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AUDIT DESIGN: KNOW-HOW TO MONITOR COMMUNITY KNOWLEDGE TRANSFER IN WORLD HERITAGE MANAGEMENT SYSTEMS

Denetim Tasarımı: Dünya Mirası Yönetim Sistemlerinde Yerel Bilgi Aktarımını İzleme Yöntemi

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Statement | Beyan:
This research is developed from the PhD thesis titled "Audit design: a semi-automated method to scrutinize community involvement in heritage management plans" which is fully funded by the Ministry of National Education of Turkey. | Bu araştırma, tamamı Türkiye Cumhuriyeti Milli Eğitim Bakanlığı tarafından finanse edilen "Denetim tasarımı: Miras yönetim planlarında halkın katılımını incelemek için yarı otomatik bir yöntem önerisi" başlıklı doktora tezinden geliştirilmiştir.

Abstract

The contribution of local communities to the development of World Heritage Site (WHS) management systems has been ubiquitous in both the literature and practice. However, the effectiveness of these engagement initiatives has rarely been audited. The structure of WHS management plans is prescriptive and they are prone to automated scrutiny, so their development can be audited and exploited from the viewpoint of deploying community ideas. This paper proposes a semi-automated method named Audit Design by examining the preparation process of participative management plan for Diyarbakir Fortress and Hevsel Gardens Cultural Landscape WHS to quantify knowledge transfer from consultations of communities to management plan actions of WHS. It illustrates the development and validation of Audit Design with Knowledge Representation and Natural Language Processing techniques, a reliable semi-automated tool, gauging five different levels of knowledge transfer and producing precise natural language representations for auditing knowledge transfer, aiding with monitoring inclusiveness in developing WHS management systems.

Keywords: mixed methods, community knowledge transfer, knowledge representation, natural language processing, world heritage management

Özet

Yerel toplulukların Dünya Mirası Alanı (DMA) yönetim sistemlerinin gelişimine katkısı hem literatürde hem de uygulamada yaygındır. Ancak, bu katılım girişimlerinin verimliliği nadiren denetlenmiştir. DMA yönetim planları yapısı gereği tanımlıdır ve otomatik incelemeye yatkındırlar, dolayısıyla bu planların gelişimi denetlenebilir ve yerel fikirlerin

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uygulanması açısından kullanılabilir. Bu makale, Diyarbakır Surları ve Hevsel Bahçeleri Kültürel Peyzajı DMA için katılımcı yönetim planının hazırlık sürecini inceleyerek, yerel paydaşlar ile yapılan görüşmelerden DMA'nın yönetim planı eylemlerine bilgi transferini ölçmek için Denetim Tasarımı adlı yarı otomatik bir yöntem önermektedir. Çalışma beş farklı bilgi aktarımı düzeyini ölçmek, bilgi aktarımını denetleyen tanımlanmış doğal dil temsilleri üretmek ve DMA yönetim sistemlerinin geliştirilmesinde kapsayıcılığın izlenmesine yardımcı olmak üzere güvenilir bir yarı-otomatik araç olan Denetim Tasarımı yönteminin Bilgi Temsili ve Doğal Dil İşleme araçlarıyla geliştirilmesini ve doğrulanmasını göstermektedir.

Anahtar Kelimeler: karma yöntemler, yerel bilgi aktarımı, doğal dil işleme, dünya miras yönetimi, bilgi temsili

"Conservation, interpretation and management of a place should provide for the participation of people for whom the place has special associations and meanings, or who have social, spiritual or other cultural responsibilities for the place."

(ICOMOS Australia, 1999, p.5)

INTRODUCTION

Community participation is at the core of UNESCO's values (UNESCO, 2013) at all levels, from overarching documents (UNESCO, 1972) to recommendations and guidelines (ICOMOS, 2005, paras 12, 13; ICOMOS Australia, 1999, para. 12; UNESCO, 2019, para. 117). Therefore, UNESCO's resource manual on Managing Cultural World Heritage (2013) states that any WHS needs to ensure community participation throughout the three processes of heritage management systems: planning, implementation, and monitoring. From a participative viewpoint, contributions from local communities should be transferred into WHS management plans through a transparent approach to ensure integrity and credibility.

UNESCO, however, is open about how participation should happen, leaving this to be decided at state party level. More importantly, UNESCO is unclear about assessing the level of community participation in these three different phases of plan development. The assessment would involve effective community engagement methods and the deployment of clear protocols and procedures to assess the effectiveness of this engagement throughout the development of WHS management plans.

UNESCO (2013) recommends a monitoring system to audit the safeguarding of WHS, however, it not explicitly defines the assessment of the effectiveness of community engagement throughout WHS management systems. The former focuses on monitoring WHS management plan outcomes, whereas the latter focuses on assessing and gauging how effectively community participation was taken on board throughout WHS management plan development.

Previous studies show that there is considerable attention to community engagement in planning, implementation, and potentially monitoring processes

(Blandford, 2006; Hodges & Watson, 2000; Landorf, 2009; Li et al., 2020; Olsson, 2008; Rey-Pérez & Pereira Roders, 2020; Ripp, 2018; Ripp & Rodwell, 2017) but little is mentioned about assessing the effectiveness of community involvement throughout WHS management system life cycles. Once planning and implementation phases are completed, practitioners, local and national authorities, and UNESCO assume that community contributions were taken on board throughout plan development and that these contributions will be part of its monitoring phases, with or without community participation in them. In fact, learning from the local communities, for instance, ensures sustainability and conservation of biocultural resources, as reported by Singh et al. (2010) from India, exploits the responsibilities of local communities in the management systems, as reported by Cho et al. (2022), from South Africa and elicits the "local resonance" (Gillespie's (2013) term) of WHS with "local perceptions" such as in Angkor Archaeological Park, Cambodia.

UNESCO requests periodic reporting on community engagement throughout project implementation phases regarding their inputs in decision-making to sustain outstanding universal value (OUV) of heritage (UNESCO, 2019).

