Conserve and Innovate Simultaneously?

Good Management of European UNESCO Industrial World Heritage Sites in the Context of Urban and Regional Planning

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Abstract: This paper addresses the general theme of conservation and/or change of heritage sites in urban and regional planning. The particular focus is on the management of UNESCO industrial World Heritage sites in Europe. Industrial heritage refers back to historic innovation and continues to be embedded today in innovation-orientated urban and regional development. The question that our study examines is: In which aspects does the management of an industrial World Heritage site coincide with (or differ from) that of areas of innovation? We identified criteria both for the management of industrial heritage sites ("Good Practice Wheel") and areas of innovation (success factors for European Science and Technology Parks). In an online survey, we asked managers of heritage sites to evaluate management criteria. Completed survey responses were obtained for 22 of 38 European sites (58%) in 12 of 15 countries concerned (80%). Our study clearly shows an overlap of conservation and innovation priorities even in the management of UNESCO industrial World Heritage sites, and underlines the importance of integrative, "good" heritage management.

1 Introduction

The management of industrial heritage sites, in particular, UNESCO World Heritage sites such as Zeche Zollverein, has to be seen in the context of urban and regional planning. The size of the sites, their technical and constructional facilities and infrastructures that were not intended for long-term preservation, and the difficulties of converting specialist industrial buildings such as winding towers, silos, or chemical plants, make the task of protection particularly difficult. Therefore, the conservation of industrial heritage, we assume, is based on innovation, in the sense of reinventing approaches, pathways, and concepts in heritage planning, conservation, and urban development. As particular areas of innovation require specific approaches to site management (cf. IASP 2019), our research question is: In which aspects does the management of an industrial World Heritage site coincide with (or differ from) that of areas of innovation?

To answer this question, we conducted a study with management representatives of UNESCO industrial World Heritage sites in Europe. Our study is in line with demands (for example, from the urban governance literature) to more systematically collect data, as the priorities of the academic discourse seem to differ from political and managerial practice (cf. da Cruz et al. 2019). Our study clearly shows an overlap of conservation and innovation priorities even in the management of UNESCO industrial World Heritage sites, and underlines the importance of integrative, "good" heritage management. To start with, we introduce the UNESCO World Heritage concept and the types of management involved.

1.1 The management of industrial UNESCO World Heritage sites

In November 1972, UNESCO adopted the Convention on the Protection of World Heritage. The UNESCO World Heritage list includes sites of natural and/or cultural significance, for instance, the Taj Mahal and Yellowstone National Park. For any site to be listed by UNESCO, its outstanding universal value (OUV) must be justified via six criteria of cultural significance (for example, "represents a masterpiece of human creative genius and cultural significance") and four of natural significance (for example, "contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance"). By 2019, the total number of World Heritage sites was 1121, comprising: 869 cultural sites, 213 natural, and 39 mixed, most commonly in Italy and China (55 each). For selecting and monitoring heritage sites, UNESCO is supported by ICOMOS (the International Council on Monuments and Sites), a professional association, founded 1965, with branches in all countries, and specialist organisations such as TICCIH (the International Committee for the Conservation of the Industrial Heritage).

Industrial heritage sites are sites of former industrial innovation (cf. Douet 2012; Oevermann, Mieg 2015). According to TICCIH (2019), this field "includes the material remains of industry – industrial sites, buildings and architecture, plant, machinery and equipment – as well as housing, industrial settlements, industrial landscapes, products and processes, and documentation of the industrial society." TICCIH was founded in 1973, and counsels UNESCO on industrial heritage. In 2019, there were around 78 industrial UNESCO World Heritage sites worldwide, which define a subset of about 7% of all sites (1121). Of these 78 sites, 52 (two thirds) are located in Europe, with Australia and Africa contributing one industrial heritage site each. Table 1 provides an overview of the industrial heritage sites in Europe.

Our study focused on European industrial heritage sites, in order to maintain a similar planning culture across all sites. Heritage sites, and in particular, industrial heritage sites, require active site management that must take into account the specific local and national planning context (Bandarin, van Oers 2012; Kalman 2014; Roders, Bandarin 2019). Herein, the integration of sustainability and the UN Sustainable Development Goals (SDGs) are crucial (Rodwell 2007; Labadi, Logan 2016). The need for management is discussed, especially in the UK, the country with the highest number of industrial UNESCO World Heritage sites. Rodwell (2002) performed a comparative analysis of management plans across these sites; Cossons (2008) highlighted the need for contemporary best-practice management standards for sustaining England's industrial heritage. Furthermore, some scholars have suggested innovation as a means for the conservation and development of industrial heritage sites (cf. Albrecht, Walther 2014).

For all UNESCO sites, a management plan must be defined and submitted (cf. Ringbeck 2008, 2018; Makuvaza 2018). Of particular concern is the preservation of the OUV (outstanding universal value) with regard, for instance, to tourism, which generally increases after the listing of a heritage site.[1] In a previous study, we analysed official documents concerning good practice for industrial heritage as per the guidelines and principles of UNESCO, ICOMOS, and TICCIH (Oevermann 2020). Based on Ringbeck (2008), we derived a systematisation of good practice for the management of urban industrial heritage, encompassing eight fields of good practice (Fig. 1): (1) management, (2) conservation, (3) reuse, (4) communities engagement, (5) sustainable development and climate change, (6) education, (7) urban development, and (8) research. We exemplified the systematisation with the case of Zollverein, which represents a complete example of coal mining infrastructure, providing evidence of the 150-year evolution and decline of this essential industry in the German Ruhr region (http://good-practice.indumap.de).

