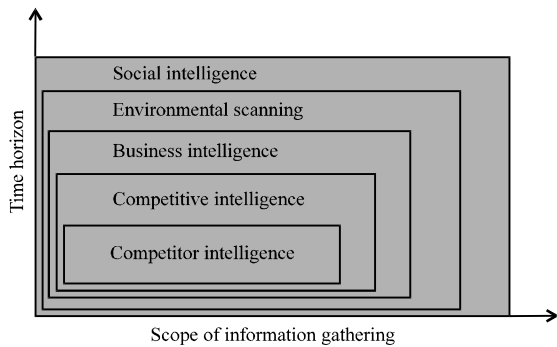


Fig. 2: Types of intelligence

**Types of intelligence:** Intelligence based on an area that covers and the objectives which fulfills is divided into several types. Accordingly, intelligence that focused on the competitive environment of firm is known as competitive intelligence (Kahaner, 1996). A CI System may track: a competitor’s capabilities and strategies; the industry’s structure and trends; the market and customer behavior; political, economic and social forces and technological developments (Hohhof, 1997). By the same token when gaining insight about the environment is a part of the purpose of Intelligence systems, Business Intelligence is introduced (Savioz, 2004). Choo believes that: since competitive intelligence is a primary objective of activities within business intelligence, those two terms can be used more or less interchangeably (Choo, 1998). Savioz presents the status of each of these concepts by using this idea which also has shown in Fig. 2. Savioz believes that: competitor intelligence is information-gathering about the actual and future activities of competitors whereas competitive intelligence’s focus is broader and embraces (Porter, 2005)’s five competitive forces model (Savioz, 2004). He also referred to the definition of business intelligence by “Gilad”, believes that regarded to the relationship between study of the feasibility of future competitive environment of intelligent field and business intelligence approaches, operationally this kind of intelligence has the same kind of fireld with environmental scanning which is defined as: “the acquisition and use of information about events, trends and relationships in an organization’s external environment, the knowledge of which would assist management in planning the organization’s future course of action” (Auster and Choo, 1994). Social intelligence which is shown in Fig. 2 is concerned with the capability of society and institutions to identify problems, collect relevant information about those problems and transmit, process and evaluate as well as ultimately put this information to use (Dedijer and Jequier, 1987).

However, what will be investigetaed in this study is the technology intelligence which is considered

more as a subset of competitive intelligence (Dugal, 1998). According to “Ashton”, technology intelligence is kind of intelligence which is conducted on technology and it’s science infrastructure. That is component of the CI system that supports project and scientific funding decisions and helps decision-makers calculate the relative strength of other organizations (Hohhof, 1997). It emphasizes the R&D function of an organization but can also encompass other technology-driven activities such as strategic planning, technology acquisition and process equipment investments.

Technology intelligence has been conceived as a capacity that allows identifying technology developments in time and moreover it comes up as a model that links the necessities of the market to technology innovation. In this way, it allows to differentiate among technology fields in use and those of interest that can be limited through future functions of the product and the weak signals in technology trends (Castellanos and Torres, 2010).

Technology intelligence based on the concept and methodology is formed by several schools. From the perspective Savioz the definition of technology intelligence is in the heart of two schools of thought.

First, there are authors that present methods with the objective of predicting the technology development of the future. On the other hand, there is an attempt for the development of systems that allows observing the technology environment in which the organization performs on a periodical basis with the purpose of evaluating its impact (Savioz, 2004). The first school in which the technology intelligence is conceived as a method to predict technology development in the future, belongs to Porter. He states that it is one of the many forms that overlap technology forecasting including the road mapping and foresight and this is why he classifies it as a family of the techniques of Technology Future Analysis (TFA) in this school, “Porter” has seen the technology intelligence as a tool rather than considering it as a necessity for the future and define it as wide current technical abilities. In this same school, Lang and Mueller (1997) with a strong approach technology-product-market (innovation), mention that the technology intelligence is a tool that allows to identify technology developments on time (Lang, 1997). However, most of the researchers belong to the second school that approaches the technology intelligence as a system that allows periodically observing the technology environment. Lopez, expresses that technology intelligence is linked to knowledge related to the predominant directions in technology development to the identification of the principal actors and to the actions that competitors in the different topics make (Lopez-Ortega *et al.*, 2006). Regarding, Lichtenthaler

