Abstract: - Role is very crucial in our daily life. People play different roles at different places and times. Their role can change from being staffs at the office, customers at shop, and parents at home. Moreover, people’s role influences their motivation level, job satisfaction, peace of mind and security to resources or belongings. Role is vital in networked collaborative virtual environment (NCVE) as all the users are invisible. They do not see each other like in face to face situation. Thus, role representation must be clearly defined and set in order to enhance communication, coordination and cooperation which lead to the achievement of shared goals in the virtual space. This paper studies roles in five organizational structures within real world organizations. In addition, investigation of roles in various applications within virtual world is also carried out. The main focus of the study is to extract the core elements of roles with respect to their involvements and authorities. The findings show that there is no direct correlation between both parameters due to the uniqueness of such elements. We conclude that there are six generic roles available in any organization.

Keywords: - Networked Collaborative Virtual Environment (NCVE), Roles, Generic Role, Communication, Collaborative Applications, Awareness, Organizational Structure.

1 Introduction
Organization structure is a mechanism that links the relationship among roles in an organization. The purpose of such mechanism is to distribute tasks, responsibilities and authorizations to the appropriate departments as well as staffs, based on their specializations and capabilities [1, 2]. The distribution must be designed and planned so that it aligns to the core purposes of the organization within its environment [1, 3]. Such distribution is also formulated based on organization’s size, strategy, technology, environment and culture [1]. The structure of organization is very important. It can create awareness among staffs since they are clear of their roles and roles of others [4, 5]. In addition, access right to vital resources and functionalities has direct link to roles that build up the organization structure. Besides, the organization structure enables managers to plan, administer, organize and monitor the organization’s activities in order to achieve goals [6, 7]. Furthermore, a well structured organization facilitates the communication, coordination and cooperation among staffs from various levels.

People work as a group to achieve common objectives in networked collaborative virtual environment (NCVE). Unlike any other organizations, collaborators in NCVE come from various organizations, countries, expertise, backgrounds and ethnics. They meet, socialize and collaborate through virtual rooms. They may have no chance to meet each other in a face to face situation, thus, it is important to have an organization structure with a set of governing rules, policies and principles for collaborators and managed by an effective management system [8].

In NCVE, each collaborator holds a specific job function such as manager, supervisor, administrator, secretary and day-to-day operation workers. Each of the job function requires them to play specific roles. Based on the role, they have specific responsibilities to be fulfilled which require them to communicate, coordinate and cooperate. Furthermore, roles in NCVE are more dynamic and frequently changed. The change is significant in order to cope with the dynamic situations for survival and take hold of opportunities [3, 8]. Therefore, collaborators are required to adapt with the changes rapidly. This paper summarizes the generic roles that presence in a virtual organization for NCVE.
Section 2 discusses user management in an organization. Section 3 gives the studies of organization structure by focusing on user roles in various organizations. Such organizations include real and virtual world. Then, a summary of generic roles in virtual environments is produced and discussed, before the concluding remarks in Section 4.

2 User Management
In an organization, role of a user is created with a set of tasks description, responsibilities and authorizations. Users are assigned to designated role in order to track their status efficiently. Any adjustment in assigning a user with a new role can be made without having to reformulate role description which is more costly [9-11]. Thus, a clear and precise role specification in any type of organization is very important. It provides a clear separation of duty which promotes job satisfaction and motivation as well as avoiding role conflict. The conflict may lead to psychology discomfort like confuse, frustration, lack of confident, lack of initiative, feeling insecure and un-decision [9]. This frequently happens when workers are not clear of what is expected from them. Furthermore, when their job scope and boundary are ambiguous, the task is consistently redundant that affect the organization’s productivity.

On the other hand, a clear role description specifies an apparent chain of command which affects the speed of decision making process [5]. Thus, role simplifies a coordination process by its clarity in defining the level of authority and decision making power. For example, by looking at a person’s role, people are able to recognize the person’s responsibility, superior and subordinates [3, 5, 12, 13]. Moreover, a clear and precise role is a source of motivation for career progression [9, 14] and loyalty [13]. In term of security, role determines the permission to access organization’s resources and system.

