Influencing Factors in Production and Use of Recycle Concrete Aggregates (RCA) in Thailand

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ABSTRACT

The key to optimal waste management of construction materials is a big challenge in Thailand. The use of recycled materials and related initiatives will bring more efficient and effectiveness in the management of construction waste. This study aims to study critical factors influencing the industrial sectors in Thailand for the use of recycled concrete aggregates (RCA) especially with concrete manufacturers and concrete users; including analyzing key influencing factors which uses RCA in the industry. Based on the research data collected from various research sources and interviews with cement manufacturers, contractors, and project managers, the critical factors influencing the industrial sector in Thailand to consider manufacturing and using of RCA are (1) Quality, (2) Source of raw materials, (3) Governmental Support, (4) Law and regulations, (5) Standard, (6) Price and (7) Confidence and Acceptance. The result from the interviews showed that the concrete producers ranked raw material, law and regulations, government support and standard as high priority where the user of RCA focused on quality, standard and price in high-rank factors.

Keywords : Construction Waste, Recycled Concrete Aggregates, Key Factors, Use.

INTRODUCTION

As many cities in Thailand undergoing transformation and urbanization, old buildings are tore down to make way for more modern buildings to be constructed. This generates the concrete waste, which is one of the main components of the constructed building materials. The use of the concrete waste in Thailand is new and is not optimally recycled or managed. Some large construction projects such as industrial plants and warehouses contributed to one of the major environmental issues regarding construction wastes. Poor management of waste will cause the problem of degradation of natural resources and environment. In addition, the expansion of the housing construction market and new built-condominiums (to meet the needs of the single-family society in the present time), has resulted in an increasing need of construction materials. As a result, it is aware of the problem of scrap construction materials. Experimentally, it has been tested that concrete can be removed from the construction material to be crushed to a smaller size in accordance with standards, using the recycled concrete aggregate (RCA) in the mixture of

concrete replacing natural coarse aggregate (NCA) in the prescribed ratio. New concrete may be an alternative material for building new constructions. The use of aggregates from concrete is also useful in the environment. It helps reducing the destruction of nature and "saves the environment" more in Thailand. More and more concrete is used every year because natural materials are reduced or due to scarcity. Using RCA also reduces economic loss and is environmentally friendly towards building sustainable development for Thailand.

This study focused on wastes from construction, especially RCA, as a substitute for NCA for concrete mixing. The study covers concept, theory, and research findings and summarizes important factors affecting the industrial sector in Thailand for consideration in production of RCA and its commercial use. Data was collected from interviews with industry representatives related to the production and aggregate use in concrete industry, and analyzed by means of strengths, weaknesses, opportunities, and threats (SWOT) Analysis. It is expected to gather the issues related to factors influencing the industrial sector in Thailand, considering the production and use of RCA. The purpose of this study was to investigate the use of RCA to reduce the environmental problems of Thailand and help foster environmental integration and sustainability.

The study from the Pollution Control Department under the Ministry of Natural Resource and Environment (2004) described the approach of solid waste management from the construction and demolition of buildings. It was mentioned that the construction waste was a common problem in the community having rapid expansion. The buildings have been built to serve residential, business and industrial needs including expansion of infrastructure such as drainage roads and public transport systems. The solid wastes from construction were not properly managed, and will be disposed of in public places, empty space or pour into the river. Elements of solid waste from construction include bricks, stones, soils, sand, concrete, non-metal, steel, canned and paper and plastic. The waste management guidelines suggested the separation of the materials that could be reused before the separation of large and solid waste. The separation was used in the same process or used in other processes such as the removal of concrete beams, pile heads for extracting RCA. The separation process is used to reduce the amount of waste for recycling purpose that is beneficial and sustainable.

Karim & Marosszek (1999) studied the cause of the construction materials waste. Construction waste can be generated at all stages by identifying the cause of construction waste. It consisted of four key staged: design and documentation, procurement of construction materials, the process of storage of construction materials and construction procedures. The study found that most of the waste generated was from the construction procedures. However, there were other causes that produce waste in the construction procedures such as excessive material orders, inappropriate storage and handling of work materials, lack of knowledge and lack of commitment to manage the waste from construction. There are also research studies on the cause of construction waste by Faniran & Caban (1998) which identified the 12 main types: Modification, cut to pieces, material loss due to packaging, design or detail error, bad weather, inappropriate material handling, lack of control and planning, purchasing wrong materials, inappropriate storage of materials, work accident, unskilled workers, material destruction and

theft. It was found that the excess left from the actual usage of the concrete material was a major cause of construction waste. The average proportion of such waste after construction was 31.3% of the total scrap of the project according to the study of Oikonomou (2005).

