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Decentralized Team Model for New Service Functions, Features and Control

Primary Topic - 3: Information Sharing and Collaboration Processing and Behaviors

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Collaborative Technologies for Network-Centric Operations

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The Title of Paper

Decentralized Team Model for New Service Functions, Features and Control

Abstract

We study the evolution and the dominance of the service-based functions and their distinguished features. As the service industry matures, many new processes have emerged to fulfill new functions, such as intense man-machine interaction, knowledge intensive activities, flexibility in the organization, and control and execution of tasks. In this paper, we discuss a wide range of interconnected topics, emphasizing the multi-faceted nature of service functions. These topics include the evolution of the service industry and their products, the computerization of products based on their large-scale adoption and the consequent creation of implicit requirements; the technology transfer processes. We argue the organization, framework, and related problems of the decentralized team on fully decentralized team. We propos the approach to solve these problems

Moreover we verify the effectiveness of our approach through the trials by a large string orchestra which is considered to be a typical and successful example on fully decentralized team. We suggest to apply our approach to the societies which are seeking for deriving a spontaneity of each participant. Finally we propose the individual centric environment which is expected to work in cooperation with the network centric environment.

Keywords: Service Features, Decentralized Organizations, Collaboration, String Orchestra

Introduction

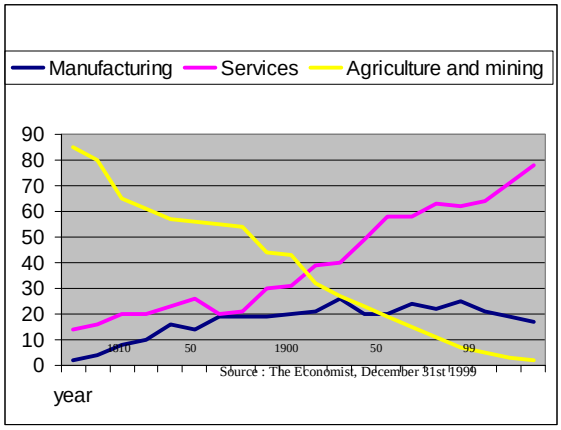
The service industry, whether it is travel, leisure, entertainment or finance, involves personalized activities requiring various forms of interaction between humans and machines. In fact, the U.S. Bureau of Labor Statistics estimates that more than two thirds of all workers in U.S. are involved in service functions at present and their numbers are increasing rapidly (Figure 1(a)).

The dictionary defines 'service' as an organized system of appliances, products, personnel and other resources to supply activities needed to satisfy a public or private need. Insurance, banking, catering, lodging, travel and entertainment activities are traditionally considered service industries. Fairly recently, TV repair service, product maintenance services, and even massage services are listed as service functions. However, the goals and the meaning of the service functions have broadened. In modern parlance, service is the work performed directly or indirectly to satisfy the needs required by customers.

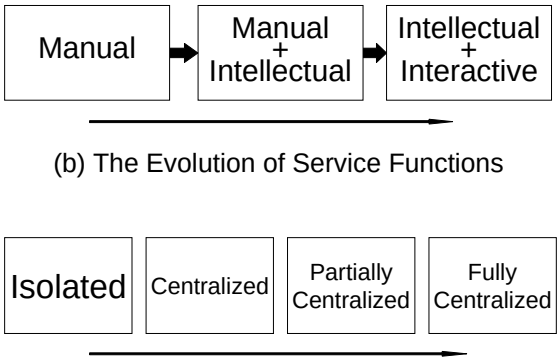
The industrial revolution in Europe brought forth manually intensive functions that have given way to mentally or intellectually intensive activities. As a part of this transformation, we have seen an increasing dependency on advanced technology, specifically information technology that is mostly on PCs and networks. As automation increased, manual chores have taken a secondary role. For instance, robotics and software agents and tools support the mental activities.

Service providers generally work in small teams that are co-located or even distributed in remote locations (virtual teams) with little impact on the quality of the collaboration working as a single team. Service functions are major components of every industry. including but not limited to finance, travel, telephone and communications, power and other utilities, health care, and entertainment.

These intellectual activities are shown to be error prone if the operator or user is stressed emotionally or physically. Studies by Andersen Consulting and others have shown that about 40-80% of the failures may be due to improper human reaction due to unnatural circumstances, including lack of knowledge, stress and confusion generated by information overload. As a result, an excess amount of useless information is accumulated, commonly referred to as data smog. The growth of service functions in US is shown in Figure 1 (a). Service functions aim to satisfy and facilitate the goals of their customers, thereby designing their service functions ergonomically. The service providers attempt to precondition, specialize or personalize their offerings to satisfy customer needs, desires, preferences and fancies. Primarily through interactions, this personalization or preconditioning is based on or derived from user requests, perceived needs and goals. The interactions are manifested as social networking using various communication technologies.



(a) The Growth of Service Industry Functions in US
Source: The Economist, December 31st 1999 (a)



(b) The Evolution of Service Functions

(c) The Evolution of Service Organization

Figure 1. The Growth of Service Industry

Hence, customers and users communicate their service needs through their interactions. The social interactions can be categorized into three main types: 1) interactions between service functions and individuals. 2) interactions between service functions and teams and 3) interactions between service functions and customer applications. By personalizing and humanizing our service products we enhance user convenience and reduce the incidence of errors, thereby improving their productivity and quality of their work.

In the case of interactions between and amongst teams, we can show that decentralized form of organization and control facilitates the effectiveness of teams. The strategy of team decentralization creates a flat organizational structure. As communications costs become negligible, establishing a rigorous hierarchical or centralized control structure becomes less important. As a result, individual initiatives are encouraged and free exchange of ideas become pervasive during decision making, all of which facilitates sharing, learning and creation of knowledge.

The third type of interaction is between the service function and the application objectives. Here the service products are preconditioned to provide high performance, reliability and safety to that specific spectrum of applications. We shall discuss these in the subsequent sections. Over the ages, the evolutionary process of technical innovation has resulted in the replacement of manually intensive tasks by a combination of mentally and manually intensive tasks. Thus these intellectual tasks are now also being replaced by a combination of both intellectual and interactive tasks through social networking technologies facilitating communication, as indicated in Figure 1(b).Figure 1(c) also depicts the evolution of team organization. As the service system moved from an isolated cluster of non-interacting entities, it migrated towards a centralized structure. Following these social hierarchies, a partially decentralized emerged that resulted in a fully decentralized, yet highly interconnected entity facilitated by advanced communications technologies. The later stages of evolution produced a system organized in one layer as a flat organization, where each entity may act as a self-directed component agent. In this paper, we study, very briefly the evolution of the service industry and the role played by automation. We shall also touch on the product improvement process as defined by customization, humanization and personalization that support service functions. We shall also comment on the process of technology transfer, and the evolution of information technology products that support service functions. Lastly, we develop some models for team-oriented systems and comment on their usefulness. We shall show that decentralization is the growing trend of team-based service-systems of the future. The study of the service function and related topics can be referred to (C.V. Ramamoorthy, 2000);(H. Yamaguchi, et al, 2003, and 2004).

