Means-Ends Inquiry: A strategy for directing inter-disciplinary research conversation

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ABSTRACT

The urban environment is shaped by the interaction among decisions by numerous design, construction and regulatory professionals. If urban development research is to be relevant to inter-disciplinary professional practice, awareness of a broad range of issues relevant to the urban environment is required, in addition to those of immediate research focus. This requires some inter-disciplinary understanding. However, appreciation of distinct disciplinary areas is time consuming.

A time efficient strategy for identifying the practical implications of inter-disciplinary collaboration, “Means-Ends Inquiry”, is presented, with a case study involving researchers from eight different urban development research projects. This involves conversation focused on A) design values illuminated by each project (design “ends”), and B) urban environmental factors that significantly influence those values (factors shaped by “means”). The results were analysed using a method originally developed for inter-disciplinary engineering product design, producing a simple, but broad-scoped and explicit, representation of a inter-disciplinary urban design problem that each project contributes towards.

This enables systematic discussion of various urban development issues and makes explicit multiple competing objectives. Because the research projects were quite diverse, limited detail from each contributed directly to the final representation. Instead there was more emphasis on fundamental “assumed knowledge” basic to each project. The strategy is likely more immediately fruitful for inter-disciplinary problems where the subject matter is strongly interacting, and where fundamental knowledge is already shared and only more detailed technical knowledge must be communicated. Nevertheless, it generated a wider urban design problem context, which forms an explicit starting point for a more sophisticated detailed understanding.

KEYWORDS: Quality Function Deployment, inter-disciplinary Methods, Means-Ends Inquiry

1 INTRODUCTION

This paper describes a “Means-Ends Inquiry” process for guiding conversation among researchers from different disciplinary areas, though who are nevertheless investigating similar or closely related subjects. Such a process was undertaken by researcher participants, each involved in one of eight projects investigating some aspect of urban development. The aim was to develop, with limited demand on participant time, a common understanding of a general problem to which participant research interests have a clear relationship, and which focuses attention on alternatives for action to solve that problem. It was also to identify to what extent the ideals motivating some research projects might be in practical conflict with those motivating others, and thus to stimulate the exploration of solution alternatives that would ameliorate that conflict. A simultaneous aim was to identify areas of closely overlapping research interests, in the expectation that this might suggest some fruitful inter-disciplinary research projects. While it proved possible to construct a representation of a common problem and to identify locations of practical conflict in motivating ideals, it was shown that participant research interests were only somewhat indirectly related to each other.

This paper first motivates the desirability of a practically-oriented guiding framework for inter-disciplinary conversations in urban development not only for professionals, but more particularly for disciplinary specific researchers engaged in focused investigation. It then describes such a guiding framework – "Means-ends Inquiry", a particular case-study where it was applied, and the results of that process. Some of the advantages and limitations of means-ends inquiry, as identified from the practical application, are discussed.

1.1 Inter-disciplinary conversation for urban environment design

The structure of the urban environment is determined by interaction among the activities of numerous construction, design, and regulatory professionals, including among others – with increasingly indirect influence - electricians, plumbers, builders, property developers, engineers, architects, urban planners, compliance inspectors, development approval authority personnel, environmental scientists, law makers, sociologists, population health professionals, and economists. By virtue of specialised training, continuing professional development, expert knowledge in a specific discipline areas, and ongoing interactions in professional practice, each professional group has a particular culture, which shapes professional decision-making and action, and is to varying degrees distinct from the professional cultures of other groups. To successfully intentionally shape the urban environment in a coordinated way requires collaborative decision-making among professional disciplines and thus some degree of inter-disciplinary decision-oriented communication.

Urban environment research must be reasonably focussed if substantial progress is to be made. However, it ultimately shapes urban development outcomes through support for professional practice, which occurs in the context of inter-disciplinary collaboration. Thus researchers should be reasonably aware of the practical decisions that their research has the potential to inform. They should also be somewhat aware of the many other factors that affect, and are affected by, the urban environment, in addition to those their research illuminates. This is also facilitated by inter-disciplinary communication.

