THE EFFECTS OF BUILDING AND PLANNING REGULATIONS ON CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

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The construction industry generates overwhelming environmental waste, particularly during construction and demolition activities. While most of the waste is inert, the small amount of toxic and hazardous substances may cause significant environmental degradation leading to socio-economic impacts. Therefore, the construction industry is not only concerned with the life-safety of buildings but management of construction and demolition waste. However, implementation of these strategies indicates that technical, legislation, and other socio-economic constraints exist. The major impediment, that is, legislation and the process in which technological solutions are accepted by authorities with jurisdiction are considered. The review involves evaluation of the interfaces between environmental, planning, and building regulations more especially how they impose constraints on each other in respect to C&DW management. The evaluation reveals that the construction industry and its stakeholders neglect legal procedures of developing and deploying technology. Consequently, authorities having jurisdiction often preclude these technology-dependant C&DW management strategies citing reasons as non-compliance with prevailing building regulations.

Keywords: building regulations, construction and demolition waste (C&DW) standards and codes of practice, town and country planning acts.

INTRODUCTION

Contemporary building, environmental and planning regulations are formulated to guard mankind against foreseeable artificial and natural catastrophes. However, in the construction industry, the interface of the regulations seems to be incompatible, it therefore creates a gap (Crowther, 2002). In fact, there is no legislation that deals directly with prevention of construction and demolition waste (C&DW) nor its management. Nonetheless, construction strategies are usually designed to prevent or eliminate C&DW at relevant project phases through design for recycling, waste specification and various construction phase methods (Drothorst and Kowalczyk, 2002; EcoRecycle Victoria, 1998). While the effects of these strategies on C&DW management may be technical, legislation, and implementation related impediments. Unfortunately, literature search indicates that legislative barriers are caused by incompliance with technological acceptance procedure (Ekanayake and Ofori, 2004; Lavers and Shiers, 2000; Ferguson *et al*, 1995)). However, environmental, planning

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and building legislation are not in harmony because independent authorities develop and enforce them. Consequently, a change in any of these legal pieces may ripple through the system thereby inciting irreparable impacts.

BUILDING REGULATIONS, CODES AND STANDARDS

Building codes and standards are generally accepted in practice that define the acceptable level of behaviour, practice, technique for construction of buildings and the production, properties and performance of building materials, components and systems (Lingard *et al*, 2000). The process and intent of building codes is to provide minimum standards to safeguard life, health, property and the public welfare. Therefore, the building code facilitates the regulation and control of the design, construction, quality of materials, use and occupancy, location, and maintenance of all buildings and structures within a jurisdiction (Wang, 2004).

The building code dates back almost 3600 years. The building code of King Hammurabi, founder of the Babylonian empire in 1700 B.C., is the earliest known code (Poon, 2000). Additional regulations were needed due to catastrophic fires such as the Burning of Rome in 64 A.D. The third great fire of London in 1666 A.D. lead to the greatest building control in England. The great Chicago Fire of 1871 caused insurance companies to become more involvement with the regulations of building construction. The need for setting minimum standards for construction materials and testing for performance of design resulted in the founding of American Society of Civil Engineers (ASCE) in 1852, the American Society for Test and Material (ASTM) in 1902, the Underwriters Laboratories (UL), and the National Bureau of Standards (NBS). Codes and standards continually changed over the years to reflect and meet challenges of new technology, materials, and construction practices. Moreover, public demand for protecting life and property prompted regular review of building regulations to enhance protection. The Uniform Building Code (nationally recognised code of America) was developed and published in the USA in 1927 by the Pacific Coast Building Officials Conference (presently, International Conference of Building Officials).

Standards are a key component of both model building codes and regulations. Parties having vested interest in the deployment of a product or technology develop standards for a potential benefit. Generally, the developer of a new technology or product will develop a pre-standard or ask a testing agency to develop a bench standard to help the manufacturer to identify what are required to show technology compliancy with health and life-safety related issues. To facilitate regulatory approval, the manufacturer can have its technology tested for compliance with this bench standard by a testing laboratory. Alternatively, the manufacturer can provide the bench standard to a standard developer as the basis for a voluntary consensus standard. Voluntary consensus standards are developed in the voluntary sector as opposed to the government sector. Committees, sub-committees representing manufacturers, government agencies, contractors and other building community sectors, or task groups composed of individuals with an interest in the product often develop voluntary consensus standards under the auspices of an organisation that develops standards. Upon adoption by government authorities having jurisdiction, model codes and voluntary standards become or are incorporated in relevant laws and regulations accordingly. Standards and the process through which they are developed are essential components of domestic and international trade, thus becoming an effective vehicle

for worldwide technology transfer. This implies that understanding the international market is critical for a producer aspiring to export his products.

