The Industrial Heritage Model for Reloading-- with embodied examples of the World Heritage Site in Iwami Ginzan Silver Mine

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Summary  
Conservation and utilization of industrial heritage-- these important processes in fact, depend on management. As the external environment changes dramatically, there is a particular need to establish a sustainable industrial heritage. Therefore, reloading the industrial heritage is indispensable. So how can we approach for it?  
From the Business Administration approach Ohshima found out the best answer in current Knowledge Management; the SECI Model for knowledge creation is a representative theory. Based on it, Ohshima introduced a prototype model-- the Industrial Heritage Model (the IH Model) at TICCIH Chile 2018 Congress.  
Today Ohshima presents a revised model-- the Industrial Heritage Model for Reloading (the IHR Model, figure 1). It focuses on Reloading industrial heritage. The IHR Model is also based on Knowledge Creation by the SECI Model, added External Environment, Organization, Industrial Heritage, and also added Communities. Organization is a unit of operating Industrial Heritage, consisting of Information, Knowledge Creation, and Actions in four phases-- Research/Analysis, Planning, Proposal/Negotiation, and Conservation/Utilization. In each phase Organization circulates the SECI Model several times; the results of each phase are fed back to Organization for the next phase through Industrial Heritage, Communities and External Environment.  
Ohshima applies this model at the World Heritage Site-- Iwami Ginzan Silver Mine in Japan under the collaboration with Nakada at Ohda City. The IHR Model, especially Actions in four phases including Multifaceted Value Analysis and Benchmarking can prove various effects for Reloading on Iwami Ginzan Silver Mine through Former Mine Railways.

1. Introduction  
1.1 Background and Aim  
The external environment around industrial heritage changes rapidly and complicated. We should find out a further effective management model for it. To establish sustainable industrial heritage site, this paper aims to propose a new model with application on the World Heritage Site.
1.2 Previous Study
In order to achieve sustainable industrial heritage site, Ohshima presented a prototype model—the Industrial Heritage Model (IH Model) at TICCIH Chile 2018 Congress. From industrial heritage point, we can also find actual study on The Good Practice Wheel. It focuses on practice for conservation and utilization. However, these were not specified for reloading industrial heritage site.

1.3 Method
From the Business Administration approach Ohshima pursued an effective management model to meet active conservation and utilization of industrial heritage, and found out the best answer exists in current Knowledge Management since it is rooted in knowledge creation. The SECI Model (center of figure 1) for knowledge creation is a representative theory. Nonetheless this model cannot directly apply it for industrial heritage management. This time Ohshima presents a reloading model—the IHR Model.

2. The IHR Model
2.1 Components of the IHR Model
The IHR Model (figure 1) is based on the SECI Model, added External Environment, Organization, Industrial Heritage, and Communities. External Environment is outside factors surrounding the Industrial Heritage site. Organization is a unit of operating Industrial Heritage in target, consists of Information, Knowledge Creation by the SECI Model, and Actions in four phases. Industrial Heritage is an object for Reloading. Communities are outside people and organizations associated with Industrial Heritage.
2.2 The SECI Model

Knowledge creation with the SECI Model is a central concept for the IHR Model. The SECI Model consists of Tacit Knowledge and Explicit Knowledge; knowledge can be spiraled-up by circulating following four steps many times:

**Socialization**
It focuses on Tacit to Tacit knowledge transfer; new knowledge can be created by the process of interactions, discussions, and analysis through various shared experiences.

**Externalization**
It focuses on Tacit to Explicit knowledge linking; it is a process to visualize the knowledge gained at the Socialization process by specified concepts, images, and written documents.

**Combination**
Combination is a process of transforming from Explicit to Explicit knowledge. Further knowledge can be gained widely from inside and outside based on the knowledge until the Externalization process.

**Internalization**
It focuses on Explicit to Tacit knowledge transfer. New Tacit knowledge is created by actual practice based on the knowledge until the Combination process; it broadens the learning spiral of new knowledge creation.

2.3 Circulation of the IHR Model

In accordance with the changes of External Environment by various factors, Organization accepts Information. In Organization, the members circulate the SECI Model several times for Knowledge Creation to find out the best practice at each phase for below Actions from Phase 1 to 4 toward Reloading of Industrial Heritage. Examples of each step in the SECI Model are, Socialization: interview and discussion on various experiences around Industrial Heritage; Externalization: visual items embodied from interview and discussion; Combination: benchmarking from other industrial heritage sites; Internalization: new experiences on Conservation/Utilization by new scheme established until Combination steps for further circulations.

