

# Role of ICT and Science Park in building Effective Knowledge that leads to knowledge based Economy and Strong Knowledge Society

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**Abstract:** Some of the main features of effective useful knowledge management (KM) are understanding on how knowledge is produced from ideas, how it has been effectively shared by others by making its information accessible securely and flexibly all time to authorized users, and how to use this knowledge by professional people who can apply technology to transfer ideas into useful products that can be utilized by others. Developing and producing knowledge as well as sharing and transferring knowledge to others would build a strong knowledge society. On the other hand, applying technology to build new products beneficial to societies, companies, investors and individual would lead to healthy knowledge based economy. In general Knowledge management deals with the capture, retention, and reuse of the foundation for imparting an understanding of how all these pieces fit together and how to convey them meaningfully to some other person. This will make an effective knowledge Management that transfers knowledge among people. However, to make it a useful KM, ideas should lead to creating products that can add value to people, humanities and to the environment. A project such as science park and techno valley would assist in making a useful KM through building the gaps between researchers and industries to transfer new ideas into useful products. In order to achieve effective KM, the work in this paper has focused on the production and distribution of KM using ICT. This can be done through secure Wired and Wireless network that have the advantages of flexibility, mobility, easy administration, reducing the information-related risk, and support of security. In addition, this paper also covers the way to make a useful KM through the support of science parks such as Riyadh Techno Valley. The analysis done in this paper would be used by designers and managers to make an efficient distribution of KM to achieve high availability within the corporation, high security, and more flexibility with easy network administration. It can also be used by company CEOs to see the benefit of joining science parks to make their company goals achievable, as well as making researcher's dream getting the benefit of applied research.

**Keywords:** *Distribution of Knowledge Management (KM), effective KM, useful KM, Sharing KM, ICT, Science park, and Techno Valley.*

## 1. Introduction

Researchers at universities, industries and research centers would try to come up with innovative ideas that improve our lifestyle and add value to science and humanities. Their efforts in creating information supported by new ideas would be useless unless they have been transferred to others, as well as taking into account the created knowledge might lead to develop new products. The way to create knowledge and transfer information or ideas into effective knowledge is called knowledge management KM. Information and Communication Technology (ICT) plays important role in the production and distribution of knowledge which is the base for creating knowledge society. On the other hand a program such us science park would assist in transferring knowledge into products which is the base for creating knowledge based economy.

The computer technology that contributed so heavily to superabundance of information started to become part of the solution for KM, in a variety of domains. By the mid-1990s, knowledge management initiatives were flourishing because of the wide spread of the Internet. The International Knowledge Management Network (IKMN), begun in Europe in 1989, went online in 1994 and was soon joined by the U.S.-based Knowledge Management Forum and other KM-related groups and publications. In 1994 the IKMN published the results of a knowledge management survey conducted among European firms, and the European Community began offering funding for KM-related projects through the ESPRIT program in 1995. Knowledge is not only about information, but rather about developing certain pattern and distribute it efficiently to selective people. In understanding of the pattern, people know new information, and what they know is knowledge. However, the real value of information and knowledge and what does it mean, is **how to manage it**.

In order to optimize the value of knowledge in an organization, experts need to know where knowledge *assets* are, and how they are being used. The value of Knowledge Management relates directly to the *effectiveness* on which the managed knowledge enables the members of the organization to deal with today's situations and effectively envision and create their future. In order to achieve an effective useful KM, the work in this paper has focused on the creation and distribution of KM using the latest ICT innovation, as well as highlighting the benefit of developing useful projects through the support of science parks that translates effective knowledge into useful products.

To create and distribute information generated by researchers as part for developing innovative ideas that might lead to build useful products, ICT can be heavily used. During the creation of new information, powerful computer system in labs and offices as well as proper application program can be used. In addition, there are many simulators related to different fields can also be used to develop new ideas as well as checking the behavior of new system before it has been developed. To make this creation successful, *high tech labs and proper application software programs* should be used. This can be done easily at science parks that provide such facilities, as well as organizing the use of existing labs available on different universities and research centers. There are other more challenging issues should be considered when it comes to distribute information among researchers and organization. These are *proper accessibility* by authorized users, *mobility*, and *strong security*.

