Secured Knowledge Sharing and Creation Using RBAC Model for e-Village

Wendi Usino, Teddy Mantoro, Media A. Ayu, Nazir Harjanto

Abstract—This paper introduces a Role Based Access Control (RBAC) model for e-Village in creating and sharing knowledge in a secure way. This includes secure information about marketing to help the products become an innovation and highly valuable. As a case study, the Pasir Region, East Kalimantan, has the 100 families who moved were originally from Jepara in order to enhance their living standard, as encouraged by the Indonesian Government. Jepara is a very famous area of craft products and carving furniture. The problem is that they have to change their livelihood from a crafter to a farmer and lack the necessary original skills. It also discusses and analyses the secure knowledge sharing and knowledge creating using e-village, not only for supporting the market development but also preserving the village culture more, especially in crafting and carving furniture. This study shows that the RBAC of e-village contributes significantly to the quality of knowledge for people in a remote area such as the Pasir Region village.

Keywords— RBAC, Knowledge Management, secured knowledge sharing, e-village development.

I. INTRODUCTION

THE Indonesian Government encouraged people from Java to migrate to other islands in order to enhance their living standard from 1980 to early 1998. This government program was called "transmigrasi". This was coordinated by the former Department of Transmigration.

In our previous study in 1996 to Pasir Region, East Kalimantan , we found that there is one area in this region that originally came from Jepara, Central Java [1]. These people are famous for their crafting and carvings of furniture. Their carvings are famous not only locally but also internationally. Total Indonesian carving furniture exports to Europe each year reach about 20 billion Euros per year. Since the European Society considers furniture products as a primary requirement [2]. The export value of craft and carving furniture in the year 2008 reached US$2, 65 million (BPS, 2009). It means also that their knowledge should become innovation product.

The innovation should direct to meets the three elements, which are: first, current, which is offering something that other people have not been able to make it. Second, complex, technology been used is very complex in order that the competitor cannot imitate it, which will inhibit competitors. Third, it has a strong design, which means that the resulting product has a long useful life that will lower the price [2].

Knowledge, innovation and creativity are keys to success with globalization of the Knowledge Economy in the new millennium.

The problem they face is that there are no markets in the village and they have to go one hour by truck to the nearest market. During our study in 1996, we had conducted a meeting in the office of Regional Division of Transmigration in the Pasir Region, Tanah Grogot, which urgently discussed the marketing of their products. After the Government realized this market is urgently needed, they built the market and macadam road. The young village people who came from Jepara wrote several small books as manuals to make carving furniture. The young people shared or transferred their knowledge of making crafts and carving furniture to other people in this village, who came from other regions. They realized that carving furniture has a higher pay than selling vegetables. Unfortunately, they were developing knowledge sharing in growing the vegetable instead of carving and later become knowledge culture in the village.

The fundamental question is how ICT affects the motivation for knowledge sharing. There are three sets of factors that should be distinguished upon which ICT influences knowledge sharing. First, individuals may differ in their appreciation of ICT as well as in which motivators will affect them. Second, a broad class of variables is discerned related to the context in which knowledge sharing is to occur. These variables include the proneness to knowledge sharing in the organization, or it describes as the "culture of knowledge transfer". Third, it is acknowledged that knowledge sharing is not a separate process that exists fully in its own right. Depending on the reasons why knowledge is shared, the process of knowledge sharing may take on a different form. In this rural example, there are certain people with knowledge, such as people from Jepara. They have that knowledge and want to share their knowledge with other people who came from other areas or regions. Consider why the people who came from Jepara wanted to share their knowledge, as they have to produce a mass production to become a valuable famous products and innovation products.

By producing these innovative products, such as carving furniture, their living standard will potentially be enhanced. It

Wendi Usino and Nazir Harjanto are with the Faculty of Information Technology, University of Budi Luhur, Jakarta, Indonesia (e-mail: {wendi.usino,nazir.harjanto}@budiluhur.ac.id).

Teddy Mantoro is with the Advanced Informatics School, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia (email:teddy@ic.utm.my).

Media A. Ayu is with the Integ Lab, KICT, International Islamic University Malaysia, Kuala Lumpur, Malaysia (e-mail: media@iium.edu.my).

turns out that the price rises continuously. By routinely sharing their knowledge and conducting discussions about village problems, the people realized that routine meetings are important. This village program perceived to realize soon in supporting the Government program in e-village, which announced in 2010.

This knowledge included in skill knowledge, which means knowing how to do something of value to the village, and it should manage through job descriptions, training programs, performance evaluations, and other means.

II. THE METHODOLOGY OF SECURED KNOWLEDGE SHARING AND CREATION IN THIS REMOTE AREA

Knowledge, like information, are worthless if not applied in decisions on necessary actions in the context of economic activity [3]. A single piece of data has no meaning unless the context is considered. Knowledge is an important resource for successful decision-making process in the whole society.

