

Siting Major Public Facilities: Facts, Values, and Accountability

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Abstract: Government agencies and other organizations responsive to a diverse constituency face enormous challenges in identifying priority sites for relocation, expansion, or new development. Of paramount importance is establishing transparent decision processes that reach accountable, defensible, and wise outcomes. Unfortunately, documented examples of successful approaches to evaluation, prioritization, and site selection are scarce. The purpose of this paper is to both offer a descriptive case study and an intellectually rigorous, fundamentally practical “best practice” approach for identifying priority sites. By employing value-focused thinking and decision analysis techniques to a complex site selection problem, we present a way to address common challenges such as potential technical and nontechnical knowledge conflicts, distinguishing between “facts” and “values,” incorporating uncertainties, generating criteria weights, making trade-offs and building consensus across interests. Our approach is contextualized in a Canadian government case study of relocating a \$300 million dollar facility.

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Introduction

Overview

From corporate headquarter relocation to waste disposal sites, responsible parties such as property developers, corporations, and government agencies are faced with the challenge of identifying the best site for locating a facility. Despite the wide array of siting issues, the core test remains the same: how is “best” defined, who should be defining best, and how is it measured? This is not a simple task. Numerous facts, values, objectives, stakeholders, constraints, and criteria confound even relatively straightforward site selection problems. In the absence of a clear process and framework, site selection choices are vulnerable to well-intended oversimplification or exposure to outside political pressure. Potential downsides include public outcry and suboptimal site selection. Our experience suggests that what is needed is an approach to site selection that clearly separates facts from values and embraces a process that is thorough, inclusive, and transparent. The results of such a process should be highly defensible and easily communicated, whether explaining site choices to a board of directors, to the general public, or communicating between decision makers and staff.

Despite the widespread need for good examples, there are few case studies in the literature that outline an approach that can be broadly applied. The purpose of this paper is to help close this

gap by outlining a sensible decision and process support (DPS) approach for site selection for a corporate headquarters facility. This paper is particularly relevant to industry practitioners who can adopt the process outlined in order to develop workable criteria and measures, and to explore the impact of values on the decision making process. Using this approach will also help to minimize the polarization and politicizing of the site selection process, and ultimately the decision itself, by focusing on the importance of the criteria before examining the range of site alternatives. The paper first outlines the common approaches used by industry practitioners in the site acquisition phase of a construction project. Next, we introduce the case study project and the site selection process adopted for this project. Finally, we draw conclusion on the broader applicability of the approach.

Perspectives in Site Selection Problems

Developing an approach to site selection requires integrating several perspectives. One comes from technical experts, such as security professionals, engineers, architects, environmental scientists, or human resource specialists. Each technical expert has some idea of what qualities define a property as “best.” A second perspective is that of accountable decision makers who not only bring additional ideas about what is a high quality site, they are also expected to balance competing interests, multiple objectives, stakeholder values, and a variety of risks that are an inherent part of site selection decisions. What we have observed as common practice is an informal decision process based on an opportunistic and reactionary approach where staff put forward a limited number of sites based on poorly defined decision criteria. Experts and decision makers are then asked to choose a site and rationalize their decision with a limited set of objectives (e.g., such as cost and availability). A step up from this approach is for technical experts within an organization to develop the site selection criteria and score site alternatives. Site selection is therefore approached as a constrained optimization problem with limited treatment of project/corporate objectives. While certainly devel-

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opment of criteria is more rigorous than the informal approach, these methods suffer from the “black box syndrome” that limits both the transparency of how these criteria were developed and the involvement of the decision makers who are ultimately accountable to the final site selected. All these approaches can alienate stakeholders and tend to have technical “hard data” (e.g., cost criteria drive out more qualitative criteria, or “soft data” (e.g., quality of life).

