THE DE-INDUSTRIALISATION DISCOURSE AND THE LOSS OF MODERN INDUSTRIAL HERITAGE IN THE ARAB WORLD: JORDAN AS A CASE STUDY

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Purpose - Industrial heritage is considered an essential part of cultural heritage in the world. This heritage suffers from continued marginalisation in the Arab world, particularly in Jordan, where many industrial heritage sites have not been protected or studied well due to the lack of a clear definition of cultural heritage. Most of these sites, built in the 20th century, are gradually disappearing or scheduled for demolition.

Design/methodology/approach - This research investigates the modern industrial heritage in Jordan as a case study in the Arab world. A comprehensive understanding of the industrial heritage has been obtained by adopting a case study approach and using a reconnaissance survey of potential industrial heritage sites in Jordan.

Findings – Seven categories were used in the analysis of the de-industrlialisation phenomenon of heritage sites: ownership; location; design and types; structure; significance; deterioration and physical condition; and conservation attempts and alterations. Three main approaches to industrial heritage were identified: demolition; occasional maintainance; and rare examples of conservation and adaptive reuse.

Originality - This research raises awareness of the de-industrialisation discourse, and highlights the value of industrial architecture dating back to the modernity period, which was short-lived in Jordan. It also calls for serious consideration of these sites to support sustainable development in the Arab World.

Research implications - This study sheds light on the ownership issue of industrial structures in Jordan and ininvites policy makers, relevant authorities, private organisations, and the public to consider the challenges and impact of de-industrialisation of such sites.

KEYWORDS: De-industrialisation; Industrial Heritage; Modernism; Arab World; Jordan; Sustainable Development

1. INTRODUCTION

The industrial revolution played a pivotal role in the changes that contributed to the revitalisation of economic life, of which industrial architecture was an important part. That revolution took place during the eighteenth and nineteenth centuries, mainly in Western countries. Unfortunately, this type of industrial architecture has been marginalised in the Arab region including Jordan over many decades and remained out of the scope of conservation and public awareness. A few studies attempted to investigate architectural conservation in Jordan, investigating architectural form (Rjoub and al-Housan 2013); focusing on construction techniques (Rababeh 2010); suggesting lifting techniques (Rababeh 2015) or compatible materials (Ciantelli, Sardella et al. 2020) that could be used in the restoration of historical sites, or developing guidelines for the Jordanian urban and architectural heritage from boht conceptual and technical points of views (Abu Al Haija 2012). Most of these previous studies examined one case study, for example Umm Qais (Abu Al Haija 2012), Ancient Gerasa (Rababeh 2015) and Petra (Rababeh 2010), or one type of buildings such as Herodian Machaerus Fortress (Ciantelli, Sardella et al. 2020) or mosques in one particular area, Mafraq (Rjoub and al-Housan 2013). Yet, research on industrial architecture in Jordan remains scarce, which has been a motivation for this study. The Arab region has gone through a process of de-industrialisation since the eighteenth century, caused by the removal or reduction of industrial heritage in the region and followed by re-industrialisation (Issawi 1980). A new development in industries also appeared alongside handicrafts in the twenties and thirties of the 20thcentury, starting at the end of the nineteenth century. The emergence of many industrial heritage sites on a large scale in some Arab regions

increased rapidly during and after World War II. On the other hand, the rise of heritage as a cultural phenomenon on a collective scale can only be attributed to times of fundamental and continuous socio-cultural changes that accompanied societies' industrialisation, focusing on nationhood, which are all products of modernity (Shawash 2011). Industrial heritage such as hydroelectric plants, which were constructed in the 20th century as innovative and technological structures in Europe, has attracted the attention of recent research (Kuban and Pretelli 2019) to develop guidelines for architectural conservation. An increasing number of studies focus on good practice in industrial heritage management and suggest combining systemisation, criteria and indicators to create opportunities for incorporating heritage conservation with urban development planning (Oevermann 2020). The transformation of industrial sites create places for cultural and recreational activities, as was the case in Norwagian cities (Swensen 2013).

Industrial heritage sites represent a particular period of Jordan's early industrialisation. They also have the potential for adaptive reuse to support sustainable development. These sites are characterised by a sense and memory of place as a gathering space for families and tourists. Previous research highlight the significance of intangible cultural heritage and experiential authenticity of place in industrial sites (e.g. Wesener 2017). Wesener (2017) investigates the authenticity of place in a combination of traditional as well as new businesses in the Jewellery Quarter in Birmingham, UK focusing on three dimensions related to the experience of: origins, continuity, and potentiality and actuality. Wesener (2017) argues that intangible cultural heritage stimulates experiences of authenticity connected with people's individual identity and related advantages or disadvantages. However, the aesthetic or architectural value of many modern industrial heritage sites in Jordan is debatable since a number of them were based on foreign aid and recommendations.

De-industrialisation is a process of social and economic change caused by the removal or reduction of industrial capacity (Rowthorn and Ramaswamy 1997), this is one of the problems facing Jordan's modern history. Heritage buildings play a crucial role in representing cultural identity; therefore, minimum intervention is called for, where physical repair or change of use of these

buildings is required (Zhang and Dong 2019). De-industrialisation is associated with a sense of place as industrial heritage is connected with the early development of modern Jordan. However, this type of heritage is increasingly being taken over by the private sector.