Distinguishing Features of Service Functions

The distinguishing characteristics of service functions include the human-centric needs of customer-driven knowledge–intensive approaches that are intellectually challenging, and automation-intensive, in order to reduce manual efforts. This is accomplished by introducing human-interaction intensive and Information technology intensive learning organizations for advanced, decentralized communications in the 21st century.

Since human needs are being addressed, the service functions are human-machine interaction intensive, knowledge intensive or manual utilizing information technology for facilitating cooperation. Teams that execute most of the functions could include clusters of human professionals and computer resources.

The service industry is highly knowledge oriented and are heavily dependent on collaborative efforts between humans and their networked computers. Collaboration is needed because the size, complexity and intellectual intensity of the service tasks. Just like software development, the service operations tend to be flexible and easily modifiable, requiring variable length times for completion. Also, the modern day service functions are focused on directly facilitating the client goals, which can evolve even as the services are being rendered.

Human Needs Driven

The human needs can be categorized into three types, namely Personal, Professional and Societal.

One major personal need is to develop machines that react more like humans so that the operator or user is always comfortable, and not stressed, surprised or confused at any time, particularly in an emergency. We call this the 'humanization' process. Individualized personal needs may depend on our disabilities, such as eye and hearing impairments, left handedness, and short attention spans. The process of individualization may also depend on our personal preferences and styles.

Professional needs of service functions call for excelling in the job and improving one's productivity and performance at work. This generally requires customizing work equipment and environment to fit the application and the employee so that the performance of the system and the productivity of the professional are improved. Societal needs of the service functions emanate from community and environmental consciousness and responsibilities, thereby eschewing altruism—befitting the theme of "The Three Musketeers,' namely, 'all for one and one for all.'

Knowledge-Technology Intensive

Service activities generally involve choosing among options and solving problems with the help of technology and knowledge, particularly scientific knowledge that produces technical innovation. Davis and Boskin (D.S. Davi, J. Boskin, 1991) have conjectured that scientific knowledge grows exponentially, doubling every seven years, which continuously elevates technological and educational levels with such rapid growth. By Ross Ashby's law (K. Weick, 1979) this has the rising tide effect; that is, the rising tide (of knowledge) lifts all the boats (improvements in functionality and quality of service).

Human Interaction Intensive

There exist many types of human interactions, e.g. amongst humans, between humans and machines, and within and across teams of humans and machines. We examine two primary types of interactions, one of which is knowledge intensive and the other, heavily oriented towards .simple keyboard interactions and bookkeeping knowledge. Knowledge intensive interactions are those in which humans have to think and interact with the computer, as one composes a report or a letter on the computer.

Information Technology Intensive

The service functions heavily depend on information technology (IT). Every aspect of the service function from customer requests to service delivery, and service evaluation by customer satisfaction-metrics is IT driven. In fact, there are striking similarities between software development processes and service functions that utilize IT. These include their knowledge dependency, their collaborative development and the ease and flexibility in modification and execution.

Evolution of Service Industry

The Austrian born American economist Schumpeter traced the growth and the impact of technologies over the last two centuries. (Figure 2, Figure 3). The figures show the waves of innovation of dominant technologies over the ages.

Knowledge Utilization and Technology Transfer

The delivery of services depends upon products, procedures and human interactions. Service products are produced by technology. Human needs, knowledge, and experience creates technology. Knowledge, in our context, implies a specific aspect of the discipline that is needed to satisfy a product technology. The ultimate aim of technology innovation is new product creation to satisfy ever-increasing and sometimes voracious human needs. Knowledge utilization and technology transfer is an important part of this process, which we consider as a very important service function that supports human progress.

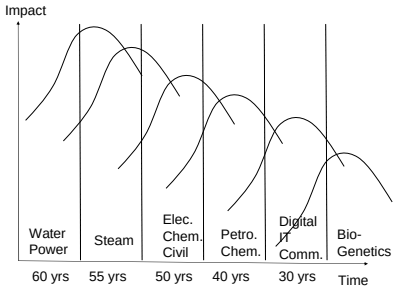


Figure 2. The growth of new technologies (Europe)

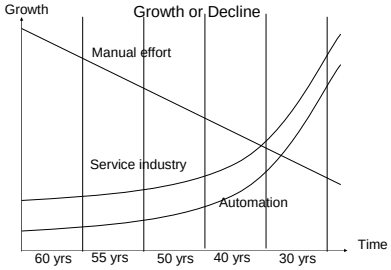


Figure 3. The growth of service industry and automation

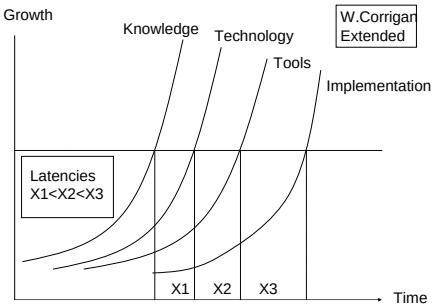


Figure 4. Knowledge Transfer (e.g. semiconductor industry)

It consists of the following four broad phases: a) knowledge generation, b) technology innovation to satisfy a broad array of human needs and c) new product line development; architecting new design methodologies, while introducing associated computer-aided tool development and d) product implementation and manufacturing. For the sake of brevity, we have omitted important steps like testing, product quality control, and marketing. Figure 4 illustrates the essential phases of this process and displays the processes associated with the growth of knowledge, technology, tool development, and implementation, over time. We define latency as the time difference between two successive phases during a specific instance of growth of a technology (Fig. 4). For example, the latency between knowledge creation and the corresponding technology development allow some specific instance of growth. Latencies, in practice, cannot be measured precisely, but only estimated based on experience. As shown in Figure 4, the latencies in the semiconductor industry between successive phases seem to follow a transitive relationship, which is x1 < x2 < x3. Thus, the time to transfer knowledge into technology (x1) is shorter than the time to develop support tools from technology (x2), and which is shorter than time to use the tool to develop the product (x3).

The Kozmetsky Effect

George Kozmetsky, recipient of the National Medal of Technology, has identified and studied the strong correlation between knowledge and technology growths. According to him, the rapidity of the knowledge growth exerts a strong synergistic effect which stimulates technology growth, pulling the technology growth curve towards it (Figure 5). In other words, the technology transfer latencies get reduced or compressed with a maturing technology. Or, the technology transfer limit becomes shortened with a mature technology. As discussed earlier, there are two reasons for this. First, knowledge and technology interact vigorously, thus accelerating the corresponding tool development. The knowledge technology curves get closer and closer to the tool development and implementation curves. Secondly, as knowledge saturation in a particular technology takes place due to physical limits, we only encounter incremental advances but no big break-through.

