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Leonard Barolli *Editor*

Complex, Intelligent and Software Intensive Systems

Proceedings of the 17th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2023)

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Editor

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Editor
Leonard Barolli
Department of Information and Communication
Engineering
Fukuoka Institute of Technology
Fukuoka, Japan

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Welcome Message of CISIS-2023 International Conference Organizers

Welcome to the 17th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2023), which will be held from July 5 to July 7, 2023, in conjunction with the 17th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS 2023).

The aim of the conference is to deliver a platform of scientific interaction between the three interwoven challenging areas of research and development of future ICT-enabled applications: software intensive systems, complex systems, and intelligent systems.

Software intensive systems are systems, which heavily interact with other systems, sensors, actuators, devices, other software systems, and users. More and more domains are involved with software intensive systems, e.g., automotive, telecommunication systems, embedded systems in general, industrial automation systems, and business applications. Moreover, the outcome of Web services delivers a new platform for enabling software intensive systems. The conference is thus focused on tools, practically relevant, and theoretical foundations for engineering software intensive systems.

Complex systems research is focused on the overall understanding of systems rather than its components. Complex systems are very much characterized by the changing environments in which they act by their multiple internal and external interactions. They evolve and adapt through internal and external dynamic interactions.

The development of intelligent systems and agents, which is each time more characterized by the use of ontologies and their logical foundations build a fruitful impulse for both software intensive systems and complex systems. Recent research in the field of intelligent systems, robotics, neuroscience, artificial intelligence, and cognitive sciences are very important factors for the future development and innovation of software intensive and complex systems.

This conference is aiming at delivering a forum for in-depth scientific discussions among the three communities. The papers included in the proceedings cover all aspects of theory, design, and application of complex systems, intelligent systems, and software intensive systems.

We are very proud and honored to have two distinguished keynote talks by Dr. Salvatore Venticinque, University of Campania "Luigi Vanvitelli", Italy, and Prof. Sanjay Kumar Dhurandher, Netaji Subhas University of Technology, India, who will present their recent work and will give new insights and ideas to the conference participants.

The organization of an International Conference requires the support and help of many people. A lot of people have helped and worked hard to produce a successful technical program and conference proceedings. First, we would like to thank all authors for submitting their papers, the Program Committee Members, and the reviewers who carried out the most difficult work by carefully evaluating the submitted papers. We are grateful to Honorary Chair Prof. Makoto Takizawa, Hosei University, Japan, for his guidance and support.

Finally, we would like to thank Web Administrator Co-Chairs for their excellent and timely work.

We hope you will enjoy the conference proceedings.

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CISIS-2023 Keynote Talks

Evolution of Intelligent Software Agents

Salvatore Venticinque

University of Campania “Luigi Vanvitelli”, Caserta, Italy

Abstract. The talk will focus on the evolution of models, techniques, technologies, and applications of software agents in the last years. Rapidly evolving areas of software agents range from programming paradigms to artificial intelligence. Driven by different motivations, an heterogeneous body of research is carried out under this banner. In each research area, the acceptance of agents has always been at once critical or skeptical and enthusiastic for promising future opportunities. Nevertheless, the efforts have been continuously spent to advance the research in this field. One example is the semantic Web vision, whereby machine-readable Web data could be automatically actioned upon by intelligent software Web agents. Maybe it has yet to be realized; however, semantic enrichment of Web metadata of digital archives is constantly growing including links to domain vocabularies and ontologies by supporting more and more advanced reasoning.

Securing Mobile Wireless Networks

Sanjay Kumar Dhurandher

Netaji Subhas University of Technology, New Delhi, India

Abstract. The area of mobile computing aims toward providing connectivity to various mobile users. There is an increasing demand by users that the information be available to them at any place and at any time. This has led to more use of mobile devices and networks. Since the wireless networks such as WLAN and Wi-Fi require the use of the unlicensed ISM band for data communication, there are increased threats to users because the data may be modified/fabricated. Additionally, these types of networks are further prone to various other threats which may even result in cyber-attacks and cyber-crime. Thus, it is a need to protect the users/devices from such threats leading to loss of important financial data and in some cases leakage of important defense documents of certain targeted countries.

