Sustainable Built Environment National Research Centre

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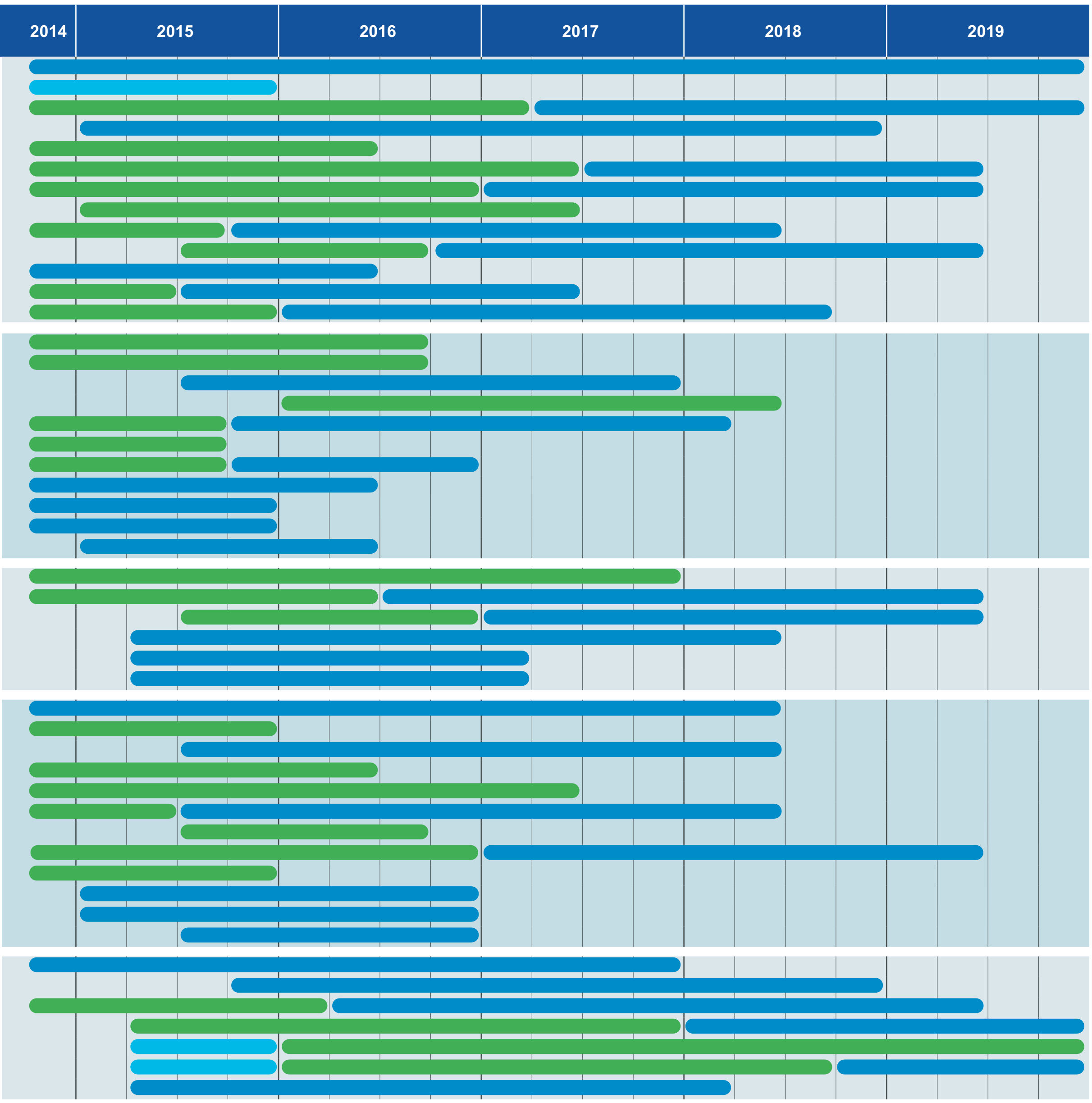
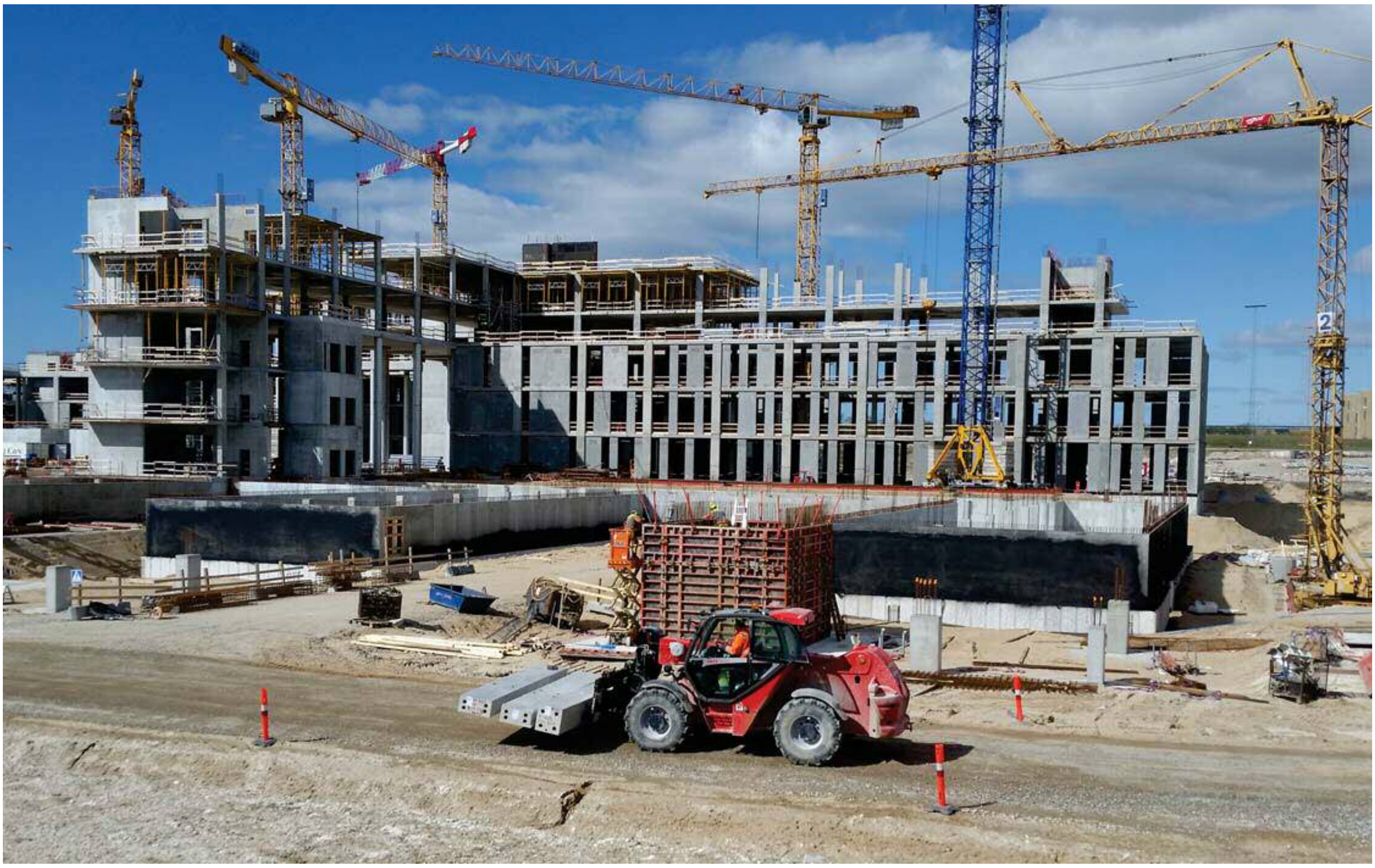
Project 2.33 New Project Management Structures: Position Paper 1