Errors in Service Engineering Activities

Service activities require intensive interaction amongst people and machines, resulting in vulnerability to intentional and unintentional errors. In the following sections, we shall explore ways of mitigating such errors. As stated in the initial studies of Andersen Consulting and others, it has been shown that 40-80% of the failures

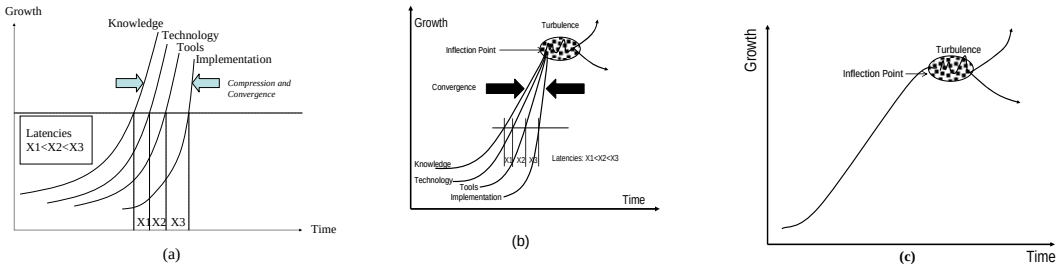


Figure 5. (a) The compression of the technology transfer phases (the Kozmetsky effect) (b) The convergence of technology transfer phases (c) Technology growth inflection point

may be due to improper human reactions. To help reduce accident and error incidence resulting from man-machine interactions, designers have considered two general methods applicable to a service applications.
One is the process of humanization, personalization and application specialization, and the other is the use of teams -groups of professionals (usually a small number) working together to accomplish the tasks. We shall discuss these in the subsequent sections.

Humanization, Personalization and Application Customization
We work long hours in intense interaction and close working relationships with computers. Sometimes we prefer to treat these intelligent machines as human-beings and expect to receive human-like responses from them. We can 'humanize' the machines to imitate human-like reactions under selected circumstances, so that their human users are not confused or stressed. This built-in 'naturalness' makes it easy for us to understand, learn and use them better. We shall call this 'humanization.

Thus 'humanization' of the machine makes it easy to use since its responses will be less confusing to the humans, whereas 'personalization' individualizes the system to the particular human user to compensate for physical disabilities or to support his/her preferences

'Customization' adapts a general-purpose computer or a machine which is generally, a cheap, mass-produced consumer or commodity item to perform more effectively and efficiently in a specific class of applications. Application customization is very common in the PC domain, particularly in visual graphic support, in database accelerators, and in sound cards for enhancing audio performance.

In summary, we 'humanize' the machines so that their responses are natural and human-like. We personalize' the machine responses to fit the user's individual preference's or disabilities.

A Layered Hierarchical Model for Application Customization. Humanization and Personalization
In order to develop system architecture based on the ideas outlined in the previous section, we shall propose a layered model much like the one- used in communication protocols, generally known as the ISO Model. In systems engineering, complex designs are often modeled and constructed by hierarchical layering (Figure 6.). Each layer is associated with a set of service processes. The layer at the lowest level interface interacts with the fast, electronic and physical elements. The next higher layer will be the humanization layer, which helps to make the system react in a humanistic fashion. This could also be dependent on the application tasks but it will focus on general human performance and reactions.

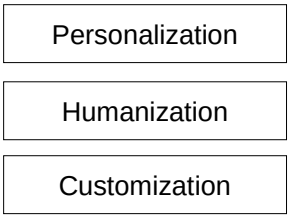


Figure 6. Layered Hierarchical Model

The top layer is the personalization layer which tries to help out in the personal disabilities or caters to user's preferences. Individual personalization is left as an option to be exercised by the user and therefore, some manual controls must be provided where warranted at the lowest level interface, and interacts with the fast, electronic and physical elements.

Comments on Humanization
The purpose of humanizing a computer or a machine is to make its interactions as natural and human like as possible to its users. By humanizing, we try to reduce the circumstances where the human user will be surprised, uneasy, inconvenienced, confused or stressed. Computer and other intelligent machines have become our constant companions. The majority of our responses during man machine interactions fall into one of the following categories:

a) Responses based on inherited and built-in natural instincts and reflexes (often called knee-jerk responses). These unconscious thoughts result in fast responses when no thinking is required.
b) Responses based on acquired knowledge, experience, education and training. As knowledge accumulates and evolves over time, our habits and responses tend to change. These are thoughtful or deliberate responses, which require introspection.
c) Responses to new and unanticipated situations which have to be dealt without prior training, preparation, experience and knowledge. Although these responses may create risk, they also provide[1] exposure to new learning experiences. These require research and more exploration or knowledge-gathering.

Teams and Team Evolution

Since service functions are enabled and executed by teams, we shall briefly comment on some pertinent characteristics, specifically their types and functions. The word "team" is defined in the Webster's dictionary as a number of persons associated in some joint action with a common goal, e.g. a team of collaborating experts, or 'draft animals' harnessed together to draw a vehicle. When a team becomes more aligned, a commonality of direction emerges; the individual energies harmonize into a synergistic cooperation. Teams in our discussion are made up of people supported by machines to achieve certain goals during some specified period of time in a cooperative or collaborative fashion. Teaming includes the processes of planning, organizing, controlling and executing the required tasks by teams.

One of the assumptions we make is that a computer cannot be smarter than its designers—who are human beings. A person with computer resources can be 'superior' to a person without such support. In essence, we can hypothesize empirically from these observations the following:

Machine < Human < (Human + Machine) < Teams of (Human + Machine)

where the symbol "<" implies "inferior to" or 'not as good as' relation.

Team Types

Team type depends on the main purpose for which the team is formed. It defines the organization and the nature of dependency amongst the team members. The criteria one can use in classification are the team's purpose, the nature of its collaboration, and its organizational and control philosophies. These govern the nature of interaction and dependency amongst its members. We shall only discuss some specific but important, types of teams employed to implement service functions, namely, the collaborative, co-operative, consensus seeking, hierarchical and virtual teams.

Collaborative team members work together in small groups, very closely, i.e. cohesively, to achieve the best outcome for their intended goal. Generally the goal of the task is well defined, and the team members are chosen because of their motivation with the objective, perceived potential and their competence in that area. Collaboration creates a synergy such that their total contribution is greater than the sum of their individual contributions. The team members are tightly coupled and work together very intensively, striving to achieve the very best outcome. A parallel concept from software engineering is cohesiveness, which implies that the components (members) of the team are very dependent on each other, and work together very closely and effectively.

Hierarchically organized teams have a command and control type of relationship amongst its members. A member in a lower hierarchy reports to or obeys the orders of those in the next, higher level. A common form of the model is an inverted tree, the root node is the commander and the leaf nodes are soldiers. The nodes in the intermediate level represent officers. Hierarchical teams are tightly coupled. Examples include military command and control systems, gangster teams, drug cartels and the common master-slave systems.