1.2 The management of areas of innovation

The motivation for our study was to ascertain how criteria for good practice in industrial heritage management relate to those for innovation. From the perspective of urban and regional planning, innovation is an issue that any site management has to be concerned with – either actively (i.e., with site management actively driving change) or passively (i.e., with the site being affected by a changing environment). A perfect example of good practice would appear to be the management of "areas of innovation". The leading association in this area, the International Association of Science Parks and Areas of Innovation (IASP), defines areas of innovation as follows:

"Areas of innovation are places designed and curated to attract entrepreneurial-minded people, skilled talent, knowledge-intensive businesses and investments, by developing and combining a set of infrastructural, institutional, scientific, technological, educational and social assets, together with value-added services, thus enhancing sustainable economic development and prosperity with and for the community." (IASP 2019)

IASP is a support and exchange network for sites and managers, which hosts a global conference each year at one of its members' sites. *Areas of innovation* is an umbrella term for innovative sites that do not fall into the more formalised category of *Science and Technology Parks*, IASP's core field of expertise.

Studying the management of areas of innovation provides access both to good practice in site management and to theory, for example, with regard to creative milieus (for example, Camagni 1991), clusters (for example, Bathelt et al. 2004) or regional innovation systems (for example, Asheim et al. 2011). IASP and its members refer, if at all, to the "triple helix" approach (for example, Etzkowitz, Leydesdorff 2000), implying managed cooperation between technology firms, research centres, and municipal politics.

Year of listing	Site	Country	Characteristic*	Focus**
1978/2008/2013	Wieliczka and Bochnia Royal Salt Mines	Poland	Mining	x
1980/2010	Røros Mining Town and the Circumference	Norway	Mining	x
1982/2009	From the Great Saltworks of Salins-les-Bains to the Royal Saltworks of Arc-et-Senans, the Production of Open-pan Salt	France	Buildings, former industrial premises	x
1992/2010	Mines of Rammelsberg, Historic Town of Goslar and Upper Harz Water Management System	Germany	Mining	x
1985	Pont du Gard (Roman Aqueduct)	France	Infrastructure (antiquity)	
1985	Old Town of Segovia and its Aqueduct	Spain	Town, infrastructure (antiquity)	
1986	Engelsberg Ironworks	Sweden	Mining	x
1986	Ironbridge Gorge	UK	Infrastructure	x
1987	Hanseatic City of Lübeck	Germany	Town	
1993	Historic Town of Banská Štiavnica and the Technical Monuments in its Vicinity	Slovakia	Town	
1994	Völklingen Ironworks	Germany	Buildings, former industrial premises	x
1995	Kutná Hora: Historical Town Centre with the Church of St Barbara and the Cathedral of Our Lady at Sedlec	Czechia	Town	
1995	Crespi d'Adda	Italy	Buildings, former industrial premises	x
1995	Hanseatic Town of Visby	Sweden	Town	
1996	Verla Groundwood and Board Mill	Finland	Buildings, former industrial premises	x
1996	Canal du Midi	France	Infrastructure	x
1997	Hallstatt-Dachstein / Salzkammergut Cultural Landscape	Austria	Town	
1997	Mill Network at Kinderdijk-Elshout	Netherlands	Infrastructure	x
1997	Las Médulas	Spain	Mining (antiquity)	
1998	Semmering Railway	Austria	Infrastructure	x
1998	The Four Lifts on the Canal du Centre and their Environs, La Louvière and Le Roeulx (Hainaut)	Belgium	Infrastructure	x
1998	Ir.D.F. Woudagemaal (D.F. Wouda Steam Pumping Station)	Netherlands	Buildings, former industrial premises	x
2000	Neolithic Flint Mines at Spiennes (Mons)	Belgium	Prehistoric tools	
2000	Blaenavon Industrial Landscape	UK	Buildings, former industrial premises	x
2001	Zollverein Coal Mine Industrial Complex in Essen	Germany	Mining	x

Tab. 1: UNESCO industrial World Heritage sites in Europe (as of 2019).
(Sources: ICOMOS 2006); Goskar 2013; Höhmann 2016; Wikipedia 2019; our additional check of UNESCO heritage listings since 2017: https://whc.unesco.org)

2001	Mining Area of the Great Copper Mountain in Falun	Sweden	Mining	x
2001	Derwent Valley Mills	UK	Buildings, former industrial premises	x
2001	New Lanark	UK	Buildings, former industrial premises	x
2001	Saltaire	UK	Buildings, former industrial premises	x
2004	Grimeton Radio Station, Varberg	Sweden	Buildings, former industrial premises	x
2004	Liverpool – Maritime Mercantile City	UK	Infrastructure	x
2005	Plantin-Moretus House-Workshops-Museum Complex	Belgium	Buildings, former industrial premises	x
2005	Struve Geodetic Arc	Latvia+9	Infrastructure	x
2006	Vizcaya Bridge	Spain	Infrastructure	x
2006	Cornwall and West Devon Mining Landscape	UK	Mining	x
2008	Rhaetian Railway in the Albula / Bernina Landscapes	Switzerland & Italy	Infrastructure	x
2009	La Chaux-de-Fonds / Le Locle, Watchmaking Town Planning	Switzerland	Buildings, former industrial premises	x
2009	Pontcysyllte Aqueduct and Canal	UK	Infrastructure	x
2010	Seventeenth-Century Canal Ring Area of Amsterdam inside the Singelgracht	Netherlands	Town	
2011	Fagus Factory in Alfeld	Germany	Buildings, former industrial premises	x
2012	Major Mining Sites of Wallonia	Belgium	Mining	x
2012	Bassin minier du Nord-Pas de Calais	France	Mining	x
2012	Heritage of Mercury. Almadén and Idrija	Spain & Slovenia	Mining	x
2014	Van Nellefabriek	Netherlands	Buildings, former industrial premises	x
2015	Speicherstadt and Kontorhaus District with Chilehaus	Germany	Infrastructure	x
2015	Rjukan-Notodden Industrial Heritage Site	Norway	Buildings, former industrial premises	x
2015	The Forth Bridge	UK	Infrastructure	x
2017	Tarnowskie Góry Lead-Silver-Zinc Mine and its Underground Water Management System	Poland	Mining	x
2019	Mining Cultural Landscape Erzgebirge	Czechia & Germany	Mining	
2019	Water Management System of Augsburg	Germany	Infrastructure	
2019	Krzemionki prehistoric striped flint mining region	Poland	Prehistoric tools	
2019	Jodrell Bank Observatory	UK	Infrastructure	