However, there are no methods to effectively gauge community contributions throughout project development, implementation, and monitoring. More importantly, there is no discussion about what criteria could be used to develop this assessment. For instance, would this be through counting the number of meetings and community participants into them? There are certainly more sophisticated criteria as communities provide vital information — for sustainable (cultural, economic, and environmental) management of WHS — which somehow comes across as community knowledge in WHS management plan development activities. Therefore, the extent to which this knowledge transfer is taken on board by practitioners while developing WHS management plans can provide early indications of success, primarily if they depend on community satisfaction and ownership.

This study focuses on gauging how much knowledge provided by communities participating in WHS management plans is effectively used throughout their development. The paper proposes a mixed method to scrutinise knowledge transfer from local community consultations into WHS management plan actions. The method is based on a qualitative assessment exercise that gauged levels of local knowledge transfer from community focus group meetings transferred into management plan actions of WHS management plans in Turkey (Parlak et al., 2022). This paper translates the qualitative assessment into a semi-automated analysis process called Audit Design.

Deploying a combination of Knowledge Representation and Natural Language Processing techniques, Audit Design is developed as a semi-automated method. It reduces time-consuming qualitative analysis processes into optimised output datasets ready for inferences to be undertaken, facilitating interpretation and transferability. This paper reports its development based on the Turkish management plan framework using the heritage management plan of the Diyarbakir Fortress and Hevsel Gardens Cultural Landscape WHS, followed by a discussion of its effectiveness and accuracy and potential avenues for future work.

METHODOLOGICAL APPROACH

Currently, many of WHS have a management plan document to record their management systems (UNESCO, 2021). All these management plans include an action plan reporting actions to be implemented with a set of monitoring indicators, their corresponding implementers, and beneficiary actors, and, though not always, assigned budgets (Parlak et al., 2022). In Turkey, these WHS management plans are developed with community participation events. Usually, meetings are held with local communities living and working in the WHS area (Regulation on the Site Management, 2005). Engagement with local communities throughout the development of the WHS management process is considered an essential indicator of success. Reports from these meetings are made public, in some cases, and provide valuable records of what was discussed, including issues and requests raised by local communities, sometimes with respective suggestions on how they can be tackled (Parlak et al., 2022). They are, therefore, valuable material to assess knowledge transfer from local communities to technicians developing these WHS management plans.

Parlak et al. (2022) proposed comparing data from these focus group meetings with the list of actions that are part of their respective WHS management plans would enable technicians to audit their design processes. I.e., to infer how much knowledge was transferred from local communities to the site management plan actions. The WHS management plan and reports of focus group meetings from the Diyarbakir Fortress and Hevsel Gardens Cultural Landscape in Turkey is used to develop the method to scrutinise community knowledge transfer.

Statements from focus group meetings were manually matched with their corresponding actions of the management plan (Parlak et al., 2022), forming a knowledge base for the analysis. This knowledge base was used to establish a manual qualitative assessment regarding transferring local knowledge from community consultations to management plan actions. Even though, adopting a knowledge management framework to extract critical information from focus groups meetings to be compared with WHS management plan actions offered a promising basis for automating several parts of this auditing process, the qualitative assessment resulted in a lengthy analysis.

This paper illustrates how the qualitative analysis from the study of (Parlak et al., 2022) was transformed into a semi-automated analysis process named Audit Design. The proposed method unites the Framework method developed from the qualitative research of (Parlak et al., 2022) with Information Extraction (IE) techniques from Natural Language Processing (NLP) and rule-based systems from the Knowledge Representation domain (Figure 1).

The knowledge base proposed in the study of (Parlak et al., 2022) is used as an input to a semi-automated assessment process called Audit Design which applies NLP techniques to it so its data can be readable by a computer (see the grey shaded box in Figure 2). Rule-based techniques from Knowledge Representation are then applied to this knowledge base to extract inferences that gauge the levels of knowledge transfer from community consultations to site management plan actions (Parlak, 2021). Audit Design has, therefore, four primary components: Analytical Framework, Information Extraction, knowledge base, rule-based system.

