Organizing for temporality and supporting AI systems – a framework for applied AI and organization research

A data perspective on organizing temporary organizations combined with recent AI advancements and their potential combination.

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Abstract: Both temporary forms of organizing (TO) and artificial intelligence have recently received increased practical and scholarly attention [HW19],[Zh19]. Their combination has not yet been subject of research or research application, nor is there a roadmap to the development of TO-specific AI applications. In relation to permanent organizations, TOs devote more time to organizing, planning, and adapting to change, but supporting organizing as a task is not yet in the scope of AI research. This article creates new links between the domains computer science and organizational theory. It reviews TOs as special vehicles for organizing endeavors, proposes relevant properties, reviews recent AI research advances, and synthesizes challenges for researching into AI-assisted organizing in TOs. A table of use cases along with proposed AI methods and required data proposes future research activities and is basis for a call for data sets, data challenges and metrics for assessing AI-assisted organizing, especially in temporary contexts.

Keywords: Temporary organizations, artificial intelligence, organizing, AI-assisted organizing, lifecycle

1 Introduction

Temporary organizations (TOs) are organizations that have a pre-determined endpoint in time, after which they dissolve [SS20]. Typically, the organization ceases to exist when it has delivered its proposed value. For TOs, organizing processes and structures, realizing the necessity of changes to it, and reacting correspondingly is vital. Compared to permanent organizations, the effort devoted to changing the organization instead of delivering value is higher [SW20]. Permanent organizations have in recent years, partly due to digitalization, experienced increased market pressure to adapt to changes quickly. As temporary organizations are typically housed within or across permanent ones, they are affected by their environment similarly [HW19].

Methods of artificial intelligence have also gained popularity in recent years. Advancements in computing power as well as algorithmics lead to approaches that generate insights previously impossible to obtain from available data. Many of these are

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based on the idea of artificial neural networks (NN, [TV16]). These have proven to be able to recognize vague or hidden patterns in text, video, structured data, or their combinations, and to generate data that is of comparable quality as the input data [Br20], [Zh21], [Ga20], [Ra21].

Change in organizations has become a novel regular state, as opposed to the exception to the rule. With line-organizations being too inflexible to yield to change; projects are instantiated to induce change, cause agility and make structure more adaptive [Ma08]. Methods of artificial intelligence in general, and those relying on a neural network paradigm in specific, have influenced permanent organizations in several aspects already [TV16]. Meta-analyses reviewed the use of the applied technical methodologies as well as the areas of application. However, most applications revolve around business-related topics like customer or supplier classification, production optimization, financial or risk assessment, process control. To our knowledge, no study to date has taken into consideration the specific application in contexts of managing and organizing for temporality.

From a theoretical perspective, structuration theory aims at explaining the relation between actors and the structures they are confronted with, or part of [Ma08]. Actions are always to be seen before the context of structures, and structures as well as actions feedback onto each other. Actors may be aware of changes they induce, related to as “intentional” actions, of unintended side-effects may be part of the systematic answer of the structures, which is induced by “unintentional” actions of an actor. In a theoretical context of temporary organizations [LS95], it becomes clear that unintentional changes become more relevant, as knowledge about structures is inherently less stable, less documented and less assessable by members of temporary organizations.

From a practical perspective, other selected problems that are specific to temporary organizations are (cf. [SS20] for these and many others) that the objectives and goals of TOs are often unclearly defined and may only exist schematically in the minds of a few people. Also, TOs change comparatively fast in terms of structure, processes and people involved. Compared to line-organizations that aim at maximum efficiency, temporary organizations’ primary concern is effectiveness, which roots in cross-functional collaboration and causes communication efforts to expand, competing for bandwidth.

The problem domain in temporary organizing is therefore dissimilar from the business-related problem domains that have so far been tackled via artificial intelligence approaches. Both in theory and practice, a gap exists, that this article proposes to be filled with the help of a research framework.

