「重生」這個詞的意思，根據某宗教經典 :

是指一個人與神建立了一種新的關係。

本書所指的「重生」，不單只是基礎設施從廢墟狀態中復活，更正確的描述 : 是指一座基礎設施與人建立了一種新的關係。

本書起源於我 2005-2007 在哈佛時研究所的最後一個作品 , 由波士頓建築學會頒發”設計的未來 The Future of Design”獎項，從此之後的歲月我不斷關注世界上類似這樣的廢棄基礎設施「把再利用視為重生」的案例。

《重生之路》一直是我教學生涯的重要指定題目 , 本書除了精選紀錄了這些世界各地廢棄基礎設施重信建立與人的關係 , 已存在的「重生」案例以外 , 也收錄了幾件我與台灣科技大學與交大建築研究所指導學生們的作品。書中所有案例仍局限於實體空間的再利用 , 因為針對遺棄在過去舊時代被淘汰而成為廢墟的基礎設施 , 無論是把 A 變成 B 或把 A 變成甲 , 人類目前對其只有這一種再利用型態。而非物質基礎設施與非實體的再利用 , 是目前尚未有案例可循的。

當代城市賴以運作的根本

城市是有系統有組織的提供公共服務以非農業產業和非農業人口集聚的集合體。基礎設施所提供的公共服務是所有的商品與服務的生產所必不可少的 , 是當代城市賴以運作的根本。很大一部分來自基礎設施的硬體建設後才有所謂的軟體服務 , 工業化或商業發展的不可或缺的”基礎”, 這樣的先行性與根本性是”基礎” 的由來。

基礎設施（Infrastructure），亦稱公共設施或公共建設，是指為社會生產和居民生活提供公共服務的物質工程設施，它是社會賴以生存發展的一般物質條件。基礎設施不僅包括交通（道路如公路、鐵路，機場、港口）、通訊（電話、網路）、供水、電網等公共設施，即俗稱的基礎建設，亦都包括教育、科技、醫療衛生、體育及文化等社會事業，即「社會性基礎設施」。同時，投資與興建基礎設施本身就在經濟上扮演了重要角色，對國家與城市的繁榮影響钜大。例如簡稱「一帶一路」的絲綢之路經濟帶和 21 世紀海上絲綢之路 , 其跨國經濟帶的核心骨幹就是透過各類大規模基礎設施投資 , 利用沿線區域的國際合作來完善基礎設施以建立自由貿易區域網。

The meaning of the word "rebirth" is based on a religious classic:

It means that a person has established a new relationship with God.

The "rebirth" referred to in this book is not only the resurrection of the infrastructure from the ruins, but a more accurate description: it refers to an infrastructure that has established a new relationship with people.

This book originated from my last work at the Harvard Institute in 2005-2007. The Boston Architecture Society awarded the "The Future of Design" award. Since then, I have been paying attention to such abandoned infrastructure in the world. Think of recycling as a case of rebirth.

"The Road to Rebirth" has always been an important design topic for my teaching career. In addition to the selection of these abandoned infrastructures around the world, this book has established a relationship with people. In addition to the existing "rebirth" cases, I also included several articles about Taiwan and Taiwan. The University of Science and Technology and the Jiaotong University Architecture Institute guide students' works. All the cases in the book are still limited to the reuse of physical space, because for the abandonment of the infrastructure that was eliminated in the old days and become ruin, whether it is to turn A into B or turn A into A, humans currently only have this kind of reuse. Type. Rather than physical infrastructure and non-physical reuse, there are no cases to follow.

The fundamentals of the operation of contemporary cities

Cities are a collection of systematically organized public services to non-agricultural industries and non-agricultural populations. The public services provided by infrastructure are essential for the production of all goods and services and are fundamental to the operation of contemporary cities. A large part of the hardware construction from the infrastructure has the so-called software service, the indispensable "foundation" of industrialization or commercial development. Such pre-emptiveness and fundamentalness are the origin of the "foundation".

Infrastructure, also known as public facilities or public works, refers to the physical engineering facilities that provide public services for social production and residents' lives. It is the general material condition for the survival and development of society. Infrastructure includes not only transportation (roads such as roads, railways, airports, ports), communications (telephone, Internet), water supply, power grids, etc., which are commonly known as infrastructure, but also include education, technology, health care, sports and Social undertakings such as culture, that is, "social infrastructure." At the same time, investment and infrastructure construction itself play an important role in the economy and have a significant impact on the prosperity of the country and the city. For example, the “One Belt and One Road” Silk Road Economic Belt and the 21st Century Maritime Silk Road, the core backbone of the transnational economic belt is to build infrastructure through various types of large-scale infrastructure investment and use international cooperation along the line to improve infrastructure. Trade area network.

所有國家所有城市都會遇到的 — 城市病

各國為確保其競爭優勢，將不斷持續提升國家基礎設施的質量來與世界競爭 , 確保擁有快速，可靠的方式來移動人員，貨物，能源和信息。投資於國家的基礎設施帶來了直接和長期的經濟效益，有針對性的基礎設施投資更可以成為創造就業和經濟增長的引擎。

不斷持續提升的前提下 , 當一個經濟體 , 無論是從一個國家或城市來看，當它由一個經濟階段往下一個經濟階段演進時 , 就會過渡而留下過時的基礎設施。從 " 必需 " 變成 " 廢物 " , 如何處理 , 升級 , 或再利用這些被淘汰的基礎設施 , 是每一個國家與城市都會面對到的問題。

這種城市病是時代改變 , 經濟增長 , 一言以蔽之進步中所需付出的代價 , 差別只在於發展進程不同所以發病的時間不同 , 有些城市因而遇到的早 , 有些遇到的晚 ; 有些城市處理的多 , 有些城市處理的少。有些基礎設施從此成為累贅與負擔 , 有些重生成為機會與發展。

歷史上基礎設施一次次反覆運算的文明演進已經告訴我們
無論如何終究會遇到

形塑地貌與時代的力量

基礎設施的出現之後人類大大的改變了這個行星的地景地貌。城鄉風貌就此改變 , 而且目前看來是只要還存在 , 就仍是不可逆的改變

這不禁讓我想起一個古老爭議
很多人都喜歡嚮往過去的建築，那些很多屬於沒有建築師的建築
很多人都喜歡嚮往過去的城鎮，那些很多屬於沒有城市規劃師的城市
相比過去，許多對現代建築與不好歸咎到工程師 建築師與城市規劃師
比起現在，感官上與感性上我也更喜歡過去。但問題在於我們總認為：

現在是過去的延續

而這個認知本身有待商確 !
現在建築現代都市不是在很多方面上來講 , 與過去的建築過去的城市（城鎮）, 也許根本就是演化後的不同物種。舉ㄧ個最底層最局部的例子：從沒水沒電，沒有衛生設備的建築，從無到有的開始有了這些設備的建築。要仰賴一個城市從過去無法供水供電，沒有衛生下水道或污水處理廠，從無到有的開始有了有這些基礎設施的都市

遠遠不止是「過去」的「升級」這麼單純

城市做了水電工程改造就變成了另外一個物種，如果大家覺得扯的話。那麼看看下面這個例子。人類改變成生化人之後把這大部分的科幻片裡面，那個生化人已經不再被視為人類，不是另外一個基於人類基礎的新物種。改變之大與涉及的層面之廣，大到深到無法用過去的標準看它們，這種改變最後影響到人思維方式的改變， 但人並沒有改變看待他們的方式，至少在與過去的連結上，還是基於一個時間上先後次序而來，如同用薄弱的血緣關係，把過去與現在視為：同一個或同一種

它們與過去的不同，是「時代」去設計塑建築與都市去成爲現在這個樣子，時代之下有更多其它更大更複雜的力量去形塑，ㄧ步步變成這個現在，並非建築師與城市規畫師去設計成我們看到的現在 , 這些人不過是時代的助產士。

時代已然成形， 工程師，建築師，與規劃師只是讓時代具體到你我眼前

All cities in all countries will encounter - urban disease

In order to ensure their competitive advantage, countries will continue to improve the quality of their national infrastructure to compete with the world, ensuring a fast and reliable way to move people, goods, energy and information. Investing in national infrastructure brings immediate and long-term economic benefits, and targeted infrastructure investments can be an engine for job creation and economic growth.

Under the premise of continuous improvement, when an economy, from one country or city, evolves from one economic stage to the next, it will transition and leave outdated infrastructure. From "necessary" to "waste", how to deal with, upgrade, or reuse these eliminated infrastructure is a problem that every country and city will face.

This kind of urban disease is the price that needs to be paid for the change of the times, economic growth, and the inconsistency. The only difference is that the development process is different, so the time of onset is different. Some cities have encountered early and some have encountered late; Some cities deal with more, and some cities deal with less. Some infrastructure has since become cumbersome and burdensome, and some have been re-generated into opportunities and development.

The evolution of civilization in history has repeatedly told us that the evolution of infrastructure has been repeated.Anyway, you will eventually meet

Shape the landscape and the power of the times

After the emergence of infrastructure, humans have greatly changed the landscape of this planet. The urban and rural style has changed, and it seems that as long as it still exists, it is still irreversible change.

This can't help remind me of an ancient controversy.
Many people like to look forward to past buildings, many of which belong to buildings without architects.Many people like to look forward to past towns, many of which belong to cities without urban planners.Compared to the past, many of the modern architecture and bad blame to engineers architects and urban planners.I like the past more sensually and emotionally than now. But the problem is that we always think:

Now is a continuation of the past

And this cognition itself has to be confirmed!
Nowadays, building a modern city is not in many respects. In the past, the cities (towns) of the past buildings may be fundamentally different species after evolution. Let's take a look at the bottommost and most partial example: buildings that have no water, no electricity, no sanitation, and buildings with these equipments from scratch. It depends on a city that has no water supply and power supply in the past, no sanitation sewers or sewage treatment plants, and has a city with these infrastructures from scratch.

Far more than just the "upgrade" of "upgrade" is so simple

The city has become a different species after the hydropower project has been transformed, if everyone feels it is. Then take a look at the example below. After humans changed into biochemical people, the biochemical person in most of the science fiction films is no longer considered a human being, not another new species based on human foundation. The magnitude of the change and the level of involvement are so large that they cannot be seen with past standards. This change ultimately affects the way people think, but people do not change the way they look at them, at least in the past. Or, based on a chronological order, as with a weak blood relationship, treating the past and the present as: one or the same

They are different from the past. It is the "era" to design plastic buildings and cities to become what they are. There are more and more complex and more powerful forces to shape in the era. It is not the architect and the step by step. The urban planners are designed to be what we see now, these people are just the midwife of the times.

The times have taken shape, engineers, architects, and planners just let the times come to you and me.

