UNDERSTANDING DECISIONS FOR SUSTAINABLE DEVELOPMENT

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Major urban development projects extend over prolonged timescales, involve a large number of stakeholders and necessitate complex decision making. This paper describes part of ongoing research to develop a Sustainability Enhancement Framework for urban re-development projects. This requires an understanding of stakeholder interaction and their influence on decisions to provide guidance on where potential enhancement actives can best influence the project's sustainability. The scope of the required interviews and analytical approaches are described and the paper demonstrates how these techniques led to the identification of key sustainability intervention points in the decision process. Conclusions are drawn on the value and robustness of the methodology.

Keywords: decision analysis, decision theory, organizational analysis, sustainability, sustainability enhancement.

SUSTAINABLE DEVELOPMENT

Bruntland's (WCED 1987) definition of sustainable development is the most widely accepted and a common starting point for scholars and practitioners (Sneddon 2006). There has been extensive debate around the definition and how to conceptualize sustainability, often closely linked to an authors subject area and expertise (Dalal-Clayton and Bass 2001, Drummond and Marsden 1999, Kates *et al.* 2005). Deitz and Neumayer (2007) argue that the concept of sustainable development has won broad appeal because it has resisted a single interpretation avoiding discrimination against approaches.

The movement towards greater sophistication of understanding is demonstrated by a move from simple Venn diagram or triple bottom line explanations of the interactions between the economic, environmental and social pillars of sustainable development towards a 'Russian Doll' or embedded model of understanding (O'Riordan 1998). The World Bank four capital model of sustainability (Serageldin and Steer 1994), addresses the resources available for societal progress through different sorts of capital, deconstructed into natural, human, social and manufactured. Forum for the Future presented a 5 capital framework developed by Parkin *et al.* 2000, which proposed a further financial category. The field of ecological economics has led the key debate surrounding the substitutability between the economy and the environment in terms of the way that human and environmental resources are valued. The debate

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can be captured in terms of 'weak' vs 'strong' sustainability (Brekke 1997, Ayers *et al.* 1998, Ekins *et al*. 2003, Dietz and Neumayer 2007, Brand 2009).

Chan (2009), reviewed the four capital dimensions of sustainable development based on Pearce's (2003) framework for understanding the application of sustainability in the British construction industry Chan (2009) concluded that success of any endeavour is based on the appropriate interactions of social, economic and political factors and the effective understanding the complex interrelations between these. A comparative analysis by Bartlett and Guthrie (2005) of seventeen leading documents aimed at practitioners suggested that sustainable development could be seen as "a process of ongoing development and maintenance of the built environment and secondly as a process toward intergenerational and intragenerational equity". It is evident that intergenerational equity has always remained a core element of the concept and common to most definitions along side the interdependence of social, environmental and economic dimensions o f sustainability, (O'Riordan T. and Voizey, 1997, Purvis and Grainger 2004, Boyko *et al.* 2005, Bebbington, 2009, Howarth 2009).

These concepts inform the standpoint for establishing approaches to sustainable development for major urban development, namely a vision of progress, which integrates immediate and longer term needs, local and global needs, and regards society, environment and economics as inseparable and interdependent. Therefore, if any development can be described as sustainable, it must integrate economic, social and environmental issues. Furthermore, major urban development projects extend over prolonged timescales (up to 25 years in the case of major regeneration projects) and involve a large number of stakeholders. Hunt *et al.* (2008) identify five major stages in the development of such projects; Visioning, Feasibility, Design, Construction and Occupancy, noting that many of the key decisions that relate to sustainability are made early in the process during the Visioning and Feasibility stages. Decisions taken at these stages and implemented during the design and construction stages will clearly impact on the sustainability of the occupancy stages. The design and construction of more sustainable infrastructure does not ensure sustainable behaviour by end-users. Sustainable urban development must facilitate the transition from current lifestyles and means of infrastructure provision to those required for a more sustainable long term future. This requires the engagement of wider stakeholders in all stages of decision making processes to ensure that the developments and the changes that arise from them are acceptable to communities and will lead to more sustainable lifestyles.

This research describes the development and application of a methodology to indentify key decision points throughout the life cycle of major urban development projects and the information needs of decision makers at these points.

