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Knowledge Acquisition Framework in Practice

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Abstract

The knowledge base of the distinct disciplines grows incrementally. A high variety of the knowledge acquisition (KA) techniques can be applied at specific domains. In this paper we introduce some KA practices related to historical watermills. The different methods complement each other, none of them is fully comprehensive (visual assessment, parts of former machines, personal inquiry, landscape check, markers, signals, geographic forms, etc.). We could set up new ontology categories on the categorization of these technical relicts. It demonstrates the applicability of these wide spread manners, so these methods are recommended also for other fields such as archeology or technical history.

Keywords: Knowledge acquisition; Document research; Reconnaissance, Interviews; Topology analysis

Introduction

Processing national heritage or technical history the need arises for an exhaustive review of a group of existing or one-time devices, equipment, objects. The simple search in one source provides really poor results. In this paper we introduce a bunch of unorthodox methods, how the data gathering can be more comprehensive. The partial results are overlapping. Some source covers more than 60% of the targeted objects; even the combination of dozens of methods cannot hit 100 percent.

The objective of the work is to build a complex accumulated database for further processing. The examples given are related to the water mills and to the early hydro energy applications in Hungary. We are dealing with object finding, recognition and identification methods excluding the technical details.

The methods can be generalized and applied to many other, rural object types" as old bridges, windmills, churches, mines, etc.

The traditional information collection methods [1] should be a little bit reassessed. In our case the Knowledge Documents are the previously collected pictures, photos, maps of the object we looking for. The Scenarios can mean mentioning a typical situation: e.g. what happened in case of flood? The interviews are mainly spontaneous chats. We must mention that the interviewee is rarely an expert, rather a local habitant. We propose a list of stereotype questions instead of a preprinted questionnaire. Before setting up brand new classes or categories we group the pieces of information to build a Decision Tree.

To get the implicit knowledge we can perform interviews, prepare questionnaires, protocol analysis, task observation, etc [2]. To exploit those pieces of information that was not reckon among real information till today, we can consider them tacit information, too. (E.g. "yes, we have a ditch on the field. We have never thought that is a clue of a mill creek.")

There is a wide range of different knowledge acquisition techniques such as 'user observation' through common social science methods, such as interviews, questionnaires, and discourse analysis [3].

New methods are developed for building (and roof) shape identification and modeling in 3D for the automatic data acquisition, clustering and data processing of urban and country buildings [4].

Some authors discuss the relation of the visual architectural topology and the ontology where formal verbal description is given for the complex building structures [5].

The personal knowledge acquisition interviews are a viable method for getting non predefined information bits. The inadequate skill of knowledge managers and workers can also cause fiascos, so the development of communication and interpersonal skills are required [6].

Nowadays more and more techniques are developed for the identification of the real objects in the remote sensing images [7]. The formalized domain knowledge is matched to the actual visual information and allows the recognition – as by the human expert.

The key to machine vision is a clear ontology that defines the object space where we can identify objects. The Ontology Based Complex Object Recognition uses this idea [8]. In the mill search we can apply it not only to aerial photo understanding but also to the human vision of the expert on the site: What can we see? What may we see? What do I know in general that may have occurred? What can I expect? To which previous pattern fits the actual view?

A lot of KA framework is given for company development purposes. Beyond the traditional techniques (Literature, Manuals, Regulations, Reports, Memos, Guidelines, Published Books, etc.) some new methods are recommended too as Interdependency Model, Data Mining, Pattern Recognition or Conflict Analysis [9].

Considerations

Ontology definition of notion "mill"

But what is the mill? What are we looking for in this research? Everybody knows the traditional water mills producing flour by rotating stones. The mill stones are moved by large under- or overshot mill-wheel through gear mechanism. The water mills are close to the water flow endangered by the flood, the robbers, the vagrants, the escaped soldiers. These mills were built and then disappeared during

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the last thousand years, so what can we count as a mill?

- Operating museum mills where you can enter buying ticket?