形隨機能， 是否存在？

19 世紀由芝加哥學派建築師『路易士．蘇利文』提出的 Form follows Function 的理論，強調建築的形態是隨著機能需要而設計或改變的，宣告合理的外型源自合理的機能。建築師設計理想上被要求遵守此原則 (類型學是一種認識的方式和思考方式，它刻意忽略建築間個別的枝節問題，以填補都市和建築個體之間的鴻溝)
西方建築類型學 Typology 的研究也說明瞭各種不同功能的建築，不同功能建築會演化出特化類型：學校會有學校的樣子，博物館會有博物館的樣子，與旅館就不會是一個樣。這些不同類型的建築彼此是異中求異，或異中求同

補充一下中式日式等東方建築則近乎相反，中式建築存在ㄧ種基本原型，它們鮮有所謂特化類型。有的是一個基本原型（單元）去擴充增長，以不同排列不同組織方式去滿足不同功能，但可能都是源自同一個基本原型。所以大部分不同功能建築的樣子基本上都還是大同小異，同中求異。從西方建築類型學角度來看 , 由基礎設施重生的建築物都是混生種或突變種，功能前後天差地遠。重生前的基礎設施多由工程師主導 , 形式與機能之間有著必然的關係 , 無過分講究美學。但重生後變成的建築功能與原本天差地遠卻依然能夠運作良好。

絕大多數的重生功能大都不是這些基礎設施”適合”被變成什麼 , 而是這些已死的基礎設施”需要”被變成什麼。沒有與原本基礎設施的空間或特質有絕對的必然關係。ㄧ次ㄧ次基礎設施重生 , 發電廠美術館 , 起重機的旅館 , 水塔住宅等每一個案例 , 每一個混生種或突變種都在說明西方建築類型學所謂的建築原型沒有絕對。

形隨機能在建築領域可能只是一種意識形態， ㄧ種建築師自己想像中的原則

這是問題的提出，而不是結論的宣告，答案還在路上

Form follows Function, does it exist?

19th century by the Chicago School of Architecture "Louis. The theory of Form follows Function proposed by Sullivan emphasizes that the shape of the building is designed or changed with the needs of the function, and the reasonable appearance is derived from reasonable functions. Architect design is ideally required to abide by this principle (Typology is a way of understanding and thinking, it deliberately ignores individual problems between buildings to fill the gap between urban and architectural individuals)
The study of Typology in Western typology also illustrates the architecture of different functions. Different functional buildings will evolve special types: the school will have a school look, the museum will have a museum look, and the hotel will not be the same. These different types of buildings are different from each other, or different from each other.

Adding to the oriental architecture such as Chinese-style Japanese is almost the opposite. There are a few basic prototypes in Chinese architecture, and there are few so-called specialization types. Some are a basic prototype (unit) to expand growth, to arrange different organizations to meet different functions, but may all originate from the same basic prototype. Therefore, most of the different functional buildings are basically the same, and the same in the same. From the perspective of Western architectural typology, the buildings reborn by the infrastructure are mixed species or mutants, and the functions are far apart. The infrastructure before rebirth is mostly led by engineers. There is an inevitable relationship between form and function, and there is no excessive emphasis on aesthetics. However, the building function that became born after rebirth is still far from the original one, but it still works well.

The vast majority of rebirth functions are not what these “fit” infrastructures become, but what these “dead infrastructures” need to be. There is no absolute relationship with the space or traits of the original infrastructure. Every case, such as the rebirth of infrastructure, power plant art museum, crane hotel, water tower residence, etc., each mixed species or mutant species is not absolute in the so-called architectural prototype of Western architectural typology.

Stochastic can be just an ideology in the field of architecture, the principles of the architect’s own imagination

This is the question, not the conclusion of the conclusion, the answer is still on the road.

從微觀基礎設施的演化來看都市演化

建築不管幾次重生皆有一死
最終只有城市是不死的

許多類型的基礎設施與建築物相比都是巨大尺度的構造物 , 建築物無論多大都只是城市的分 , 但許多基礎設施都是跨城市規模的。不同於一棟棟建築物組成城市硬體是形式上的分子，基礎設施是支撐這個城市運轉一部分的系統 , 即便這個系統有時候確實還是以單棟建築物呈現。微小的 , 局部的 都市更新。

退役淘汰的基礎設施 :
為何要再利用？
如何再利用？
與怎麼用？
這本身不是建築議題 , 而是牽涉市政 , 經濟 , 開發等層面更複雜的議題 . 只是表面上讓我們看到的解決手段是屬於建築議題。一場工程師與建築師的世紀接力：上一代由工程師主導的基礎設施在退役死亡後由這一代的建築師接手。微小的 , 局部的都市更新。

只要有真正商業利益存在的地方，並不需要政府去大力推廣，整個市場自然就會跟進，自然就會讓公私部門前僕後繼地去再利用再開發 , 去帶動都市老舊區域的演化。我們不排除許多老建物或基礎工程的再利用從表面上看來某一種懷舊情懷 , 但大多數造成這個重生動機的真正理由都是地點存在投資價值後，才有評估物件是拆除亦或再利用。當然在資本主義掛帥的今日下依然不排除有看見好的潛力物件如紐約 Highline 之後才提出新的計劃

以長遠的時間來看城市內的「不成功的作為」都比「不做為」要更好 , 重點在於保持活力。
對城市的經營者與土地的持有這而言，這些再利用計畫都是他們所樂見的，因爲基礎工程的重生案就算最後失敗，只要城市土地有在使用與運作意味都市演化都在持續，最終，城市本身都是贏家。

Urban evolution from the evolution of micro-infrastructure

No matter how many times the building is born again, there is a death.
In the end, only the city is not dead.

Many types of infrastructure are large-scale structures compared to buildings. Buildings are mostly urban, but many infrastructures are cross-city. Unlike a building that forms the city's hardware is a form of numerator, the infrastructure is a system that supports the operation of the city, even if the system is sometimes presented as a single building. Tiny, partial urban renewal.

Infrastructure for decommissioning:
Why use it again?
How to reuse?
And how to use?
This is not an architectural issue in itself, but involves more complex issues at the municipal, economic, and development levels. It is only the surface that allows us to see solutions that are architectural issues. A century-old relay between engineers and architects: The previous generation of engineer-led infrastructure was taken over by this generation of architects after the death of retired. Tiny, local urban renewal.

As long as there is a place where real commercial interests exist, and the government does not need to promote it, the whole market will naturally follow up. Naturally, the public and private sectors will continue to use redevelopment to drive the evolution of the old urban areas. We do not rule out the reuse of many old buildings or basic projects. On the surface, there is a nostalgic feeling, but most of the real reason for this heavy machine is that the value of the investment exists in the location, and then the evaluation object is demolished or reused. . Of course, under the current capitalist command, it is still not possible to exclude new potential projects such as New York Highline.

Looking at the "unsuccessful actions" in the city in the long run is better than "doing nothing", and the focus is on maintaining vitality.
For the operators of the city and the holding of the land, these re-use plans are all they like, because the reincarnation case of the basic project will eventually fail, as long as the urban land is in use and operation means urban evolution. Sustained, eventually, the city itself is a winner.

實體之外 , 再利用本身的進化

智慧城市正在為我們帶來未來的基礎設施 , 而基礎設施一詞所定義與涵蓋的範圍也不斷的在更新。但撇開新型態的基礎設施先不談 , 光是既有的基礎設施本身技術的升級與進化就足以再次改變地貌， 例如當可控制核融合 (核聚變) 技術成熟到足以成為新能源與人類的主要發電方式 , 高效低價低無染的電力就能讓人類做到以前受限於能源成本做不到的事 : 例如淡水很可能不再是地球上的稀缺資源，在低成本的能源下人類可以更大規模直接電解海水取得淡水 , 環境工程上此舉便能將沙漠變綠洲。農業會全面進入以室內人工照明加快光合作用 , 可控物理環境的溫室工廠化時代能夠在有限土地下增加產量。同時，大量傳統的發電廠如煤電廠、水電廠 , 核分裂廠被廢棄或進入再利用階段，水壩被拆掉，農田變成草原、森林、湖泊與公園

然而本書談的是基礎設施的過去與現在再利用型態的趨勢 , 但不是基礎設施本身與基礎設施的未來 , 不是下一代的基礎設施。基礎設施本身的未來 , 例如從新的融資模式與管理模式 , 到新型態的工程基礎設施 , 綠藻供電網 , 自動充電道路 , VR 體感站 , 如太空機場與太空站乃至外星殖民地的再利用等等 , 那是另一個領域另一本書了。至於這本書本身 , 它更好比是一個戀物癖紀錄般的集合體。

當科技文明逐漸進步 , 人類的基礎設施會逐漸不再局限於由鋼筋混凝土的物質硬體 , 其所定義與涵蓋的範圍也不斷的在更新 , 所謂的再利用也不會侷限於對新型態基礎設施的實體再利用，再利用本身也會跟著進化。真正新型態的基礎設施會帶來新形態的再利用 , 智慧城市浪潮持續下新型態的非物質的基礎設施與它們非物質超越實體的再利用 , 是我們現在仍無法預期的。

下一代的基礎設施 , 未來的基礎設施的再利用型態的趨勢

存在更未來的未來

Beyond the entity, reuse its own evolution

Smart cities are bringing us the infrastructure of the future, and the definition and coverage of the term infrastructure is constantly being updated. But apart from the new state of infrastructure, the upgrade and evolution of the existing infrastructure itself is enough to change the landscape again, for example, when the controllable nuclear fusion (nuclear fusion) technology is mature enough to become a new energy source and human. The main way of generating electricity, high-efficiency, low-cost, low-noise electricity can enable humans to do things that were previously limited by energy costs: for example, fresh water is likely to be no longer a scarce resource on the planet, under low-cost energy. Humans can directly electrolyze seawater to obtain fresh water on a larger scale, and environmental engineering can turn the desert into an oasis. Agriculture will fully enter indoor artificial lighting to accelerate photosynthesis, and the greenhouse industrialization era of controlled physical environment can increase production under limited land. At the same time, a large number of traditional power plants such as coal-fired power plants, hydropower plants, nuclear-disruption plants were abandoned or re-used, dams were demolished, and farmland became grasslands, forests, lakes and parks.

However, this book talks about the past and present reuse patterns of infrastructure, but not the future of infrastructure itself and infrastructure, not the infrastructure of the next generation. The future of the infrastructure itself, from new financing models and management models, to new-type engineering infrastructure, green algae power grids, automatic charging roads, VR somatosensory stations, such as space airports and space stations, and even alien colonies. Use and so on, that is another book in another field. As for the book itself, it is better than a collection of fetish records.