However even a rudimentary appreciation of many different disciplinary perspectives requires the prior exploration of a potentially large body of specialist knowledge. It requires at least the appreciation of basic fundamental factual principles (such as the administrative relationship among federal, state and local regulatory authorities, or the biological mechanisms for human disease interrupted by sewage treatment) and more detailed facts (development approval rates vary significantly among local authorities, standard laboratory tests for detecting pathogenic micro-organisms are also sensitive to benign ones) as well as the underlying general (effectiveness of development regulation; human health) and specific (reliability, fairness, probity, flexibility; absence of infection, adequate immune response, adequate nutrition) issues of interest to any particular perspective.

Deeper appreciation of alternative disciplinary perspectives may eventually result in a more subtle understanding of the differences in nuances, assumed connotations, and other implicit assumptions among different perspectives in the interpretation of important terms (London, Chen and Bavington 2005). It may require an awareness of differences in understanding of what constitutes reliable evidence (case studies versus population statistics, expert testimony versus published literature versus direct observations), acceptable standards of professional behaviour and professional work, or adequate methods of analysis and practice. However, a deep appreciation of the perspectives of a different discipline requires a great deal of time, effort, and where interpersonal communication takes place, patience and mutual goodwill. While it may be possible for an individual to develop a deep understanding of several different worldviews over a lifetime, there may not always be enough time to do so as a prerequisite for engaging in fruitful collaboration as need and opportunity arise.

When limited discussion time is available, inter-disciplinary conversation should move reasonably quickly towards agreement about what are the most important issues and their relationship. Ideally such a conversation would also provide an opportunity to explore these questions, allowing for the acquisition of further information and reflection, before elaboration and revision, while still moving essentially forward. One strategy is to attempt to identify those aspects of individual disciplinary expertise which have relevant implications for a practical collaborative task. Once these aspects have been well understood, they represent a good starting point for further conversation that explores relationships among different areas of disciplinary expertise.

2 MEANS-ENDS INQUIRY

One way to structure inter-disciplinary conversation around a practical collaborative task is to conduct a means-ends inquiry. Professional activities that shape the urban environment, whether directly or indirectly, are directed towards meeting some kind of objectives within constraints (ends), often several, to yield results that are in some sense desirable (eg profitable, compliant, attractive, low impact, structurally sound). There are sometimes a number of candidate solutions (means) that achieve the required ends (materials, dimensions, components, configurations), at least one of which – preferably one of the better candidates – should be implemented. Professional activity consists of identifying preferred solutions for implementation or recommendation. Even when done by individuals, this typically requires consideration of multiple ends in the identification of acceptable solutions, although many are often implicit in standard professional practices. The activities of different professionals will have different (but possibly overlapping) ends and means. Thus, when inter-disciplinary collaboration amongst professionals is required, an even greater number of ends is brought to bear, and a wider range of factors may be candidates for specification within an identified collaborative solution means.

A means-ends inquiry is a process of A) identifying the ends (objectives and constraints) that a particular solution is to meet, that is, the sense in which implementation is expected have a desirable outcome and B) identifying the range of factors that could be altered to meet the identified ends. In an inter-disciplinary context the ends must often be made explicit, since these can be quite discipline specific, and negotiation may be needed in order to relax some constraints so that a satisfactory solution can be found. Identifying the parameters under consideration within a candidate solution space is helpful because this can expand the range of candidate solutions, or identify how a proposal to meet some ends can adversely affect meeting other ends. In this way a means-ends inquiry can motivate the identification of innovative means that more satisfactorily meet the required ends.

Hence, a means-ends inquiry is a time efficient strategy for identifying relevant practical implications of the interactions in inter-disciplinary collaboration (compare the principle of policy-driven science of Dennison and Abal 1999). Inter-disciplinary means-ends inquiry can result in the articulation of a common inter-disciplinary perspective on a particular problem situation, which can provide a wider context to which any particular disciplinary contribution towards solving a component sub-problem stands in clear relationship. Research that supports inter-disciplinary professional collaboration practice, by focussing on a particular aspect of a wider problem, can also benefit from being informed by inter-disciplinary means-ends inquiry. The wider context identified can highlight opportunities to reformulate a research project to be more directly relevant to practice, particularly practice that requires inter-disciplinary co-operation.

