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# In pursuit of value on large public projects using "spatially related value-metrics" and "virtually integrated precinct information modelling"

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## Abstract

The paper argues that large, public and precinct scale government building projects present a difficult proposition in dealing with the full spectrum of value issues that confront such projects. A new approach is proposed, namely *spatially related value-metrics* and its core means of implementation being *Virtually Integrated Precinct Information Model*. The approach aims to synthesize BIM, GIS and GPS technology. The technology serves to track, map and analyze human usage of the built environment spaces, thus measuring the demand that a given precinct generates. The usage data can then be related to more traditional measures of value including the likes of building costs, gross lettable area, rental returns and so on. The research methodology utilizes a critique of the literature that expands on the above issues by identifying common perspectives of value within the built environment and the ensuing gap in dealing with value from an end user and human activity perspective. A case study precinct project is used to identify the relevance and potential benefits of the proposed approach. Findings identify how a greater emphasis on linking objective value with subjectively perceived value could serve to improve synergy among stakeholder objectives. The contribution to knowledge of this work is a new way of looking at value from an outcomes perspective which is particularly relevant on large and public, precinct scale developments where the client's objectives include significant commitment to societal, vibrancy and human activity outcomes.

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## 1. Introduction

From a Government perspective, public projects need to efficiently, transparently and quantifiably demonstrate value in order to justify public investment and to achieve appropriate societal outcomes. On large built environment projects which manifest at an urban precinct scale of development, the above can be difficult to achieve given the significant diversity of stakeholders and their varying perspectives of value (Oliomogbe and Smith 2012). The different dimensions of value tend to interplay variously across a raft of separately motivated government agencies, commercial stakeholders and public interest groups, as covered in detail by authors such as Ruuska et al (2009), Zhai et al (2009) and Flyvbjerg et al. (2003). Traditional appraisal, calculation and valuation techniques are often found wanting. Specific parts of the problem include:

- As precinct scale projects become larger and more complex, risk and uncertainty increases - many of the variables that influence decision making are based on unavailable, poor quality, ad hoc or hard to quantify data, thus reducing the ability to demonstrate transparency and reliability in the decision making process.
- Many government agencies and commercial stakeholders have their own specific interests in such project and there is often the lack of a central and meaningful vehicle for progressing collaborative decision making, within the project governance structure.
- Lack of the above prevents the ability to optimise synergy between the components that make up large precinct scale projects.
- Value is perceived differently by different people – there is the need to create new ways of expressing and measuring value especially where monetary terms alone are inadequate.
- The method for determining value tends to be purely cost oriented, fragmented and often supply side driven. Subsequently, there is little attention to end users, human activity and the urban vibrancy needs which are particularly important on precinct scale projects.
- Many of the tools and methods used to analyse value are suited to individual building projects but are less suited to the value outcomes sought in urban scale precinct developments.

Interest in value tends to be fuelled by past failures to deliver projects on budget or according to expected returns or yields. Potted examples include Flyvbjerg et. al's research (2002) which found significant cost overruns on large project and the contribution of misinformation, excessive optimism and misrepresentation as key causes. Cantarelli et al (2012) found that the length of the implementation phase and especially the length of the pre-construction phase were important determinants of cost overruns in the Netherlands. Gil & Lundrigan (2012a, 2012b, 2013) looked at project case studies including London's Crossrail, London's Olympic Park, and BAA's Heathrow Terminal 2, all of which suffered significant cost escalations.

Taking a somewhat different direction, Oliomogbe and Smith (2012) point out that the meaning of 'value' has changed from being about cost and earned value management, to being more about project outcomes and competitive advantage. Attention subsequently turns towards ways of creating value but this immediately carries with it the question of who will benefit from the value created (Winter et al 2006). Oliomogbe and Smith (2012) go some way to fleshing out this issue by asserting that internal stakeholders (such as the client and contractor) are primarily interested in value from Project Management deployment of resources, whilst external stakeholders are mainly interested in project benefits.

The nature of this paper chooses to focus on external stakeholder outcomes – primarily concerning end users and human activity arising from the finished development – but unlike the assertion above, this paper aims to determine if such outcomes are mutually exclusive from internal stakeholders needs – mainly the client - where a public and precinct scale urban redevelopment projects are involved. Here, it seems that traditional approaches to defining and calculating value have potential limitations due to the public outcomes required of such projects as distinct from purely commercial outcomes. As a result, this paper aims to identify and further consider such shortcomings, and then respond by presenting the idea of *spatially related value-metrics*. It is also proposes that the best means of implementing this concept is via *virtually integrated precinct information modelling* which aims

to provide a visual basis for tracking, mapping and presenting quantitative data within an intelligent 3D model of the precinct environment.