There are two types of standards: (a) a prescriptive standard – this standard prescribes the minimum criteria for a given type of material, for instance, physical and chemical properties for aggregates. Therefore manufacturers are required to show that their products comply with the applicable local, national or international prescribed requirements. (b) a performance standard - this type of standard requires the manufacturers to test their products in an approved manner to establish the to meet legal functional requirements or minimum performance criteria. For example, contractors are required to test concrete to ascertain it meets the compressive strength specified for the job. Standards may be accompanied by a direct or indirect prohibition. A direct prohibition in a building regulation states that something is not allowed or is, through a requirement to do something else, which is prohibited by default. An indirect prohibition imposes requirements in such a way that what is proposed, although not directly prohibited, cannot be implemented (National Evaluation Services Inc. 2002, Scottish, 2003).

Model building codes include enforceable technical and administration provisions, including references to standards, which can serve as a comprehensive set of building regulations. Code adoption involves state government directly or indirectly through relative legal agencies. In America, the Federal government have traditionally undertaken adoption of building codes for Federal buildings and facilities. Some states may have authority to adopt building codes that apply throughout the state (province). In most cases, respective legislatures delegate code adoption and administration to one or more agencies. In United States without such an authority, adoption and administration of codes is delegated to the local government. Adopting authorities usually make amendments as necessary to address local geological, geographical and climatic conditions. Ironically, these amendments often decrease the probability that a product meeting local model codes can be readily accepted internationally. The latter highlights the importance of product innovators' participation in the development of standards and model building codes.

Upon adoption, model codes are law, and legal authority is granted for their implementation and enforcement as building regulations. Building Construction Regulations are the body of mandatory provisions that must satisfy to construct, rehabilitate, operate, and maintain buildings and products, systems and equipment therein. Documenting compliance with these regulations rests with various private-sector entities (manufacturers, builders, designers, product specifiers, contractors, building owners, utilities, and others). Model codes typically contain three types of provisions that form the basis for approval, viz. simple prescriptive, prescriptive based on testing and certification, and performance provisions. Demonstrating compliance is generally the responsibility of the building owners. This responsibility is often delegated to specialist agents, namely, the architects, engineers, builders, contractors, and others with expertise in the design and construction. These agents, in turn rely on the manufacturers of building products or technologies to provide the necessary documentation that verify code compliance. Documentation that is needed to show compliance can include testing, certification, quality assurance, calculation, simulation and other activities, all of which are intended to verify the degree to which the applicable standards and model building codes are satisfied. The National Evaluation Services Inc. Report (2002) states that enforcement consists of: (a) reviewing construction documents, specifications, test data, evaluation reports and other relevant

materials, (b) issuing construction permits, (c) inspecting buildings during construction, (d) issuing certificates of occupancy, and (e) verifying that existing buildings continue to be maintained in a safe manner. Nevertheless, these measures neither exonerate professionals' from their duty to exercise skill and care nor the contractors' responsibility to execute the works competently. But, however, professionals are not obliged to watch every detail of the work as undertaken by the contractors but expected to monitor the contractors' adherence to the contract specifications and drawings.

The National Evaluation Service Incorporated report (2002) further states that developing a new product does not necessarily mean that consumers will beat a path to your door. An innovative product or technology can only achieve market success if it conforms to relevant building legislation. This requires technology or innovative products to be accepted by authorities having jurisdiction. Therefore, to curtail a long hiatus before technology could be accepted, developers should ascertain if: (a) available standards cover the testing of innovative technology, (b) model codes have specific provisions that pertain to the technology, (c) the technology has been tested and also meets referenced standards, (d) technology has been listed by an independent third-party quality assurance or inspection agency, (e) technology is labelled for approval and use, (f) technology literature and information refer to the codes and standards, (g) builders and specifiers are familiar with the technology, (h) code officials have received training on the technology, and (i) contractors are available that can apply the technology. Moreover, an innovative technology or new product should be competitive in all respects.