* Proposed typology, with some reference to Höhmann (2016); the characterisation is indicative, and may differ from the self-characterisation of the heritage site (cf. Tab. 3). ** Focus of our study.

Fig. 1: Industrial heritage management: Good practice wheel (GPW).
(Source: Oevermann and Mieg, http://good-practice.indumap.de)

Two of the clear messages from the last twenty years of research on local innovation are (cf. Mieg, Mackrodt 2010): firstly, areas of innovation – and in particular science and technology parks – require active, professional management; and, secondly, areas of innovation must be developed as attractive urban locations. There is global competition for high potential individuals (the "creative class"). Urbanity has become a necessary feature of today's areas of innovation. In many cases, industrial heritage sites – such as former industrial plants – were reused with specific reference to the industrial culture of a place. Examples can be found in almost any European city (cf. Oevermann, Mieg 2015). However, an explicit link from the management of areas of innovation to the discourse on heritage conservation is (still) missing.

1.3 Industrial heritage conservation and innovation

The tension between conservation and change in heritage management – and the resulting trade-offs – have not only become a topic in the scientific community (for example, Oevermann, Mieg 2016), but are also discussed by ICOMOS:

"In terms of assessing the effect of any impact on OUV [outstanding universal value], concepts such as 'limits of acceptable change' and 'absorption capacity' are being discussed, although there is no consensus yet on the usefulness of these concepts, or on how to operationalise them. There is also no consensus on how to revive heritage value that has been eroded." (ICOMOS 2011: 1)

The above quote is taken from the introduction to ICOMOS' guidelines on Heritage Impact Assessment, a tool that should help assess the impacts of changes at a heritage site or in its environment. Heritage Impact Assessment should support the monitoring of a site, one of the many tasks of heritage management.

Heritage Impact Assessment is derived from environmental impact assessment, a reliable tool in environmental protection (cf. European Commission 2014). Similarly, other patterns of regulation and tools – such as monitoring – are also borrowed from environmental protection. In environmental protection the subject of protection is nature, whereas in conservation it is a monument or, more generally, the heritage site. The conflict between conservation and change is mirrored in the discussion on sustainability. Can we allow for trade-offs between environmental concerns on the one hand, and economic or social ones on the other hand, for example, in the context of sustainable urban development (Mieg 2012)? Compensatory models allow for such trade-offs, with the risk of ending up with high economic growth and high environmental costs; non-compensatory models restrict such trade-offs (Rowley et al. 2012).

Mieg (2012) explicitly discussed the relationship between sustainability and innovation in urban development. He advocated a resource-based model that differentiates between core resources that should be preserved, and additional growth resources such as funding. From this point of view, the grown local identity (monuments as well as social networks, etc.) can be considered a core resource and can be used as a story and brand to develop the particular site in both a sustainable and innovative way.

As industrial heritage sites were formerly locations of industrial innovation, the common denominator among industrial heritage management and innovation management is *industrial culture* (cf. Hoppe 2020). The industrial culture of a site might represent a potential resource both for conserving and developing a site.

2 Materials & method

Our research question is: In which aspects does the management of an industrial World Heritage site coincide with (or differ from) the management of an area of innovation? To further illuminate this link between conservation and innovation, we developed an online survey on industrial heritage management, emphasising the applied management criteria.

2.1 Sites

The questionnaire survey focused on industrial heritage sites in Europe (Table 1), to ensure a somewhat common planning culture across the surveyed sites. We excluded very new sites that were listed during 2019, as we cannot expect a robust management experience with these sites. We also excluded sites whose heritage dates from before the year 1500. In these cases, we cannot expect a potential line of industrial culture combining the heritage with current planning. Furthermore, we excluded sites that represent an entire town (such as Hallstein, Lübeck, or Visby) or that focus on urban planning (such as canals in Amsterdam). In these cases, a separate site management strategy does not make sense, since the site forms part of the municipal administration. Thus, the survey population encompassed 38 sites (cf. Table 1), of which four are multi-national and one (Liverpool) is classified by UNESCO as being "in danger."

2.2 Criteria

To study the covariance of heritage and innovation management in industrial heritage we bring together two sets of criteria – from heritage management and managing areas of innovation (see Table 2). On the one hand, we use the criteria for good practice in urban industrial heritage management, as systematised by the Good Practice Wheel (cf. Oevermann, 2020). On the other hand, we use the "success factors" for the management of science and technology parks, as reported by Rowe (2014).