There are many different methods can be used for good accessibility and sharing knowledge of information such as, internet, intranet, conducting seminars and conferences, offering courses at universities and colleges, supporting wired and wireless LAN, and developing projects at science parks. Wireless Local Area Network (WLAN) technology is rapidly becoming a crucial component of computer networks that widely used in the past few years [1, 2, 3, 4]. It provides mobility as well as essential network services where wire-line installation proved impractical. Users of wireless technology need to be aware of its performance in term of *coverage, throughput, accessibility and security*. The security factor is critical in wireless LAN. There are many research papers discussing how to improve the security of wireless system to an equivalent or better rate than wired LAN [5, 6, 7, 8, 9]. An evaluation of Wireless LAN performance has been undertaken according to the above identified criteria to highlight on the advantages and disadvantages of using WLAN [10]. It is clear from the results obtained from [10] that WLAN response time is more affected by network load and very little effect by the size of encryption of WEP used in WLAN. Hence, larger WEP key size should be used over WLAN for better secure network.

Securing the distribution of knowledge among group members from different organizations and research institutions become crucial to the success of building useful products. Different analysis has been conducted by researchers to secure the network used for storing information as well as sharing information. Different level of security has to be applied started from risk management, to analyze intrusion and evaluate vulnerability, to apply strong authentication mechanism and proper authorization policy, to implement proper monitoring and accounting policy, and to apply proper protection mechanisms with the help of antivirus, firewall and intrusion prevention. Example for evaluating the risk of computer network to assess its security has been described in [11]. This work related to evaluating assets in relation to vulnerability, probability of threats and failures.

There are many requirements should exist for making the transfer of knowledge easily and productive. Such as evaluating researcher's ideas to determine its innovation and usefulness to societies or humanities, the availability of fund needed for development, the availability of resources and skills needed for development, the coordination and effective management among participants, the monitoring and improving productivity, and the support from marketing team to promote the outcome products. Science parks such as Riyadh Techno Valley [12] would provide the resources, services and facilities to fulfill these requirements and eventually develop useful effective KM which is the base of creating knowledge based economy.

## **2. Effective useful Knowledge Management**

Knowledge management incorporates the ability to define and manage intellectual skills. Whereas, technology supports knowledge management activities by incorporating collaboration, and other helpful features into systems and work processes. As shown in figure 1, researchers come up with new ideas, assuming they would be useful based on their skills, knowledge, expertise, motivation and other support factors. However, to demonstrate creativity and innovation of their ideas, these ideas should be validated through implementation as well as through comparison to existing information stored in Data Base in order to prove its originality and innovation. With the help of ICT, these ideas would be proved through legitimate implementation and comparison, and documented using computer system for future accessibility. Once an *idea* is proved and documented, it becomes new *information* that can be retrieved and used by eligible people at any time. There are two types of documentation; propriety documentation that adds values to individual or group, and open shared documentation that contribute to knowledge society. The new information wouldn't be useful until it has been shared among others, which then becomes *knowledge*. This new knowledge remains ineffective if not used for developing new

products. This will create knowledge based economy that benefits everyone including researchers, companies and the nation. It is clear from figure1 how important is the use of ICT, for developing, promoting, and managing knowledge to make it very effective. Moreover, science parks such as RTV, would provide excellent services and facilities as well as right environment to use ICT for creating the best knowledge. In addition, it would assist in transferring this knowledge among researchers and professional people from industries to develop useful product, and therefore make it *useful knowledge*. This is the base for strong knowledge based economy that most leading countries are focusing on.