While circulating the SECI Model, Organization performs four phases of Actions as below:

**Phase 1: Research/Analysis**
For Reloading Industrial Heritage, further Research/Analysis-- Rediscovery and Reevaluation are needed. Ohshima proposes Multifaceted Value Analysis. It is a Rediscovery and Reevaluation tool by revealing the various potential values of Industrial Heritage. It consists of 11 items: Characteristics (Rarity, Representativeness, and Diversity), Current Status (Authenticity, Integrity), Technical Value, Economic Value, Historical Value, Artistic (Landscape) Value, Global Value, and Conservation/Utilization (figure 2). To summarize and analyze Multifaceted Value, Ohshima also proposes Industrial Heritage Analysis Table (figure 5). Through this table Organization can get new opportunities such as paragraphs and stories, also clarify superiority points-- Core Values, and inferiority points-- Issues.
The results of Rediscovery and Reevaluation are summarized into the Industrial Heritage Analysis Table. Organization analyses it, clarifies Core Values and Issues. Benchmarking is an effective way to further enhance Core Values and solve Issues. This allows Organization to adopt the essence of other industrial heritage sites that perform Best Practices.

Phase 2: Planning
Organization makes an Action Plan for Reloading. Since Organization can deeply understand the objective position of Industrial Heritage through Phase 1, can create embodied Action Plan for Reloading such as Restoration, Reuse, Renovation, and Relationship toward next phases.

Phase 3: Proposal/Negotiation
Organization appeals Action Plan to Communities and External Environment, and also actively involves them; because Organization needs their support.

Phase 4: Conservation/Utilization
Based on the achievement until Phase 3, embodied Restoration, Reuse, Renovation, and Relationship puts into action. Reloading can be finally established in this phase.

Organization circulates the IHR Model at above each phase; the results of each phase are fed back to Organization for the next phase through Industrial Heritage, Communities and External Environment. Even after Phase 4 is complete, as long as Organization continuously circulates this model in response to changing External Environment, sustainable Industrial Heritage can be developed.

3. The World Heritage Site in Iwami Ginzan Silver Mine with application the IHR Model
We propose an actual example of the IHR Model in the World Heritage Site—Iwami Ginzan Silver Mine in Japan.

3.1 Background—Rediscovery of Former Mine Railways
Iwami Ginzan Silver Mine was found out in the XVI\textsuperscript{th} century, Many Mine Shafts were dug up. In the Meiji-era, with the introduction of modern technology, Denzaburo Fujita also began many businesses including Mining; he invested in Mine Railways at Okubo Mine Shaft, and Shimizudani Smelter with Hydrometallurgy technology in 1895.
However, this Smelter only operated for a one year and a half due to the lack of feasibility study. In 1896 Okubo Mine Shaft, Shimizudani Smelter, and Mine Railways were abandoned till now.

In Nov. 2018 Ohshima found out Dog Spikes with Sleeper at the World Heritage Site— Okubo Mine Shaft. We conducted a further survey, could find out 36 pcs of Dog Spikes, Sleepers and Trace of Sleepers (figure 3, 4), and could ensure the existence of Former Mine Railways. They were "conserved" at least as they were in 1896. Through this Rediscovery the World Heritage of the Iwami Ginzan Silver Mine, which had been valued until the pre-modern Edo-era, was given a new heritage— Former Mine Railways in the Meiji-era, and the value of the World Heritage could be further enhanced. Evidence of Former Mine Railways was not reported even at the World Heritage nomination stage.

3.2 Application of the IHR Model to Iwami Ginzan Silver Mine

After Rediscovery and analysis of Former Mine Railways, Ohshima proposed to Ohda City which is operating the World Heritage Sites to adopt a new framework— the IHR Model. Now Ohshima (Japan Industrial Archaeology Society, JIAS) and Nakada (Ohda City) collaborate with this model. Current status is as below:

Phase 1: Research/Analysis
1) Rediscovery of Former Mine Railways
   In connection with 3.1 above, Ohshima clarified the Rail Gauge (1ft 8in) and Weight (9, 12lbs/yard), Steelworks of Dog Spikes and Steel Rail (Krupp in Germany).
2) Reevaluation on the relics in the past
   Ohshima also undertook a Reevaluation on the relics excavated in the past, found out 23 pcs of Dog Spikes and 1 pc of Steel Rail. They had been categorized as "Iron Product" or "Unknown".
3) Reevaluation of Former Mine Railways
   For Rediscovery and Reevaluation Ohshima completed Industrial Heritage Analysis Table by Multifaceted Value Analysis (figure 5).
**Former Mine Railways in Iwami Ginzan Silver Mine: Okubo Mine Shaft, Okubo Mine Shaft-Shimizudani Smelter**