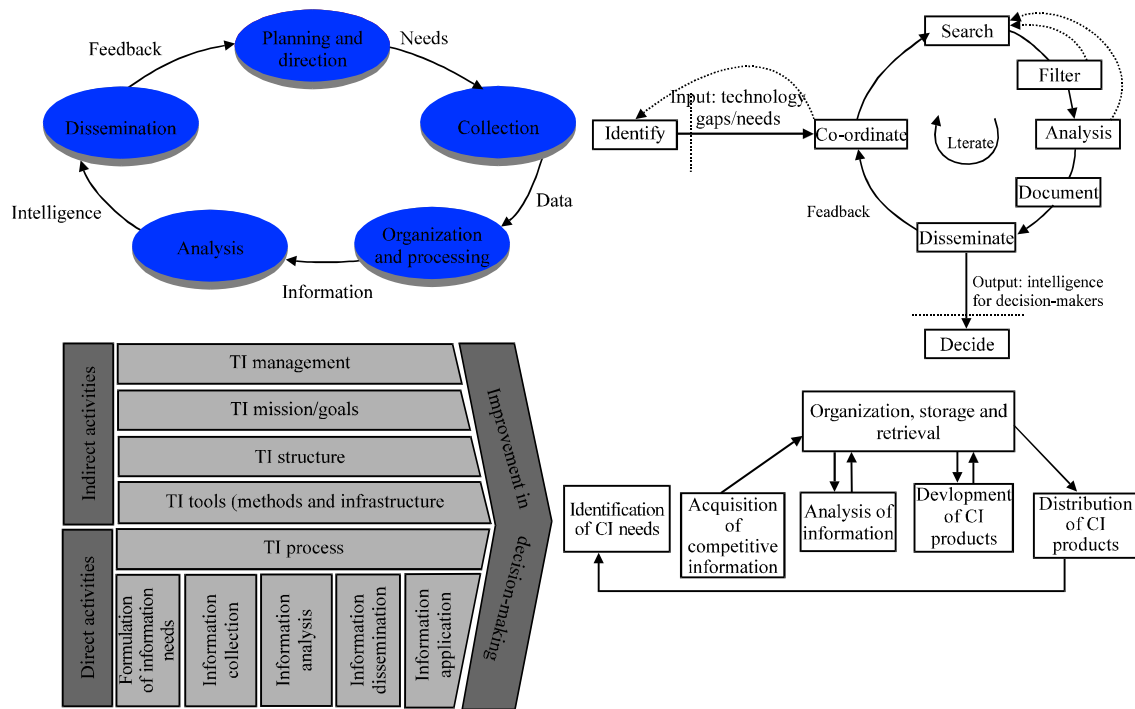


Fig. 3: CIA, Kerr, Savioz, Bouthillier models

(2003) he conceives it as a group of activities related to the collection, analysis and communication of relevant information, taking into account the technology trends that support the technology decisions and the most general ones of the company (Lichtenthaler, 2000). And this is why he states that it must be a systemic approach. This matches Rodriguez and Escorsa (1998) when they state it includes an analytical work through time (Rodriguez and Escorsa, 1998).

**Current intelligent cycles and models:** In this study, we will review the intelligence cycles or models that provided by experts belonging to the second school. These models are developed for competitive intelligence models and business intelligence in the company's level. The oldest and the most well-known of them is the model of The Central Intelligence Agency of the United States (CIA) which is shown in Fig. 3 (upper left side) (Kahaner, 1996). The other model belongs to the Savioz which is presented by utilizing Porter's value chain Fig. 3 (bottom left). Savioz work has differences regarded to other cases. He introduced two sets of activities. The first group is TI process activities include determining the need for technology intelligence process, data collection, analysis, dissemination and use of information about the activities which is defined as original or direct activities for value creation and the second group is indirect activities or supported activities that make the main activities

possible. In Savioz chain the value in improving decision-making (through improved data quality (in terms of content and timing) and thus reduce uncertainty) is found (Savioz, 2004). Third model is presented by Kerr to create technology intelligent system in company level from summarization of models available until 2006. The model as shown in Fig. 3 (top right) includes 6 steps of coordination, search, filtering, analysis, documentation and dissemination (Kerr *et al.*, 2006).

Also Kerr believes that any intelligence system in an organization has four distinctive modes. According to Fig. 4 the first mode (down left) is related to the time which the required intelligence in a system exists inside the organization and the organization is aware of its information weaknesses. In this condition the system will search them and explore the needed parts. The second mode (up left) is equal to the time when the required intelligence exists in the organization but the organization is not aware of it. In this condition the system should specify that who knows about information and where are documents (Kerr *et al.*, 2006). Unlike these two modes of system which concentrate on inside of the organization, two other modes have external focus. The third mode (down right) equals to the time when the organization knows what it is looking for and where should it concentrate but in the fourth mode of organization even does not know about what it wants.