Approach

The approach introduced in this paper builds on the substantial body of work in location theory, particularly in the siting of undesirable facilities [see ReVelle and Eiselt (2005); Klose and Drexler (2003)], the use of objective functions to optimize facility siting (Flahaut et al. 2002) and the use of the analytical hierarchy process technique to improve site selection decisions (McIntyre and Parfitt 1998). However, it is the goal of this paper to go beyond static and deterministic problem formulations and provide help to practitioners facing real world problems such as the influence of stakeholders with a wide range of interests, limited data, inherent uncertainty, and values (Owen and Daskin 1998). In addition, our approach offers a practical and straightforward method that avoids some of the confusion and potential pitfalls associated with the alternative choice applications [e.g., analytical hierarchy process (AHP) (Dyer 1990; Harker and Vargas 1990; Saaty 1990; Holder 1991)].

The approach discussed in this paper is based on a facilitated participatory process, using negotiation theory as a framework guide. Much of the core methodology of decision and process support referred to herein as DPS, is derived from multicriteria and expressed preference methods coming from the field of decision analysis (Keeney von Winterfeldt 1991; von Winterfeldt and Edwards 1986; Clemen 1996; Keeney 1992). The approach incorporates constraints, clarifies technical and nontechnical criteria and integrates the values of the stakeholders. Importantly, as the DPS name suggests, it is used to support the decision process, not replace it. This means that accountability stays with the responsible parties (decision makers and managers). The expanded inclusiveness and additional insight gained by using this approach improves site selection outcomes, facilitates legitimacy, minimizes conflicts, and allows for key tradeoffs (both technical and value based) to be productively addressed. The approach can be broken down into three tasks, as described below.

The first task is identifying what is important (values or objectives) by defining a complete range of decision-relevant criteria and practical constraints. This necessarily requires taking a participatory approach, working with all those interested, involved, or potentially impacted in the selection of a site. By eliciting from these participants factors that are important in the context of the site selection problem, an unambiguous list, or hierarchy, of structured criteria can be generated. The hierarchy of criteria frames the problem and helps refine stakeholders' thinking by providing a framework for systematically appraising site selection choices. The second task is to establish clear criteria attributes. These are the performance measures used to test how well alternative sites satisfy the criteria, within the defined constraints. Establishing clear performance measures greatly facilitates communication by clarifying what exactly the criteria mean, as well as being essential to conducting a consistent, quantified analysis. The third task is to explore and incorporate value-based information in the form of relative value weights. There are several techniques available to derive these weights such as swing weighting or pairwise com-

parisons (Hobbs and Horn 1997). The basic concept is to determine which change between different performance measures is most important (i.e., is a cost savings of \$2 million dollars more or less important than an average daily per staff time saving of 10 min from a reduced commute). For a single decision maker, this process is relatively straightforward. Where there are multiple decision makers, the use of a facilitator who is knowledgeable of decision tools and techniques has the experience facilitating multidisciplinary groups becomes a key component in the success of the approach.

Once both the technical information from the performance measures and the value weights are agreed upon, this quantitative information is used to develop simple algorithms to rank and sort site choices which provides insights into tradeoffs that need to be made in the identification of priority acquisition decisions. Qualitative information is used to support the ranking and to improve communication. Spreadsheets can be easily developed to model and support the process, providing instant feedback and results, and can be helpful in group settings to communicate the value systems of the multiple decision makers.

Case Study: Headquarter Relocation

In order to illustrate features of the site selection process introduced, we apply it to a unique building infrastructure project proposed for construction by 2011 in the Metro Vancouver. Trousdale and Nelms were asked to develop and implement an accountable and transparent site acquisition process that would include economic, social, environmental, and technical decision criteria. One writer of this paper (Nelms) was on the project management team for over two years and was therefore familiar with all technical and user requirements of the project. The project is both capital and operationally intensive with a proposed budget in the order of \$300 million dollars and a construction period in excess of 2 years. The facility is proposed to accommodate 1,800 employees in a new 55,000 rentable square meters consolidated facility. The volatility in the construction market place, high client involvement in the site selection and design phases because of the uniqueness of the functional program, special technical performance requirements, and the multiplicity of stakeholders including all three levels of government are just some of the complexities of the project which make it unique.

