Organizational Memory Systems: Challenges For Information Technology

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Abstract
Organizations subsist on communication and coordination. An organization’s ability to remember and learn from its past, in other words, its ability to use its “organizational memory” has been around for centuries as a means of learning, exchanging and accumulating knowledge to help the organization realize its objectives. Successful organizational memories have been described, for example, for copier repair technicians [27] and midwives [20]. In these, and similar, cases, members of an organization learn by participating in the activities of the organization. In such communities of practice [22], learning results from working in a community and in learning to speak the vocabulary of the community.

Organizational memories are generated and used in communities of practice with little, if any, explicit effort devoted to their development. Information technology offers the promise of helping to build and use such organizational memories. For the most part, however, this promise is unrealized. In this paper, we explore why this is so and consider the challenges to developing and maintaining organizational memories.

1 Introduction
Organizations subsist on communication and coordination. Whether the organization is a multinational conglomerate with a centuries-old history or school children playing soccer at recess, success of the organization depends on the ability of its members to communicate and coordinate. Communication and coordination provide the means to produce and store information that the organization needs. Information technology offers the promise of helping to build and use such organizational memories. For the most part, however, this promise is unrealized. In this paper, we explore why this is so.

An organization’s ability to remember and learn from its past, in other words, its ability to use its “organizational memory” has been around for centuries as a means of learning, exchanging and accumulating knowledge to help the organization realize its objectives. Successful organizational memories have been described, for example, for copier repair technicians [27] and midwives [20]. In these, and similar, cases, members of an organization learn by participating in the activities of the organization. In such communities of practice [22], learning results from working in a community and in learning to speak the vocabulary of the community.

Organizational memories are generated and used in communities of practice with little, if any, explicit effort devoted to their development. Learners often encapsulate knowledge in stories [22]. Organizational memory is a side effect of learning; and learning, in turn, derives from working in a community. Recent attempts to use new ideas and new technologies to support the generation and capture of organizational memory have, for the most part, not improved on existing practices. In fact, technology seems often to hinder, rather than facilitate, forming organizational memories. In this paper, we review the challenges of developing and maintaining organizational memories and explore the reasons why technology does not seem to help in their formation. We begin by examining the concept of organizational memory. Then, we consider approaches to building organizational memories. Finally, we consider the challenges to developing and maintaining organizational memories.

2 Organizations and memory
In this section, we consider how to define organizational memory. Although this is a very difficult problem, it is an appropriate first step. Then, we note that organizational memory cannot be separated from organizational learning; the two are
tightly intertwined. Finally, we propose a framework for discussing approaches to organizational memory.

2.1 Organizational memory

Organizational memory is concept that has no single, universally accepted definition. A web search engine, for example, will return thousands of “hits” for the phrase organizational memory, but it is difficult to tell how any of the retrieved items relates to any other.

In the most general sense, organizational memory is concerned with being able to reuse an organization’s experience [2]. Ackerman and Halverson [2] also noted that early efforts assumed that organizational memory could be considered “as though it were a single, monolithic repository of some sort for the entire organization.” Davenport and Pruzak [11] define knowledge as “a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.” Further, they note “In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms.” Schein [31] defined organizational culture as the organization’s “embedded memory.”

As these definitions highlight, organizational memory is more than just simple information. In communities of practice, it is a combination of experiences and skills about projects, products and decisions that is more often embedded in the minds of the workers, or entrenched in the organization’s culture as tacit knowledge, rather than stored in formal documents, reports and manuals as explicit knowledge.

Others caution about using the term organizational memory. Ackerman [1] is critical of the reification of the term memory, asserting that people may forget that it is a metaphor and expect technology to remedy the failings of human memory. Brown and Duguid [4] express similar concerns and wonder whether information technologists have promised more from technology than is possible.

While proposing a unifying definition of organizational memory is beyond the scope of this paper, two aspects of such a definition will be highlighted and will guide the discussion in the remainder of this paper. First, organizational memory is concerned with the reuse of an organization’s experience. Second, providing effective organizational memories is not a problem that information technology has solved and, perhaps, one that information technology alone is incapable of solving.