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to determine the optimal angle, proved to be more efficient than the conventional method for both routes, taking less time to complete. The measured time of the proposed method was shorter than that of the conventional method under identical circumstances. Notably, for each of the four measured times using the proposed method, the predicted time was longer than the measured time for the Megijima-Takamatsu Port route, while the predicted time for the Takamatsu PortMegijima route was longer than the time measured using the proposed method. One probable reason for the difference between the simulated and measured values using the proposed method is the inadequate calculation of wave effects. For future improvement, we suggest reducing the error by accounting for the angle of the head to the direction of the waves, the weight of the vessel, and the surface area where the vessel comes in contact with seawater while calculating the amount of deceleration, in addition to the constant speed deceleration according to wave height.

3.4 Future Issues

To operationalize the simulator, we propose the incorporation of GPS technology to obtain the current location of the vessel. We suggest the use of Google Maps JavaScript API Elevation service to discern between land and sea when navigating near islands. The Elevation service returns positive values for land coordinates and negative values for sea coordinates, which provides a basis for determining the terrain. Additionally, the simulation was conducted in Euclidean space, but the spherical shape of the Earth introduces errors when navigating. Hence, we recommend modifying the simulation program input in this study to operate based on latitude and longitude instead of Euclidean space coordinates.

4 Simulation Results

4.1 Ride-Sharing Allocation System

Twenty reservation records were generated, and a scenario was assumed where two vessels were allocated to carpool these reservations. The optimal carpooling patterns for each of the generated reservations were as follows. Although several combinations may lead to such patterns, the reward in both cases was 700, which represents the optimal solution. The test was executed with 100 training sessions, 10 operations per episode, and 1,000 trials. Table 3 displays the top three rewards that were frequently obtained after three runs of the program, each comprising 1,000 trials. The figures in parentheses specify the number of times the rewarding combination was chosen throughout the trials.

These outcomes suggest that the present program can allocate vessels to some degree, while it remains challenging to achieve an optimal resolution.

4.2 Optimal Path Finding Algorithm

An instance of a simulation that searches for an optimal route for a ship is presented, where the optimal route from the port of Naoshima to the port of Shodoshima is obtained.

Table 3. Results with 100 studies

	1st run	2nd run	3rd run
1	460(313)	450(271)	430(727)
2	430(267)	240(238)	450(196)
3	280(140)	230(165)	570(41)

During the analysis, a map image which depicts the departure and destination ports is loaded. Yahoo! Maps was used in the analysis. The pixel size in the Euclidean space was considered as 1 in the computation. Dummy data were employed for the tidal currents, where $(u_x, u_y) = (-1.8, 0.2)$ [m/s], and the east and north directions were consistently positive for all coordinates owing to the simulation area being small in the Seto Inland Sea. The wave height was uniformly set to $H = 1.5$ [m] for all coordinates as dummy data.

When searching for a potential route for the vessel, two paths are explored, one to the right and the other to the left, every time it maneuvers around an island. Hence, as the sailing distance increases and the obstacles between the departure and destination ports become more complex, an increasing number of potential paths will be searched. If some of the solutions diverge owing to obstacles or the vessel fails to reach the destination port altogether, or when a detour route is being investigated, the search may become protracted. Thus, an upper limit is established for the number of turns and solutions that do not converge or detours from the candidate optimal routes are excluded. In this simulation, when the number of turns reaches 30, the path is removed from the list of candidate shortest paths as an unsuitable path, and the next candidate path is sought. Figure 2 exhibits the simulation outcomes.