It is anticipated that the tenant organization will enter into a lease agreement with the contracting organization who will own the facility. This results in a multiplicity of organizations being involved, which complicates the decision making process to meet the program requirements of the two primary organizations, and brings in risks related to long time lines to reach consensus. The potential for a change in government leadership, or changes in organizational policies (of both organizations) in a government environment that is in flux highlights the need for effective communication between regional and national offices as well as between organizations, and the need for a process that can track the evolution of decision making over time and justify the final decision made. Other project stakeholders include government authorities from all three levels of government. In addition, the tenant organization has service delivery responsibilities to the public and to other government agencies.

It is uncommon for a facility of this size and with the unique program requirements to be constructed in the region. The tenant organization tends to be influenced by world events, and how best they respond to complex domestic or international situations

Table 1. Simplified Overview of Sequential Screening Process for Potential New Building Sites

| Phase | Comments |
|---|---|
| Phase 1. Regional screening technical analysis using mandatory technical criteria | The region of interest for HQ site selection is reduced through mandatory requirements at a regional level. |
| Phase 2. Site analysis using mandatory criteria | Number of potential sites is reduced through technical analysis using mandatory criteria requirements at a site level. |
| Phase 3. Site analysis using preferential criteria | <ol style="list-style-type: none"> 1. Number of sites is reduced through first a technical analysis of preferred criteria. Technical scores indicate dominance analysis/red flags to minimize the smaller number of potential sites for detailed analysis 2. Value weights are elicited from Senior Managers and applied to performance measures (technical scores \times value weights). Number of sites is reduced through a preferential analysis using weighted performance measures to arrive at a smaller number of potential sites for detailed analysis. |
| Phase 4. Final due diligence and negotiation | Subject to detailed analysis, final candidate sites from Phase 4 are examined with a focus on key tradeoffs and requisite due diligence. Negotiation with landowners is initiated and a final decision made. |

makes it difficult for the scoping of site selection and associated technical requirements. In addition, the tenant organization has changing needs, which has implications for the flexibility in the building site to accommodate future changes, as well as technical, security, postdisaster, and environmental design performance requirements. As a result, there is a substantial risk that the selected site will not be responsive to user needs at the time of building occupancy, a primary risk that the project team wishes to ensure is minimized.

Decision Support Process

The decision support process followed in this project applied the process described earlier and contextualized it in a simple three-step process. The first step was to define the problem. Above all, the tenant and contracting organizations wanted a site selection process that was rigorous and practical, and would result in identifying the best potential site. The project manager required a process that would result in a transparent and easily communicated set of site requirements and preferred qualities to assist with the communication of decision criteria in a complex stakeholder environment of a technically sophisticated facility that was flexible to changes in both the owner and tenant organizational and operational policies.

The second step involved identifying interested, involved and knowledgeable parties, or stakeholders, to work through the issues related to the potential construction of the new facility. Starting with contracting organization senior management, where final accountability rests, an initial set of key issues and stakeholders was generated. We then reviewed both the contracting and tenant organizations national and regional strategies and developed a preliminary list of mandatory and preferential site selection criteria. Interviews were then initiated with experts within both organizations, technical and nontechnical staff, and other relevant government agencies to refine the criteria to be more specific to the decision context. These expert interviews allowed us to generate initial performance measures and identify key data gaps that would help distinguish between sites. We also used these interviews to translate objectives outlined in the national and regional strategies, which are broad in context, to objectives that are applicable in the site selection process. These interviews were iterative as multiple technical experts were consulted with to review all performance measures and units to come up with relative mea-

asures based on available data and judgment and to provide qualitative support and explanations. This includes suggestions for developing indices, indicators, constructed scales, or proxy performance measures. The goal of this step was to develop measures that were relatively accurate (rather than absolute) and provide basic insight into the objective.