Pichayapanya (2015), reported that the contractor or the person responsible for the construction or demolition project was required to perform the recycling process stage. However, the production of RCA required time and energy to transport the concrete waste to a manufacturing plant to get it produced. Therefore, the cost from waste separation and transportation cost are greatly increased. The contractor does not wish to waste time separating the rubbish from the construction. To produce the aggregate production of RCA, the used concrete is required to be separated from the other construction wastes. The other construction wastes when used in concrete can resulted in the reduction of concrete performance significantly (Prasittisopin et al. 2017). The mixing with other debris caused by the construction or demolition of buildings, such as glass chips, wood chips, plastic debris, resulted in time wastage. Most contractors did not carried out this separation process and most of them contacted the removal vendors to manage the waste. Thereafter, most of the wastes from construction are relocated to empty lands.

This study aims to study critical factors influencing the industrial sectors in Thailand for the use of RCA, especially dealing with concrete manufacturers and concrete users. This also includes analyzing key influencing factors which uses RCA in the industry. It is found that the critical factors influencing the industrial sector in Thailand to consider manufacturing and using of RCA are (1) Quality, (2) Source of raw materials, (3) Governmental Support, (4) Law and regulations, (5) Standard, (6) Price and (7) Confidence and Acceptance. The contribution of this study may support the policy maker and related stakeholders to overcome the concerns of manufacturing, used of RCA and to support the use of such recycled materials for the country's sustainability in construction industry.

MATERIALS AND METHODS

The study covered concept, theory, research findings and summarized important factors affecting the industrial sector in Thailand for consideration in production of RCA and its commercial use. Data were collected from interviews with 3 industry representatives related to the production and aggregate use in concrete industry having experiences in the field between 4-20 years as defined here as "producer" and the interviews 6 representatives who are experienced project managers, project advisors, marketing managers, and architects, as defined here as "user." All data are then analyzed by means of SWOT analysis. It is expected to gather the issues related to factors influencing the industrial sector in Thailand, considering the production and use of RCA.

RESULTS

By compiling the main factors that affect the decision to produce and use the aggregate of commercial recycled concrete. The below factors were derived from interviews with representatives of two concrete companies which are top 2 concrete producers having total market share of 70% of Thailand domestic market and who have the potential to produce RCA in Thailand and representatives of the companies, consultants/advisors, architects in Thailand. The ranking of the factors from interviews with representatives of concrete manufacturers and matrix analysis is shown in Table 1 and 2, respectively. The ranking of the factors from with project managers, project advisors, marketing managers, and architects and matrix analysis is shown in Table 3 and 4, respectively. Results indicate the difference between the rankings of the factors from each representative group.

Table 1 Ranking of the factors from interviews with representatives of concrete manufacturers in Thailand

(The first is the most important and the seventh is the least), and the weight percentage of each factor.

Factor	Manufacturer 1	Manufacturer 2
Quality	No. 6 (5%)	No. 5 (10%)
Raw material	No. 3 (20%)	No. 1 (30%)
Governmental support	No. 1 (23%)	No. 4 (12%)
Law and Regulations	No. 2 (22%)	No. 2 (22%)
Standard	No. 4 (15%)	No. 3 (17%)
Price	No. 5 (10%)	No. 7 (3%)
Confidence and acceptance	No.7 (0%)	No. 6 (6%)

Table 2 Matrix analysis showing priority of each factor resulting from Table 1 (using weight average ranked by 2 manufactures).