Knowledge is a product of successful decision-making process and knowledge modeling and knowledge representation is an important research field. The development of knowledge-based systems was seen as a process of transferring human knowledge to an implemented knowledge based [4].

Knowledge management is becoming one of key success factors for organization in global economic environment. Knowledge management is a process that support and facilitates knowledge creation, access, modification and reuse [5]. Knowledge management is about organizational learning and about organizational thinking [6]. Except, of course, organizations do not ever really learn or think – only the people who work for them can do that. Why is knowledge sharing important? Since by sharing knowledge can they hope to develop their capabilities and be able to obtain new knowledge and eventually create valuable products from this new knowledge? Knowledge management, especially knowledge sharing, is not simply the arguments about the latest hardware, software, or groupware offering, but it is about the people thinking and learning. It is about what they spent on information technology to get the new knowledge that they can use it to enhance their new knowledge. Information and Communication Technology (ICT) could enhance knowledge sharing by lowering temporal and spatial barriers between knowledge workers, and improving access to information about knowledge [7]. Since knowledge sharing is related to communication, it means that there is a discussion between that entire village people in that area. It also means during the discussion, people will share their knowledge to other people without decreasing or losing their knowledge, but instead they will enhance their knowledge or get a new knowledge from others. It is also an act of externalization. Knowledge sharing is needed as an act of reconstruction. Knowledge sharing is performed by at least two people, one is the knowledge holder, and the other is the knowledge seeker.

Knowledge sharing is identified as a major focus area for knowledge management [7]. The relevance of this theme particularly derives from the fact that it provides a link between the levels of the individual knowledge workers, where knowledge resides, and the level of the organization (or the rural area of my research), where knowledge attains its (economic, competitive) value. In the [8], it shows how Tanaka created knowledge in a 2x2 matrix. In each quadrant, knowledge is either tacit or explicit. There are also four modes of transfer from quadrant to quadrant, which are: socialization, externalization, combination, and internalization. This transfer from quadrant to quadrant in this village, shown in Figure 1.

Fig. 1. The transfer from quadrant to quadrant

The taxonomy of the knowledge sharing can be mapped into knowledge map which can be arranged as a hierarchical tree [9].

To link ICT to the motivation for knowledge sharing [4], which presents a model that may help understand the additional factors to be considered and we consider to combine it in term of the role relations involved using RBAC.

The more fundamental question is to assess how ICT affects the motivation for knowledge sharing. This focus also takes the interest in knowledge-sharing technologies beyond their empowerment function. It leads to the recognition of questions concerning how using ICT may stimulate or perhaps even frustrate the will to share knowledge.

The village in East Kalimantan, Grogot Region (where our study conducted) shows that the village people still have the courage to share their knowledge on carving furniture. Since they know that, this carving furniture is a valuable product not only in Indonesia but also internationally. Therefore, when the village people group heard that the government would soon build the market and the macadam road, the young people conducted a meeting to set a program for asking all village people to share their experience in making off-farm products, included crafted furniture, and other crafts or carving furniture. Two people who came from Jepara were making living room furniture, which are two chairs, one sofa chair, and one table. They transfer this knowledge to other people in this village.

Then they built a small workshop, not only for knowledge sharing but also for building a training place for making this carving furniture and other crafts. It shows that other people, who came from Jepara were making carving furniture and transfer it to other people, who were not from Jepara.

Nevertheless, there are still problems that exist in this transfer, where they still need the information about the price of exporting or the price of the furniture products in other cities, which they formerly bought from Java. Therefore, we suggested to the Local/Region Government that they should build a social network. A social network, information on resources, relation/network and behaviors spread within networks [8]. Continuous dissemination of this information produces information on position, practice, and reputation of this village. Finally, this village can be a place for learning. Knowledge flow, which will occur in a socio-technology network, will become a basis of innovation.