Furthermore, the last two decades witnessed a systematic destructing of industrial heritage sites in Jordan, unlike the case in some European countries. In some countries like Spain, the interest in the industrial heritage goes back to 1980s where polices have shifted from destruction to preservation, and enhancement (Del pozo and González 2019). The aim of this research is to investigate the reasons for this lack of interest in industrial heritage and propose guidelines for the conservation of industrial heritage in Jordan, which will also be applicable to the Arab region.

This paper contributes to architectural heritage literature by providing new insights on neglected industrial sites and structures in Jordan, as well as recommendations to inform the general public, policy makers, private organisations and relevant authoroties. The paper starts with a literature review to provide background and context of the research. Following that, the qualitative research approach and case study methods are explained. The findings are presented in relation to the seven categories which were used in the analysis of the de-industrlialisation phenomenon of industrial heritage sites in Jordan: *ownership*; *location*; *design and types*; *structure*; *significance*; *deterioration and physical condition*; and *conservation attempts and alterations*. The future of modern industrial heritage in Jordan is discussed after that. The paper concludes with a discussion on the main approaches to industrial heritage in the Arab World, and proposes recommendations to policymakers, relevant authorities, private organisations, and the public in order to address the de-industrialisan phenomenon.

2. LITERATURE REVIEW

Industrial heritage has long been underestimated in the Arab World. The de-industrialisation discourse has shed light on a hidden part of the modern heritage in the region, particularly in Jordan, positioning it as central to understanding the present (Jarrar, 2021).

De-industrialisation as a concept has variously been defined in developed countries as well as developing countries (Harvey 1990). There has also been different understandings of conservation and development (Oevermann and Mieg 2015). Oevermann and Mieg (2015) argue that industrial heritage sites are crucial parts of urban transformation and its planning practices. Previous research has also focused on sustainable heritage practices related to demolition and deconstruction (Creba 2020, McCarthy 2020). Lack of interest or even rejection of industrial heritage can be due to considering industrial heritage as an economic resource with no connections to memory or identity (Del pozo and González 2019). Adaptive re-use of industrial heritage has accomplished great acceptance among developing countries providing financial, educational, and human interests to communities (Samadzadehyazdi, Ansari et al. 2020). Some countries intended to convert industrial sites into tourist development areas, while others no longer adopt industrialisation projects in their discourse (Oevermann, Degenkolb et al. 2016). In China, there is an emerging interest in the reuse of industrial heritage sites to develop industrial heritage tourism as creative parks (Yang, Xu et al. 2019). On the other hand, interest in developing the monuments and museums has been prioritised in some countries while industrial heritage was largely neglected. Previous research has argued that industrial remains are part of cultural landscapes to shorten the gap between the institutional and economic aspects of industrial heritage (Del pozo and González 2019). Mengüşoğlu and Boyacioğlu (2013) explained that global shifts in the nature, scale, and organization of production have resulted in fundamental changes in many developed countries. During the 1990s, the French and British governments proposed different strategies for the industrial heritage role in repairing the effects of de-industrialisation (Rautenberg 2012). These buildings are reused and preserved to prevent the destruction of social memories of a community. Industrial heritage is not only associated with identity and memories, traditions, and labor movements; it is also connected with the development of cities and sites (Swensen 2013, Oevermann and Mieg 2015). There are many ways to deal with industrial heritage sites including heritage conservation and urban development planning (Oevermann 2020) as well as the industrial heritage tourism management (IHTM) (Perfetto and Vargas-Sánchez

2018). It is worth noting that there are few organisations worldwide that are concerned with industrial heritage, such as The Industrial Committee for the Conservation of Industrial Heritage (TICCIH), which is an organisation that brings together a wide range of nationalities, professionals and interests (Oglethorpe, 2005). Furthermore, the international charters, principles, and declarations concerned with defining and preserving the industrial heritage in the world, have unfortunately been marginalised in Jordan and most of the Arab region. The majority of the international charters consider industrial heritage as cultural remains that include historical, technological, social, architectural, or scientific value. Some of the significant international charters include the following:

- The Nizhny Tagil Charter for the industrial heritage, 2003;
- Dublin Principles - Joint ICOMOS – TICCIH Principles for the conservation of industrial heritage sites, structures, areas, and landscapes, 2011;
- Taipei Declaration for Asian industrial heritage, 2012; and
- Industrial heritage analysis: World heritage list and tentative list, UNESCO World heritage center, 2001.

Arguing for the significance of industrial heritage has presented a unique challenge for those who recognise the role that industrial culture plays in the shaping of national and regional identities (Landorf 2011). The visualisation of the industrial heritage, as a result of the cultural heritage practice at many sites, has created places that are highly appreciated but also conflict generating (Högberg 2011). However, the development of many industrial heritage sites as tourism destinations raises a number of issues for tourism-led policy (Jones and Munday 2001). Heritage sites management process is usually restricted to a relatively narrow view of heritage value and conservation practice (Landorf 2009).

