ROADMAP FOR THE INTEGRATED DESIGN PROCESS
PART ONE: SUMMARY GUIDE
This document has been compiled by Busby Perkins+Will and Stantec Consulting for the BC Green Building Roundtable (BC Hydro, Canada Green Building Council, Canada Mortgage & Housing Corporation, Cascadia Region Green Building Council, City of Vancouver, Greater Vancouver Regional District, Lighthouse - Sustainable Building Centre, Natural Resources Canada, Terasen Gas, and Shared Services BC). This document is not intended to constitute or render engineering, architectural, legal or other professional services or advice. Nor is it a substitute for such services or advice from an experienced professional directed to the specific design situation.

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EXECUTIVE SUMMARY

The Roadmap to the Integrated Design Process has been developed for the BC Green Building Roundtable. The Roundtable shares the increasingly accepted view that an “Integrated Design Process” (IDP) is required in order to achieve high performance (sustainable) buildings while avoiding or minimizing incremental costs.

The Integrated Design Process provides a means to explore and implement sustainable design principles effectively on a project while staying within budgetary and scheduling constraints. It relies upon a multi-disciplinary and collaborative team whose members make decisions together based on a shared vision and a holistic understanding of the project. It follows the design through the entire project life, from pre-design through occupancy and into operation.

The Roadmap is divided into two distinct parts: Part One: Summary Guide; and Part Two: Reference Manual, catering to both the novice and advanced IDP practitioner. Part One can easily be read in one sitting to gain an overview and consulted thereafter as a quick reference. Part Two can be consulted periodically as a more comprehensive reference manual.

Part One: Summary Guide offers a concise but comprehensive overview of the Integrated Design Process as a concept. It examines the goals, principles, key features, and ideal team composition for an IDP, as well as providing a one-page summary for each of the seven design phases covered in more detail in Part Two.

Part Two: Reference Manual, takes the reader through the process for each design phase: Pre-design; Schematic Design; Design Development; Construction Documentation; Bidding, Construction, and Commissioning; Building Operation (startup); and Post Occupancy (long-term operation). Each phase is explained using a consistent structure that covers process activities, output development, helpful tips, case studies, and resources.

Part Two also contains a detailed bibliography which directs the reader to additional resources that will aid them through various aspects of IDP. In addition, the appendices provide a series of useful summary tables and the complete case study credits.
INTRODUCTION

WHY THIS ROADMAP WAS DEVELOPED

The Roadmap to the Integrated Design Process has been developed for the BC Green Building Roundtable. The BC Green Building Roundtable comprises public sector and non-profit organizations collaborating to advance green building principles and practices within the building industry in British Columbia, Canada, and beyond. Roundtable members currently include: BC Hydro, Canada Green Building Council, Canada Mortgage & Housing Corporation, Cascadia Region Green Building Council, City of Vancouver, Greater Vancouver Regional District, Lighthouse - Sustainable Building Centre, Natural Resources Canada, Terasen Gas, and Shared Services BC. For the purposes of the Roadmap to the Integrated Design Process, the Roundtable also partnered with the City of Seattle. The Roundtable shares the increasingly accepted view that an “Integrated Design Process” (IDP), as defined below, is required in order to achieve high performance (sustainable) buildings while avoiding or minimizing incremental costs.

“The Integrated Design Process (IDP) is a method for realizing high performance buildings that contribute to sustainable communities. It is a collaborative process that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle. The IDP is designed to allow the client and other stakeholders to develop and realize clearly defined and challenging functional, environmental and economic goals and objectives. The IDP requires a multi-disciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives. The IDP proceeds from whole building system strategies, working through increasing levels of specificity, to realize more optimally integrated solutions.”


This Roadmap was developed to overcome the barriers that the Roundtable sees as preventing IDP from being widely practiced. The guide is intended to do so by providing a comprehensive guide for IDP facilitators, as well as novice and seasoned participants. Simply stated, the guide outlines what the integrated design process is, how it works, and how to implement such a process.
HOW THE ROADMAP WAS DEVELOPED

The Roadmap was developed through an extensive literature review of existing best practices, an expert workshop, guidance from the Roundtable, and with input from professionals practicing IDP.