As the technological civilization progresses, the human infrastructure will no longer be confined to the physical hardware of reinforced concrete, and its definition and coverage will be constantly updated. The so-called reuse will not be limited to the new state. The physical reuse of infrastructure, and reuse itself will also evolve. The true new state of the infrastructure will bring about new forms of reuse, and the smart city wave continues to undermine the new state of non-material infrastructure and the reuse of their non-material transcendental entities, which we still cannot predict.

The next generation of infrastructure, the trend of future infrastructure reuse patterns

There is a future for the future

拆與不拆的辯證

目前高架橋這類的基礎設施，除了全部拆光，是否還有「存」與「不存」外的選項
我們先看看世界上較有名的案例

第一種：不拆者

Highline, 藝術高架橋
存
釋放出土地沒有太高的利用價值
土地政策或建管政策下保存較有利項目整體推進
拆除工程難度高曠日廢時耗資巨大
具有歷史意義或工程價值，反正就是由文史工作者找出任何一個理由
新功能非常好整合入既有基礎設施，改造工程難度低成本低
反對拆除的抗爭強烈
政治力介入

第二種：全拆者

Big dig, 清溪川
不存
釋放出土地有非常高的利用價值，或能帶動周邊發展增值
土地政策或建管政策下拆除較有利項目整體推進
拆除工程難度低地成本低
影響公共安全已到非拆不可
不具有歷史意義或工程價值
根本沒有適合的新功能非可以整合入既有基礎設施，改造工程難度高
拆除的請願強烈
政治力介入
2006 年我在做東京市場時，提出了第三種

Dialectical of dismantling and not dismantling
At present, the infrastructure such as the viaduct, in addition to all the light-removal, has options other than "Save" and "Do not save".
Let’ s take a look at some of the more famous cases in the world.

The first type: no dismantling
Highline, art viaduct
Save
The release of land does not have too high utilization value
The overall promotion of more favorable projects under the land policy or the construction management policy
It is very difficult to dismantle the project.
Historically or engineeringly, anyway, it is up to the literature and history workers to find any reason.
The new features are very well integrated into the existing infrastructure, making the project difficult and low cost.
Strong opposition to dismantling
Political involvement

Second: full demolition
Big dig, Cheonggyecheon
Not saved
The release of land has a very high use value, or can drive the development of the surrounding development
Demolition of favorable projects under the land policy or construction management policy
Demolition works are low in cost and low in cost
Affecting public safety has not been removed
No historical or engineering value
There is no suitable new function at all, it can be integrated into existing infrastructure, and the renovation project is difficult.
Demolition petition is strong
Political involvement
When I was doing the Tokyo market in 2006, I proposed the third

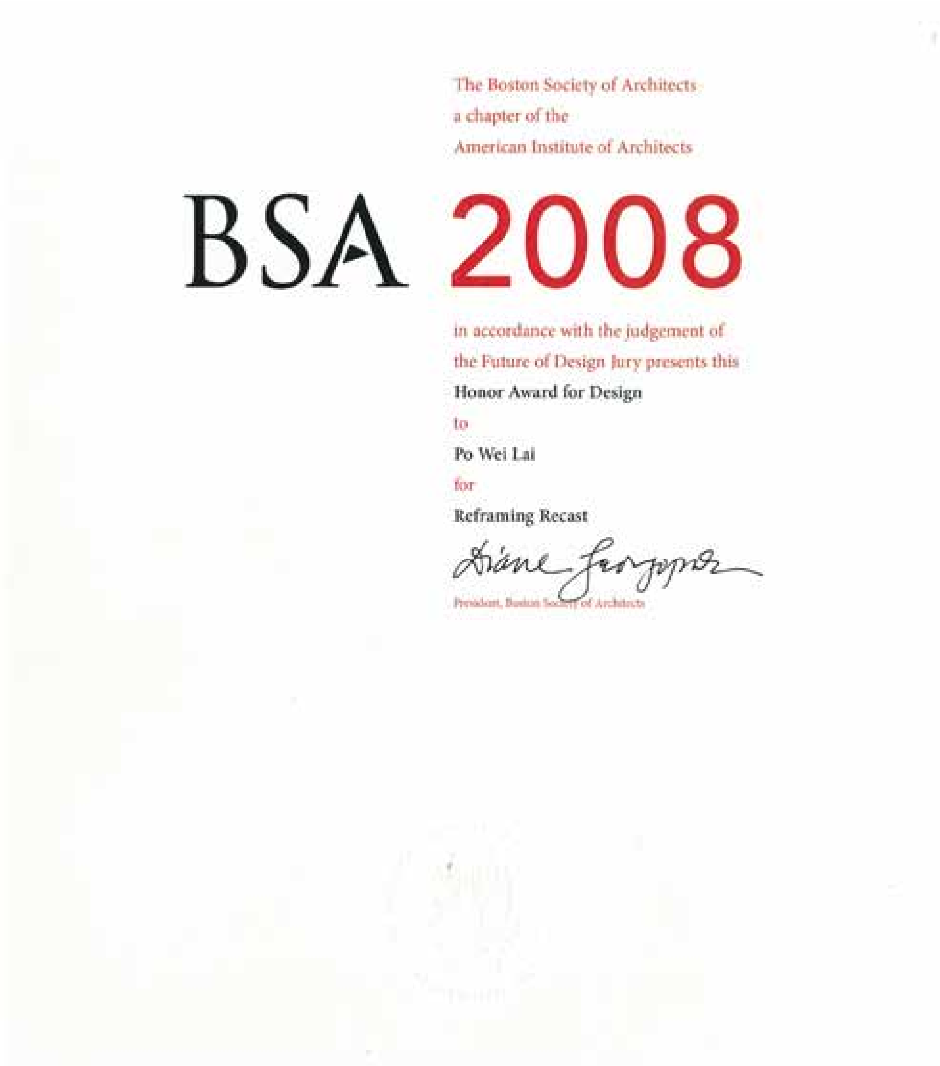
第三種
介於拆與不拆之間

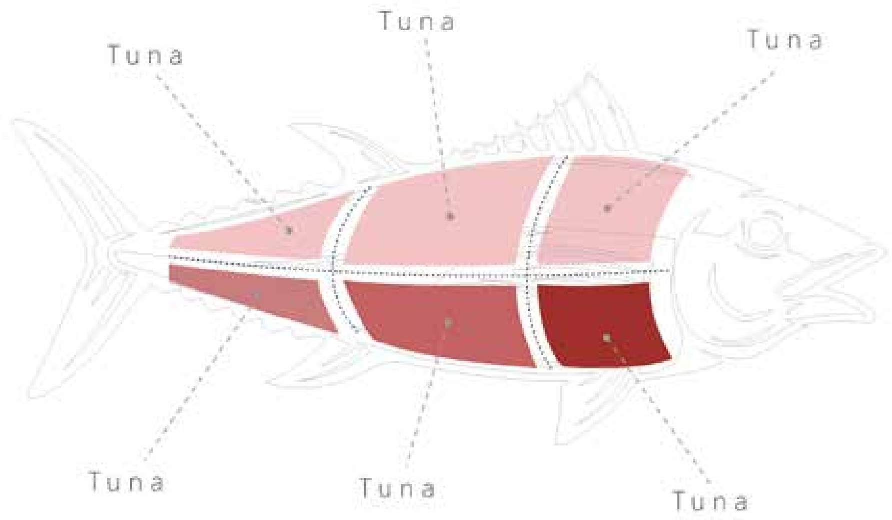
Tokyo highway Market

除了全部拆光，是否還有「存」與「不存」外的選項
在拆與不差的中間還是有一種可能性是存在
局部的保留做再利用。東京的高速公路市場碰巧的闖入的這一個中間地帶
浮在河上的土地根本無法取得
除非
使用高速公路本身

Third
Between dismantling and not dismantling
Tokyo highway market

In addition to all the light, there are options other than "Save" and "Do not save".
There is still a possibility that there is a possibility in the middle of dismantling and not bad.
Partial reservations are reused. Tokyo’ s highway market happens to break into this middle ground
The land floating on the river cannot be obtained at all.
unless
Use the highway itself

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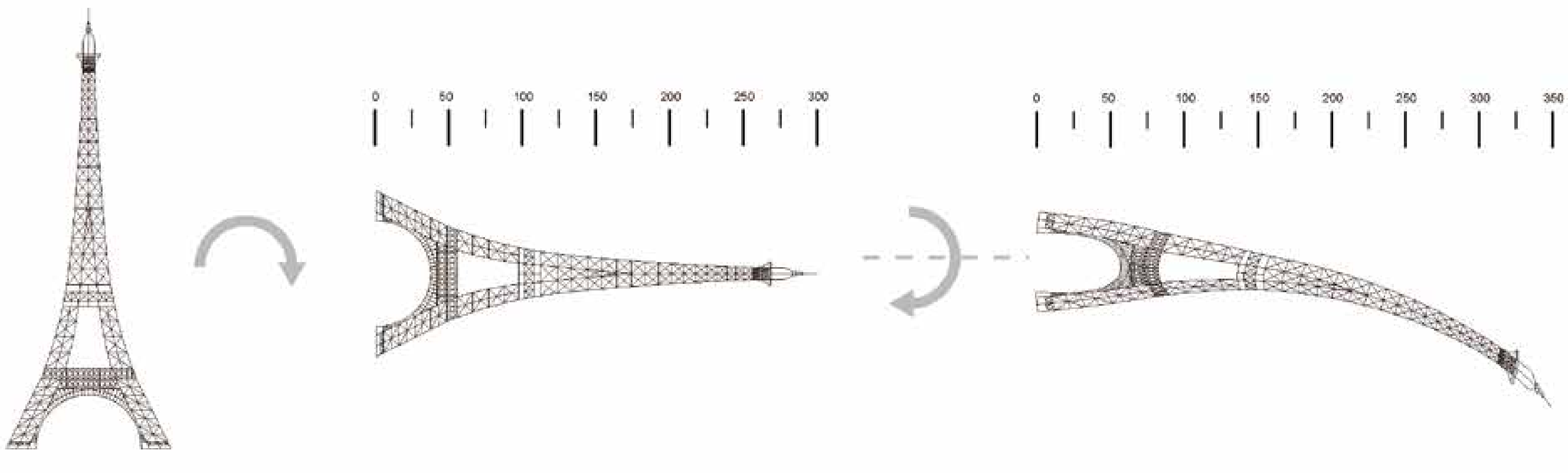