Another important element that contributes to a winning organization is team work which arises from successful communication among team members. The communication depends on of the role and responsibilities that the member is holding [5, 9]. Besides, awareness is another vital element that enhances communication by ensuring every member is aware of each other’s role [4]. In short, it is undeniable that role played by staffs in any organization are important that can affect the organization’s performance and a teamwork promotes efficiency in product development [15]. Role can also have great effect on achieving organization’s goals.

3 Role in User Management
This section investigates various roles in an organization in the context of real to virtual world. The focus is to capture the important elements of roles that contribute to the success in managing invisible users within a virtual space.

3.1 Role in Real World Organization
In any organization, role is important as a mechanism for separation of duty. It is important to avoid ambiguity and conflict especial when it is dealing with shared resources [10, 16, 17]. Besides, a well structured role could improve the organization efficiency, productivity and performance as well as reducing cost [5]. Most organizations are structured based on five types of organization structures; traditional hierarchy (tall hierarchy), flat hierarchy, network, matrix based hierarchy and horizontally linked organizational structure. A well designed organization structure could influence the successful of an organization [15] because it affects the flow control, coordination, communication and decision making.

In traditional hierarchy (as shown in Fig. 1 (a)), staffs are ranked by levels that correlate with authority. There are many levels in the hierarchy that constitute less staffs working at the higher authority. In other words, each manager manages a few people, thus, the people are rigidly controlled. The lowest level staffs occupy the operational works. The next upper level is the first level manager who monitors these day-to-day operational workers. One level above this manager is the middle manager who is responsible for his department and he will report to the top manager. Lastly, the top manager is responsible for the overall directions of the organization [5].

There are a few advantages of traditional hierarchy that include obvious authority line, clearly defined promotion path and having staffs who are loyal to their department [18]. On the other hand, traditional hierarchy are bureaucratic that results in slow response to any changes and decision-making. For each of these processes, approval from each higher level must be gained. In addition, the hierarchy restricts the responsibility of staff, requires a lot of internal and external communications, increases management cost, and limits the scope of decision making that focuses on department rather than the whole organization [18].

Similar to traditional hierarchy, a flat hierarchy divides positions into layers but the layers are much shorter. Fig. 1(b) depicts the structure of this hierarchy. Since the layers are shorter, the span of
control becomes wider. Therefore, each manager manages a big group of staff [5]. This type of organizational structure is suitable for small organization, partnership, and private limited company.

Unlike hierarchy, staffs in networked organizational structure (Fig. 2(b)) gain authority from their specialized knowledge and skill. Networked structure links staffs across department, functionality and geographic locations. The structure is suitable when staffs are highly self-motivated, self-management with sense of responsibility and require less monitoring. The structure could be used by multiple large organizations from disperse locations working together via web to achieve goals. It could also be small organizations work collaboratively in order to compete against larger organizations. At the early stage of structuring, staffs must explore various ways to work effectively. Some adjustments are needed until some kind of agreements can be achieved. This is to ensure that team members are comfortable and agreed to an acceptable working culture and values. Most of the communications are informal [20, 21].

The key advantage of networked organizational structure is its fast adjustment and flexibility in line with the changing circumstances. Moreover, staffs are closer to each other and customers which speed up communication between them [20]. In addition, the structure promotes shorter information path, quick information transfer, good visibility whereby staffs are aware of others and decisions are made based on group discussion [21]. In contrast, due to differences in the individual’s background and invisible working environment, the managerial control may be affected [15, 22].

The latest trend in organizational structure is horizontally linked as shown in Fig. 2(c). In this structure, staffs are organized along the chain of process and activities [19]. For example, process1 starts its operation on task X. Next, process 2 continues to operate the task X and sends the task over to process 3 for later processing.
The horizontally linked structure is often adopted by IT department and other process chain activities like restaurant, spa, hotel, hospital and saloon. The structure works best with strong teamwork and direct communication. Staffs could make their own judgment and estimation for any decision making. Thus, it could increase their job satisfaction and motivation. The chain of command is minimal since the staffs can directly report to the owner of the business [22].

