Build up circular city planning index with EAM

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Abstract. This study is aimed to build up a structure of circular city planning index with Essential Analysis Model (EAM). As countries around the world are engaged in finding solutions against increasingly exhausting resources and energies, the circular city is trending the metro development in future. This mandates a structure for index in circular city planning in future. To ensure the practice of the structure, it is to be based on circular economy and derived by "target oriented" essence logic. This study employs semi-structured exert interview to get professional inputs from more comprehensive population. A hierarchical structure of 18 major and 53 minor indexes is set up with the help of mind map software which may be referenced by government agencies, metro governance, urban and rural planning, and relevant competent authority in their circular city planning endeavor.

1. Introduction

Natural resources have been being consumed and wasted since the industrial revolution with the linear "Cradle to Grave" product design and production mechanism. This consumes and wastes natural resources and overburden the environment as resources of the planet is limited. The circular economy is aimed to exploit resources \cite{1}, and treat wastes as recyclable resources and meet the target of "zero wastes". The narrower concept of circular economy is to replace the linear economy model in the past to circular one in the future. That is, change the short-term circular model of reuse and renewal into long-term model of continuously recycling. The concept of generalized circular economy may spanning into regulation implementation, public infrastructure, geographical environment, industrial R&D capacity, supply chain and demand and supply balance. To achieve the long-term goal of sustainable development, it's necessary to contain the idea of urban planning and development in circular economy. This study is then set to build up a structure of circular city planning index.

2. Literature review

It benefits metro development by containing the idea of circular economy in a city's management policy. The "Cities in the circular economy: an initial exploration" survey by the Ellen MacArthur Foundation in 2017. It suggests that circular economy benefits a city's strategical targets in the dimension of: (1) reduced burden on city budget, (2) more disposable income, (3) incentive in transforming into an innovative urban economy, (4) reduced carbon emission, (5) better habitability of the city, (6) last but not the least of more employment opportunities \cite{2}. A lot of emerging states and cities follow suit of the Netherlands in the latter is circular economy policy implementation. "The role of municipal policy in the circular economy" report on 43 EU cities by Goldschmeding Foundation in 2019 found that interference on circular economy policies by municipal policies do lead to more...
investments and job opportunities. When migrating from traditional to circular economy (by containing circular economy in city governance) the Amsterdam City Government, the Netherlands defined the vision and action map of circular city. Encouraged to provide economic, social, and environmental benefits systematically, and anticipated to improve quality of life by making the most of the 7 principles of closed loop, reduced emissions, value generation, modular design, innovative business models, region-oriented reverse logistics, and natural systems upgradation [3]. In 2015, the Taoyuan City Policy research team has contained the vision of circular economy in its preliminary planning for the Taoyuan Aerotropolis by implementing the assessment system of sustainability index in 8 dimensions of community, economy, environment, governance, culture, science, technology and resources [4]. Aligning with the central government's policies, the Taoyuan City Government is the first city in Taiwan to avail its circular economy development strategy and proposal as well as the execution solution. The latter gives specific short-, medium-, and long-term implementation program with respect to regulations, industry, agriculture, shared economy, renewable energy, greenhouse gas reduction, industrial supply chain, and technological innovation. It also worked with relevant industries for the program's implementation and came up with valuable research outcome [5].

3. Research methods

3.1. Semi-structural expert interview
The semi-structural expert interview employed by this study is designed to dig into ideas and thoughts of questionees by combining conventional questionnaire with face-to-face interview. Differing from hierarchical questionnaire, this not only digs into ideas and thoughts of questionees but also suffices contents and scope of questionnaire. This is especially beneficial in case of setting up guidelines for policy or assessment system as it may lead the questionees professional presentation and focusing on research objectives.

3.2. Essential Analysis Model (EAM)
Essential Analysis Model (EAM) is an analysis mechanism integrated with "conclusion oriented" logical inference and designed to explore causes hidden behind surface of problems and potential variables. It was first used by Professor Chang to analyze the cross-strait integration and development direction of education and culture in terms of fundamental fusion issues with respect to education system, learning model, cultural background, and thinking in 2018 [6]. Another EAM based research on the essence of industrial circular economy in 2019 [7], concluded that current circular economy policies not only waste more but also overload the environment if we assess them exclusively in terms of economy factors, e.g. by reviewing the product's recycle-reuse process throughout its service life cycle based greenhouse gas only.

4. Establish a circular city planning index structure

4.1. The index hierarchy
The index hierarchy with Level "0" reserved for the sustaining development and another three tiers 1, 2, and 3 down below. Index in Level 1 is the summary of those in subindex which, in turn, tally up those in subsubindex. The hierarchical structure is the foundation for later inference and is designed to determine associations of index between tiers and assist in validating them.

4.2. Essence analysis
See Figure 1 for an environment dimension illustration of the hierarchy. The input to the material index model is set to "less resource exploit" (essence) and the output "recycle and reuse" (goal). Then check the material index in subindex and whether those in subsubindex can serve as effective planning index. Try to contain each and every items mandated by material index in Level 2 in the environment aspect.
4.3. The conclusion oriented index inference

Regarding the "conclusion oriented" logic index inference: infer each index as a subsystem while its counterparts in lower Level are independent from each. Index in Level 1 would be the summary of its counterparts in subindex and subsubindex. In Figure 2, we tried to illustrate how relevant operation items of the environment relevant material and source of material indexes are identified and how their inferences are ultimately targeted at fully recycle, reuse, and renewal.

Figure 2 Environment dimension material index inference

4.4. Build up structure of circular city index

With a series of analysis and review process of expert questionnaire, essence analysis, and conclusion oriented logic inference as shown in Figure 3. The operations covered by individual items are more aligned with the planning requirements of circular city while the ultimate goal of each index is aimed at zero waste and contained in the loop of recycle, reuse, and renewal. Aligned with the four dimensions including environment, economy, community, and governance of sustaining development,
this study has built up a structure of circular city planning index composed of 18 major and 53 minor ones.

5. Conclusion
A circular city is virtually a large system of circular loop. It mandates the future disposal of products right from the beginning of planning and design to ensure their back into the industrial and biological cycle as nutrient or the recycle and reuse cycle as material of another product. The essence of circular economy is to reduce the exploit and use of resources by building up a structure of index system to ensure its adherence to the initial essence direction of service life cycle. This, in turn, is used as the

Figure 3 Structure of circular city overall planning index
rule of initial input for index review with the goal to set individual components of the product recycled for reuse and renewal. The circular city planning is a task of total collaboration and integration. It is required to consider the feasibility of individual fundamental factors including environment, economy, community, and politics, at the same time to enable a circular city's sustaining growth. The more the planning scope is the more comprehensive collaboration and promotion can be implemented. This study has come up with a total structure for circular city planning index by interviewing experts for their professional ideas, repeated brainstorming, and deep thinking into the development direction and index of planning of circular city to meet phased or systematic requirements of circular city planning. The next step of the study if to fine tune the assessment operations and connect to relevant global specification to build up an assessment system for circular city to benchmark the total execution performance.

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