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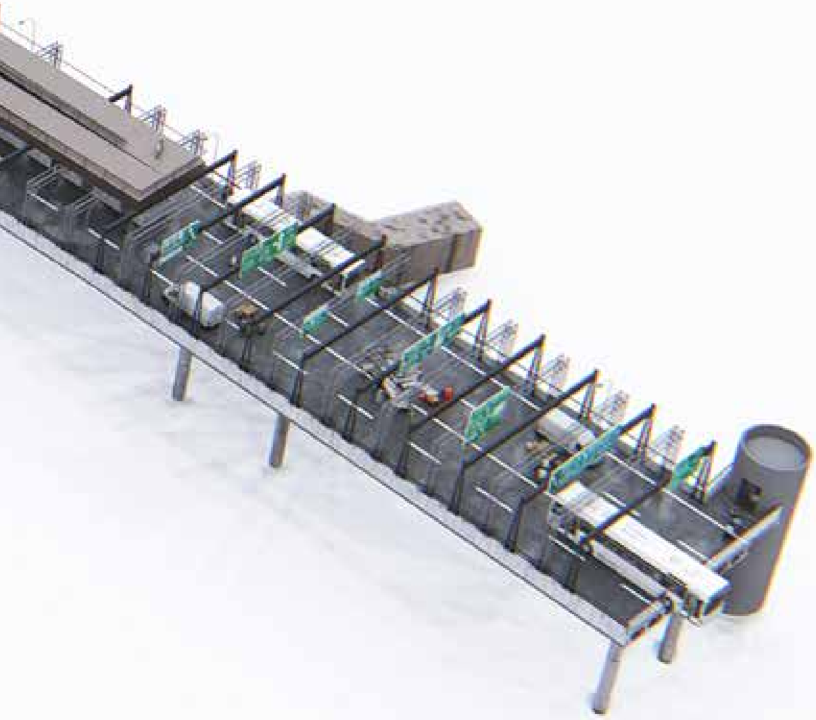
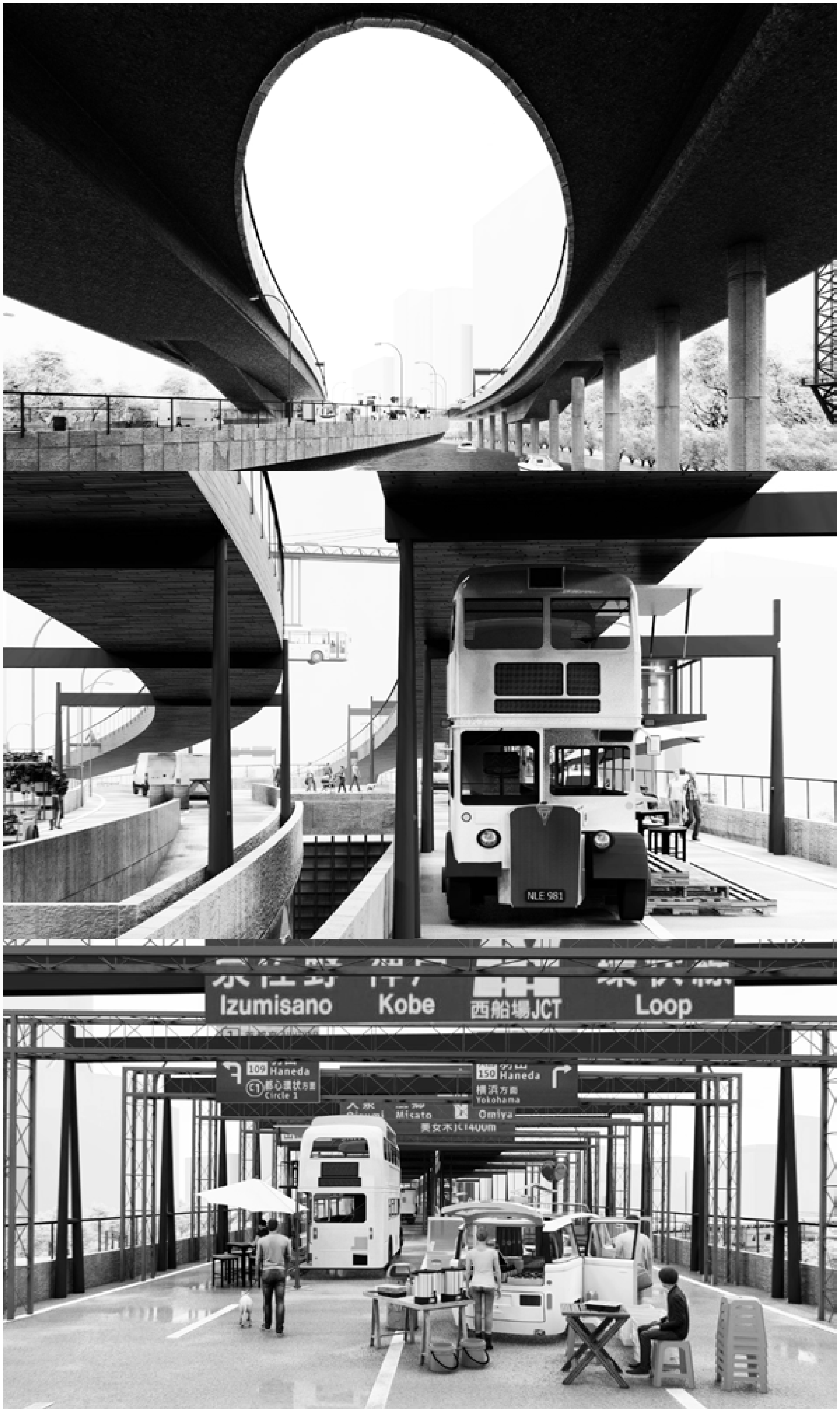
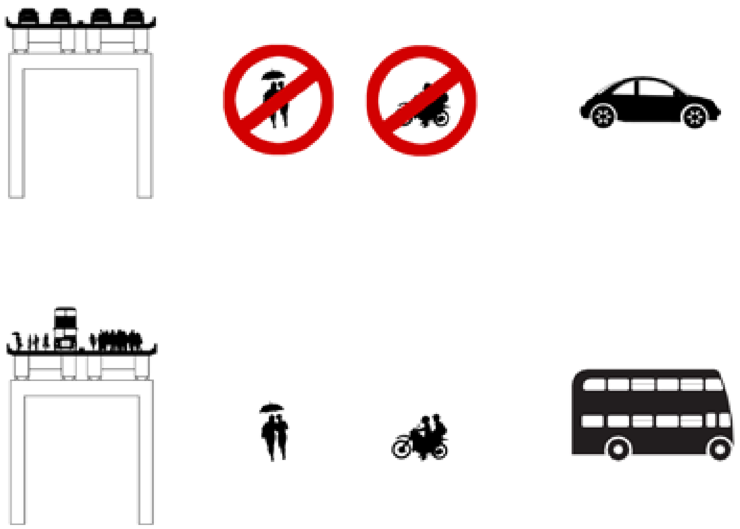
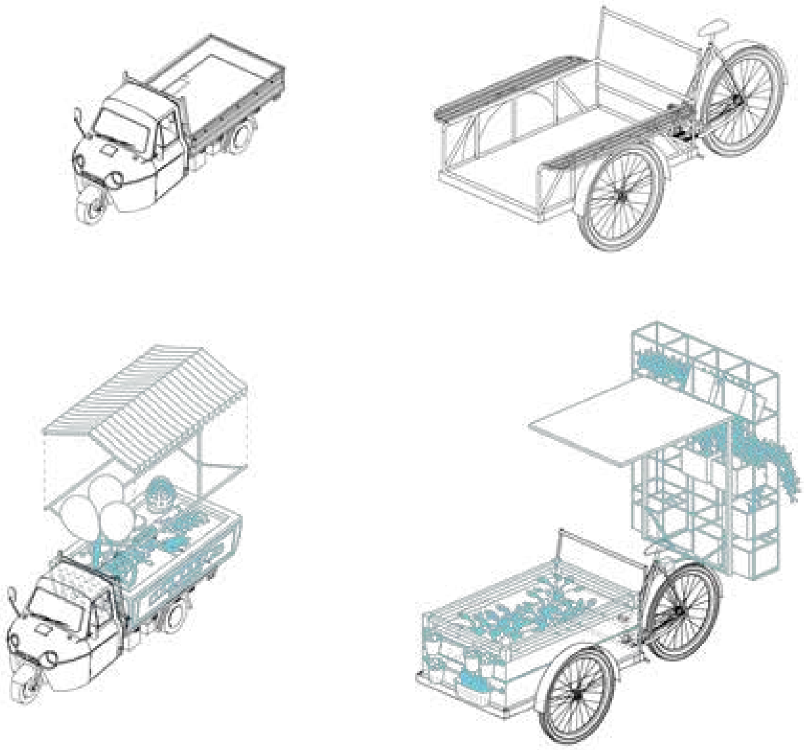
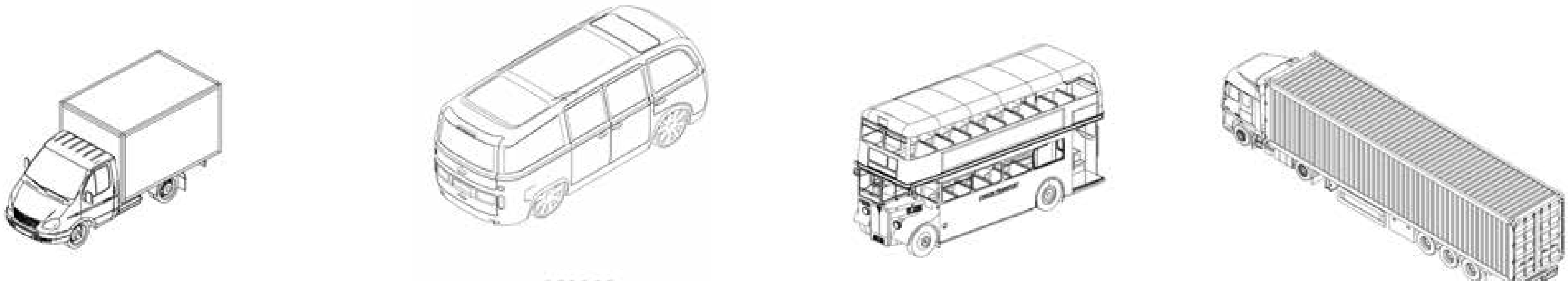