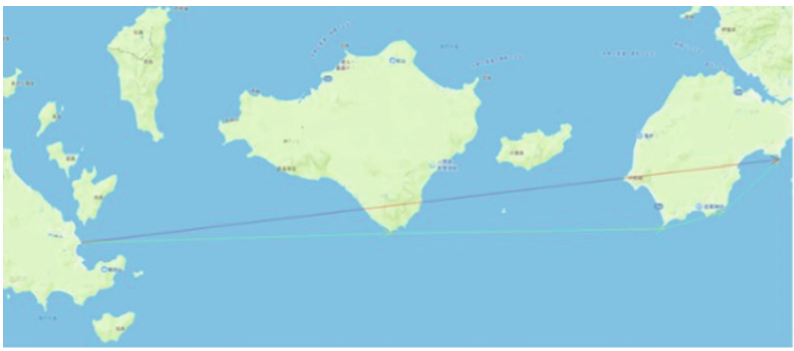

Fig. 2. Optimal route from Naoshima to Shodoshima

The upper arrow in Fig. 2 represents the straight line between the departure port and the destination port, whereas the lower arrow represents the optimal route between these two ports. The simulation outcomes are deemed accurate as they are equivalent to the optimal path that can be anticipated based on their appearance. Table 4 illustrates

the distance to be covered, elapsed time, and direction to be taken by the vessel at regular intervals once the optimal path has been established. While the optimal path is determined every 30 s in actual simulations, this paper showcases the simulation results of the optimal path at 5-min intervals. The last line of the Table 4 shows the time, distance covered, and direction of travel upon the vessel arriving at the destination port on Shodoshima Island.

Table 4. Simulation result

Elapsed time(min)	Distance traveled (km)	Direction of travel(°)
0	0	1.9678
5	2.9564	1.9678
10	5.9128	1.9678
15	8.8607	1.1696
20	11.7992	1.1696
25	14.7377	15.3546
27.9998	17.3100	41.8631

5 Related Work

This chapter presents related research. Firstly, we describe related work on The Sharing Allocation System. Kurozumi et al. [5] investigated a Min–Max type cab dispatching problem, considering shared-riding. In their study, they introduced a standard deviation into the objective function to minimize the longest route taken by shared cabs. To solve this problem, we proposed a new neighborhood operation, combined with the tabu search method. Our approach differs from the tabu search method in that we use the optimal combination for carpooling, rather than individual cars. While Kurozumi et al. evaluated combinations based on the shortest path distance, we evaluated a combination that satisfies constraint conditions as a superior combination, with a larger number of passengers on board.

Next, we discuss related research on the Optimal Path Finding Algorithm. Hukuchi et al. [6] used a time-optimal control method to find the voyage time of a ship, which minimizes the evaluation function. They obtained the optimal path by considering the effects of waves and ocean currents. In comparison, Hagiwara et al. [7] developed a simulation program using forward dynamic programming to calculate the optimal route of an aircraft. Specifically, they studied the flight performance of a Boeing 747,400 flying between Narita and San Francisco, and simulated optimal routes by clarifying the relationship between flight altitude, airspeed, and fuel consumption relative to aircraft weight. To find the optimal path, they set transit points at regular intervals between destinations and recalculated the optimal path while the aircraft flew towards the next transit point, rather than the original destination. Similarly, we applied this method to a small vessel, a sea taxi, in our research.

6 Conclusions

In this study, an algorithm to identify optimal routes from departure to destination ports was presented, aiming to enhance the efficiency of marine transportation. Initially, a route which circumvents obstacles between the departure and destination ports was planned, and subsequently, the direction of navigation was computed after compensating for environmental factors, such as currents and waves, along the route. In future studies, an additional function will be incorporated to enable the collection of real-time data such as tidal currents and waves, through an API, for practical applications.

