Online Managerial Tools as Research Tools to Apply Artificial Management: Results of Research

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Abstract: Artificial intelligence (AI) can augment human intelligence in teamwork, however, it is still not clear how to implement artificial management. This rapid development of computer science gives opportunities to replace team managers with robots. However, it is still not possible to employ a robot in a managerial position. Therefore, the aim of this paper is to present a theoretical foundation for such an information system which could be widely used by human managers in their day-to-day work. At the same time, it could collect data on managerial work in order to implement artificial management. The research problem concerns the theoretical assumptions needed to design this solution. Two research questions arise from this research problem: (RQ1) What types of research methods should be used to collect data on managerial work? (RQ2) How to implement research methods into the managerial tools to make the managerial work automated? The research methods used in the paper are: literature studies, technical documentation of online managerial tools created by the author, and a long-term observation of human-managed teams. In Section 2 we present the theoretical foundation of research in management science which is the answer to the first research question (RQ1). Section 3 contains the theoretical assumption of the information system design which is the answer to the second research question (RQ2). In Section 4 we present examples of research conducted by the author as the practical use of answers to both research questions (RQ1 and RQ2). Section 5 includes conclusions on the use of the information system in artificial management. The main contribution of this paper is as follows: Firstly, to answer the first research question (RQ1) about the types of research methods which should be used to collect data on managerial work in order to make them automated. The answer is the mixed method as the most appropriate method to study what a manager really does. Secondly, the paper contains the answer to the second research question (RQ2) on ways of implementing research methods into the online managerial tools aimed at artificial management.

Keywords: Artificial management, Artificial intelligence, Information system, Research methods, Managerial work, Team management

1. Introduction

For the last 20 years there has been a rapid development of information technology, robotics and the replacement of people's work with machines or algorithms. Managers commonly work with electronic tools that facilitate their work whilst registering their work (Ewenstein, Hancock and Komm, 2016), e.g. in logistics processes (Dash, McMurtrey and Rebman, 2019), IT sector services (Keller, 2017) as well as team management (Davenport and Kirby, 2015). This rapid development of computer sciences gives opportunities to replace team managers with robots. However, it is still not possible to employ a robot in a managerial position.

Artificial intelligence (AI) can augment human intelligence in teamwork, however, it is still not clear how to implement artificial management (Flak and Pyszka, 2022). Research on AI shows that it could enhance human teams in the area of team coordination, knowledge sharing and learning, supporting decision making, as well as evaluation and team performance (Khakurel and Blomqvist, 2022). Additionally, the use of transformer-based language models in artificial intelligence (AI) has increased adoption in various industries and led to significant productivity advancements in business operations (Bouschery, Blazevic and Piller, 2023).

The idea of replacing human managers with robots has been shaped by the idea of an intelligent knowledge system in an organization (Davern, 2007). Nowadays, there are many information systems for knowledge management in organizations focused on sale, distribution or production (Yanchinda, et al., 2011). However, there is still very little research in the field of team management. Despite the fact that it is common to track activities of Internet users or some online applications (i.e. Google apps) and a wide theoretical background of knowledge systems in organizations and a large number of computer systems in companies (SAP, ERP), there is hardly any research based on online management tools in order to obtain data about managers' behaviours. It seems that there is a lack of a complex system of management tools for team management and collecting data for using pattern recognition of human managers' activities.

Therefore, the aim of this paper is to present a theoretical foundation of such an information system which, on the one hand, could be widely used by human managers in their day-to-day work, and on the other hand, it could collect data on managerial work in order to implement artificial management.

The research problem concerns the theoretical assumptions needed to design such an information system. Two research questions arise from this research problem:

RQ1: What types of research methods should be used to collect data on managerial work?

RQ2: How to implement research methods into the online managerial tools to make the managerial work automated?

The research methods used in the paper are literature studies, technical documentation of online managerial tools created by the author, and a long-term observation of human-managed teams.

In Section 2 we present a theoretical foundation of research in management science. Section 3 contains theoretical assumptions of the information system design which is the answer to the first research question (RQ1). In Section 4 we present examples of research results conducted by the author as the answer to the second research question (RQ2). Section 5 includes conclusions on the use of the information system in artificial management.