2 Life cycles of TOs

'A temporary organization can be defined as an aggregate of individuals temporarily collaborating for a shared cause' [NHW17] (pg. 255). Temporary organizations have been attributed more specific properties, like novelty of the task they are designed to tackle, uniqueness of the endeavor [Ba10]. The most specific one is arguably, that the ending of the organization is defined, more or less clearly, and graspable for every person that is part of the TO [HW19].

TOs hence form and dissolve. The in-between has been described in different approaches. [LS95] Lundin and Söderholm relate to the Project Management Institute (PMI) to partition a TO's lifetime into the phases as described in table 1.

These phases have been widely adopted in TO research and have been used on various occasions to discuss in more detail about phenomena that TOs produce. But the phase labels alone remain too abstract to deduce problems whose solving process may benefit from AI methods. Therefore, a more descriptive phase-labelling is proposed, along its back-reference to the Lundin-Söderholm phase naming:

Phase name	**Lundin-Söderholm**	**Description**
Instantiation	Concept	Definitional begin-point, giving a cause to a TO.
Vision and goal formulation	Concept	Translating the TO cause into different formats, helping to convey an idea of endpoint of the TO and outcome caused by its actions.
Organizing	Development	Structuring the problem and solution space in relation to endpoint and outcome, deduction of organizational structure (teams, sub-teams, roles, etc.)
Planning	Development	Logically assigning work to teams and roles, forecasting resource usage and deducing time-consumption.
Value creation, coordination, and communication	Implementation	Resources working on assigned work with the aim to long-term reach what was understood as goal and objective. Passing information for reasons of coordinating work and provision educts for subsequent combination into products or services the TO is supposed to produce.
Intervention and adaptation		Adaptation of the TO system (structure, processes) in reaction to external or internal impulses and realization thereof.
Termination	Termination	Termination phase

Tab. 1: Proposed TO phase framework

Like Lundin and Söderholm described for their phases, the actions taken and decisions made in each phase are not without overlap. For example, instantiation and vision and goal formulation are intertwined as different levels of detail of visions are being formulated. The presented approach foresees an individual phase because TOs typically have to spend substantial amounts of time on identifying requirements and expectations as to the overall objective and outcome, which is in part re-negotiated during that phase [LS95].

3 TO-specific challenges and TO latent space dimensionality

At the very core of any TO lies the challenge, that it is new [SW20]. However, TOs are typically not completely “new” in terms of the people that interact with each other. They make implicit use of shared mental models that their members previously established, putting more emphasis on a relational perspective of TOs [Ro20]. These models help to address some challenges easier or quicker. However, in comparison with permanent organizations, the relevance and impact on effectiveness of shared mental models, mindsets etc. is greater than that of structures and processes [Ma20].

Mindsets, shared beliefs or values as beliefs [Ma20] are latent constructs and not easily defined; however, they seem to be what make e.g. agile teams perform often better from the start [GT19] and are therefore highly relevant. As such, they are unfortunately not directly observable. But they leave behind patterns in the actions and the artefacts or TOs. These patterns should be reoccurring throughout all types of TOs, but they will probably not be found repetitively within the lifetime of one TO. This makes data gathering on them very difficult, as one has to compare (many) TOs in similar life-stages and in similar situations and between similar actions. Measuring the patterns in TO organizing is not per se a high-dimensional problem. Miler and Gaida only identified 50 potential items with which to assess agile mindsets in organizing work in temporary contexts [MG19].

Proposition 1: Latent constructs of low dimensionality exist that cause patterns in organizing TOs along their life cycle and are comparable between TOs, e.g. mindsets.

In practice, structured approaches like project management methodologies, or even simple heuristics like copying known structures as a basis for organizing temporary teams [Mi16], help modeling TOs on a level that is abstract enough for integral consideration yet at the same time detailed enough to allow for effective organizing. Often, they come with templates for specific artefacts that serve as (non-IT) tools in organizing, like organizational charts.