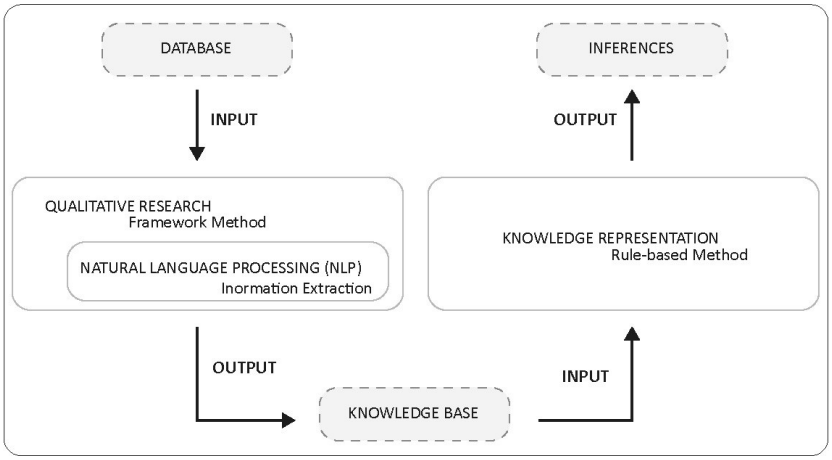

Figure 1. Methodology Framework

Note. Own elaboration

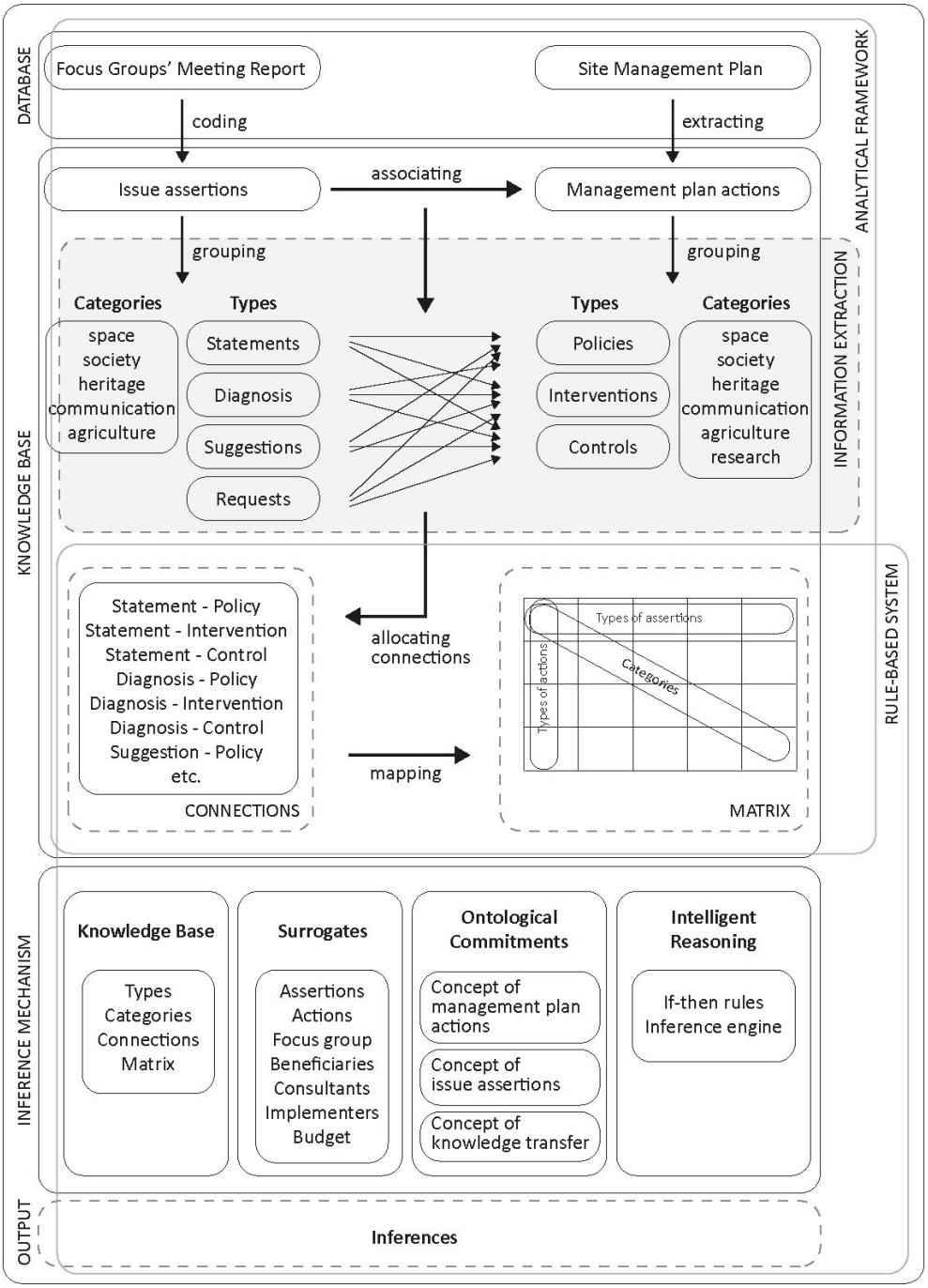

Figure 2. Methodology Diagram

Note. Own elaboration

Dataset

The dataset used to enable this semi-automated analysis included: (i) community input in written form (the community focus group meetings' report in this case) and (ii) actions proposed in the site management plan. The former data comprising the sayings/opinions of the community is used to extract issue assertions. The latter illustrates how technicians interpreted and considered these issues while developing WHS management plan actions.

Analytical Framework & Information Extraction

The Framework method developed in Parlak et al. (2022) was used as a basis to inform automated information extraction in Audit Design. NLP is then applied to the dataset to search for helpful information and extract `entities` (Hobbs & Riloff, 2010). NLP processes and analyses the dataset by decomposing it into several stages in Computer Sciences by developing algorithms and tools (Chowdhury, 2003, p. 51). NLP decomposition occurs in three major stages; `lexical and morphological analysis (syntax), semantic and discourse analysis (semantics), and knowledge-based approaches (pragmatics)` (Chowdhury, 2003; Dale, 2010). At the first stage, segments of language are processed by the syntax, then, the meaning is defined by semantics, and finally pragmatics works with the context and the utilisation of language (Chowdhury, 2003; Dale, 2010). Audit Design works at the syntax level because the Framework method provides the meanings and the context embedded in the data definition. Each entry is labelled with linguistic references which are extracted as new data called `metadata` (Jackson & Moulinier, 2007).

Extraction of information from unstructured data and transformation of it to the "legible" input by the computer rather than a human being is automatically done by one of the subfields of NLP called Information Extraction (IE). In this research, an open-source NLP software comprising different IE systems called GATE (General Architecture of Text Engineering) is employed to automate data extraction. Therefore, in Audit Design, the knowledge base was automatically constructed, contrarily to what was done in the previous work (Parlak et al., 2022).

GATE employs ANNIE (A Nearly-New Information Extraction System) and JAPE (Java Annotation Patterns Engine) as information extraction tools.

Extraction of sentences containing indicators based on entity recognition is the task called sentence classification undertaken by these tools. A text document is formed using the local knowledge which is then converted into the structured text by GATE for ANNIE to process for entity recognition. The structured text, in other words `corpus`, is analysed by ANNIE and JAPE, the former runs `tokeniser, sentence splitter, and Part-of-Speech (POS) tagger` and the later labels the sentences with the categories and types defined before employing manually defined rules (Figure 3).