- A mill with whole fixtures but out of operation?

- A hotel at the riverbank called "Mill hotel"?

- An empty, ruined building?

- A pure sluice-way and –valve on a dried canal?

- Tracks of a former spillway close to the river bed?

I this research we are going to identify all the buildings, ruins, sites if there is present evidence showing that a watermill operated there in the last centuries.

Mill or Machine?

Another group of the traditional hydro energy applications is the water driven machines. These are more mystic and hardly typified. Sometimes their former place is known but there are no remains, the construction is unknown. Recent technicians are trying to puzzle out the operation. It requires a real quest in archives about the role, usage, possible structure. Some examples:

✓ The 14th century hydrolifting (special pump) machine in Buda, Hungary.

✓ The miraculous hydro machine from 15th century Esztergom, Hungary, widely known from the Turkish Empire, due to descriptions by Evlija Cselebi, a Turkish traveler. [1] [2] [3]

✓ The 15th century mill wheel driven mine elevator and the water feeding channel system at Úrvölgy in former Hungary (Špania dolina, SK).[4]

✓ The 18th century mill wheel driven hydro pump of Veszprém in Hungary.[5]

✓ From the 18-19th century, still existing, hydro piston engine, as shaft elevator machine of Hell József Károly and later Kachelmann Károly and a water feeding channel and reservoir system at Selmecbánya, former Hungary (Banska Stiavnica, SK).[6] [7] [8] [9]

Water mill sitting

The mills are deployed

✓ **Directly into the water-course** (creek mills) – the natural streambed was narrowed

✓ **With external channels** – the original water flow is dammed and the water is let out through a head-race (upper) canal to the mill wheel or turbine facility and returns to the original riverbed through the tail-race (lower) canal

✓ **On the bank of the river** (riverside mills) – the water is buffled by weir close to the from-the-shore hanged wheel

✓ **On the dam of the reservoir** – the small creeks did not provide enough water flow that is why retaining reservoirs had to be built. Lakes allowed for fish breeding. Having enough water after opening the sluice gate the water was used by the cascade of mills.

✓ **On a ship** – these are the floating mills

Classification of water mills

A possible grouping of the mills is based on the task of the arrangement, and the main elements of the water mills: (Table 1).

Naming convention

The mills used to be called by its owner's or renter's family name. A mill can be known by different names after the different owners during centuries (e.g. Krajczár or Bukovecz or Stefi mill at Vigántpetend). Sometimes distinct mills wear the same name because a certain family owned many properties (e.g. close to Ajka city every second mill is called Kun mill). Other mills are called by their function: fuller-mill, saw-mill, and hammer-mill. A possible appellation convention refers to the relative geographic position: upper-mill, lower mill, middle-mill. In the spoken language the names are often distorted. The name can be acquired from maps, descriptions, history, letters, and inhabitants in the neighborhood.

Groups of mills

Before electrification the water mill was the widest spread over mechanical energy source. It was used everywhere IF the need occurred (population density, appropriate level of economy, industry or agricultural activity) AND the natural resources made it possible. Although we met some isolated constructions, normally there are several in a smaller region. Sometimes the "one village – one mill" rule

Power Capture		Connection Element	Driven Mechanics
spoon pitchback overshot breastshot undershot	wooden mill wheel	direct connection cog-wheel transmission belt	stone for wheat milling or mastication steel drum for wheat milling or mastication strainer oil mill willow fuller stamp hammer paper mill painting mill saw stone saw drill generator pump windbag grilling tedder, etc.
Francis- Bánki	metal turbine		

Table 1: Genealogy of mills.

[1] Gy.Kolumbán: Watermachine in Esztergom (Az esztergomi érseki reneszánsz vízgép kutatási- helyreállítási munkáinak állása 2004-ben); http://www.freeweb.hu/gep-ujsag/04oktnov/kolumban.pdf

[2] A. A. Deák: The history of the Esztergom watermachine (Az esztergomi reneszánsz vízgép históriája); Esztergomi Duna Múzeum; www.dunamuzeum.hu

[3] Clashig tup – renovation of the Esztergom water machine (Csattogó kos - Újjáépítik Mátyás király esztergomi vízgépét); MNO 2004. augusztus 14.