Evolution a of service organization

In this subsection, we shall model the evolution of service organization. The four models use simple directed graph structures.

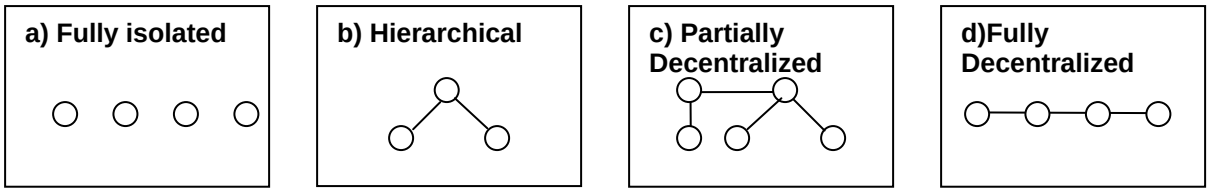


Figure 7. Evolution of Service Organization

(1) In the first model, each node represents a team that is independent and isolated. There are no links or emanations from the nodes. Nodes have little or no communication capability, i.e. each node is isolated from others. Each node makes its own decisions. We shall label this as a totally isolated team model shown in Figure 7. a).

(2)The second model is centralized and portrays a top down hierarchy, in which one node, the root node of the tree acts, as a controller or director receiving informal reports from its subordinates, while giving directives to its subordinates. This models a centralized enterprise, where the head office receives status information from the branch offices and sends out directives or commands to the subordinate nodes to carry out. Military organizations, which use the command and control regimen, as well as street gangs, are examples of the centralized, tightly coupled hierarchical organization. This model is illustrated in Figure 7(b).

(3)The next model (partially decentralized model) is illustrated in Figure 7(c). The sub-trees are organized like the centralized model.

(4)The fourth model is the fully decentralized model and is shown in Figure 7(d). This model assumes full connectivity between the teams or nodes and the inter-node communication is assumed to be instantaneously with negligible cost. Ideally, the teams can have total access to each other's information databases at all times. Each node makes functional and administrative decisions rapidly and collaboratively with others based upon a set of agreed-upon rules, protocols and principles. The designers of the system must carefully check and validate those rules and roles to avoid conflicts, inconsistencies, and ambiguities to thwart any security breaches and catastrophes that could occur during faults, malfunctions or virus invasions on the system.

We envision that a realistic system may portray any one of the above organization models or combinations thereof. A flexible or a reconfigurable system can switch between these configurations to adapt to the changes in the application, communication environment and other conditions.

Fully Decentralized Teams

In modern organizations, such as large business or government agencies, public domains will have little choice but to become information-based team or organizations. Consequently the center of gravity in employment is moving fast to knowledge workers and the operating organization becomes an organization of knowledge workers of all kinds. Although they do not usually produce a physical artifact, they produce knowledge, idea, information, and concepts. This knowledge-based organization is comprised largely of specialists who convert data into information. They produce a product by themselves or by others collaboratively or cooperatively with other specialists. The new jobs require a good deal of formal education and the ability to acquire and to apply theoretical and analytical knowledge to use knowledge, theory, and concept in organization. They require a different approach to work and a different mind-set compared to the traditional work style.

The motivation of the knowledge worker depends on his actual effectiveness for achievement. Each distinct specialist receives the order and reports directly to upper management in the decentralized organization. Knowledge workers cannot be supervised closely or in detail, but they must direct themselves, and they must do so toward performance and contribution. Consequently, the organization structure will shift toward totally flat without any middle management. Because of its flatter-structure, the decentralized information-based organization takes the first tentative process of converting raw data to actionable information. These decisions are processed through the management structure which gets work done as information travels fast throughout the world.

The truly important features of the decision are neither their novelty nor their controversial nature. They are: the definition of the required specifications that the answer to the problem had to satisfy. The knowledge workers work as members of an organization. The organization can convert the specialized knowledge of the knowledge workers into performance. Specialized knowledge emerges as a separate specialty. Others in the value chain must take them as initial input and convert them into usable output. Each knowledge worker thinks and behaves as a chief executive officer. It also requires great change in the knowledge worker's thoughts and actions from what most of us are used to. Knowledge workers have to manage themselves profoundly to adapt to challenges in social structure. Every knowledge workers in a modern organization is an "executive." He must take responsibility for his contribution. The first decision process is clear specifications as to what the decision has to accomplish. What are the objectives the decision has to reach and what are the goals it ha to attain, what are the conditions it has to satisfy? The more clearly boundary conditions are stated the greater the likelihood that the decision will indeed be an effective one and will accomplish what it sets out to do. Increasing effectiveness may be the only area where to raise the level of the knowledge worker's performance, and achievement, and satisfaction.

The knowledge worker, i.e. individual professionals who are expected their knowledge to make decisions in the normal course of their work that have impact on the performance and results of the whole. For the authority of

knowledge is surely as legitimate as the authority of position. In this sense, moreover, these decisions are of the same kind as the decisions of top management. Every knowledge worker in a modern team is a "manager" if he is responsible for performance contributions. In the information-based team, every individual is required to take information responsibility. The key to such a system is that every one asks who in this organization depends on me for what information and on whom, in turn, do I depend? It requires each individual to address two sorts of information responsibility. What are its management problems likely to be? Information-based organizations, in other words, which require clear, simple, common objectives that translate into particular actions, also need concentration on one objective or, at most, on a few. Each person must take the fullest information management responsibility (The information-based team require self-discipline and emphasis on individual responsibility for relationships and for communications.

The Organization Structure of the decentralized team

The information-based, decentralized team must be structured around goals that clearly state management's performance expectations for each knowledge workers. It demands that each knowledge worker (Specialist) think and behave as a chief executive officer that implies a revolution in human affairs (Figure 8). This big change in the knowledge worker's thoughts and actions departs from traditional approaches in the hierarchical team (P.F. Drucker, 2003).