The guide went through much iteration in an attempt to distil the essence of IDP from the wealth of information gathered. The team was mindful of the distinction between IDP and high performance or sustainable building design. Over time the technologies and strategies employed in creating high performance buildings will change, but this will happen independently of the IDP concept. The Roadmap is therefore not intended to be an exhaustive reference for high performance building design strategies and technologies, but rather a concise and comprehensive guide to IDP, the process recognized as the most effective way to achieve such buildings.

The guide also went through much filtering in order to provide the core broadly-applicable themes while addressing some of the key variations on these themes that arise for different project types, sizes, delivery methods, etc. The reader’s judgment is required to recognize aspects that may not be applicable to his/her specific project and to seek additional guidance as needed.

HOW TO USE THIS ROADMAP

The Roadmap has been divided into two sections: Part One: Summary Guide; and Part Two: Reference Manual.

Part One of the Roadmap gives a concise but comprehensive overview of the Integrated Design Process as a concept. It lays out the overall intent of employing an IDP and thus explains why a client, developer or design practitioner would choose to employ such a process. Part One examines the goals, principles, key features, and ideal team composition of IDP, as well as providing a one-page summary for each of the seven design phases covered in more detail in Part Two.

Part Two of the Roadmap outlines what an IDP can contribute to each phase in a building’s life and gives a more detailed overview of the steps to be taken. The typical building lifetime is divided into the following seven phases: Pre-design; Schematic Design; Design Development; Construction Documentation; Bidding, Construction, and Commissioning; Building Operation (start-up); and Post Occupancy (long-term operation). For the purpose of clarity, a consistent structure is applied to all phases, which addresses the following themes:

- How to coordinate a team;
- How to establish a foundation;
- What key meeting can take place;
- Key outputs and process activities;
- The connection between IDP and green building certification programs;
- Helpful tips;
- Case studies; and
- Resources.
Part Two also contains a bibliography which directs the reader to more detailed resources and references that will aid them through various aspects of IDP.

The Leaf icon is used throughout the Roadmap to flag sections that have resources associated with them and/or are referenced in the bibliography and appendices.

In addition, the following appendices provide several summary tables as well as the complete case study credits:

- Appendix A is a one-page summary chart of the seven design phases and that can be used as a quick reference chart for novice and experienced IDP practitioners.

- Appendix B summarizes the different roles and responsibilities for various core and additional team members throughout the seven phase design process.

- Appendix C was developed in order to address one of the key variations: project type. This summary table offers scenario-based considerations for developer, institutional, owner/occupied and existing building project types for each phase of the design.

- Appendix D provides the full team credits for each case study.

The two-part structure evolved out of a desire to provide a concise and readable document accessible to both novice and seasoned participants while also covering the depth and breadth of information that was gathered through the literature review and from the experiences of expert IDP practitioners. Part One can easily be read in one sitting to gain an overview and consulted thereafter as a quick reference. Part Two can be consulted periodically as a more comprehensive reference manual.
In general, the integrated design process is an approach to building design that seeks to achieve high performance on a wide variety of well-defined environmental and social goals while staying within budgetary and scheduling constraints. It relies upon a multi-disciplinary and collaborative team whose members make decisions together based on a shared vision and a holistic understanding of the project. It follows the design through the entire project life, from pre-design through occupancy and into operation.

IDP is a term that is not exclusively associated with high-performance building design; in principle it is a flexible approach that can be applied to almost any type of design or decision-making process. In this Roadmap, IDP is examined within the context of high performance (sustainable) building design, and the specifics of the process are tailored to this context.

The specific steps and strategies employed are directly related to the project’s design intent, which not only differ between projects but also continually change as the industry evolves. For example, new building developments increasingly go beyond consideration of their immediate site to emphasize integration with the surrounding social, ecological, and economic communities. The Roadmap presents IDP in a way that can be applied regardless of the specific design intent.

Generally, IDP is:

- an iterative process, not a linear or silo-based approach;
- a flexible method, not a formula;
- different each time, not pre-determined; and
- an iterative process with ongoing learning and emergent features, not a preordained sequence of events.