2.1 Beyond Means and Ends

In addition to identifying means and ends, knowledge of the causal relationship between them is also required for professional understanding adequate to specifying a solution. That is, to what extent does altering the means have an impact on the meeting (or not meeting) of the various ends? This characterises the content of technical knowledge (which choices of window materials result in low energy consumption, which styles of building facade results in a visual character consistent with the existing streetscape). Identifying or confirming such a causal relationship is typically the subject of empirical research. Appreciation of the wider institutional context within which problem solving takes place – including the various interests of multiple stakeholders - can also be important (see also the framework in Brinsmead 2004, and identify ends with “values”, means with “strategies”, their causal relationship with “description”, and stakeholder identification with “context”).

It is furthermore helpful to distinguish “process” and “product”. For urban development, a general problem is the realisation of urban environments – the product – that are high quality (meeting the material, psychological and social needs of inhabitants) which do not have unacceptable associated costs (financial, ecological, external economic or social). The processes that solve this general problem include planning, regulation, monitoring, financing, design and construction of the urban environment. More generally, it is useful to distinguish between understanding some problem in order to directly assist in its solution, and understanding a process designed to solve a problem into order to improve the process, thereby indirectly contributing to the problem’s solution.

3 URBAN-DEVELOPMENT MEANS-ENDS INQUIRY CASE-STUDY

The following describes a series of means-ends inquiry workshops involving researcher participants from eight different urban development research projects, over the course of approximately one year. Three workshops took place, the first being a full-day framing workshop approximately one month into the programme. The second and third refining workshops were shorter at half a day each, at the fifth and eleventh months respectively. Follow-up interviews with research project representatives were conducted after each workshop in order to clarify points raised and to confirm details not available at the time. In addition, written reports were provided to the participants after each workshop, allowing opportunities to make amendments as required.

The urban development research projects included a Visual Character project developing a computerised tool to assess the consistency of streetscape visual character, a Fauna Tracking project developing a miniature electronic device for cost-effectively tracking wildlife, a Water project exploring the integrated design of water, waste-water and storm-water infrastructure including decentralised design, a Community Health project aimed at improved population health outcomes (broadly conceived) through better urban design, a Leisure and Recreation project investigating the diverse range of leisure and recreation activities engaged in by different demographic groups, a Policy Conflicts project investigating inconsistencies among various policies, practices and procedures during the development approvals process, an Urban Flows project investigating how spatial flows of goods, services, money, labour, and communication change over time within geographical regions and a Research Interactions project to identify the relationships among the other projects as described here.

The means-ends inquiry showed that the most inter-related and closely interacting projects were those with some interest, at a particular common spatial scale (the subdivision), in the urban environment (ie not development process). These projects were the Water, Community Health and Leisure and Recreation projects. The Policy Conflicts project (and to a lesser extent, the Community

Health project) was more focussed on the urban development approvals process, which shapes the urban subdivision (as well as acting at other scales). The Visual Character and Fauna Tracking projects were aimed at improved measurement methods for quite specific characteristics of the urban environment, methods which could be used within the development approvals process, and also applicable at the subdivision (and larger) scale. The Urban Flows project, at a regional scale, provides a wider geographical and temporal context, a context both within which individual subdivisions are designed and serve the changing needs of their inhabitants, but also which is itself strongly shaped by the aggregate designs of its subdivisional components. Thus, the subdivision scale urban environment is one possible centroidal reference system that forms a common link to each project (the local government planning process would make another reasonable linking reference system).

3.2 Workshop Description

The first workshop consisted of a session introducing the research participants to a common jargon for means-ends inquiry: ends, means, their causal relationship, product versus process. While the concepts are relatively straightforward, they are known in different fields and contexts by many different terms with many nuanced interpretations. The participants were initially invited to first reflect on their own projects and to identify which urban development values (ends) the projects might ultimately contribute to and/or in what ways (ends) the urban development design and approvals might be improved. They were also asked to identify the nature of practical recommendations (means) that might be informed by their individual projects. This was preliminary preparation to the following group discussion. The participants then discussed, as a group, what qualities (ends) would be realised by an ideal urban environment, and what qualities would be realised by an ideal urban development process, in order to explore what other participants considered important, in as much specific detail as possible at this early stage in the research programme. They were also asked to sketch a diagram showing the relationship among the research projects.

A report was provided to the participants that descriptively summarised the quality ideals (ends) identified during discussion for the urban environment, and for the urban development process. The report also listed the possible types of recommendations (means) that might eventually result from each of the research projects and how such recommendations might result in improvements or detractions from the quality ideals identified (means-ends causal relationship).