Therefore, we suggested to the head of the Region and village to build an e-village, in Local and Region Governments. In 2010, the Ministry of Information and Communication Technology announced that they will build an e-village in each village in Indonesia and they will build a prototype of an e-village in Bali and Jawa. E-village means that they will equip a village with electronic devices, which make information needs available in the village, and the village people can access data & information from every national or regional agency and institution. Villages should have professional staffs equipped with the talent and IT kiosks to tackle all aspects including agriculture, economic and business. These in-house engineers and technicians designed a custom system to meet the specialized requirements for the village people. Whether the project is for village developments or commercial buildings, but it is useful for informing the village people about whatever information service needed by them and they could be accessed easily.
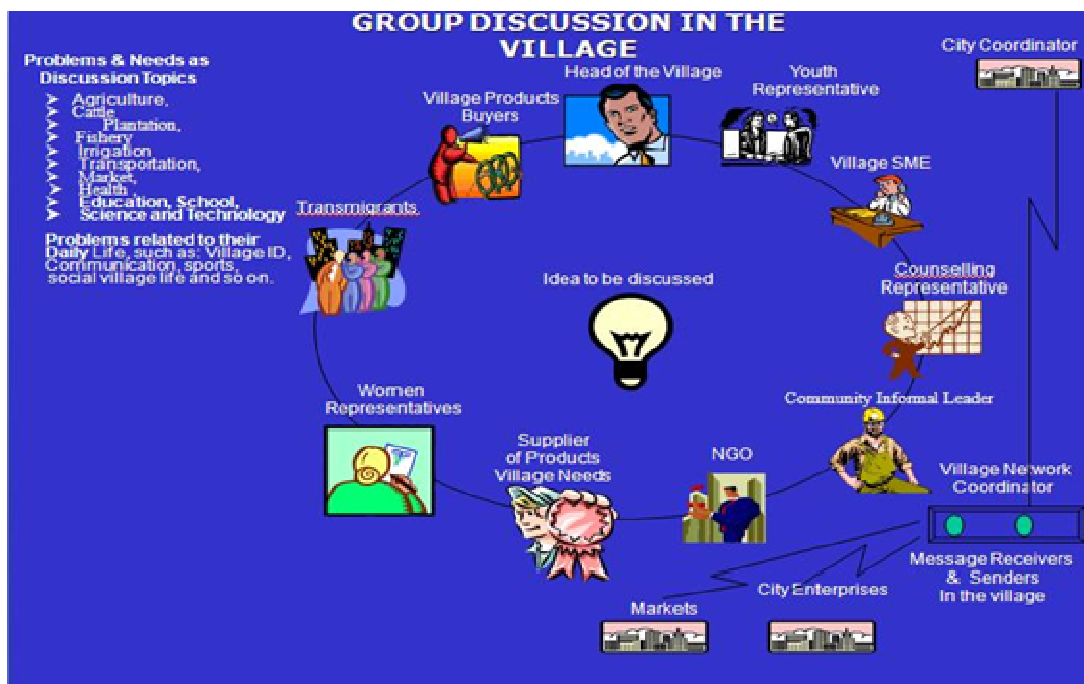

Fig. 2. Meeting group based on role of each knowledge seeker in a remote village.

We suggested to the Head of the village that they create a regular meeting with all groups of the village people, shown in Figure 2. They also share experiences or knowledge that they have. If the e-village is constructed, then the data and information as a result of the meeting will be stored in the village database. This meeting should be conducted regularly and become a village culture. Figure 2, above shows the regular village meeting. The idea of knowledge development in remote areas is that we have to grab their knowledge in this context which means, the accumulation of experiences, values, contextual information, intuitions and comments of several experts [2]. Nonaka and Hirotaka suggested to simulate a knowledge flow from tacit knowledge [6],[9].

Tacit knowledge creator should be transferred to tacit knowledge seeker by using discussions. If they simulate it through internalization or write the discussion, this tacit knowledge will become explicit knowledge. This explicit knowledge when added by other people's explicit knowledge or other written experiences becomes a combination of knowledge. From this combination of explicit knowledge, the seeker then simulates through externalization by reading this culminated knowledge in order to understand the sense of knowledge. In addition, this explicit knowledge will be stored in the village library and village database, if they have already

built it. If the knowledge seeker wants or needs it, they can find or read from this explicit knowledge in the village library or database. This knowledge cycle should become a culture in this village and it helps the village create valuable products.

Carving furniture is knowledge they can either receive from Jepara, or they can create it anew. Then, this creating of knowledge will become a decision for the village to produce this product based on their new knowledge or not. If they built an e-village, then they will connect with other villages or other institutions or agencies in the cities or Departments/