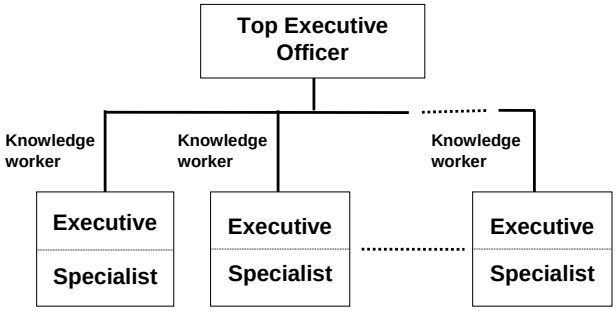


Figure 8. Organization Structure of Decentralized Team

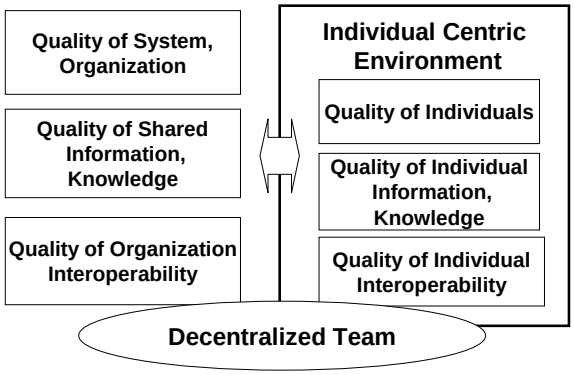


Figure 9. Framework of Individual Centric Environment

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Framework of the Decentralized Team

The decentralized team framework should subsume the net-centric and human-centric frameworks including technology, individual and organizational processes. Figure 9 depicts the relation between network centric and human centric framework relevant to the quality of organization, individuals, information, knowledge and interoperability focused in information-based functionalities.

Problems

In a decentralized team, the knowledge workers face a tremendous challenge they need to exploit as an opportunity as mentioned below:

- They must direct themselves toward performance and contribution, that is, toward effectiveness
- They must take responsibility for their contribution
- They expected by virtue of their position or their knowledge should be able to make decisions daily that impact the performance and results of the whole.

The realities of the knowledge workers' situation both demand effectiveness from them and make effectiveness exceedingly difficult to achieve. The specific characters of the knowledge workers are considered as follows:

- Knowledge workers cannot be supervised closely or in detail.

- The motivation of the knowledge worker depends on his being effective, on being able to achieve. If effectiveness is lacking in his work, his commitment to work and to contribution will soon wither away, and he will become a time-server going through the motions from nine to five.
- Therefore, unless they build one's information feedback mechanism for confirming the level of contribution they performed, they may condemn themselves to ineffectiveness.

The Approach to solve the problems

We elaborate on the realistic approach to solve the problems described above for the knowledge workers in the decentralized teams.

(*1*) ***Every knowledge worker must take management responsibility to oneself***
To derive full potential spontaneity such as talents, inspiration, and energies of the individuals for the better team performance
(2) ***Every knowledge worker must take management responsibility to others***
To cognize uncanny capabilities of the individuals for creating a unified direction as a whole.

Management responsibility to oneself
Management responsibility to oneself is still largely neglected. Everyone in the information-based team needs constantly to be thinking through what information is needed to be extracted from the data. In order to know what they are doing and finally appraise how well they are doing it, he or she requires to do the job and make a contribution. Information responsibility may seem obvious.

Management responsibility to others

Information responsibility to others is increasingly understood. Each knowledge worker decides what information he or she needs to able to decide what they should be doing. Now we need to connect all the knowledge centers on the globe together into a single global network which could usher in an amazing era of prosperity, innovation, and collaboration, by companies, communities, and individuals.

Security Issues essential for realizing the Decentralized Teams

We argue the information privacy issues considered to be an important functions for preserving the privacy of customers.

Anonymous Customer Opinion Survey Scheme

We emphasize how essential it is for the knowledge-based service providers to follow a strategy that can improve their services through continuous customer feedback. These practices provide an opportunity for service providers to hear directly about what makes customers complain by conducting surveys of customer satisfaction, customer support, and the provider overall. In fact, an anonymous opinion polling scheme enables customers to offer their opinion without revealing their private properties, such as their name and ID number, while the service providers are able to evaluate the eligibility of the user (Yamaguchi, Tsujii, 2003).

Private Information Retrieval for the Knowledge Database
Publicly accessible databases are an indispensable resource for retrieving up-to-date information and knowledge. But they also pose a significant risk to the privacy of the user, since a malicious manager of database servers can follow the user's queries and infer what the user is after. For example, an investor that queries the stock-market database for the value of a certain stock may wish to keep private the identity of the stock he is interested in. This raises hope for the users to obtain the desired information, while the database server (by observing only the query sent to him) gets no information on the identity of the item the user is interested in. Extensive work has been presented in which many of the solutions are based on the simple quering structure for determining unique relations. We provide practical solutions that are suitable for querying even the multiple relations (SQL: JOIN, CARTESIAN RODUCT). We modified the mix-net scheme C. Park (C. Park 94) and K. Sako (K. Sako, 1995)

A Mix-net Anonymous Channel

Public information : $p = kq + 1$ (p, q prime), $g = (g')^k \bmod p$ (where g' is a generator mod p)
Public key of center i : $y_i = x^{xi} \bmod p$
Secret key of center I : $x_i \in Z_q^*$
Query from the user : s

Encrypting a Query

The user generates a random number r_0 and sends

$$Z_1 = (G_1, S_1, A_1) = (g^{r0} \bmod p,\ (y_1 \cdot \cdot \cdot y_m)\, s \bmod p,\ (y_1 y_2 \cdot \cdot \cdot y_n) \bmod p$$

For Center 1, where Center m: Database server, Center n: The user to be sent the answer of the query, $m < n$)

Processing a Query

Center i (i = 1, …, n-1) generates a random number r_i, and computes the following with his secret key x_i:

$$\begin{aligned} G_{i+1} &= G_i \cdot g^{ri} \bmod p \\ &= g^{r0+\ +ri} \bmod p \\ S_{i+1} &= S_i \cdot (y_{i+1} \cdot \cdot \cdot y_m)^{ri} / G_i^{xi} \bmod p \\ &= (y_{i+1} \cdot \cdot \cdot y_m)^{r0+\ +ri+} \cdot s \bmod p \\ A_{i+1} &= A_i \cdot (y_{i+1} \cdot \cdot \text{Publicl} \cdot y_m)^{ri} / G_i^{xi} \bmod p \\ &= (y_{i+1} \cdot \cdot \cdot y_m)^{r0+\ +ri} \bmod p \end{aligned}$$

He sends $Z_{i+1} = (G_{i+1}, S_{i+1}, A_{i+1})$ (permuted with the other processed encrypted queries) for uses by Center i+1.

Center i (I = m) recovers q by computing

$$q = Q_m / G_m^{xm} \bmod p$$

and obtains the answer a for the query q and constructs

$$A_{m+1} = (y_{i+1} \cdot \cdot \cdot y_m)^{r0+\ +ri} (s \mid a) \bmod p, \quad \text{where } \mid \text{indicates concatenation}$$

And sends to Center i+1.

Center i (i = n) recovers q and a by computing

$$s \mid a = A_m / G_m^{xm} \bmod p$$

In this model, users and centers cast their information (G_i, S_i, A_i) to the bulletin board which is public and can be read by any party and no party can erase any information from the bulletin board, but each active participant (users, centers) can append message to its own designated section) to support the verifiability for the correctness of each processes of participants. All the correctness of centers can be verified through the zero-knowledge interactive proofs shown in (K. Sako, 1995).