2. Theoretical Foundation of Research in Management Science

Saunders and Bezzina (2015) write that in organization theory (it seems also more broadly: in management science – author's note) two main epistemological positions are evident. The first is the positivist paradigm, which can now be called neopositivist (Ebneyamini, 2022). The second option is the anti-positivist one called the interpretivist paradigm (Saunders and Bezzina, 2015). These two approaches are quite separate in the management sciences, and they are even considered as opposites (Sułkowski, 2012).

On the one hand, the positivist paradigm is characterized by quantitative research methods, while the interpretivist paradigm is characterized by qualitative methods (Saunders and Bezzina, 2015). In the case of the positivist approach, the value of the obtained knowledge is measured by the following characteristics:

- representativeness, understood as the degree to which reality has been studied and the possibility of drawing conclusions about the larger collective of objects studied (Blackler and Brown, 1983),
- intersubjectivity, i.e. the possibility of obtaining the same results in different research processes of the same objects (Frankfort-Nachmias and Nachmias, 2008),
- unambiguity (Ying He, 2021), which means the facts in organizational reality are understood in the same way by most researchers.

In the positivist approach, knowledge is obtained by verifying (or falsifying) hypotheses about relationships between variables (Ying He, 2021). However, it is necessary to keep in mind the neo-positivist asymmetry of the reliability of verification and falsification, introduced to the scientific world by Popper (2002).

It is still worth mentioning that if at the same time a normative approach is used in the field of ontology in the positivist approach, a special term is used in the literature for this kind of perception of organizational reality. This perception is called the science of construction management (in the original, "the science of construction management") (Runeson, 1997).

On the other hand, the interpretivist paradigm highlights the importance of qualitative methods in research in the organization sciences. Van Maanen wrote in the 1970s that qualitative research does not have a clear meaning in the management sciences and therefore it is a set of techniques for describing, interpreting, decoding or inquiring into the meaning but not on the frequency of certain phenomena occurring in the social world (Van Maanen, Sorenson and Mitchell, 2007).

A qualitative approach may seemingly mean describing a phenomenon to the exclusion of numbers or any statistics. However, this is not quite the case. It is more about a multi-disciplinary, multi-perspective approach based on a deep interpretation of phenomena (Cassell and Symon, 2006).

Taking into account both paradigms, it can be said that the avoidance of quantitative approaches causes difficulties in identifying the causes of phenomena, specifically organizational performance. This is also the root of the conflict between management science and so-called business practice. This is because, from the point of view of practitioners, the explanations and recommendations formulated are not very specific, impossible to implement, and they are sometimes simply based on contradictory assumptions (Cepeda and Martin, 2005).

Returning to the current division of research approaches in the management sciences into qualitative (positivist paradigm) and quantitative (interpretivist paradigm), the literature offers the view that there are rare examples of combining these two approaches (Sułkowski, 2013). This is for the following reason: If one assumes that a measure of the quality of scientific inquiry is high intersubjectivity, it can be shown that a contradiction is hidden in the interpretative approach. Interpretation is subjective, as the word interpretation itself indicates. The researcher subjectively apprehends the reality being studied (Gillespie and Cornish, 2010). The main differences between the positivist and interpretive approaches in management science are shown in Table 1.

Table 1: Metatheoretical assumptions in positivist and interpretive approaches

Elements	Positivist approach	Interpretive approach
Ontology	The researcher and the reality under study exist separately.	The researcher and the reality under study are inseparable.
Epistemology	Objective reality exists outside the human mind.	Knowledge about the world is created intentionally based on human experience.
Object of study	The object of study has immanent characteristics that exist independently of the researcher.	The object of study is an interpretation created in the mind of the researcher based on his experience.
Method	Statistics, content analysis	Phenomenology
Theory of truth	Correspondence theory of truth: testing the veracity of claims against reality.	Truth is intentional: an interpretation of the object of study within the researcher's experience.
Tractability	Relevance is ensured by properly collected data about reality.	Claims about reality are defensible by the researcher.
Reliability	Reproducibility of research results.	The researcher's awareness of the role of interpretation of reality.