RESEARCH METHODS

The author's previous studies of the decision making processes have shown that the large number of stakeholders involved and the nature of their interaction results in a much less rational and less structured approach to decision making than has been previously assumed (Butler *et al.*, 2003, Ashley *et al.* 2004). The research has also demonstrated the non-linear, iterative nature of the decision making process. Figure 1 (Markus, 1972) provides a useful model of the design process that illustrates the sequential, but iterative nature of the decision process.

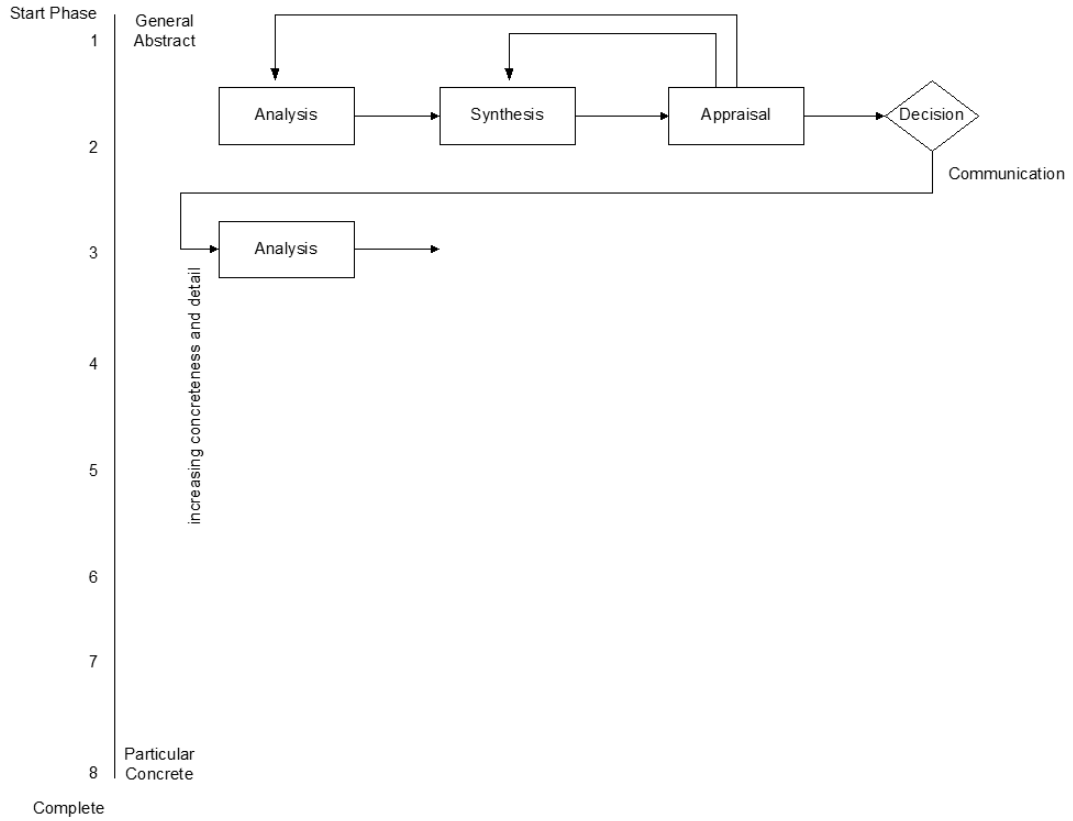

Figure 1: Model of the design process (from Markus 1972)

Each of the several iterative phases, which are repeated throughout the decision process, end with a decision being communicated. A methodology was therefore developed to identify key decision nodes where decisions are made to establish how this information is processed and to establish the nature of the resulting outputs. The methodology will identify what information is transferred, how it is used and will therefore provide a full understanding of opportunities to influence the sustainability of the project and to provide sustainability assessment data to the decision makers.

The mapping methodology builds upon the authors experience of the application of techniques such as decision mapping (Bouchart, Blackwood, and Jowitt, 2002) and data flow diagrams (Blackwood *et al.*, 2000), which have proved effective in identifying decision criteria and showing how decisions were taken. Other authors have used decision mapping to share and control knowledge (Robinon *et al.* 2006, Driessen *et al.* 2007, Klotz *et al.*, 2008). Robinon *et al.* (2006) also states that knowledge management is "central to the sustainability debate" and that knowledge management helps to promote innovation from people, improves stakeholder's involvement and promotes improvement. Thompson and El Haram (2009), combine knowledge management and decision mapping. Their study aimed to understand the role of stakeholders through a building project, and illustrated the use of different sustainability tools at project stage, and presented a number of mapping approaches relevant for this study.