[4] www.slovakiatourism.sk

[5] I. Wöller: Watermills of Veszprém (Veszprémi vizimalmok)

[6] http://www.kfki.hu/physics/historia/h/e/hellj/helljpant.html

[7] L Benke: The history of the mining (script - A bányászat története)

[8] www.slovakiatour.sk

[9] Writing at Selmecbánya múzeum

limited the number, but the millers' technical and economic mutual help built up a regional mill culture along the creek. The part of this common knowledge is the building and the mechanical construction, the transport, the tax, the education, the spare part distribution, the mill stone procurement - and the good income for the mill owners.

From the second half of the 19th century the mills were registered (water, ship, steam, wind, animal-actuated). There are different lists but in the then Hungary over 24 thousands unit were mustered.[10] In the present Hungarian country area there had been almost 7000 water mills. The number of the mills fluctuated because of the natural disasters, the state measures (harnessing of rivers).

After finding a new object many doubts and open questions remain:

Is this the mill we are looking for?

What was/were the name/s of it?

Was this building/ruin really a mill? etc.

Search Methods

Like the hunter scouts the game, the mill hunters must have several abilities to find the objects. Basic rule: "Mills are everywhere but you must find them!" They can be found from ground, from water and air. Mills can be "chased" on foot, by car, by bicycle, by boot, in suit, in tie. Unintended findings rarely happen but we can come across "un-forecasted" objects. In spite of our thoroughness, we can miss some mills; they may have been demolished before. There is no exhaustive and to all circumstances applicable methods. Here we list techniques to search wanted mills:

Written documents

The traditional KA for explicit knowledge starts in the libraries. Although it is a tight point if we have an explicit written statement about an object, sometimes we go to the library after finding an unknown ruin to seek for written mentioning for verification our intuition.

- **Local history brochures, publications** – almost all the local brochures contain more or less explicit mandatory statements e.g. "This village had 3 water mills in the medieval age…"

- **Libraries, archives** – this is the classic way of mapping a topic. Takes a lot of time but this is by far the best method to dig out the history of a small region, the history of individual mills.

- **Internet** – The most up-to-date search tools provide billions of information sparkles. In spite of the public access to these sources a lot of hidden descriptions and references can be collected from digitalized documents, pictures.

- **'Mill street'** – really common and talking name

- **Denominations of sites** – working at a county map (e.g. Bakony mts. in Hungary) we meet dozens of indications for mill sites despite no mill existing there today.

X mill; Y ranch – X malom; Y tanya

Accommodation road to mill –Malom uti dulo (Szentgal) Stonemill bottom – omalom alja (Borszorcsok)

Millfield – Malom-foldek (Kolontar)

Millbottom road – Malom-alja dulo (Varvolgy) Small-mill road – Kis-malom uti dulo (Rede)

Mill road – Malom dulo (Jasd)

Mill valley – Malom volgy (Ganna)

Stone mill cutting – Komalom irtas (Homokbodoge)

Stone mill fallow – Komalom parlag (Papateszer)

Mill

Malom erdo (Fenyofo)

Mill meadow – Malomrét (Gic)

Miller meadow – Molnárrét (Bakonytamasi)

Local, physical clues

An expert has sense for the feeling some tacit blew of the landscape:

-Visual assessment – a building holds a lot of signs that can't be rebuilt, covered e.g. ratios of the measures, holes, windows, siting, form of the roof, etc.

-Mill stones – a circular mill stone was used for years, but after it wore out it was thrown out, built in the wall, was used as a pave stone or as a table. It was rarely moved far from its origin. Therefore it shows the vicinity of a mill for centuries. One of the evidences.