Ministries/National Agencies in the Central Government. This is the method by which the remote areas will get more information and knowledge. The decision making on producing the local products based on their local knowledge becomes an asset of the village, since from this synergized work of the people and creativity and also motivation of having higher living standard, they will produce innovation and will enhance their public service and it will be appreciated by the village people and the Government. Figure 3 shows the development of knowledge in remote village.
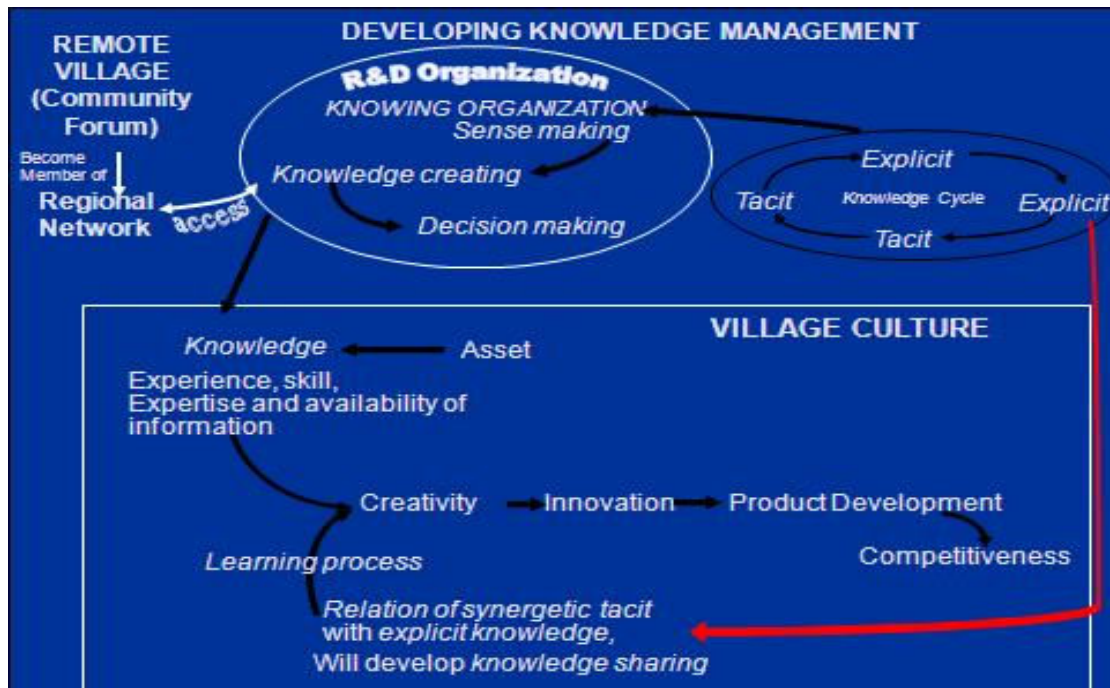

Fig. 3. The development of knowledge sharing in remote village.

In order to put the village in a regional or even national network, the Regional Government should also develop a Regional Network composed of the Regional Division, Local SMEs, Regional NGO, and National Universities, High Schools, and there must also be the Head of every village in this region as a member. Moreover, according [10] the Local Government also builds Knowledge by using the Knowledge Cycles of Hirotaka and Nonaka.

This regional network should also connect it to all Local Institutions, and National Institutions, such as Research Institutes, Ministries Information, and Central Agencies, such as National Agency for Planning and Development, as shown in Figure 4.

Figure 5 shows the Regional Network which connect nationally. If the network of the village connects using the internet, then it should be built with an internet infrastructure. By internet, they will easily access any data and information from every connected village, city, and institution in Indonesia. This internet provides the common base knowledge

that allows data exchange across all platforms.The number of independent platforms, even in incomplete platforms, has not decreased even as the Desktop-computing Environment has standardized itself in Windows.

III. THE IMPACT OF KNOWLEDGE EXPLORATION ON VILLAGE PEOPLE STANDARD OF LIFE.

This innovation will be successful, if the information needed is available, and if there is the ability or capability of the village people to produce new commercialized products, heart ware (means desire to realize the production of the product) and commitment of the village people. However, the price of carving furniture is available in the Jepara's statistic only in the year of 2008, which is about Rp. 10,000,000 (ten million rupiah). Since, in 1997, Indonesia had an economic crisis and it was very difficult to get the standardized price of furniture for 1996 and 1997.

However, there was still a continuing benefit from manufacturing furniture and they do not deforest the jungle,

since they plant teak trees for making furniture. The important thing is that they do not lose knowledge of furniture manufacturing.

All these efforts mentioned above were used to grab the knowledge from Jepara through the village peoples'