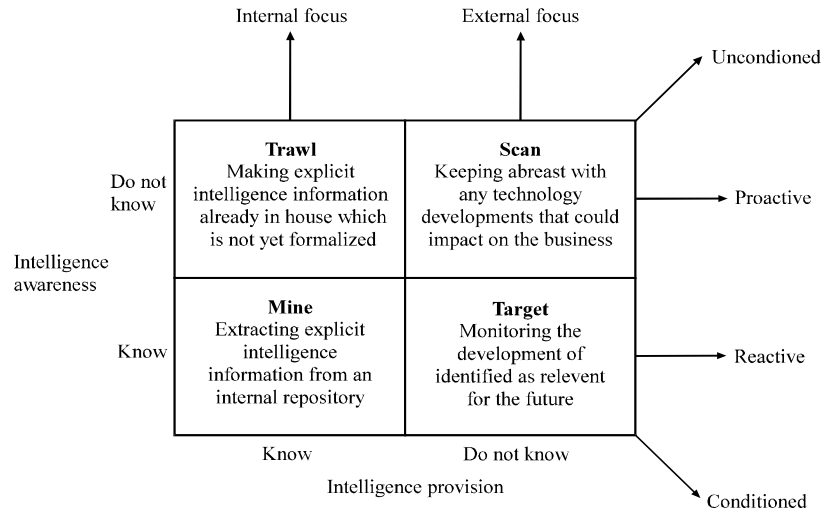


Fig. 4: Four modes of intelligence system in every organization from Kerr view

**MATERIALS AND METHODS**

This research based on its purpose is applied research because that is trying to answer a difficult problem in reality. Also this research based on method is qualitative research. Community of experts and interviewees are limited and descriptive data and results are wide and open. This research extracts the functional architecture of the system for designing of a technology intelligence system at the national level. However, due to the reasons which explained in preference, the structure of fuel cell advanced technology is presented.

Systems are integrated set of interoperable elements, each with explicitly specified and bounded capabilities, working synergistically to perform value-added processing to enable a user to satisfy mission-oriented operational needs in a prescribed operating environment with a specified outcome and probability of success (Wasson, 2006).

Each of these elements is known as the physics that are responsible for one or more functions. Functions are processes of changes inside the system which have series of inputs and outputs. In other words, functions are saying a system as a whole (which is responsible for the main functions) and subsystems (which are responsible for sub functions) what will be doing and physics are responsible for performing these functions. Set of functions and their relationships form the functional architecture and set of physics and their relationships form the physical architecture and finally connection between the two structures together with the appropriate interfaces, creates the whole system (Wasson, 2006; Buede, 2009). Thus the functional architecture of the system is a map of what the system must do to meet the needs of its stakeholders. Therefore, to design the functional architecture of a system first we should

determine stakeholders and their needs (Wasson, 2006; Buede, 2009). In this research the result is conducted through explored semi-structured interviews. The population is divided to two groups on this point. One group is customers, investors and capital funders who decide on technology choosing and second is the professionals, developers and researchers who will decide on the acquisition and application of fuel cell technology. The first group is defined for people who ordered one project for fuel cell technology or invested on it and the second group is people who have presented at least one scientific paper about this subject. Data for this section were analyzed using content analysis and based on that the framework of technology intelligence needs of fuel cell is presented.

After identifying stakeholders and their needs, based on that the functional architecture of the system is designed. To derive the functional architecture, due to the novelty of the subject, limited resources and even the experts it is used from two steps processes. In the first stage the functions of the system is derived by using of a comparative study of current models and cycles, analysis and interpretation of data which are obtained from library research and finally researchers experience in the system analysis and design. In the second stage the functions derived from the first stage is completed and the relations between them are explored by a 10 people expert panel (including experts in intelligence, data mining and information technology) and by using storm thinking and What If Scenario.

**RESULTS AND DISCUSSION**

**Stakeholders of fuel cell technology intelligence system:**  
 A fuel cell is an electrochemical cell that converts chemical energy produced from the reaction directly into

electrical energy. This technology is in the first step of its life cycle and does not enter to the marketing step seriously; therefore presently a considerable part of the technology portfolio includes research and development. It is hoped that this technology is replaced with alternative available products in the market in the near future. Fuel cell applications will consist of a wide range of applications. Mainly places in three groups: power plants, portable and transportation for this reason many stakeholders are concerned for this technology. Based on the results of the content analysis of the results semi-structured interviews with population introduced, stakeholders of fuel cell technology are placed in ten groups as follows.

Specialists and manufacturers of fuel cell. Investors and financial supporters, consulting firms and inspectors, research and academic organizations, maintainer organization of standardization, the owners of the exclusive rights; customers: private or governmental companies which require this technology based on their needs. The difference between fuel cells and other energy supply resources is that some of its advantages and applications are unknown till now and therefore has a great potential of customers which need this technology as soon as they inform of its applications. Therefore, we can divide this group in to two groups of potential customers and actual costumers; policy makers, compatitors.

The mentioned stakeholders based on the similarity of the decision field are divided into five groups in accordance with Fig. 5. Both customers and investors based on their needs (profitability of investment, energy supply, energy security, etc.) choose an appropriate product technology and then order the specifications and indices of the selected product to the professionals and vendors. The other three groups are making decision

about acquisition and utilization of technology. These groups should decide about which method be used to meet the costumers' needs and profit more. Also, these people should be able to use the achieved technology in various applications to attract potential customers.