Feasible example of Decentralized Team:

"Large String Orchestra without Conductor"

There are clues in other kinds of information-based teams, such as symphony orchestras (Figure 10.). The organizational structure is totally flat. Nevertheless, the system worked remarkably well for a long time, in large part because it was designed to ensure that each of its members had the information needed to do his job. Each specialty has its own knowledge, its own training regimen and methodology

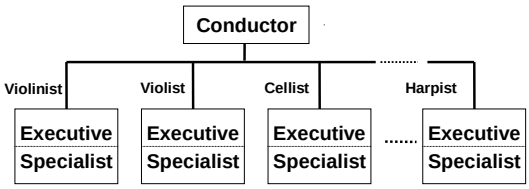

Figure 10. Organization Structure of Symphony Orchestra

The Role of Conductor

In some modern symphonies, hundreds of musicians, each a high-grade specialist are on stage and play directly to the conductor without an intermediary. Over the past one hundred and fifty years the position of conductor has risen in stature form that of mere time beater to complete overlord. In fact, the complete duties of a conductor's role have become indispensable in large modern orchestras.

It would be catastrophic to attempt any rhythmically complicated and complex piece of the twentieth century music without a conductor, while an orchestra could stay together quite well in baroque and classical music, and even in some of the romantic music.

The mere physical distance of one player from another in a modern symphony orchestra makes it difficult, and sometimes impossible, for players to hear each other, and for this reason alone, the conductor is necessary, as a means of producing for the eye what cannot be achieved by the ear.

From the practical standpoint, the conductor is more important to the players today than he was in the eighteenth-century orchestra.

A conductor is technically precise and takes out to the orchestra to follow his vision of creativity and directions. Conductor can be considered to be upper management as described in the knowledge-based team.

The Concert Master; Middle manager?

The duties of concertmaster are varied and slightly different in every orchestra, depending upon the traditional custom of its orchestra, or the personality of the conductor. Some conductors rely heavily upon the musical advice of their concertmaster, delegating a great deal of authority.

He is both a player and, as such, must tread the tightrope of diplomacy in dealing with his colleagues on one hand. On the other hand, an orchestra player has the need to look up to one central authority, one all-knowing father-figure; "Concertmaster." So far we recognize, a concertmaster is not a middle manager. A concertmaster will coordinate with all the players during rehearsals and performance.

The Role of Players

The role of every one of the players has a responsibility such as:

-Each a high-grade specialist

-Directly to the conductor, without an intermediary.

-Each player has a responsibility not only on their technical and musical aspects of his own performance but also another player's performance.

Because of its flatter structure, the best example of a large and successful knowledge-based team and one without any middle management at all, will be the large modern symphony orchestra.

Cognition Process

The structural analysis of human ability to transfer stimulus such as aural, visual and other information into the cognition have been expected for long time. For example, the research focused on the individual differences including much variability among the subjects is presented as the Semantic Differential method. We briefly introduce the coordinated cognition metrics in the following algorithms (M. Murakami, 1990). Let the cognition items j for sample i by the subject k be denoted by x_{ik}, where i = 1,…,I j = 1,…,J k=1,…,K). $P_k(j, j')$ denotes the ability index of the subject k where (j, j') shows the covariance between the cognition items j and j'. This algorithm can be applied to the feedback system shown in Figure 11.

$$P_k(j, j') = \frac{\sum_{i=1}^{I} u_{ijk} u_{ij'k}}{I} \qquad (1)$$

$$u_{ijk} = \frac{x_{ijk} - \bar{x}_{\bullet j k}}{s_j} \qquad (2)$$

where $\bar{x}_{\bullet jk} = \frac{\sum_{i-1}^{I} x_{ijk}}{I}$,

$$s_{jk} = \sqrt{\frac{\sum_{i=1}^{I} (x_{ijk} - \bar{x}_{\bullet jk})^2}{I}}$$

$$s_{\underset{s}{j}} = \sqrt{\frac{\sum_{k=1}^{K} s_{jk}^2}{K}}$$

Feedback System

A feedback has to be built into the decision to provide continual testing against actual events, and relate them to the expectations that underline the decision. Seeking consensus and budding creative structures that favor consensus give feedback to each other, even if they know nothing about the other person's instrument. The building into the decision of the action on carry it out the thinking the boundary conditions and the solution that will fully satisfy the specification This is built into the decision of the action to be carried out. Converting the decision into effective action is usually the most time-consuming one, which is "Feedback that tests the validity and effectiveness of the decision against the actual course of events. A player's process scheme constructs a feedback system as shown in Figure 11. The ensemble process scheme includes an inner feedback system that constructs a player's process scheme. Generally, the dynamic characteristics of each feedback system are considered to form the first-order response character, so the dynamic characteristics of the ensemble will form the secondary-order response.

The trials by the large string orchestra

Can such a decentralized team exist and if so, can it actually make performance effective? P.F. Drucker suggested its possibility in some earlier examples, such as the symphony orchestra, and hospital.(P.F. Drucker, 2003). We proved the correctness of its possibility by our approach mentioned above through the trials of a large string orchestra. The organization structure of string orchestra without conductor is depicted in Figure 11.

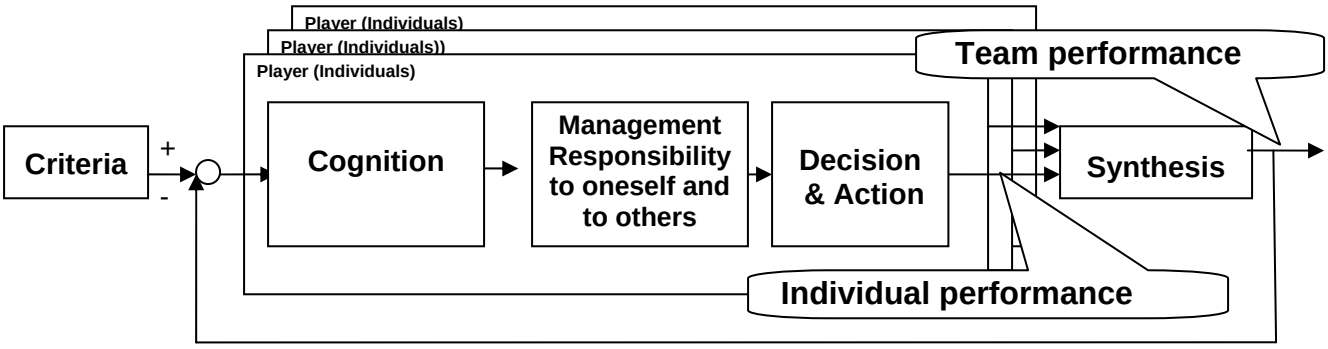

Figure 11. Process Diagram of String Orchestra (Decentralized Team)

We modify our approach described above for each player in the large string orchestra as follows;

Trial 1. Management responsibility to oneself:
To derive full potential spontaneity such as talents, inspiration, and energies of the individuals.

