

ATTRIBUTING VALUE TO WASTE: THE DIFFICULT ROAD TO EFFICIENT WASTE MANAGEMENT FOR RENOVATION PROJECTS

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The focus on sustainability has pressed the construction sector to process and optimise Construction and Demolition Waste (CDW) activities. The potential of collecting and recycling of waste has received a considerable amount of attention. The life cycle of various products and material is well documented and many models are aiming at optimizing the supply chain and logistic processes. The processes of new built seem to be under control in the Swedish context, but the handling of renovation and demolition waste, traditionally considered as low value work, is still lacking behind. Moreover, the different actors included in this process tend to attribute the responsibility of this situation to each other. In this context, we are interested in how the actors value waste in the different phases of a renovation project. To do so, we build on the concept of value as defined by the sociology of economics, which enables us to appreciate the creation of value as the result of direct interactions in delivery activities and analyze these processes as socially shaped and consequently open to possible changes. We focus on the case study of a renovation project to illustrate the various interpretations and translations of value. We gathered observations on site and interviews with the actors involved: client, architect, contractor, sub-contractors, workers on-site and future users. The preliminary results point at a diversity of understanding and practices of what value is for the different actors, sometimes even contradicting each other, which may jeopardize the expected results for CDW management. The concept of value helps us to analyze the shaping of these practices and consequently may contribute to the improvement of the CDW processes.

Keywords: actors, construction and demolition waste management, value

INTRODUCTION

The European Commission indicated construction and demolition waste as one of the voluminous waste streams; statistically, it accounts for about 25% - 30% of all generated waste streams in the European Union (EuroCommission 2016). This waste consists of concrete, bricks, gypsum, wood, glass, metals, plastics, solvents, asbestos and excavated soil that are considered to have a residual value that can be recycled (EuroCommission 2016). The European commission has indicated that there is a re-use market for aggregates derived from construction waste in roads, drainage and in other construction projects. Moreover, waste management technologies developed and established for sorting and recovery of materials should ease the process

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(EuroCommission 2016). Accordingly, waste could either be avoided to a large extent or reduced, which should produce benefits for construction industries and ensure a green environment.

Despite the established model for waste management i.e., reducing, reusing, recycling, and residual disposal (4Rs) within the construction sector (Peng *et al.*, 1997), most of the construction companies have been slow to embrace these practices. Waste reduction activities have traditionally not been considered as cost-effective, efficient and compatible with core construction activities (Teo and Loosemore 2001). Although Sweden is one of the leading nations in terms of sustainability and environmental consciousness, waste management does not yet reach the expected recycling target (Hall and Nguyen 2012). However, considering the large amount of buildings in need of renovation, waste management is critical to the sector and has the potential to become a new business (Bosch-Sijtsema and Buser 2017, Hall and Nguyen 2012, EuroCommission 2016).

To address the challenges of Construction and Demolition Waste Management, (CDWM) our literature review reveals a large production focusing on measuring waste generation through simulations, live cycle analysis, and mathematical models, or on the sorting of singular material (Bosch-Sijtsema and Buser 2017, Yuan 2013). The majority of the papers in this area focus on new-build and the specificities of renovation or refurbishment are generally not addressed. Renovation waste management follows a different process than new build and is less regulated. The material is often composite, its quality complicated to assess and consequently difficult to reuse or recycle. To increase CDWM performance on site, authors recommend to invest in CDW planning and management tools, organize adequate supervision of waste management activities, deliver clear company policies, provide training and education for all stakeholders, support with financial rewards and incentives, engage the participation of all stakeholders in taking initiatives and responsibility and optimize the supply chain and its connection. Whereas the contractor role is central in this discussion (Alzahrani and Emsley 2013), other stakeholders such as sub-contractors and recycling companies active in reusing, recycling or disposing of renovation waste, take an increasing role in developing new practices related to CDW management in the industry and creating new business value (Adams *et al.*, 2017).