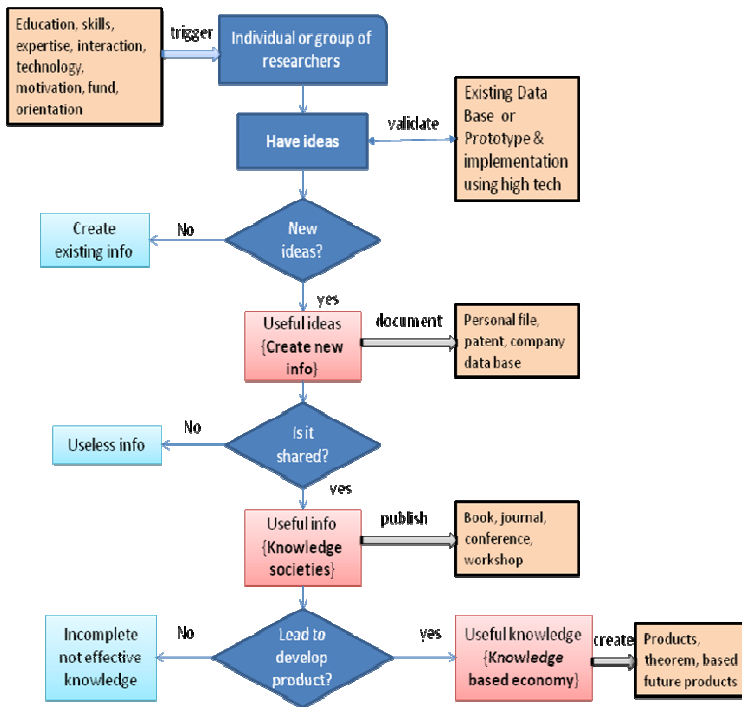


Figure 1, Phases of developing useful knowledge from ideas

To compare the outcome of individual researchers working independently Vs researchers working as part of science parks, table 1 illustrates the difference between the two. It is clear from this table how important is the support of science parks in a nation which leads to make applied research that benefits the whole nation.

Criteria of effective knowledge management	Individual effort of researchers	Effort of researchers with help of science parks
Develop new ideas	<i>Effective</i>	<i>Very effective</i>
Validate ideas	<i>Weak</i> Limited access to DB	<i>Strong</i> Easy access to DB and facilities
Develop effective information	<i>Some how</i> Lack of ICT & facilities	<i>Yes</i> Good of facilities, and use of high tech of ICT
Develop effective knowledge	<i>Not very effective</i> Lack for ICT for creating and sharing information	<i>Yes</i> Use of ICT for creating and sharing information
Develop useful knowledge {Knowledge societies}	<i>No</i> Can't transfer knowledge into products	<i>Yes</i> Easy to transfer knowledge into new products
Develop useful products {Knowledge based economy}	<i>No</i> Lack of creating products	<i>Yes</i> Create products useful to nation, companies and humanities

Table1, Comparison between individual researchers and researchers with help of science parks

### 3. Role Of ICT in KM

Technology supports knowledge management activities by incorporating collaboration, and other helpful features into effective systems and work processes. Knowledge Management deals with creating of effective information, and managing the distribution of information effectively and securely. ICT plays important roles for allowing researchers to access other information as well as assess the validity of their ideas using high tech labs and simulators, as well as assist in creating valuable research using powerful software application programs. In addition, ICT is a powerful mechanism for distributing and sharing information that is the base for creating knowledge society. Groups of people will work together more effectively when individuals are willing to share knowledge with coworkers in their group. The goal of knowledge management initiative should be to maximize the accessibility of assets and how they are used, and to minimize the risk of missed opportunities and threats. In order to have good knowledge management that can be used to develop strong effective useful knowledge, proper mechanisms should be adopted for creating and sharing information, for easy accessing information, for securing assets and information, and for monitoring and testing productivities.

- Creating and sharing of information:

New ideas would be developed in the mind of researchers. These ideas wouldn't be useful unless they can be *proved*, *documented* and *shared* among others. High technologies would allow the access of existing data base to check if the ideas are new and effective. In addition, the new idea has to be proven which requires implementation through the use of existing platform, or new platform and simulator. This would require at some stage powerful and expensive resources which is not affordable by individual. Science parks would facilitate the use of resources, existed at universities and industries, by researchers to validate their ideas. Furthermore, seminars, conferences, and workshop can be good mechanism for sharing the new ideas effectively through discussion to create knowledge societies.

- Mobility and ease of accessibility:

The ease of configuration of wireless mesh LAN, the mobility of clients, and the large coverage make it attractive choice for supporting wireless technology in local and metropolitan area networks. Enterprise managers want to deploy wireless networks with several important qualities. These include; high security, highly reliable and available WLANs with very little downtime, quick deployment, and high performance. Furthermore, the networks should have the flexibility needed to support load balance and changes in the radio environment. Improving the mobility management has been addressed in [13] based on dividing the location management into two levels, intra and inter mobility. This will reduce the amount of signaling traffic, but still didn't address the problem of reliability and availability. Supporting security, reliability and quality of services in dynamic environment has been discussed in [14] using modified routing protocol OSPF-MCDS over WLANs. In [15] securing the distributed wireless management has been addressed with reliability and high availability.