2.2 Organizational learning

Typically, most organizations consider learning, as an activity that is separate from working. Brown and Duguid [4] discuss the impact of an organization’s view of learning on the effectiveness of its employees’ activities. They argue that not only is learning inseparable from working, but that individual learning is inseparable from collective learning. Individuals share their experiences through stories with other individuals who work in the same or similar environments. These stories are used to exchange experiences and knowledge among the other individuals within a group or community setting. These groups are sometimes identified as “communities of interpretation” or “communities of practice” because it is through the continual development of these communities that the shared means for interpreting complex activity are formed, transformed and transmitted. In addition, the communications and interactions of the people within these groups changes over time as the demands of the working environment force the group to revise knowledge in accordance with the changing needs of that environment. An important goal of an organizational memory is to facilitate the interaction within these communities so that it can foster the organization’s learning objectives.

2.3 A framework for organizational memory

In use, an organizational memory system can be described in terms of two major components - the acquisition and retention of information and the search and retrieval of information.

Knowledge acquisition and retention. Memory acquisition describes the process of collecting and gathering memories, codifying or organizing them, and placing them into memory stores. The stories frequently used within communities of practice satisfy this requirement easily. Many organizations, however, are not comfortable with stories that “float free” in the environment and seek to create a more permanent record. Creating such records may cause loss of information, however, since the information in the story is processed and this processing is often done by “knowledge managers”, who may not be expert in the practice of the knowledge.

Davenport and Pruzak [11] outline four basic principles to guide the codification of organizational knowledge: (1) managers must decide what business goals the codified knowledge will serve, (2) managers must be able to identify knowledge existing in various forms appropriate to reaching those goals, (3) knowledge managers must evaluate knowledge for
usefulness and appropriateness for codification, and codifiers must identify an appropriate medium for codification distribution. While these principles may be necessary, we wonder if they can be sufficient without explicitly involving the people who are expert in the practices of the knowledge.

Locating the sources of the organizational knowledge is a challenging task, because sources for both tacit and explicit knowledge need to be identified. Within a community of practice, shared practices make it clear who probably possesses the knowledge that is sought and, even if the initial starting point does not yield the answer, information foraging [28] from that point will likely lead to the answer.

Within a community of practice, it is relatively simple to create a knowledge map, showing who knows what. Within an organization, this is typically much harder. While organization charts exist, they are not always helpful in this respect, because they show reporting hierarchies and not where knowledge resides.

**Storage and retrieval.** An important part of an organizational memory is its ability to store information and permit users to retrieve this information, as they need it. These memories can exist in either a tacit (implicit) or explicit form.

Individuals hold most of an organizations memory in their own minds as tacit or informal knowledge. Their knowledge and expertise is based on their skills and experiences. They remember projects they have worked on in the past, and they know and understand how and why certain decisions were made in the organization’s past projects. Their memory of these decisions and how they were used to resolve problems enhances their effectiveness in their current projects and jobs. This type of knowledge is usually elusive and difficult to reproduce.

Within an organization, explicit knowledge is often retained in manuals, formalized reports and documented processes that contain information about action-outcome theories, explanations or predictions of the organizations projects or products [34]. An organization can also take advantage of external sources of knowledge stored in repositories such as shared databases, knowledge bases, or even the Internet [34]. These more traditional memory repositories are difficult to sort out. The stories used within communities of practice describe the context in which the knowledge is to be used and this context aids in retrieval. When information is moved to a database, however, the contextual information is often lost.

## 3 Approaches to building organizational memory systems

Four basic approaches to building organizational memory systems are summarized below. Interestingly, the first three are the dominant approaches in the research literature, but there are no claims of prolonged outside of a laboratory context; the final approach, for which claims of actual use can be made, is built on traditional information technology concepts.

### 3.1 Design rationale

Design rationale captures the history of the arguments that are associated with design decisions. The goal of systems based on argumentation is to structure the communication between individual designers and also record the reasons underlying design decisions. It is this “why it came to be the way it is” knowledge that is of value to the community of practice. The focus of these approaches to design rationale is not so much to describe what the system is, but why it came to be the way it is.

The information in design rationale systems is typically structured formally; in IBIS [30] and gIBIS [7] it is structured in terms of issues, answers, and arguments, while in QOC [24] it is structured as questions, options, and criteria. In DRL [23] the structures are equally formally but much more elaborate.