The third step was to structure the problem. This required translating the issues into a criteria-based analytical framework with clear performance measures. Central to this was understanding the issues so that means and ends criteria could be separated, as could regional and site specific aspects, mandatory site requirements, preferential site criteria, and influencing factors. Steps two and three were iterative, as the additional insight derived during this step uncovered more stakeholders and issues. Based on the information gathered, we developed with Senior Management a phased decision process as summarized in Table 1 and discussed further in the following section. A phased approach was developed as a time saving exercise to narrow the list of candidate sites to a manageable few.

Description of Decision Support Framework

Phase 1. Regional Screening

Phase 1 involved the identification of priority areas as opposed to sites. Two mandatory criteria were identified for use in the regional evaluation. First, it was required that the site not be located in areas with zoning that was not available for development, such as provincial parks or the provincial agricultural land reserve. Second, it was required that the site meet basic emergency preparedness requirements with respect to the avoidance of large-scale disaster areas covered by two subcriteria: flood risk and seismic risk. Areas that did not meet defined minimum standards of acceptance were excluded from further consideration (e.g., the site must be located outside the 200-year flood zone). Because the new facility was proposed to include a postdisaster unit, the second subcriteria included the requirement that the facility be located south of river to ensure regional distribution of facilities with postdisaster functions (in this case, a facility with postdisaster functions was located north of the river).

Phase 2. Site Analysis Using Mandatory Criteria

After the regional evaluation was complete, potential sites within these regions could be evaluated. Phase 2 involved the evaluation of sites using three mandatory site-specific criteria. First, the site had to have a minimum size to accommodate the tenant organization user and expansion flexibility requirements. Technical experts estimated the number of full time equivalent employees that would occupy the facility, parking requirements and uses to define minimum site areas. For example, based on a 25-year planning horizon for the new facility, it was determined that site size and configuration provide for a minimum 25% future expansion of employees housed at the site (therefore, effectively 2,250 full time employees), including area for additional parking. Further minimum size requirements included basic environmental setbacks from the high water mark of water bodies and a physical security perimeter around and between the proposed building footprints. The second mandatory criteria involved meeting the contracting organization's basic adjacent land use, prior land use and access requirements. Third, to be considered, the potential site must have a reasonable chance to have a final negotiated price within the approved maximum amount allocated to site acquisition in the project budget.

Phase 3. Site Analysis Using Preferential Criteria

Each site satisfying the Phase 2 mandatory criteria was evaluated using eight fundamental preferential criteria. The practical reality of site selection is that no site is optimal for every criterion. Therefore, a clear way to evaluate the implications of imperfection is done through preferential criteria. As the name suggests, preferred criteria could be traded off against each other. In other words, a little more flexibility to accommodate existing and future program requirements might be traded off against improved service delivery.

Promote Tenant Organizations Service Delivery

A fundamental reason for the construction of a new facility by the tenant organization was to improve service delivery well into the 21st century. Two service delivery criteria, operational response and business travel, were identified as contributing to this objective. Operational response was defined as travel directly related to the fundamental performance requirements of the organization. This was measured in travel time, using models that account for traffic during different times of the day and type of road (e.g., 2 lane rural versus freeway). The second service delivery criteria, business travel, was defined as the travel related to meeting internal or external clients and partners to discuss programs or administrative matters.