Source: Cepeda and, Martin (2005)

According to the positivist approach, there is a real object, which is organizational reality (Saunders and Bezzina, 2015). Despite such a simple and internally consistent approach to the object under study, there is resistance to use a quantitative approach in management science. The opponents' argument is that the object of interest in management science is human beings, the motives of their behaviour, social relations, organizational culture, knowledge, conflict resolution, creativity, etc. This fact at the same time is an argument in support of the thesis that a qualitative approach is much better.

From the early 1980s onwards, some researchers began to question the position of positivist epistemology in management science. At that time, there was also a turn to interpretivist approaches (Nodoushani, 2000).

Summarizing the comparison of these two scientific approaches, it is worth pointing out that representatives of the qualitative approach accuse "positivists" of seeking the truth. Despite the assumptions of objectivity of scientific inquiry, in fact, the obstacle was the perception of reality in a subjective way. However, the same scientists propose to use an even more subjective research method - the interpretative qualitative approach (Malina, Nørreklit and Selto, 2011).

Representatives of the qualitative approach also point to epistemological problems arising from the use of the hypothetico-deductive model, which falls under the quantitative approach. This model involves deriving hypotheses from general scientific theories and then testing them with empirical data analysed quantitatively (!). It is believed that the models formulated in this trend are fragmentary, and the models themselves are priori constructs.

In the literature one can find opinions in favour of a quantitative view of organizational reality. Nodoushani (2000) even argues on the role of positivist epistemology in management science that if we abandon the positivist model of science in management science, then at the same time we must conclude that this world of organizations is something different from the world of nature. Once again, it is worth emphasizing that the division into qualitative and quantitative is not right.

Taking into consideration these opinions and answering the first research question (RQ1) which concerned the types of research methods which should be used to collect data on managerial work, it is possible to say that a

mixed method is the most appropriate to use (van Dun, Hicks and Celeste, 2015). This is one of the assumptions of the system of organizational terms which is a research methodology designed by the author to study the behaviours of team members in order to implement artificial management (Flak, 2020). This concept is briefly described in Section 3.

3. Theoretical Foundations of the TransistorsHead.com and Artificial Intelligence

The idea of replacing human managers with robots can be shaped by the idea of an intelligent knowledge system in an organization (Davern, 2007). In order to build an information system which could be used as research tools in implementing artificial management, the system of organizational terms was designed and applied to the system of online management tools (TransistorsHead.com) (Flak, 2023). The concept was being developed and tested during 2007-2018. The results of the research was published in many papers by the author (Alnajjar and Flak, 2016; Flak, 2018).

The view of managerial work has been changed since the birth of scientific management. At the beginning of the 20th century the picture of a manager was defined by his classical functions (set of activities), such as a planner, an organizer, a motivator and a controller. 50 years later, the idea of a manager has been dominated by two approaches and it has lasted until today.

Firstly, Koontz and O'Donneil (1964) launched a discussion on the meaning of managerial skills. A few years later an approach in which managerial work was represented by managerial skills was proposed. The managerial skill was than defined as an ability to work effectively as a team manager in order to build cooperative effort within the team (Katz, 1974). Secondly, in 1980 Mintzberg concluded that the managerial work in a team can be described in terms of 10 roles within interpersonal, informational and decisional areas which were common to the work of all types of managers. He defined a managerial role as an area of job activity which is undertaken by a manager.

These terms still do not recognize what a team manager really does (Sinar and Paese, 2016). So that, it is not possible to recognize (1) a sequence of managerial actions done one after another by a team manager, and (2) their content. These two aspects are included in the second research question (RQ2), concerning a way of implementing research methods into the online managerial tools to make the managerial work automated.

It is said that artificial intelligence has emerged as a promising and increasingly available technology for managerial decision-making. With the adoption of AI-enabled software, organizations can leverage various benefits of the technology, but they also have to consider the intended and unintended consequences of using the technology for managerial roles (Leyer and Schneider, 2021).

Regarding outcomes, teams perform equally as well under both types of management, with trends towards even superior performance from the AI-managed teams. Furthermore, team members perceive the interventions from both the AI and human manager as equally relevant (Gyory, et al, 2021). Some research on mixed human–robot teams show that teams that comprise both robots and humans has expanded attracting the attention of researchers from different disciplines (Wolf and Stock-Homburg, 2022). However, there are many knowledge gaps regarding the characteristics of human-AI teams, including a lack of understanding of how certain human-human teaming concepts may or may not apply to human-AI teams and how this composition affects team performance (McNeese, et al., 2021).