Judging from the number of papers describing methods for capturing design rationale, this concept has a great deal of intuitive appeal. However, while many currently claim that design rationale will have value, there are few studies suggesting any value. For example, one issue of the journal *Human-Computer Interaction* was devoted to the issue of design rationale. Of the six papers in this issue, only one [7] described the application of design rationale to a real project and presented anecdotal evidence that it was of value.

Why is an idea that has such broad appeal on both theoretical and intuitive grounds used so little? We believe there are two reasons; one related to the way knowledge is managed and one related to the knowledge workers, themselves. Within communities of practice, knowledge is often stored as process. For example, stories highlight the process by which work is done not the artifact that is produced. With design rationale schemes, there is a clear focus on process, but the process is used to structure the knowledge that is then embedded in an artifact. That is, knowledge is not embedded in the process. Further, because the process that is used to structure knowledge is not part of the normal work process, extra effort is often required to
use it. This violates the "benefit-work rule" that governs collaborative efforts. That is, benefits should go to those who do the work. With existing schemes, however, designers do the work, but others benefit; as a result, this work is not done well or not done at all. We will return to this problem later.

### 3.2 Scenarios

Scenarios describe how a system will be used. As reported by Guindon [17], scenarios of use are often used by software designers to enhance their understanding of the requirements or to find faults in the design (see also [5]). Curtis, Krasner, and Iscoe [9] also noted "designers needed operational scenarios of system use to understand the application's behavior and its environment" but also that "these scenarios were too seldom passed form the customer to the developer."

Why, since scenarios of use are close to the stories that are found in communities of practice, are they not a better medium of communication and knowledge sharing? We believe this is because the primary intent of scenario development has generally been to facilitate understanding, not communication. Because building an understanding is based on what a person or group of people already know, scenarios for understanding do not represent what is known so much as they represent how currently unknown aspects interact with those that are known. In a sense, scenarios for understanding are egocentric, in that they focus on individual understandings. Scenarios for communication need to be group-centric and represent what the entire group knows. Scenarios constructed in a collaborative fashion, rather than by individuals, would be more likely to fall into this category.

### 3.3 Domain-oriented design environments

Domain-oriented design environments are similar to design rationale systems in that they embed knowledge in artifacts. They go further, however, in providing environments in which these artifacts can be used to solve design problems. Conventional software development environments are domain-independent. General purpose programming languages and tools are used to implement solutions. Because the languages and tools are closely tied to the implementation, the system builder is lead to focus more on problem solving activities than on problem understanding. Domain-oriented design environments [14] are intended to allow the system builder to focus more on problem understanding by providing primitives ("building blocks") that relate to the problem domain and provide a "language of doing" [13] that supports communication among all those involved in system development.

A shortcoming of the domain-oriented approach, we believe, is that information about the intended uses of domain objects is lost or, at best, passively stored, once the objects are developed. For example, the Janus system [15] supports kitchen design and much thought and attention was given to how an object, such as a "stove", "sink" or "refrigerator" interacts with other objects. In effect, the builders of this system had a model of how kitchens operate and how objects interact and this model was a basis of communication among the developers and users of this system. That model, which provides context, is not apparent, however, to someone who was not involved in originally defining the object. While this information could be encoded as agents ("critics"), this is a separate encoding of the information and may be subject to translation errors.

### 3.4 Organizational memory information systems

An organizational memory information system [32] is built from traditional information technologies, such as databases and telecommunications links. The intent is to use this "superstructure" provided by information technology to capture and disseminate knowledge within the organization.

Wijnhoven [34] describes three case studies of organizational memory information systems – Veronica Broadcasting, Andersen Consulting, and Nationale-Nederlanden General Insurances. While all three systems were apparently used, there is little data that would support their usefulness. While we do believe that these systems were useful, we note that the descriptions focus primarily on capturing and storing information.

Zimmermann, Atwood, Webb, and Kantor [36] describe the Knowledge Depot system that is built on top of a Lotus Notes platform. This is an organizational memory system that has been in use for several years and is deployed at 25 locations through six states in the United States and supports over 2000 users. While these authors acknowledge that data collection is difficult, some evidence for the usefulness of this system and its ability to meet organizational goals is provided.