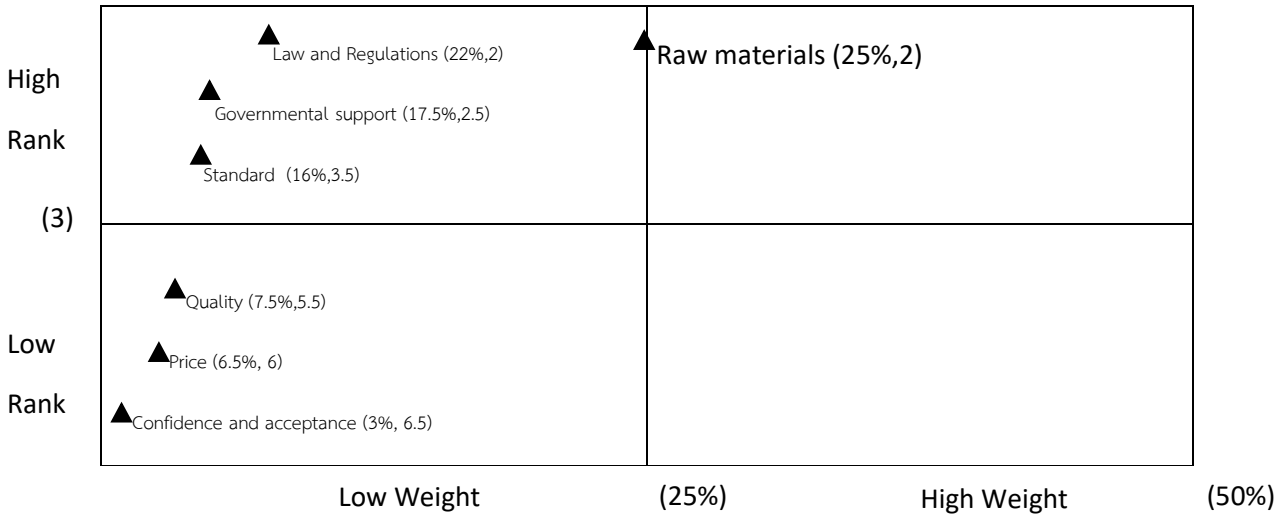
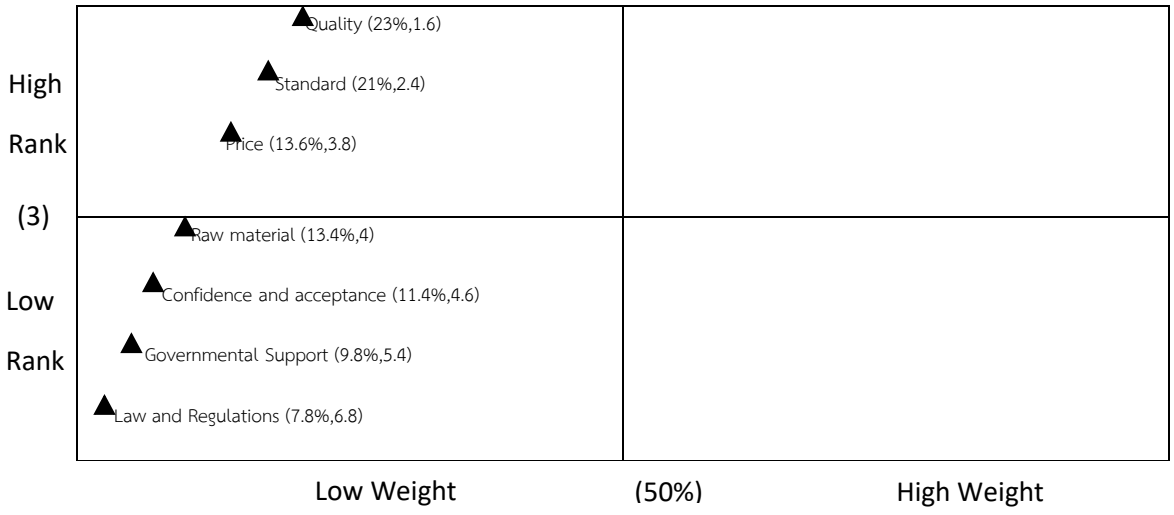


Table 3 Ranking of the factors from interviews with project managers, project advisors, marketing managers, and architects in Thailand (The first is the most important and the seventh is the least), and the weight percentage of each factor.