The municipalities of Amman, Zarqa, and As-Salt in Transjordan were excluded from any power plant projects within their borders until the end of the 1930s (Dieterich 2003). According to the Food and Agriculture Organisation of the United Nations (FAO), intensive irrigation projects have been implemented in Jordan since 1958, when the government decided to divert part of the Yarmouk River water and constructed the East Ghor Canal. Furthermore, several nation-

building projects, such as dams and energy projects, have been erected in the Jordan Valley and Amman, however the issue of lack of a definition of industrial heritage is one of the most important dilemmas facing the Arab region. The Jordanian government had approved Architectural and Heritage Protection (Law No. 5 of 2005), which considers not only the conservation of the archeological sites according to Law No. 21 (1988) but also the conservation of buildings built after 1750 (Abu Al Haija 2012). However, there is no effective implementation of this law in Jordan. This research investigates modern industrial heritage in Jordan as a case study and aims to propose guidelines for the conservation of industrial heritage in the Arab world.

3. RESEARCH DESIGN AND METHODS

This research applies a qualitative approach based on case studies (Yin 2014) to develop a deep understanding of the modern industrial heritage in Jordan using spatial surveys of potential heritage industrial sites in Jordan as a primary data collection method, as well as complementary informal conversations with engineers and officers involved in the management of the surveyed sites. For example, in Kafrein and Sharhabeel dams, conversations with the directors of these dams, who are civil engineers affiliated with the Jordan Valley Authority, focused on the structural design, details, dimensions, and history of the buildings in terms of changes during the past decades. Yin (2014) defines the case study approach as an empirical enquiry which investigatesthe single or multiple cases in great depth within its real-world context. According to the Nizhny Tagil Charter for industrial heritage (2003: 2):

"*Surveys of areas and different industrial typologies should identify the extent of the industrial heritage. Using this information, inventories should be created of the sites that have been identified. They should be devised to be easily searchable and should be freely accessible to the public*".

Twenty case studies (structures/sites) were surveyed (see Table 1). This number represents a sample of industrial sites all over Jordan that can be considered under industrial heritage classification and covering eighta ccessible governorates out of twelve.

This research used a field reconnaissance level survey, which has widely been used in research (e.g. Dumitru 2015, Xu 2017) and can also be referred to as

"impact assessment" or "rapid inventory". Reconnaissance survey is different from the intensive survey, despite the fact that both of them involve the same process of documentation where sufficient data should be gathered to give a professional description of the physical appearance and condition of a site or structure. The difference is that an intensive survey is designed to identify wholly and precisely all sites or structures in an area. In contrast, a reconnaissance survey includes an inspection of a site, where it is used to form the basis for more intensive, detailed survey efforts.

Furthermore, the researchers followed the guidelines for local surveys mentioned in the U.S national park service's magazine (National Register Bulletin, No.24) to identify and organise the data in a non-sequential process. Reconnaissance surveys are essential for gathering basic information about the modern industrial heritage, such as design, significance, structural analysis, and materials. Additionally, these surveys cover the investigation of the current and future levels of interventions. The survey aimed to identify marginalised industrial heritage. Samples of those Jordanian sites/structures dated back from a period ranging from1900s-1970s were identified. This timeline covers the construction period of the surveyed sites, which extends from the last years of the Ottoman era in the 1900s until the1970s, which is the beginning of modernity that emerged in Jordan with the establishment of the Hejaz railway. The end of that period was in the 1980s when the official discourses and practices of development in Jordan had taken place through a different phase of geopolitical and socioeconomic transformations. Daher (2016) argued that this phase starts with the enforcement of structural adjustment programmes from the World Bank towards the 1980s. Therefore, Jordan witnessed a significant decrease in the country's welfare mechanism and the removal of state subsidies through the beginning of the privatisation of sectors, including water, electricity, and telecommunication. Figure (1) illustrates one industrial/historical development patterns associated with industrialisation during early periods of nation-building in Jordan, which is East Ghor Canal.

Figure 1 East Ghor Canal in Irbid Governorate Jordan

Figure (2) illustrates the locations of all selected sites, the circles indicate the sites for which sufficient information was collected including existing sites that were accessible or the demolished sites for which old documents, pictures, and plans were collected. As for the diamond shape, they are sites that have not been sufficiently studied due to certain conditions or because they were demolished, dismantled, or no longer functioning today. The square shapes show the sites where access was not allowed, and they were not covered despite their significant historical and architectural value. The triangle shape represents a site that was not considered in this survey due to logistical issues. All the sites were classified under the following facilities: bridges/tunnels, dams, depots/lathes, canals, historical plants, military bases, mill/silos, power plants, pumping stations, railway stations, warehouses, and water towers/tanks.