Encourage Staff Retention and Recruitment

Another significant issue, with site selection implications, facing the tenant organization's management was staff retention and recruitment. Potential factors that were necessary to consider included: commute time, affordable housing, staff safety, and the attractiveness of the new work location. Minimizing staff commute time was an issue in staffing and was affected by the accessibility of the site by both public transit and private automobile. Challenges that arose in the evaluation of this criteria included the identification of where the staff currently live, the potential for moving nearer to the new building, and choice of transit. The

potential for staff to move nearer to the new building was related to access to affordable housing. Another issue considered in this preferential criteria was the safety and security of the staff. The personal safety and security of employees could be enhanced not only by the location of the site but also the opportunities the site offers for building and landscape design by using such approaches as crime prevention through environmental design (CPTED) principles and defensive layering. A final issue that was made clear in interviews with staff representatives was that the new location should be attractive. The new site should contribute to "live-work-play" opportunities by providing easy access from the new building site to service and retail nodes, trail systems, and parks. These factors were deemed desirable for a supportive work environment and staff satisfaction.

Promote Flexibility to Accommodate Existing and Future Program Requirements

Site location and shape would impact its ability to accommodate existing and future program requirements in new facility design. Already established as a minimum standard in Phase 2, it was recognized that different sites will offer advantages allowing for more, or less, flexibility in the facility design, including current proposed use and future potential use. Limiting factors that may inhibit flexibility included site size, shape, and geographic constraints. Considering buffer requirements for security and environment, usable acreage was a proxy for flexibility. A second aspect that was considered was the access to the site itself. For example, corner lots that facilitate automobile access are preferred as are sites that provide access to major arterials, including number of arterials and their distance from the site.

Support Environmental Sustainability

Supporting, promoting, or just being consistent with environmental sustainability is a common theme. However, it is often not adequately described or measured, and therefore is not adequately addressed in most site selection challenges. For the new facility site selection, the issue of environmental sustainability was addressed through four criteria. First, it was to be compatible with the Regional District's Livable Region Strategy. The second criteria was simply to minimize environmental impacts. To do this, the site would need to support more general organizational initiatives and environmental objectives with respect to both the contracting and tenant organizations. Also, the preferred sites would be sites where environmental impacts are avoidable or easily mitigated, considering species and habitat, (flora/fauna), sensitive areas, hydrology, drainage, land forms, and regulations. Third, in addition to minimizing environmental impact, the site selection process would give preference to sites where there was an opportunity to promote environmental improvement. These would include brown-field site cleanup opportunities, redevelopment sites, and habitat restoration opportunities. Of course, detailed assessment would be conducted as part of the final evaluation and environmental issues would be part of removing "subject to" conditions prior to acquisition. Fourth, was to promote sustainable building principles. It was recognized by technical staff that the some sites would have favorable attributes for implementing a "green building" or environmental technologies, including opportunities for on-site water, waste-water, and storm-water self sufficiency.

Encourage Public Acceptance and Positive Corporate Image

Public acceptance and image are important to the tenant organization. The selection of a site for the new facility would need to be responsive to the general public, in particular neighbors, and sited to promote a positive corporate image. In practice this meant two things. First, local business and community impacts should be minimal. Site selection would consider the contributions of the tenant organization to local traffic congestion, increases to local commute time, local truck route interference, ambient noise levels (in particular related to helicopter access routes), and visual impacts. Second, the sheer size of the facility would suggest that it could have visibility issues associated with it. The tenant organization was interested in encouraging a positive corporate image by giving preference to potential sites with public visibility, where the prestige and presence associated with the tenant organization could be highlighted. This meant that visibility from major arterials and transportation routes would be desirable.

Promote Positive Partnerships (Current and Future)

Working together with government agencies and multiple levels of government was also considered to be desirable by the tenant organization. The site selection could embrace opportunities for federal, provincial, and municipal partnerships to achieve greater value from expenditures by the tenant organization, such as favoring sites that offer opportunities for collocation and complementary services with governmental organizations.

Promote “On-Time” Project Schedule

Of critical importance was the minimization of potential project schedule delays. Schedule delays can result in significant project costs and were therefore undesirable. Preferred sites would be sites that offer a minimum of potential development delays, such as delays caused by removing “subject to” clauses, permit process delays, and delays related to assurances on compatibility of future use zoning.