When one considers the use of artificial intelligence to replace a human manager with an artificial manager, the recent new technology ChatGPT cannot be overlooked. ChatGPT literature is still in its early stages, comparable to the formative years of "early childhood", where the understanding of ChatGPT's traits remains in a state of immaturity.

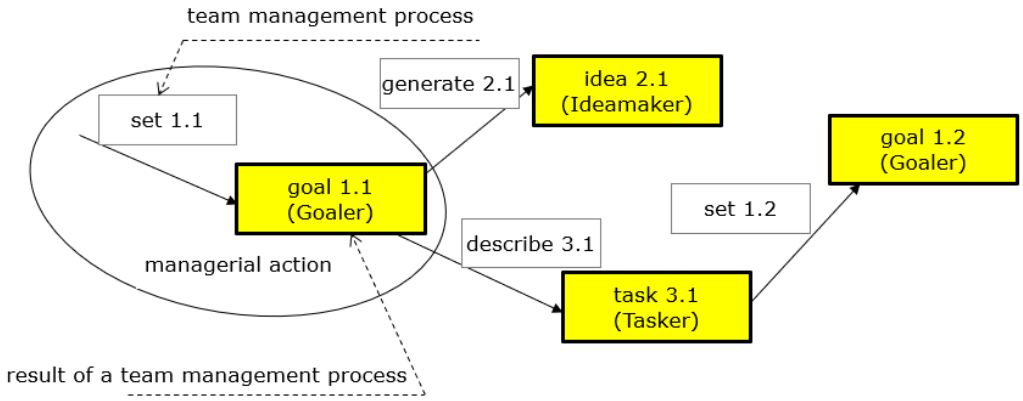
It is said, that there is a knowledge gap which the present qualitative enquiry aims to bridge, enlisting a diverse cohort of interviewees whose perspectives have contributed to a comprehensive philosophical framework for understanding the humanlike traits of ChatGPT in the role of a team manager (Lilly, Ismail, Abunaser, 2023). The point of contention of the current discussion is the Generative Pre-trained Transformer (GPT) models by the private company OpenAI. ChatGPT, a GPT-3.5-based application, has gathered much attention lately as of early 2023. ChatGPT can then be used to generate text by providing it with a prompt or a seed text, which it uses to generate a coherent and fluent response. GPT-3.5 and similar models can also perform other language-based tasks such as question answering, text completion and sentiment analysis. Thus, the model is, of course, not "thinking" but simply predicting what to say next (Burger, et.al., 2023).

However, ChatGPT has shown the potential of emerging general artificial intelligence capabilities, as it has demonstrated competent performance across many natural language processing tasks. Additionally, ChatGPT, as a type of generative AI, is a state-of-the-art LLM (Large Language Model) that is bundled with extensive capabilities which can enhance decision-making process, planning efficiency and AI-mediated communication fluency (Wong, Lian and Sun, 2023). What is more, ChatGPT has been one of the most talked about computer programs amongst management educators in recent weeks due to its transformative ability to change how assessments are undertaken and graded (Ratten and Jones, 2023).

Let's go back to the answer to the question of how to represent managerial work. As proved in the author's previous research, it can be found in the relationship between managerial roles and managerial skills. In order to play managerial roles a team manager should have some managerial skills. It results in the understanding of how playing managerial roles within their managerial skills by the day-to-day activities of managers', affect the managerial actions made by these managers. Therefore, the managerial action can be defined as a real activity, which a manager does in order to play a managerial role and have a certain managerial skill (Flak, Yang and Grzegorzek, 2017). The managerial action is a key term in the system of organizational terms.

The system of organizational terms is a methodological concept which consists of ontological and epistemological aspects designed for research team management aimed at artificial management. The philosophical foundation of the system of organizational terms is based on Wittgenstein's philosophy, his theory of facts (the only beings in the world) and "states of facts". According to this approach the organizational reality can be represented by events and things (Flak, 2020).