Even special types of assisting software like project management suites offer support in digitalizing TO organization. However, diligently setting these systems up is itself a time-consuming task. In addition, IT systems may be helpful organizing tools for some stakeholders, but at the same time are not adequate channels of communicating TO properties for others.

Proposition 2: Although solutions exist for storing organizational structures of TOs digitally, their level of detail is typically limited. For an encompassing view on TO organization, additional unstructured data, like that of human communication, must be considered as well.

As soon as TOs start their existence and organizing takes place, feedback of the environment and from internal feedback loops is perceived and processed. The TO is then in a collective state of permanent learning: every TO member learns about facts, opinions, beliefs, visions, objectives, plans of others that they interact with as well as micro-political dynamics, internal and external relationship dynamics, requirements etc. [AS01]. TOs constantly adapt in the light of those continuously gained new insights. Thus, the TO's organizational structure and its plans could be updated continuously. Due to the many different dimensions of organizing and planning, many artefacts must be adapted, quality-assured, communicated, received, acknowledged, understood, and accepted among all affected members of the TO and potentially outside stakeholders.

Proposition 3: The effectiveness and efficiency of inducing changes to the organization and plans of a TO is dependent on effective and efficient communication of the necessary changes to each of them. This in turn relies on proper, consistent documentation.

4 TO-specific artefacts

Project management frameworks define in varying levels of detail artefacts that are used to facilitate the statement and communication of structures, processes, plans and ideas. E.g. the Project Management Body of Knowledge, the PM2 framework, the V-Model XT, or Prince2 all define deliverables that are used to give meaning and direction to TOs. On the other hand, many TOs likely start off without selecting a project management standard. In these cases, TO management relies on self-made documentation that serves similar purposes: define structures and plans.

Drawing from prior work experience, numerous experts in the field agree on the point that none of the given professional project management frameworks is unique concerning the hard organizing artefacts. All of them handle goals, requirements, structures, processes, responsibilities and so on in compatible ways that would be translatable from one framework to the other with little complications.

Proposition 4: Regardless of the standards employed, TO organization and plan artefacts are semantically similar, while their formats may differ.

Some examples of artefacts used for organizing and planning as observed in practice are listed in the following. The listing is naturally incomplete but was enhanced by descriptions regarding typical forms of information contained within them, with the help of TO and project experts.

Artefacts	Description	Typical formats
Project charter	Mostly textual description of the projects initial situation, problem setting, goal, expected outcomes, approach.	Written text document, potentially enriched by 2D graphical imagery as alternate means of communicating relevant relations

Artefacts	Description	Typical formats
Organizational charts	lines and boxes, names of persons, organizations, potentially responsibilities	2D representation, boxes confining individual actors or groups of actors, lines representing relations
Approach descriptions, process descriptions	high-level process descriptions with phases, steps, responsibilities, differing formats possible (BPMN, etc.)	2D representation to include time as (abstract) dimension, shapes may have specific meaning
WBS	Named work packages, responsibilities, forecast for work effort / duration, due dates, buffers, dependencies	2D representation similar to organizational charts, boxes/shapes confine work packages and related information; spreadsheets and tables with similar data
GANTT charts	Similar to WBS, with added time dimension	2D representation to WBS, dependencies may be made explicit through lines between shapes
Work plans	Tables with work packages, dates, amount of work, available time, start and end dates, deadlines, dependencies, responsibilities	Spreadsheets/tables from spreadsheet or planning software, potentially exported in raw formats, potentially also screenshotted and pasted in emails (2D graphical representation from underlying data)
Work packages descriptions	Mostly textual descriptions of work packages, outlining approaches and necessary steps to produce outputs	Textual descriptions, potentially with header information in tabular form, enumerations
Status reports	Reports with header information about reporting cycles, traffic lights symbology for status, prose text or bullet-point formatted information about previous and upcoming activities, risks and decision needs, information on work packages and milestones	Mixed formats, prose, enumerations, imagery, symbology, 2D graphic representation

Tab. 2: TO artefacts, descriptions and analyses of structural formatting aspects

These artefacts may be embedded within other communication structures like emails, meetings, presentations and thus have communicational contexts that they relate to.