NLE 981
Izumisano
Kobe
西船場JCT
Loop
Haneda
Haneda
Yokohama
Misato
Omiya

機動車輛以另外一種形式回到這裡
Vehicle come back but in another form







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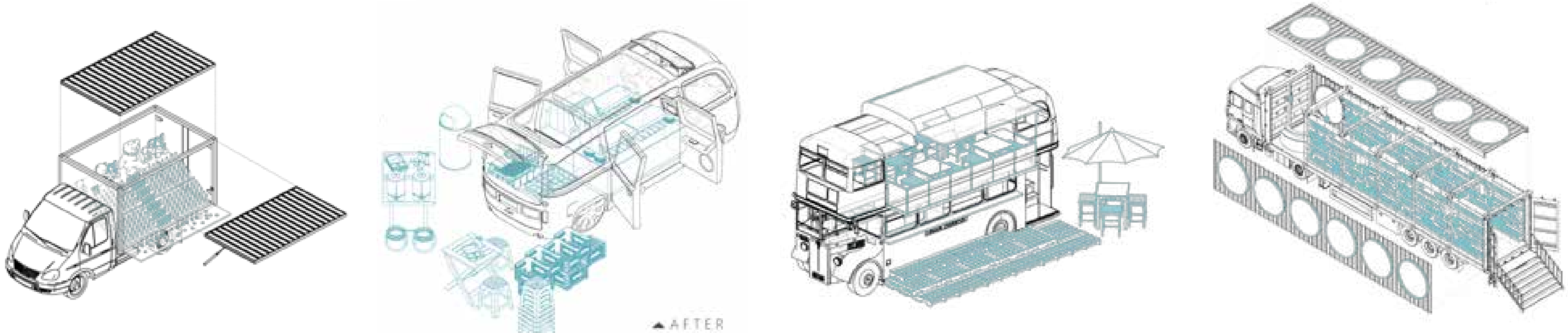

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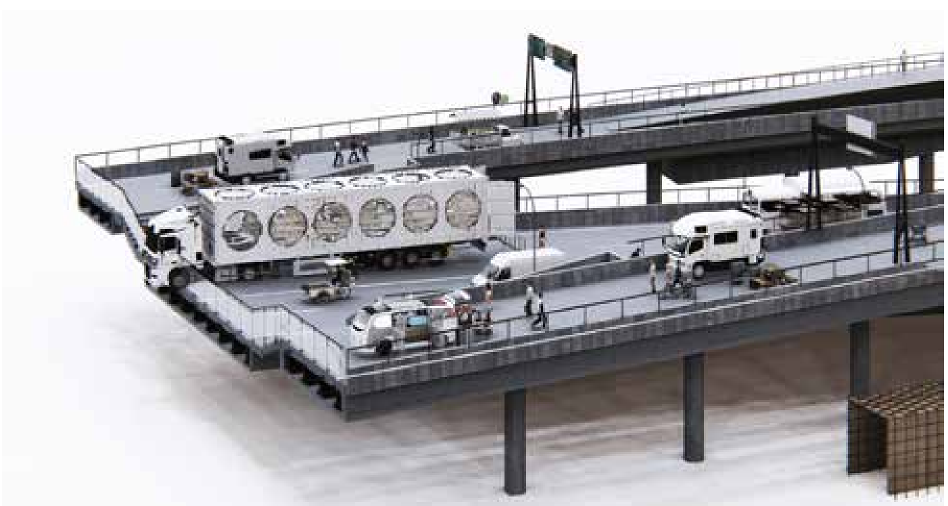

Ch1 基礎設施的史觀

基礎設施的史觀

這些先後出現的基礎設施 , 構成了人類的文明 , 人類如何透過興建基礎設施 , 一步步克服物種與環境上的限制 , 從屈服大自然 , 利用大自然 , 到駕馭大自然形成而今日的地球上人類集中的都市環境 , 不論是非 , 不論代價 , 此過程中一次又一次的技術突破與人定勝天的野蠻中仍然宣告了基礎設施的演進史就是人類文明的演進史。

基礎設施這個術語在 19 世紀 80 年代後期首次用於英語。1987 年，美國國家研究委員會的一個小組採用了“公共工程基礎設施”這一術語來指代功能模式，包括高速公路，機場，供水和資源，電信，以及這些要素組成的組合系統。
適用於大型和小型組織框架，只要有物理組件需要，基礎設施就可以包括各種系統和結構。例如，跨越城市，州或國家的電網是基於所涉及的設備以及向其支持的區域提供服務的意圖的基礎設施。所以，構成在特定位置內運行的公司的數據網絡的物理佈線和組件也是所討論的業務的基礎結構，因為它們是支持業務操作所必需的。

IT 基礎設施

由於它們在特定商業環境中提供的關鍵功能，許多技術系統通常被稱為基礎設施，例如網絡設備和服務器。如果沒有信息技術（IT）基礎設施，許多企業都難以以提高工作場所效率的方式共享和移動數據。如果 IT 基礎結構出現故障，則無法執行許多業務功能。

基礎設施類型

基礎設施可以分為幾種不同的類型，包括：

軟基礎設施：這些類型的基礎設施構成了有助於維持經濟的機構。這些通常需要人力資本，並有助於為人口提供某些服務。例子包括醫療保健系統，金融機構，政府系統，執法和教育系統。

硬基礎設施：這些構成了物流系統，使得必須經營一個現代化的工業化國家。例子包括道路，高速公路，橋樑，以及使其運營所需的資本 / 資產（公交車，車輛，石油鑽井平台 / 煉油廠）。 此書討論主要集中於此

關鍵基礎設施：這些是政府定義的對社會和經濟運作至關重要的資產，例如住房和供暖設施，電信，公共衛生，農業等。在美國，有負責這些的機構關鍵基礎設施，如國土安全部（政府和緊急服務部門），能源部和交通部。
除上述外，基礎設施還包括垃圾處理服務，如垃圾收集和當地垃圾場。某些行政職能，通常由各種政府機構負責，也被視為基礎設施的一部分。還可以包括教育和醫療設施，以及特定的研發功能和必要的培訓設施。這部分此書案例排除

History of infrastructure

These successive infrastructures constitute the human civilization. How can human beings overcome the limitations of species and the environment through the construction of infrastructure, from yielding nature, using nature, to harnessing the formation of nature and today's humans on Earth. The concentrated urban environment, regardless of whether it is right or wrong, regardless of the cost, the technological breakthroughs in this process and the barbarism of the people who have won the battle, still declare that the history of the evolution of infrastructure is the evolution of human civilization.

The term infrastructure was first used in English in the late 1880s. In 1987, a team of the National Research Council of the United States used the term “public engineering infrastructure” to refer to functional models, including highways, airports, water and resources, telecommunications, and a combination of these elements.
Suitable for large and small organizational frameworks, the infrastructure can include a variety of systems and structures as long as physical components are required. For example, a grid that spans a city, state, or country is an infrastructure based on the equipment involved and the intent to provide services to the areas it supports. Therefore, the physical wiring and components of the data network that make up a company operating in a particular location are also the infrastructure of the business in question, as they are necessary to support business operations.

IT infrastructure

Due to the critical functions they provide in a particular business environment, many technical systems are often referred to as infrastructure, such as network devices and servers. Without an information technology (IT) infrastructure, many organizations struggle to share and move data in ways that increase workplace efficiency. If the IT infrastructure fails, many business functions cannot be performed.

Infrastructure type

Infrastructure can be divided into several different types, including:

Soft infrastructure: These types of infrastructure constitute institutions that help sustain the economy. These often require human capital and help to provide certain services to the population. Examples include health care systems, financial institutions, government systems, law enforcement and education systems.

Hard infrastructure: These constitute a logistics system that necessitates the operation of a modern industrialized country. Examples include roads, highways, bridges, and the capital/ assets (buses, vehicles, oil rigs/refineries) needed to operate them. The discussion of this book is mainly focused on this

Critical infrastructure: These are government-defined assets that are critical to social and economic operations, such as housing and heating, telecommunications, public health, and agriculture. In the United States, there are key infrastructures responsible for these, such as the Department of Homeland Security (government and emergency services), the Department of Energy, and the Department of Transportation.
In addition to the above, the infrastructure also includes waste disposal services such as garbage collection and local landfills. Some administrative functions are usually the responsibility of various government agencies and are also considered part of the infrastructure. It can also include educational and medical facilities, as well as specific research and development functions and the necessary training facilities. This part of the book is excluded

基礎設施類別

西元前 1 世紀的古羅馬水道橋 Roman aqueduct 證明當時已有公共基礎工程的觀念 , 顯然供水系統與城牆一樣 , 被古羅馬人視為城市必備的基礎設施。
(說不定競技場與大浴場對古羅馬人而言也算是 , 但從本書觀點而言這兩者不能算)

未來的基礎設施正在伴隨智慧城市發生 , 但目前真正有被在利用重生案例的基礎設施多源自於這些舊時代的基礎設施 , 先回顧各項舊時代基礎設施大分類與出現的時間

目前的基礎設施分類
引用自維基百科的定義
各類公共設施
不同時期對城市基礎設施的發展、完善、配套有不同的要求。城市基礎設施是一個系統工程，包含的項目有能源供應系統、環保系統、交通運輸系統、通訊系統、文化與休閒建設和防衛防災安全系統。

能源系統
供應水、電、瓦斯、天然氣等民生所需能源，包括各式發電廠、輸電網絡、變電所、自來水管、油管及天然氣管等輸送管線。

通訊
包括郵政系統、電話線路、網際網路等。
安全
防衛居住地的安全系統包括城牆、軍事武器，也包含無形的網際網路防火牆等。

交通
包括飛機場、港口、公共道路、停車場、鐵路基礎設施（德語：Eisenbahninfrastruktur）、大眾運輸系統等。

環保
處理廢棄物的公共建設，如廢棄物掩埋場、垃圾場、焚化爐
文化與休閒建設。
包括公園、美術館、博物館等供大眾休閒或增進生活品質的設施。本書中的基礎設施重生案例中 , 不少重生後是變成公園、美術館、博物館 , 況且我們並不認為文化與休閒建設列入基礎設施範圍 , 美術館、博物館乃至圖書館等文化建築雖對城市至關重要 , 但在認定上我們偏向選擇那些維持城市基本運作與基本維生功能 , 與構成這些系統關鍵部份的建築。

Infrastructure category

The Roman aqueduct of the ancient Roman waterway bridge in the 1st century BC proved that there was a concept of public infrastructure engineering. It is obvious that the water supply system, like the city wall, is regarded by the ancient Romans as an essential infrastructure for the city.
(Perhaps the arena and the big bath are also considered by the ancient Romans, but from the point of view of the book, the two cannot be counted)

The infrastructure of the future is happening with smart cities, but the infrastructure that is currently being used in the case of rebirth is mostly derived from the infrastructure of these old times. Let’ s review the time and appearance of the old infrastructure.

Current infrastructure classification
Quoted from the definition of Wikipedia
Various public facilities
Different periods have different requirements for the development, improvement and matching of urban infrastructure. Urban infrastructure is a systems engineering project that includes energy supply systems, environmental protection systems, transportation systems, communication systems, cultural and leisure construction, and defense and disaster prevention safety systems.