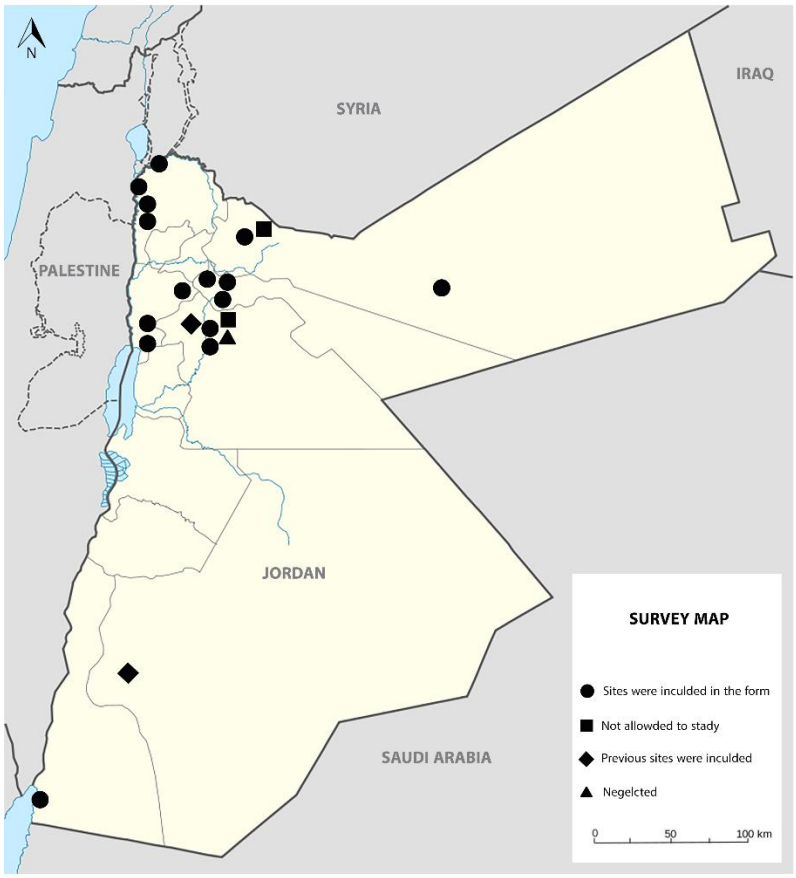

Figure 2 Location Map of the Surveyed Potential Industrial Heritage Sites in Jordan

The twentycase studies were selected based on the following criteria:

- Notable industrial structures that cover the majorityof the modernity period (e.g., Hussein thermal power plant in Zarqa, Sharhabeel Dam in Irbid, and East Ghor Canal).
- Groups of buildings, structures, or sites representing industrial/historical development patterns and associated with industrialisation during early periods of nation-building in Jordan (e.g., Petroleum refinery in Zarqa).
- Groups of structures that show industrial or technological developmentsin the second half of the 20th century (e.g., Phosphate plant in Russeifa).

The case study approach is used to provide rich descriptions of the selected cases and a deep understanding of the modern industrial heritage in Jordan.

4. FINDINGS

Most of the identified Jordanian industrial heritage structures and sites that were studied in this research date back to the period of modernity, except some facilities that belong to the Hejaz railway, which were built before that during

the late Ottoman period. Table 1 summarisesthe technicalfeatures of the identified case studies. The twenty industrial heritage sites and buildings in Jordan were listed in alphabetical order, which are part of dozens of sites in Jordan, representing the modern industrial heritage in the Kingdom. Most of the selected sites are built in the 1960s and 1970s, representing valuable examples dating back to the modernity period, which was short-lived in Jordan and the Arab world. The current status of the selected sites is either active, inactive, scheduled for demolition, or have already been demolished.
>>See Table 1 in the Appendix

Seven categories were used in the analysis of these industrial sites: *ownership; location; design and types; structure; significance; deterioration and physical condition; and conservation attempts and alterations*. These categories are discussed in more detail below.

Ownership

The surveys developed a deeper understanding of the ownership of industrial heritage structures in Jordan by classifying them into four main categories: public, private, privatised, and nationalised. For the first two classifications, it is normal to have public or private sector industrial buildings in the country, which is the general state of any economy. However, the ownerships of many of these carefully selected sites and buildings have been transformed to the private sector in the last two decades (around 30% of the total number), which is referred to as privatised buildings. In contrast, nationalised buildings represent a small portion of the buildings that used to be privately owned and are now public properties.

Location

The vast majority of the case studiesare located in the northern half of the Kingdom, specifically in four governorates: Amman, Balqa, Irbid, and Zarqa, as shown in Table (1). Zarqa is considered the industrial capital of Jordan since its foundation at the beginning of the 20th century. The Jordanian state' 's high interest in this part of the country corresponds to an evident marginalisation of the other part in the south, except for Aqaba, as it is the only port of the country. It is clear that since the establishment of the Kingdom in the mid-1940s, Jordanian governments did not pay attention to the southern region, as is the case in the governorates of Karak, Tafila, and Ma'an (despite the latter being the

largest governorate in Jordan, accounting for about 36% of the total area of the country). The Hijaz railway and its facilities, such as stations, depots, water tank towers, and administrative buildings that were expanded at various times during the twentieth century, are excluded.

Design and types

Many nation-projects were implemented in the 1960s and designed by western engineers. For instance, Sir Matt MacDonald and Partners of London were awarded the contracts for design works in most of the national water-related projects at that time including East Ghor Canal (First Phase), Sharhabeel or Ziglab dam, Kafrein dam, and Shueib dam. Moreover, most of those projects are considered to have a modern industrial and public typology, which expresses the significant development in terms of architectural and construction techniques, and it is characterised by innovative use of concrete and steel structures.

Sub-categories for each type of those structures were identified. For example, the dams were classified according to their function and form into four main types: earth-fill dams, arch dams, buttress dams, and gravity dams. Irrigation canals were classified based on the type of boundary surface into three main types: rigid surface canals, alluvial canals, and non-alluvial canals. Metal truss bridges were classified according to the truss form into two main types: pratt trusses, and warren trusses (Comp and Jackson 1977), (See Table 2). Al-Himmeh metal bridge in Irbid Governorate, for example, is a combination of two pratt types: camelback and pratt trusses.