In the second workshop, the characterisations of ideal qualities for each of the urban environment and urban development process were refined. Later, these criteria were organised into categories and represented in a hierarchical tree structure (see Figure 3.3.1.i below). Participants also identified causal interactions among the subjects of study of each research project (eg swales that improve stormwater infiltration and flow adversely affect maintenance costs). A preliminary identification of stakeholder categories was also performed. It was hoped that, at that stage in the research projects (five months into one year), the participants may have predicted some of the more specific recommendations that might result from their work. However, most were not able to do so at the time, not having had sufficient data analysis completed. The workshop also explored some potential collaborative research projects that were thought possibly worth pursuing. A report summarising the second workshop was also provided to the participants.

It was only by the third workshop, towards the projects' completions, that participants were able to make some more concrete recommendations, and then to discuss how they might enhance or limit the various quality criteria identified in previous workshops. It was also only at this time that a reference system, the urban environment at the subdivision scale, became more apparent. In order to focus discussion, participants were asked to identify no more than five recommendations each that would

make a significant difference to the most important quality criteria, and to single out a most significant recommendation. It was then possible to associate these recommendations with various factors in the urban environment and development process, and then to also represent these factors in a hierarchical tree taxonomy (Figure 3.3.1.ii). It also became possible to systematically consider the effect of each recommendation on each of selected quality criteria (see 3.4 below). For this reason, in order to keep the analysis reasonably tractable, the number of factors and criteria were limited to about thirty (see Clausing 1994, pp134, 155).

3.3 Results

The main results from the inquiry include identification of A) a range of important criteria for evaluating either the urban environment at a subdivision scale, or the urban development process, B) the most important factors for realising them and C) the dominant design trade-offs in an urban subdivision and those in the approvals process. These last results highlight the fact that many political conflicts over urban development occur because many criteria for desirable urban environments are in inherent practical conflict. Where the various criteria are valued differently by different stakeholder groups this raises the very important practical question of how the benefits and risks of alternative options should be appraised and shared. In particular it raises questions of what principles should guide the extent to which decisions should be made by a market mechanism or expert judgement, and in the case of the latter – what principles should guide that judgement (for discussion of these alternatives, see Gunningham and Sinclair 2004).

3.3.1 Subdivision Environment Criteria, Significant Factors, Dominant Trade-offs

The most important criteria for evaluating the urban environment were identified from discussion as

- support for physical wellbeing (adequate air quality, adequate drinking water, adequate accommodation, encouragement for exercise and adequate safety),
- support for psychological and social wellbeing (adequate recreation, adequate aesthetics, encouragement for inclusive social cohesion),
- provision of access to services (basic services – post office, newsagent, etc; suburban scale mobility; urban scale mobility; suburban legibility),
- ecological impact (adequate water services provision, minimum energy consumption, adequate wildlife habitat) and
- economic benefit (minimum development capital costs, minimum residential maintenance costs, minimum council maintenance costs, maximum amenity value, maximum commercial profits, maximum affordability).

These criteria were represented in hierarchical tree structure (see figure 3.3.1.i) as commonly used in multi-criteria analysis (Hajkowicz et al. 2000). These criteria were decomposed further into subcriteria. Adequate recreation was characterised more specifically as diverse demographic groups served and diverse recreational needs met (communal, individual, indoor and outdoor). Adequate aesthetics include components such as minimum overshadowing, minimum bulk, acceptable street scale complexity and acceptable allotment scale complexity. Adequate water provision includes components such as provision of sufficient safe, potable water; minimisation of stormwater flow and maximisation of infiltration; maintenance of natural hydrological connections; minimisation of waste water load; adequate disposal of waste water; minimisation of contaminant export; infrastructure cost minimisation and minimisation of water mains demand. A more comprehensive collection of urban subdivision evaluation criteria, which

have been used for comparing master planned to traditional developments, may be found in Blair et al. (2003). Compare also Figure 1 of Johnson (2005, p300).