Energy system
Supply water, electricity, gas, natural gas and other energy needs for people's livelihood, including various types of power plants, transmission networks, substations, water pipes, oil pipes and natural gas pipes.

communication
Including postal systems, telephone lines, the Internet, etc.
Safety
Security systems that defend homes include city walls, military weapons, and intangible Internet firewalls.

traffic
Including airports, ports, public roads, parking lots, railway infrastructure (German: Eisenbahninfrastruktur), mass transit systems, etc.

Environmental protection
Public construction of waste disposal, such as waste landfills, landfills, incinerators
Culture and leisure construction.
It includes parks, art galleries, museums and other facilities for the general public to enjoy or enhance the quality of life. In the case of the infrastructure rebirth in this book, many of them are turned into parks, art galleries, and museums after reborn. Moreover, we do not think that cultural and leisure construction is included in the infrastructure. Art museums, museums, and even libraries are all about the city. Important, but in the identification we prefer to choose buildings that maintain the basic operations and basic living functions of the city, and the key components that make up these systems.

1700 年以前的基礎設施主要包括道路和運河。運河用於運輸或灌溉。港口和燈塔為海上航行提供了幫助。一些先進的城市有公共噴泉和浴室的渡槽，而下水道則較少。

最早的鐵路用於礦井或繞過瀑布，被馬或人拉。
1811 年，John Blenkinsop 設計了第一台成功且實用的鐵路機車，並建造了一條連接米德爾頓煤礦和利茲的鐵路線。

1837 年 7 月 25 日，Euston 和倫敦卡姆登鎮首次成功展示了電報。
1839 年 4 月 9 日它從帕丁頓車站到西德雷頓的 13 英里（21 公里）的大西部鐵路上進入商業用途。
1876 年，亞歷山大·格雷厄姆·貝爾首次成功傳輸了明確的電話。很快，一個鈴聲被添加用於發信號，然後一個挂機，電話利用了電報網絡中已經採用的交換原理。

1863 年，倫敦地鐵成立。
1890 年，它首先開始使用電力牽引和深層隧道。
1878 年的巴黎博覽會上，沿著歌劇院和歌劇院安裝了電弧燈。
1925 年，意大利是第一個建造高速公路的國家，將米蘭與科莫聯繫在一起。

1982 年，互聯網協議套件（TCP / IP）被標準化，並引入了稱為互聯網的全互聯 TCP / IP 網絡的全球網絡概念。
按時間段

（主要文章：運河，電氣電報，電力傳輸，高速公路，鐵路運輸的歷史，公路運輸的歷史，公共交換電話網絡和電話）

1700 年之前

1700 年以前的基礎設施主要包括道路和運河。運河用於運輸或灌溉。港口和燈塔為海上航行提供了幫助。一些先進的城市有公共噴泉和浴室的渡槽，而下水道則較少。

道路

第一條道路是經常跟隨遊戲 路徑的軌道，例如 Natchez Trace。

第一條鋪砌的街道似乎是在公元前 4000 年在烏爾建造的。燈芯絨道路都建在格拉斯頓伯里，英格蘭在 3300 BCE [4] 和磚鋪成的道路都建在印度河流域文明在印度次大陸從大約在同一時間。在公元前 500 年，Darius I the Great 在波斯（伊朗）開始了廣泛的道路系統，包括皇家大道。

隨著羅馬帝國的興起，羅馬人使用深層碎石路板作為底層建造道路，以確保它們保持乾燥。在更重地行駛的路線，有，包括六面 capstones，或攤鋪機，其減少了灰塵，減少了額外的層拖動從車輪。

在中世紀的伊斯蘭世界，整個阿拉伯帝國都建造了許多道路。最先進的道路是那些的巴格達，伊拉克，它被鋪上了柏油 8 世紀。

The infrastructure before 1700 mainly included roads and canals. The canal is used for transportation or irrigation. The port and lighthouse have helped to navigate the sea. Some advanced cities have aqueducts with public fountains and bathrooms, while fewer sewers.

The earliest railways were used in mines or bypassed waterfalls, pulled by horses or people.
In 1811, John Blenkinsop designed the first successful and practical railway locomotive and built a rail line connecting the Middleton Coal Mine to Leeds.

On July 25, 1837, Euston and London's Camden Town successfully demonstrated the telegram for the first time.
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In 1876, Alexander Graham Bell successfully transmitted a clear phone for the first time. Soon, a ringtone was added to signal, and then an on-hook, the phone took advantage of the switching principles already used in the telegraph network.

In 1863, the London Underground was established.
In 1890, it first began using electric traction and deep tunnels.
At the Paris Expo in 1878, arc lamps were installed along the opera house and opera house.
In 1925, Italy was the first country to build a highway, linking Milan to Como.

In 1982, the Internet Protocol Suite (TCP/IP) was standardized and introduced a global network concept called the Internet's fully interconnected TCP/IP network.
By time period

(Main article: Canal, electric telegraph, power transmission, highway, history of rail transport, history of road transport, public switched telephone network and telephone)

Before 1700
The infrastructure before 1700 mainly included roads and canals. The canal is used for transportation or irrigation. The port and lighthouse have helped to navigate the sea. Some advanced cities have aqueducts with public fountains and bathrooms, while fewer sewers.

the way
The first road is a track that often follows the game path, such as Natchez Trace.

The first paved street seems to have been built in Ur in 4000 BC. Corduroy roads are built in Glastonbury, England at 3300 BCE [4] and brick paved roads are built in the Indus Valley civilization in the Indian subcontinent from about the same time. In 500 BC, Darius I the Great began a wide range of road systems in Persia (Iran), including the Royal Mile.

With the rise of the Roman Empire, the Romans used deep gravel roads as the underlying road to ensure they remained dry. On a heavier driving route, there are six-sided capstones, or pavers, which reduce dust and reduce the extra layer drag from the wheels.

In the medieval Islamic world, many roads were built throughout the Arab Empire. The most advanced roads are those of Baghdad, Iraq, which were paved with asphalt in the 8th century.

運河和灌溉系統

已知最古老的運河建在美索不達米亞 c。公元前 4000 年，現在是伊拉克和敘利亞。從公元前 3300 年開始，印度和巴基斯坦的印度河流域文明擁有先進的渠道灌溉系統。在埃及，運河的歷史可以追溯到公元前至少 2300 年，當時建造一條運河繞過阿斯旺附近的尼羅河上的白內障。

在中國古代，早在戰國（公元前 481-221）就建立了大型的河運運河。到目前為止，最長的運河是公元 609 年完成的中國大運河，仍然是當今世界上最長的運河，全長 1,794 公里（1,115 英里）。

在歐洲，由於 12 世紀的商業擴張，運河建設始於中世紀。著名的運河是 1398 年德國的 Stecknitz 運河，1642 年連接法國盧瓦爾河和塞納河的 Briare 運河，1683 年連接大西洋和地中海的米迪運河。運河建築在 17 和 18 世紀在德國穩步發展，有三條大河，易北河，奧得河和威悉河被運河連接起來。

1700 至 1870

道路

隨著英格蘭交通水平的上升和道路的惡化，收費公路由 Turnpike Trusts 建造，特別是在 1730 至 1770 年間。收費公路也是後來在美國建造的。它們通常由政府特許經營的私營公司建造。

19 世紀早期，河流和運河上的水運從阿巴拉契亞山脈和密西西比河之間的美國邊境運載了許多農產品，但是越過山脈的較短道路有優勢。

在法國，皮爾·瑪麗·杰羅姆·特雷薩格特被廣泛地建立第一記科學的方法，以道路建設，對今年 1764 年它涉及到巨大的岩石層，由小礫石層覆蓋。John Loudon McAdam（1756-1836）設計了第一條現代高速公路，開發了一種廉價的土壤和石料骨料鋪路材料，稱為碎石。

運河

在歐洲，特別是英國和愛爾蘭，然後在早期的美國和加拿大殖民地，內陸運河在工業革命最早階段的鐵路發展之前。在 1760 年至 1820 年間，英國建造了一百多條運河。

在美國，可通航的運河進入了偏僻的地區，並使他們與世界接觸。到 1825 年，伊利運河長 363 英里（584 公里），有 82 個鎖，打開了從人口稠密的東北到肥沃的大平原的連接。在 19 世紀，運河的長度從 100 英里（160 公里）增加到超過 4,000 英里（6400 公里），與加拿大的複雜網絡使五大湖可以通航，儘管一些運河後來被排幹並用作鐵路通行權。

Canal and irrigation system
The oldest known canal is built in Mesopotamia c. In 4,000 BC, it is now Iraq and Syria. Beginning in 3300 BC, the Indian River Basin civilizations of India and Pakistan have advanced channel irrigation systems. In Egypt, the history of the canal dates back to at least 2300 BC, when a canal was built to bypass the cataracts on the Nile near Aswan.

In ancient China, large river canals were established as early as in the Warring States (481-221 BC). So far, the longest canal is the Grand Canal, completed in 609 AD. It is still the longest canal in the world, with a total length of 1,794 kilometers (1,115 miles).

In Europe, the construction of the canal began in the Middle Ages due to commercial expansion in the 12th century. The famous canal is the Stecknitz canal in Germany in 1398, the Briare canal connecting the French Loire and the Seine in 1642, and the Canal du Midi in the Atlantic and Mediterranean in 1683. The canal building developed steadily in Germany in the 17th and 18th centuries, with three large rivers, the Elbe, the Oder and the Weser River connected by a canal.

1700 to 1870
the way
As the level of traffic in England and roads deteriorated, toll roads were built by Turnpike Trusts, especially between 1730 and 1770. The toll road was later built in the United States. They are usually built by private companies that are franchised by the government.

In the early 19th century, water transport on rivers and canals carried many agricultural products from the US border between the Appalachian Mountains and the Mississippi River, but the shorter roads over the mountains had an advantage.

In France, Pierre Marie Jerome Tresgate was widely established as the first scientific method to build roads, and in 1764 it involved a huge rock layer covered by a small gravel layer. John Loudon McAdam (1756-1836) designed the first modern highway and developed an inexpensive soil and stone aggregate paving material called gravel.

canal
In Europe, especially the United Kingdom and Ireland, and then in the early US and Canadian colonies, the inland canal was before the development of the earliest stages of the industrial revolution. Between 1760 and 1820, the United Kingdom built more than a hundred canals.

In the United States, navigable canals enter remote areas and bring them into contact with the world. By 1825, the Erie Canal was 363 miles (584 km) long and had 82 locks that opened the connection from the dense northeast to the fertile Great Plains. In the 19th century, the length of the canal increased from 100 miles (160 kilometers) to more than 4,000 miles (6400 kilometers), and the complex network of Canada allowed the Great Lakes to sail, although some canals were later drained and used as railroads.