Minimize Costs

Cost is always a fundamental issue, and one with an array of variables associated with it. Of course, the purchase cost would need to be within the allotted budget as a prerequisite for consideration. However, it was agreed that site development costs should also be considered in the evaluation. This included reviewing aspects related to site geotechnical conditions (e.g., soil type, drainage excavation requirements etc.), the presence and capacity of utilities (water sewer, electricity, gas, fiber optics, and cable feed), environmental mitigation, protection or enhancement costs, and threat risk assessment mitigation costs to address security risks identified by the tenant organization.

Developing Measures

To make the criteria meaningful so that the sites could be consistently compared, measures are required. Some of the measures were “natural” measures, which are widely recognized. Cost, measured in dollars, is one such measure. For example, minimizing costs associated with site development is an exercise in estimating costs and pricing them out. In other cases, natural measures were combined with proxy measures. For example, ac-

cess to affordable housing used cost in dollars as the measure, but the proxy was the average cost for a three-bedroom detached two-level house in a 10 km radius to the site. Similarly, the use of travel time to respond to an occurrence was used as an indicator for service delivery and average roundtrip drive time (staff home-new facility) using personal vehicle was used as a proxy indicator for commute times.

Still, other criteria were unique to the new facility site selection process and required the development of “constructed” measures [see Keeney (1992)]. Most are familiar with constructed measures, such as “high, medium, low,” or a “1 (worst) to 10 (best)” scale. Two aspects of developing constructed measures are important to highlight here are first, to establish consistency and legitimacy in such a system of measure, these scales need to be defined. These can be single attribute scales such as what was used for avoiding project delay with a score of “2” for “no delays expected (less than 4 months)” a score of “1” for “delays are mitigable and negligible (4–12 months)” or a score of 0 for “long delays expected, not controllable (such as dependant on a regulatory authority) or high technical requirements.” For other criteria, such as the attractiveness of the work location, a multiattribute index was developed and then given a score: 0–2 if the site is within walking distance (under 0.5 km) to public park, green space, or nature trail system and an additional score of 0–4 if the site offers positive urban aesthetics such as historic buildings, pleasantly treed or landscaped, diverse mid to upscale services and small retail outlets, absence of institutional buildings and derelict or semiderelict spaces. The development of such constructed measures provides a means for helping experts agree on the meaning of criteria and for participants to make tradeoffs between different levels of both easy- and hard-to-define values relevant to the decision at hand (Trousdale and Gregory 2004). Because getting experts to agree on consistent measures, the use of formal expert judgment solicitation was undertaken (Keeney and von Winterfeldt 1991). This was especially useful in areas where uncertainty and data gaps of many technical attributes affecting the anticipated consequences of selecting alternative sites, such as those surrounding security.

With the measures in place, technical staff assessed a full range of potential sites. This activity helped to test the adequacy of the performance measures and to establish the range of potential impact each criteria might have on the site selection decision. Having an understanding of the range, “best to worst,” for each criteria established the required context and is a prerequisite for making meaningful value judgments as part of Phase 4 of the decision process. For example, affordable housing across the sites ranged from a best of \$297,000 to a worst of \$355,000 using the proxy measure of an average cost for a three-bedroom-detached two-level house in a 10 km radius to the site.

Providing Value Judgments

To prioritize the candidate sites, value input quantified as a “weight,” is required. This weight provides insight into the relative importance of the range of the technical scores for each fundamental and subcriteria. To achieve this, a two-hour meeting with both the tenant and contracting organizations senior management, ultimately the accountable decision makers, was held. Senior management participants were sent a premeeting package that included a detailed explanation of the criteria and measures as well as information related to the test sites that were used to establish the range of measures. Also included was a set of exercises in a workbook. These exercises were used to solicit