2.3 The survey

We designed and programmed an online survey (system: LimeSurvey) consisting of three groups of questions. Firstly, six questions concerning the site: the year the site's management was established (3 ranges); international exchange with other sites; characteristics of the site (for example, defined by mining, infrastructure, etc.); characteristics of the environment (from urban to rural); size of the site (4 ranges); number of visitors in 2018 (3 ranges).

Secondly, we defined 17 criteria for industrial heritage management (Table 2, left side) and 9 for managing areas of innovation (Table 2, right side). Two criteria for innovation management also qualify for industrial heritage management: STP3 *Multi-level governance* (=GPW6b) and STP8: *Defining the organisational model* (=GPW1a). The nine STP criteria were defined such that they apply to heritage sites. For each criterion, the question was whether it plays a role in the local site management (3 options: major role; minor role; no role/does not apply). The criteria were mixed and thematically regrouped (issues of, for example, cooperation, resources, etc.).

We included four additional criteria for innovation management: identity of site (InnoSuD), a criterion of site management bound to sustainability and innovation (Mieg 2012); cooperation with consultancies and service firms (InnoEcoGeo), an economic geography criterion for corporate headquarters (Taylor 2005); cooperation with investment firms (InnoFinEco), a criterion of "financial ecologies" that foster innovation (Grafe, Mieg 2019); and cooperation with local companies (InnoLocBiz), as a tentative criterion for the level of local activity. Thirdly, the survey format provided space for respondents to add their own criteria and comments.

3 Results

3.1 Sample

In July 2019, we contacted the 38 sites (cf. Table 1, marked x in the last column). We explained the purposes of our survey and requested email addresses for the local coordinators. One site declined to participate. The online survey ran for one month (4 September to 5 October 2019) and reminders to participate were sent each week. Ultimately, we obtained fully completed questionnaires representing 22 sites in 12 countries, i.e., more than half of the sites (58%, i.e., 22 of 38) and 80% of all 15 countries involved.[2] The corrected response rate is 73% (i.e., 24 of 33 after excluding five sites that were not reachable[3]).[4]

Table 3 shows the characteristics of the industrial heritage sites covered by our study. The first three characteristics concern the sites and the second three the site's management. Almost half of the sites (10 of 22) cover more than 100 hectares. Most sites (12 of 22) are predominantly characterised by buildings and former industrial premises, and many sites (8 of 22) by infrastructure. Half of the sites are located in an urban environment (versus periurban or rural). At half of the sites, the local site management was established between 2000 and 2010 (versus earlier or later). Most of the sites (12 of 22) had less than 100 000 visitors during 2018. At most sites (15 of 22) the management is involved in international site networking.

Conservation criteria: Good Practice Wheel for Industrial Heritage Management (GPW, cf. Oevermann 2020)	Innovation criteria: Key Success Factors for Science and Technology Parks (STP, Rowe 2014)
Management System GPW1a: Defining the organisational model for managing the conservation & development of the site* GPW1b: Continuous improvement of heritage-oriented management tools GPW1c: Funding from multiple sources (for example, public, private, fees…)	**Strategy and objectives:** "Setting out the strategy and objectives of the new park and deciding on the best model for implementation" ➪ STP1: Widely communicating your strategy and objectives for the conservation & development of the site
Conservation GPW2a: Including the site's OUV (Outstanding Universal Value) in local cooperation agreements GPW2b: Double-checks of all local cooperation agreements for protecting the site's authenticity and integrity GPW2c: Permanent collaboration with national conservation institutions	**Engagement of the knowledge base (for example, universities):** "Engagement of the knowledge base – an active, effective and multi-dimensional relationship with a university or other public sector research organisation is often seen as crucial" ➪ STP2: Cooperation with universities and research institutions
Reuse GPW3a: Adaptive reuse of the site (new functions, new target groups…) GPW3b: Inclusive access and accessibility of the site	**Interaction with the public sector:** "Interaction with the public sector at local/regional, national and European level" ➪ STP3: Multi-level governance (close cooperation at several levels: local, regional, national)*
Communities Engagement GPW4: Communities engagement (with neighbourhoods, local stakeholders, community-based organisations…)	**Land, capital, revenue:** "Securing the land, capital and revenue to establish the STP and ensure its on-going growth is often a critical and time-consuming stage" ➪ STP4: Securing reserve land as well as long-term capital and short-term revenues/cash-flows for the conservation & development of the site
Sustainability / Climate Change GPW5a: Applying the United Nations SDGs (Sustainable Development Goals) GPW5b: Responding to climate change (measures for mitigation and adaptation)	**Local skill base:** "Assessing the nature of the local skill base" ➪ STP5: Understanding and supporting the local skill base (crafts, people, firms…)
Urban Development GPW6a: Specific projects for integrating local development and heritage conservation (for example, in public transportation, housing…) GPW6b: Multi-level governance (close cooperation at several levels: local, regional, national)*	**Regional / national markets:** "Addressing the availability of regional and national markets or corporate supply chains" ➪ STP6: Connection to regional and national markets (tourism, supply chains…)
Education GPW7a: Promoting "education as information": providing information about the site through signs, websites, guided tours, etc. GPW7b: Promoting "education as learning" through public workshops, school collaborations, youth camps etc.	**Key services to tenants:** "Selecting the package of services to deliver to tenant companies and businesses in the wider economy" ➪ STP7: Providing support and services for tenants at the site
Research GPW8a: Obtaining, preserving, and updating comprehensive data on your site (by active research) GPW8b: Permanent, comprehensive evaluation of the changes at your site	**STP model:** "Deciding on the appropriate science park model – most STPs stakeholders require that the STP achieves financial sustainability within a reasonable timescale." ➪ STP8: Defining the organisational model for managing the conservation & development of the site*
	Leadership: "Selecting a strong leadership based on a board/committee structure that has good connections into the local economy (private and public) and a CEO with appropriate sector experience and strong leadership and management skills" ➪ STP9: Clear and strong leadership

Tab. 2: Management criteria: conservation vs. innovation.