**IDP VS. CONVENTIONAL DESIGN**

There are as many variations on how to practice an IDP as there are IDP practitioners; each team has a slightly different methodology, and perhaps a different idea of the “right” method. There is, however, a broad consensus about how IDP differs from the conventional design process. Outlining these differences, as shown in the summary table below, helps highlight the salient aspects of IDP.
What is an IDP?
Part One

In conventional design, “the architect (or designer) and the client agree on a design concept consisting of a general massing scheme, orientation, fenestration, and the general exterior appearance of the building. Then the mechanical, electrical and structural engineers are asked to implement the design and to suggest appropriate systems. The problem with conventional practice is that this design process is too quick and simple, often resulting in high operating costs, poor comfort performance and very few sustainable gestures that fall within the client’s restrained budget.” (Pearl, 2004)

### Integrated Design Process

- Inclusive from the outset
- Front-loaded — time and energy invested early
- Decisions influenced by broad team
- Iterative process
- Whole-systems thinking
- Allows for full optimization
- Seeks synergies
- Life-cycle costing
- Process continues through post-occupancy

### Conventional Design Process

- Involves team members only when essential
- Less time, energy, and collaboration exhibited in early stages
- More decisions made by fewer people
- Linear process
- Systems often considered in isolation
- Limited to constrained optimization
- Diminished opportunity for synergies
- Emphasis on up-front costs
- Typically finished when construction is complete

Figure 1 compares the design team’s level of involvement throughout a conventional design process with that for an integrated design process. The figure also relates this involvement to the diminishing opportunities to influence sustainability, depicting that the effort in an IDP is much more front-loaded, allowing the team to take best advantage of opportunities to influence sustainability.
IDP AS A MINDSET

The integrated design process is as much a mindset as it is a process. Having the right mindset without the process is unlikely to lead to success, and following the process without the right mindset is almost certain to fail. The importance of mindset is evident in a set of principles which underpin a successful integrated design process.

Some of the principles outlined pertain to “soft” skills, such as those teambuilding, which a written document does not easily convey. To this end, other available training and resources are noted where possible, but learning by doing is the best way to hone these skills.

The following principles, in combination with the listed strategies, are vital to the integrated design process.

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<td>Open-mindedness and creativity</td>
<td>Innovation and synthesis</td>
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<td>Rigour and attention to detail</td>
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<td>Iterative process with feedback cycles</td>
<td>Post-occupancy evaluation</td>
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IDP AS A SET OF PRINCIPLES

The principles stated in the table above are applicable irrespective of the specific details of a particular project. These principles are examined more closely in this section.

BROAD COLLABORATIVE TEAM

Perhaps the most important principle for a successful IDP relates to inclusiveness and collaboration which should translate into the establishment of a broad collaborative team.

Ideally, the team includes all relevant disciplines and stakeholders who remain involved from start to finish. A broad interdisciplinary team representing all necessary
What is an IDP?

Part One

"Collaborative process that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle...The IDP requires a multi-disciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives. The IDP proceeds from whole building system strategies, working through increasing levels of specificity, to realize more optimally integrated solutions." (Pope, 2004)

"Front-loaded design process (not more time-intensive; time is distributed differently) ... Extra time for charrettes offset by less back-and-forth with client later in process." (Malin, 2004)

"Collaborative process that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle...The IDP requires a multi-disciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives. The IDP proceeds from whole building system strategies, working through increasing levels of specificity, to realize more optimally integrated solutions." (Pope, 2004)

"Front-loaded design process (not more time-intensive; time is distributed differently) ... Extra time for charrettes offset by less back-and-forth with client later in process." (Malin, 2004)

skills, knowledge, and perspectives is essential to ensure all relevant knowledge and resources are brought to the table.

The team must also be cohesive; members must be willing and able to work in collaboration. A project is more likely to be successful if its members trust each other and are able to cooperate. There are many excellent resources available which offer techniques that foster teamwork and cooperation. See the bibliography in Part 2: Reference Manual for a detailed listing of resources.

The make-up of the core team is project-specific and will change through the process. For more information on team formation see the next section, The Integrated Design Team.

WELL-DEFINED SCOPE, VISION, GOALS, AND OBJECTIVES

An outcome-oriented mindset is characterized by a clear statement of vision, goals, and objectives. To define these three components it is necessary to question underlying assumptions surrounding the scope of the project. For example, should a new building be built at all, or would a major renovation be more appropriate? Failing to ask these sometimes difficult questions early can suppress the synergies hoped for from interdisciplinary teamwork. To achieve effective outcomes, the team must develop a shared vision of what they are trying to achieve; in other words, you have to know where you’re going in order to plan how to get there.