<table>
<thead>
<tr>
<th>Name</th>
<th>Former Mine Railways in Iwami Ginzan Silver Mine: Okubo Mine Shaft, Okubo Mine Shaft-Shimizudani Smelter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>6-1628, Ohmori-Machi, Ohda City, Shimane Prefecture, JAPAN</td>
</tr>
<tr>
<td>Opening / Closing</td>
<td>Opening: 1895, Closing: Oct. 1896</td>
</tr>
<tr>
<td>Purpose of Mine Railways</td>
<td>To smoothly transport the mined ore to the Shimizudani Smelter through the 1st Funnel (Vertical Shaft)</td>
</tr>
</tbody>
</table>
| Overall Length, Gauge, Rail Weight, and Track | Total length: 120m (Okubo Mine Shaft), 90m (Okubo Mine Shaft-Shimizudani Smelter)  
Gauge: 1ft 8in (508mm)  
Rail Weight: 90lbs/yd (4.5kg/m) (Okubo Mine Shaft)  
12lbs/yd (6kg/m) (Okubo Mine Shaft-Shimizudani Smelter)  
Double Track (Okubo Mine Shaft)  
Single Track (Okubo Mine Shaft-Shimizudani Smelter) |
| Dog Spikes found out in sites | 22 pcs (Okubo Mine Shaft)  
14 pcs (Okubo Mine Shaft-Shimizudani Smelter by sampling survey)  
All Dog Spikes heads have a "dog head" shape |
| Reevaluated Dog Spikes | 2 pcs (Mine head of Okubo Mine Shaft)  
21 pcs (Shimizudani Smelter)  
All Dog Spikes heads have a "dog head" shape |
| Reevaluated Steel Rail | 1pc (Shimizudani Smelter) |

### Characteristics
- **Rarity**: It is a valuable industrial heritage with large-scale Former Mine Railways traces in the Meiji-era. Especially for Dog Spikes and Sleepers, Former Mine Railways have the following two features:
  1. A small Dog Spike with a "dog head" shape, which is considered to be a first large-scale and systematic discovery in Japan.
  2. Dog Spikes and Sleepers over 125 years ago miraculously remained at the scene as they were at that time. This point is an outstanding value peculiar to Okubo Mine Shaft and Okubo Mine Shaft-Shimizudani Smelter, and it is unprecedented even in railways and tracks nationwide in Japan.

### Current Status
- **Authenticity**: The existing Dog Spikes, Sleepers, and Traces of Sleepers are still in the state of 1896 at the latest without any renovation or renewal. Figure 3 is a prominent example.
- **Integrity**: Considering the characteristics of Dog Spikes and Sleepers as consumables, which are usually replaced within 30 years at the longest, even if the existing quantity is limited, the actual existing cases of Okubo Mine Shaft and Okubo Mine Shaft-Shimizudani Smelter belong to valuable conservation examples. However, it is necessary to consider how to preserve the Traces of Sleepers at the Okubo Mine Shaft, which is open to the public. At the Okubo Mine Shaft-Shimizudani Smelter, it is necessary to take measures against the risk of collapse.

### Technical Value
- **The "dog head" shaped Dog Spikes are considered to be a first large-scale and systematic discovery example in Japan**. Former Mine Railways in Okubo Mine Shaft and Okubo Mine Shaft-Shimizudani Smelter prove an important history of mining technology breakthrough in Japan.

### Economic Value
- 1) Silver and Copper produced at Iwami Ginzan were exported to foreign countries even during the Meiji-era, contributing to the trading in Japan and many countries.

### Historical Value
- Former Mine Railways support the history that the European technology and Modernization were introduced in Iwami Ginzan Silver Mine in Meiji-era by the Denzaburo Fujita and Fujita Group.

### Artistic (Landscape) Value
- The "dog head" shaped Dog Spikes are also interesting as a design. Small Dog Spikes are as cute as small dogs, and the "playing heart" at that time can also be guessed. Industrial Landscapes on Former Mine Railways, especially with Dog Spikes, Sleepers, and Trace of Sleepers is also distinctive.

### Global Value
- **During the Meiji-era, when Modernization was promoted at mines in Japan, Dog Spikes and Steel Rails were introduced from Europe in the field of Mine Transportation. The existing Industrial Heritage sites of Former Mine Railways at the Okubo Mine Shaft, Okubo Mine Shaft-Shimizudani Smelter are prominent large scale proof of the Global technology transfer from Europe to Japan, and remain as it was more than 125 years ago. These points are outstanding in Global.**

### Conservation utilization
- Based on the Industrial Heritage Model for Re-Loding, Action Plan for Re-evaluation, Reuse, Renovation and Relationship of Former Mine Railways are being carried out and Sustainable and Long-term Conservation/Utilization of the iwami Ginzan Silver Mine is expected. Through this Action Plan the World Heritage of the Iwami Ginzan Silver Mine, which had been valued until the pre-modern Edo-era, was given a new heritage-- Former Mine Railways in the Meiji-era, and the value of the World Heritage can be further enhanced.