Although, there is a general agreement in both the literature and among practitioners about the potential value of CDW, the notion of value itself seems to be taken for granted. However, previous work indicates that the value the stakeholders assign to waste is not univocal and covers different meanings and interests (Buser and Bosch-Sijtsema, 2017, Bosch-Sijtsema and Buser 2017). So, in order to discuss some of the challenges of renovation waste management and inform on the lack of generalised processes, we build here on the notion of value or more precisely on the act of valuation. Valuation can be defined as: any social practice where the value or values of something is established, assessed, negotiated, provoked, maintained, constructed and or contested (Doganova *et al.*, 2014); it gathers the practices which structure markets through categorizing, ordering and hierarchizing goods enabling consumers and others to make decisions (Kornberger 2017). The paper contributes to the understanding of waste management, by underlying that the valuation of renovation waste covers a number of different and sometimes conflicting practices and outcomes.

Theoretical Frame

A large part of literature in economics assumes that value is either inherent to the property of object or service and accordingly can be measured in terms of profit (Kotler and Armstrong 1997, Lanning 2003), or that it is the result of subjective preferences representing particular value interpretations and interests of specific groups (Grönroos 2000, Miles 2005). Applied to the case of renovation and demolition waste, the value would either be the price calculated in reference to type, quality and weight of the material, or the results of the interest and mitigation of the professional actors of the sectors debating the market.

Another view, building on economic sociology and valuation studies (Callon 1998, 2007, Muniesa *et al.*, 2007), aims at conceptualising value as the association of ongoing valuation practices. Valuation practices are participating to the construction of markets, defined as an arrangement of heterogeneous elements such as rules, and regulations, technical and calculative devices, discourse and material infrastructure (Doganova and Karnøe 2015). These devices appear as critical elements in the valuation process as they stabilize and visualise the product's qualities. But they do not erase uncertainty, rather they highlight the existence of differences in valuation practices (Callon *et al.*, 2007). Orlikowski and Scott (2014) suggest that the shift from actors and categories to practices contributes to a more dynamic and broader understanding of the valuation process. This shift to a practice-based view brings attention to "the specific everyday activities that constitute valuation processes and the outcomes generated as a result" (Orlikowski and Scott 2014, p. 869).

For waste, it means to study the valuation practices that constitute waste as valuable in the first place (Heuts and Mol 2013). This includes the practices of evaluating and ordering material with measurements, norms, standards, indexes, classification, rankings or prices; of mediating between producers, clients, administration and experts, between competing claims, assessments and legitimations, between professional and academic knowledge, between industry guideline and behaviour on site, between theoretical properties of waste material and its properties on site. It contains as well the struggles over competing claims in regards to the legitimacy of different valuation practices, devices and criteria and the categorisations of what is valuable (Kornberger 2017). These practices are seen as constitutive, they do not only mirror existing value but are actively involved in the construction of values (Kornberger 2017). Besides, they are not mere abstraction, but are organised through concrete bases such as material, concrete technologies and visualisation that enable and amplify their actions (Feldman and Orlikowski 2011). This valuation perspective has been used in contexts as diverse as the wine industry (Bessy and Chauvin 2001), law school ranking (Espeland and Sauder 2016) online hotel assessment (Orlikowski and Scott 2014), or cleantech technology (Doganova and Karnøe 2015).

Building on these insights, we explore the constitution of waste value by focusing on the practices and devices involved in the valuation process of a group of stakeholders engaged in the management of renovation waste in a Swedish big city.

METHOD

The present article reports the preliminary findings of an ongoing three years' interdisciplinary research project gathering both practitioners and academics active in CDWM in Sweden. The project focuses on gaining an overall picture of the CDW industry, their practices as well as how they develop new innovations in both material

and processes. The method is multidisciplinary and employs an interpretive approach to discuss the empirical material (Bryman and Bell 2011). The theoretical frame draws on a selective literature review focusing on valuation as well as a literature review on the CDW management in construction. The objective is to develop an appreciation and articulate the dynamics of practices and describe how waste valuations, their boundaries, properties and identities, are performed. We aim at identifying these valuations by focusing on the different actors' accounts and practices (Cecez-Kecmanovic *et al.*, 2015).

To do so, in the joint project platform, we have participated in and observed three general meetings and three workshops organised by the research project discussing the potentials, challenges and barriers of CDWM (see table 1 below). The workshop consisted of a selection of representatives of the CDWM industry and focussed on small group discussions based on a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) of recycling of construction waste.