Factor	Condominium Project Manager (for Concrete or Lean Concrete)	Project Manager (Used for structural work)	Project Advisor (Overall use)	Marketing manager of a construction company (Overall use)	Architect (Overall use)
Quality	No. 3 (15%)	No. 1 (30%)	No. 2 (20%)	No. 1 (25%)	No. 1 (25%)
Raw material	No. 6 (10%)	No. 3 (20%)	No. 3 (15%)	No. 4 (10%)	No. 4 (12%)
Governmental support	No. 2 (20%)	No. 6 (6%)	No. 7 (3%)	No. 6 (10%)	No. 6 (10%)
Law and Regulations	No. 7 (5%)	No. 7 (5%)	No. 6 (4%)	No. 7 (10%)	No. 7 (15%)
Standard	No. 4 (10%)	No. 2 (20%)	No. 1 (40%)	No. 3 (15%)	No. 2 (20%)
Price	No. 1 (30%)	No. 4 (10%)	No. 5 (6%)	No. 5 (10%)	No. 5 (12%)
Confidence and acceptance	No. 5 (10%)	No. 5 (9%)	No. 4 (12%)	No. 2 (20%)	No. 7 (6%)

Table 4 Matrix analysis showing priority of each factor resulting from Table 3 (using weight average ranked by 5 users).



The essential factors (quality, material source, government support, legal, standard, price as well as confidence and acceptance) that affect manufacture and usage of RCA can be analyzed and classified as SWOT analysis as shown in Tables 5 to 11, respectively.

1. **Quality factor**

According to the interview, it was found that the concrete manufacturers ranked the quality factor between No. 5 and No.6. One manufacture believed that if the manufacture can control the quality by proving that RCA can be used without compromising whether in the short or long

term, the quality should not be the key factor. Both pointed out the same comments that if the government supported on research and production of RCA (e.g. providing research funds to research institutes or universities to publishing the usefulness of RCA, providing tax incentives etc.), the quality would not be the concern. The manufacturer's ability to maintain production standards was controlled and the production of such products was subject to acceptable quality standards. In addition, the production of recycled aggregates was higher than the standard, depending on the technology used in the production, which was not as difficult as the acquisition of raw materials with separate screenings. Quality control of concrete aggregates according to standard ranked top priority for the users. Most of the project managers or contractors preferred to select standardized-quality concretes because of the structural effect and warranty. Unless RCA used for some types of work have no effect on the structure, such as lean concrete, the quality of concerned was not the main factor. This was because of non-structural work which did not have an effect on the overall project quality and warranty. Even though the quality of the material was not standardized, it did not affect the project. In this particular case, the users valued the price factor as of utmost important as it reduced the cost of the project (if the material was cheaper). For large projects or complex construction, they needed to promote high-quality structural or material used to ensure structural integrity and quality. Claims for damages or guarantee against the structural quality will impact the value of the construction greatly.

Table 5 SWOT analysis of quality factor.

Weaknesses Due to its high water-absorption characteristics of RCA, concrete is considered as a low-quality aggregate, comparing to that of NCA in the views of producers,. The fact that its hardened characteristic is lower than the NCA results in a reduction of strengths. When mixing recycled concrete, it is likely to render the poorer quality than that added with NCA.	Strengths Both producers and users believed that the quality of aggregates plays an important role on concrete fresh properties, hardened characteristics and durablility. Proper aggregates should not interact with cement components as this might cause impacts on stability of concrete amount. Also, additives deleterious to cement paste’s strength and stability are strictly prohibited. If the manufacturers add recycled concrete to the aggregates and accomplish to elevate its quality to be comparative to that of natural decay, they might get a possible substitution.
Threats/Risks It is true that we still lack of ability to anticipate its quality and chances to product and structure deterioration owing to several attributes, including physical, chemical and quality properties of this material in the views of users.	Opportunities In the views of producers, the opportunity to apply RCA instead of NCA is promising in case of development of the concrete recycling to be as potential as NCA since recycling likely requires lower production cost.

As for the weaknesses, the RCA cannot prevail NCA in terms of quality. The manufacturers need to understand usage problems and obstacles related to concrete recycling in order to effectively employ this aggregate and avoid associated problems. Moreover, raw materials used to produce RCA contribute to unstability of the products. Also, if manufacturers who RCA are in small-scale production and their production potential tend to be unsteady, this may cause an occasional flawed production. When the entrepreneurs and engineers do not meet quality expectation of clients when it comes to construction, they risk being sued. The manufacturers, the entrepreneurs and the engineers, therefore, choose the NCA over the RCA despite the higher costs to diminish lawsuit fines.