鐵路

最早的鐵路用於礦井或繞過瀑布，被馬或人拉。1811 年，John Blenkinsop 設計了第一台成功且實用的鐵路機車，[1] 並建造了一條連接米德爾頓煤礦和利茲的鐵路線。在利物浦和曼徹斯特鐵路，[9] 認為是世界首條城際線，在 1826 年開業。在隨後的幾年中，鐵路傳遍了英國和世界，並成為陸地運輸的主要方式了近一個世紀。

在美國，1826 花崗岩鐵路在馬薩諸塞州是第一個商業鐵路通過不斷的業務演變成一個共同的載體。在巴爾的摩和俄亥俄，於 1830 年開業，是第一個演變成一個大系統。1869 年，這條具有像徵意義的橫貫大陸的鐵路在美國完成，在猶他州的海角（Promontory）開闢了一個金色的穗狀花序。[10]

電報服務

1837 年 7 月 25 日，Euston 和倫敦卡姆登鎮首次成功展示了電報。[2] 它在 1839 年 4 月 9 日從帕丁頓車站到西德雷頓的 13 英里（21 公里）的大西部鐵路上進入商業用途。

在美國，電報是由 Samuel Morse 和 Alfred Vail 開發的。1844 年 5 月 24 日，莫爾斯在華盛頓特區的美國國會大廈最高法院分庭向巴爾的摩的 B & O 鐵路外部倉庫（現為 B & O 鐵路博物館）發送了一條消息，首次公開展示了他的電報。莫爾斯 / 韋爾電報在接下來的二十年中迅速部署。1861 年 10 月 24 日，建立了第一個橫貫大陸的電報系統。

第一條成功的跨大西洋電報電纜於 1866 年 7 月 27 日完成，首次允許跨大西洋電報通信。在 Euston Station 首次安裝後的 29 年內，電報網絡越過海洋到達南極洲的每個大陸，這使得第一次全球通信成為可能。

1870 年至 1920 年

道路

Tar-bound 碎石，或柏油碎石，在巴黎等城市的 19 世紀末應用於碎石路面。在 20 世紀初，柏油碎石和混凝土鋪路延伸到了鄉村。

運河

在此期間完成了許多著名的海上運河，如 1869 年的蘇伊士運河，1897 年的基爾運河和 1914 年的巴拿馬運河。

電話服務

1876 年，亞歷山大·格雷厄姆·貝爾實現了第一次成功的電話傳輸清晰演講。第一部電話沒有網絡，但是私人使用，成對連接在一起。想要與不同的人交談的用戶擁有盡可能多的電話用於此目的。希望說話的用戶，吹口哨進入發射器直到另一方聽到。然而，很快就增加了一個鈴聲用於發信號，然後一個挂機，電話利用了電報網絡中已經採用的交換原理。每部電話都連接到本地電話交換機，交換機與中繼線連接在一起。網絡以分層方式連接在一起，直到它們跨越城市，國家，大陸和海洋。

railway

The earliest railways were used in mines or bypassed waterfalls, pulled by horses or people. In 1811, John Blenkinsop designed the first successful and practical railway locomotive, [1] and built a railway line connecting Middleton Coal Mine and Leeds. On the Liverpool and Manchester Railways, [9] considered the world's first intercity line and opened in 1826. In the following years, the railway spread throughout the UK and the world, and became the main mode of land transportation for nearly a century.

In the United States, the 1826 Granite Railway in Massachusetts was the first commercial railroad to evolve into a common carrier through continuous business. Opened in 1830 in Baltimore and Ohio, it was the first to evolve into a large system. In 1869, this symbolic transcontinental railway was completed in the United States, opening a golden spike in the Utah promontory.

Telegraph service

On July 25, 1837, Euston and London's Camden Town successfully demonstrated the telegram for the first time. [2] It entered commercial use on the 13-mile (21-kilometer) Great Western Railway from Paddington Station to West Drayton on April 9, 1839.

In the United States, the telegraph was developed by Samuel Morse and Alfred Vail. On May 24, 1844, Morse sent a message to Baltimore's B&O Railway Warehouse (now the B&O Railway Museum) in the Supreme Court Chamber of the US Capitol in Washington, DC, which publicly showed his telegram for the first time. The Morse/Vail Telegraph was deployed rapidly over the next two decades. On October 24, 1861, the first trans-continental telegraph system was established.

The first successful transatlantic telegraph cable was completed on July 27, 1866, allowing transatlantic telegraph communications for the first time. In the 29 years after the first installation of Euston Station, the telegraph network crossed the ocean to each continent of Antarctica, making the first global communication possible.

1870-1920

the way

Tar-bound gravel, or tarmac, was applied to gravel pavement at the end of the 19th century in cities such as Paris. In the early 20th century, tarmac and concrete paving extended to the countryside.

canal

During this period, many famous sea canals were completed, such as the Suez Canal in 1869, the Kiel Canal in 1897 and the Panama Canal in 1914.

phone service

In 1876, Alexander Graham Bell delivered a clear speech on the first successful telephone transmission. The first phone has no network, but is used privately and connected in pairs. Users who want to talk to different people have as many phones as possible for this purpose. The user who wishes to speak, whistling into the transmitter until the other party hears. However, a ringtone was quickly added for signaling, and then an on-hook, the phone took advantage of the switching principles already used in telegraph networks. Each phone is connected to a local telephone exchange, and the switch is connected to a trunk. Networks are connected in a layered manner until they cross cities, countries, continents and oceans.

電力

在 1878 年的巴黎博覽會上，沿著歌劇院和歌劇院安裝了電弧照明，使用電動 Yablochkov 弧光燈，由 ZénobeGermme 交流發電機驅動。
Yablochkov 蠟燭需要高壓，不久之後實驗人員就報導弧光燈可以在七英里（11 公里）的電路上供電。
在十年內，許多城市將擁有使用中央發電廠的照明系統，該發電廠通過電力傳輸線為多個客戶提供電力。這些系統與當時占主導地位的煤氣燈公用事業直接競爭。

第一個供應白熾燈的電力系統由 Edison Illuminating Company 在曼哈頓下城建造，最終服務於一平方英里，在珍珠街站設有六個“巨型發電機” 。

1891 年在法蘭克福舉行的國際電工技術展期間，第一次使用高壓傳輸三相 交流電。甲 25 千伏輸電線路，大約有 175 公里（109 英里），連接勞芬上內卡與法蘭克福。在整個 20 世紀，用於電力傳輸的電壓增加了。到 1914 年，運行電壓超過 70,000 V 的五十五個傳輸系統正在使用中，當時使用的最高電壓為 150,000 V. [14]

配水和下水道

在 19 世紀，為應對霍亂威脅，在倫敦建造了主要的治療工程。1852 年 “ 都市水法”頒布實施。 “根據該法案，任何自來水公司在 1855 年 8 月 31 日之後從泰晤士河的潮汐河段取水供國內使用變得非法，並且從 1855 年 12 月 31 日起，所有這些水都需要被有效過濾。大都會下水道委員會成立後，必須進行水過濾，並在 Teddington Lock 上方建立新的泰晤士河進水口。

利用壓縮液化氯氣淨化飲用水的技術是由陸軍醫學院化學教授，美國陸軍 少校 卡爾羅傑斯達爾納於 1910 年開發的。Darnall 的工作成為當今市政水淨化系統的基礎。

地鐵

1863 年，倫敦地鐵成立。1890 年，它首先開始使用電力牽引和深層隧道。不久之後，布達佩斯和許多其他城市開始使用地鐵系統。到 1940 年，19 個地鐵系統正在使用中。

electric power
At the Paris Expo in 1878, arc lighting was installed along the Opera House and the Opera House, using electric Yablochkov arc lamps, driven by the Zénobe Germme alternator.
The Yablochkov candle needs high pressure, and soon the experimenter reported that the arc lamp could be powered on a seven-mile (11-kilometer) circuit.
Within a decade, many cities will have lighting systems that use central power plants that provide power to multiple customers through power transmission lines. These systems compete directly with the gas lamp utilities that dominated at the time.

The first electric system to supply incandescent lamps was built by the Edison Illuminating Company in lower Manhattan, serving one square mile and six "giant generators" at Pearl Street Station.

During the International Electrotechnical Exhibition held in Frankfurt in 1891, the first use of high voltage transmission of three-phase AC. A 25 kV transmission line, approximately 175 km (109 miles), connects Laufen to Neckar and Frankfurt. Throughout the 20th century, the voltage used for power transmission increased. By 1914, fifty-five transmission systems with operating voltages exceeding 70,000 V were in use, with a maximum voltage of 150,000 V. [14]

Water distribution and sewer
In the 19th century, major treatment projects were built in London in response to the threat of cholera. In 1852, the “Urban Water Law” was promulgated and implemented. "According to the Act, it was illegal for any water company to draw water from the tidal reaches of the Thames for domestic use after August 31, 1855, and all of this water needs to be effectively filtered from December 31, 1855. After the establishment of the Metropolitan Sewerage Commission, water filtration must be carried out and a new Thames inlet should be built above Teddington Lock.

The technique for purifying drinking water using compressed liquefied chlorine was developed in 1910 by Professor of Chemistry at the Army Medical College and by the US Army Major Carl Rogers Darna. Darnall's work is the foundation of today's municipal water purification systems.

subway
In 1863, the London Underground was established. In 1890, it first began using electric traction and deep tunnels. Soon after, Budapest and many other cities began using the subway system. By 1940, 19 subway systems were in use.