Next to the joint project platform, we interviewed a group of representatives of diverse companies and services and administration engaged in construction renovation. The list of interviewees is presented in table 1 and consists of representatives participating in renovation waste management and contributing to the valuation practices of waste. We followed their concrete considerations, choices and actions handling waste management from design to recycling, burning or landfilling. The 27 interviewees are listed below; the majority of the interviews were recorded and transcribed (see table 1).

Table 1: list of the people involved in the data collection

	Interviews	Workshop
Contractors (project managers, site manager, production manager, sustainability coordinator)	10	2
Subcontractor	1	
Demolition contractor	1	
Recycling contractor/firm	6	1
Architect	1	1
Suppliers		2
Municipality (Gothenburg)	4	3
Industry representatives (associations etc)	1	1
Clients/FM	3	1
Researchers		9
Total	27	20

We followed a single renovation case study and visited the site in different phases of the project, performed observations on the site and interviewed the site manager, production manager, FM firm, and sub-contractor. These events were documented with notes and pictures and some discussions were also recorded.

Besides, we have gathered numerous written documents including professional guidelines, norms and certifications, companies' websites, renovation projects and quality control protocols, waste material descriptions, price lists and price calculations, and national and European governmental reports. As this study is

exploratory, we have followed a rather iterative process. The material has been organised and analysed according to the emerging themes related to value and valuation.

VALUATION PRACTICES OF WASTE

The following description presents the valuation practices of a group of stakeholders participating to a renovation project including waste management in one of the largest cities in Sweden.

Valuation Practice at the Property Company

The FM-firm is a mid-sized property company which is running university and office buildings. The main task of the property company is facility management and accordingly they renovate their facilities on an almost continuous base. They flag sustainability as their main competence and use environmental certification to frame the scope of their renovation. Though they let the contractor deal with the organisation of the site and the management of waste during the renovation project, the FM-firm is eager to set clear requirements for handling and recycling of waste during their projects. They wish to have reliable statistics on the treatment of their waste once it has left the building site. As it stands now, the contractor is only obliged to act as much as possible according to sustainable practices. The only information the FM-firm possesses currently, is the quantity of the waste either in kilos or number of dumpsters. Dumpsters are related to the quality in term of material: electric, plastic, metal, tree, gypsum, and "burnable" which gathers everything not fitting with the previous descriptions or is smaller than one-meter. The FM-firm would like to test out how to set up more precise requirements and how to follow up on these with their main contractor to be sure that the waste produced by their sites is treated in the "most sustainable" way. However, the two project managers we have talked to, with no background in construction depend very much on the contractors' expertise regarding the quantity and quality of the building material and waste. Besides, the FM-firm has developed an app for the recycling of equipment and material collected on site. It allows to manage objects such as doors and lamps stored to be reused in future projects. So far, the app has received positive attention but no piece of equipment has yet been reclaimed. The FM-firm's interest in waste is motivated by the sustainable branding of the company. It presents itself as the one "developing sustainable environment" and would like to demonstrate that they do the "right thing".

Valuation Practices at the Contractor's Office

For the large contractor responsible of the project, the design phase of renovation, waste seems to be more a cost than a value. The handling of waste is calculated in terms of work-load and workforces that are needed to dismantle and clean the premises before the proper renovation can start. These calculations follow standards developed in-house, according to the type of buildings and period of construction and follow the legal demand (an audit for hazardous material is necessary). The size of the expected waste is estimated and the cost of transport, handling (sorting on site or not) and taxes are calculated accordingly. In some occasion, when space is scarce on site, the planning also requires precise transport logistic. The contractor works according its own internal CDWM policies and goals. The waste is not attributed to a financial value, but its management serves the purpose of attaining the company's sustainable goals and contributes to improving their reputation and brand as a green and sustainable contractor. It also helps fulfilling the environmental criteria for green

certification. The valuation practices are performed by specifically assigned roles that intermediate between the practices on the construction site, developments in the market and the strategy of the contractor's office.