The methodology comprised three parts; Information Flow Diagrams, Knowledge Categorization and Decision Process Conceptualization. Data collection comprised semi-structured interviews with key project team members and document analysis.

Information flow diagrams

The Information Flow Diagram techniques have been used successfully in previous work by the authors (Blackwood *et al.* 2004, Gilmour *et al.* 2005) to identify information flows to and from decision makers. The Information Flow Diagrams (IFD's) enable the information flows between stakeholders to be identified and the nature of any decision criteria or indicator used in a project to be determined. These provide a reference point during the analysis of the information flows and identify the associated document associated with the information flow.

Knowledge categorization

Each of the Information Flows identified above were examined to establish the sources and types of knowledge within the information. The categories used to assign knowledge are based on the ASHEN model (Snowden, 2000), which identifies five components; Artefacts; Skills; Heuristics; Experience and Natural talent. These are discussed in depth in Snowden (2000) but a simplified definition can be given as follows.

- Artefact: all existing explicit knowledge and /or codified information within an organization e.g. documents, databases.
- Skills: expertise, practiced ability, dexterity, tact that we can identify, a tangible measure of their successful acquisition.
- Heuristics: rules of thumb, often used to make decisions.
- Experience: actual observation or practical acquaintance with fact or events and the knowledge resulting from this.
- Natural talent: special amplitude, faculty, gift.

Decision process conceptualization

The two approaches above identify the nature of the information used to support decisions but do not reveal the key points in the process at which decisions are made. A Decision Process conceptualization approach was developed to identify key decision points as shown in Figure 2.

The concept behind Figure 2 is that the project team member, on receipt of the input information can do a number of things with it.

1. Store the information as received without using it.
2. Communicate the information as received to another stakeholder or stakeholder(s).
3. Use the information as received in reaching a decision, the outcome of which is communicated to another stakeholder or stakeholders.
4. Analyse and transform the information using a tool and store the information without using it.
5. Analyse and transform the information using a tool and then communicate the processed information another stakeholder or stakeholder(s).
6. Analyse and transform the information using a tool and use this information in reaching a decision, the outcome of which is communicated to another stakeholder or stakeholders.