Table 2. Example of a Subcriteria Ranking and Weighting Exercise for the Primary Criteria “Staff Retention and Recruitment”

| Rank | Weight | Subcriteria | Worst | Best | Comments |
|------|--------|---|-----------|-----------|---|
| | | Staff commute time | 93 | 63 | Average round-trip drive time (home-HQ) using personal vehicle |
| | | Access to affordable housing | \$355,000 | \$297,000 | Average cost for a 3 bedroom detached 2 level house in a 10 km radius to the site (\$) |
| | | Staff safety, crime prevention through environmental design | 0 | 3 | - Topography meets DIVISION surveillance requirements (Yes=1/No=0) - Site is conducive to DIVISION security (Note: if security on the site is unacceptable, site will not be considered in this phase of evaluation; also priority sites will be subject to a final detailed evaluation) 0=high security concerns; 1=mod; 2=low Total out of a possible category score: 0–3 pts |
| | | Attractive work location | 0 | 6 | 0–2: Walking distance (under 0.5 km) to public park, green space, or nature trail system 0–4: Urban aesthetics—workplace is in area of historic buildings, pleasantly treed or landscaped, offers diverse mid- to upscale services and small retail outlets, absence of institutional buildings and derelict or semiderelict spaces Total out of a possible category score: 0–8 pts |

the value weights. The worksheets were designed as a swing-weighting exercise (von Winterfelt and Edwards 1986). The worksheet asked senior management to consider a range of possible outcomes, from worst to best, for each fundamental and subcriteria. Although the information was provided prior to the meeting, the exercise itself was conducted at the meeting so that clarifications could be made.

Senior management were asked first to rank order the criteria. Then they were asked to weight them on a scale of 1–100, with 100 associated with the criteria they ranked as number 1 (see Table 2 for an example). Each senior manager independently developed his or her own set of value weights. During the break, these weights were entered into an interactive spreadsheet computer model developed specifically for this meeting. The model normalized each manager’s score and these were placed on the screen next to each other so that participants could compare and discuss similarities and differences, which the model automatically highlighted. The advantage of this approach was that key value differences could be discussed, perceptions separated from reality, and unnecessary conflict avoided. The ultimate goal was to develop a consensus set of weights, rationalized, and agreed upon by senior management that could ultimately be applied to the potential sites. Through this process, consensus was quickly achieved with all senior managers having a mutual understanding of the priorities. With both the technical site scores and the value weights quantified, it is possible to combine these and come up with a weighted score to prioritize sites as they are evaluated.

Once value weights are quantified and value independence is established, the combination rule for additive functions is applied. An additive function, given criteria x_1, \dots, x_N , $N \geq 2$, can be written as

$$U(x_1, \dots, x_N) = \sum_{i=1}^N k_i u_i(x_i)$$

where U =overall value (in this case the weighted property evaluation score); and the k_i =value weights showing the relative contribution to the overall value from a change in a specific criteria, x_i . The u_i are technical scores, (or the single attribute utility functions), one for each of the x_i criteria (Keeney 1992).

Phase 4. Final Due Diligence and Negotiation

One advantage of the decision model provided an objective and rigorous method to identify the best sites and distinguish between them (e.g., why is Site A scoring higher than Site B). Nevertheless, it is a decision aid and does not replace final decision making. It does however help internal communication by clarifying the main reasons why sites score differently, as well it provides the staff that must negotiate sites with more information about the best sites and perhaps even more importantly, what priorities the senior management have so that these can be pursued in the negotiation.

Conclusion

There are many advantages to undertaking a more thoughtful and rigorous approach to site evaluation and selection. First, and most importantly, it will improve the quality of decision making by facilitating clear thinking and good communication. Furthermore, because of the improved communication, internal conflict is also reduced between decision makers and staff. An explicit process also helps to insulate against charges of favoritism or other accusations that often arise in scrutinized processes that can, in the extreme case, result in legal challenges. Finally, thoughtful application of the DPS approach should not result in additional costs or time requirements. In fact, because of the higher level of transparency, the ability to quickly evaluate sites over time and improved communication, both time and cost should be reduced over the entire planning phase of the project.

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