Valuation practices at the contractor building site

The site manager is in charge of organising the cleaning of the site and handling of waste. The contractor is responsible for the logistics on site as well as the health and safety. In our case a small demolition company has been sub-contracted to carry out the demolition work and deal with the demolition waste material according to the contract agreed with the FM-firm. For demolition, three dumpsters were placed on site (gypsum, metal and burnable); the electric components are collected by the electricians who are recycling the material on their own. The handling of windows containing asbestos is organised separately by the subcontractor. As the work progresses, the first floors are stripped and the rebuilding can start, so the demolition and construction workers are active in parallel. The stripping of the building has revealed unexpected material and construction which have been added during earlier renovation. The suspicion of asbestos in a plastic flooring which needs to be sanded down is for example stopping the work for several days on one floor. The planning on site is updated on a daily base. At the time of our first visit, the work is behind schedule by three or four days, which the site manager is keen on catching up. Dismantling quicker, means less attention given to the sorting of material. However, the small difference of prices between the costs of delivering mixed or sorted waste to the recycling central does not justify a further delay on site. So, the quality of the waste sorting seems to depend on other criteria than the quality and efficiency of the recycling loop. During our second visit, the site is now three months behind schedule due to the discovery of mould in the roof. A large part of its structure needs to be dismantled and a new demolition contractor is brought in. The waste is not sorted anymore, all the material taken out ends up in the same dumpster as there is no time for sorting waste. The project is too late and over budget and waste sorting is deprioritized. The project manager has the possibility to ask for more labour, but this would need to be paid by the client.

Valuation practices at the demolition company

Demolition contractors are hired for the demolition work by the main contractor and the main contractor is legally responsible for the CDWM. The contract is based on the work to be carried according to the age and type of buildings as well as the scope of the renovation. However, the demolition contractors plan their own work, hire their own team and take care of the waste in their own way with their own companies supporting further waste sorting. However, well trained to sorting waste, the employees recognise that a large amount of waste is ending in the "burnable" dumpster. The demolition company is the one selling waste to other recycling companies and therefore attributing a concrete financial value to the material. The quantity and price are not necessarily negotiated for each project, waste can be collected from different building sites before being collectively transported to the recycling central, where there are weighed at their arrival.

Besides, the valuation for demolition companies is reputation and branding in that they are perceived as a reliable partner for demolition in terms of CDWM. On the other hand, they are also driven by contract and cost for their work procured by the main contractor.

Valuation Practices of the Other Sub-Contractors on the Building Site

The valuation practices of the other sub-contractors concerning waste are primarily contract driven and cost driven. Sub-contractors are usually obliged contractually to sort their own waste on site. The main contractor is however responsible for CDWM and feel it is sometimes difficult to motivate sub-contractors to participate in CDW sorting practices. In our case to the exception of the electrician, the other craftsmen are not involved in the management of the demolition work and sorting of waste.

Valuation in Norms, Standards and Professional Guidelines

The Swedish Environmental Protection Agency (SEPA) aims at that 70% of waste produced in Sweden should be recycled and less than 10% should end up in landfill. These figures have been adapted from the European agencies. However, as the production of demolition and renovation waste is not legally monitored in Sweden, reaching these targets is depending on the assessment carried by the contractors on their own production. SEPA has published a handbook on the recovery of waste in civil engineering. The handbook provides guidance values of both hazardous and non-hazardous substances. It should be noted though that these guidance values do not have legislative force for non-hazardous waste. Waste management for the renovation and demolition of buildings is regulated in the Building Code (SFS 2010:900) and guidance is given by the Swedish National Board of Housing, Building and Planning. An inventory of the generation of hazardous waste is required prior to the demolition or renovation of buildings. This inspection plan should include information on: sorting into waste fractions, precautionary actions to prevent environmental and health risks and the final disposal of the waste. They build on the following classification: metal waste, ferrous; metal waste, non-ferrous; metal waste, mixed, glass waste, plastic waste, wood waste, mineral waste; and mixed waste, not specified. Waste tax is currently SEK 500 /t (EUR 54 /t) (2016). Some waste types (e.g. metal wastes) going to recycling are free of charges. To help the contractors gain better control on their waste management, the Swedish Construction Federation has provided guidelines on CDWM and sorting of CDW on site. Besides, addressing the different stakeholders and advising on the possible role and responsibility they could take in waste management, the guidelines enumerate all the waste fractions organised by type of material and propose a classification on the many objects and substances that can be found on site (in rubric such as electricity or type of paint). They focus is on waste minimization and the management of CDW enabling recycling. The renovation and demolition waste are addressed in terms hazardous waste risk management.