## 2. Research Method

With the aim of fostering new and improved methods of realising value in the built environment, the paper begins by setting out and undertaking a critical review of the common perspectives and associated methods used to define value in construction, property and the broader based built environment – including the gaps left behind when trying to optimize value on large public precinct wide building projects. The paper then explains the basic tenets of the proposed *spatially related value-metrics* and *virtually integrated precinct information modelling*. This new and complimentary pair of approaches utilise technologies such as BIM, GPS and GIS technology which are explained in generalist terms and then explained in terms of application to the above mentioned approaches. The paper then uses a case study of an existing large, public and precinct scale urban re-development project in Sydney to demonstrate the extent to which the above approaches have relevance to both external stakeholder and client outcomes. The case study also serves to show how the proposed approaches can add to the existing framework of value analysis methods with examples of potential application.

## 3. Different Perspectives of Value in Building and Built Environment Projects

As mentioned previously, different views of value exist in the building and property industry and manifest at different stages during the project life cycle. The following discussion does not aim to be exhaustive in addressing each perspective but rather aims to capture common methods and mindsets among the various disciplines typically involved in building projects

### 3.1. The construction perspective

In the construction context, and at a fairly basic level of inquiry, costs derived from the physical work are typically used as a simplistic surrogate measure of value. The basic principles are well known and primarily vested in measuring the quantity of physical construction work and then estimating associated cost rates according to the units of measure used (Marsden, 2002). At a more advanced level, such data is viewed strategically via the cost planning process and its aims of identifying potential economies, ensuring that expected costs are well-balanced across the various elements in the building, directing design to be accountable to cost, and aligning the budget with tender submissions (Brooks, 2012). Though fine for the internal needs of a project, many issues are still omitted from a broader view of value – primarily because the equation is treated purely as a function of aggregated production costs.

More advanced in scope is the response of the market and the act of testing it when calling for tender submissions on a project. The bidding behaviour of contractors varies according to supply and demand factors, uncertainty, risk, contract conditions and so on. Early studies in this area go back as far as authors such as Uher (1991) and more recently accounts such as the House of Commons Business and Enterprise Committee (2008) from the UK.

In delving further, the likes of lean construction aims to provide a theoretical framework using cues from the manufacturing sector, for realising value as a consumer led objective that is realisable in production methods and applied processes onsite. The basic premise is that the customer wants value in terms of goods and services at the right time, price and quality (Oakland and Marosszeky 2006, 205). Even so, the intention of lean construction tends to focus more on converting these ideals into value based activities in production processes primarily via improved integration, the removal of non-value adding activities and the encouragement of flow in supply chains and delivery processes (Oakland and Marosszeky 2006). Even variants of this approach such as target value design (Zimina et al., 2012) assume an experienced client who can develop a sophisticated project brief and can be involved in actualizing its implementation in production.

Despite the intentions of such approaches, it can be said that they still tend to focus on value from an internal stakeholder's perspective and indeed a supply side perspective. Such approaches do not deal well with the kind of external stakeholders alluded to previously - especially where revolving around end users satisfaction, human activity and the way they respond to precinct scale development, as distinct from individual building projects.

### 3.2. *The property economics perspective*

The property sector focuses more on equating value with valuation. There is still an emphasis on quantifying, measuring and estimating value but instead, this typically revolves around rental levels, yield, capitalisation of net returns and the market value of building when put up for sale (Australian Property Institute, 2007).

Here, supply and demand dictate market prices and so usage value can be determined according to what consumers are prepared to pay for a given building. The ability to define value accurately is reliant on a highly competitive and comparative market of building stock and rental rates. However, a problem arises in large public precinct developments because there is less ability to make comparisons. Further, things like parkland, transport infrastructure and "place-making" do not easily translate into the typical methods of property valuation.

Given this, large public precinct wide projects represent an anomalous situation because the precinct itself needs to attract demand in order to attract people into it. It must work in an interconnected way where the individual buildings must add to something that is greater than the sum of its parts. If this cannot be achieved then those leasing space within will not be prepared to pay premium rents. Further to this, such projects need to represent public value in diverse ways including environmental, social and infrastructure needs. Ideally, these things need to be measurable in order to allow governments and delivery agencies to show that they are meeting required performance levels and spending public money wisely. This is not easily achieved using conventional property valuation methods. Instead, external stakeholders are potentially important in helping internal stakeholders to achieve expected outcomes. Therefore, it can be said that the principles underlying property valuation require supplementation when applied to public and precinct wide developments, including a more user focused view of value; and a means of considering the synergistic value between building development within the precinct.