Trial 2: Management responsibility to others:
To cognize uncanny capabilities of the individuals for creating a unified direction as a whole.

H.E. Dickson suggested the importance of these player's responsibilities in an orchestra (H. E. Dickson, 1969). We assumed the two kinds of playing environments for the players to keep their independency from a conductor and other players in a same part.

-No conductor (Figure 12)

-Randomized allocation for each players

Each player sits down in random position and backward against the conductor's position. This arrangement does not allow every player to receive any visual information regarding to other players in the same section and a whole view of ensemble at a glance (Figure 13). Y. Mori has cognized and researched for long years how to derive the spontaneity, spark of human inspiration potentially possessed in the depth of musical player's mind. She has held the "Capacity Building Course" in Nagaokakyou Ensemble since 2001 in which each participant think oneself on the given issue and put its result to practice by playing a musical instrument and confirm each other, and consequently recognize their effectiveness. The trials mentioned above are the extension of this capacity building course and others.

The main objective of trial 1

The main objective is to derive full potential talents and energies of the individuals, which are not explicitly expressed under the existence of the conductor. This approach is needed in order to evaluate the quality of tone and harmonization of a code performed by a string orchestra. We evaluated the effectiveness of this issue by performing the simple codes without conductor. We required each player to have an open mind and devote oneself to create the better tone as an ensemble in a whole. This means that each player does not wish to play better than other players a commonly observed situation during internal competition in business domains especially

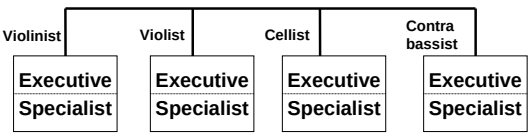

Figure 12. Organization Structure of String Orchestra without a conductor

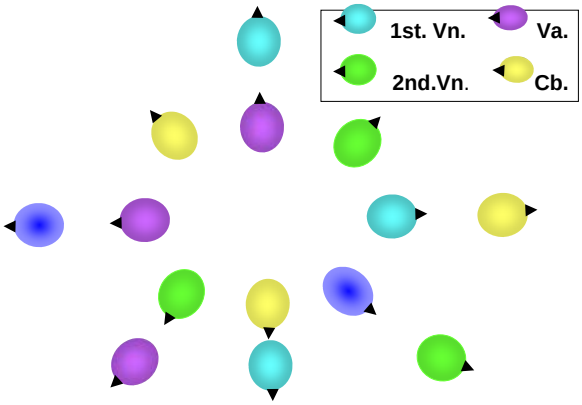

Figure 13. Backward (without a conductor), and Random Allocation of String Orchestra

The main objective of trial 2

The main objective is to cognize tremendous abilities of the individuals for creating a unified direction as a whole.

To make the objective simple, We selected the ritardando issues which is considered to be very hard to create the unified time-based direction under the ultimate environment for realizing the independency due to the conductorless and random allocation of each player.

Words for the modification of tempo, such as ritardando, fermata, stringendo and occasionally rallentando are employed for structural purposes to mark the beginning or end of a composition or a performance and sometimes used to enhance the expression of text where all of these changes of note value are slight nuances of expression. This problem of practicing a modified tempo is generally considered to primarily depend on the conductor's direction due to a deep dependency of visual information. This objective of this trial is aimed to prove the item of "Management of Information Responsibility to others. The intention of this tempo rubato was already transferred and exercised by the conductor in the rehearsal. "Tempo Rubato" can be altered for expressive purpose that deeply depends on its atmosphere of performance. Therefore, we could say also that criteria does not exist in a tempo rubato. We evaluated this problem in the piece of a part of the second movement, "Serenade for String Orchestra" composed by P. I, Tschaikovsky, Op. 48. as an typical and complicated example of the modification tempo in the Pieces. In the perception and evaluation/decision process, management oneself/to others take an important role to execute his performance. Basically it will be indispensable to adjust the time variant each other, while listening to the whole performance. However there is no better way to play other than to play with each player accord, while each player recognizes a time variant they perform together. Figure 14 depicts the part of modification of tempo with a notation of "Stringendo, Ritalrando, and Fermata,"

The rehearsals are performed prior to the execution of these trials and transferred the ideas, vision, and technical and musical precise are lectured and trained and each player obtained the consensus as result. The whole concept and detailed part in technical and artificial point of view was indicated and trained by Y. Mori in the rehearsals prior to the trails.

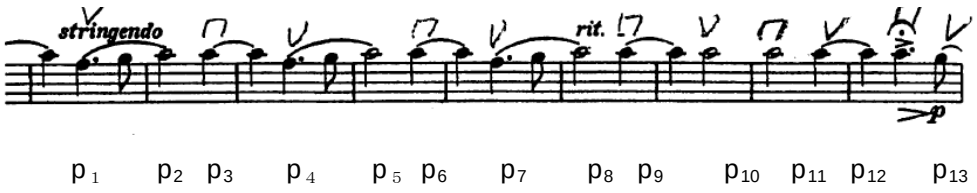

Figure 14. Phases of the second movement, "Serenade for String Orchestra" composed by P. I. Tschaikovsky.

The large String Orchestra

we executed the trials on this problems by the large string orchestra at the Prince Takamado Memorial

Orchestras' camp (The Federation of Japan Amateur Orchestras Corp.10th - 12th January 2004) lectured by Y. Mori.

Result of Trials

(1) Trial 1
Through several trials, player's talents and energies concentrate on the single goal of harmonizing a simple code that produced incredible clear tone that impressed and inspired many of listeners as well as each player. Through listening and confirming their performance, each player realized how important and effective they can become by taking the responsibility to play oneself.
(2) Trial 2
The tempo is modified according to the notation, "stringendo" and "rit" (ritardando). To measure the modification process of the phases, we annotated the measure points in the phase as $p_{1,...,}$ p_{11} in Table 1. The length of each point t_i , (i=1,.., 11)is measured in seconds, and the ratio t_i / t_{i-1} is computed and shown in Table 2. According to the notation on the tempo rubato, the sound volume is varied in accordance with the progression of modification of tempo. The average sound volume of each point, s_i is measured and the ratio s_i / s_{i-1} is computed and shown in Table 1.
The average deviations / each length are measured as the level of 3-5% which are in the same level with at the rehearsal with conductor. Each ratio t_i / t_{i-1} $_{(I=1,..., 9)}$ is within the level of -0.93 to 1.31, therefore keeping its linearity. Thus, each player can recognize the linear relation between each measured points which are played in one bowing. This estimation can be applied to the linearity of each ration s_i / s_{i-1} , where each player perceives the modification of each volume on P_i and decides the length of each measure point same as the case of ratio t_i / t_{i-1}.
However on the measure point p_{10}, p_{11}, we cannot determine it with the aid of numerical expression. The "Management Responsibility to others" encouraged the ability of adjusting the complex modification of tempo in the environment that no visual information could be obtained by the players. This evidence indicates the potential ability of the players relevant to the managing to others without any visual information.