The tokeniser detects every entity i.e., word, punctuation, etc. as a token. The sentences are recognised by the sentence splitter. The POS tagger adds grammatical attributes to these tokens such as *noun, verb, plural, modal*, etc. The medium of the GATE applications is English by default, so ANNIE works with

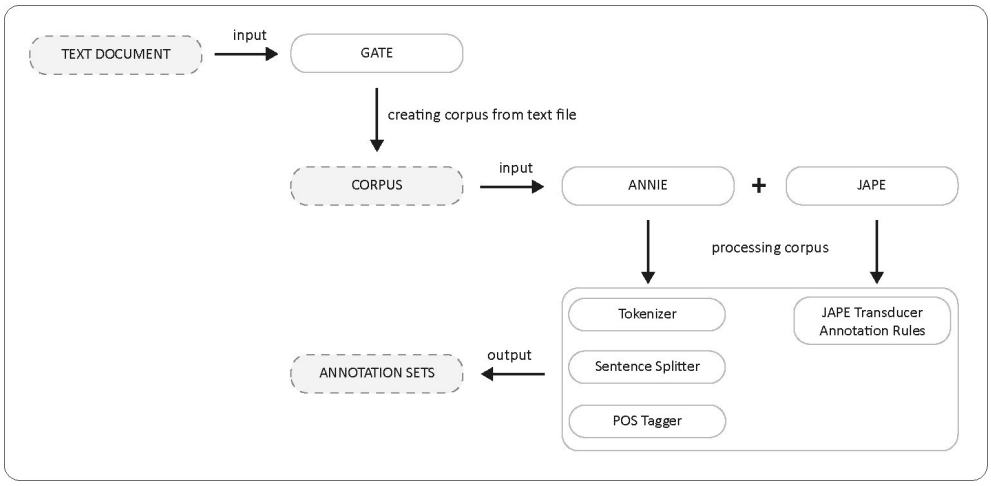

Figure 3. GATE Information Extraction process

Note. Own elaboration

the English language, however, some other languages are also supported with plugins (Cunningham et al., 2014, Chapter 15).

The JAPE transducer extracts recurrent semantics and linguistics by working with annotation rules written in a specific language. The corpus is annotated by running these rules. The outputs (a.k.a. annotation sets) from this IE process are then automatically structured into a knowledge base using the thematic matrices from the Framework method.

Knowledge Base and Rule-based System

As the result of the information extraction process, the knowledge base is generated and ready to be processed to make inferences about the levels of knowledge transfer using a rule-based method from the knowledge representation domain (R. Davis et al., 1993; Grosan & Abraham, 2011; Musen, 2014). In Artificial Intelligence (AI), systems knowledge bases are symbolic representations of the outside world (E. Davis, 2015). E. Davis (2015, p. 98) defines them as representing "*how the beliefs, intentions, and value judgments of an intelligent agent can be expressed in a transparent, symbolic notation suitable for automated reasoning*."

Knowledge representation is explained by its five main roles (R. Davis et al., 1993); (i) surrogate provision, (ii) imposition of ontological commitments, (iii) constitution of a theory of intelligent reasoning, (iv) provision of a medium for efficient computation, and (v) provision of a platform of expression and communication (R. Davis et al., 1993) (Figure 4).

In this study, surrogates of the knowledge base are management plan actions, community assertions, budget information, actors, etc., whose content is constrained by ontological commitments (Figure 4), for instance, knowledge base solely contains management plan actions addressing community assertions. In order to derive a set of inferences that the rules sanctioned or recommended, the theory of intelligent reasoning should be constituted.

In Audit Design, the knowledge base is processed by *if-then* rules coming from human experts in this domain which represents the intelligent reasoning of the system. The output is the inferences, a set of natural language representations, drawn within the rule's premises defined by the concepts (Grosan & Abraham,

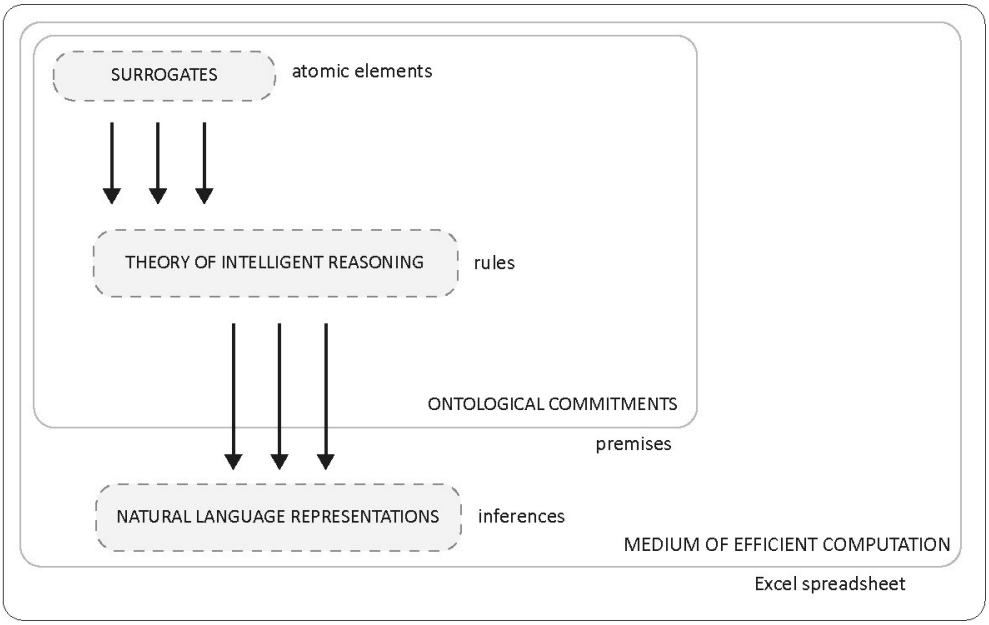

Figure 4. Knowledge Representation Framework

Note. Own elaboration

2011). Audit Design uses an Excel spreadsheet with formulas to compute the proposed collection of *if-then* rules, since the Excel spreadsheet interface is easy to use, and the size of the knowledge base is moderate. A dedicated application for Audit Design can be produced in the future after broader testing.

DEVELOPING AUDIT DESIGN

The Diyarbakir Fortress and Hevsel Gardens Cultural Landscape was inscribed on the UNESCO World Heritage List in 2015 (UNESCO WHC, 2015, p. 208 Decision: 39 COM 8B.32) and provide a rich case study to develop a semi-automated method to gauge community knowledge transfer in WHS management plans. The area is home to low-income communities active in local and typical agriculture and includes a 'site' plus its 'cultural landscape'. Its WHS management plan was developed in close consultation with the local community through a site manager coming from the area, bringing technical and local knowledge to the WHS management process.