However, technology acceptance is often complicated because legislation, regulations, codes, or other documents addressing issues outside the scope of building regulation may also affect it. To expedite the process, product innovators should engage in the following chronological technology-acceptance procedures parallel with technology research, development, and deployment (National Evaluation Service Inc. 2002): (a) identification of existing codes and standards affecting technology, (b) reviewing and assessing those documents and other regulations to identify problems or opportunities, (c) developing a rationale and supporting documentation showing that technology complies with the intent of existing regulations, (d) secure an evaluation report verifying the technology's compliance with relevant codes, (e) develop new standards or revise existing standards, (f) conduct research and preparation of documentation in support of standards, (g) secure approval of standards, (h) conduct required conformity assessment activities, (i) revise codes and develop supporting documentation, (j) secure approval of revised codes, (k) develop informational materials that describe the technology and code compliance, (l) dissemination of informational materials to code officials, designers, builders, and other interested parties, (m) monitor technology acceptance in the field, and (n) conduct field research to shape the next version/generation of the technology. The report further suggests educational support to the construction industry and code communities (especially code officials and prospective compliant-parties) pertaining to the correct use of technology through field tests, educational programmes, literature, and other mechanisms.

Standards and model building codes are written with existing products in mind and address known technologies and solutions to public safety issues in new and existing buildings. Presently, technology development often precedes both development and adoption of standards and codes. Consequently its supporting-infrastructure usually

trails its availability in market. It is upon this premise that building regulations may directly or indirectly preclude modern construction and demolition waste management strategies. To remove the seemingly barrier and long hiatus, technology developers shall engage in development of new standards, change existing standards, or modify model codes to ensure that issues affecting their innovative products or technology are addressed. However, this involvement is a long process as it may affect other regulations outside the building industry. In fact, radical changes to building regulations may ripple through the construction industry inciting negative socio-economic impacts. For instance, blanket stringent regulations may prove costly to the low-income public sector thus driving them in the city periphery. In densely populated countries or regions prone to natural catastrophes, codes of practice and building regulations deliberately control design and construction of buildings to ensure life-safety and property protection. Nevertheless, these regulations neither prohibit incorporation of secondary material nor sustainable construction technology that comply or enhance performance of structures. The onus is on innovators to prove beyond reasonable doubt that life-safety and property protection is not compromised for technology invention or innovation. Furthermore, any C&DW management strategy including design for recycling shall meet property insurance and more importantly green or sustainable construction requirements.

TOWN AND COUNTRY PLANNING ACTS

The town and country planning is designed to regulate the development and use of land. It is an important instrument for protecting and enhancing the environment in the town and country, viz. preserving the built and natural heritage and conserving the rural landscape. The planning and zoning division is responsible for updating and implementation of long-term planning, daily planning activities on proposed developments, and amending and implementing the zoning code or short-term planning. The zoning code contains the land development regulations for cities/towns to establish comprehensive controls for the development of the land within the long-term comprehensive plan. The codes are designed to preserve the character of cities/towns to promote and improve public health, safety, comfort, order, appearance, convenience, morals, and the general welfare of people. It also protects the natural and man-made resources and maintains, through orderly growth and development, the character and stability of present and future land use and community development. This requires developers to observe the following: (a) prescribed setbacks, (b) maximum allowable building heights, (c) fence regulations, and (d) regulations for other structures within the city, some of which may not need building permit.

While planning and building regulations are two separate functions, they impose certain constraints on each other. In general, building regulations lay down standards of construction that are primarily to ensure the health and life-safety of people in and around buildings. Therefore, perusal of construction drawings and specifications is concerned with compliance of development details with building regulations. Planning officials grant a permit, which allows an applicant to carry out the proposed development. However, the requirements of building regulations pertain to access for fire fighting vehicles, means of escape, structural fire precautions, and the provision of access for disabled people are stringent, virtually influencing design of buildings and the external layout of the site including access roads.

In the present, overwhelming waste management strategies advocate for on-site sorting and re-processing of material into reusable form to minimise haulage costs.