The system of organizational terms combines the resource approach and the process approach in the management science in a way that team management processes affect the team's resources. Therefore the managerial action is defined as a real activity, which a manager does in order to play a managerial role when he has a certain managerial skill (Yang, Flak and Grzegorzek., 2018), the managerial action structure consist of, e.g. event 1.1 and thing 1.1. It is shown in Figure 1.



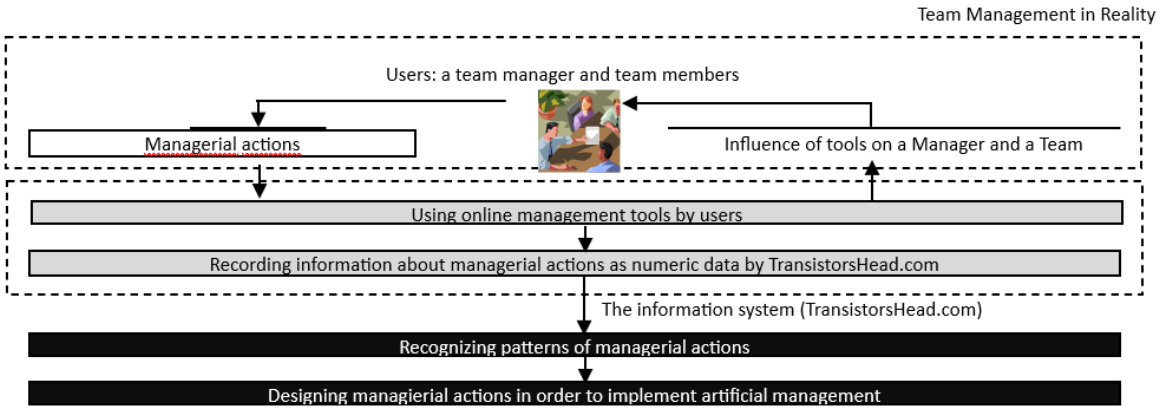
Source: Flak and Pyszka (2022)

Figure 1: The example of creating resources by processes in team management

As it is shown in Figure 1, when a team manager sets a goal (a team management process represented by event 1.1 – setting 1.1), it is possible to measure features of goal 1.1. If later (e.g. after describing a task – describing 1.1 and task 1.1) this team manager does the next setting of the same goal, he launches the next team management process. Then the features of this team management process are changed and represent the second version of this team management process (setting 1.2 and goal 1.2). The difference between features of goal 1.2 and goal 1.1. Let us do the reasoning on the team management process which happened in this period of time.

If it is only possible to measure things (e.g. goal 1.1), there should be a special research tool which could let us record the parameters of goal 1.1 keeping to the rule of minimum influence on a team manager. The solution is a research tool built into a management tool, which a team manager uses during day-to-day work. In other words, when a manager does something (e.g. set a goal) with a certain tool, this tool should record the parameters of the goal during the managerial work (e.g. before and after setting). This is the answer to the second research question (RQ2). The research method is built into the online management tools used by managers and their team members in their day-to-day work.

The Figure 2 shows a full course of the research methodology built into the information system included in online management tools and aimed at applying artificial management.



Source: Own elaboration

Figure 2: The use of the research methodology aimed at applying artificial management

4. Results of Research

The practical use of answers to both research questions (RQ1 and RQ2) as the results of field research are presented below. The information system TransistorsHead.com was used as a research tool to study behaviours of team managers and team members in order to apply artificial management. The results of the long-term observation is shown below. TransistorsHead.com recorded managerial actions of team management in 10 areas as follows: 1 - set goals (GOALS), 2 - describe tasks (TASKS), 3 - generate ideas (IDEAS), 4 - specify ideas (SPECIFICATIONS), 5 - create options (OPTIONS), 6 - choose options (DECISIONS), 7 - check motivation (MOTIVATION), 8 - solve conflicts (CONFLICTS), 9 - prepare meetings (MEETINGS), 10 - explain problems (PROBLEMS). The dashboard of the online management tools are presented in Figure 3.