### 3.3. *The project management perspective*

For large public projects, overarching project management comes under scrutiny as a vehicle for delivering value. Leadership and governance are important in terms of the direction taken in trying to achieve value from such projects. A recent technical report from the Centre for Infrastructure Development in the UK (Gil & Lundrigan 2013) draws together debate among industry experts and academics who identified problematic areas (p2) including who is the ultimate client in large projects; the need to empower the executive team whilst also requiring them to explain their rationale for actions to others. They note that for this to happen there is a need for openness, sincerity, consistency, communication and a willingness to engage with key stakeholders.

A common aspect of project management is value management which has its original roots in Value Analysis (VA) and Value Engineering (Miles 1972). In this context, Thiry (2006, p3) defines value as "..... the relationship between the satisfaction of need and the resources used in achieving that satisfaction". Along these lines, Value Standards started emerging throughout the 1970 to 1990s - as an example, the first Australian New Zealand standard was AS/NZS 4183 (SAI Global, 1994). Predominating concepts include expressing functional needs in terms of purpose but independent of specific solutions; using cross-functional teams to achieve breadth and to increase knowledge; use of a structured process that enables the use of creative thinking. In building on this, Thiry's work is well recognized in the project management field being the first to write a book on Value Management (Thiry, 1997). He advocates a modified process which includes:

1. Sensemaking - including function analysis to understand the situation and arrive at a shared agreement on critical success factors (qualitative expected benefits) and key performance indicators (quantitative measures).
2. Ideation - a process for creative generation of alternatives in innovative ways.

3. Elaboration - where alternatives are evaluated in terms of achievability and contribution to expected benefits to develop viable options.
4. Choice - results in selecting/prioritizing best options.

This offers a good framework for dealing with the ambiguity of stakeholder needs and the complexity of changing business environments. Even so, this and similar approaches are in a generic format and therefore only assist in an over-arching way. They lack specific direction - in this case they lack direction in addressing the specific needs in identifying value for precinct scale built environments projects. There are also changing views about the approaches used in identifying and optimising value in projects. Oliomogbe and Smith (2012) make the point that “Project management value has moved from ideas of 'value management' to ideas of 'understanding how stakeholders value different things’” (p617). They subsequently identify the need to determine which stakeholders have the most influence on a project and whether this will change over time.

Of note, the *spatially related value-metrics* approach proposed in this paper provides a more tailored and built environment specific set of tools that works towards providing finer grained detail about value regarding stakeholder perspectives of value – primarily in the context of end users and human activity. Of note, this can be used to supplement value management and also understanding why stakeholder value different things.

### 3.4. *The broader built environment perspective*

The fragmentation of the built environment disciplines – as distinguished to some extent by the previous subheadings - tends to mean that few consider value in a more holistic sense where value is accountable to the society and environment as a whole. For convenience in making this point, attention is given to a special edition of the highly regarded journal “Building Research and Information” in May 2008. The edition ostensibly revolved around the question as to whether there was need (or not) for a theory of the built environment (Koskela 2008). Theoretical perspectives drawn from that edition include:

- Hillier (2008) – focuses on built environment professionals being able to foresee social outcomes from decisions about the physical and spatial form of the built environment.
- Vischer (2008) – focuses on developing a user-centred theory of the built environment including user’s experience and the user–environment relationship.
- Atkinson(2008) – reviews contributions to the sustainability debate based on the link between asset accounting and indicators of sustainable development.
- Moffatt and Kohler (2008) – take an historical perspective that analyses the concept of the built environment as a social–ecological system.
- Rabeneck (2008) - develops a theoretical scheme of the uncertainties of the product (what to build?) and the process (how to build?), then opts for a transactional framework of building activity moderated by regulation.

Arguably the most notable aspect of these contributions is simply the bias of the authors in focusing on end users, society and the natural environment as the subject of built environment theory – as distinct from production theory and the perspectives raised earlier in the paper. It is also clear that these papers in general terms support the importance of the position taken in this paper concerning an emphasis on end user and human activity outcomes from the built environment. Indeed, the above positions are well aligned with the type of public and precinct scale projects focused upon in this paper. Of note, this larger scale of development begins to unveil the complexities of value in a built environment setting, as distinct from individual “buildings” which more readily defer responsibility for broader concepts of value to urban planning and local government decision-making.