-Personal inquiry – arriving in the village one can ask old local people sturdily but respectfully "Where was the watermill?" (instead of "Was there any watermill in the neighborhood?") – usually we get the right direction. Getting far away in time from the everyday operation of the mills, the common human memory becomes dimmer and dimmer.

-Geographical characteristics of the landscape – overlooking the scenery on a bright day (and also on the map) there are a lot of "should have been" sites where the mills could ever exist.

-Unintentional flash – a glimpse from the moving car, bus or train, or a background scene of a movie. Sounds strange but happens.

-Grouping – The mills (also the millers, the mill culture and the demand for the mill) rarely were stand alone, single and unique object in a small region. The mill is "social" stuff. A common setting is the chain of the mills along a creek with "frequency of 1-3 km.

-The canal – almost horizontal, dry, grassy and lost ditches lead up to sluice or mill ruin (tail-race, mill-race).

-Damming on a river – an abandoned, ruined old dam, definite bar, outlet from the riverbed hints to a channel start.

-Direct signaling – only the renovated, in-mill-form leveraged "official mills" have this feature: museum mills, mill hotels, national heritages

-Official markers – from the 19th century the mills were registered by the authorities (for custom and also for hydrology purposes). The registered mill had an official iron cast that marked the maximum damming level. It was fixed by hardly removable plumb seals. Facing such a seal means clear evidence.

-Old road direction – The century old road led to a definite target. If there is only one crossroad from the village to the river and there existed a riverside mill, in this case the mill must have been at the end of the historic road.

[10] Malomipar 1906. 9-26; http://www.tankonyvtar.hu/konyvek/magyar-neprajz/magyar-neprajz-malmok-081201

-Sign stone – Decades before the plumb seals usage some marker stones were dug in front of the mill gate. They can rarely be found (e.g. Mátrafüred, Hernádszentandrás)

-Pine trees – a lot of mills were built to fringe of the forest or in woods. Or the mill put away was thence afforested. Finding 2-4 pine trees in regular shape close to the supposed site strengthens our initial assumption.

-Archeology – Nowadays only tenths of the ever built mills exist. Theoretically the underground evidences can be identified with different archeological analysis technologies. Of course towards a historical registry these techniques can be hardly applied.

Cartography

The morphology analysis works typically on Pattern Matching base. We know some signs, forms, shapes – we looking for its.

-Maps – the maps contain several repeated signs without textual description that hints for the targeted object: stand-alone building out of the habited area close to the water flow, sign of watermill

-Special arrangements – checking the water flows on detailed maps some branching and parallel channels surely diverse from the original natural tracks. These used to be the former mill canals

-Satellite maps – e.g Google Earth or GPS navigation devices – unorthodox but useful methods. Sometimes we find coordinates in different descriptions (e.g. geocaching) but the accurate follow up of the riverbed on aerial views can show us some objects hidden by a forest. The coordinate marking is a part of the posteriorly documentation (Figures 1-5).

Society as information source

The socialized tacit knowledge can be also remotely collected:

-**Networking** – a presentation in a professional community, an article, a conference paper initialize the avalanche of voluntary information flow and exchange between the topic specialists

-**Associations** – There are some national and international professional associations that can have some extra information: Association of the Hungarian Water Millers, Association of the Molinology, etc.

-**Self excitating data source** – After sending out information about a topic through different channels (news, mails, informal ways, family, work place, other communities) an emerging stream commences to shed information voluntarily about the related topic ("… the grandfather of mine…", "… during my travel I have seen…")

Figure 1: Denoted mill sites.

Figure 2: Marked mills.

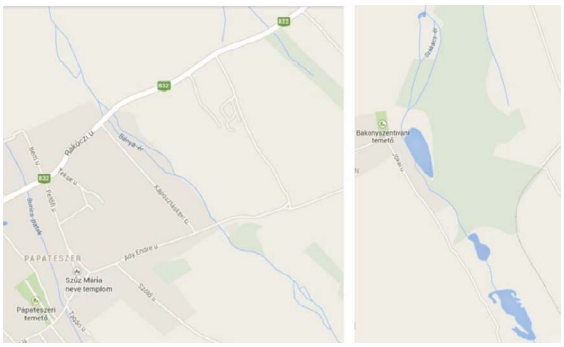

Figure 3: Forks of creek/Old dams on a creek.