Source: Flak (2023)

Figure 3: The dashboard of online management tools as research tools

The research was conducted from December 14, 2022 to January 14, 2023 among the students of the management faculty of Jan Kochanowski University of Kielce, Poland. The study involved 26 participants in 5 groups. Participants in the long-term observation were given the task of preparing the documentation for the program project on the YT channel in the Talent Show format. The task of the participants was as follows: formulate an organizing problem and solve this problem - propose a detailed format for the program and preparations for its implementation. Participants used the online management tools implemented in the information system TransistorsHead.com platform, including 10 online management tools, as shown in Figure 3 and described in the Section 3.

In this paper we show the example of one team, consisting of a team manager and 4 team members. Table 2 shows the total time spentusing the online management tools by each participant in this team. Table 3 contains the number of uses of each tool by individual team members.

For example, a team manager used a tool for setting goals (type 1) for 3792 seconds throughout the study (Table 2) and the goal-setting tool (type 1) was used by the team manager 141 times (Table 3). This does not mean that the manager produced 70 different goals. It means that he went back to the tool and worked on existing or new goals. It can be noted that team member 3 worked with some tools longer than the team manager, and also that team member 4 was hardly active at all while the team was working.

Table 2: Duration of a given managerial action taken by individual team members in seconds

User of online management tools	Type of managerial actions									
	1	2	3	4	5	6	7	8	9	10
team manager	3792	3092	3744	5670	1085	4916	3603	319	5605	5997
team member 1	365	5544	2567	2109	4644	786	1675	70	1957	4870
team member 2	696	1731	2826	1833	987	764	1837	405	1342	4943
team member 3	6550	2492	2814	1884	1215	652	1691	108	3285	3613
team member 4	0	0	375	0	0	0	0	0	1471	2395

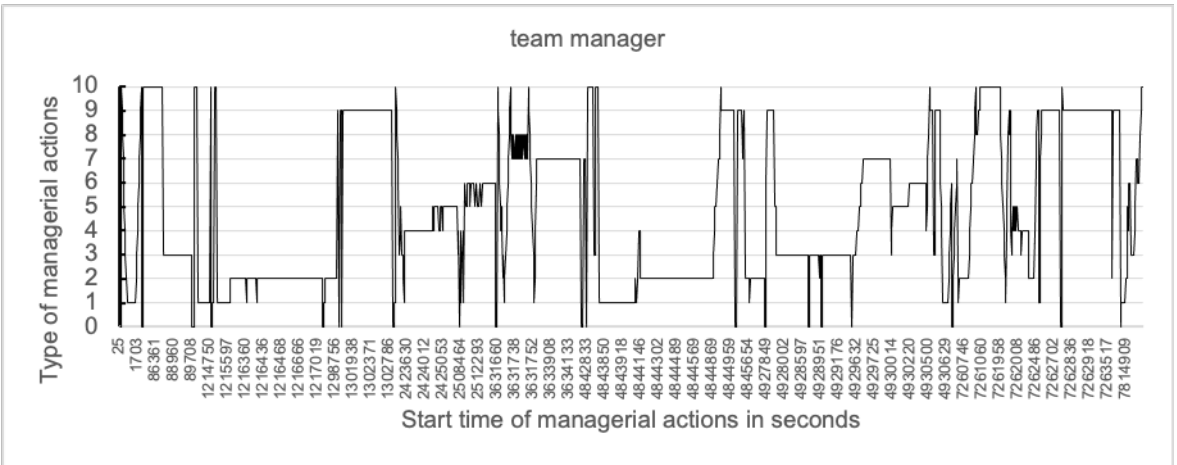
Source: Own elaboration

Table 3: Number of managerial actions taken by individual team members

User of online management tools	Type of managerial actions									
	1	2	3	4	5	6	7	8	9	10
team manager	141	324	179	96	96	84	138	32	254	93
team member 1	17	75	98	63	76	64	91	5	64	42
team member 2	13	31	97	53	71	71	89	10	31	38
team member 3	27	54	108	63	64	55	81	7	69	46
team member 4	0	0	30	0	0	0	0	0	44	6