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Issues and Challenges When Metaverse Replaces the Workplace

Ardian Adhiatma(✉), Nurhidayati, and Olivia Fachrunnisa

Department of Management, Faculty of Economics, UNISSULA, Semarang, Indonesia
{ardian,olivia.fachrunnisa}@unissula.ac.id

Abstract. This study aims to develop a conceptual framework that describes the essentials needed when an organization uses the metaverse as an alternative to virtual offices. Recent discussion in the existing literature widely concludes that hybrid working offers high productivity, wellbeing, and employee mental health. However, not all work types can be done through metaverse, while certain parts of work might be finished in the metaverse. Another discussion also offers that the metaverse as a place for leisure rather than work. Drawing from a review of the current literature and interviews with three senior leaders, we provide detailed insight ranging from essential needs to strategy for maximizing the metaverse as a virtual office, an action list to be taken by the top management team, and modifications to organizational policies and practices that can be considered for implementation. The specific outcome to be targeted in this research is to understand the opportunities and challenges of the future of work and workplace.

Keywords: Metaverse · Future work · Future workplace · Mental health · Wellbeing · Virtual environment

1 Introduction: Metaverse as Future Workplace

Mark Zukerberg has imagined a future working in the metaverse, with people teleporting as holograms present at the office, banishing the need for commuting. This can bring about a sense of awkwardness, as this vision promotes the 'feeling' of being in the room together, having a shared sense of space, and making eye contact. However, there are other uses of VR in the workplace, such as technical training, socializing, and onboarding. For Meta, the challenge will be understanding and proving where VR will make the difference. This continues to be an issue that they have not been clear about. Various research has been conducted on the advantages of the metaverse, with varying conclusions. There are also discussions on what must be prepared in order to implement hybrid offices. Additionally, issues on how much one can handle anxiety, migraine, and nausea as a consequence of virtual or hybrid offices linger to be solved. As such, there are still opportunities for a wider discussion on the chances of utilizing the metaverse as an option for virtual offices.

Numerous studies have proven that hybrid work positively impacts productivity. For instance, [1] mentions that working in the metaverse can help reduce issues with

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overpopulation and help maintain environmental sustainability. At the same time, [2] also suggests that the metaverse will accelerate the success of digital transformation in the workplace. Results from a literature survey conducted by [3] on employee experience in the metaverse provide a summary that the requirements on its infrastructure, such as text mining and analytics and data visualization, will become part of the hard infrastructure, and employee adaptability, as part of the soft infrastructure, is a vital elements in need of awareness. Aside from that, metaverse will be of frequent use in training programs and development [4], recruitment [5] and also within the area of customer service [6].

When various research and opinions state that the metaverse is an alternative virtual office that results in many benefits [7, 8], what do organizations need to prepare to respond to this phenomenon? This article aims to provide insights into what is needed in designing a metaverse as a hybrid or virtual office so that factors such as productivity and the mental health of each organizational member are well maintained.

2 Finding Insights: Methodology

To gain insight into these changes and how to prepare for them, we conducted a survey of 17 literatures with the theme of the future of workplace, metaverse as a workplace, the digital office, the virtual office, and essentials things towards hybrid works. In addition, we also analyzed the transcript of an interview with three senior consultants of leading executive search firms, published in YouTube and as a podcast. We did so understand how they perceived the changing role of leaders, given that they assist organizations in identifying the metaverse as an office alternative.

3 Essentials Need for Metaverse as Future Workplace

3.1 Digital Global Leadership

Global and digital leadership is an activity within cognitive competence that results in effective behavior that is effective in understanding digitalization prospects. Whereby they can carry out all their assignments with little to no obstacles due to the ease of digitalization. Each competent global leader will have a stronger instinct for managing relevant information, observing contextual signals, behaviors, and cultures, along with the capability to connect this information, resulting in a meaningful pattern. Global leaders can also develop a complex perception regarding their very own context of productivity. Global leaders differentiate between their work context and their work process, especially if a leader possesses the initiative to conduct change on a global scale.