自 1920 年以來
多車道
多車道高速公路

道路

1925 年，意大利是建立一個高速公路樣的道路，它連接的第一個國家米蘭到科莫，[15] 被稱為的 Autostrada DEI 拉吉。在德國，高速公路形成了世界上第一個限制進入的高速公路網，第一部分從法蘭克福到達姆施塔特於 1935 年開通。美國第一條長途農村高速公路通常被認為是是賓夕法尼亞州收費公路，於 1940 年 10 月 1 日開通。[16] 在美國，州際公路系統由 1956 年的聯邦援助公路法授權。[17] 該系統的大部分在 1960 年至 1990 年之間完成。

互聯網

分組交換的研究始於 20 世紀 60 年代初。在 ARPANET 特別是導致了協議的發展互聯網絡，在多個獨立的網絡，可以連接在一起成什麼將成為第一個兩節點網絡的網絡 ARPANET 是相互關聯於 1969 年 29 月 [18] 訪問 ARPANET 1981 年美國國家科學基金會（NSF）開發了計算機科學網絡（CSNET）。1982 年，互聯網協議套件（TCP / IP）被標準化，全球互聯 TCP / IP 網絡的全球網絡概念稱為互聯網被介紹了。1986 年，當美國國家科學基金會網絡（NSFNET）從研究和教育組織提供對美國超級計算機站點的訪問時，TCP / IP 網絡訪問再次擴展。[19] 商業互聯網服務提供商（ISP）在 20 世紀 80 年代末和 90 年代初開始出現。ARPANET 於 1990 年退役。1995 年，當 NSFNET 退役時，互聯網已商業化，取消了使用互聯網承載商業流量的最後限制。[20] 互聯網在 20 世紀 80 年代中後期開始迅速擴展到歐洲和澳大利亞 [21] [22]，並在 20 世紀 80 年代末和 90 年代初期迅速擴展到亞洲。[23] 在 20 世紀 90 年代後期，據估計，公共互聯網上的流量每年增長 100%，而互聯網用戶數量的平均年增長率被認為在 20%到 50%之間。截至 2011 年 3 月 31 日，估計的互聯網用戶總數為 20.95 億（佔世界人口的 30.2%）。

Since 1920
Multi-Lane
Multi-lane highway
the way

In 1925, Italy was building a highway-like road that connected the first country of Milan to Como, [15] known as the Autostrada DEI Raj. In Germany, the highway formed the world's first restricted access highway network. The first part was opened in Frankfurt in 1935 from Frankfurt to Münstadt. The first long-distance rural highway in the United States is generally considered to be the Pennsylvania Turnpike, which opened on October 1, 1940. [16] In the United States, the interstate highway system was authorized by the Federal Assistance Highway Act of 1956. [17] Most of the system was completed between 1960 and 1990.
the Internet
The study of packet switching began in the early 1960s. In ARPANET in particular led to the development of protocols for the Internet, in which multiple independent networks can be connected together into what would become the first two-node network of networks ARPANET is interrelated with 1969 in September [18] Visiting ARPANET 1981 The National Science Foundation (NSF) developed the Computer Science Network (CSNET). In 1982, the Internet Protocol Suite (TCP/IP) was standardized, and the global network concept of the global interconnected TCP/IP network called the Internet was introduced. In 1986, when the National Science Foundation Network (NSFNET) provided access to US supercomputer sites from research and education organizations, TCP/IP network access expanded again. [19] Commercial Internet Service Providers (ISPs) began to appear in the late 1980s and early 1990s. ARPANET was retired in 1990. In 1995, when NSFNET was retired, the Internet was commercialized, eliminating the final restrictions on using the Internet to carry commercial traffic. [20] The Internet began to rapidly expand to Europe and Australia in the mid to late 1980s [21] [22] and rapidly expanded to Asia in the late 1980s and early 1990s. [23] In the late 1990s, it was estimated that traffic on the public Internet grew by 100% annually, while the average annual growth rate of Internet users was considered to be between 20% and 50%. As of March 31, 2011, the estimated total number of Internet users was 2.095 billion (30.2% of the world's population).

基礎設施作為資產類別

基礎設施也被視為一種資產類別，其長期波動性往往低於股票，並提供更高的收益率。因其穩定，一些公司和個人喜歡投資基礎設施基金
以獲得防禦性特徵，例如運輸或水基礎設施所涉及的資金。

未來的基礎設施

基礎設施下的建築演化論

死亡之後的迭代與突變種

改變物種 , 突變的物種 , 新的建築物種。
這種演化建築師思維與工程師思維雜交出來的「突變種」, 大部分的基礎設施一開始是由工程師為了其他目的設計建造 , 但後來在廢棄不使用之後可以變成由建築師來設計轉變成人使用。

人類建造的許多基礎設施例如產業的生產設施都隨著人類生活方式的改變與產業結構的興衰而告終。在重生的過程中 , 也產生了新的建築物種 , 過去沒有過的建築類型
在生物學上 , 生命並不是被創造出來的，而是時間演化出來的
但在建築類型的演化上，這可能真的是被創造出來
生物透過新的基因組合以達到催生新的物種 , 透過演化的力量透過天擇
而人類對建築卻透過再利用重生新物種 , 透過創意與設計的力量

建築類型的特化 , 功能與外型的連帶關係 , 這件事情是否是必然？建築的外貌與功能的必然性
因為重生的建築與原本的功能大相逕庭甚至不是同一個種類。

演化偏好

要橫量物種的演化成功與否，看的就是這個物種的 DNA 複本存在世界上的數量多寡。生物演化的基礎是差異，而不是平等。個體誕生的背後就只是盲目的演化過程沒有任何預設的目的， 生物的演化目的的或者是說沒有唯一目的 , 都是偶然都是隨機 , 但建築的演化多半是有特定目的 , 這種演化是人擇 , 當然不可能是天擇 , 選擇的依據是當代人類的社會需求商業需球市場需求的建築類型 , 迭代的新功能，都是提供滿足當代的需求。

Infrastructure as an asset class

Infrastructure is also seen as an asset class, with long-term volatility often lower than stocks and providing higher yields. Because of its stability, some companies and individuals like to invest in infrastructure funds.
Get defensive features such as funds involved in transportation or water infrastructure.

Future infrastructure

Architectural evolution theory under infrastructure

Iterations and mutants after death

Change species, mutant species, new building species.
This kind of "mutation species" that evolved from the thinking of architects and engineers, most of the infrastructure was originally designed and built by engineers for other purposes, but then it can be turned into an adult by the architect after being abandoned. .

Many infrastructures built by mankind, such as industrial production facilities, have come to an end with the changes in human lifestyles and the rise and fall of industrial structures. In the process of rebirth, new types of buildings have been created, and types of buildings that have not been used in the past.
In biology, life is not created, but time evolved.
But in the evolution of building types, this may really be created.
Bio-transmission of new genes to achieve new species, through the power of evolution through natural selection
And humans are re-using new species through building, through the power of creativity and design.

The specialization of the type of building, the relationship between function and appearance, is this thing inevitable? The inevitability of the appearance and function of the building
Because the reborn building is very different from the original function, not even the same kind.

Evolutionary preference

The success of the evolution of a species of cross-cutting species depends on the number of DNA copies of this species in the world. The basis of biological evolution is difference, not equality. Behind the birth of the individual is only the blind evolution process without any presupposition. The purpose of the evolution of the organism or the purpose of not having the sole purpose is that it is random at random, but the evolution of the building mostly has a specific purpose. This evolution is People's choices, of course, can't be natural choices. The basis for choice is the social needs of contemporary humans. The types of buildings that need the market demand for the ball market, and the new functions of iteration are all to meet the needs of the present.

生命周期快速的演化時間

重要的不是新的建築物種產生的原因 , 而是新的建築物種帶來的結果 , 基礎設施重生建築的演化繞過了生物基因演化 , 開啟了文化演化的快速道路 , 而不用再等待基因演化這條總是堵車的道路
基礎設施的命運從一出生就注定要毀滅 , 只是它們的結束大多早於其生命周期內 , 意即絕大多數都在它們壽終正寢前就停止使用了就淘汰，大部分基礎設施都不是因為使用時間太長或年久失修被淘汰。而那些不只一次重生成為一般建築使用的基礎設施，它們大多也都在生命周期結束前就進入了下一個時代。進步與改變的速度，通常比建築與基礎設施本身的生命周期還要快。這些歷經迭代後死亡而再次重生的基礎設施對照到建築本身 , 不禁讓我們延伸了這個問題

建築價值的永恆
在進步與改變的速度更快比
是否仍持續存在？
是否仍值得追求？

過去的教堂動輒蓋百年，今日的重點地標文化建築動輒蓋數十年 , 但人類之所以可以接受這麼長的工期，在信仰之外，這些建築百年千年長遠來看它們帶來的影響是長遠的，建築的價值是永恆的。

正在今日社會快速迭代的狀態下，我們還該忍受這麼長的工期嗎？如果遙遠的未來，基督教或天主教或任何宗教信仰有一天從地球上徹底消失的時候，那麼未來的人類不至於馬上催毀它們，卻也會開始動腦筋去對大部分的教堂做再利用。

如果建築的將來也如同這些基礎設施一樣會不斷地改變不斷重生，而且周期越來越短。那麼
既然它遲早會改變，又何必追求永恆？
既然能不追求永恆，又何苦忍受這麼長的工期？
是否簡單快速的工期，遠比抱負遠大的設計來得重要。

反正它們終將改變， 終將演化。

一場工程師與建築師的世紀接力

演化論的基本原理就是升殖成就最高只生存
基因的樣本數最多
目前看來住宅或是飯店這種住宿導向類型的重生案例相對來講是變最多的主導

隨然明顯有取樣不足的問題可是以對人類目前建築產業的了解世上這是非常好理解的

Fast evolution time of the life cycle

What is important is not the cause of the new building species, but the result of the new building species. The evolution of the infrastructure reborn building bypasses the evolution of biological genes, opening the fast path of cultural evolution without waiting for genetic evolution. The road is always a traffic jam

The fate of infrastructure is destined to be destroyed from birth, but their end is mostly before their life cycle, meaning that most of them are eliminated before they are used. Most of the infrastructure is not due to the use of time. Too long or lost in disrepair. And most of the infrastructure that was regenerated into general building use, they mostly entered the next era before the end of the life cycle. The speed of progress and change is usually faster than the life cycle of the building and the infrastructure itself. These infrastructures, which have died after iteration and are reborn again, are linked to the building itself, and we can' t help but extend this problem.

Eternal value of architecture
Faster than change and change faster
Does it still exist?
Is it still worth pursuing?

In the past, churches have been covered for centuries. Today's key landmark cultural buildings have been built for decades. But humans can accept such a long period of time. Beyond their beliefs, the impact of these buildings in the long run of a hundred years is long-term. The value of architecture is eternal.

In the state of rapid iteration of today's society, should we endure such a long period of time? If the distant future, Christianity or Catholicism or any religious belief disappears from the earth one day, then the future humans will not immediately destroy them, but they will also start to use most of the church to reuse.

If the future of the building is like this infrastructure, it will continue to change and regenerate, and the cycle will be shorter and shorter. Then
Since it will change sooner or later, why bother to pursue eternal?
Since you can not pursue eternal, why bother to endure such a long period of time?
Whether it is a simple and fast construction period is far more important than a design that is ambitious.

Anyway, they will eventually change and will eventually evolve.

A century relay between engineers and architects

The basic principle of evolution is that the highest survival rate only survives.
The largest number of samples
At present, it seems that the reincarnation case of residential or restaurant-oriented type of accommodation is relatively the most dominant.

Obviously, there is a clear problem of under-sampling, which is a very good understanding of the current human construction industry.