Characteristic of site and/or site management	#
Size	Up to 1 hectare: 3 More than 1 hectare and up to 10 hectares: 2 More than 10 hectares and up to 100 hectares: 7 More than 100 hectares: 10
Type of site [multiple answers allowed]	Mining: 4 Buildings and former industrial premises: 12 Infrastructure: 8 Urban development: 3 None of these: 1
Location	Urban: 11 Mixed urban/rural (periurban): 5 Rural: 6
Year when the local site management was installed (with its own structure, budget, staff…)	2000 or earlier: 4 From 2000 to 2010: 11 After 2010: 7
Number of visitors during 2018	Up to 100000 tourists: 12 More than 100000 and up to 1 million tourists: 8 More than 1 million tourists: 2
Are you involved in international networking and exchange of experiences with other industrial heritage sites?	Yes: 15 No: 7

Tab. 3: Characteristics of the UNESCO industrial World Heritage sites studied and their management (n=22).

3.2 Industrial Heritage Management (Good Practice Wheel)

Figure 2 ranks the 17 criteria of the Good Practice Wheel for Industrial Heritage Management (see Table 2). The ranking is based on how often a criterion is attributed a major role (between 0 and 22). The highest-ranked criterion is *Promoting "education as information"* (GPW7a), representing one of the two criteria for education. The next two most important criteria are *Funding from multiple sources* (GPW1c) and *Multi-level governance* (GPW6b). *Multi-level governance* and the criterion that follows on the fourth rank, *Defining the organisational model* (GPW1a), also represent essential innovation criteria and feature in Figure 3.

Post hoc tests of between-group differences (Chi-squared, 5% level) show that two preferences for specific GPW criteria are significantly associated with site characteristics (cf. two groups named in Figure 2):

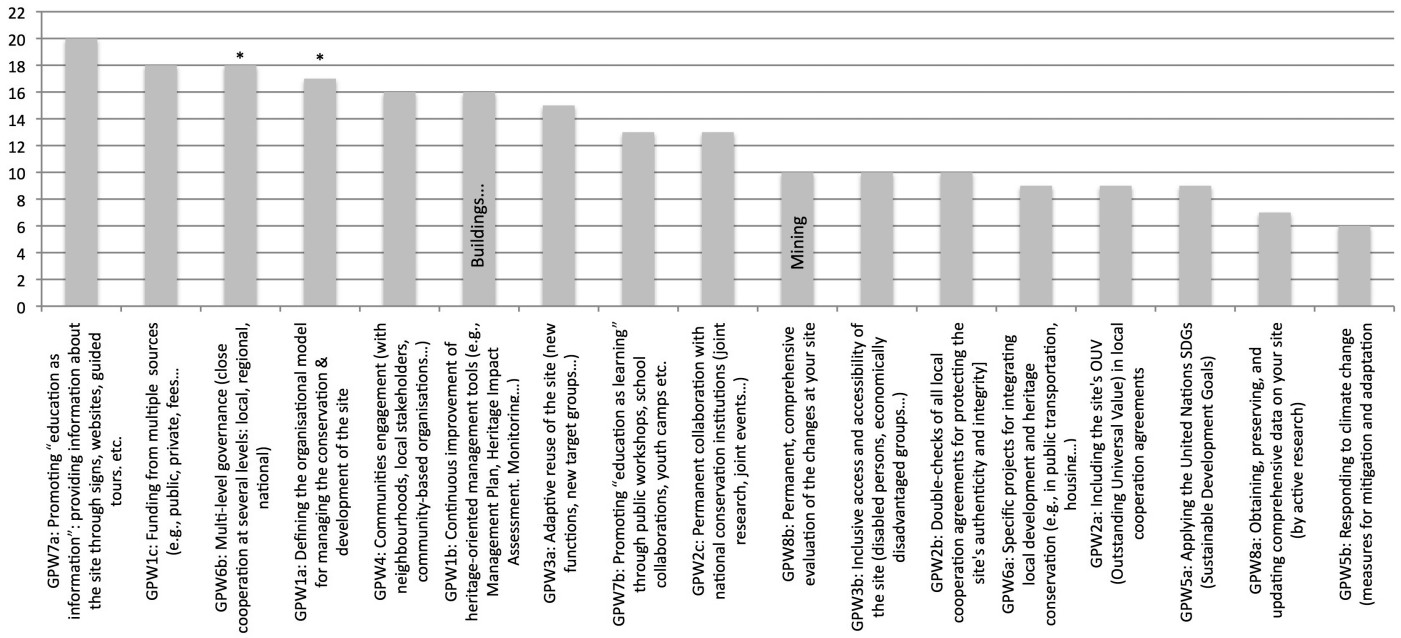
1) "Building…": The management of sites that are predominantly defined by buildings and former industrial premises give preference to continuous improvement of heritage-oriented management tools (GPW1b).

2) "Mining": The management of mining sites strongly emphasises the ongoing, comprehensive evaluation of changes at the site (GPW8b).

Furthermore, Cronbach's alpha indicates internal consistency (alpha = .80). Therefore, the set of GPW criteria can be utilised as a scale for measuring good practice in industrial heritage management. In order to do this, the responses should be quantified ("major role" = 2, "minor role" = 1, "no role or does not apply" = 0).