**Framework of needs of fuel cell technology intelligent system:**

The first group of stakeholders' is policy makers often include a government, unions (national and international) or even Parliament. These decisions because of great importance in the development of technology must manage and be guided by the system. System has the task of intelligence management of this group and how to deal with this system is not demand-driven. The next group is potential customers who do not have any demand of fuel cell because of lack of knowledge about the technology, lack of recognition or presentations related to their applications in the field of fuel and etc. These people needs to be informed about this technology to become actual customers which needs a kind of neutral and universal intelligence from the system. While the potential costumer does not apply any request to the system, actual customers, professionals, researchers, etc., apply their demand to the system. This demand can be a simple demand which is merely a request for information on a specific topic (information demand). The system should meet their demand as soon as possible and analyzing information and data is no longer needed. In that case, the user gives an intelligence demand to the system it means, his request is not raw data, the system must answer it the user according to its needs. However, according to person interviewed the whole needs of all stakeholders are not what they say. Part of stakeholder needs are the needs that decision makers are not aware of it now and it does not demanded, therefore it is not easy to estimate it accurately. We call these kinds of needs as

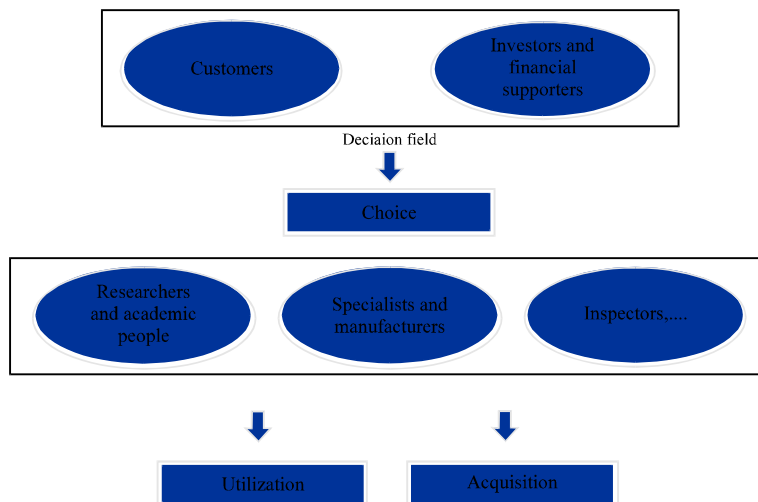


Fig. 5: Decision field of system stakeholders

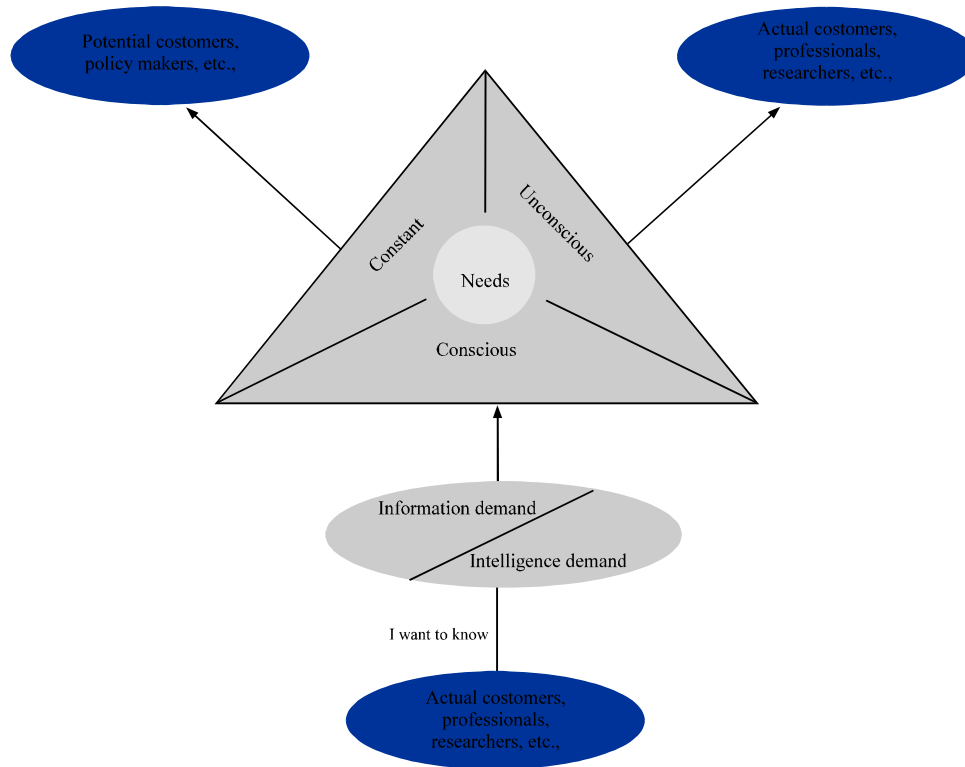


Fig. 6: Framework needed for needs of fuel cell technology intelligent system

unconscious needs. And in case of previous needs which decision maker are aware of it and ask for it from the system are conscious needs. Intelligence demands are output of conscious needs.