Project Management Intervention:

LBS/WBS Influencing ISO Project Management Standards





Kenley, R & Harfield, T (2015) *Project Management Intervention:LBS/WBS Influencing ISO Project Management Standards*. Project 2.33 New Project Management Structures Position Paper 1. Sustainable Built Environment National Research Centre (SBEnrc), Perth.

1 November 2015

Introduction

Work Breakdown Structure (WBS) is an essential component of all types of Project Management and is of great significance in infrastructure construction. The commonly accepted definition for work breakdown structure is: "…a product-oriented family tree subdivision of the hardware, services and data required to produce the end product which is structured in accordance with the way the work will be performed and reflects the way in which project costs and data will be summarised and eventually reported." (Kerzner, 2013). Interestingly, very little literature underpins this definition (Kenley & Harfield, 2013).

WBS emerged as a tool to ensure scope management from the earliest days of formalising processes for the management of projects. The WBS created a framework for network planning (CPM) and thus was a method for driving task allocation in projects in the 1950s and 60s. It has subsequently been accepted as a fundamental of Project Management with very little challenge (Weaver, 2007).

According to Archibold and Villoria (1967), project definition equated to a WBS, with eight substructures.

1. Project Organisation
2. Network Plan
3. Calendar Time
4. Estimating
5. Chart of Account
6. Funding
7. Authorisation Control
8. Report

These sub-structures have become the basis of project administration processes.

The evolution of construction project management practices is linked to the development of cost and time control mechanisms found in PERT, a network based control system for product completion. Systems theory indicates that these constituent parts must 'mesh' into an adaptive whole. However, in practice this is very difficult to achieve for construction management systems (Norman *et al.*, 2008). This problem of integration obviously reduces productivity, especially in project management processes.

The original purpose of WBS was to ensure product completion from a work-to-be-done perspective. The focus of the work perspective is on project completion as specified, within budget and on time. Definitions of the work-to-be-done begins with project scope leading to project targets and deliverables calculated by methodologies for planning and control. The management problem is that not all projects have the same context and therefore cannot be controlled to provide the same end-product as factory manufacturing. Put another way, the purpose of construction projects is to create the built environment based on variety not standardisation.

Construction: A Location-Based Project

The essential characteristic, location, of construction projects suggests the need to revisit project management basics in order to consider models that focus on location in managing construction projects.

Construction projects, whether bridges, road or rail lines, high-rise or wide-rise buildings, have one common characteristic. All construction projects provide "products" for a specific location; and for the majority of projects and programs of projects much the actual construction continues to take place at that location (Kenley *et al.,* 2012). Construction projects are 'location-oriented', with location being both implicit and explicit for all construction management endeavours.

The Location-Based Management system (LBMS) described by Kenley & Seppänen (2010) is an integrated network of management system components potentially involving all stages of construction, from design through to completion. The system components are unified and location allows the integration of many data components into a knowledge-base for a project. This makes the LBMS rich in integrated data which parallels other initiatives such as BIM for integrated project delivery or the integrated project environments that are now emerging.

Scheduling a Project

Project Management practice as defined in the Project Management Standards, considers projects as being capable of decomposition through hierarchical structures. This process is carried out to ensure the smallest task is defined and is able to be managed within a complex system. The process of decomposition is based on hierarchical tree through 'parent and child' segmentation of the total project (Stal-Le Cardinal & Marle, 2006). Each sub-division must fit into the defined project scope and completion deliverables.

The lowest WBS level of decomposition usually contains 'work packages' (Norman *et al.,* 2008). The work packages generally form the link to subsequent processes, most particularly scheduling. Detailed time scheduling will break work packages down further into component activities, a process that may involve further hierarchical decomposition.

Activity-based scheduling is the current dominant scheduling technique. The underlying maths provides a topological map of discrete activities joined by logical relationships. Each individual activity is considered free to move in time as long as it maintains the logical relationship with its predecessors and successors. This model suits activities that are completely discrete and have no structural correlation with other activities.

The term location-based is adopted to describe this methodology. The project may be modelled by including individual packages of works (activities) into a connected whole entity called a task which represents the aggregation of activities in multiple locations. The focus of the method is on the task moving through production units (locations) and the project data sits in both the task and the location.

While in its basic form the methodology is largely graphical, modern methods have shown that it is possible to incorporate the full range of CPM logical relationships allowing for greater power and flexibility for modelling construction projects.

Location Breakdown Structure (LBS)

Ibrahim *et al.* (2009) found that the most frequently used decomposition criteria in the formulation of WBS for building projects are elements, work sections, physical location and construction aids. This indicates that location is embedded into the WBS hierarchy on construction projects. Indeed, they proposed a hierarchical decomposition of a building project based on these criteria.

One important concept of LBMS is the Location Breakdown Structure (LBS). Utilisation of an LBS for construction projects, along with suitable project models and management strategies, can systematically improve project production efficiency.

Location as the unit of analysis is at the heart of the Location-Based Management system (LBMS). Location provides the container for all project data, and is used as the primary work division through a location breakdown structure (LBS)—rather than the more familiar work breakdown structure (WBS).

Location is the container for data which relates to the quantum of the project. The LBS is hierarchical so that a higher level location logically includes all the lower level locations. Each of the location hierarchies has a different purpose.