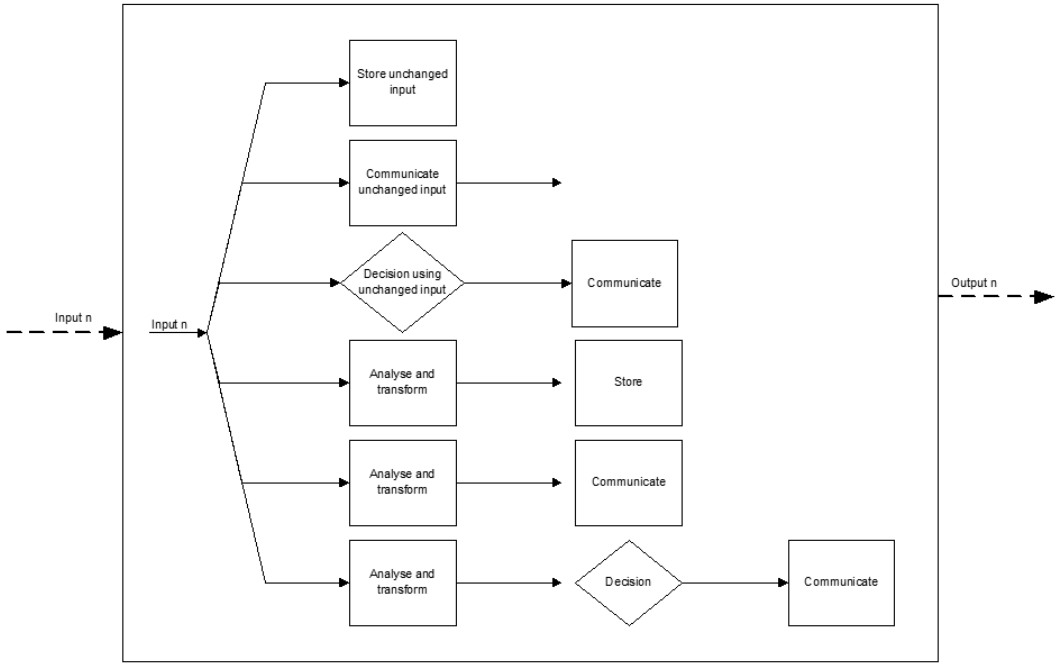

Figure 2: Decision process conceptualization

In this way, the decision process can be described for each phase. The tools used in the information transformation within the process will be identified and catalogued, and key decision nodes within the sphere of influence of the interviewee can be identified.

CASE STUDY APPLICATION OF METHOD

Case study

The Dundee Central Waterfront Development is a £250 million, 30 year regeneration of Dundee City Centre. The project aims to reconnect the city centre with the waterfront, through creating a high-quality, mixed-use, riverside urban-quarter in the heart of the city. The methodology has been applied to support Dundee City Council (DCC) in demonstrating due consideration of sustainability issues during this project, and where possible and identify further opportunities to enhance sustainability as set out in their statutory duty (Local Government Scotland Act 2003).

Application of method

Information Flow Diagrams were used to establish the network of stakeholders and their methods of interaction. Figure 3 presents an example of an information flow diagram which illustrates the wide remit the City Engineer within his responsibility for all the infrastructure provision in the waterfront area. The interview identified the Waterfront Feasibility Report as a key information flow; other key flows were on a project level with contractors and consultants.

An extract from the set of Information Flows is shown in Table 1. The flows are numbered to enable reference to be made to them during the analysis of documents.

The information flows were further analysed. Firstly, the Knowledge Categorization process was applied to establish the nature of the information. In this example only three categories were used, Rule of thumb (heuristics), Professional practice (training and experience) or Guidance document (artefact). Secondly, the Decision

Conceptualization Process was applied to identify the key points in the project's develpment at which decisions are made.

Examples of the results of Knowledge Categorization and the Decision Process Conceptualization for three stages of the project from the flows in Table 1 are presented in Table 2.

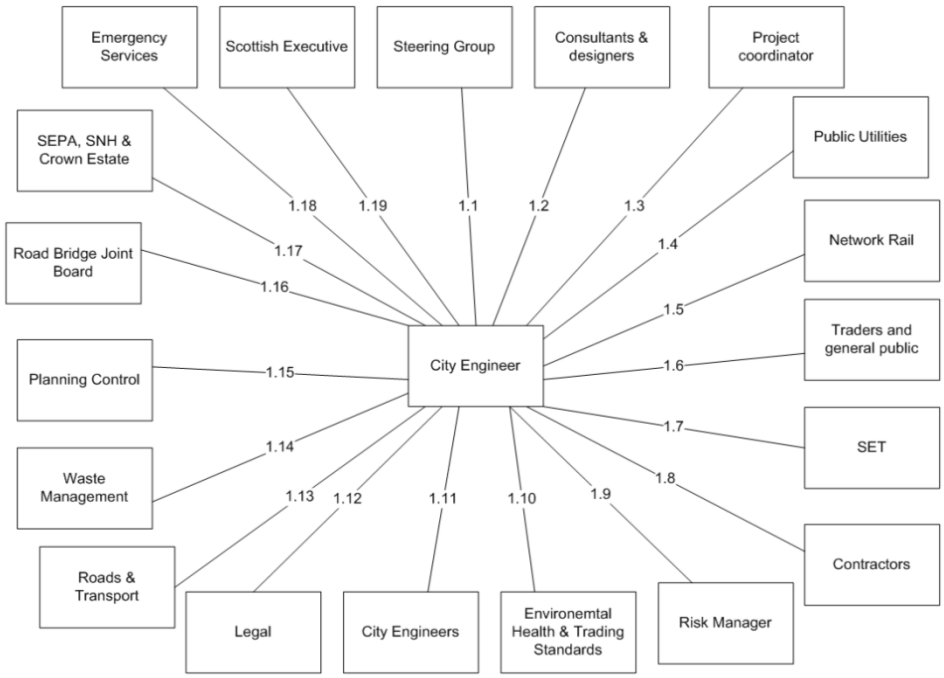

Figure 3: Information flow diagram – city engineer

Table 1: Information flows city engineer (extract)