### 3.5. *The human (consumer) perspective*

Following on from the previous discussion (and as alluded to throughout the paper) there is the need to consider a human activity and end user perspective value. Of note, most of the previously discussed perspectives revolve

around the physical nature of the built environment as the central object of interest, but those who use it and subjectively interpret it, will ultimately reflect its true value.

Whilst literature on value in the context of end users and human activity in the built environment is hard to find, much has been written from a more generalist perspective in the marketing and business literature. Here, value is portrayed as being a relativistic decision made by consumers that mediates price and quality - including the specific qualities that differentiate one solution from another. Delving deeper, Holbrook (1994) defines value as “a relativistic (comparative, personal, situational) preference characterizing a subject’s experience of interacting with some object – thus making value partially subjective and objective. The comparative nature of value is most evident in Holbrook’s attention to value as an opportunity cost defined by the difference between a chosen option when compared to the next best contender. Another component of Holbrook’s definition is that “value attaches to an experience and pertains not to the acquisition of an object but rather to the consumption of its services (i.e. its usage or appreciation).” (1994, p28). This is thought to be important in rationalizing value by end users in built environment contexts – especially the public and precinct scale projects focused upon in this paper. This is because as previously mentioned, the precinct must preferentially attract people to the location given competition from other precincts. This is separate to the other aspects of value discussed previously, but without it, a precinct lacks demand and therefore, the previous forms of value are less tenable on their own.

The problem that remains is the need to flesh out in detail how to measure this form of value - based on end user behaviour, human activity and urban vibrancy. This is not easy given changing dynamics, human usage patterns and external influences. There are also the myriad of government authorities and departments which have overlapping interests in a precinct but have potentially different views on how the public should engage with such space and subsequently how it should be designed to function correctly.

This creates the subsequent need to further explore and profile value from an end user and human activity perspective - especially in the way people relate to the space, how they move through it, how they chose to link or avoid spaces, and how long they choose to stay in the locality. Further, how is this value created and captured in the design of the precinct and maintained over its operational life.

#### **4. Introducing the concept of spatially related value-metrics**

Spatially related value-metrics is offered here as a new concept aimed at bridging some of the gaps mentioned in the previous discussion. It is inspired by existing concepts such as *spatial economics* which uses modelling to spatially link economics with insights from other disciplines such as geography and urban planning i.e. as a means of explaining where economic activity occurs and why (Fujita et al, 1999). Even so, the approach proposed here has some specific features in terms of:

- its emphasis on value and the built environment (seen as an interconnected system that provides service to end users and society);
- its intended level of detail in identifying individual buildings and facilities, and the linkages both within and with either adjoining infrastructure or urban areas;
- its emphasis on recording real time usage of such spaces by individual end users and the translation of this into measurement of human activity including social, business, urban and architectural aspects of usage;

The aim is to quantitatively identify themes and trends derived from usage and human activity data and correlate this with other forms of quantitative value data, but to present this in a visual 3D model of the built environment to enable improved understanding of complex issues and thus facilitate improved decision making. For instance human activity could be correlated with the location of individual buildings (such as office buildings, cultural centers, restaurants) and this could then be linked to rental returns or the turnover attained by restaurants and cafes. This could be analyzed at different times of the week to better understand the differences between week day and weekend usage patterns. Hence it becomes more realistic to include and link objective value with the previously discussed, subjectively perceived value. It also becomes easier to identify synergy between the parts that make up the precinct i.e. which bits coordinate well together from an end user and human activity perspective.

As an example of how this could be put into action, it would be possible to measure street activity attained for a certain mix of building types in a given precinct (including residential, commercial, retail), as associated with a popular precinct, and then use data to help inform design in a new precinct location. It would also be possible to identify population levels at the periphery of the new precinct and then widening circles around it, to determine how many people can be drawn in from adjoining precincts and how many must be coaxed in from further afield. Finally, it could be used once the precinct is operational to determine how the area could be improved by adapting the space. For instance, upgrading the access to food using the likes of coffee carts and adding side style events may help link areas within the precinct which previously suffered from isolation.

Though some other approaches touch on similar methodologies, most do not record or use real time user data and instead use generalised demographic data that tends to be less accurate in predicting usage patterns for a given location because assumptions are taken from a much broader population.