>> See Table 2 in the Appendix

Structure

The most substantial effects of modernism in all surveyed structures were construction techniques and materials. There is no specific construction system for these structures. However, in general, they can be classified into two central systems: Reinforced Concrete (RC) structures and steel/wooden truss structures. These two structural systems were using state of the art techniques in terms of their construction at that time. There was a recurrence in the use of the RC systems since the 1920s. Frames and solid slab systems are the most exceptional and are evident in two cases: Jordan hydroelectric power plant in Baqoura, and

Hussein thermal power plant in Zarqa. This structural solution increased the strength of the structure while allowing for wide spaces without using pillars or any other supporters. The RC system is used as well in other industrial heritage structures such as dams, East Ghor Canal, and Petroleum Refinery. Kafrein, Shueib, and Sharhabeel dams, as Erath fill dams, are all constructed of compacted heterogeneous clayey core protected by a layer of rock to protect the body of the dam from the wavesofwater, located on top of a layer with sand and gravel.

As for steel structures, there was a need to use trusses in several cases. For instance, Al-Umm Butma Bridge, used for Hejaz Railway transportation on the Haifa-Dera'a segment, is multi-span over two masonry pillars. Its structure is a combination of camelback truss and pratt truss and has extensive v-lacing and lattice. Furthermore, Amman Electricity Hanger (AEH) at Ras el-Ain also has a significant structural system of I-Beams-trusses which givesthe Hangar a unique industrial atmosphere.

Significance

The examined case studies share values, which give them cultural significance. These values include: historical; architectural and structural; aesthetic; economic; technological; social; informational; and environmental merits. Most of the reviewed structures span over a period from the 1920s to the late 1970s, with exception to Hejaz Railway stations" structures (Umm Butma Bridge, Amman Depot/Lathe, which were constructed in 1900s). This short-lived era also represents a transitional period. It is associated with early development and nation-building projects, particularly electrification, transportation, and irrigation projects.

These modern structures represented functional and architectural landmarks in Jordan. They are characterised by considerable extra strength compared to other ordinary structures at that time, obtained using different construction techniques such as frames and solid slabs for concrete structures and trusses and I-beams for steel structures. Many foreign engineers and architects worked on most of these structures where they adopted modern architecture, typology, and international standards. Most of these structures are characterised by vast spans as well as high volumes and have the ability to accommodate multiple functions.

They also have potential through adaptive re-use and renovation. The structures represent the innovative use of concrete and steel and the potential to provide information on a particular period of the industrialisation. Most of the structures were among the first of their kind in Jordan, such as dams, power plants, train stations, grain silos, and refineries. They represent the processes of industrialisation. These structures are characterised by a sense of place and memory. Some of them provide open spaces for families and tourists, such as Sharhabeel Dam and Amman Electricity Hanger. The structures provide information on a particular period of Jordan' 's early industrialisation. Furthermore, they have the potential to aid a comparative analysis of protected or adaptive re-used sites, such as the Amman Electricity Hanger. Some sites are located at eco-parks such as Ziglab Dam. Others, as the First Jordan Power Plant in Baqoura, is situated in a unique natural landscape, including both arid and wetland environments, which is home to many species, and it is a suitable location for migratory birds.

Deterioration and physical condition

The assessment of the current condition of the investigated industrial heritage structures focused on material and techniques. The investigation was carried out through in situ diagnostic observations. As for concrete structures, different cracks were noted, some of which are related to the contact surface between two different materials such as reinforced concrete and hollow block concrete walls. Spalling is another problem which was apparent in almost all cases of observed concrete structures. Spall are flakes of material that are peeled off a larger body and can be produced as a result of weathering. Furthermore, some concrete walls and slabs are damaged due to the corrosion of steel bars. As for steel structures, many of them are exposed to erosion and rain factors. This is evident in Umm Butma railway bridge where steel elements and welding joints are affected by corrosion. The old phosphate plant in Russeifa is another case of those structures where the roof trusses are deformed, due to their thin transversal section and to the lack of wind bracing. In general, there are more defects commonly found in almost all assessed industrial heritage structures, including the growth of vegetation, material loss, vandalism, and looting.

Conservation attempts and alterations

Conservation efforts of Jordan's industrial heritage sites and structures are usually modest and insufficient. There is a general belief in the country that these industrialisation-related structures should not have existed for a long time, especially in the city centers. Furthermore, they are not part of the definition of heritage. Dozens of cases were completely or partially demolished in Jordan due to lack of understanding of the importance of this heritage. However, this does not mean that there are no serious attempts to preserve this heritage or re-use it differently. Amman Electricity Hanger, located in Ras el-Ein, represents one of the unique local caseswherethis heritage was preserved from disappearance. The structure was converted to an open cultural space, with minimum interventions. Careful consideration was given tothe new place, structural system, architectural elements, and materials (See Figure 3).