All these artefacts are logically connected through the management frameworks that define them. So, there is an underlying logical structure that defines the relation between all these documents. It is dynamic and prone to changes over time. As an example: the TO management is bound to report, therefore status reports exist that relate to work packages, working times, milestone dates, etc. This information can be described as data models of graph-like structures that build up as the TO starts to organize and adapts as TOs reacts to external impulses.

Proposition 5: All organizing artefacts are bound together by a logical structure. Functions exist that reflect upon the rules according to which the TO is organized and continues to adapt its organization.

Such structures can be represented as knowledge graphs [Al20]. Such graphs help computerized methods access and process information stored within them – and deep NN approaches have been shown to successfully operate on such graphs. Researchers have recently shown that creating knowledge graphs helps with strategic planning in text-based gaming problem settings. Therefore, potential is seen that such approaches may also help in real-life planning [Ad20]. The context elaborated here, however, calls for specifically adapted, complex graph structures with extensive attributes and properties that reflect upon organization of TOs – TO organizing graphs (TOOG) – in the sense that it holds encoded information about its structures and plans.

Proposition 6: TO organizing graphs should be conceptualized. They are the basis of intelligent systems which make use of various AI methods to support organizing.

Proposition 7: Intelligent systems are proposed that support TO organizing in such ways, that:

- They generate TOOG from any TO organizing artefact.
- They generate useful and overall-consistent organizational artefacts.
- They identify conflicting relations between two TOOG efficiently and act as consistency checkers.
- They merge non-conflicting TOOGs efficiently.
- They propose decisions to bring about consistency when conflicting TOOGs are compared.

In the following section, the article reviews selected recent advancements in AI research that show potential for further development into functions on TOOG. Afterwards the article continues to map such approaches to TO lifecycle stages and useful implementation scenarios, before requirements towards corresponding data sets and TOOG are discussed in more detail.

5 Review of recent advances in AI methods

Stunning research advances have taken place in the discipline of processing both image data and written, natural language. The immense progress in accuracy, precision, as well as reliability largely rely on deep learning methodologies or deep neural networks. Noteworthy sub-categories of image processing through artificial neural networks are image labelling, image captioning, image (semantic) segmentation, object detection and bounding box generation within images e.g. with YOLO or COCO, and others [Zh21]. AI methods that are applied are artificial neural networks (NN), convolutional NN, recurrent NN, LSTM cells, deep NN, but also transformer approaches have been applied successfully [Do20]. Typical inputs can range from "low" parameters spaces, with e.g. 27x27 pixels of 7-bit greyscale imagery in the typical MNIST data set for handwritten numbers of which 50.000 labelled examples exist, up to high resolutions of 640x480 in more than 200k RGB-colored pictures e.g. for the COCO data set [Li15].

Text analysis and knowledge extraction is the text-based correspondence to this type of image processing described. Through text analysis, knowledge from within the texts can be extracted, e.g. by means of named entity recognition, disambiguation, alignment, or linking, instance extraction, fact extraction, relationship extraction and more. Rule-based approaches have exploited just as the more recent transformer-based deep NN approaches [Al20].

Equally intriguing is the build-up of AI capabilities of processing text, i.e. natural written language. With hundreds of billions of parameters, the latest autoregressive models can produce written texts, while only consuming few words, or even questions, as inputs. OpenAI's GPT-3 is one example of this [Br20], just as open-sourced alternatives like GPT-Neo or GPT-NeoX. After using convolutional or recurrent neural networks, also LSTM techniques had been employed in natural language processing tasks. Often, auto-encoder approaches have been used. A major leap forward was attained by introducing the transformer models, that allows algorithms to learn and choose for themselves what context to consider while selecting words and sequences that produce the final text. It is a specific type of auto-encoder or at least relies on encoder-decoder mechanisms inherently [Va17]. In a similar fashion, data-to-text approaches, e.g. based on the ROTOWIRE data set [Wi17] attempt to create review texts for NBA basketball games from given raw datapoints, that appeal to the reader as if humans had written them. Other typical task types of natural language processing include classification, (sequence) labelling, summarization, but also question-answering, part-of-speech tagging, fact-verification, relational extraction, topic modeling, named entity recognition, translation, and many more. Publicly available data sets and code exist in high numbers (https://paperswithcode.com/).