Time should be invested at the start of the project to host a Visioning Charrette or Workshop, in order to develop a clear vision accompanied by well-defined goals and objectives. These elements can be translated into discrete measurable targets which will guide the entire process, keeping the team on track. Figure 2 illustrates how Pre-Design and Schematic Design are front-loaded with more charrettes and workshops.

EFFECTIVE AND OPEN COMMUNICATION

Open and continuous lines of communication are essential throughout the process, both during and between meetings. Transparent methods of communication will build trust and give participants a greater sense of ownership over the process, reducing conflicts and allowing the project to benefit from each individual’s unique contribution. Key decisions should not be made without team input.

An expert facilitator involved at the beginning of the project can set the stage for effective communication throughout the design process by instilling effective communication skills within the group and fostering an atmosphere of lasting respect and trust. See section on Tips for Effective Facilitation at the end of Part 1.

INNOVATION AND SYNTHESIS

A determination to foster open-mindedness and creativity is key to encouraging the level of innovation and synthesis required to meet the complex requirements of a high performance building. Synthesis is, by definition, the integration of separate elements to create a cohesive whole, and the term implies that the whole is greater than the sum of the individual parts. A design charrette can be used to foster an environment conducive to brainstorming, creating, and imagining exercises. Once participants have experienced true collaboration to produce innovative solutions, they will not want to go back to “business as usual”.
A desire for rigour and attention to detail leads to a clearly defined and understood decision-making process. "It is important for each individual to understand his/her own roles and responsibilities and how decision-making will occur." (National Charrette Institute (NCI) 2004). There are many tools that can facilitate effective decision-making including modeling programs, green building certification systems like LEED and Go Green Plus, and life-cycle costing.

**Green Building Certification Programs**

There are many reasons why buildings are formally certified as green buildings. Standardization of language and performance, industry recognition, and third party verification have all been cited as drivers for formal certification. Both formal certification and the informal reference to certification programs through the design process helps guide teams by providing direction and resources.

Numerous green building certification programs are available; some require third party verification, while others are self-certifying. Most address new buildings but some focus on existing building stock. Design teams wishing to pursue certification should consider some or all of the following factors when selecting a guideline:

- stage in building’s in life-cycle (new, existing, retrofit)
- the type of space (tenant fit-out, core and shell space, etc.)
- the level of effort desired
- the owner’s requirements
- any local design guidelines
- funding requirements

Some of the more popular certification programs include:

- LEED® (Leadership in Energy and Environmental Design) is administered by the Canada and US Green Building Councils, and has a suite of products for certifying a range of project types including new buildings, existing buildings, commercial interiors, and core and shell projects. Ratings systems are also under development for other project types including Campuses and Multi-Building Sites. The LEED rating system covers a wide range of performance criteria concerning site, water efficiency, energy efficiency, materials and resources, and indoor environmental quality. Information can be found at www.cagbc.org and www.usgbc.org.

- BOMA Go Green and Go Green Plus are Canadian certification programs administered by the Building Owner’s and Manager’s Association. This program is for existing commercial buildings. Information can be found at www.bomagogreen.com.

- Green Globes is an on-line auditing tool that lets designers, property owners and managers: assess and rate existing buildings against best practices and standards; and integrate principles of green architecture at every phase of project delivery for retrofits and the design of new buildings (refer to www.greenglobes.com).

- Built Green – a program for new residential projects, Built Green is administered by the Canadian Home Builders Association in BC. Information can be found at www.chbabc.org.
ITERATIVE PROCESS WITH FEEDBACK LOOPS

A mindset of continuous learning and improvement is imperative for a successful IDP. Unlike a conventional linear design process in which decisions and assumptions made upstream are often left unchallenged, an integrated approach includes feedback mechanisms to evaluate all decisions. An iterative process ensures that decisions reflect the broader team’s collective knowledge, that interactions between different elements are considered, and that solutions go through the steps needed for optimization. Regular feedback loops can keep the team engaged and produce small successes, which reinforce the effectiveness of the process.

Feedback loops within a typical IDP include not only several design iterations but also commissioning and post-occupancy evaluation, which not only inform a building’s design but also its ongoing operation. IDP is oriented to learning and improvement not only during the design process but also between projects. Lessons learned from the successes and failures of past projects are used to improve sustainable building practices for future endeavours. See Figure 2 for an illustration of this iterative process.