So, what the system should meet them is classified to four major groups according to Fig. 6. The first are intelligence needs which are asked from the system by the decision-makers and we call it intelligence demands and the system provides them according to receiving the request. The second one is constant needs that should be met by the system generally and continuously and are not request-based (such as potential customers need). Third are unconscious needs which decision maker is not aware of them and the system must alarm to the decision maker about it. These needs are also not request-based and the system should meet that by use of scanning environment continuously and finally the information demand that is requested from the system.

**Functional architecture:** After stakeholders of the fuel cell technology intelligence system and their needs framework are specified, we explored the functional architecture of system based on that and by analyzing and studding of current intelligence models, analyzing and explaining the data gathered from library studies,

researchers experience in system design and also forming a 10 person panel from expertise which results will discuss in next step.

Based on what has been discussed so far, the main function of each technology intelligence system is to enhance decision-making power in the field of technology. Based on the results of this study, the top level function will divided to six parts in second level which are: identifying and direction; search and acquisition; processing, organization and storing; analyzing; documenting; disseminating. Figure 7 shows the second surface (layer) of the system. Using IDEF0 tools in this figure, we show that each of these six are working in cooperation with other functions and have inputs and outputs to each other. In addition as the function of the first surface divided to these six functions, each of these functions is divided to sub functions in lower levels which will be discussed.

**Identifying and direction:** Based on needs and requirements which are obtained by part 2-4, the system must receive two demands of intelligence and information from customers and answer to them. But before answering the demands should be analyzed regarding to the law of system and if they match it should be responded

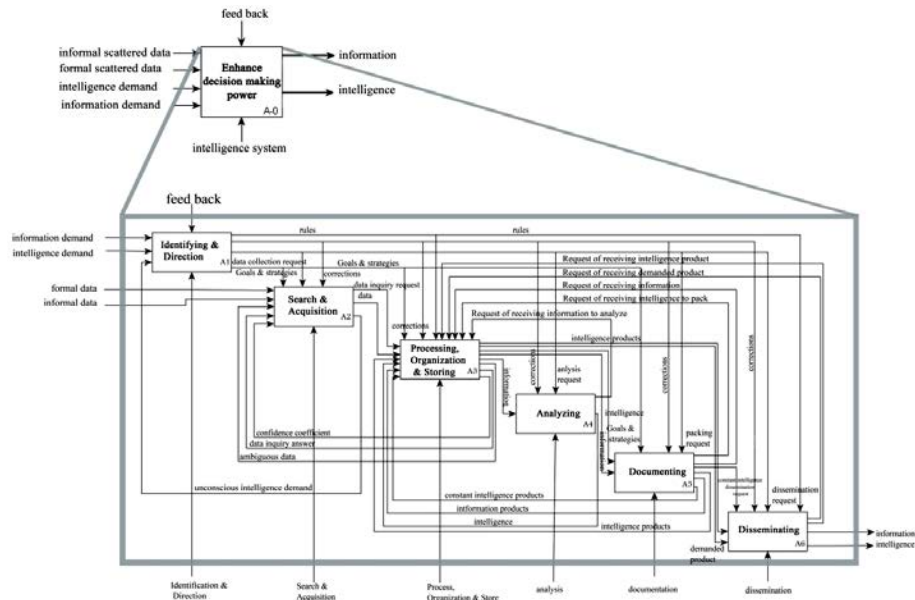


Fig. 7: IDEO chart of system second level

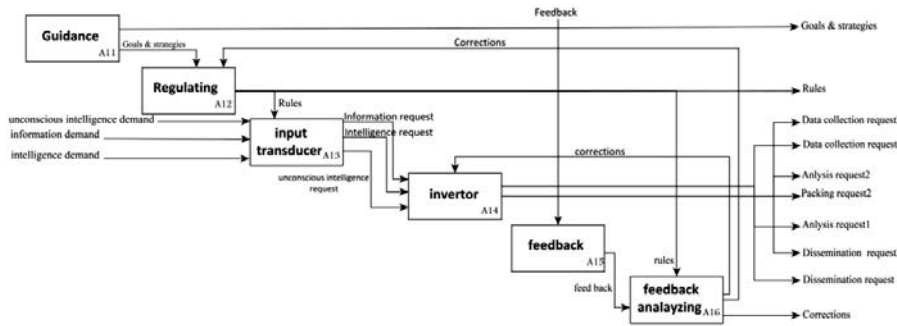


Fig. 8: The third level requires the following system functions and navigation

(the system has no obligation to respond to any demands). This is done by the function called input transducer. This function with output transducer function are parts of the basic functions system which monitor whatever enter to the system and whatever the logged out of the system. Because of there are lot of users work with this system and in some cases there are strategic and vital information of companies inside this system, it must have a regulatory rule to avoid any probable abuse.