Additional systems are reported by Domingue and Motta [12] for an academic setting, by Szykman et al [33] for a government setting, and by Corby and Deing [8] for a corporate setting. Although evidence of actual use is scant, it is apparent that these systems were successfully fielded in non-laboratory settings.
4 Challenges facing organizational memory systems

Challenges to developing successful organizational memory systems fall into three primary areas. First, there are challenges related to managing the knowledge. Second, there are challenges related to the people who generate and use the knowledge. Finally, there are challenges related to practices used to build systems.

These challenges have in common that they focus more on organizational goals than on technical goals. We believe that a major reason why more organizational memory systems have not been fielded is a clear focus on the technical goals and the related tendency to define technical goals independently of the goals the organization has for the technology. Clearly, there can be no technical success without organizational success. Technical goals must be focused more on overcoming organizational obstacles than on overcoming technical obstacles. The focus on purely technical goals often leads to overlooking the fact that organizational memory technologies need to be designed specifically to suit the needs of the organization for which it is intended [26].

4.1 Managing formal and informal knowledge

Maintaining a process perspective. Managing informal and formal knowledge is one of the most obvious challenges facing the development and implementation of an effective organizational memory. In order to do this effectively, Conklin [6] suggests that organizations shift their view of knowledge from its current artifact-oriented perspective towards a more process-oriented view. We concur with this suggestion.

Informal knowledge is wild and untamed, and is usually very difficult to capture. While the stories within communities of practice capture this knowledge readily, they do so because the stories describe the process of doing work. When process is transformed to artifact, useful process information is lost. An organization’s view of informal knowledge can also affect how easily or difficult it is to capture and process that knowledge. Many business cultures, for example, value output from processes that it can see, such as documents and reports, and, as a result, a less tangible form of knowledge that focuses on process is not considered valuable output.

Preserving document context. Communications technology and document processing tools add another dimension to the complexity of the organizational memory challenge because they do not easily retain the context of documents. Most of these systems lack the ability to capture the rationale and the context behind traditional artifacts, which are the glue that connects otherwise meaningless piles of documentation [6]. A word processor for example, can produce documents that look well organized and polished, but ignore the extensive thinking that lies behind the document. Eventually, an organization is left with collections of these types of documents, which are lifeless without the context and history behind them. Developing the capability to retain the context behind these artifacts will provide organizations with the opportunity to build useful organizational memories.

Further, knowledge has a lifetime. That is, knowledge that is relevant at one time is not necessarily relevant at all other times. Storing relevant information is a key requirement for any organizational memory system. Storing too much information, however, will reduce the “signal to noise” ratio of relevant data and make retrieval of relevant information less likely. Deleting information that is no longer relevant is a much harder requirement to meet than initially storing that information.

Providing relevant knowledge. Retaining the context of organizational memories will inevitably ease the process of locating relevant knowledge to meet the specific needs of a knowledge seeker. Knowledge loses its relevance and thus its value over time (cf, Conklin, [6]), and the challenge of an organizational memory is to sort through the available information and recall whatever information is relevant for any particular inquiry. Again, the context in which knowledge is useful must be retained in the organizational memory.

Maintaining social context. In their book The social life of information, Brown and Duguid [4] highlight the fact that information exists within a social context and, once that context is lost, the information loses value rapidly. They acknowledge that while information technologists may be aware of the importance of social issues, they find it extremely difficult to integrate these issues into a computer system. Similarly, Ackerman and Halverson [2] propose that organizational memory researchers look where knowledge actually exists in an organization rather than looking for areas where technological enhancements might be applied. These authors advocate research on the social-technical gap, “the divide between what we know we must support and what we can support technically.”

4.2 Challenges related to knowledge workers

Knowledge workers play a significant role in the development, implementation, use and maintenance of any organizational memory. There are a number of
challenges related to knowledge workers that must be overcome before an organizational memory can be successfully implemented in any organization.

**Work vs. benefit.** There is a disparity that exists between the users who put their effort into maintaining a groupware tool for organizational memory, and the users who actually benefit from that application [18]. Take for example, a customer service representative who has to update a knowledge repository, as part of his daily work process. He or she may not necessarily benefit from the existence of the knowledge contained in that same repository in the same way that the Customer Service Department head would. Ensuring that most users will find benefit in the organizational memory, and thus be encouraged to contribute to it, and take advantage of it will reduce this disparity.