Forming the Knowledge Base

The Framework method from the study of Parlak et al. (2022) was used to extract and code issue assertions from community focus group meeting reports and associate them with management plan actions by searching for them in the management plan which would, in theory, respond to corresponding issue assertions raised by the community. Coding issue assertions and management plan actions, and then associating assertions with actions were done manually to form the knowledge base by employing Framework method (Parlak et al., 2022).

Connections

The Diyarbakir Fortress and Hevsel Gardens Cultural Landscape WHS management plan has 189 defined management plan actions. On the other hand, 91 issue assertions were extracted from focus groups' meetings. Connections were established between those actions and assertions depending

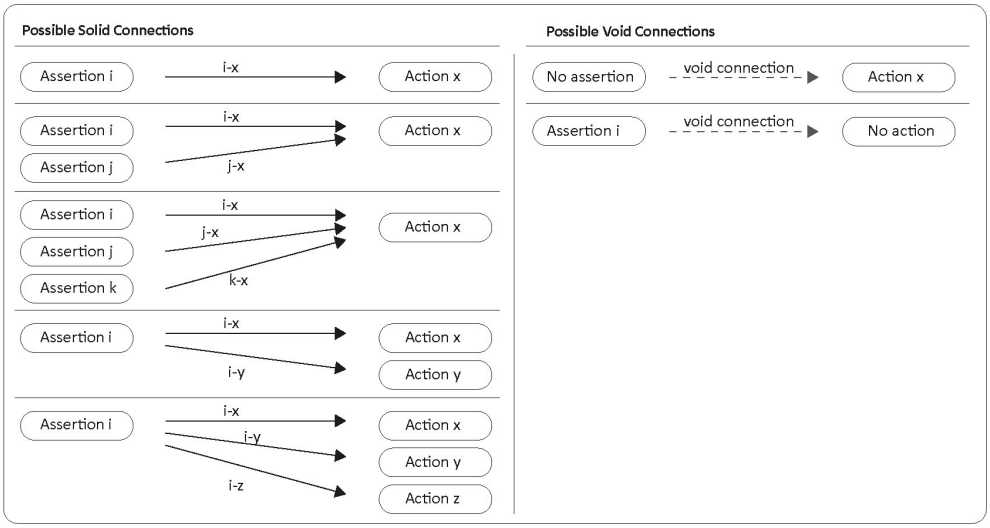

Figure 5. Connection types between assertions and actions

Note. Own elaboration

on their correspondence to each other. Two types of connections were established: solid and void. The former refers to a connection where both action (s) and assertion(s) are present. The latter, on the other hand, refers to a missing side in the connection, either action(s) or assertion(s). In total, 220 connections were established in this case in which 177 were solid, and 43 of them were void.

The way of establishing connections is illustrated in Figure 5 through arrows, each of them refers to a connection. For example, if only one action addresses one issue assertion, it creates one solid connection (i-x). If two issue assertions were addressed by only one action, two solid connections (i-x and j-x) would be created, etc. However, any actions might not address an assertion (i), or any issue assertions might not be addressed by an action (x), in both cases, the connection established is void.

Following the construction of the connections above, recurrent categories and types were identified (Figure 6). The descriptions of these categories and types with the corresponding linkages between them could be formally defined by an analytical framework (Spencer et al., 2014, pp. 284–285). Types and categories filtered meaningful information from issue assertions and management plan actions.

Categories and Types

Based on different knowledge domains, six categories were defined for issue assertions and management plan actions, and they were identified as space, society, heritage, communication, agriculture, and research. They were also classified according to their content into a variety of types; policies, interventions and controls for actions, and statements, diagnosis, suggestions, and requests for issues (Figure 6).

Once connections, types and categories were established, Information Extraction (IE) techniques from Natural Language Processing (NLP) were used to group issue assertions and management plan actions into categories and types based on linguistic clues and considering semantics of sentences automatically using GATE (Parlak, 2021)[1]. This step translated the framework proposed by (Parlak et al., 2022) into a knowledge base matrix suitable to be interrogated automatically through the application of rule-based methods (Parlak, 2021).

(1) GATE requires information to be in English therefore documents were translated from Turkish to English and translations validated using a randomly chosen UK WHS management plan to evaluate classification accuracy as well as the quality of the translations, e.g., English jargon contained in the UK management plan aided in identifying translations flaws and mistakes.

Categories

(i) Space - assigned if an issue assertion or action referred to a physical space present conditions, organisation, or design.

(ii) Society - assigned if an issue assertion or action referred to communities living in or around the heritage site, including problems related to their social and economic conditions.

(iii) Heritage - assigned if an issue assertion or action referred to heritage components, values, and safeguarding.

(iv) Communication - assigned if an issue assertion or action referred to supportive, educational, or awareness-raising activity bridging the heritage site and the local community.

(v) Agriculture - assigned if an issue assertion or action referred to an agricultural activity since the cultural landscape in the case study area includes agricultural fields.

(vi) Research - assigned if an action referred to conducting studies to evaluate or extract the current situation in the heritage site.

Types for management plan actions

(i) Policies - assigned to actions that led to decisions related to development, support, encouragement, or conduction of specific types of activities.

(ii) Interventions - assigned to actions that were an implementation of spatial planning decisions.

(iii) Controls - assigned to actions that refer to monitoring or supervising a situation.

Types for issue assertions

(i) Statements - assigned to assertions that were a clear expression or a declaration of a given situation.

(ii) Diagnosis - assigned to assertions which were statements followed by a cause.

(iii) Suggestions - assigned to assertions that state a proposed problem's solution, even if implicit.

(iv) Requests - assigned to assertions that stated a demand, a need, a request, or a necessity with a reason explicit or not in the assertion.