1. The highest level is used to optimise construction sequence.
2. The middle levels are used to plan production flow of structure (and often reflect physical constraints).
3. The lowest levels are used for planning detail and finishes.

This breakdown allows data to be collected at different levels within the hierarchy. The location contains the following types of data:

- building objects or components such as elements and sub-systems
- planned and actual building component quantities
- building system production assemblies
- planned and actual material costs
- building system costs.

LBS is not a building information model (BIM) but rather a methodology for interacting with a BIM, placing demands on the BIM for both properties and characterisation (breakdown).

New Project Breakdown Matrix

Turner (2000) considered the potential of 'breaking down' a project from a number of different perspectives. He suggests both a Product Breakdown Structure (PBS) which is indicative of project objectives, and a major structural container focused on responsibility and personnel in an Organisational Breakdown Structure (OBS). He suggests the WBS is actually a two-dimensional matrix (PBS X OBS) formed by the intersection of the two hierarchical breakdowns at corresponding levels of breakdown. Thus, the WBS is actually a 2D container for managing a project.

This important concept, considering the intersection of two differently focused breakdown structures, has received little attention by project management researchers (Kenley & Harfield, 2013). Yet, potentially the concept of a 2D model as a container reveals a significantly different view of the WBS from the conventional definition (Kerzner, 2013).

This matrix-like view provides a hint for alternative ways to break down project data providing the possibility of productivity gains through more efficient data management.

The key to changing the way we think about the management of projects is to change the way we decompose the project structure.

The problem with current practice is that the WBS is a single hierarchy structure which must meet conflicting demands. It is therefore proposed that breakdown structures strip out location from the hierarchy to create a matrix, as shown in Figure 1.

Breaking down a project in this way clarifies the advantage of location-based management. The WBS, once freed of location-repetition, can more efficiently describe the work being done. Then the repetition of each level of the WBS across multiple locations can be handled by the matrix using the LBS.

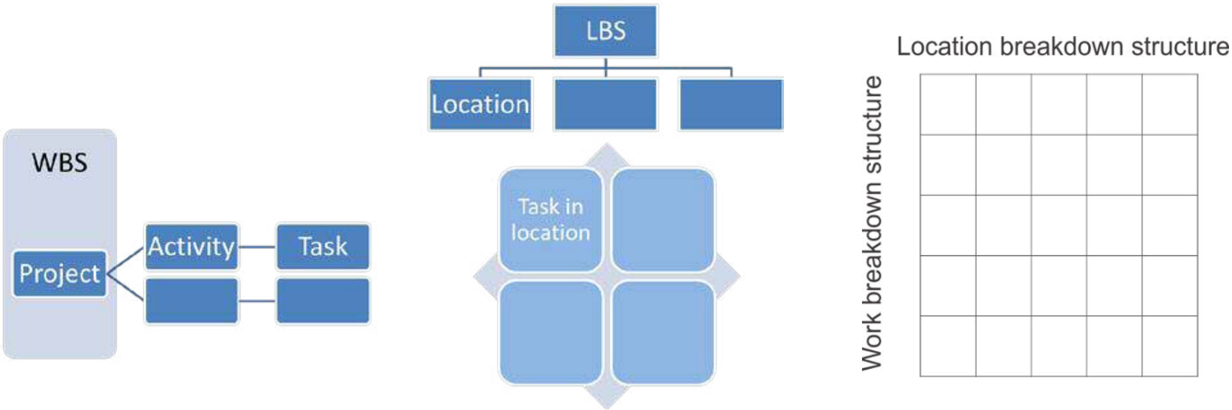


Figure 1: Project Breakdown Matrix

In fact, this technique can be applied in any situation. It can use any technical platform. It is not a specific location-based tool, but a productivity concept.

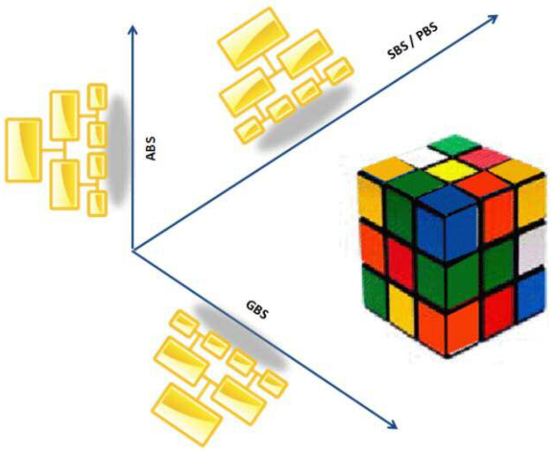


Figure 2: 3D WBS (from Moine, 2012)

The opportunity to use location-based techniques for any management system by stripping out the location hierarchy from the WBS has been demonstrated by Moine (2012) who argued for a 3D WBS as represented in Figure 2.