3.3 Management of areas of innovation

Figure 3 shows the ranking of the nine innovation criteria, as defined by the success factors for science and technology parks (see Table 2), as well as the four additional innovation criteria. The ranking is based on how often a criterion is attributed a major role (between 0 and 22). The highest-ranked criterion is *Multi-level governance* (STP3), followed by *Defining the organisational model* (STP8) and *Widely communicating your strategy and objectives* (STP1). The first two criteria represent conservation criteria and are therefore also listed in Figure 2. Among the four additional innovation criteria, *A clear identity* (InnoSuD) seems to play an overall major role, whereas *Cooperation with investment firms* (InnoFinEco) is ranked lowest of all the criteria in this study.



Some subgroups of the industrial heritage sites differ from the others (cf. Table 3, second row): Buildings … = defined by buildings and former industrial premises, Mining = defined by mining: The management of sites with these characteristics shows a significant preference for the particular GPW criterion.

* also an innovation criterion (cf. Fig. 3)

Fig. 2: Ranking of Good Practice Wheel (GPW, see Table 2) criteria for industrial heritage management (How often a criterion is attributed a major role).

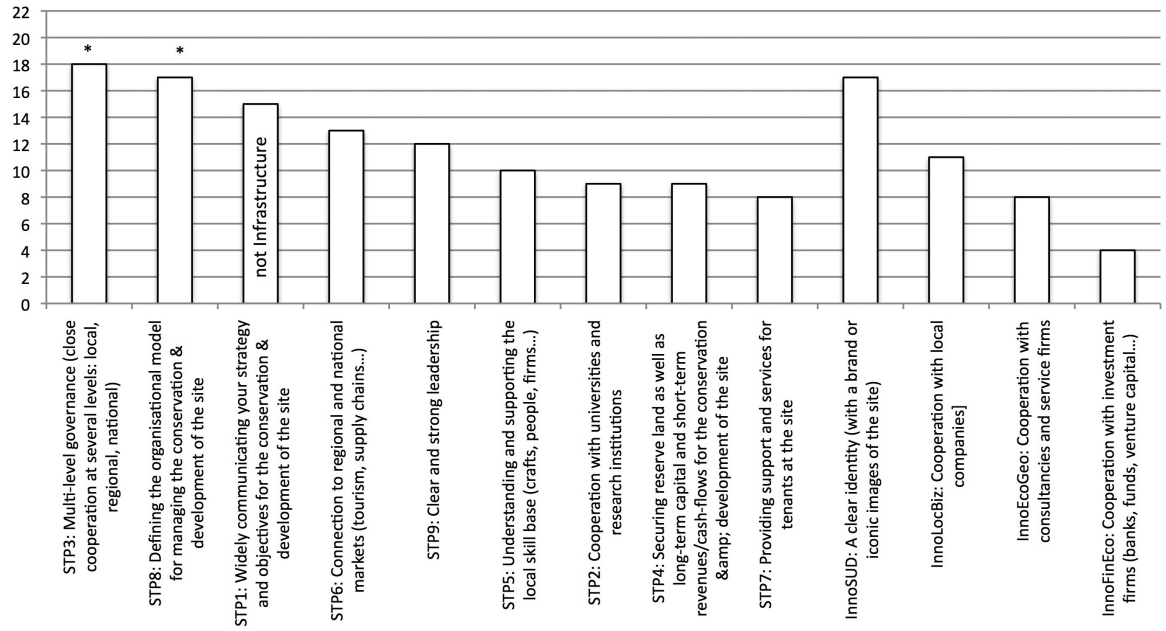
Post-hoc tests (Chi-squared, 5% level) were used to test for differing preferences for innovation criteria between sites. Only one statistically significant – inverse – effect was found ("not Infrastructure"): The management of sites that are not defined by infrastructure assign a major role to widely communicating the strategy and objectives for the conservation and development of their site (STP1).

The nine innovation criteria for science and technology parks define a scale with near-acceptable internal consistency (Cronbach's alpha = .69) in industrial heritage management. For this we could quantify the responses ("major role" = 2, "minor role" = 1, "no role or does not apply" = 0). Adding the four additional innovation criteria, the consistency of the scale increases (Cronbach's alpha = .78), indicating that we could use the group of 13 criteria to assess the level of innovation displayed in managing industrial heritage sites.

Using the two new scales – one for heritage management (17 criteria), the other for managing areas of innovation (13 criteria) – we see:
1) More heritage than innovation: At the surveyed sites, the level of heritage management is slightly but significantly higher than that of areas of innovation (means 1.50 vs. 1.36, t-test for means, 5% significance level).
2) Role of management in mining heritage: Heritage sites defined by mining display higher levels of management for both heritage and innovation than seen at other types of sites (t-test, 5% level).
3) Role of international networking: The levels of heritage management and area of innovation management are not correlated to the intensity of tourism at the sites; however, the level of both types of management increases significantly with *Increased international networking* (t-test, 5% level). For heritage and innovation management, international networking seems to be relevant whereas tourism is not.

3.4 What is the relationship between industrial heritage management and the management of areas of innovation?

The main concern of the study was to determine whether there is a relationship between industrial heritage management, oriented to-



One subgroup of the industrial heritage sites differs from the others (cf. Table 3, second row): not Infrastructure = not defined by infrastructure: The management of sites with these characteristics shows a significant preference for the particular STP criterion.