3.2 Digital Ethics

The digital environment carries specific challenges for building communication and socialization ethics, which are then referred to as ‘digital work ethics’. As expected, we cannot easily convert the similarity between work ethics in the offline environment and work ethics in the virtual environment. Digital ethics have been discussed many

times in previous literature and are defined as a formulae system or rules in communication behavior for maintaining a relationship with other stakeholders according to their respective roles and positions both within the formal and informal relationship through the digital media. [9] defines digital ethics as individual values and ethical morals in using technology responsibly within the digital era.

In this research, we argue that leaders need to build digital ethics for spiritual engagement of employees. Since the possibility of work relationships in the metaverse is the limited of face-to-face interaction, this does not mean an ignorance of the importance of shaping employee engagement. By initiating 'digital work ethics' in the metaverse, we hope that employees will still engage with the organization's goals and values.

4 Strategy to Maximize Metaverse as Future Workplace

Our analysis from the existing literature and by observing a few transcripts on how to maximize metaverse as future workplace led us to the following three strategies that must be implemented by leaders:

a. Encourage the productivity

When organizations decide to carry out the hybrid working policy through the medium of a virtual office, leaders must assure the measurement of productivity and outcome that must be met by each member of the organization. Employees will be given freedom to finalize their work, utilizing the resources that are made available within the organization, and also make sure that work can be delivered in a timely manner.

b. Encourage the flexibility

The use of virtual offices offers flexibility in works schedule and pattern of executing work. As such, policies on the use of metaverse as a virtual office must be balanced with work flexibility. Research shows that work flexibility will work out when stabilized with work goal certainty, adequate facilities, and work characteristics that are capable of being completed from anywhere or working from anywhere. This work flexibility will make allow each member of the organization that collaborates in different location and different time zone to arrange a mutual decision in when and how they will carry out work.

c. Encourage the connectivity

However, each individual that is part of a virtual work team is a human. They possess the basic needs to socialize and connect with each other. When the metaverse becomes an option, leaders must make sure that sometime in the future, they can have physical rooms to socialize with each other and build emotional bonding. Nowadays, there are many applications and tools that can be utilized to facilitate affective connection in the virtual room. However, we argue that a physical office today is not only for completing work, but more than that, it is a room to socialize and fulfill connective needs both mentally and spiritually. Offices or work cubicles are not only defined as a place to complete work but more so as a 'value space and learning space', a place to increase the value that we have as human beings and also a place to continue learning to become a better self. As a 'value space' offices provide a social room for their employees, facilitate relationships, and create innovative collaborations.

5 Action List for Top Management Team

The following actions must be taken by the top management team when creating the metaverse as a virtual workplace:

a. Build shared understanding

   Shared understanding is an effort to create a similar understanding and perception among all individuals within an organization regarding the foundational philosophy of why the top management team creates the metaverse as an alternative. This is due to the possibility that not all departments within an organization are befitting of carrying out their work within a virtual space. This shared understanding can also prevent the presence of misleading information or jealousy.

b. Build shared identity

   This social identity in a virtual environment is important. Identity is a tool to understand individual actions, thoughts, and even individual feelings when joining a community. This virtual identity engagement will be beneficial for an organization because, firstly, when members of the organizations interact, they will share positive behavioral elements such as affection, motivation, and attributes that can increase performance, such as collective efficacy and a higher degree of team potential. Second, each member of the organization will compare their input and output within the organization. This is what is called social comparison. Each individual will participate in a competition to adjust their engagement in comparison with other members of the team. As such, it is clear that engagement built upon a shared identity in the virtual community will increase organizational performance.

c. Build Value Co-creation

   The third element that an organization requires to go fully virtual or hybrid is ensuring that each individual holds the same values. This value is not the sum of each individual's values, but rather a co-creation of values between leaders and members of the organization. In our previous research, we argued that value creation is the desired goal of the organization, to help it understand the needs of its members. If value can be created, then this effort will support rapid learning because experience among members is an efficient way to create value.