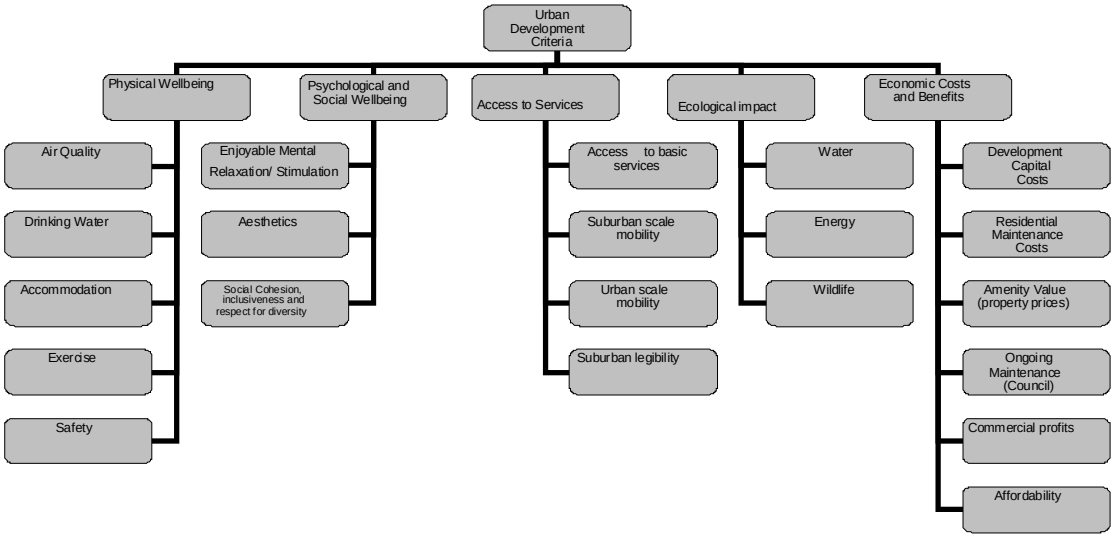

Figure 3.3.1.i **Urban Environment evaluation criteria (top level tree)**

The range of criteria identified is limited by practical considerations and is thus not comprehensive. However, the large number identified reveals a need for professional urban designers to A) prioritise and rank criteria, B) understand how well various alternative means satisfy them, and more importantly, C) provide, given any few specific criteria, several alternative candidate means to satisfy them, in case some means are ruled out due to still other criteria.

The main urban environment factors influencing these criteria were identified from discussion as

- public space (open space – parkland, bushland; transport routes – low speed, high speed)
- public facilities and built infrastructure (recreational facilities, electrical and communications, water system – swales, greywater recycling, decentralised wastewater treatment)
- private space (residential space – average lot size, rainwater tanks, vegetation, ventilation, zoning principles, building facade, pervious surface area, building dimensions [footprint, floorspace, height, volume, orientation]; and commercial space – local commercial services)
- public service provision (solid waste collection, youth services, public transport)

See figure 3.3.1.ii. The workshop discussions identified one of most significant decisions at the subdivision scale as being the quantity and configuration of private space versus public open green space. Open space moderately affects community health through the provision of communal recreational facilities supporting social cohesion and accessible exercise opportunities, and occasionally supports air quality. It significantly affects leisure and recreation criteria through potential provision of outdoor, communal and individual, recreational opportunities for all demographic groups. It can provide moderate benefit to ecological wildlife preservation as natural habitat, and ecological water criteria through stormwater detention and infiltration, also providing options for stormwater or treated greywater usage. However, public open space imposes maintenance costs (often on local government) and can be a safety hazard due to fire risk. It may also reduce the possibility of public surveillance by providing visual cover, increasing actual or perceived crime threat (although increasing privacy opportunities). Most significantly however, it reduces the available area for private property development, including human

accommodation. Hence, like low density housing, it indirectly increases transport distances and possibly diminishes housing affordability.

There are also tradeoffs in open space configuration – fewer larger areas versus numerous smaller areas. Larger areas accommodate some activities that smaller ones cannot and the maintenance of fewer areas is typically less costly. However, numerous small areas may be accessed within shorter average travelling distances.