Valuation at the City Municipality

The city is interested in optimising waste management on its territory. The discharge of construction waste in nature is a situation the city would like to avoid. The security and respect of work conditions and health and safety rules are also a major concern. The city is focused on maintaining and creating a sustainable environment for the citizen and following the government regulations and laws. They perform these through controlling the application of particular regulations for the demolition inventories and hazardous waste rules. Besides, being legally responsible for the respect of environmental laws, the city has to ensure that no one is trespassing. However, the number of public servants attached to the task is far too little to effectively control the numerous building sites in the city. Therefore, controls are often taken place after citizens complains or denunciations. When confronted with

misbehaving, the strategy of the city is to advice and guide offenders and bring them back to the expected comportment rather than to fine or punish them. One of the reasons to explain this soft policy is the high cost of engaging pursuits as these require the participation and coordination of several public services. The city is nevertheless, keen in interacting with the industry and test different practices to improve the recycling of construction waste.

Valuation practices in the waste management companies

The valuation practices of the waste management company for their customers build on the complementarity of the types of waste to be collected: gypsum, burnable waste, impregnated wood, wood, waste or metal as well as the work needed for the waste to be sorted. The financial value of this different material is attributed according to the size and quantity of waste. Although these prices are public, the final fees can be negotiated for almost every customer, private or business. To the exception of burnable waste, the material delivered to the central is going through a second round of sorting. In term of profit, a large quantity of waste is burnt and substantially contributes to the production of energy for the city. Recycled material is sold further for reuse. In the case of specific construction waste such as gisp or concrete, the possibility of recycling is depending on the quality and purity of the sorted material which therefore needs to be to assessed. These quality values have been determined by specialists and experts to ensure the quality of the new artefact. However, according to some of our interviewees, these values are too strict and prevent a large amount of sorted waste to be reused.

DISCUSSION AND CONCLUSION

Building on the different valuation practices of the stakeholders engaged in renovation waste management enables us to understand how value is attributed to waste. First the value of waste cannot be reduced to apparent objective measures or quantities but are constituted of practices. Second, the analysis underlines the diversity of not only the interpretations between the actors, but also between the different calculation and estimation devices and how these are mobilised to legitimised practices. The stakeholders seem to focus on their own organisational purposes and don't seem to integrate a more holistic view of the recycling processes. Even within the same organisation as in the case of contractor, we find different properties attributed to waste and competing valuation practices. Third, our analysis suggests that the recycling directives and proposed implementations schemes do not align with the renovation practices of the contractor and demolition companies. The possibility of recycling relies on the pure quality of substances and material which is hard to achieve within renovation where waste is mixed and composite. So, to conclude, for improving the waste management for renovation projects, it becomes important to build on some stabilised practices that can be recognised by most of the stakeholders. However, there is still a difficult road ahead to reach an efficient waste management process for renovation projects.

REFERENCES

Adams, K, Osmani, M, Thorpe, T and Thornback, J (2017) Circular economy in construction: Current awareness, challenges and enablers. *In: Proceedings of the Institution of Civil Engineers: Waste and Resource Management*, 170(1), 15-24.