With regards to strengths and opportunities, the recycled concrete may gain a huge interest as a potential substitute for NCA if the manufacturers are capable of developing it to be eligible. Even if it might not be as qualified as NCA, it can be compensated by its significantly lower production cost. Still, its quality is sufficient for reclamation, land levelling, temporary road extension and subbase for roads and so on. However, with lower cost benefit, RCA should be resorted to escalate its quality to be as potential as NCA to stimulate commercial usages.

2. **Material source factor**

The raw material factor is one of the primary factors for the manufacturer of RCA. From the interviews with the concrete manufacturers, it was found that the raw material factor was one of the essential factors and ranked as top priority. The first priority is the management of solid waste from buildings. Large solid waste and solid materials such as concrete and pile waste should be separated from other types of wastes so that the materials can be recycled with better efficiency. Acquiring qualified waste materials from the separation method/s with sufficient quantities will result in the production of RCA. However, two out of five users said that it was important to review the raw materials (specification), which affects the quality to assure the use as well.

Table 6 SWOT analysis of material source.

Weaknesses The producers explained that separating concrete fractures from other wastes after construction or destruction is a time-consuming process. The manufacturers find it barely possible not to get other wastes such as glass, wood and plastic. Furthermore, laboring and area usage for the process are not cost-effective enough when compared with the values of the material sources	Strengths In the views of producers, producing the recycled concrete from the construction and destruction positively fosters publicity and raises sustainable organization image. By doing so, the organizations are considered responsible for communities. Still, to achieve this plan, governmental supports and recycling law enforcement are required.
Threats/Risks In the views of producers, various struggles are found for concrete extraction from construction and destruction such as cost, transportation or storage inconveniences as well as lack of motivation to separate the material.	Opportunities According to the interview with the producers, it was recommended to develop guidelines associated with the whole waste-handling procedures, ranging from sources to raw material achievements in order to further recycling.

To bolster material source management, it is advised to spare central areas for storage. Public sector should also establish recycling centers which covers waste-separation processes. These centers should be accessible at all towns and cities, especially those which contain large numbers of construction wastes. This accounts for an opportune solution of transportation for construction organizations. Increasing publicity exposure to stakeholders should also be done to promote uses and efficiency of these centers. Alternatively, public may render the privatization scheme for these centers or promote cooperation between concrete manufacturers and construction organizations as well as cooperation between public and private sectors. This action should be accomplished by specific plans and goals to reach the full capacity of waste transformation while being responsible for the society.

3. **Governmental support factor**

Based on the interviews with concrete manufacturer representatives, governmental support was the major factor among all of seven factors that RCA manufacturers had prioritized. Manufacturers wished that the government will efficiently promote and encourage the use of RCA. However, the users did not give priority to governmental support as an important factor due to lack of confidence and benefit impact. At present, many users mostly rely on their own business decision rather than receiving governmental support because the latter was not forthcoming and efficient.

Table 7 SWOT analysis of governmental support factor.

Weaknesses Both producers and users suggested that publicity push has not been done sufficiently. Not only did the government analyze the real problem causes, but it also lack of integration in dealing with difficulties and supports. Rather, the government tended to separately solve problems such as the establishment of factories handling waste from construction.	Strengths In the views of producers, integrated supports of public section directly led to commercial encouragement and stimulation for sustainable RCA production. This showed why government should aim at planning for factor effects on RCA manufacture. In an integrated way, the government should foster usage of recycled materials, including recycled concrete.
Threats/Risks The government has never nationally issued recycling policy in the views of producers and users. It has neither database of benefits along with their deep impacts nor manpower to study this information. There seems to be numerous offices and bureaus involved in the policy while catering for different objectives. As a result, policies or actions are not relevant and fail to resolve problems to full capacity.	Opportunities Both producers and users observed that if the government establishes the effective database to identify benefits and effects, it can attain law enforcement and adopt policies to promote recycled material usage as expected. This also reduced undesirable effects on RCA producers, transporters and users including those who create wastes for recycling. It can turn out sustainable and integrated.

Government should study the advantages and their deep effects to provide opportune supports and issue policy in terms of national economy, business trend and growth, problems, obstacles and requirements of every sector in the value chain. It is beneficial for the government to promote and enforce policies to meet expectations of all stakeholders, especially to foster recycled material production and usage in an integrated way. Campaigning for employing recycled materials to obtain tax reduction (tax policy mechanism) represents a possible example.