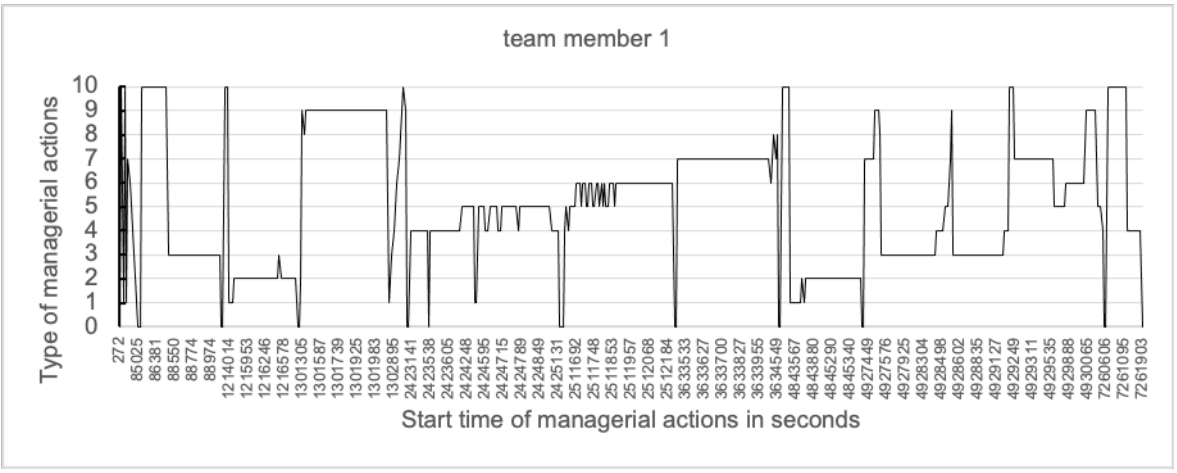
Source: Own elaboration

Figures 4, 5, 6, 7, 8 show the different trajectory of 10 managerial actions, recorded by 10 managerial tools in TransistorsHead.com in the team work period. The numbers in the types of managerial actions mean: 0 – no managerial action, 1 – setting goals, 2 – describing tasks, 3 – generating ideas, 4 – specifying ideas, 5 – creating option s, 6 – choosing options, 7 – checking motivation, 8 – solving conflicts, 9 – preparing meetings, 10 – explaining problems.