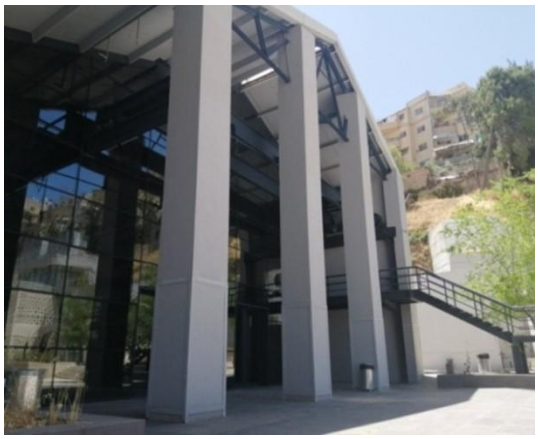

Figure 3 Amman Electricity Hanger at Ras el Ain

The de-industrialisation discourse in Jordan coincides with witnessing a significant decrease in welfare mechanisms and the removal of state subsidies through the increased privatisation of sectors, including water, electricity, and telecommunication. The research findings show that five of the twenty surveyed industrial sites and structures were recently demolished or scheduled for demolition, which shows that over 20% of the modern industrial heritage in Jordan had been destroyed for different reasons. The destruction over the past decades has extended to famous industrial landmarks. Marka's old power station in Amman, grain silos at Aqaba Port; satellite earth station in Baqaa; and several mills in Ras el-Ain, were among those destroyed structures. At that time, the

newly born Kingdome had witnessed some early nation-building projects since the 1950s when it started to extract phosphate at Russeifa mine (See Figure 4).
>>Insert Figure 4 here

Figure 4 Old Phosphate Mine in Russeifa Jordan

Jordan was among the vast Arab regions that the Ottoman Empire controlled. However, most of the areas located east of the Jordan River remained outside the state's modernity accounts. On the other hand, many national projects linked to modernity emerged in Jordan later on, such as public works, electrification, and irrigation projects, social housing. Despite the fact that the area has only limited natural resources including water, agricultural land, and energy sources, there is a long history of mineral investment in this land (Ababsa 2013). The Arab region witnessed the introduction of modern industrialisation features since the beginning of the 20th century. However, this matter was different from one city to another. Amman and other areas of Transjordan remained almost entirely dark until the late 1930s, while Cairo and Alexandria were the first two Arab cities that used electricity in lighting and transportation purposes in 1893, followed by other cities, such as Damascus in 1903, Beirut in 1906, and Jerusalem in 1910.

Modern industrial heritage in Jordan and its future

Industrial heritage refers to the physical remains of the history of technology and industry as well as power and transportation infrastructure, or places used

for social activities related to industry among other structures with values from a variety of fields. Additionally, the privatisation of many industrial heritage structures has worsened this marginalisationas law no longer protects them. Sadly, it is not apriority to preserve Jordan's modern heritage as the official government discourse only cares aboutthe financial return from creating new projects, which are often constructed over the ruins of old industrial heritage sites. However, there are a few attempts to preserve modern industrial heritage sites in Jordan, such as the electricity hanger of Amman at Ras el-Ain whichdates back to 1939. This electricity hanger was restored in 2010 and converted to an open cultural space as discussed above, despite the difficulty of enforcing the architectural and urban heritage protection law, which was recently unimplemented due to the controversy over the necessity to compensate the owners of those heritage buildings. Back in the 1950s and 1960s, the industrial backbone of Jordan's modern economy - the potash, phosphate, and cement industries - were developed and the country had a small private sector in small craft production and agriculture.

Unfortunately, the country's failure to announce a list of industrial heritage sites or even heritage sites and the inactivation of the protection of heritage law led to the commission of explicit violations by owners of houses classified as heritage. Furthermore, the privatisationof those sites, their demolition under investment arguments or lack of appreciation are among the most common reasons for the destruction of Jordan's industrial heritage sites. Some examples include Marka Old Power Plant in Amman and Aqaba Old Silos. Marka Old Power Plant in Amman was the first governmental power plant in Jordan which remained in operation for decades until it was demolished in 2018 (See Figure 5(a) and Figure 5(b)).

Figure 5a Exterior of Marka Power Plant Amman

Figure 5b 1nterior of Marka Power Plant Amman

Aqaba old silo was converted to apartments. Figure 6 shows an advertisement of a real estate developer published during the construction stage back in 2017 for a villa compound project. The old Aqaba grain silos, appear in Figure 6 on the waterfront opposite to the new-built village in the foreground, were already scheduled for demolition. Figure7 shows the destruction of the old silos in Aqaba Port, Jordan. It is worth noting that this example is one of other privatised sites which have high architectural, historical, symbolic, and social values. It was also an essential project at the national level. Therefore, it is crucial to gain deeper understandings of industrial heritage structures in the country which have been transferred to the private sector. This example of industrial structures converted into appartments presents the potential and challenges associated with the adaptive reuse of industrial heritage. On one hand, this can support sustainable development by converting abandoned industrial buildings into affordable residential projects that can help resolve housing shartages. With the recent COVID 19 pandemic, many organisations are increasingly operating remotely and more people are either forced or even

choose to work from home. More adaptive comfortable homes are therefore needed. On the other hand, preserving industrial structures is equally critical.