In summary, organization structure is very important for the survival of an organization. Many researchers put their best efforts in finding the most effective organizational structure design for getting the optimum result. Similarly, virtual organization which operates in virtual world requires more attention in formulating a well organizational structure with a clear role specification.

3.2 Role in Virtual Organization
An organization structure in NCVE can adopt any real world organization structure that is best suit the collaborative work. Even though users are invisible, they require specific roles to perform a team work in a virtual space. The roles can determine users’ level of authority and involvement in the collaborative works. The authority refers to allocation of mandate on human resources to specific users based on job titles (top manager, middle manager, first level manager and day-to-day operation members). One of the examples of authority is the power to control the roles of other collaborators before or during the collaboration. This includes the authority to accept members to join the project, terminate the membership status, distribute tasks and allocate responsibilities to members. On the other hand, the day-to-day operation members have the authority on the material that they are currently working. The authority includes collaborating, cooperating, coordinating, designing, developing and maintaining artifacts.

In virtual organization, active members are users who involve the most in an activity. On the other hand, a manager will only get involve when any conflict arise among members. Besides, the manager is also responsible to ensure that the project is moving towards the directed goals. Unlike any other job title, top manager does not involve directly with the artifact. He concerns more on the overall organization’s performance. Similarly, administrator, internal and external advisor do not involve with the collaborative work directly. They act as the supporting staffs and provide their expertise to ensure the collaborative work meets its goals. In contrast, visitor and hidden user are not authorized to involve in any of the collaborative work nor do they have any power. Mainly, they visit the system to get the overview of the company such as company objectives, mission, vision and background. The next sub-sections discuss users’ roles in various collaborative works that include publication, project, and software development. In addition, virtual learning environment and collaborative game are also considered.

3.2.1 Publication Development
An author, purpose agent, and central user are the main actors in publication development. They are the most active users of the system [23, 24]. Moreover, they have less authority when it comes to user management but they could contribute ideas. On the other hand, peripheral users (reviewer, viewer) and site designer help and support the main task of the publication [24, 25]. They have no power over other collaborators. Similarly, an administrator who provides support functionality to other staff members also has no authority to involve neither in the collaborative work nor on human capital [24].

3.2.2 Project Development
Team members are people who are responsible to perform project activities. They have the most involvement in the project. Even though their authority is low, they can contribute ideas. Likewise, a team leader also involves in the project by providing technical directions to team members, reviewing deliverable, and managing any conflicts and issues. They are responsible to ensure that the team members work towards the project’s objectives. Even though a sponsor, project director
and project manager have the highest authority, they do not involve directly in the day-to-day operation. Their focuses are more on overseeing the project which include management, strategic planning and monitoring project members. On the other hand, an advisor who might be a domain expert has neither authority nor direct involvement. His expertise could influence decision making or resolving issues [12].

3.2.3 Project Management (Software Development)
Unlike any other project management work, a project manager of software development team is fully involved in the day-to-day work along with his designers and programmers. He has the highest authority as compared to others. He is responsible to delegate the project module to the best members based on their expertise. In contrast, a designer, programmer and recorder (record and feedback any software defect) have low authority on human capital. Most of the minor job reallocations among themselves are based on agreement. On the other hand, the reviewer and recorder involve only in a certain phase of project development. An equally important team member is system administrator who acts as a supporting staff. He is responsible to provide necessary facilities for other team members, even though, he is not directly involved nor having any authority on the project.

3.2.4 Virtual Learning Environment
In virtual learning environment, the key people are lecturer, tutor, student and course manager. They involve in discussion, distribution of assignment, course content delivery and socializing. On the contrary, a director who has higher authority does not involve directly during chatting or course management. Instead, they focus on managing the overall organization. Similarly, administrators do not have direct involvement but support and provide facilities to collaborators. Besides, an advisor could be students’ friends who assists them in their assignments and project works. Moreover, the advisor could also be external expert who provides his expertise for course formulation. Even though the advisor can give suggestions to solve any problem, he has no power to make decision. Other roles, visitor and member are users who neither have authority nor involvement, instead of having a limited access to the collaborative system.