Ref Number	Information flow	Ref Number	Information flow
1.1	**Steering Group**	**1.10**	**Environmental Health**
1.11	Recommendation	1.101	Air quality data
1.12	Programme changes	1.102	Noise control
1.13	Finance Updates	**1.11**	**City Engineers**
1.2	**Consultants and Designers**	1.111	Project management
1.21	Road Infrastructure	1.112	Work supervision
1.22	3D plan	1.113	Drainage design
1.23	Marina reports	1.114	Contract documents
1.24	Drainage designs	1.115	Preliminary designs
1.25	Air quality	**1.12**	**Legal**
1.3	**Project Coordinator**	1.121	Land Acquisition
1.31	Updates	1.122	Valuation
1.32	Finance Reports	1.123	Contract documents
1.33	Programmes	1.124	Agreements
1.34	Advice notes	**1.13**	**Roads and Transport**
1.35	Feasibility report	1.131	Pedestrian Access

Table 2: Decision nodes and predominant sources of knowledge

Phase in Project	Key Decision nodes	Predominant source knowledge
Design and Phasing	Traffic Management	Professional practice
	Reuse of temporary material	Guidance document
	Drainage design	Professional practice
Tender documents and Specification	WMMP policy	Guidance document
	SWMP expectation	Guidance document
Appointment of contractors	Quality assessment	Professional practice
Construction	SWMP	Guidance document
	Considerate construction	Guidance document
	CEEQUAL	Guidance document

CONCLUSION

The three parts of the methodology enabled the identification of the key decision points. The full understanding of the decision making process has enabled a Sustainability Monitoring and Enhancement Framework to be developed as shown in Figure 4.

The methodology has ensured that the indicators selected for sustainability monitoring are closely aligned to information used with the decision making process of the project. The decision points reveal opportunities to influence the sustainability of the development by embedding best practices, thereby ensuring that the resultant changes in the sustainability monitoring benchmark indicators are in the desired direction.

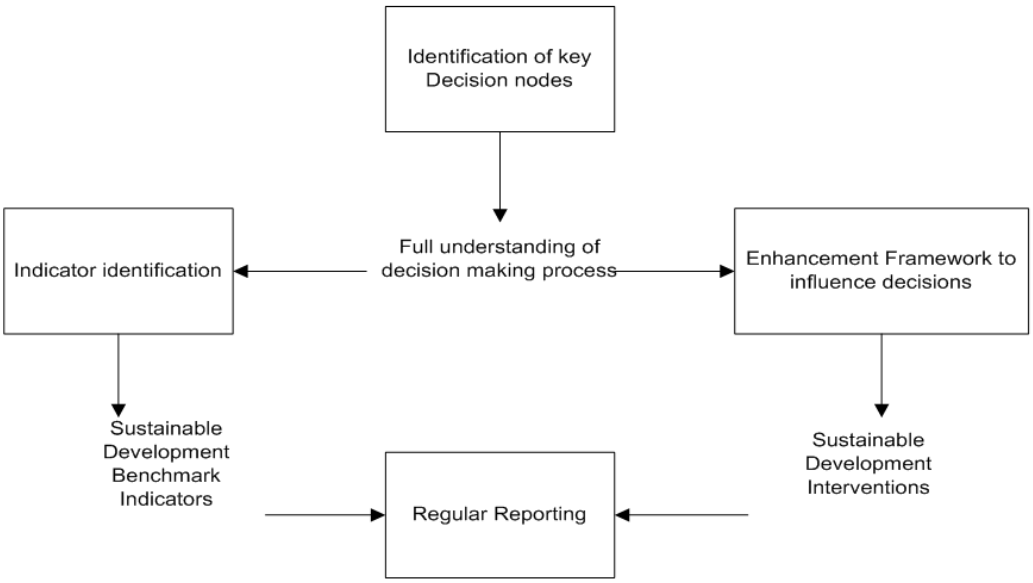

Figure 4: Sustainability monitoring and enhancement framework

The method has been successfully applied to the case study project to allow the network of information flows for each stage of the project to be mapped and analysed, resulting in development of a Sustainability Monitoring and Enhancement Framework, which is currently being further developed and tested in conjunction with Dundee City Council.

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