Figure 6 Al Raha Village Apartments Aqaba Jordan

Figure 7 The Destruction of the Old Silos in Aqaba Port

6. DISCUSSION AND CONCLUSIONS

This research identified the need to appreciate modern industrial heritage in the Arab World, particularly in Jordan. It proposes incorporating this type of heritage into the national cultural heritage and highlights this significant topic that

supports sustainable development (Creba 2020, McCarthy 2020) and conveys a sense of place, memory, and national identity. The research discussed the de-industrialisation problems in Jordan which lacks a clear definition of this heritage as well as the implementation of laws and legislation regarding protecting industrial heritage. We build on a new discourse which emerged over the past two decades to shed light on this part of the modern history in Jordan and the Arab world, despite its relatively short-aged era compared to other regions of the world (Abu Al Haija 2012, Rautenberg 2012, Kuban and Pretelli 2019).
This study employed a case study approach and used a reconnaissance survey of several sites in Jordan, which represented modern industrial heritage, to highlighthow the country deals with this heritage and its role in sustainable development. Three main approaches to industrial heritage have been identified:

- Demolition and loss of the old industrial historic fabric. Unfortunately, it is the common way to deal with industrial heritage sites and structures in Jordan, either to construct other new ones instead of them, for health and safety reasons, or because the country does not value its significance.
- Occasional maintenance of industrial heritage however this attitude does not often happen in privatised structures or sites.
- Rare examples of architectural conservation or adaptive re-use of old industrial facilities.

Most of the case studies are abandoned despite their potential for future development through adaptive re-use or renovation and the role they can play in sustainable development. This lack of interest and appreciation led to apparent neglect of those buildings and loss of an essential part of architectural heritage. Furthermore, the negative change in the country's discourse regarding these sites was fundamental. One of the most critical aspects of this change is the withdrawal of infrastructure projects due to the incline towards privatisation and neoliberal transformations.
This study sheds light on the ownership issue of industrial heritage structures in Jordan. Noticeably, the ownerships of many of these selected sites have been transformed into the private sector in the last two decades. This shift in

ownership pattern concentrates on the industrial structures, especially those belonging to the energy sector. It is also linked to neoliberalism and privatisationinin the last decades, as Jordan represents a clear example of neoliberal urban restructuring and emerging forms of spatial ordering and engineering. The most substantial effects of modernity in all examined structures were construction techniques and materials. The surveyed sites share values, such as historical, architectural, aesthetic, economic, social, technological, and informational ,which add to their cultural significance. Most of these structures are characterised by vast spans and high volumes and have potential for adaptive reuse or other sustainable development approaches.

This research also invites policy makers, relevant authorities, private organisations, and the public to seriously consider the challenges and impact of de-industrialisation of such sites by recommending the following:

- Emphasize the need to establish a legislative and institutional framework that will ensure modern industrial heritage preservation. Therefore, there is an urgent need to implement the heritage protection law Number 5 of 2005 in Jordan.
- Highlight the plurality and diversity of modern industrial heritage through various examples found in all Arab countries and demonstration projects. This industrial heritage should be considered as part of the heritage of the Arab countries. Academics can achieve this aim at universities and related institutions by collaboting with well-reputed institutions dealing with modern industrial heritage research. The government should work to protect the industrial sites by stopping the privatisation of national facilities that fall under the classification of modern industrial heritage. Industrial sites are considered historic assets linked to nation-building projects, they can also be converted tofacilitateeconomic activities.
- Support studies that aim to change the hostile attitude towards the conservation of industrial heritage sites.

In this paper, we have addressed a very important problem and highlighted how industrial heritage sites can significantly contribute to sustainable development.

By protecting and re-using industrial sites and structures, cultural heritage of a particular period of industrialisation and modernisationis also preserved. Many industrial heritage sites are characterised by large spaces and high volumes and have potential for adaptive re-use of buildings. However, the level of intervention should be minimal to preserve the authenticity and integrity of the industrial heritage as much as possible and to serve the local community and tourism activities. The study has limitations related to restricted access to some sites and the assessment of the current condition of industrial heritage structures using diagnostic observations only. Future research candiagnose the condition of materials in specialised laboratories and focus on sustainable design approaches to re-use and renovate industrial heritage structures.

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Appendix

Table 1Technical features of case studies industrial heritage sites B

No.	Sites	Location in Jordan	Const. Period	Type	Current Ownership	Structure	Design	Deterioration patterns	Current Status (2021)
1	Al-JweidehGrain Silos	Al-Jweideh, Amman	1979	Grain Silo	Jordan Silos and Supply General Co. (Public)	Reinforced Concrete done by slip forming method	Multi-story structure	• Crust formation • Determination of moisture and dust pollution	Active
2	Amman Electricity Hanger	Ras el-Ain, Amman	1938-1939	Power plan (currently: cultural center)	Amman Greater Municipality (Nationalized)	Steel structure (Post and Beam) I-beams, Double I-beams	One-story structure, with a mezzanine terrace	N/A	Active - Reused
3	Amman Hejaz Railway Station	Mahatta, Amman	Depot: 1905 Lathe: 1953	Railway Station	Jordan Hejaz Railway (Public)	Reinforced Concrete + Stone	One-story structures	• Metal part is rusted • Crust formation • Determination of moisture and dust pollution	Active
4	Aqaba Old Grain Silos	Aqaba Old Port, Aqaba	1979	Grain Silo	Aqaba Development Corporation (Privatized)	Reinforced Concrete done by slip forming method	Multi-story structure	N/A	Demolished (2018)