4. **Legal factor**

According to an interview with a concrete producer, priority was also given to the legal factor. It is the second major factor that manufacturers of RCA pay attention to; in contrary, the users ranked it as second last priority.

Table 8 SWOT analysis of legal factor.

Weaknesses In the views of users, small construction companies or contractors may not acknowledge law or regulation details concerning material separation and storage. Actually, there are several related acts but most of them do not indicate sufficient or precise information. For instance, the Department of Public Works and Town & Country Planning legalized an act to restrict the trading area for recycled material in suburb without regarding higher costs for transportation.	Strengths From the producers' perspectives, in case of integrated legitimation in both supportive and enforcing ways, this will raise awareness of harmful effects of construction waste dispersal, thereby, stimulating recycled material usage.
Threats/Risks The producers observed that there is no official national policy to exert recycled materials. The current supportive measurements fail to guide with integration or to lead to concise and effective solutions, missing full advantages. Another point is that the government does not concentrate on publicity push. Also, it lacks proper enforcement and manpower to monitor afterwards. This ends up by citizens failing to potentially observe the law.	Opportunities In the views of producers, with integrated legitimation in both supportive and enforcing ways, the government will attain awareness raising of harmful effects of construction waste dispersal, thereby, persuading recycled material usage.

The law and regulations that should be adjusted to promote recycled material usage, the government should issue national policies to enhance opportunities of recycled material usage. Public sector should represent the leader of this trend by budgeting for and purchasing these environmentally friendly materials. This should be added in the Regulations of the Office of the Prime Minister on Procurement B.E.2535, additional amendments (2) B.E.2538, (3) B.E. 2539 and (4) B.E.2541.

5. **Standard factor**

Table 9 SWOT analysis of standard factor.

Weaknesses Currently, both producers and users believed that Thailand does not have any reliable standards or regulations related to RCA, especially from Thai Industrial Standard (TIS). As a result, both users and manufacturers lack confidence in commercially exerting recycled concrete as they lack suitable guidelines.	Strengths In the views of producers, standards can be used as guidelines for the manufacturers and users and can be applied according to engineering aspects.
Threats/Risks The producers recommended that to adopt new standards, cooperation of public and private sectors is necessary. Both sectors need to study the related research and comparison procedures which can be time-consuming.	Opportunities In the views of producers and users, the new issued TIS standard would be good starting point for the user to rely on RCA.

It is suggestible to adapt the international regulations and standards concerning RCA reapplication. Some countries classified these recycled and reused materials as standardized materials, increasing motivation and confidence of entrepreneurs in these materials. Most regulations and standards in Thailand excessively depend on physical attributes of aggregates or materials rather than their main attributes. General regulations are developed from long-term surveys of natural materials. These natural materials' stable quality is documented; by consequence; the regulations turns out to be immensely instant, lacking sound adaptation to recycled materials. To illustrate, the regulations may not indicate the required amount of aggregates. Only a small number of regulations allow adaptation to products or task types. When applying the recycled materials to tasks for natural materials, users tend to expect the similar qualities to those of natural materials. Even though the RCA meet standards and regulations, there are some differences between the two types. Users may feel suspicious to apply them although the differences do not affect the task qualities. To conclude, identifying the RCA as standardized and issuing the regulations may successfully encourage the application.

6. **Price factor.**

Table 10 SWOT analysis of price factor.

Weaknesses In the views of users, price does not account for a primary factor for RCA usage owing to very little confidence in using the material to add more value to the essential work such as construction.	Strengths From producers' perspectives, if the cost of RCA sources and production can be controlled, the significant lower price of the aggregates may subjugate that of natural materials. Even for work requiring low quality such as reclamation or road construction, these waste materials' prices are still more comparative than those of natural materials.

Threats/Risks The producers suggested that construction material separation is possible but the cost for the processes can be expensive. The processes demand massive laboring and time. Also, the quality of the RCA is still low while construction materials are sold at low rates. If the buyers do not benefit from the considerable price gaps or earn confidence in the quality, the commercial trade of these recycled materials may not be attainable.	Opportunities In the views of producers and users, to continue using RCA, natural resources can be significantly exploited. This will lead to future shortage of construction materials, demand-supply imbalance as well as price increase. With potential to produced RCA with equal or higher qualities at lower prices, recycled concrete usage will be more common.