- Security:

Network security management plays a crucial role in protecting organization assets including its new developed information and its computer infrastructure. This can be done by identifying the vulnerabilities and developing effective control that reduces the risk of attacks and failures. To preserve the value of these assets, they must be protected from failure or attacks. The main factors affecting failure are possible of system failure, threats which can be related to internal and external attacks, environmental threat, and process related threats. Poor risk management of information system projects often leads to failure. Risk management plans usually have four, linked, goals (*eliminating risks*; *reducing* those that can't be eliminated to 'acceptable' levels; *to live with them*, exercising carefully the controls that keep them 'acceptable'; or *to transfer them*, by means of insurance, to some other organization). Risk analysis is the process of identifying key factors affecting the health of system operation and how it is related to profit and loss. To preserve the confidentiality of new developed knowledge and allow authorized users to access it, a proper solution should consider a proper *authorization* mechanism for creating and storing information, a proper *authentication* mechanism for accessing shared information, a proper mechanism for *monitoring* and *auditing* access of information, a proper mechanism for *protecting* information and assets from attacks and failures.

- Monitoring and test of productivity:

A proper KM should deal with monitoring the distribution of information to detect if it has been accessed by illegal people, so further strong action can be considered. In addition to monitoring the access of information, monitoring should also cover the storage of information, the physical access to servers, the system process behavior, and the distribution of information. To measure the quality of new products, testing productivity should also be done at different stage. ICT and high tech instruments can be used for this purpose.

#### 4. Role of Science Parks in KM

Science parks have been supported in many countries to foster collaboration between researchers and industries that leads to better innovation and developing new products through applied research. This will make KM more effective and useful to nation and humanities. Moreover, it boosts the national economy through possible profit obtained from tenant's investment as well supporting a sustainable knowledge based economy.

The following *criteria* can be used as guideline to make an *effective KM* based on successful science parks:

1. **Strategic location** and the support of ideal location that provides hub for creating innovation.
2. **Strategic** well defined focused **goals**. Focusing on the future to continuously broaden human capital, learning, communication networks, and future goals or plans.
3. **Proper process** for **measuring objectives** to meet the defined goals and measuring productivities.
4. **Government support** to promote innovation.
5. Use of **ICT and high technology** for better productivities and efficiencies.
6. **Exploit existing national resources** including raw materials, as well as utilize researcher skills.
7. **Collaboration** with **famous research centers** and **leading universities**
8. **Support of startup companies as well as leading companies**. Support and encourage applied research that leads to knowledge based economy.
9. Provide **incentive plan** to attract tenants.
10. Provide **excellent services and good facilities**.
11. **Support active coordination** between researchers and industries. Maintain knowledge and facilitate communication would add more creativity and better knowledge.
12. Have **well defined investment program for evaluating tenants** and its productivities, for **managing fund** and grants, and for **evaluating research proposals**.
13. Have well defined **marketing plan** with good public relation program. Allow companies to have their marketing offices within the park.
14. Have well defined **education programs** to benefit from the developed projects and create knowledge societies. Encourage knowledge sharing, conduct seminars and conference session.
15. Support **new useful projects** that benefits societies and meet the nation and international needs.
16. Ability to **create new job opportunities**.
17. Provide **high competency** and good award program.
18. Create an **ecosystem environment** that has all means and facilities
19. Provide **incubation** for startup companies, and individual innovators
20. Provide opportunities and good environment for **entrepreneurs**

#### 5. Performance Evaluation of science parks in relation to effective KM

There are many examples of developed science parks in the world that have common success stories in building and supporting different technologies. They have met the predefined goals for science parks in fostering interaction between industries and universities [16], in boosting the economy [17, 20], in attracting big name factories and research institutions [18, 19], in providing ideal place for work and living [20], and in supporting incubators labs at low cost space that can be useful for short period projects [20].