* also a criterion for heritage management (cf. Fig. 2)

Fig. 3: Ranked criteria for managing areas of innovation (How often a criterion is attributed a major role), here derived from the success factors for science and technology parks (Rowe 2014, see Table 2).

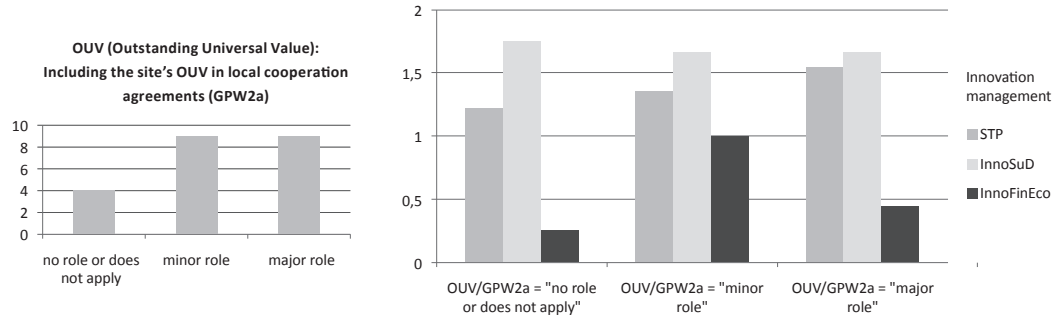
wards conservation, and the management of areas of innovation.

Before conducting any quantitative analysis, it can be seen that the management of these two types of sites has two common criteria: the necessity of defining an organisational model (GPW1a = STP8) and multi-level governance (GPW6b = STP3).

Moreover, the GPW and STP criteria (see Table 2) show strong and robust correlation (Pearson r=.64, Spearman rho=.60, 1% level of significance). *Thus, in our sample of industrial World Heritage sites, the level of heritage management increases with the level of innovation management.*[5]

To illustrate the kind of innovation management practised at the sites surveyed, we can take a closer look at the data for the core conservation criterion GPW2a (see Table 2), *Including the site's OUV in local cooperation agreements* (Figure 4a&b). Heritage management based on the OUV can be considered *best practice*. Therefore, we would expect all UNESCO World Heritage sites to place the greatest emphasis on this criterion. However, four sites state that this OUV criterion plays no role or does not apply (Fig. 4a, left side). Contrary to what might be expected, the role of innovation management (here measured as STP) *increases* with the importance of GPW2a (Fig. 4b right side). Site management that attributes a major role to including the OUV in local cooperation agreements also scores higher in innovation management (the difference for the groups GPW2a="major role" and GPW2a="no role" being significant (t-test, 5% level)).

However, we also see that this preference for innovation refers to a "soft" form of innovation, as characterised by InnoSuD ("A clear identity"), which is a criterion of sustainable and innovative urban development (cf. Mieg 2012). InnoSUD always ranks high in our sample (cf. Fig. 3 and Fig. 4b, right side), whereas the criterion InnoFinEco for "financial ecologies" (Grafe, Mieg 2019), which can be associated with "hard", i.e. more disruptive innovation, always ranks low (cf. Fig. 3 and Fig. 4b, right side).



a b

Fig. 4a & b: Best practice for UNESCO industrial World Heritage management: The criterion "Including the site's OUV (Outstanding Universal Value) in local cooperation agreements" (GPW2a, left side) and preferences for innovation management (right side).

OUV: Outstanding Universal Value. STP: a measure for innovation management (= mean of ST1 to STP9, cf. Table 2). InnoSuD ("A clear identity"): a "soft" innovation criterion from innovative sustainable urban development (cf. Mieg, 2012); InnoFinEco ("Cooperation with investment firms"): a "hard" innovation criterion for "financial ecologies" (cf. Grafe, Mieg 2019). STP, InnoSuD, and InnoFinEco are quantified ("major role" = 2, "minor role" = 1, "no role or does not apply" = 0).

3.5 Further criteria for the management of industrial heritage

Last but not least, we should consider the additional criteria and comments suggested by the survey respondents. Some of the proposed criteria appear to rephrase existing criteria, for instance, the proposal to include "participation" matches our GPW4 "communities engagement". One comment proposes generally avoiding applying common standards or rules. In terms of conservation, respondents often mentioned that each site or monument is very specific.

Further propositions concern new criteria or new aspects that seem relevant to the management of industrial heritage sites:

- Functional: "Continued operational use (still performing original function)"
- Industrial culture: "Cultural impact of the site as an engineering and national icon"
- Regional aspect: "Plans concerning spatial planning and development of the region"

4 Discussion & conclusion

Our study clearly shows an overlap of conservation and innovation priorities in the management of UNESCO industrial World Heritage sites. We interpret this finding as evidence for the importance of integrative, "good" heritage management. Good practice in industrial heritage management needs to take into account the type of heritage (for example, mining) and, most often, needs to preserve the specific industrial culture of the place. We conclude with three points of discussion, of which the first and main point concerns management, and add a specific conclusion for urban and regional planning on using a plurality of management criteria sets for more systematic data collection.

4.1 Active management, good management

The previous review of the management of areas of innovation reveals the importance of active site management (cf. Mieg, Mackrodt 2010). This seems equally important for managing industrial heritage sites. Our main finding is the correlation between the measure of industrial heritage management (GPW) and the management of areas of innovation (STP). However, this does not mean that industrial heritage sites adopt innovation management in the strong, narrow sense of simply pursuing "change". Firstly, in our study, the level of heritage management is higher than that of innovation management. Secondly, if innovation comes into play, it takes a rather weak form, such as the criterion of *A clear identity* (InnoSuD), rather than an innovation-driving factor such as *Cooperation with investment firms* (InnoFinEco). To conclude: we see a common factor of *good* management (active locally and internationally). Both industrial heritage sites and areas of innovation require good management. This, in particular, includes being involved in international networking and exchange of experiences with other (industrial heritage) sites.