knowledge, and share their knowledge to others in the village. This knowledge will become an asset to the village or people in this remote area, then, it will enhance their living standard. The knowledge introduced in this remote village will become a culture for innovation and will enhance their living standard.
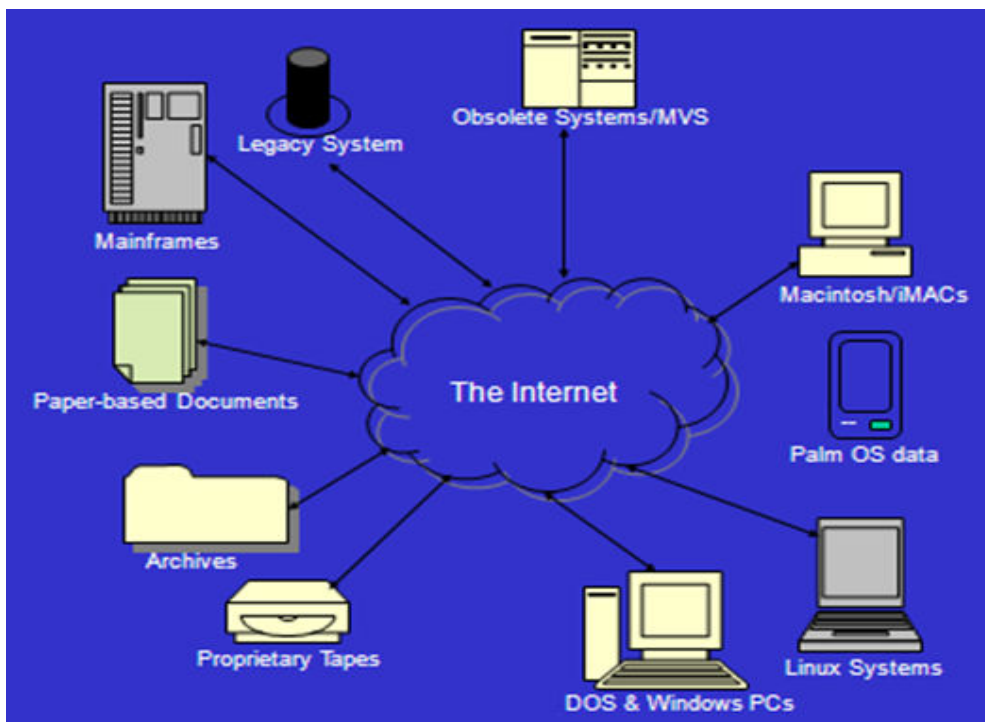

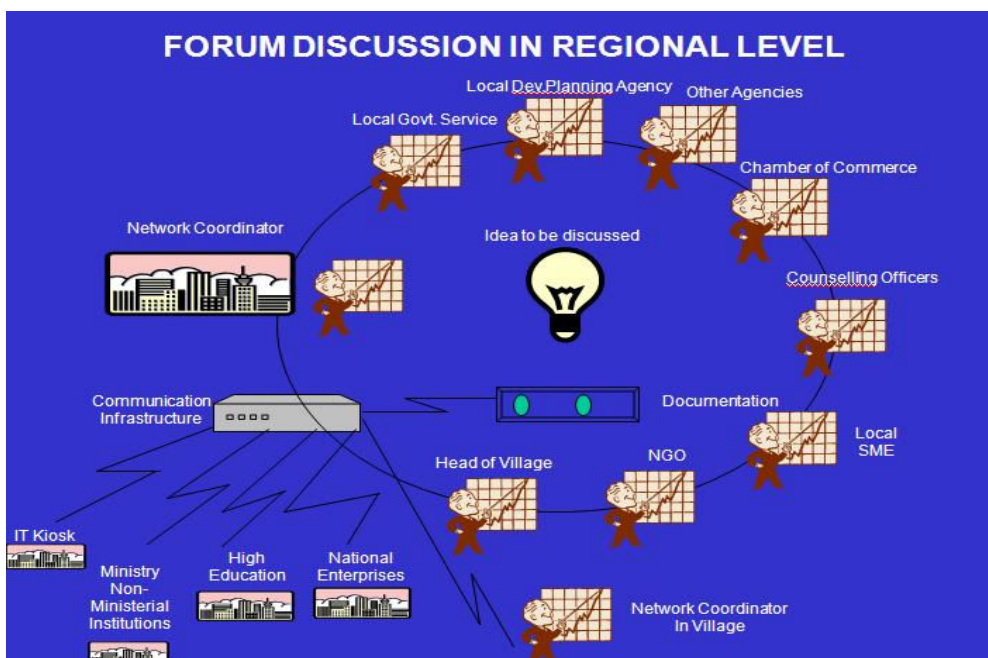Fig. 4. Discussion forum as a knowledge cycles in the Region (Kabupaten)

Fig. 5. Network Connecting Internet

IV. RBAC Model and Implementation in e-Village.

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). **This applies to papers in data storage.** For example, write "15 Gb/cm^2 (100 Gb/in^2)." An exception is when English units are used as identifiers in trade, such as "3½ in disk drive." Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength H is A/m. However, if you wish to use units of T, either refer to magnetic flux density B or magnetic field strength symbolized as $\mu_0 H$. Use the center dot to separate compound units, e.g., "A·m^2."

Role-based access control (RBAC) is a method of regulating access to a computer or network resource based on the roles of individual users within an enterprise. In this context, access is the ability of an individual user to perform a specific task, such as view, create, or modify a file. Roles are defined according to job competency, authority, and responsibility within the enterprise [11].