3.2.5 Collaborative Game
Unlike any other virtual collaborative work, a game does not specify any authority among its players. Players can gain power as they move to a higher level in the game. A leader may emerge through influence rather than being authorized by someone. In term of involvement; leader, team member, trial user are fully involved as they play the game. On the other hand, a helper who has partial involvement assists any player in the game. Other roles; viewer and supporter, do not involve in the game. They are observers who watch the players. The viewer performs an evaluation before purchasing the game, while the supporter cheers up the players [4].

Most of the collaborators in NCVE are independent and self motivated people. Therefore, the suitable organization structures for NCVE are network, flat and matrix type since not much of management and monitoring are required.

4 Generalized Role in NCVE
Based on the content analysis in Section 2 and 3, a role is an important element in user management. The user’s role must be able to form rapidly and adapt with changes to any transformation of organization. Due to the unstructured user management in current virtual collaborative systems, it is difficult to draw the separation of duty among collaborators. The content analysis performed in this research shows that the hierarchical type of real world organization structure gives a clear view of user’s role based on authority. Most of the virtual world organizations focus more on the users’ involvement. Therefore, we propose the generalized role in NCVE is based on authority and involvement factors.

4.1 Authority
Each role is associated to different level of authority which determines different responsibility and expectation. The level refers to the user’s power to structure and restructure human resource in order to meet the objectives of collaboration. Table 1 illustrates the level of authority that correlate to job title in user’s role for virtual organizations.

**Role A** has the highest authority in the organizational structure. One of the job titles is top managers. They are authorized to choose project directors, managers and team leaders. Similarly, project directors, managers and team leaders have the authority to reorganize and restructure their team members. Likewise, lecturers whose job title is also **Role A** can block problematic students from entering the virtual room. Moreover, they can also reallocate poor students to different room for special attention.
Table 1. Authority vs. Job Title

<table>
<thead>
<tr>
<th>Application</th>
<th>Role A Highest authority</th>
<th>Role A Low authority</th>
<th>Role B No authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual organization</td>
<td>Top Manager, Director</td>
<td>Active</td>
<td>Administrator,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Member</td>
<td>Visitor, Hidden</td>
</tr>
<tr>
<td>Publication</td>
<td>-na-</td>
<td>Author, Purpose</td>
<td>Administrator,</td>
</tr>
<tr>
<td>development</td>
<td></td>
<td>Agent, Central user</td>
<td>Peripheral Users</td>
</tr>
<tr>
<td>Project</td>
<td>Sponsor, Project Director</td>
<td>Team Member</td>
<td>Advisor</td>
</tr>
<tr>
<td>Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Project Manager, Designer</td>
<td>Designer, Programmer</td>
<td>Reviewer, System</td>
</tr>
<tr>
<td>Development</td>
<td></td>
<td>Recorder</td>
<td>Administrator</td>
</tr>
<tr>
<td>Virtual Learning</td>
<td>Director, Lecturer,</td>
<td>Tutor, Secretary</td>
<td>Administrator,</td>
</tr>
<tr>
<td></td>
<td>Course Manager</td>
<td></td>
<td>Visitor, Member,</td>
</tr>
<tr>
<td>Collaborative Game</td>
<td>-na-</td>
<td>-na-</td>
<td>Viewer, Supporter,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leader, Team Member,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trial User, Helper</td>
</tr>
</tbody>
</table>