In most cases, the demand is logged does not indicate the work should be done. All system users do not have enough knowledge about the analysis tools to define which sources or data will provide their needs. The Task is presented here as a function of the converter is responsible for overcoming these challenges. This function will translate needs of users for data gathering, analysis, documentation, and finally, publish according to Fig. 8.

**Search and acquisition (R&A):** Intelligence matrix “Kerr” which was shown in Fig. 4 provides a good idea to specify the search and acquisition functions within the intelligent national system of fuel cell technology. But to bring up the idea at the national level there are fundamental differences between the organizational level and national level which should be considered. One of these differences is that an organization usually is aware of internal activities and changes in projects and does not need to scan and monitor its internal environment; however it is not true for national level. In the interview which is done with stakeholders of fuel cell technology, 80% of the stakeholders of fuel cell filed point to the weaknesses in having access to the internal data of the country and lack of proper information about facilities, projects, activities and developments of internal technologies and they believe these kinds of problems are more important than others. Therefore, R&A on



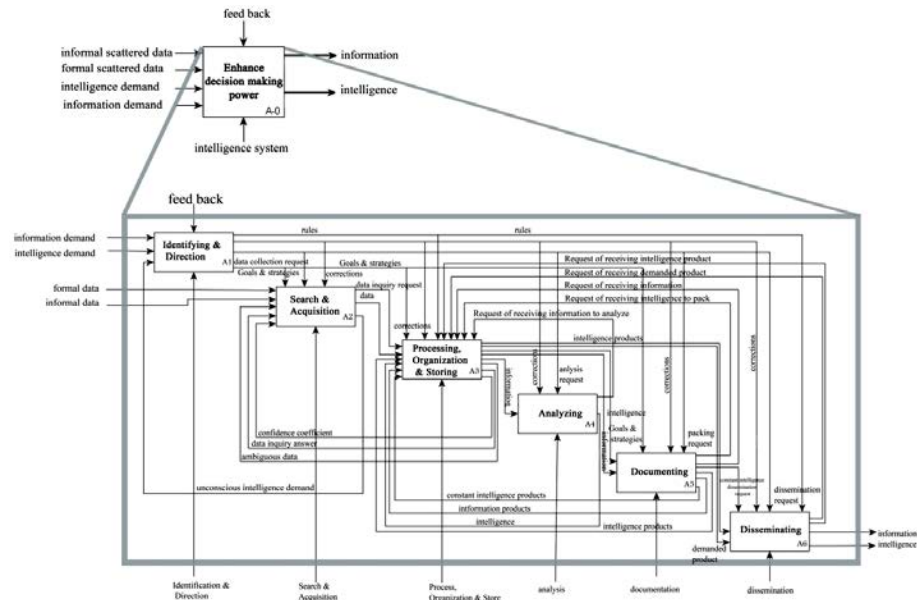


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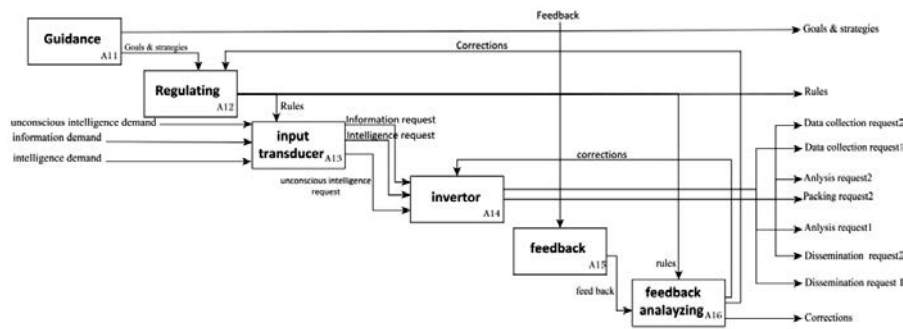