On the other hand incubators and pop up labs like Kibu, and boutique labs like Snowpolis in Finland [21] start emerging as alternative solution to science parks for small startup companies, where small space would be provided for these companies as well as supporting collaboration and focusing on specialized technology. VT Knowledge works [22] is on the list of 10 incubators in the US. It is an enhancement program that is open to entrepreneurs. Moreover, there are mobile incubators that may shift lab facilities from place to place as companies develop. Universities science parks cannot remain islands, they need to develop alliance or links to other clusters of creativities beyond their campus to become part of greater research clouds.

*Role of RTV in building Knowledge based Economy of Kingdom of Saudi Arabia* is an example of a science park. King Saud University has initiated the Riyadh Techno Valley (RTV) project to attract local and global investment in the field of ICT, chemical, and energy. The RTV project will coordinate the research activities conducted at the universities and industries to make applied research beneficial to the economy of the country. This will enable the existing economic institutions to utilize available resources and to generate or transfer advanced technology, thus helping to achieve a knowledge-based economy in the Kingdom. Table 2 illustrates the plan of RTV based on the desired criteria set for science parks as described in previous section 4, as well as highlighting the achievements of RTV up to date. RTV achievement percentage for each of the desired criteria has been estimated based on the achievements obtained from RTV web site [12] and according to plan.

<b>Desirable goals for effective KM in RTV research program</b>	<b>KSU RTV plan</b>	<b>RTV achievements</b>	<b>RTV achievement percentage</b>
1. Strategic location	To build science park in Riyadh KSU that has strategic location in the kingdom, middle east and the world	Development has been started at KSU, the heart of Riyadh that is located at the centre of Meddle east.	100%
2. Strategic focused goals	To support 3 core technologies: - ICT - Chemical & biotech - Power	KSU has large number of faculties and researchers who are working in ICT, chemical, bio technology, nano technology, and power system. These selected domains are important to Kingdom of Saudi Arabia.	100%
3. Objective measurement and well defined process	Meetings and reports have been used for measuring RTV objective. <i>Better process should be considered for effective measurement and results.</i>	Currently meetings have been conducted to evaluate and measure the planned objectives. Quantitative matrices associated with each objective should be documented regularly.	40%
4. Government support	The project has full support by the kingdom of Saudi Arabia	Budget has been allocated by government for RTV, and RTV departments have developed yearly budget and plan to execute and allocate the budget to different tasks and projects.	90%
5. Support of high tech	- Support high tech labs in RTV - Utilize existing KSU labs	- New RTV labs would be built to support different tenant's project. - Coordination is undergoing between RTV colleges and KSU to use their labs	0% 10%
6. Strong resources	- KSA has rich mineral fields, and chemical resources - KSU has large number of faculties doing research in many fields including the three core technologies identified in item 2. - KSU has good attracting talent program	- KSA is among the richest countries in the world for its mineral and chemical resources. - KSU has around 4500 faculties/researchers are working in many fields including ICT, energy, biotechnology, and chemical. - KSU has many high tech labs in the important fields listed above. - KSU has attracted large number of researchers/skilled instructors to join RTV and KSU as part for Attracting Unit for Distinguished Researchers and Instructors. In addition KSU has signed contract with 14 scientists who have Nobel prize. [23]	100% 100% 100% 100% 80%
7. Collaboration with leading universities and research centers	RTV has a goal of liaising and collaboration with leading national and international universities and institutions	- RTV has started the communication with leading universities to join RTV projects. It established good relation with 12 reputed institutions around the world - RTV has made agreement with local research institution at KSA to play important role in RTV	10% 70%
8. Attracting companies	The main goal of RTV is attracting big companies, as well as small startup companies.	- 14 of big companies have signed agreement with RTV. This number is expected to double by mid 2010. - Communication has started with startup companies to join RTV.	60% 10%
9. Incentive program	Little incentive program is currently supported. This should be improved through discount in services fee.	Free tax is already supported at RTV. More incentive program would be considered.	10%
10. Excellent Services and facilities	One of the goal is to build accommodations, offices, restaurants, hotels, and other facilities	There is plan to support excellent services and facilities which can be measured after completing the construction.	20%