## 5. Implementation using “virtually integrated project information modelling”

*Virtually integrated project information modelling* (VIPIM) is ostensibly an adaptation of existing technologies whereby the chosen name depicts and responds to its intended application. It aims to provide a technology driven means of functionally implementing the *spatially related value-metrics* concept described previously, for precinct scale built environment projects. Here, Building Information Modelling (BIM) is applied at a precinct scale instead of building scale - there is less emphasis on fine grain detail inside the building and instead, the main emphasis is on key buildings, infrastructure and areas within the precinct. As Eastman et al (2011) elaborate, BIM typically involves an intelligent 3D design of a building and then integrates the likes of a 4th dimension (i.e. time scheduling and process modelling) and a 5th dimension (i.e. cost modelling). Here, it is intended that the precinct scale manifestation of BIM will only carry higher level cost, valuation, rental, yield and time scheduling information i.e. for the main building stock, infrastructure and public areas. Obviously, other dimensions (N dimensions) are also possible and of note, VIPIM aims to extend this by adding end user and human activity patterns as an extra dimension i.e. using Geographic Information System (GIS) technology to harness the recorded real time human activity data and then to map this onto the 3D model. Incorporated in this is the need to include real time locating systems and GPS technology to map how people use the space and how long they spend within it. Similarly, there is the potential to track vehicle, public transport and other movement data onto the 3D Model.

Hence, the VIPIM approach aims to provide a strategic tool to help decide, evaluate and adapt value within the context of large public precinct projects. It also provides a transparent platform for negotiation and collaboration among stakeholders and should reduce confusion about performance measurement because most issues can be linked to modeled objects such as buildings, infrastructure and recreational areas. Key Aims of VIPIM:

- To simplify communication through visualisation of spatially related value-metrics data.
- To provide a much needed vehicle for facilitating collaborative decision making including simplified presentation of information, rapid absorption of information and reduced risk of confusion.
- To increase value through synergy – as provided by an improved ability to understand complex interdependencies and jointly optimise outcomes.
- To identify and measure built environment value in new ways including the interconnected and spatial relationship between buildings – especially as perceived by usage and human activity patterns.
- To record and analyse real time usage data once the development is occupied about building rental rates, logistics for peak events, public transport, advertising and adaptation of the space for improved usage.
- To conduct multi-faceted simulation and behavioural usage of public space to assist optimum decision making.
- To undertake post project evaluation and facilitate ongoing adaptation of the space.

The VIPIM approach is a concept under development but is realistically possible, using existing technologies.

## 6. Case Study of a Public Precinct Scale Urban Renewal Project (Barangaroo)

The Barangaroo project is currently under development on the periphery of Sydney's central business district and is used here as a case study to tease-out issues raised in the previous discussion - particularly in terms of displaying the relevance of both *spatially related value-metrics* and the related need to incorporate value from an end-user and human activity perspective (being consumers of the space).

Barangaroo represents the largest urban renewal project in Australia this century, valued at over \$6billion and will evolve over the next 10 to 20 years (BDA, 2012a). It involves some 22 hectares of area which was previously used as foreshore storage area for shipping containers and is now ripe for higher and better land use (BDA, 2012). Some of the features include the bounding harbour foreshore as well as being in close walking distance to the city's iconic Harbour Bridge, the city's CBD and the Darling Harbour entertainment precinct.

Plans for the site revolve around three sectors including a large foreshore park; a commercial and high density residential sector; and a sector devoted to innovation, cultural, civic and entertainment activities ((BDA, 2012a).

The Governance structure for the project is largely vested in the Barangaroo Delivery Authority (BDA, 2012b) which was set up under a government Act in 2009. The Authority's stated objectives are reflective of a number of the value-based issues raised in the previous discussion including the need to make Barangaroo:

- A proud addition to Sydney, acclaimed globally for its innovative and inspiring architecture, public spaces and iconic cultural attractions.
- A dynamic and connected world class CBD precinct giving the waterfront back to Sydneysiders to work, live and play, alive with 100,000 people every day of the week.
- Carbon neutral, water positive and zero waste: defining Sydney, NSW and Australia as a world leader in environmental and social sustainability.
- A \$6 billion financial services headquarters and public domain built by the private sector. A long-term revenue producer for the State generating more than \$1.5 billion annually to the economy and a cultural investment.
- A major catalyst for Greater Sydney's physical and functional transformation to reaffirm its position as Australia's number one city.