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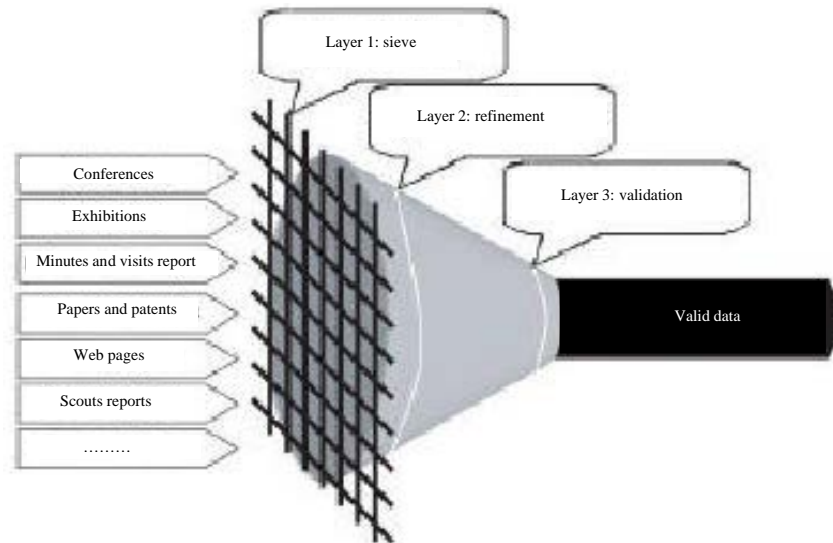


Fig. 9: Defense layers

internal environment is one of the functions which should be considered. The R&A can be done in 2 modes: continuous and demand-base. To explain the continuous R and A (internal and external), we describe it to a radar which gives alarm about the unknown and disruptive technologies. This case is used to learn about new technology which is able to affect the agency business. Continuous R&A (internal and external) is used to define intelligence for unconscious needs. In this case, there is no cognitive about needed intelligence than and therefore, it would be no demand for it. Therefore, this function should be monitored and scanned continuously the fuel cell technology domains which are relevant to data and develop the intelligence of demands to identifying and direction function.

Another discussion that defines in following function is the data sources used by the system. The system must have both formal and informal resources for collecting and evaluating its data and in the case utilization trend without identifying and evaluating data cannot respond to these needs and is a high risk project. Another function in this direction is providing identification for the resources. This certificate should be concluded with reliability of the sources, the level of availability, quality and up to date information and...

**Processing, organization and storing:** Based on the results of the study, in order to avoid errors in the output layer of the system three defense layers is defined here. The first layer of defense is a sieve performance data collected will be evaluated in order to eliminate waste and duplication. The second function is related to the collected data and clarification of ambiguous data and the third one is analyzing functionality accuracy of

the information. There are two possibilities for the misinformation, one is that information are wrong inadvertently wrong and second one is that the information is presented wrongly by competitors in order to deceive the system. These two cases should be considered to determine the identity of sources of information. Three functions of sieve (excluding waste and duplication), refine (excluding unrelated and obscure) and validation, according to experts opinions is shown in Fig. 9.

The next function after these three layers is determination of level of access to the data acquisition system. When a system is identified in national, it needs to fulfill the needs of all to use their cooperation. So, before anything else level of access to information should be defined. This function works in four categories, general, confidential, highly confidential and secret.

Collected and processed data should be stored at the local place and because of we need to find them easily when we are searching they must be organized and encoded before storage. Data organizations should be rated based on the need for intelligence and information retrieval and encoding must be able to demonstrate hierarchical relations (e.g., company X->Roadmap->Vision->Mission). Two cases encoding and organization are very similar and so we define them as encoding functions.

The next function is data storage in the data station system and subsequently retrieval of its adherents. Since, the data are growing at an exponential rate and also the system is not able to store any volume of data, an existence of a function for the disposal of expired data is necessary. We call this function the extruder (Fig. 10 and 11).

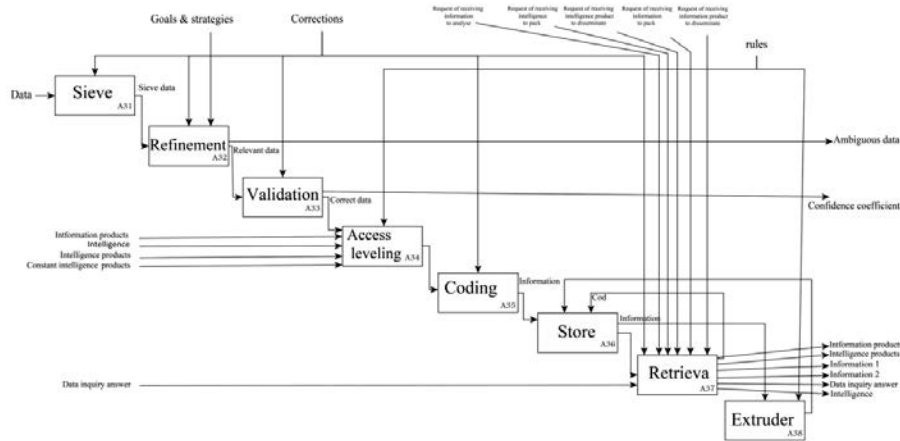


Fig. 10: The third level of system; processing, organization and storing subfunctions