**Information capture difficulties.** In a wide review of design rationale systems, Regli, Hu, Atwood, and Sun [29] note that capturing information presents significant difficulties for organizational memory systems. One concern is how to capture information with minimal overhead and with the least interference with the natural progression of work that an individual is involved with. A second difficulty is how to resolve the conflicts that arise when new information captured is in opposition to information previously captured. That is, the system needs to note that the context in which information is valid no longer applies.

**Disruption of social process.** The implementation and use of groupware solutions for organizational memory can lead to activities that violate the organization’s social taboos, and threaten existing political structures. (cf. Orlikowski, [25]) As a result of this disruption of the organization’s social processes, there may be a decrease in usage by the bulk of the employees whose participation is directly related to the successful implementation and maintenance of such a system. If users begin to feel like their job security is threatened because they have been sharing their knowledge, they will become reluctant to use the organizational memory.

**Adoption process.** The process of adopting groupware applications into a system must be handled carefully; the users that will benefit from the organizational memory must participate in the design and development process to ensure that the system will meet their needs.

In addition, acquiring significant user participation in the use of the organizational memories is necessary to validate the decision to maintain organizational memories [18]. The challenge of maintaining a critical mass of workers who utilize the organizational memory is one that must be overcome by developing an organizational memory solution that most users feel will meet their specific knowledge needs. This solution must be implemented without creating undesirable repercussions to the users (i.e. loss of job security, additional stress because of additional organizational memory activities etc.).

Increasing the users’ awareness of the organizational memories and encouraging users to use it and contribute to it is also a difficult task, because the group memory has to be marketed to them in such a way that it appeals to each individual according to their specific knowledge needs [36]. The users’ involvement in the development of the organizational memory system will go a long way to support the creation of an organizational memory that users feel they can use. Their participation in the design process will ensure that their requirements will be included and implemented into the final design.

**Resource constraints.** Resource constraints can make it difficult to allocate the people needed to develop, implement and maintain an effective organizational memory system. Many managers would prefer to avoid allocating their worker’s time to organizational memory activities while there is still “real work” to be done. In the same token, even organizations that attempt to integrate organizational memory activities into their work processes drop these activities once their “real work” is threatened by the pressure of approaching deadlines. The urge to shelve organizational memory activities into the background where they are likely to be forgotten or ignored must be resisted.

**Individual work and group work.** Orlikowski [25] identified three factors that hindered adoption of a groupware system designed to help people communicate and share information. These factors are related in that each points to organizational factors that encourage individual work rather than group work. First, the reward system that is in place typically rewards people for doing their “real work” and offers no incentive to adopt a new system into their work practices. Second, the policies and procedures that are in place parallel the reward system with a focus on individuals and individual performance. Finally, many organizations highlight hierarchical communication, communication up the “chain of command” over later communication, communication among peers.

### 4.3 System development practices

Organizational memory systems provide a rich and active domain for researchers. As with any domain, there is a gap between research and application and with organizational memory systems, the gap may be especially wide.

Two factors make it especially difficult for technologists to bridge the gap between research and
application of organizational memory systems. First, systems are best developed within the context in which they will be used. That is, if we are to develop a system for a given organization, we must work closely with members of that organization. Second, introducing a new system into an organization must not disrupt the normal operations of the organization. That is, any system that is introduced must be robust and complete.

Contrast these factors with the way that researchers typically approach system development. We may begin with proof of concept prototypes and progress to small test beds that help to demonstrate and refine functionality.

As Hughes et al [19] point out, a major cause of the failure of system introduction is the attempt to scale up form a small test bed to a robust system. While there are well-defined system development practices for research and similarly well-defined practices for operational systems, we lack well-defined practices for bridging between research and operation.

5 Summary

The challenges facing any organization that intends to implement an organizational memory are difficult to transcend. There are a few examples of organizations that have implemented successful organizational memories and there are no prescriptive approaches that define how to develop an efficient and effective organizational memory. This should not be surprising; since each organization is unique, so must each organizational memory system be unique. The challenges may be common, but the solutions must be unique.