(BDA, 2012b)

The above objectives reflect a different perspective of value compared to purely commercial projects. Many of the stated objectives aim to benefit the end user, human activity and societal outcomes – as emphasized throughout this paper. These beneficiaries are primarily the so called “external stakeholders” mentioned earlier in the paper and even though BDA represents the main client and therefore an “internal stakeholder”, the objectives of the two positions appear to be aligned in terms of expected outcomes. Even so, a broader mix of stakeholders are involved in including a mix of government stakeholders who BDA must liaise with including:

- Sydney Harbour Foreshore Authority
- Tourism New South Wales
- Infrastructure New South Wales
- Sydney City Council
- New South Wales police
- Transport New South Wales from
- Sydney International Convention and exhibition and entertainment precinct

It is relevant to make the point that all of these organisations have vested interests and therefore different perspectives of value regarding the Barangaroo development. Further, the development involves long term leasing of the certain portions of land which allows private development to take place. Consequently, there are binding interdependencies if value is to be optimised within the precinct.

It is therefore asserted that in order to make the most of the project, there is a need to view the precinct in terms of a complex system of interconnected buildings, infrastructure and recreational areas. There is the need to create



value through synergy but this is often neglected in many existing approaches to value because each building is often dealt with in isolation of the others.

To make this point more fully, the determination of value in public projects such as Barangaroo is guided by public policy documents such as the NSW Government Guide to Economic Appraisal (NSW Treasury, 2007). It provides a structured framework for appraising assets and the subsequent allocation of public sector resources including things like:

- Up-front capital costs and ongoing recurrent costs
- The systematic evaluation of alternatives
- The quantification of benefits and re-examination of strategic objectives
- The management of assets
- The ongoing assessment of the performance of such assets.

In preparing an economic appraisal under this framework, it is standard practice to identify and analyse different options, benefits, costs and qualitative factors. It is also common to undertake sensitivity testing and post implementation reviews. Decision-making can be undertaken in the context of screening processes, choices between mutually exclusive projects, and ranking of the main options under consideration.

The argument for using spatially related value-metrics is set against this backdrop and aims to improve and extend upon the main methods called upon such as Cost Benefit Analysis (CBA) and Cost Effectiveness Analysis (CEA). CBA is – under the NSW Government Guide to Economic Appraisal – used where sound and reliable monetary information is available, thus allowing comparison between different project options. CEA is used where the major benefits cannot be valued in monetary terms but where comparison between options with similar objectives, is possible. It can be readily applied where social as opposed to economic outcomes are important.

In an overall sense, both methods leave significant and unattended gaps in the appraisal of value especially on the likes of the Barangaroo project. When many different agencies are involved, the inability to deal with complex interdependencies can cause an unwanted disaggregation of costs and benefits. The lack of knowledge pooling can also limit the ability to avoid unnecessary group costs and the ability to realise areas of group gain.

This is where the use of spatially related value-metrics has potential because it aims to offer a strategic framework which can facilitate and integrate decision making. It allows data to be appended to specific assets (such as buildings), without foregoing a networked view of the value proposition offered by the broader project.

## 7. Conclusion

The paper contributes a new and technically progressive means of conceptualising and managing value in large and complex built environment projects by introducing the idea of *spatially related value-metrics* and by operationalising it using *virtually integrated precinct information modelling*. It aims to assist and extend the sophistication of existing approaches to calculating value. The case study project demonstrates how and why this approach could be useful to precinct scale developments. It serves to firstly demonstrate that greater attention is required in measuring value in terms of end user and human activity including the way they interpret and use the built environment from a spatial standpoint – thus explaining demand generated by a precinct. Secondly, the case demonstrates why greater attention in precinct developments is required in understanding how an amalgam of buildings and spaces (constituting a built environment as opposed to an individual building project) work as a complex network in providing value, and that for end users, this may be as much about subjectively perceived value as it is about objective value.

The concept can be delivered by joining a number of existing digital technologies including BIM, GIS, GPS and real time locating systems. Consequently, 3-D modelling of the built environment space allows a variety of value concepts to be viewed within a common framework hence facilitating the ability to analyse, and collaborate among stakeholders, with a view to engineering and optimising value in projects. Here, BIM is realigned to meet precinct scale by changing the level of detail to a more strategic level of inquiry.

Future work will focus on implementing the proposed approach on an active project with input from both the project management team and a spectrum of stakeholders. End user data arising from the project will be analysed with a view to its usage in the project decision making processes. Periodically, the approach will be evaluated and tweaked accordingly to improve its effectiveness.

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