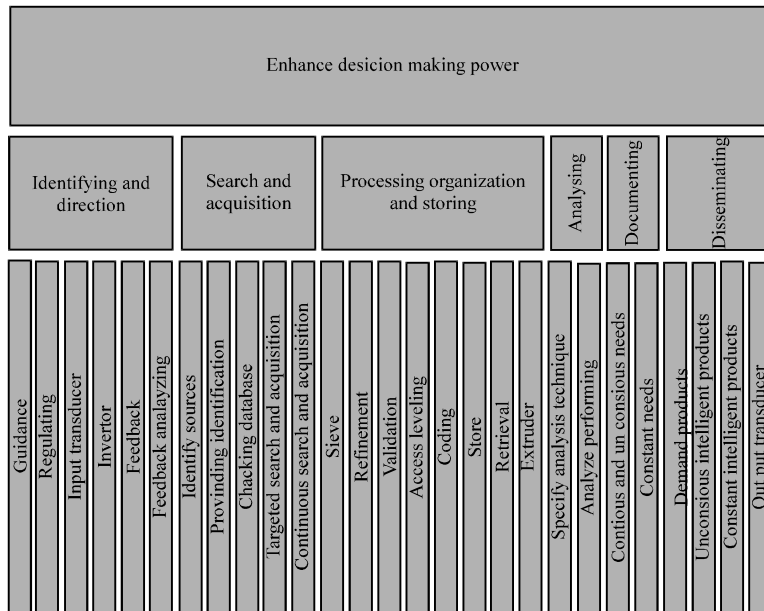


Fig. 11: Enhance decision making power

**Analyzing:** This function can be considered as an intelligence brain for business. Data collection without analysis has no value, and if analyzes in not done whole the intelligence unit will change to a service unit of the library. Depending on the circumstances, form of the organization and users need different types of analysis can be performed on the data. But analysis has the highest value, for example, one or more proposals to be presented to the decision maker. Different methods of analysis are considered as a tool in the service of an intelligent system and are not considered as functions. Two sub functions which are placed under this function are analysis and the analysis performing.

Current literature provides an extensive literature range of tools and methods which are useful in technology intelligent. The important question is which method should be used where? Technology strategy, environmental complexity and uncertainty of the industry, can be influencing tools choice of analyzing tools. Another important factor is the time of concentration. Available analysis tools do not have same power in analyzing of the present and future.

**Documenting and disseminating:** The task of this step is to organize the outputs of analysis for different groups of users and stakeholders. The analysis depends on the

audience that will receive it. For example, analytical analysis for delivery to the professionals must be different with senior managements. As it was brought in competent stakeholders' part, stakeholders of fuel cell qualified into five groups of customers; investors and financial supporters-specialists and manufacturers-inspectors, laboratories and centers, researchers and academic people. To provide intelligence, each of these groups has a specific format to be followed. Reports that are provided for researchers, scholars and instructors should be along with the technical details; however, such a report is not acceptable for investors.

There are two sub-functions, corresponding to the three types of fuel cell stakeholders needing. First sub-function based on the request of identifying and direction function provides the information for responding to the received request from customers (conscious need) and also from continuous R&A function (unconscious need). And the second sub-function has the task of providing constant needs and therefore, prepare information as magazines, newspapers ... regarded to the kind of information and situation of organization.

**Disseminating:** On time delivery of intelligence products to the people who need to receive it is the output of this function. Here there are three types of emissions. The first one is to provide fixed needs which are in the frame of bulletins, periodicals and magazine and... The second one is publishing in order to respond to the request for information dissemination and application of intelligent system and the last one is concerned for beneficiary who they should be aware of this information. The method of intelligence publishing is an important method for effectiveness and success of the method which can be done in different ways such as talking face to face, telephoning, emailing, mail, magazines, bulletins, posters, and etc. Selecting any one of these methods largely depends on the characteristics and parameters of the recipients and the nature of intelligence.

## CONCLUSION

In this research a technology intelligence system is introduced as a modern method to increase the power of decisions made by managers, investors, experts, professionals and all people who work in this field. We then discuss the design of a system for a sample high technology (fuel cell) field at the national level. To design a Fuel Cell Technology intelligence system at the national level, we first identified the fuel cell stakeholders and their needs through semi-structured interviews. Next, ten groups were identified based on the relevant interests,

and these ten groups were further divided into five groups based on their needs and then their frame needs were extracted. Based on the results of this research, we identified three categories of stakeholder needs: conscious, unconscious and constant. After extracting the needs framework of fuel cell stakeholders, the functional architecture of the system was driven by a library study, a comparative study, the researcher and an expert panel. The architecture included 34 collected functions and is shown in the following diagram.

Evaluation by the researcher of all the above data showed that the lack of the 34 specified functions identified in this research and the lack of communication and connection between these functions provided by the IDEF0 Model cause instability in the system at the national level. In addition, this structure could also be used as the basis for the implementation of an intelligent system for other technologies.

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