6 Modification of Organizational Practices and Policies

With regard to converting to hybrid work, we conclude that an organization needs to modify some organizational practices and policies. These practices and policies correspond to how an organization manages its human capital.

6.1 Gamified Based HRM Practices

Aligning with the increase in discussions on the metaverse as an alternative style of work office, the management of employees based on technology through the gamification approach will be appropriately fitting to implement in an organization. The gamification approach is an approach to human resources management based on games supported by the use of technology that exude relaxedness for employees and also increase their competence to innovate and capability to reach organizational goals.

We recommend that efforts to develop gamification concepts, including *gamified training, gamified compensation,* and *gamified performance appraisal,* will help increase employee *engagement.* Furthermore [10] also mentions that gamification positively impacts work engagement for employees who collaborate from separate workplaces.

6.2 Establishing Fundamental Religious Work Values

In relation to the new understanding of the office as a medium to socialize and gather, we then propose that spiritual work value will need to be built by the leaders. Spirituality is one of the most influential factors that is significantly related to employee attitudes, values, and behavior. It specifically describes the effect on the problems that exist in an organization, including the approach and decisions of managers and employees. Based on the above understanding, it can be concluded that spiritual work values are the application of divine values or concepts as an order in the organization so that they have good moral and ethical principles and can distinguish between good and right [11–13].

The outcome of spiritual work values has a positive effect on the meaning of work [12]. Employees who incorporate spiritual values have their own experiences at work. Spiritual work values are an essential factor in activities in the world of work to remind employees to always behave based on spiritual values. This is reinforced by previous research by [14]. In conclusion, the more employees who have high spiritual values at work, the more meaningful work will be, fostering a sense of meaning.

6.3 Prepare Individual Readiness to Change

If today we face a change in work characteristics towards virtual or even using the metaverse, then it is only a matter of time before there are many changes that will impact on business models, offices, and procedures for carrying out work in the future. The success of an organization in finishing the job more or less depends on individual readiness to change. Individual readiness for change is defined as the extent to which individuals are prepared to participate in different organizational activities [15].

As such, in order to prepare for the metaverse as an alternative to hybrid work, a collection of HRM practices and organizational situations must be arranged to drive individuals to possess a high level of readiness, in various situations and conditions that will trigger the change. A summary of our research findings can be described and illustrated in Fig. 1.

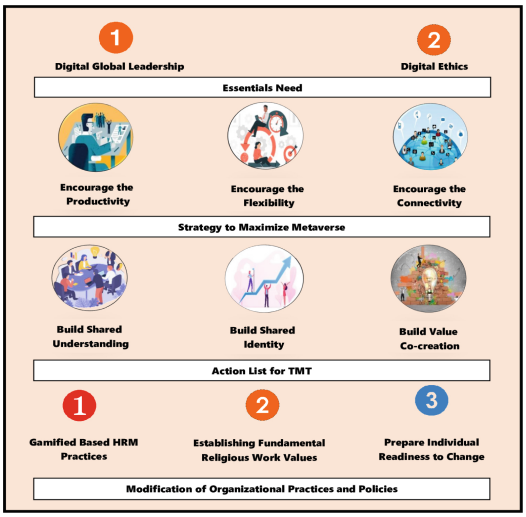

Fig. 1. Essential things for using the metaverse as a future workplace.

7 Conclusion

Our review offers insights into the essential needs for establishing the metaverse as a virtual workplace and provides some key strategies and conditions to be met. However, given the volatility of world work, we cannot guarantee that the pre-requisite conditions offered will remain the same for the next 5–10 years. The advance of virtual reality development may replace the leadership trait and style, the robot and machine may replace our whole work, ethical standards might be changed as well. However, we strongly recommend that spiritual values, especially those rooted in religious values, will take their place as basic fundamental values to catalyse any changes that occur within organization. Therefore, further research is needed to include how to select talent and prepare future leaders that are agile, adaptive, and empathetic to human needs in virtual environments.

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