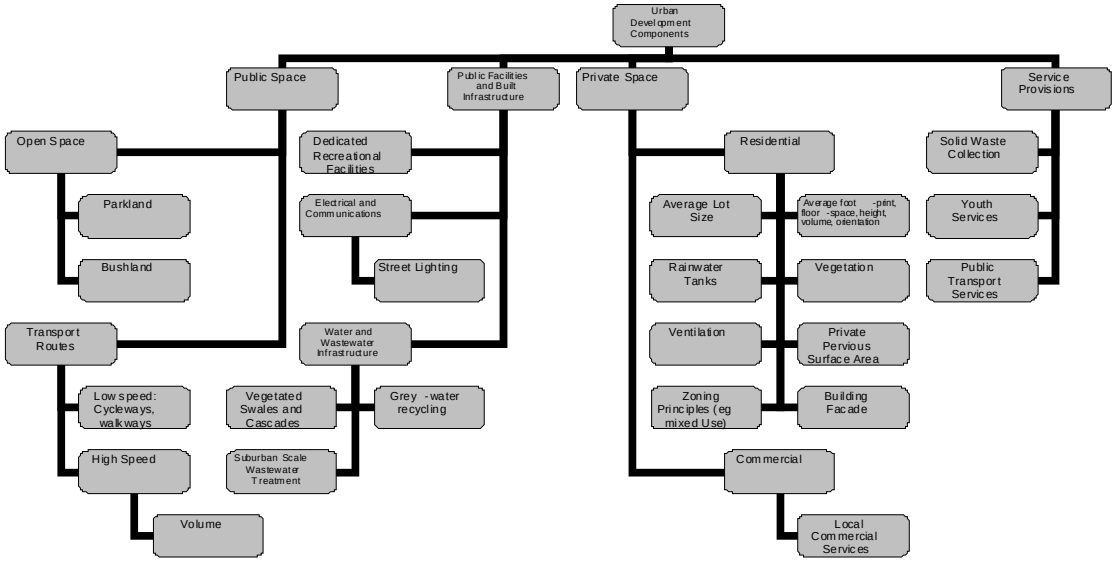

Figure 3.3.1.ii **Significant Urban Environment Factors (top level tree)**

3.3.2 Development Approvals Process Criteria, Significant Factors, Dominant Trade-offs

For evaluating the urban development process, the most important criteria were identified as

- encouraging of high quality developments (sensitive to local community context, sensitive to local geographical context, supportive of innovation),
- efficient (timely, low cost) and
- equitable (reliable, transparent, sensitive to all legitimate stakeholders).

The most important contributing factors in the urban development process were identified as

- participation in decision making
- formal approvals standards (assessment reliability, context dependence, explicitness, stringency, trade-off reliability, simplicity)
- purchaser sophistication

In the development approvals process the appropriate specification of formal approvals standards is subject to challenging tradeoffs. They should be not only transparent, reliable and simple, but also sufficiently flexible to cope with innovative solutions and case-specific circumstances, where it is either impractical or impossible to provide highly detailed specification in advance. It is noted that star rating systems, if they can be adequately developed, have a number of advantages – potentially including a balance of flexibility, reliability, transparency, communicability, specificity, and accessibility. This shows

how systematic identification of conflicting desirability criteria (eg for the approvals process) can motivate exploration of different solutions (eg a star-rating system rather than prescriptive regulations).

The relationship between the development process characterisation here and the urban environment outcome characterisation above is that, within the development process, each of more effective community participation, improved formal approvals standards, or an increase in purchaser sophistication, requires improved sensitivity to urban environment criteria of the sort specified above by respectively: the wider community, regulatory authorities, or purchasers. And in each case, the individuals making the final judgement of acceptability must have either direct or indirect access to evaluations of the proposed or actual urban environment in terms of similar criteria. Urban environment design professionals are then also required to have a sufficient understanding of the relationship between their design options and the extent to which such criteria are met.

3.4 Factor Significance and Stakeholder Analysis

The workshop results were analysed using an abridged version of Quality Function Deployment (Clausing 1994), a methodology originally developed for inter-disciplinary engineering product design, but which has also been applied to building design (Huovila 1999). A small number of Quality Function Deployment (QFD) analysis methods were applied, including criteria analysis (identifying their importance rating, directionality and necessity), criteria correlation analysis (systematic pairwise checking of criteria to identify which are reinforcing and which are in tension) and factor-criteria relationship analysis (estimating the significance of each factor in realising each criterion – eg Figure 3.4). A simple weighted sum of factor significance (weighted by criteria importance) provides a quantitative approximation to the qualitative importance of each factor.