11. Research coordination	To have team responsible for coordinating the activities between industries and researchers from universities	<ul style="list-style-type: none"> <li>- Initiative for creating Research groups covering area of ICT, renewable energy, chemistry and biotech has been started. Web site will be developed and invitation will be sent to researchers for participation. Then meeting will follow up</li> <li>- Coordinate workshop in the area of Energy. More workshop will be supported</li> </ul>	20%  60%
12. Well defined investment program	<ul style="list-style-type: none"> <li>- Evaluating tenant proposal for joining RTV and for developing projects. A guideline template for joining RTV will be developed.</li> <li>- Managing grants</li> </ul>	<ul style="list-style-type: none"> <li>- Evaluation form has been developed and 30 companies have already signed agreement with RTV. The evaluation process would be improved internally through the research department involvement and consultation assistance.</li> <li>- To develop Plan for managing grants.</li> </ul>	50%  0%
13. Marketing program	To use electronic media, news paper, tv program, internet, and research events	<ul style="list-style-type: none"> <li>- Brochure has been created, and requires improvement</li> <li>- Started developing presentation CD</li> <li>- Social network using Linked, facebook, and internet has been started.</li> </ul>	80% 20% 40%
14. Support good education program	<ul style="list-style-type: none"> <li>- To conduct training courses, seminars, conference.</li> <li>- To encourage publication</li> </ul>	<ul style="list-style-type: none"> <li>- There is plan to support host 2 conferences per year, and conduct few seminars.</li> <li>- Short courses for training RTV staff would be supported</li> <li>- In addition to support short courses for tenant and KSU students.</li> <li>- Budget has been allocated to attend and present articles in conferences and journals</li> </ul>	10%  10%  10%  10%
15. Sponsor project	To sponsor or find sponsors for building projects beneficial for societies and nation	Plan has been developed to start the initiative to manage and build project by RTV, and budget has been allocated for future projects.	10%
16. New job opportunities	<ul style="list-style-type: none"> <li>- To create new job opportunities for expertise/specialist to work at RTV</li> <li>- To prepare students at KSU to build skills</li> </ul>	<ul style="list-style-type: none"> <li>- Around 30 skilled people had joined RTV program. This number is expected to increase to 100 by mid of 2010, and to rise to 3000 skilled people in the future.</li> <li>- A program has been developed to support KSU student through attending conferences, seminars, workshop, internship, and job seeking opportunities.</li> </ul>	60%  10%
17. Competencies and award program	There is a clear understanding for the need for award which is supported through budget. <i>A clear plan should be developed for this purpose.</i>	Budget Plan has been considered to support award program and competencies among tenants. Plan should be developed to specify the exact award and competencies events.	10%
18. Ecosystem environment	There is a plan to provide all means and facilities, which would make RTV an attractive science park to live, play and work	Development of offices, accommodations has started. Hotels, restaurants and other facilities will be developed in the future.	20%
19. Incubation centre	Incubating new startup companies and individual innovators is one of the goal of RTV.	Currently there is incubation center supported by KSU, which might join RTV program. Other incubation centers would be developed in RTV.	30%
20. Opportunities for <i>entrepreneurs</i>	Entrepreneurs would be accommodated in RTV center, and would play important role in transferring knowledge	Entrepreneurs would be encouraged to join RTV and involve in future projects. Once projects have started in the new centers, entrepreneurs would contribute to the success of these projects	0%

Table 2, RTV performance status according to desired criteria of science parks

## 6. CONCLUSION

A new methodology for defining an effective useful knowledge management has been described in this paper. It focuses on the different phases of creating, distributing, and making a useful knowledge. The important role of ICT in creating knowledge, and effectively distribute it, as well as managing it through technologies has been described. In addition, the role of science parks in making knowledge management useful, which leads to developing useful product and builds knowledge based economy, has also been covered. Evaluating the performance of RTV based on a set of predefined goals that are aligned to successful science parks has been analyzed and illustrated. It is clear from the analysis that science parks have a strong positive effect on building knowledge based economy through increasing the employment opportunities, making applied research, providing ideal environment for researchers and investors for better outcome, and establishing a strong relationship between industries and researchers working at universities and research centers. RTV has currently been developed, and based on its progress; it will have a promising successful future that will benefit all parties including the whole nation of the kingdom of Saudi Arabia.

### Acknowledgment:

I would like to pass my tribute and special thanks to Dr Khalid Alkharfy, who is the head of research group at RTV, for his valuable information and his contribution toward the completion of this paper.

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