RBAC appears to be a promising method for controlling what information computer users can utilize the programs that they can run, and the modifications that they can make. Role based security has been used in a variety of forms for computer system security for at least 20 years, and several proposals for incorporating roles into exist¬ing access control mechanisms have been published   [12], [13], [14]. More recently, formal definitions for general- purpose RBAC notions have been proposed [15], [16]. When properly implemented, RBAC enables users to carry out a wide range of authorized tasks by dynamically regulating their actions according to flexible functions, relationships, and constraints.

This is in contrast to conventional methods of access control, which grant or revoke user access on a rigid, object-by-object basis. In RBAC, roles can be created, changed, or discontinued as the needs of the enterprise evolve, without having to individually update the privileges for every user.

The following conventions are used in defining an RBAC model in relation to the knowledge sharing in Pasir Region:

- S = Subject = A person or automated agent, consisting of {Head of Village|Buyer|Supplier|Informal Leader|Transmigrant|Counselling Officer|... }
- R = Role = Job function or title which defines an authority level, consisting of P = Permissions = An approval of a mode of access to a resource, consists of
- P = Permissions = An approval of a mode of access to a resource, consists of {Access granted|Access Denied}
- O = Operation = specific functions to Objects consist of {Scan|Read|Write|Erase|Create|Modify|Access Control|Supervisor|...}
- O = Object = Data/Resources that Subject trying to access, consists of {Product Design|Tools &

Methodology|Supplier|Buyer|Product Availability|Crafter|...}
- SE = Session = A mapping involving S, R and/or P
- SA = Subject Assignment
- PA = Permission Assignment
- RH = Partially ordered Role Hierarchy. RH can also be written: ≥ (The notation: x ≥ y means that x inherits the permissions of y.)

Recently, considerable attention has been paid to researching the security needs of commercial and civilian organizations, which are concerned with protecting the confidentiality of information. This includes the protection of personnel data, marketing plans, product announcements, formulas, manufacturing and development techniques [11].

Implementation of RBAC in the e-Village at Pasir Region is based on the Sadhu et al. model [17] and Osborn et al. [18] as shown in Figure 7.
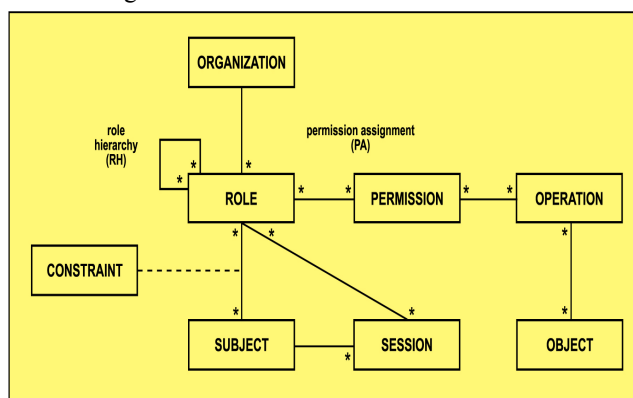

Fig. 7. The RBAC Model for e-Village adapted from Ravi S. Shandu et al. [17] and Osborn et al. [18].

A. Administering RBAC

In this section, we discuss the Discretionary access control (DAC) policies that will be considered in administering the RBAC. DAC has been used extensively in commer¬cial applications, particularly in operating systems and relational database systems. Due to the tradition and culture in Pasir Region Vilage, implementing DAC is more suitable than Mandatory Access Control (MAC). The central idea of DAC is that the owner of an object, who is usually its creator, has discretionary authority over who else can access that object The central idea of DAC is that the owner of an object, who is usually its creator, has discretionary authority over who else can access that object. In other words the core DAC policy is owner-based administra¬tion of access rights. There are many variations of DAC policy, particularly concerning how the owner's discretionary power can be delegated to other users and how access is revoked. This has been recognized since the earliest formulations of DAC [19],[20].

Our approach here is to identify major variations of DAC and demon¬strate their construction in RBAC. The constructions are such that it will be obvious how they can be extended to handle other related DAC varia¬tions. This is an

intuitive, but well-founded, justification for the claim that DAC can be simulated in RBAC.

The DAC policies we consider all share the following characteristics.

- The creator of an object becomes its owner.
- There is only one owner of an object. In some cases ownership remains fixed with the original creator, whereas in other cases it can be trans¬ferred to another user. (This assumption is not critical to our construc¬tions. It will be obvious how multiple owners could be handled.)
- Destruction of an object can only be done by its owner.

With this in mind, we now define the following variations of DAC with respect to granting of access.

(1) **Strict DAC** requires that the owner is the only one who has discretion¬ary authority to grant access to an object and that ownership cannot be transferred. For example in Pasir Region Village, suppose Head of Village (HoV) has created an object (HoV is owner of the object) and grants read access to Councelling Officer (CO). Strict DAC requires that CO cannot propagate access to the object to another user. (Of course, CO can copy the contents of HoV's object into an object that he owns, and then propagate access to the copy. This is why DAC is unable to enforce information flow controls, particularly with respect to Trojan Horses.)