The concept of organizational memories is not a new one; communities of practice have long developed persistent and useful memories. While information technology offers the promise of improving on the capture, storage, and retrieval of organizational memory, this promise is largely unfulfilled. In addition, changes in the business environment make the need for organizational memory even more important than it has been in the past. However, the old methods of managing organizational memory are not effective enough to satisfy an organization’s need for constant relevant knowledge.

The challenges facing the development of organizational memory systems fall into two general categories, one dealing with managing knowledge and one dealing with the workers who create and use the knowledge.

With respect to managing formal and informal knowledge, we see four primary challenges.

- **Maintaining a process perspective.** When it is codified for storage in a knowledge base, information about how to do something can lose its process perspective, since it is easier to store artifacts than processes in databases.
- **Preserving document context.** Information is only useful if we know the context in which it can be used. Capturing and retaining context information is crucial.
- **Providing relevant knowledge.** Knowledge has a lifetime. At some point, it ceases to be relevant. We must be able to sort through knowledge and retrieve only that which is relevant.
- **Maintaining social context.** Information exists within a social context and, once that context is lost, the information loses value rapidly. Ties between the social context and the information must be maintained.

With respect to challenges related to knowledge workers, we see six primary challenges.

- **Work vs. benefit.** Ensuring that the people who contribute to the organizational memory see benefit from their contributions is crucial.
- **Information capture difficulties.** Information must be captured with minimal overhead and consistency must be maintained between newer and older information.
- **Disruption of social process.** Adding a groupware system into a functioning organization carries the danger that effective work practices can be disrupted. Existing work practices must be understood before an organizational memory can be introduced.
- **Adoption process.** An organizational memory only has value if it is used by the organization. The workers in the organization must see the system as theirs and not one imposed by others.
- **Resource constraints.** Resource needs for organizational memory are ongoing. Management must be committed to supporting a system throughout its life cycle.
- **Individual work and group work.** Organizational memories are built through group work, but organizations tend to encourage individual work rather than group work.

Finally, we noted problems with system development practices. The techniques that are productive for building research systems do not proceed smoothly to the delivery of operational systems.

6 Final comments

As noted in the introduction, organizations subsist on communication and coordination. Success of the organization depends on the ability of its members to communicate and coordinate. The promise of
Organizational memory systems is to address this need - that is, to empower organizations to create and manage their knowledge assets. However, despite claims of “great potential,” demonstrated successes are rare.

Organizational memory is not a new concept for organizations. Organizations have long been concerned with capturing and preserving their intellectual capital and communities of practice have done this quite well. However, the introduction of new technologies and concepts can change the way in which information is managed. Currently, much of the information generated within an organization is stored with the people in the organization. That is, information about procedures, goals, practices, and history is stored in people’s memory, desk drawers, and bulletin boards. For decades, this informal method of managing information was, although not ideal, generally adequate. However, as organizations increase in size and complexity and as the workforce becomes increasingly mobile, the need to capture and store information increases. Despite the need, the obstacles outlined above have hindered successful deployment of organizational memory systems.

Several researchers have suggested ways to overcome these obstacles. Anderson and Anderson [3] advocate the use of “socially grounded engineering;” Davenport and McKim [10] advocate more use of field studies and less reliance on laboratory studies. Both of these suggestions could prove useful.

A more complete list of strategies for alleviating these obstacles was suggested by Grudin [18] in considering the challenges in introducing groupware systems. Since organizational memory is a form of groupware, this list applies here. This list includes:

- Adding collaborative features to single-user applications
- Finding niches where existing groupware succeeds despite problems elsewhere
- Building on existing shared information systems
- Finding ways to provide benefits to all group members
- Educating managers and users about the benefits of working with end users
- Using an empirical approach to better understand decision-making processes.

The area that deserves more attention than it has been afforded previously is the adequacy of system development methods. While the final two points above would help to improve development methods, more is needed. Understanding how to bridge from building research prototypes to the delivery of operational systems is not a problem unique to organizational memory, but is remains a significant problem to resolve.

The challenges summarized in this paper present an opportunity for researchers in the various fields related to the study of organizational memory to monitor the long-term success of existing organizational memory projects, and to re-evaluate the challenges for organizational memories. This opportunity also represents significant challenge. But, for researchers engaged in the community of practice of understanding organizational memory, it is an appropriate challenge in that it requires the collaborative development of our organizational memory.

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8 References