		Promotes high quality	*Locally Appropriate*	Sensitive to Community	Sensitive to Space	*Supports Innovation*	**Efficient**	Timely	Cost	**Equitable**	Reliable	Transparent	Sensitive to all stakeholders
	Direction	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑	↑	↑
	Necessity	/	/	/	/	/	/	/	/	/	/	/	*
	Importance	5	3	3	3	3	1	1	1	3	1	3	3
10.0	**Community Participation**	O	:	⊕	O	∇	:	O	O	:	⊕	O	O
	Approvals Criteria												
7.2	Component assessment reliability	.	:	.	.	O	:	⊕	⊕	:	⊕	O	.
6.4	Explicitness	.	:	.	.	O	:	O	O	:	O	⊕	.
8.8	Component context dependence	.	:	⊕	⊕	O	:	.	.	:	O	.	.
10.0	Component Tradeoff reliability	.	:	O	O	⊕	:	∇	∇	:	⊕	O	O
4.5	Stringency of Standards	⊕	:	O	O	O	:	∇	∇	:	∇	.	∇
8.8	Simplicity	O	:	O	O	.	:	⊕	⊕	:	O	O	O
9.7	**Purchaser Sophistication**	O	:	∇	O	⊕	:	⊕	⊕	:	∇	∇	∇

Interaction Strength	
Strong	⊕
Moderate	O
Weak	∇
Negligible	.
Derivative	:

Figure 3.4 **Development Approvals Process- Means-Ends Interaction Matrix**

For the urban environment, the most important factors thus identified were A)i) building dimensions and orientation and ii) lot dimensions, B)i) low speed transport routes, ii) high speed transport routes, iii) public transport and iv) locally available commercial services and C)i) parkland and ii) bushland. This latter conclusion was consistent with informal discussion which identified the trade-off between public and private space as one of the most significant. However the more systematic method of analysis revealed, in addition, the importance of the other factors. Building dimensions and lot dimensions are

significant because they directly influence population density, and thereby indirectly affect many other criteria, especially cost per capita. Transport factors and locally available commercial services affect access to services, exercise, air quality, energy usage, and safety. There was quite a marked difference in the quantitative rating between the factors mentioned above and those with the next highest score.

A similar analysis of the development approvals process was less conclusive (Figure 3.4). It identified the more important aspects as including A) purchaser sophistication, B) the extent of community participation in decision making, and C) the reliability with which criteria components may be traded off against each other. Aspects of secondary importance include d) the extent to which criteria are dependent on local context and e) the overall simplicity of the process.

A stakeholder-criteria analysis estimated the importance that each stakeholder group (including existing landowners, property developers, future landowners, immediate neighbours, the wider community, ecological interests, and local and state governments and utilities service providers) would place on each quality criterion. This showed the inherent political challenges of resolving conflict between groups because specific groups have interests in specific criteria which are in tension.

For example, recreational open space may provide a health benefit (to local residents, and in addition a recreation benefit), a subsequent financial benefit to the state government (which is responsible for health services provision) and an increase in property prices (beneficial to any incumbent residents and the developer). However, it may also result in decreased public surveillance and thus increased crime threat and decreased privacy in public space. Furthermore, it may result in some loss of developer revenue and local government rates (fewer private properties to release to market), and ongoing maintenance costs (accruing to the local government). This predicts that the state government should favour larger open areas, while local government would be opposed. Local residents should be moderately in favour (assuming the perceived health and recreation benefits outweigh any increased crime threat and so on), whereas developers may or may not be in favour depending on perceived net impacts on development revenues. This demonstrates the importance of developing workable principles for resolving conflicts among group preferences and/or criteria.

4 DISCUSSION

The value of the means-ends inquiry process is in deliberatively articulating, critiquing, debating and refining the underlying conceptions of what constitutes a desirable urban environment and an adequate urban development process. While means-ends inquiry is useful as an individual exercise, it is even more relevant to a inter-disciplinary collaboration where it is necessary to communicate what each collaborator is trying to achieve and how they might achieve it. The process is also useful in that it focusses attention on practical questions of what interventions lead to the greatest likelihood of improvement.