Figure 6. Categories based on knowledge domains and types based on content

Note. Parlak, 2021

Extracting Natural Language Representations

Knowledge representation has five distinctive elements; surrogates, ontological commitments, intelligent reasoning, efficient computation, and medium of expression (R. Davis et al., 1993). The surrogates are representations of reality in the knowledge base in which they symbolise the intended referent, meaning each element in the knowledge base should be clearly defined. The surrogates for Audit Design are *issue assertions, management plan actions, focus groups, beneficiaries, consultants, implementers, budget, and output* (Parlak et al., 2022).

Concepts

Extracted natural language representations were analysed to select the relevant data for the rule-based system. The selection is achieved by applying ontological commitments, a set of decisions about what is relevant to be assessed. Ontological commitments can be defined by the two following concepts: `knowledge transfer: management plan actions` and `knowledge transfer: issue assertions` (Parlak, 2021). These concepts about knowledge transfer defines the premises on how to make choices to include or exclude data into the inference mechanism and how this data is going to be represented. The syntax ':' represents assessment.

The former concept decides whether knowledge transfer should be assessed for a given management plan action (Figure 7). Knowledge transfer is assessed only if the action addresses at least one issue assertion.

The latter concept considers if the actor who raised issue assertions is from the community focus groups or not (Figure 8). If the actor is from a non-community focus group, raised issue assertion is not assessed. Otherwise, the issue assertion is assessed and if a corresponding action is found, there is some evidence of knowledge transfer. Otherwise, no assessment is made.

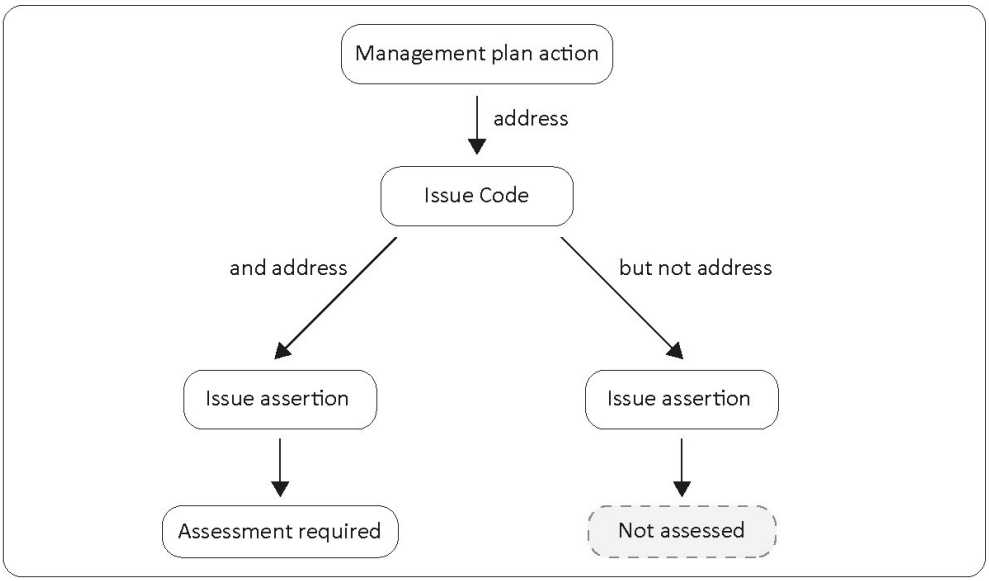

Figure 7. Concept of `Knowledge Transfer: management plan actions`

Note. Parlak, 2021

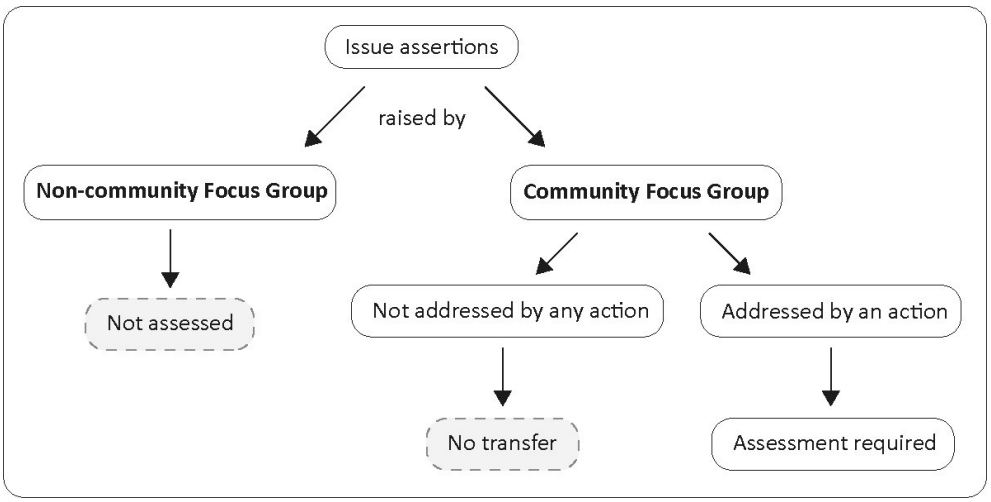

Figure 8. Concept of `Knowledge Transfer: issue assertions`

Note. Parlak, 2021

Rule-based System

A rule-based system is composed of rules with premises and a conclusion, and a rule interpreter that derives new knowledge from data patterns triggering some rules' premises (Musen, 2014). This study uses the forward-chaining method to reach conclusions, meaning it starts with available data and reaches conclusions by applying rules to this data (Grosan & Abraham, 2011).

The first rule to be applied to the data set checks if the premises of the concepts are valid for assessment. I.e., if concepts `knowledge transfer: management plan actions` and `knowledge transfer: issue assertions` are true. The second rule to be applied to the dataset checks if the action has a budget or not. For example, Issue 26.1 is about accessibility in heritage site and Action 5.6.1.4 is addressing to this issue.

> Issue 26.1: The site needs transportation planning due to problems related to density in traffic.
>
> Action 5.6.1.4: Prepare transportation and circulation plans for pedestrian and cyclists in the management plan area to encourage them.