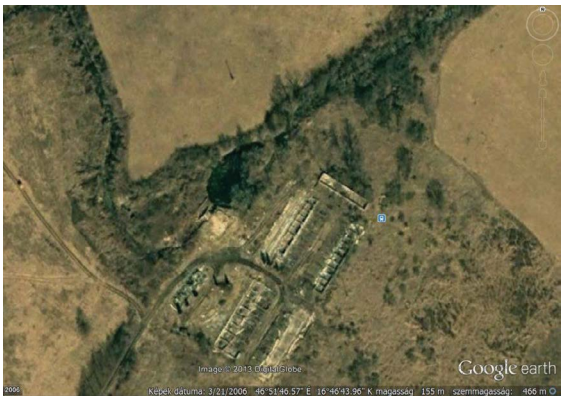

Figure 4: Mill ruin on Zala river, 2006.

The following figure shows the percentages of the methods used for seeking out more than 700 mills and mill sites in present Hungary. The other columns show the estimated percentage of the applications of these tools to scout all the historical sites. In another region of former Hungary (e.g. in Transylvania) the mills were used till the millennium. That is why the ratio between the possible tools could differ but the armory is similar (Figure 6).

Anomalies on the maps

The conflict resolution is a stationary point of the research. The more data source we have the more pieces of information are not fit. The 3rd Military Geography Survey[11] was issued by the Austro-Hungarian Monarchy from 1880 to 1915 on 240 sheets. The number of the visualized mills/mill places fit to other estimations. This bundle of maps provides a good overview about the locations but small variances occur in the details. During decades (and centuries) there were a lot of minor and major changes:

✓ In a southern rural area (Baranya) the dozens of signalized objects can't be found nowadays

✓ The most famous, several hundred years old Hungarian mill is not marked, nor are the dozens of the mills among the northern mountains (Jósvafő). These objects did not represent military importance.

✓ At creek 'Bene' in Mátra mountains several mills are marked (as they can be found today), in the next similar valley ('Mill creek in Markaz') no object has been denoted. Lack of former information service.

✓ On one hand in the Hungarian Highland between the hills in spite of the natural aptitude for the miss construction the flour mill is rare (because of the large ratio of the potato in the nutrition instead of wheat). On the other hand the water wheel driven hammers are really prevalent close to the miners' settlements.

[11] 3 rd Military Mapping Survey of Austria-Hungary, http://lazarus.elte.hu/hun/digkonyv/topo/3felmeres.htm

Figure 5: Location of former mill on Zala river, 2009.

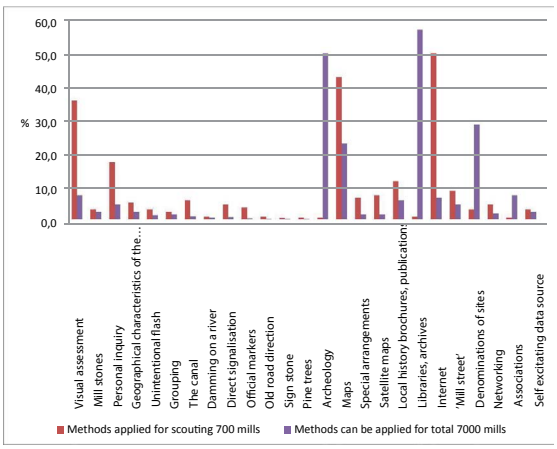

Figure 6: Seeking methods.