Figure 2 illustrates the form and methodology of a typical IDP as it progresses from a broad-scope concept to tangible reality through a series of iterative feedback loops. The figure shows how the process begins in an exploratory phase with a broad scope and loosely-defined constraints and moves toward increasing specificity through a series of iterative design loops punctuated by topic-specific meetings and all-team workshops. The occupancy and operation phases are characterized by broad team meetings that ensure proper handoff, education of operations staff and users, along with a periodic examination of the building performance through post-occupancy evaluation.

The mindsets described here may not at first be shared by team members who are new to IDP; however, participating in an integrated design process tends to foster them among team members. In other words, IDP participants tend to become the leaders and champions of future IDP endeavours.

Resources on occupancy evaluations:
The Usable Buildings Trust
www.usablebuildings.co.uk
The Centre for the Built Environment
www.cbe.berkeley.edu/

Resources on Commissioning:
www.oregon.gov/
www.lbl.gov
Figure 2: Integrated Design Process

Front End

- PD: Pre-design
- SD: Schematic Design
- DD: Design Development

CD: Construction Documents

Back End

- BC: Bidding, Construction, Commissioning
- BO: Building Operation (start up)
- PO: Post-Occupancy (long term)

Legend:
- Project Constraints
- Exploratory Design Process
- All Team Workshop
- Focused Team Workshops (water, energy, materials, etc)
- Iterative Process
- Additional Iterations as necessary

Image Credit: Bill Reed of Integrative Design Collaborative, Doug Pierce of Perkins+Will and Busby Perkins+Will
### SUMMARY OF IDP BENEFITS

There are a multitude of distinct positive outcomes that stem directly from employing the principles of an integrated approach. The following table summarizes some of these key benefits associated with each of the principles of IDP outlined in the previous section. The table also lists some of the culminating or net benefits that arise from a successful IDP.

<table>
<thead>
<tr>
<th>IDP Principle</th>
<th>Benefits of Successful IDP</th>
<th>Net Benefits</th>
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</thead>
<tbody>
<tr>
<td>Broad, collaborative team from outset</td>
<td>Early formation of a broad, interdisciplinary team ensures necessary expertise is present when <strong>opportunities for impact are greatest</strong>. Collaboration <strong>harnesses the team’s best effort</strong> and collective wisdom.</td>
<td>Realization of challenging goals and objectives</td>
</tr>
<tr>
<td>Well-defined scope, vision, goals and objectives</td>
<td>Investing time up front ensures <strong>common understanding</strong> and ‘buy-in’.</td>
<td>Realization of high-performance (sustainable) buildings</td>
</tr>
<tr>
<td>Effective and open communication</td>
<td>Transparency <strong>builds trust</strong> and increases team’s sense of ownership. Respectful communication <strong>avoids disputes</strong> and harnesses a team’s best effort and enthusiasm.</td>
<td>Realization of more optimally integrated solutions</td>
</tr>
<tr>
<td>Innovation and synthesis</td>
<td>Fostering open-mindedness and creativity leads to innovation and synthesis, which allow the team to <strong>achieve the complex requirements</strong> of a high performance building.</td>
<td>Maximized benefits and quality</td>
</tr>
<tr>
<td>Systematic decision-making</td>
<td>A clearly defined and understood decision-making process can lead to <strong>better choices</strong>. Tools like life-cycle costing can foster the type of <strong>holistic and long-term thinking</strong> necessary for sustainable design.</td>
<td>Minimized cost</td>
</tr>
<tr>
<td>Iterative process with feedback loops</td>
<td>Providing opportunities for feedback along the way <strong>allows lessons to be learned</strong> from start to finish.</td>
<td>Good team relationships that may result in lasting partnerships for future projects</td>
</tr>
</tbody>
</table>
From the outset of the project, formation of an appropriate design team is crucial for controlling budgets while meeting green targets and the owner’s goals. That is why establishing the team is one of the first steps in undertaking the integrated design process. The ideal IDP team is one in which:

- The client takes an active role throughout the design process.
- A broad range of expertise and stakeholder perspectives is present.
- A team leader is responsible for motivating the team and coordinating the project from pre-design through to occupancy.
- An experienced facilitator is engaged to help guide the process.
- The core group of team members remains intact for the duration of the project.
- Team members collaborate well.