Firstly, system checks if the first concept is true; Action 5.6.1.4 addresses Issue Code Accessibility and addresses Issue 26.1. The second concept affirms that issue assertion was raised by Hevsel Garden community focus groups and addressed by Action 5.6.1.4. Since the concepts are true, the second rule checks the budget, in this case Action 5.6.1.4 is an action with budget meaning budget is allocated.

The third rule to be applied to the dataset checks the relations between actors. I.e., if the beneficiaries/implementers/consultants of the action are part of community focus groups or not. In the previous example, when the system checks if the actors are matching or not, it finds out that there is not any match between actors. The fourth rule checks for connections between types and categories of assertions and actions and decides the degree of knowledge transfer for each connection. For instance, Action 5.6.1.4 was labelled under space category and intervention type by NLP whereas Issue 26.1 was labelled under space category and request type. Then system makes an inference on this connection as:

> Results:
>
> * Budget allocated.
>
> * There is not any match between actors.
>
> * Knowledge transfer level: p-full.
>
> * A spatial intervention is taken for a spatial request.

In this example, spatial intervention is the preparing transportation and circulation plans for pedestrian and cyclists addressing to the spatial request of transportation planning due to traffic density.

Shortly, a rule instance is shown in Figure 9 for better comprehension; firstly, checks if the premises of the rule are true (1), i.e., the criteria are valid for the assessment. It then looks for a budget (2), checks for relations between actors (3), checks for connections between assertion and action types and categories (4). Finally, the rule makes an inference saying that knowledge is transferred, and knowledge transfer level is partial. Besides, a natural language representation gives the content of this connection as "*A spatial suggestion is considered by a spatial intervention*." meaning a suggestion type assertion from the community about space is turned into an intervention action about space.

Inferences and Levels of Knowledge Transfer

Twelve major inferences were defined using the previous study as a basis (Parlak et al., 2022). The inferences are described in detail in (Table 1). The table show two basic inferences: 'Positive' and 'Contextual'. The first results in knowledge transfer if the connected action refers specifically to the issue assertion. The second gauge the level of knowledge transfer depending on the context.

However, these two classes are not enough to determine levels of knowledge transfer. Therefore, expert knowledge was sought from the previous study (Parlak et al., 2022) to inform the automation of this part of the assessment.

```
Rule X
   If:(1) Assessment criteria;
          MPA addresses to IA.
          IA is raised by community focus group.
      (2) MPA is an action with budget.
      (3) Actors;
          Relation = 0 for MPA: implementers, consultants
          Relation = 0 for MPA: implementers, consultants, IA: focus group
      (4) Connection;
          Type: IA: Suggestion – MPA: Intervention
          Category: IA: space – MPA: space
   Then:
      Budget is allocated. There is not any match between actors. A spatial sug-
      gestion is considered by a spatial intervention. Knowledge is partially
      transferred.
      (IA = Issue Assertion, MPA = Management Plan Action)
```

Figure 9. Example of applying rules 1 to 4 using a pseudo-code

Note. Own elaboration

Three levels of knowledge transfer were defined in (Parlak et al., 2022): *fully transferred, partially transferred, and not transferred*. These levels were used to label connections between issue and action types and between issue and action categories. These labels with their respective connections were inputted into a data analysis tool called WEKA (Waikato Environment for Knowledge Analysis) (Witten & Frank, 2005), to run a canopy clustering analysis.

Regarding the cluster analysis, the three levels of knowledge transfer were increased to five (Parlak, 2021): (i) full or fully transferred, (ii) p-full (classified between partial and full), (iii) partial or partially transferred, (iv) n-partial (classified between partial and not transferred), (v) no transfer or not assessed (connection not taken into consideration by assessment process). These newly defined knowledge transfer levels (p-full and n-partial) were validated using WEKA *tree classifier J48* which returned 96.81% accuracy. Outputs from WEKA were used to create natural language representation for knowledge transfer levels, and results are reported with examples provided in Box 1 and 2.

Table 1. Inferences based on connections between action and issue assertion type

Note. Own elaboration

Connection	Inferences based on connections
Statement - Intervention	Contextual
Statement - Control	Positive, if control follows statement.
Statement - Policy	Contextual
Suggestion - Intervention	Positive, if intervention follows suggestion.
Suggestion - Control	Positive, if suggestion is control.
Suggestion - Policy	Positive, if suggestion is policy.
Diagnosis - Intervention	Positive, if intervention solved the problem.
Diagnosis - Control	Positive, if control check on the problem.
Diagnosis - Policy	Positive, if policy solves the problem.
Request - Intervention	Contextual, unless intervention explicitly requested.
Request - Control	Contextual, unless control explicitly requested.
Request - Policy	Contextual, unless policy explicitly requested.

```
"Results:
* No budget allocated.
* There is not any match between actors.
* A spatial situation related to heritage is controlled."
>>> Knowledge transfer level: n-partial.
```

Box 1. Statement in the space category – control in the heritage category

Note. Own elaboration

```
"Results:
* Budget allocated and explained.
* There is no match between beneficiaries, consultants, and implementers, but
there is match between focus groups and beneficiaries, consultants, implementers.
* An agricultural intervention is taken for a request related to communication."
>>> Knowledge transfer level: full.
```

Box 2. Request in the communication category – intervention in the agriculture category

Note. Own elaboration

VALIDATION OF AUDIT DESIGN

Audit Design is validated by using the results of the rule-based system and results of the qualitative assessment (Parlak et al., 2022). They are compared to evaluate the method based on similarity between the automated assessment and the human-made one.

Validating Types and Categories

Validation of issue assertion types was undertaken by manually comparing GATE annotations with manual annotation sets and reported an accuracy of 96%. Precision and recall were calculated by the formulas[2] indicated in (Grishman, 2019, p. 685) and respectively showed 0.96 (=85/89) precision and 0.93 (=85/91) recall.

(2) Equations 1 and 2 from Grishman, 2019, p. 685.