The combination of both techniques discussed before has recently shown astonishing results: text input and image generation were combined to generate images from text. As an example, given the input "a tapir made of accordion" generates an image of a fictitious animal with a typical tapir face, four legs and a torso that looks like the typical accordion bellows [Ra21]. Other examples of translation of diverse inputs into images have been explored before, for example drawing realistic images from sketches [Gh19] (https://arnabgho.github.io/iSketchNFill/), [Ga20].

In TO organizing, helpful use cases would be to get relevant results for a request like "a work breakdown structure, containing only work packages that external companies account for". One might critically remark that this use case might as well be solved by a mere filter on a table of work packages in a project management IT system. A counter argument, however, would be that GPT-like networks contain such factual table-data within their billions of parameters just as well.

Another example for a combinatorial challenge of working on image/graphical as well as textual data is the research by [Co21]. They attempted to identify structures in tables (given as 2D visual structures) to extract the relevant data from the individually identified cells. They too rely on CNNs and YOLO, amended by OCR methods to obtain very good results on recall, precision, and F1-Scores.

Looking at it from a user-perspective, works like that of [Gh19] prove that AI research is far from being theoretical only. Interactive user interfaces allow for direct interaction with the AI algorithm, allowing for the creation of meaningful output in a (wo)man/machine co-creative manner. However sketchy the input of the user may be, the AI model takes care that the output reconciles both user requirements given as an input, as well as semantic soundness as good as possible. See for example StyleGAN by Härkönnen et al., StyleFlow by Abdal et al. [Hä20] [Ab20]. The TO Organizing Graph proposed in the previous section would attempt to build such underlying structures for AI algorithms that attempt similar things to those discussed in the previous paragraphs. A corresponding use case would e.g. be to obtain organizational charts with different views, like different levels of detail, or structural choices like the order of sub-projects displayed.

6 Use cases of AI in TO contexts

The presented research shows how usable AI methods have become for practical use cases, and that there are data sets, data challenges as well es metrics for researchers to work with and measures against. TO research needs an AI research roadmap, including corresponding data sets and challenges for researchers to respond to.

In the following, this article lists on one page a conceptual model that combines TO lifecycle considerations with one to two challenges that, AI models should have the potential to tackle successfully. Implications for data sets are amended, indicating challenges to data set compilation for future TO/AI research as proposed above.

The challenges described below can be grouped into areas of analysis and generation. Analysis serves the aspect of understanding input and creating underlying TOOGs [Hu20]. Generation focuses on text generation, image generation or a combination of both in the sense of combined artefact generation. Also, translation/transformation of inputs in diverse formats are proposed. Multiple challenges describe varying inputs, like text or graphical documents that are to be translated into other document types. For some challenges, this process is described as reliant on underlying data structures like the TOOG described above.

Lifecycle phase	**Challenges**	**Proposed AI methods**	**Data requirements**
Vision and goal formulation	Create summaries of various lengths of project charters, combining	knowledge graph extraction, training on graph	Project charters and additional information