Table 1: Result of Trial 2.

	p_1	p_2	p_3	p_4	p_5	p_6	p_7	p_8	p_9	p_{10}	p_{11}	p_{12}	p_{13}
Length of half note t_i (sec)	0.66	0.62	0.59	0.49	0.48	0.42	0.40	0.55	0.64	0.80	1.10	1.26	3.19
$Ratio \cdot r_i(t_i / t_{i-1})$	1.00	0.94	0.96	0.83	0.98	0.88	0.95	1.40	1.16	1.25	1.30	1.15	2.53
Sound volume s_i (Ratio)	1.00	1.01	1.05	1.11	1.23	1.35	1.34	1.31	1.25	1.17	0.95	0.67	0.45
$Ration \cdot r_2(s_i / s_{i-1})$	1.00	1.10	1.04	106	1.11	1.10	0.99	0.98	0.95	0.94	0.81	0.71	0.68

Lessons learned from the trials

(1)Trial 1
The correctness of our approaches are proved by the Trial 1 in which each player has management responsibility to oneself, i.e. each player is directly and personally responsible to produce better quality of ensemble tone and music itself.
-Player's potential passions, energies, and abilities can be impacted to the whole performance
-Awareness of this involvement leads to inspire and encourage each player and improve his performance.
This evidence suggests the unconscious player's ability for creating an essential of music.

(2)Trial 2
The correctness of our approaches is also proved by the Trial 2 in which each player has to take management responsibility to others players.

The player's ability to create the unified direction is proved even under the environment without any visual information except for the information obtained by the ear.
This evidence indicates the tremendous ability of the players relevant to the managing to others without any visual information.
The abilities of players who potentially possess, including their own idea, creativity, energies, passions and self-evaluation to improve for their performance are extremely inspired and expressed through the encouragement player's responsibility. In addition to this realization, we proved the unprecedented ability to collaborate themselves to ensemble in terms of tempo creation which is considered to be hard in general.

Future research

Our approach and trials can be applied to the other decentralized team such as government, business, research institute etc. in which the individuals generally lack the confidence and experience to delegate effectively in hierarchy organizations.
We briefly discuss how to apply this results of trails to other decentralize teams like business world or others.

(1) Research on design and process
Many of us have recognized that now is the time to start a new research to foster, to identify and to extend a core of human centric behaviors that deals with interdisciplinary research among the various disciplines including human science, engineering, and economics in collaboration with academia, Government and business facing with the problems of decentralization and its effective and efficient management

(2) Developing the methodologies and techniques
We need to explore and utilize the methodologies and techniques applicable to other decentralized are.

(3)Understanding
The action will be required as a forum for ideas, a center of knowledge and an exchange for information by extending the benefits of these trials and process to all who seek to understand and apply it in accordance with the defining principals.

(4)Training and Education
All employees and managers in decentralized organization should receive training in teamwork and team building based on the concept of practicing the information responsibility themselves.

(5)Applying our approach to other area.
Figure 15 depicts the possible cooperation with the international organization, many societies in the public, non-governmental, and private sector as well as the business, education, government who are seeking the evolution of individual.

Individual Centric Environment
As written above, an organization constituted by competent specialists cannot operate successfully without the capacity of "managing oneself" and "managing others." On the contrary, as long as all members have this capacity, the flat organization of versatile specialists could achieve self-synchronization and thereby accomplish the mission. We would like to denote such organizations as *"Individual-Centric Environmen*t."
The possible applications of our approach we argued above are not limited to decentralized teams. More importantly, it will make definite steps to encourage community participation who are developing a certain skill or competence for general upgrading of performance ability including many international organizations, societies in the public, non-governmental and private sector (Figure 15.).

Comments on the model
We envision that a realistic system may portray any one of the organization models shown in Figure 7. or combinations thereof. A flexible or a reconfigurable system can switch between these configurations to adapt to the changes in the application, communication environment and other conditions.

Conclusion

Service functions have matured, and have readied the most dominant position by entwining themselves with the advances of information and business technologies. .We considered four distinct types of team organizations, namely isolated, centralized or hierarchal, partially decentralized and fully decentralized. When the communication and computer processing costs are negligible, fully decentralized disciplines appear to be most congenial to the rapidly evolving technologies and economies.

We discussed the decentralized information-based team and verified the possibilities of its realization through the trials executed by the string ensemble with no conductor and randomized playing allocations.
These trials will also suggest the possibilities for the forthcoming decentralized information-based organization in business, governmental agency, and communities.

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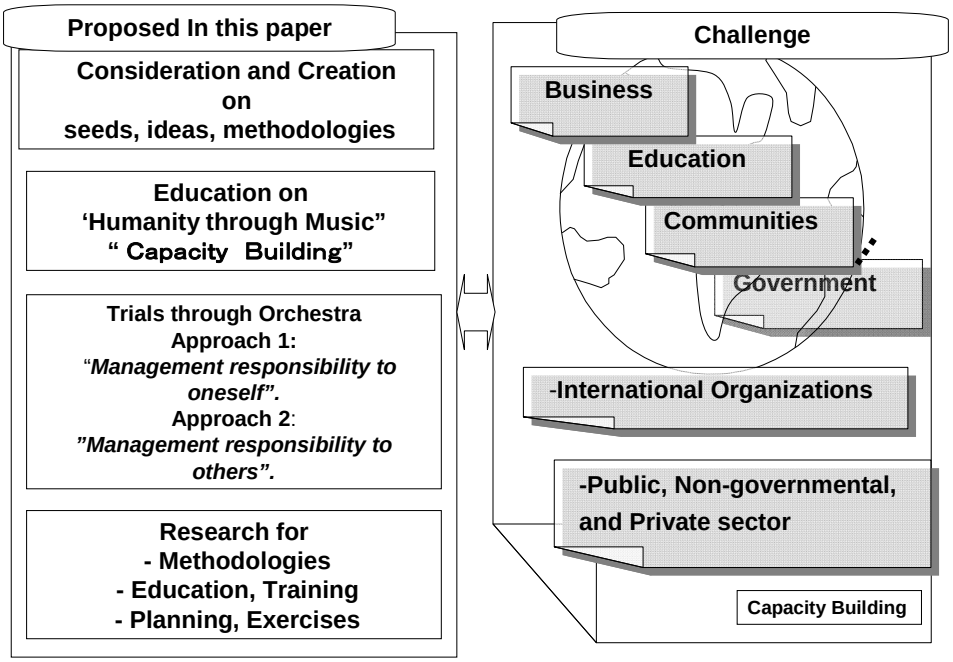

Figure 15. Cooperation with other areas

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