The value of selecting a small number (twenty to thirty) criteria and factors is in forcing prioritisation judgements to be made. This condenses the typically broad and detailed expert knowledge of the participants into key issues. Being specific, if not comprehensive, in this selection and making it explicit provides a starting point for moving conversation forward towards a more elaborated mutual understanding that is also practically relevant. The framework is moderately flexible, allowing for the evolutionary refinement of criteria and factors as understanding evolves. It is also readily adaptable the more detailed elaboration and expansion of the characterisation of problem subcomponents (eg the contribution of low speed transport routes to energy demand. For formal methods for identifying decomposable sub-problems, see Shin and Kim 2000). However, by being explicit, the rate of change in a common problem characterisation is limited and any such change is more reliably communicated to

the other collaborators. In some instances this may be a disadvantage – hampering the ability to opportunistically change the problem characterisation radically. For example, given the particular subdivisional urban environment reference system constructed here, it would be difficult to redirect attention to federal transport organisations, or even simply to cultural attitudes of urban developers, design professionals and regulatory bureaucrats to urban sustainability. A strength of the methodical and systematic treatment offered by the QFD methodology is thoroughness. A corresponding weakness is the risk of stifling innovation if the articulated constraints of any current reference characterisation are taken too seriously.

Since in this case study the topics of interest to the workshop participants were quite diverse, their relevant interactions were often more merely touching than deeply inter-related. As a consequence, the workshop participants were frequently required to explain to others assumptions, concepts, and basic knowledge which were, from their own disciplinary perspective, trivially obvious and/ or fundamental background, but which nevertheless was important to the wider context and of insight to other participants unfamiliar with that knowledge domain. It took quite some time (workshop three) for a common reference system to be identified. As mentioned above, the finally selected common reference system was more inclusively relevant to some projects than others, and the problem characterisation is quite broad and currently lacking precise technical detail. However settling upon a common reference proved necessary before significant elaboration progress was possible. The process is likely to be more straightforwardly employed, and to produce more unexpected insight, when applied to research projects where the subject matter is more strongly overlapping or interacting, and where the majority of fundamental background knowledge is already shared. In retrospect the analysis and concrete representation framework of the QFD methodology also supported faster progress, and would have been worthwhile introducing at an earlier stage in the workshops.

5 CONCLUSION

A case-study of “Means-Ends Inquiry” involving researchers different in eight different urban development research projects, and using Quality Function Deployment analysis, has been demonstrated to be capable of producing a simple, but explicit and specific, characterisation of a reference urban development problem to which each project has a clear relationship. This characterisation is compact, requiring the issues investigated in each contributing project to be ruthlessly summarised, and focussed on key issues only, which is a necessity for providing an easily understandable systemic overview. The method has a strong orientation towards identifying specific practical applications. Where fundamental empirical investigatory research has potential to inform numerous diverse practical activities (eg the Urban Flows project) it is difficult to accurately characterise the full range of applications. However, identifying a specific practical problem around which discussion can be held is particularly helpful for focussing inter-disciplinary conversation. The sooner a suitably inclusive specific problem can be characterised, the sooner can a coherent basis for conversation be established, and the characterisation be refined and elaborated.

The more distantly related are the interests of the participants in a means-ends inquiry, the more general and encompassing will be the problem characterisation guiding conversation, the more removed it will be from the participants' immediate practical concerns, and the more time and effort will be required to discuss fundamental principles and basic assumptions. The exercise has demonstrated the usefulness of recognising and distinguishing both product and process, but it has also shown that selection of a single scale of analysis is also extremely helpful for simplifying at least an initial problem characterisation. Where sufficiently distinct scales of analysis are relevant, it is likely that discussion would best proceed by first characterising separate inter-disciplinary reference sub-systems at each

scale, and only later considering sub-system relationships. The recommendation that number of criteria and factors to be considered should be restricted to about thirty, has been confirmed.

The systematic nature of the QFD analysis was highlighted the importance of factors in the urban environment that were not immediately obvious in the workshop discussions. Discussions focussed primarily on open space rather than transport and commercial services infrastructure, and private building and lot dimensions and orientation, which also proved on closer analysis to be significant factors in urban environment quality. Systematic stakeholder analysis reveals that some stakeholder interests are in inherent conflict, leading to the practical question of how these conflicts ought to be justly resolved.

The process has identified many, often conflicting, requirements that should be met either by the urban environment or the urban development process. This demonstrates a need in inter-disciplinary practice for A) prioritising and ranking requirements, B) understanding how to meet them, by C) a wide range of alternative candidate options. The more that collaboration is required, the greater need that these practices become explicit and deliberative.

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