Most of the countries have adopted one or all of the following land use and regulations and policies, which may exclude provision of land space for secondary material processing: (a) provision of park and open space land and protection of natural resource, (b) promotion of compatibility between development and existing neighbourhood character, (c) provision for necessary public facilities and services, (d) protection of life and property from foreseeable natural and artificial hazards, (e) reduction of dependency on the automobile on per capita basis, and (f) implementation of adopted neighbourhood (District) plans. Item (c) implies that any development shall be adequately served with the full range of public facilities and services including water, sanitary sewer, transportation facilities, fire and police protection, parks, open space, recreation facilities, surface water management and drainage facilities, and schools. These services shall be available or committed prior to approval of development. Land use Policies and Regulations do not directly regulate demolition or expansion of building activities but requires any development to maintain residential neighbourhoods at existing zone and plan density designations. Ironically, the latter requirement allows density change only if the existing services would support the resulting additional load. It is apparent that management of waste resulting from construction and demolition activities is not covered by both building and planning legislation. However, town planning policies and regulations have sufficient flexibility to permit local authorities to propose measures to adapt development to unique and difficult site conditions. It further accommodates amendments to the comprehensive plan and zoning map that respond to local criteria of public facilities, and other standards. The policies and regulations have a periodic review provision within the relevant law to ensure they remain current and responsive to community needs. Authorities having jurisdiction, e.g. Planning Commission or Local Authorities, may initiate legislative amendment to comprehensive plan (long-term) text or map. Any interested association or individual may request the planning commission or local authority to initiate legislative amendment (o behalf of the public) to the plan text/map. While planning policies and regulations are not clear on change of open space designated use, compatibility of dissimilar land use is possible through a clause that permits buffering or screening. Even so, buffering for C&DW management purposes may not provide adequate partition to comply with environmental law requirements pertaining to nuisance (Poon, 2004a and b). Consequently, any conversion of open space into secondary material reprocessing centre would amount to the rigmarole of reviewing environmental law and other affected pieces of law.

WASTE MANAGEMENT LEGISLATION

Most state governments still rely upon generic waste management legislation in respect of solid waste generation and management. For example, In Botswana, Contemporary Waste Management and Pollution Control Act 1998, which covers C&DW management is too general rendering it ineffective without sector complementary legal framework (Merafe, 2006). The act's principal (Agenda 21) objectives are to preserve, protect and improve the quality of the environment, contribute towards protection of human health, and ensure prudent and rational use of the natural resources.

Unlike other countries that rely on environmental legislation, Australia has developed building and development legislation to promote C&DW management at certain levels of implementation (Crowther, 2000). However, the code of Australia, which could be

the most appropriate for technology development and deployment, has no legal force (Crowther, 2000). In Scotland, the Environment Act 1995 mandated the Scottish Environment Protection Agency (SEPA) with the national regulation and strategy responsibility regarding waste management. However, domestic waste management is the local authorities' responsibility while commercial/industrial waste is the responsibility of the producer. Even so, it is a requirement that planning authorities should consult SEPA on development plans to foster a relationship between development plans and waste strategy. Still, a review of contemporary C&DW management in both industrialised and developing countries suggests an imminent need for an effective waste management tool.

PROPOSED TOOL FOR VETTING BUILDING AND DEMOLITION PERMITS

A proposed C&DW management as shown in Figure 1 is expected not only to facilitate implementation of state of the art waste management strategies but also to harmonise activities of all authorities involved in the permit application phase, construction phase, operations phase and demolition phase. The secondary aim of this C&DW management model is to shrink the gap between research prescriptions and practice (Taylor, 2005). The tool or model derives its power from planning, environmental, and building legislation and other factors that influence generation and management of C&DW management.

CONCLUSIONS

Construction and demolition of buildings and other structures are a complex process that is initiated by several factors. Evaluation of causes of C&DW shall not only consider design and construction phases but other activities that influence decisions of all involved in the building process. Building, planning, and environmental regulations were not phrased to address C&DW management directly but may be adapted for that purpose if legal procedures are followed. However, C&DW management officials and the construction industry shall ensure that proactive management strategies meet the requirements of code officials before implementation. However, legislation will be ineffective if the construction industry fails to formulate and incorporate effective and practical methods of minimising C&DW. While the proposed vetting tool is expected to facilitate implementation of contemporary C&DW strategies, there is need to continual update it to meet ever-changing technology development.