Proposed New Categorization

Based on our research experience, we can state that the simple notion "water mill" covers different shapes and displacements. There are no two identical mills but we can classify the mills in Hungary (and abroad). As the result of the research the following morphology categories are recommended:

✓ Vertical axe – Ancient arrangement with spoon form horizontal wheel, constructed on stands. No gear system, can be made of wood without metal parts (Ogerlistye).

✓ Simple building – made for subserviency. Larger than a living room, rectangular, made of wood or stone. It contains only the mill structure (Torocko).

✓ Huge baroque mills – for the early industrial operation in the lordship, stubby, bevel edge, built in miller's home, multi-storey, with oval attic windows (Frankl mill in Hidas).

✓One storied long peasant house. The wheel is put to the end of the long house. The wheel axe and the house are parallel (Uny, Orvenyes, Mecseknadasd). The house seems to be a simple porch house.

✓The tiered mill building is perpendicular with the mill creek, the miller's flat is on the opposite side than the mill wheel (Diszel, Hegymagas).

✓ "Zala" type "modern" turbine mill – typical for Zala country, with vertical axe Francis turbine, from the end of the 19th century. Sluice made of concrete, the grain and flour transported inside the building in special channels and by elevators. (Zalabér, Zalacséb, Zalalövő)

✓ "Flowing through the building" designed for protecting the wheel against icing in winter. The water comes from the backside to the overshot wheel and comes out in the front. (Nyirád, Diszel, Ábrahámhegy, Gyöngyössolymos, veszprémi Budai malom, Orfű)

✓ Mill on the weir – In case of low runoff the water was accumulated behind a dam. These artificial lakes had long dams. The mills were combined by the weir – The building is tiered from the headwater side and two-storied from the tail water side. The wheel is typically overshot (Pápateszér, Hanta).

✓ Hall mill – Large mills of the lordship with 6-10 wheels. The mill stones are placed on a mezzanine. (Bonchida, Kőszeg - Gullner mill, Cifra mill in Tata)

The basic form of the building was defined at the construction, the machinery was changed (the drive from wheel to turbine, the flour mill from stone to drums. The system was completed by strainers and elevators (Figures 7-16).

Conclusion

A wide variety of the KA methods was applied for knowledge generation to the "watermill" domain. Based on the above mentioned considerations the following results can be mentioned:

-Ontology definition was analyzed of notion "mill"

-Genealogy of mills was established

-Clues of former mills were assembled

-The water mills were classified by siting and by building shapes

-Naming convention was analyzed

-Collection of methods for mill search were given in framework: Written documents - Local, physical clues – Cartography clues –

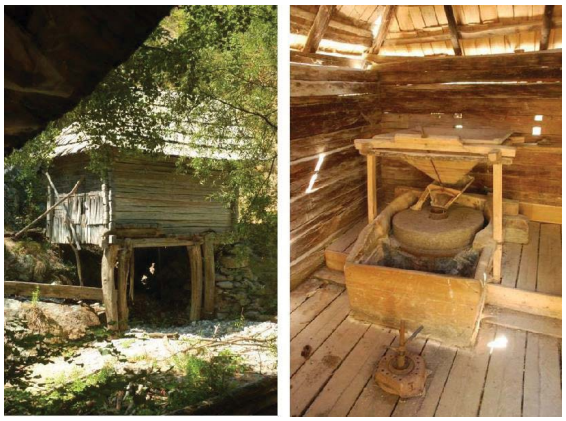

Figure 7: Vertical axe mill,Ógerlistye.

Figure 8: Simple mill building,Torockó.

Figure 9: Baroque mill,Franklmühle, Hidas.

Figure 10: One storied long peasant house, Uny.

Figure 11: Perpendicular, Keszler mill.

Figure 12: Turbine mill in Zala county, kerkáskápolna.

Figure 13: Flothrough the building", Diszel, Szarvas mill.

Figure 14: Mill on the weir, Kisbér – Ászár.

Figure 15: Baroque hall-type mill, Bonchida.

Society as information source

The methods can be generalized and widens the arsenal of researchers of archeologist and industry historians.

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