Lifecycle phase	**Challenges**	**Proposed AI methods**	**Data requirements**
	textual descriptions of project endeavors.	neural network in conjunction with learned embeddings of textual descriptions, GPT-like translation (e.g. into a modeling format)	(proposals, contracts), masked/tagged according to relevance for different levels of details for project descriptions
Organizing	Create work breakdown structures, organizational charts, graphical depictions of planned approaches (one-page summaries) from textual descriptions, sketches, tables in conjunction with available text of vision and goal formulations.	knowledge graph extraction, training on graph neural network in conjunction with auto-regressive text-generating NN models, GPT-like translation (e.g. into a modeling format)	All of the above, plus work breakdown structures, work package descriptions and org charts labelled according to accuracy of depiction
Planning	Create time-plans (tables with dates, GANTT charts, milestone lists, etc.) that rely upon conventional knowledge of typical lengths of phases or work package (i.e. workshop series typically last weeks, not hours, workshops last hours not, months), but also on several textual inputs (project charters, work package descriptions) allow for real-time regulation.	Graph neural networks with underlying knowledge graphs from previous phases, neural rendering or auto-regressive text-generating NN models, GPT-like translation (e.g. into a modeling format)	All of the above
Value creation, coordination, and communication	a) Screening texts (emails) for risks regarding timelines; observe	Multi-label/multi-class classification of text, especially conversations	Conversation in chats/emails, documentation like protocols,

Lifecycle phase	**Challenges**	**Proposed AI methods**	**Data requirements**
	email/chat/document content for sentiment analysis, risks, compatibility of technical detail levels; b) Summarizing weekly/monthly activities for status reports in different levels of detail.	with multiple participants; relation extraction regarding causalities wrt/ to time planning; auto-regressive text-generating NN models, GPT-like translation	text documents like concepts, presentations
Intervention and adaptation	Process proposed changes to TO organizations (plans and structures), in textual or graphical depictions, work breakdowns, timelines, milestones and dates and create consistent adaptations of existing artefacts.	Knowledge graph regression, image segmentation, semantic extraction, extractive text summarization, question answering, fact verification	Segmentation masked inputs of intervening graphical content, like counter-proposed project plans or organizational structures; labelled texts that propose different organizing as compared to current organizational structure.
Termination	Summarization of the core results of the TO in various lengths and depths of detail, e.g. for a final project report. Qualitative review of vision, goals, organizational structures, plans as they changed over time.	Text summarization, text regression, data to text / table / image translation	All deliverables mentioned above

Tab. 3: TO Lifecycles, AI challenges and methods and data requirements

7 Data requirements, collection and further research

To tackle the challenges outlined in this article, useful data sets need to be compiled, and data challenges need to be thought up that help develop useful algorithms and define novel methodological approaches that generate value for contexts of organizing for temporality.

The data requirements described in the table above summarize as follows. Artefacts like organization charts, project charters, work package descriptions, visual representations of approach concepts, documented communication, external plans, etc. must be collected in an artefact collection. The files should be categorized and attributed with meta-data that can be referenced. The meta-data should encompass artefact type, timestamps, authorship (pseudonymous), keywords, short descriptions, comments, communication, plans whether they effectively influenced the TO, whether they did so partly, or not at all, and more.

The references would occur from within a TO organizing graph. This type of data structure serves as a database that holds information about the organizational structure of the TO in a more formalized form. It should contain information about beginning and end of the TO, so it can synchronize with timestamps within the artefact collection. The TOOG should be versioned, so that ideally for every timestamp of each artefact within the artefact collection, there would be a version. More versions should be allowed, because some artefacts would cause the factual TO organization to change with delay.

Viewing it from the perspective of some of the described challenges, parts of the data set would need to be enhanced even further, e.g. through masking of visual plans or concepts so that e.g. algorithms could be guided to specific parts that developed influence onto the TO organization. The data set and data set creation could also be made subject to AI algorithms, in that it would profit from automated, consistent pseudonymization.

8 Conclusion

This article laid out the specific management challenge of organizing temporal endeavors and the dynamic nature of temporary organizations. Typical artefacts that are created while organizing in TOs have been listed and described. Through a series of propositions, it was argued that AI methods can support TO organizing tasks. Recently developed AI methods have been reviewed in the view of their potential to provide valuable output for TO organizing tasks. Corresponding use cases in terms of challenges for future researchers have been proposed. The necessity for a unique data set for researching the use and potential of AI in TO organizing was argued, basic requirements towards such a data set were proposed. This article calls for further development of such a data set and consequently corresponding AI research.

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