(2) **Liberal DAC** allows the owner to delegate discretionary authority for granting access to an object to other users. We define the following variations of liberal DAC.

- (a) One Level Grant: The owner can delegate grant authority to other users but they cannot further delegate this power. So HoV being the owner of object O can grant access to CO who can grant access to Supplier. But CO cannot grant Supplier the power to further grant access to Buyer.
- (b) Two Level Grant: In addition to a one-level grant the owner can allow some users to further delegate grant authority to other users. Thus, HoV can now authorize CO for two-level grants, so CO can grant access to Supplier, with the power to further grant access to Buyer. However, CO cannot grant the two-level grant authority to Supplier. (We could consider n-level grant but it will be obvious how to do this from the two level construction.)
- (c) Multilevel Grant: In this case the power to delegate the power to grant implies that this authority can itself be delegated. Thus HoV can authorize CO, who can further authorize Supplier, who can further authorize Buyer, and so on indefinitely.

(3) **DAC with Change of Ownership**: This variation allows a user to transfer ownership of an object to another user. It can be combined with strict or liberal DAC in all the above variations.

For revocation, we consider two cases as follows.

(1) **Grant-Independent Revocation**: Revocation is independent of the granter. Thus CO may be granted access by HoV but have it revoked by Supplier.

(2) **Grant-Dependent Revocation**: Revocation is strongly tied to the granter. Thus if CO receives access from HoV, access can only be revoked by HoV.

In our constructions, we will initially assume grant-independent revocation and then consider how to simulate grant-dependent revocation. In general, we will also assume that anyone with authority to grant also has authority to revoke. This coupling often occurs in practice. Where appropriate, we can decouple these in our simulations because, as we will see, they are represented by different permissions.

These DAC policies certainly do not exhaust all possibilities. Rather these are representative policies whose simulation will indicate how other variations can also be handled.

B. Configuring RBAC For DAC

To specify the above variations in RBAC it suffices to consider DAC with one operation, which we choose to be the read operation. Similar construc¬tions for other operations such as write, execute and append, are easily possible. Before considering specific DAC variations, we first describe common aspects of our constructions.

(1) Common Aspects

The basic idea in our constructions is to simulate the owner-centric policies of DAC using roles that are associated with each object.

(a) Create an Object. For every object O that is created in the system we require the simultaneous creation of three administrative roles and one regular role in Figure 8.

—Three administrative roles in AR: OWN_O, PARENT_O and PARENT-withGRANT_O

—One regular role in R: READ_O

(b) Role OWN_O has privileges to add and remove users from the role PARENTwithGRANT_O which in turn has privileges to add and remove users from the role PARENT_O The relationship between these roles is shown in Figure 8. The administrative roles are shown with darker circles than regular roles. The dashed right arrows indicate that the role on the left contains the administrative permissions governing the role on the right. Figure 8(b) shows the administrative role hierarchy, with the senior role above its immediate junior, connected by an edge. For instance role OWN_O has administrative authority over roles PARENT¬withGRANT_O as indicated in Figure 8(a). In addition due to the inherit¬ance via the role hierarchy of Figure 8(b) OWN_O also has administrative authority over PARENT_O and READ_O.

OWN_O   PARENTwGRANT_O PARENT_O   READ_O
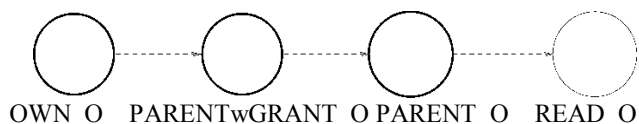
(a)
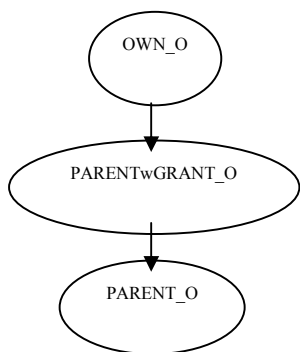
(b)

Fig. 8. (a) Administration of roles associated with an object;
(b) Administrative role hierarchy.

In addition, we require simultaneous creation of the following eight permissions along with creation of each object O.

canRead_O: authorizes the read operation on object O. It is assigned to the role READ_O.

—destroyObject_O: authorizes deletion of the object. It is assigned to the role OWN _O.

—addReadUser_O, deleteReadUser_O: respectively authorize the opera¬tions to add users to the role READ_O and remove them from this role. They are assigned to the role PARENT_O.

—addParent_O, deleteParent_O: respectively authorize the operations to add users to the role PARENT_O and remove them from this role. They are assigned to the role PARENTwithGRANT_O.