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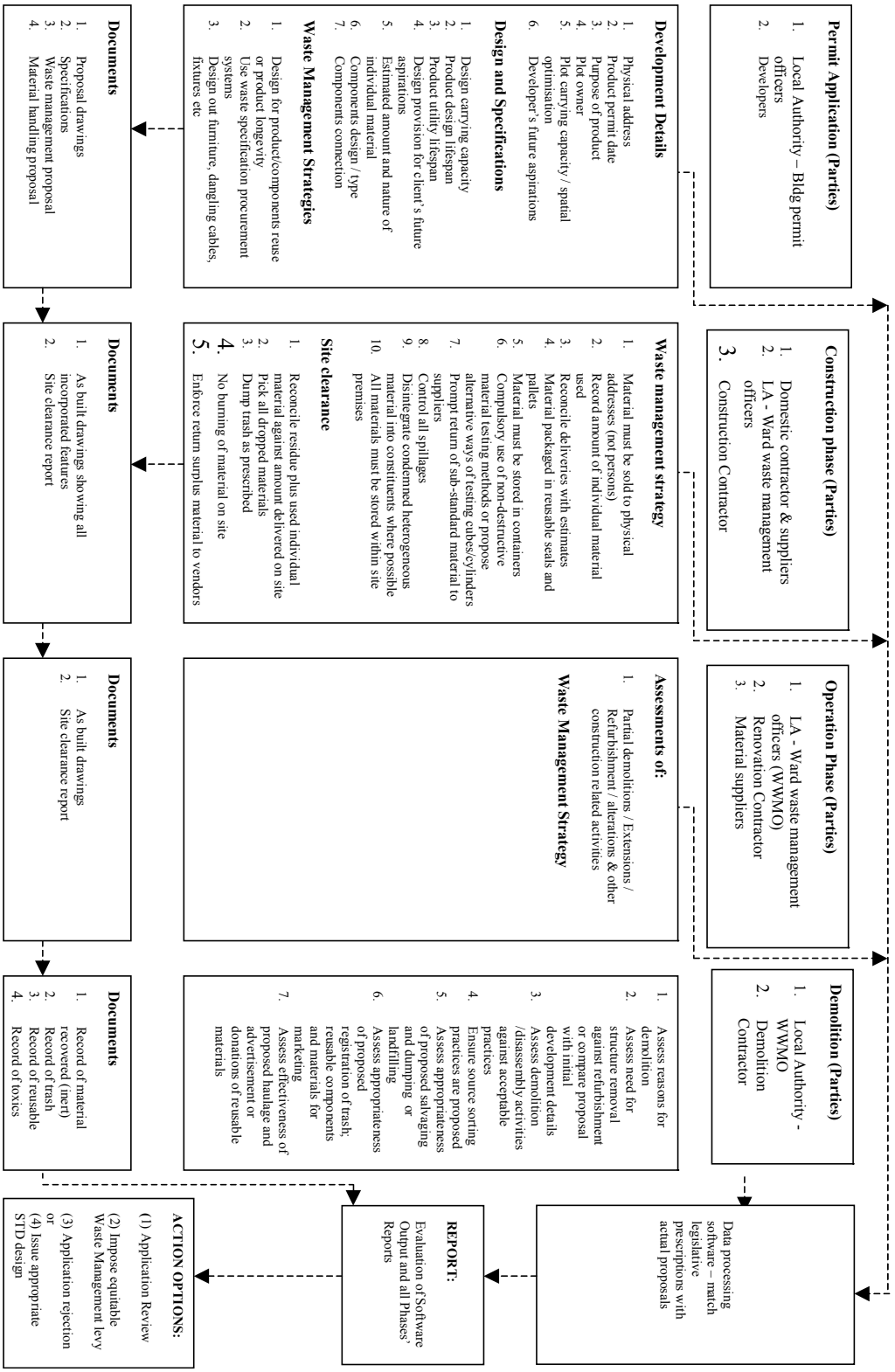

Figure 1: A tentative tool for vetting building and demolition permits documents