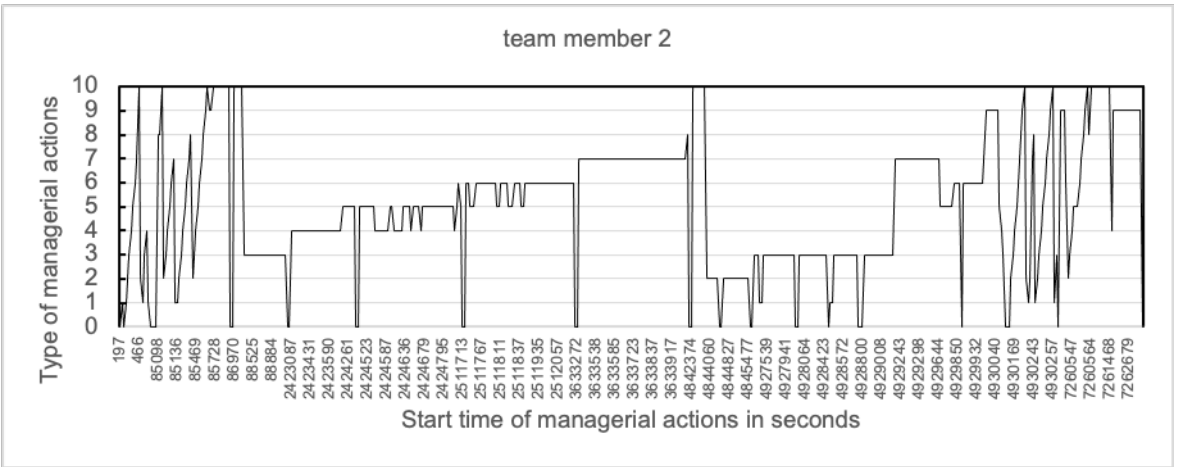
Source: Own elaboration

Figure 4: Trajectory of 10 managerial actions taken by a team manager



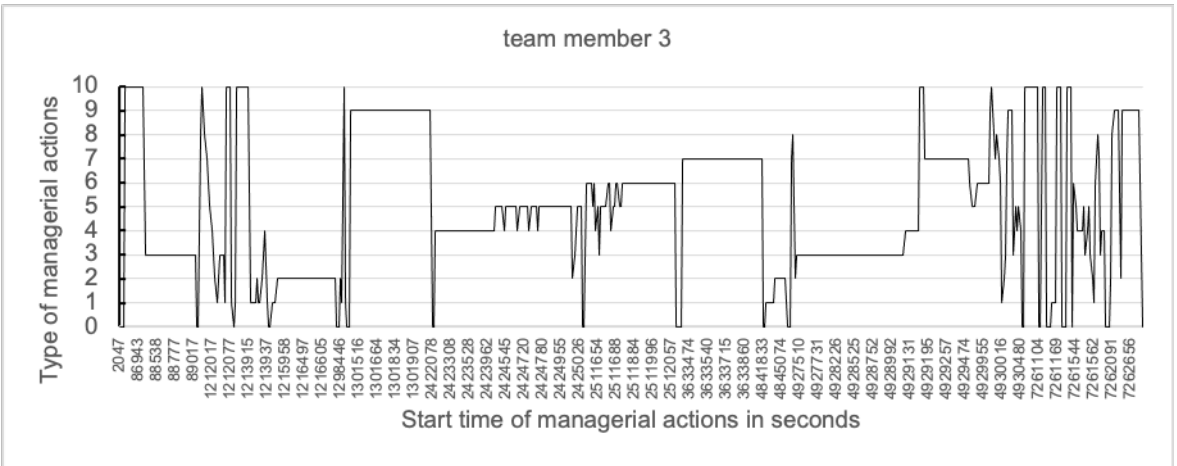
Source: Own elaboration

Figure 5: Trajectory of 10 managerial actions taken by a team member 1



Source: Own elaboration

Figure 6: Trajectory of 10 managerial actions taken by a team member 2



Source: Own elaboration

Figure 7: Trajectory of 10 managerial actions taken by a team member 3

Source: Own elaboration

Figure 8: Trajectory of 10 managerial actions taken by a team member 4

Interestingly, all team members' managerial actions had a different trajectory even when they were working on the same projects in the same team. This shows that the information system TransistorsHead.com can be used as a research tool to detect and collect data on human behaviour aimed at artificial management. Having recorded what a manager really does gives a necessary foundation to emulate his behaviour in team management, which is the practical use of answers to both research questions (RQ1 and RQ2).

5. Conclusion

The aim of the paper was to present a theoretical foundation for the information system which could be widely used by human managers in their day-to-day work and collect data on managerial work in order to apply artificial management. The content of this paper in Section 2 and 3 is the solution to the research problem which concerned the theoretical assumptions needed to design such an information system.

In Section 2, the answer to the first research question (RQ1) about types of research methods which should be used to collect data on managerial work was presented. The answer is the mixed method as the most appropriate method to study what a manager really does. The mixed method is understood as a combination of quantitative and qualitative methods.

Section 3 contains the answer to the second research question (RQ2) about a way of implementing research methods into the managerial tools. The answer is included in Figure 1, 2, and 3 as well as the theoretical and technical description.

In Section 4 there is an example of the practical use of the information system as a research tool which collects data on team management aimed at artificial management. Figures 4, 5, 6, 7, 8 show the trajectory of managerial actions which were taken by the team members. Having this set of data it is possible to emulate their behaviour which would lead to the automated managerial actions, as shown in Figure 2.

As the previous research of the authors proved that this approach can be used to apply artificial management (Yang, Flak and Grzegorzek, 2018; Flak and Pyszka, 2022), now ChatGPT shows the potential of emerging general artificial intelligence capabilities in team management automation. It has demonstrated competent performance across many natural language processing tasks (Amin, Cambria and Schuller, 2023). Additionally, ChatGPT, as a type of generative AI, is bundled with extensive capabilities which can enhance the decision-making process, planning efficiency and AI-mediated communication fluency (Wong, Lian and Sun, 2023). Therefore, the next step to implement artificial management seems to be a use of ChatGPT as an intelligent agent operating on the data collected by the TransistorsHead.com. This research approach is the next step in the development of replacing human managers with artificial management.

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