Table 2. Roles vs. Job Title

<table>
<thead>
<tr>
<th>Application</th>
<th>Role 1 Highest involvement</th>
<th>Role 2 Low involvement</th>
<th>Role 3 Not involve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual organization</td>
<td>Active Members</td>
<td>Manager, Internal</td>
<td>Top Manager,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and External Advisor,</td>
<td>Visitor, Hidden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Administrator</td>
<td>Users</td>
</tr>
<tr>
<td>Publication</td>
<td>Author, Purpose Agent,</td>
<td>Peripheral Users</td>
<td>-na-</td>
</tr>
<tr>
<td>development</td>
<td>Central User</td>
<td>(reviewer, viewer),</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Site Designer</td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>Team Member, Team Leader</td>
<td>Sponsor, Project</td>
<td>-na-</td>
</tr>
<tr>
<td>Development</td>
<td></td>
<td>Manager, Director,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Manager,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Advisor, Administrator</td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Project Manager, Designer,</td>
<td>Reviewer, Recorder of</td>
<td>-na-</td>
</tr>
<tr>
<td>Development</td>
<td>Programmer</td>
<td>defect in software</td>
<td></td>
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<td></td>
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<td>product, System</td>
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<tr>
<td></td>
<td></td>
<td>Administrator</td>
<td></td>
</tr>
<tr>
<td>Virtual Learning</td>
<td>Lecturer, Tutor,</td>
<td>Advisor, Administrator</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student, Course Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborative Game</td>
<td>Leader, Team Member, Trial</td>
<td>Helper</td>
<td>Viewer, Supporter,</td>
</tr>
<tr>
<td></td>
<td>User, Player</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Authority vs. Job Title

Holders of **Role B** are authorized with low authority. They do not have the permission to reallocate users directly. However, they can seek advice from higher authorities. On the other hand, Holders of **Role C** have no authority to involve in any reallocation of human resources. Despite, they can contribute ideas and involve in the collaboration. They merely follow the order set by holders of **Role A**. In games, all the players are holding **Role A** regardless of their job titles. They have no authorities over other players. Despite, they can report any discrepancy to the game owner who can take action like terminating membership of problematic players.

### 4.2 Involvement

Different role requires different responsibility and involvement in operational work. Involvement means that the role holders are actively collaborate in the virtual room. They involve in designing, developing and maintaining the artifact. On the other hand, users are also allowed to log into the system without participating. Table 2 depicts different job titles in virtual applications and their respective involvements.

Holders of **Role 1** have a full responsibility and involvement in the activities. Mostly, they are first level and middle level staffs in the organizational structure. They are also responsible in making decision concerning the artifact under discussion. Some of them are the artifact owners such as author and designer.

**Role 2** holders are partially involved in the collaborative work and expected to join the virtual discussion when needed. Mostly, they are responsible in monitoring, advising and designing tasks. For task monitoring, they monitor the whole project in order to achieve goals. Even though they may not know much on the technical aspect of the project, they involve in the project delivery. An instance of **Role 2** holder is an advisor. He can be a domain expert who joins the virtual discussion for a certain period of time to offer his expertise. Another example of **Role 2** is side designers who monitor the artifact’s format to ensure that the artifact follow the standard. Lastly, holders of **Role 3** are not involved in the collaborative work. They will not enter the virtual room. An example of job titles in **Role 3** is top managers. They are interested in the overall organization performance and rarely involved in the operational work. Similarly, visitors do not involve in the collaborative work, but they are only interested in getting general information of the organization. Likewise, in the collaborative game, supporters do not play the game but they are there to support the game play.

### 5 Conclusion

Organizational structure is made up of job titles. Each job title has responsibility and expectation that need
to be carried out called role. A clear and well defined role is vital because it is consistently linked to authorization of information resources and functionalities. Besides, the role affects staff management, job satisfaction, motivation, role clarification, teamwork, and decision making. Proper role management can avoid various negative feelings. The roles are very much depended on organization structures. Most organizations are based on five structure types: traditional hierarchy, flat hierarchy, network, matrix based hierarchy and horizontally linked. This paper has studied various real and virtual organizations. Based on the roles, the real world organizations give clear view of authority, while the virtual organization relates users’ roles with involvements. Derive from the authority and involvement; roles in NCVE are generalized according to the job titles. The job titles clearly define separation of duty that enables collaboration to be carried out. Thus, a structured management of users can be conceptualized to construct a virtual organization with improved allocation of mandate to human resources.

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