Whether application of RCA will be successful or not depends on market incentives. The main factors of market incentives represent prices and costs of construction waste handling and transportation. These factors impact the decision to locate the grinding and recycling factories. They also affect the further investment interests when comparing with transportation costs. The RCA are of lower quality but the prominent margin price gap can help the construction companies earn massive profit. They, therefore, do not target the quality development; instead they sell at lower prices than those of NCA to convince the purchasers to buy the recycled materials. Quality development of the RCA would help maintain the prices; however, it can be difficult as it means additional costs (Ismail and Ramli, 2013; Prasittisopin et al., 2017). This, therefore, dwindles the profit margin and raises the breakeven point for the manufacturers. When they cannot adjust the selling prices, they might not be prevailed by the idea to develop the RCA's qualities. For entrepreneurs, pricing is also affected by types of work. Applying the RCA to construction work other than road building does not significantly benefit from prices.

7. Confidence and acceptance factor

Table 11 SWOT analysis of confidence and acceptance factor.

Weaknesses From producers' point of views, technically, recycling of construction wastes relies on approval and confidence in the construction wastes themselves for specific objectives. The confidence and approval can be earned through qualifications of regulations and standards. Without official regulations or standards, users may hesitate to apply the materials. Currently there are no reliable regulations or standards for recycled concrete.	Strengths Both producers and users believed that as a way to decrease construction cost, recycled concrete gradually gains popularity for low quality work, namely reclamation and subbase.
Threats/Risks In the views of producers and users, the most common method of natural material usage is to obtain the materials from the same source since anticipation and control of the quality are possible while controlling and	Opportunities Both producers and users suggested that establishing reliable government-issued standards of concrete made from RCA to control the usage quality is suggestible, as well as researches and development

expecting quality of the RCA can be more struggling. This considerably renders adverse impacts on confidence and approval of the wastes for construction work, especially for that of large scale, requires strict quality control. Showing safety responsibilities paves the way to positive images of the construction organizations.	of its quality to tackle more complicated work such as structuring work. Besides, governmental encouragement for RCA application might bring about confidence of engineers and entrepreneurs.

Chances to recycling the construction wastes depend on their approvals project-by-project. Similarly, industrial products to be approved of for particular objectives massively rely on their qualifications that reach standards for these objectives. If the construction wastes' qualities fluctuate depending on their sources, the RCA will be still confined for reclamation, temporary road extension and subbase for low traffic roads, unlike the NCA. Most construction organizations use materials from the same sources because this facilitates property expectation and quality control. RCA are not stigmatized with optimistic images, causing difficulties to be approved of or qualified as high quality materials. Consequently, they are aimed at low quality construction. Users are likely to be suspicious of these materials despite learning about possibilities to develop them.

CONCLUSIONS AND DISCUSSION

According to studies, manufacturing concrete products from RCA raises private sector's interests in utilizing them. This is called 'Value Added' product which is vastly applied in European and American countries. It intensifies motivation to manage deconstruction wastes as well. However, it is noted that private companies in these countries acquire integrated supports from their governments since these complete procedures are costly in terms of investment. Establishing waste-handling centers along with research and development, guidelines to diminish construction wastes, waste source reduction, recycling and industrial production is beneficial for completely economic and environmental waste-handling.

Apart from that, discipline rules related to recycling supports and construction waste delivery are essential for construction projects. Punishment and rewarding schemes should be set up to promote waste recycling and usage. There should also be the waste handling plan that suggests details, types and amounts of the wastes as well as separation, recycle methods as standards and guidelines for companies. Supportive ways should be carried out by the appropriate technology and machine development to intensify construction waste handling and recycled material usage. It is also suggestible to increase exposure of information and effects on environments to both executives and employees to raise awareness of these consequences and benefits of waste recycling and re-usage.

Remarks

1. There are no dependable guidelines or discipline rules for waste separation. (Neither for planning, design, construction nor deconstruction.) Re-usage, recycling, transportation and elimination guidelines are not at hand.
2. The construction work for RCA is restricted to reclamation.

3. Associated laws do not efficiently facilitate construction and deconstruction waste management.
4. Collaboration and cooperation among public sector, private sector and professional associations to develop waste reapplication are still limited. (Especially for approved quality materials for more advanced work than reclamation.)
5. The users' typical attitude towards these materials represents the RCA, obstructing positive recognition of their quality.

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