The study findings also underline the value of the Good Practice Wheel. The wheel's eight categories (management, conservation, etc.) can be operationalised through more specific criteria (GPW1a to GPW8b, see Table 2), which can even be used as a scale to measure the level of heritage management. Moreover, the two highest-ranked innovation criteria (cf. Fig. 3) are already criteria of good practice in heritage management, *Multi-level governance* (GPW6b) and *Defining the organisational model for managing the conservation & development of the site* (GPW1a). In addition, the preservation of local identity (InnoSuD), which seems important for innovative sustainable urban development (Mieg 2012), could be included as a fourth item within the "Management System" category (GPW1, cf. Fig. 1, Table 2).

4.2 Not urbanity but type of heritage

Besides the issue of active management, the previous review of the management of areas of innovation reveals the importance of urbanity as an attraction factor (cf. Mieg, Mackrodt 2010). In the present study, however, location (urban vs. periurban vs. rural) plays no role. Instead, in our cases of industrial heritage, site management depends on the type of heritage (cf. Bärtschi 2008; Höhmann 2016), such as mining; infrastructure; buildings and former industrial premises. In particular, former mining sites that include specific technologies and structures require a high level of management.

Coordination with urban/regional planning is one of many tasks involved in managing industrial heritage sites. The two main criteria addressed in the present study are *Multi-level governance* and *Communities engagement* (cf. Fig. 2). Specific projects for integrating local development and heritage conservation play a lower-ranking role. In this study, the planning context re-emerges in the comments made by the site managers, through the importance of specific infrastructural planning and the need for legal compliance.

4.3 Industrial culture

Something we take from this study is that what we (also) have to preserve at a site of industrial heritage is "technological/industrial functioning". In the case of railways and bridges, this means securing and maintaining the continued operation of the heritage. In contrast, at former mining sites, it is not possible to preserve the original operational functions. Similar considerations hold for former industrial plants: The specific industry has gone; however, it is possible to preserve the core identity of the site (as assessed by InnoSuD). Industrial culture provides a link between the present-day site and its industrial heritage (Hoppe 2020). Therefore, as a starting point, the concept of industrial culture might help in understanding which elements of industrial heritage must be preserved.

4.4 Conclusion for urban and regional planning

A recent review of the urban governance literature (da Cruz et al. 2019) revealed a divide between the academic discourse and political practice: whereas the academic discourse is concerned with themes of public engagement and participatory issues, the priorities of political practice in cities are budgets and efficient administration. Our study shows how differentiated the management of UNESCO industrial World Heritage sites can be, for instance prioritising "education as information" (GPW7a) before "funding from different sources" (GPW1c) and both issues before "communities engagement" (GPW4) and "education as learning" (GPW7b).

A conclusion from our study, in line with da Cruz et al. (2019) is to find smart ways of collecting data for both planning and research purposes. Today, the conservation of industrial heritage sites, like any local or regional development project, is subject to various pressures; formal or informal requirements; and evaluation schemes from different actors and levels of planning, including industry, politics, or science, and from local business cooperation to the SDGs of the United Nations. We have to find ways to translate all of these expectations through criteria sets that allow for survey results that can be retranslated into both local planning projects and planning theory.

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Notes

1 The World Heritage Centre, which surveys the heritage sites, is keenly aware of these problems. In 2008 it published a list of factors endangering OUVs, starting with those concerning Build-

ings and Development, such as urban sprawl, and concluding with threats related to management and institutional factors (cf. https://whc.unesco.org/en/factors/).

2 In the case of the Struve Geodetic Arc, ten countries are involved (Belarus, Estonia, Finland, Latvia, Lithuania, Moldova, Norway, Russia, Sweden and Ukraine). In this particular case, we only counted the coordinating country, Latvia.

3 For four sites, the email addresses provided were non-functional in September. The coordinators of two sites started but did not complete the online questionnaire.

4 We also tested the validity of sample choice (38 sites out of 52 in total), checking which sites had their own website (as of September 2019). A dedicated website seems to be a necessary element of actively managing a site. Of the 38 initial sites, seven (18%) do not run their own website (with its own domain) but instead have a subdomain of a governmental website (often tourism-focused). Among the 14 excluded sites, seven do not have their own website (50%), which differs significantly from the 38 sites that responded to the questionnaire (Chi-squared, 5% level). Thus, our sample choice of necessarily managed heritage sites seems justified.

5 For this correlation test, we make two provisions. Firstly, we look for two distinct, non-overlapping sets of criteria. Therefore, criteria STP3 (=GPW6a) and STP8 (=GPW1c) are only counted as criteria for the management of areas of innovation. Using the criteria twice on both sides of the comparison would risk creating an artificially strong correlation. Secondly, we quantify all responses ("major role" = 2, "minor role" = 1, "no role or does not apply" = 0). We do not base our comparison solely on the number of "major-role" nominations. A first nonparametric test reveals that the 15 GPW and 9 STP criteria differ significantly in the importance of their roles (Chi-squared, 5% level). The reason is not that the GPW criteria are more often assigned a "major role" (compared with STP criteria), but that STP criteria are more often considered non-applicable or having no role. Therefore, it is necessary to take into account other nominations besides "major role".

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