### Notes
- In 2019, "Dog Spikes and Steel Rail in the Meiji-era at Iwami Ginzan Silver Mine" was certified as a Designated Industrial Heritage by the Japan Industrial Archeology Society (JIAS).
Core Values of Former Mine Railways are as follows:

i) Rarity, Authenticity
Dog Spikes and Wooden Sleepers over 125 years ago were miraculously left as they were. Such relics can almost only be found in Iwami Ginzan Silver Mine.

ii) Global Value
Former Mine Railways proved technology transfer from Europe to Japan in the Meiji-era.

4) Benchmarking
To strengthen above Core Values, we examined some Best Practice cases.
Regarding Reuse and Restoration, Nakada referred to examples of utilization of other World Heritage Sites, also studied Virtual Reality (VR) and Augmented Reality (AR) technology. Regarding Relationship, Ohshima investigated the Asian Network of Industrial Heritage (ANIH) and the European Route of Industrial Heritage (ERIH).

Phase 2: Planning
Based on the Phase 1, we summarized the below Action Plan:

1) Reuse
Nakada planned to exhibit Dog Spikes at Iwami Ginzan World Heritage Center. Meanwhile, in response to a proposal from the Ohmori area Communities, Nakada planned a new utilization for fermentation and aging of German Bread using the stable environment of the Mine Shaft.

2) Renovation
Nakada planned to add VR exhibitions on Mine Shaft including Dog Spikes at the Iwami Ginzan World Heritage Center; also creates AR system so that the Former Mine Railways can be reproduced by Smartphone at the site in Okubo Mine Shaft.

3) Relationship
We planned to establish various global networks, such as Horizontal network with Jinguashi and Ruifang Mine in Taiwan; Vertical network with Krupp in Germany. Ohshima also planned to establish Global Industrial Heritage Routes with ANIH and ERIH.

Phase 3: Proposal/Negotiation

1) Appeal to Society
Ohshima proposed and got certified Former Mine Railways to JIAS as "Designated Industrial Heritage"; also published the official paper in the Academic Journal of JIAS.

2) Presentation to the Japanese Government
Nakada proposed and got approved to the Agency for Cultural Affairs Japan to utilize VR and AR at Okubo Mine Shaft.

3) Appeal to Ohda City
Former Mine Railways will be officially included in "Iwami Ginzan Site Second Phase Development Plan". New plan for Fermenting/Aging German Bread is also waiting for approval.

4) International Relationship
Nakada waits for final decision of International Friendship Center with Jinguashi and Ruifang Mine in Taiwan.
Phase 4: Conservation/Utilization
1) Reuse
Dog Spikes were exhibited at the Iwami Ginzan World Heritage Center and other Museums. In particular, Dog Spikes are attracting attention as "The Oldest Small Dog Spikes in Japan".

2) Renovation
At the Iwami Ginzan World Heritage Center, VR experience corner in Okubo Mine Shaft including Dog Spikes has been set up and well received.

Most of the Action Plans have already reached Phase 3 and some items have already completed Phase 4. We continue to promote all items into Phase 4, achieve our goal for Reloading.

3.3 Expansion and further Proposal for the IHR Model
The Reloading described above is related to Former Mine Railways. We plan to expand the application of the IHR Model to other fields such as the townscape conservation/utilization of the Ohmori area, and strive to fully strengthen the World Heritage Site. We will continue to circulate the IHR Model, finally develop Iwami Ginzan Silver Mine into truly long-term sustainable stage.

A Reloading Model also leads entire Rehabilitation to promote the sustainable conservation/utilization of industrial heritage. Through this model, not only individual industrial heritage can be reloaded and upgraded steadily, but it can be expected that the entire industrial heritage will resonate and rehabilitate on a global scale, such as Global Industrial Heritage Routes. Finally, we propose that if possible, TICCIH recommends the IHR model as an effective reloading and rehabilitation model.

4. Conclusion
In order to enhance the sustainability of industrial heritage, we proposed the IHR Model, applied it to Former Mine Railways at the World Heritage Iwami Ginzan Silver Mine. We could prove the effectiveness of this model by deriving many practical and utilization examples for reloading, especially through Multifaceted Value Analysis and four phases of Actions. We will continue to circulate this model, develop the Iwami Ginzan Silver Mine as a long-term sustainable World Heritage Site. Finally, we propose that this model be recommended by TICCIH as an effective reloading and rehabilitation model.

References
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Caption

FIGURE 1: The IHR Model, Ichiro Ohshima
FIGURE 2: Image of Multifaceted Value Analysis, Ichiro Ohshima
FIGURE 3: Dog Spikes with Sleeper at Okubo Mine Shaft, photo by Ichiro Ohshima
FIGURE 4: Traces of Sleepers in Okubo Mine Shaft, photo by Ichiro Ohshima
FIGURE 5: Industrial Heritage Analysis Table for Former Mine Railways in Iwami Ginzan Silver Mine, Ichiro Ohshima