—addParentWithGrant_O, deleteParentWithGrant_O: respectively autho¬rize the operations to add users to the role PARENT_O and remove them from this role. They are assigned to the role OWN_O.

These permissions are assigned to the indicated roles when the object is created and thereafter they cannot be removed from these roles or assigned to other roles.

(b) Destroy an Object. Destroying an object O requires deletion of the four roles namely OWN_O, PARENT_O, PARENTwithGRANT_O and READ_O and the eight permissions (in addition to destroying the object itself). This can be done only by

the owner, by virtue of exercising the destroyObject_O permission.

(2) Strict DAC

According to Osborn et.al, (2000) in strict DAC, only the owner can grant/revoke read access to/from other users. The creator is the owner of the object. By virtue of membership (via seniority) in PARENT_O and PARENTwithGRANT_O, the owner can change assignments of the role READ_O. Membership of the three admin¬istrative roles cannot change, so only the owner will have this power. This policy can be enforced by imposing a cardinality constraint of 1 on OWN_O and of 0 on PARENT_O and PARENTwithGRANT_O.

This policy could be simulated using just two roles OWN_O and READ_O, and giving the addReadUser_O and deleteReadUser_O permis¬sions directly to OWN_O at creation of O. For consistency with subsequent variations we have introduced all required roles from the start.

V. CONCLUSION

It proves that the Government's program on e-village is truthful and this program will enhance the village peoples' standard of living through sharing and creating knowledge, and the availability of data & information for all people even though they are in remote areas, which in the future will result in innovative products and services even in remote areas. Therefore, this village should develop e-learning as a village cultural heritage, through knowledge sharing and creating.

This paper proposed RABC for e-Village in creating and sharing knowledge in a secure way. This includes secured information about markets to help the products become an innovation. This paper discusses and analyses secured knowledge sharing and knowledge creating using e-village, not only for supporting the market development but also preserving the village culture, especially in crafting and carving furniture.

Currently, the crafting and carving furniture are produce not only in Jepara but also in East Kalimantan, and they will supply the export to the Philippine, Korea and Japan. Even they have to send it to Jakarta before exporting the products.

Innovation that comes from this East Kalimantan village cannot be identified easily, since they make the craft and carving furniture in old traditional way. Therefore, it is very hard to be distinguished their with the products from Jepara.

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Wendi Usino was awarded a BSc from Department of Management Informatics, Faculty of Information Technology, University of Budi Luhur, Jakarta, Indonesia, 1989, MSc from Coleman College, San Diego, California, USA, 1991 and Magister Management University of Prasetya Mulya, Jakarta, Indonesia, 1997.

He is currently a senior lecturer at Faculty of Information Technology, University of Budi Luhur, Jakarta, Indonesia and pursue his PhD in Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia. His research area is in e-governance, Management Information Systems.

Teddy Mantoro, holds a BSc, an MSc and a PhD, all in Computer Science. He was awarded a BSc (Ir.) from Department of Informatics Engineering (Computer Science), Faculty of Information Technology, University of Budi Luhur, Jakarta, Indonesia, 1989. MSc from Department of Computer Science, School of Advanced Technology, Asian Institute of Technology, Bangkok, Thailand, 1994 and a PhD from Research School of Computer Science, the Australian National University (ANU), Canberra, Australia in 2006

He is currently working as an associate professor at School of Advanced Informatics, University of Technology Malaysia (UTM), Kuala Lumpur, Malaysia. His research interest is in Ubiquitous Computing, Pervasive Computing, Context Aware Computing and Intelligent Environment. He has authored more than 100 research papers, 4 academic books, several book chapters and has four patents pending to his credits in the area of pervasive/ubiquitous computing.

Media A. Ayu, received her BSc (hons) in Agroindustrial Technology from Bogor Agricultural University (IPB), Bogor, Indonesia and MSc in Industrial Engineering from School of Advanced Technology, Asian Institute of Technology, Bangkok, Thailand. She has graduated with PhD in Engineering and Information Science from School of Engineering, the Australian National University (ANU), Canberra, Australia.

She is currently working as an assistant professor in Faculty (Kulliyyah) of Information and Communication Technology (KICT), International Islamic University Malaysia (IIUM), Gombak, Kuala Lumpur. She has published more than 50 papers in international conference and journals, several book chapters and academic books. Her research interest is around the area of intelligent environment, smart applications, activity recognition and education technology.

Nazir Harjanto was awarded a BSc from Faculty of Maths and Science, University Indonesia, Jakarta, Indonesia, 1965. MA from International studies (Management of Technology) University of Denver Denver, Colorado, USA, 1982.

He is a senior lecturer at Faculty of Information Technology, University of Budi Luhur, Jakarta, Indonesia. His research area is in knowledge management and knowledge sharing.