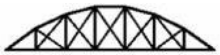
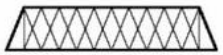
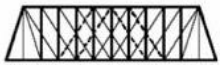
No.	Sites	Location in Jordan	Const. Period	Type	Current Ownership	Structure	Design	Deterioration patterns	Current Status (2021)
5	Baqaa Earth Station/	Baqaa, Balqa	1970	Earth Station	Orange Jordan (Privatized)	Reinforced Concrete , Steel structures	Multi-story structure	N/A	Demolished (2015)
6	East Ghor Canal (King Abdullah Canal)	Jordan Valley	1961-1969 (1st. stage)	Irrigation canal	Jordan Valley Authority (Public)	Reinforced Concrete	Rigid surface canal	• Cracks • Crust formation • Soot and dust Erosion	Active
7	First Jordan Power Plant (Rutenberg)	Baqoura, Irbid	1927-1933	Hydroelectric Power Plant	Jordan Valley Authority (Nationalized)	Reinforced Concrete	Two multi-story structures	• Cracks • Crust formation • Corrosion • Vegetation Moisture	Inactive
8	Fuheis Cement Plants	Fuheis, Balqa	1951 (1st. stage)	Plant	Lafarge Cement Jordan (Privatized)	Reinforced Concrete, Steel structures	Multi-story structures	N/A	Inactive - scheduled for demolition
9	H-5 Oil Pumping Station	Safawi, Mafraq	1934	Oil Pumping Station	Government of Jordan (Public)	Stone	One-story structure	• Vegetation Exposed by erosion and rain factors	Inactive - Reused partially

No.	Sites	Location in Jordan	Const. Period	Type	Current Ownership	Structure	Design	Deterioration patterns	Current Status (2021)
10	Hussein Thermal Power Plant	Al-Hashimiyah, Zarqa	1975 (1st stage)	Heavy fuel Power Plant	Central Electricity Generating Co (Privatized)	Reinforced Concrete, Solid slabs	Multi story structure	• Cracks • Crust formation Corrosion	Inactive - scheduled for demolition
11	Jordan Petroleum Refinery	Hashimiyah, Zarqa	1961	Water cooling Tower	Jordan Petroleum Refinery (Public)	Reinforced Concrete	Multi-story structure	• Corrosion • Crust formation • Determination of moisture and dust pollution Cracks	Active
12	Jordan Salt Refinery	Azraq, Zarqa	1979	Plant	Azraq Cooperative Society (Private)	Steel structure	Multi-story structure	N/A	Demolished/ Dismantled (2003)
13	Kafrein Dam	Ash-Shunah al-Janubiyah, Balqa	1965-1967	Earth fill Dam	Jordan Valley Authority (Public)	Reinforced Concrete ,Compacted heterogeneous clayey core protected by a layer of rock	One-story structure	• Cracks • Crust formation	Active

No.	Sites	Location in Jordan	Const. Period	Type	Current Ownership	Structure	Design	Deterioration patterns	Current Status (2021)
14	Maan Old Glass Plant	Maan, Maan	1980	Plant	Gulf private company (Private)	Unknown	Unknown	N/A	Demolished/ Dismantled (2009)
15	Marka old power plant	Marka, Amman	1965	Power plant	Central Electricity Generating Co (Privatized)	Reinforced Concrete ,Steel structures	Multi-story structure	• Metal part is rusted Exposed by erosion and rain	Demolished (2018)
16	Phosphate Pilot Processing Plant	Russeifa, Zarqa	1979	Plant	Jordan Phosphate Mines Co. (Privatized)	Steel structures	One-story structure	• Metal part is rusted Corrosion	Inactive - scheduled for demolition
17	Raghadan Mill	Mahatta, Amman	1950s	Mill	Modern Flour Mills & Macaroni Factories Co. (Private)	Reinforced Concrete + Steel structures	Multi-story structure	N/A	Active
18	Sharhabeel Dam	Wadi Ziglab, Irbid	1964-1965	Earth fill Dam	Jordan Valley Authority (Public)	Reinforced Concrete, Compacted heterogeneous clayey core protected by a layer of rock	One-story structure	• Cracks • Crust formation • Vegetation	Active

No.	Sites	Location in Jordan	Const. Period	Type	Current Ownership	Structure	Design	Deterioration patterns	Current Status (2021)
19	Shueib Dam/ Wadi Shueib Dam	Karameh, Balqa	1967-1969	Earth fill Dam	Jordan Valley Authority (Public)	Reinforced Concrete ,Compacted clayey core protected by a layer of rock	One-story structure	• Crust formation • Cracks Exposed slightly by erosion and rain	Active
20	Umm Butma Bridge	Al-Himma, Irbid	1905	Truss bridge	Jordan Hejaz Railway (Public)	Steel structure, Masonry pillars	Multi span: Pritt truss/ Camel back truss	• Corrosion • Crust formation	Inactive

Table 2Main types of metal trusses

Pratt trusses		Warren trusses
 Pratt	 Parker	 Warren
 Howe	 Camelback	 Warren (with Verticals)
 Bowstring	 Pennsylvania	 Double Intersection Warren
	 Double Intersection Pratt	