Moine's 3D model consists of three specific changes.

1. Activities (ABS, Activity Breakdown Structure) become "Install / build", as defined actions or processes.
2. Products (PBS, Product Breakdown Structure) become "components", that is to say, equipment, materials or engineering works to finer decomposition levels of the tree. On the upper floors, the PBS is composed of functional systems (SBS, System Breakdown Structure).
3. Areas (GBS Geographical Breakdown Structure) become "somewhere", which can be geographical or functional according to the phases of the project.

In this model the WBS results from the crossing of GBS, PBS and ABS. One of the key benefits of this approach is rapidly built schedules that exploit activity repetition.

Influencing ISO Project Management Standards: Adding the LBS/WBS Matrix

Although most elements of the final built environment product (building, road or oil rig) do require unique solutions, over time, standard solutions have been developed that can be applied to many construction management problems.

International and national organisations such as the Project Management Institute and the Australian Institute of Project Management develop guidelines, definitions and methodologies to support the standardisation efforts.

A significant coordinating feature of standardisation is to set out processes that support ways to manage project management variability. In the academic literatures and in real-world practice, it is referred to as 'control'. The purpose being to control external and internal uncertainty that is fundamental built environment projects. Thus, management techniques to 'control' how work-to-be-done is maintained, is considered a major part of any construction project to improve project productivity (Eastman *et al*., 2008).

The concept of productivity improvement implies that this improvement is possible through production efficiency, such as completing a project early. Thus a number of tools or methodologies for managing projects have been developed specifically to control internal construction project processes claiming productivity improvement. For example, BIM (Eastman *et al.*, 2008) and LBM (Kenley & Seppänen, 2010).

Location-Based Management (LBM) and Building Information Modelling (BIM) are two environments that support project management practices aiming to improve construction process efficiency. These environments rely on industry development of standards that will be accepted globally. Because of the fragmented nature of the construction industry and individual programs of projects, these types of control systems are limited in their effectiveness to change total productivity.

However, change at industry level is the purpose of three standards development groups. The International Organization for Standardisation (ISO) was founded in 1947. Since then representatives from over 150 countries have contributed to the development of national and international standards that support trade and quality products. The growth of the organisation in setting production standards as well as business process standards assists government agencies carry out their service mandates.

The Australian (AS) and New Zealand (NZS) standards organisations work together for many standards. They both support development project management standards at the international level. The Global Alliance for Project Performance Standards (GAPPS) provides a bridge between both commercial and practice-based (Crawford, 2013).

All these types of standards are developed through co-operative meetings globally. For example, GAPPS holds three day working sessions to map the Project Management 'bodies of knowledge'. This includes Australian Institute of Project Management Standards (AIPM) and Australian National Competency Standards for Project Management (ANCSPM). What is lacking in the current standards are new construction project and portfolio data management methodologies to improve productivity by reducing data-handling waste (cost is added without the addition of commensurate value) such as the LBS/WBS matrix.

Membership on national and international working groups or committees is an option that provides an opportunity to directly influence adoption of new methods considered by project management standards bodies. Currently only a product breakdown definition is reflected in the Project Management standards (SA-AS4817-2006; PMI-WBS-2006; PMI-PMBOK-2013; ISO21500-2012).

It is strongly recommended that researchers on this project become members of technical committees and their working groups. It is also strongly recommended that researchers support the up-dating of national and international standards for construction management.

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Acknowledgement

This research has been developed with funding and support provided by Australia's Sustainable Built Environment National Research Centre (SBEnrc) and its partners. Core Members of SBEnrc include Core Members of SBEnrc include Aurecon, BGC, Queensland Government, Government of Western Australia, New South Wales Roads and Maritime Services, New South Wales Land and Housing Corporation, Curtin University, Griffith University and Swinburne University of Technology.

The research team also acknowledges the contribution of interviewees who were a central part of this project.

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