- Bakshan, A, Srour, I, Chehab, G, El-Fadel, M and Karaziwan, J (2017) Behavioural determinants towards enhancing construction waste management: A Bayesian Network Analysis. *Resources, Conservation and Recycling*, 117(B), 274-284.
- Bessy, C and Chauvin, P M (2013) The power of market intermediaries: From information to valuation processes. *Valuation Studies*, 1(1), 83-117.
- Bosch-Sijtsema, P and Buser, M (2017) Construction and Demolition Waste Management on the Building Site: A Literature Review. In: Chan, P W and Neilson, C J (Eds.), *Proceedings 33rd Annual ARCOM Conference*, 4-6 September 2017, Fitzwilliam College, Cambridge, UK. Association of Researchers in Construction Management, 269-278.
- Boverket (2005) *Förnyelse för hållbar utveckling [Renewal for sustainable development]*. Stockholm: Boverket.
- Buser, M and Bosch-Sijtsema, P M (2017) From construction waste to business value: Defining new value propositions for construction contractors. In: *Proceedings to NFF (Nordic Academy of Management) Conference*, September 2017, Bödo, Norway.
- Callon, M (Ed.) (1998) *The Laws of the Markets Volume 6*. Oxford: Blackwell.
- Callon, M, Millo, Y and Muniesa, F (2007) Market devices (Post-Print halshs-00177891, HAL.).
- Chiapello, E (2015) Financialisation of valuation. *Human Studies*, 38(1), 13-35.
- Doganova, L and Karnøe, P (2015) Building markets for clean technologies: Controversies, environmental concerns and economic worth. *Industrial Marketing Management*, 44, 22-31.
- Doganova, L, Giraudeau, M, Helgesson, C F, Kjellberg, H, Lee, F, Mallard, A, and Zuiderent-Jerak, T (2014) Valuation studies and the critique of valuation. *Valuation Studies*, 2(2), 87-96.
- Espeland, W N and Sauder, M (2016) *Engines of Anxiety: Academic Rankings, Reputation and Accountability*. New York: Russell Sage Foundation.
- European Commission (2016) Construction and Demolition Waste Management in Sweden. Available from http://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en [Accessed 2nd September 2015].
- Feldman, M S and Orlikowski, W J (2011) Theorizing practice and practicing theory. *Organization Science*, 22(5), 1240-1253.
- Hall, D and Nguyen, T A (2012) *Waste Management in Europe: Companies, Structure and Employment*. European Federation of Public Service Unions, Available from http://www.swfm-qb.eu/main/wp-content/uploads/2012_Waste_mngt_EWC.pdf [Accessed 18th July 2018].
- Heuts, F and Mol, A (2013) What is a good tomato? A case of valuing in practice. *Valuation Studies*, 1(2), 125-146.
- Kareem, W A, Asa, O A and Lawal, M O (2015) Resources conservation and waste management practices in construction industry. *Arabian Journal of Business and Management Review (Oman Chapter)*, 4(7) 20-31.
- Kent, M (1986) Visibility analysis of mining and waste tipping sites - A review. *Landscape and Urban Planning*, 13, 101-110.
- Kornberger, M (2017) The values of strategy: Valuation practices, rivalry and strategic agency. *Organization Studies*, 38(12), 1753-1773.

- Li, J, Tam, V W, Zuo, J and Zhu, J (2015) Designers' attitude and behaviour towards construction waste minimization by design: A study in Shenzhen, China. *Resources, Conservation and Recycling*, 105(A), 29-35.
- Lu, W and Yuan, H (2011) A framework for understanding waste management studies in construction. *Waste Management*, 31(6), 1252-1260.
- Muniesa, F (2007) Market technologies and the pragmatics of prices. *Economy and Society*, 36(3), 377-395.
- Muniesa, F (2011) A flank movement in the understanding of valuation. *The Sociological Review*, 59(s2), 24-38.
- Orlikowski, W, Scott V (2014) What happens when evaluation goes online? Exploring apparatuses of valuation in the travel sector. *Organization Science*, 25(3):868-891.
- Osmani, M, Glass, J and Price, A D (2008) Architects' perspectives on construction waste reduction by design. *Waste Management*, 28(7), 1147-1158.
- Peng, C L, Scorpio, D E and Kibert, C J (1997) Strategies for successful construction and demolition waste recycling operations. *Construction Management and Economics*, 15(1), 49-58.
- SEPA (2012) From waste management to resource efficiency. In: SEPA (Ed.) *Sweden's Waste Plan 2012-2017*. Stockholm: Swedish Environmental Protection Agency.
- Teo, M M M and Loosemore, M (2001) A theory of waste behaviour in the construction industry. *Construction Management and Economics*, 19(7), 741-751.
- Wang, J, Yuan, H, Kang, X and Lu, W (2010) Critical success factors for on-site sorting of construction waste: A China study. *Resources, Conservation and Recycling*, 54(11), 931-936.
- Yuan, H (2013) Key indicators for assessing the effectiveness of waste management in construction projects. *Ecological Indicators*, 24, 476-484.
- Yuan, H and Shen, L (2011) Trend of the research on construction and demolition waste management. *Waste Management*, 31(4), 670-679.