Equation 1:

$$Precision = \frac{number\ of\ correct\ GATE\ annotations}{total\ number\ of\ GATE\ annotations}$$

Equation 2:

$$Recall = \frac{number\ of\ correct\ GATE\ annotations}{number\ of\ manual\ annotations}$$

For issue assertion types, out of 91 manual annotations, GATE was able to annotate 89 of them and four of these were annotated incorrectly (Table 2). The precision of GATE is 95 % (=85/89) whereas the recall was 93% (=85/91) which are very good for GATE annotation. On the other hand, the precision of GATE annotations is 81.6 % (=74/89) for issue assertion categories, whereas the recall of GATE is 79.7% (=74/91). One can infer that types are defined more robustly than categories for GATE to annotate.

189 management plan actions were inputted to GATE, out of which 179 types were correctly annotated. The remaining 10 had more than one indicator and, therefore, could not be accurately labelled through automated annotation. All management plan actions were labelled by types, so the precision and recall are the same and 95 % (=179/189) (Table 3). For the categories, GATE precision was 83.5% (=159/182), whereas recall was 80.4% (=159/189) which is the lowest

Table 2. Comparison of Manual and GATE annotation for ***issue assertions***

Note. Own elaboration

Issue assertion	Number of issue assertions annotated		
	Manual Annotation	GATE Annotation	Correct GATE Annotation
Statement	24	20	20
Diagnosis	18	17	16
Suggestion	26	28	26
Request	23	24	23
Total count for TYPES	**91**	**89**	**85**
Agriculture	7	7	7
Communication	11	5	5
Heritage	22	26	20
Society	17	16	12
Space	34	35	30
Total count for CATEGORIES	**91**	**89**	**74**

Table 3. Comparison of Manual and GATE annotations for ***management plan actions***

Note. Own elaboration

Management plan action	Number of issues annotated		
	Manual Annotation	GATE Annotation	Correct GATE Annotation
Control	44	45	41
Policy	88	87	84
Intervention	57	57	54
Total count for TYPES	**189**	**189**	**179**
Agriculture	20	16	16
Communication	35	39	34
Heritage	73	69	61
Research	24	26	20
Society	4	5	4
Space	33	27	24
Total count for CATEGORIES	**189**	**182**	**159**

rates. This is because the management plan actions have more complicated sentence structures; therefore, one action sentence might include more than one indicator confusing the classification of types.

Validating inferences

Assessment results (105 out of 120 matched) displayed 87.5% accuracy, indicating that the validation has been thorough; and that the rule-based system is robust. In addition, in each issue theme, the levels of knowledge transfer in the manual qualitative assessment were the same or very similar to those from the rule-based system (Table 4).

Issue Themes	Fully transferred		Partially transferred		Not transferred	
	Qualitative Assessment	Rule-based System	Qualitative Assessment	Rule-based System	Qualitative Assessment	Rule-based System
Surici Urban Area	3	4	8	7	6	6
Social and Economic Problems	2	2	13	10	18	21
Public Use	0	0	3	5	5	3
Agriculture	13	10	25	29	6	5
Management	1	0	6	6	1	2
Spatial Planning	2	1	5	9	3	0
Total	**21**	**17**	**60**	**66**	**39**	**37**

Table 4. Comparing results for the qualitative assessment with the rule-based system

Note. Own elaboration

CONCLUSION

The results of Audit Design are not merely percentages of different levels of knowledge transfer but also the statements to investigate further and scrutinise the weaknesses of the management system or the challenges of locality. The success of the Audit Design method mostly depends on the globally defined structure of management systems. Most of the WHS management plans are primarily similar in defining actions, stakeholders, consultants, and implementers, Audit Design can be used to automate the audit of these plans regarding how much they effectively take community knowledge on board while developed and deployed. Themes, annotations, and categories in the result statement called as natural language representations refers to the strengths and weaknesses of the management plan from a local perspective. Audit design produces explicit natural language representations on the content of different connections between issue assertions from focus group meetings and WHS management plan actions. Its ability to post-process connections can expand the set of inference rules in new case studies and help creating a pool of knowledge for Audit Design to be further developed.

Even though this assessment can be made qualitatively by a researcher, it consumes high levels of time and effort. Audit design significantly reduces the time and effort consumption while producing natural language representations giving insights and stating levels of knowledge transfer helping to scrutinise the inclusiveness of the management plan.

In this paper, authors explained the transformation of a qualitative method into a semi-automated method in order to lessen the amount of work needed to gauge the levels of knowledge transfer from local communities into heritage management plans.

Overarching results from Audit Design validation are promising and can be summarised as follows:

- Identification of issue types resulted in 96% precision and 93% recall.
- Identification of management plan action types resulted in 95% precision and 95% recall.
- Identification of knowledge domains a.k.a. categories for issues resulted in 81.6% precision and 79.7% recall, whereas action categories were automatically identified with 83.5% precision and 80.4% recall.

- Connections containing non-community input were the 45% of the total and they were not assessed neither in the qualitative assessment (Parlak et al., 2022) nor in the Audit Design, proving that Audit Design could correctly identify information to be assessed.
- Identification of the knowledge transfer levels resulted in 87.5% accuracy.
- Inference rules deepened the comprehension of knowledge transfer levels defined as fully transferred, partially transferred, and not transferred. The nuances were accommodated variations of knowledge transfer within connections which could be spotted only through human assessment. Therefore, two more levels were added: p-full and n-partial. They are flagged for human inspection, reducing enormously the time and the burden of the assessment.

However, to fully achieve objective assessments of community knowledge transfer to WHS management plans, establishing potential benchmarks at a national (and, in the future, international) level, Audit Design should be applied to more case studies. This is essential to enrich Audit Design's current pool of categories and types of issue assertions and management plan actions and levels of knowledge transfer in different forms of connections between them.

In addition, further research is needed, in partnership with UNESCO, to enhance and enrich protocols for community engagement and participation in WHS management plan consultations, so more granularity is provided about documenting different interests within community groups. More research is also needed about querying knowledge domains within WHS management plans to enrich categories and types with sub-categories and sub-types so further scrutiny can be pursued in establishing connections between issue assertions and management plan actions towards improving Audit Design accuracies and propel its full deployment in practice.

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