The design team’s composition, structure, and member roles will naturally be adapted to every project, with its unique context, specific constraints and opportunities, delivery methods, and client type and values. Identify the core team described below:

**CORE PROJECT TEAM MEMBERS**

- Client or owner’s representative (i.e., with expertise in facilities and operations management)
- Project manager
- Architect
- IDP facilitator
- Champion (optional) (alternatively, could be a member of the design team)
- Structural engineer
- Mechanical engineer with expertise in:
  - Simulation: energy modeling, thermal comfort analysis, and/or CFD simulations.
  - Energy analysis: an energy engineer and/or bioclimatic engineer may be required in order to cover the necessary areas of expertise, such as: passive solar design, renewable energy technologies, and hybrid–tech strategies.
The Integrated Design Team

Part One

“...The key to achieving a sustainable building is to assemble a project team with both the experience and the desire to employ a systematic, integrated design. It is important to take a team-oriented, multi-disciplinary approach in which all members of the project team recognize and commit to the steps and actions necessary to achieve the project vision.” (Whole Building Design 2002)

- Electrical engineer
- Green design specialist
- Civil engineer with expertise in: stormwater, groundwater, rainwater, and/or wastewater systems
- Facilities manager/Building operator (maintenance and operations)
- Cost consultant (with experience in life-cycle costing)
- Landscape architect
- General contractor or construction manager.

The core team should be responsible for identifying and bringing in additional members as required depending on the project type, expertise of the core team, and client preferences.

ADDITIONAL MEMBERS

Additional members, who may be brought in for the duration of the project or only for a few workshops, include some or all of those outlined below.

- Ecologist
- Occupants’ or users’ representatives
- Building program representative, if appropriate for the building type
- Planning/regulatory/code approvals agencies representatives
- Interior designer/materials consultant
- Lighting or daylighting specialist
- Soils or geotechnical engineer
- Commissioning agent
- Marketing expert
- Surveyor
- Valuation/appraisal professional
- Controls specialist
- Other experts as required (e.g., natural ventilation, thermal storage, acoustic)
- Academics and/or students with knowledge of a relevant subject
- Members of the community who are affected by the project.

Appendix B (provided in Part 2) provides a detailed table illustrating the roles of these team members as the project proceeds from start to finish.

An IDP continually challenges assumptions. In doing so it reveals the subjectivity of many design aspects sometimes considered fixed, such as some engineering norms. Sometimes, additional perspectives can be gained by having more than one specialist in a particular field. Openness to hearing “second opinions” can be an important attribute of an effective team.

An expert may only be brought in for a brief time and still make an invaluable contribution. Some design teams have credited their overall success on a project to a single meeting with a particular specialist. A meeting with an outside specialist can inspired a team to reach further, making them want to build a better project.

In addition to being technically competent, team members must be effective communicators, have a cooperative attitude, and be open-minded. Two additional
The Integrated Design Team
Part One

roles, the IDP Facilitator and the Champion, are designed to help develop and maintain the right mindset. These roles may be filled by existing team members or by others hired specifically for the task.

FACILITATOR
The Facilitator manages the Integrated Design Process. The Facilitator and the Champion may be the same person. This role might also be filled by the coordinating professional or project manager, or by another professional entirely. The facilitator ideally has the following characteristics:

• Is the steward of the goals and targets, which are set during the charrettes and/or workshops and updated throughout the process.
• Is skilled in the art of facilitation and group dynamics.
• Has knowledge of green design principles but need not be an expert.
• Ensures the participation of all team members and draws out the assembled expertise.
• Will ensure a proper flow of information during the charrettes and potentially for all green design matters.
• Can be the one responsible for keeping the team on time and on target for specific events like charrettes or more broadly for green building certification or the whole project.
• Has a good level of knowledge of both the integrated design process and green building certification (if pursued).

CHAMPION
The Champion is someone who is motivated and able to lead the team in the direction of sustainability. The following are characteristics of a good IDP project champion:

• Will champion the vision of the project and empower the team.
• Must be able to think laterally and challenge others to think that way.
• Must be able to challenge the client as well and therefore must have the ear of the client.
• Should help deal with the “political” issues and barriers when required to move the process forward.
• Does not need to be at all the meetings but should be at those where the project vision and goals are set or updated.
• Should be able to speak the same language as the design or ownership team and understand how projects of the type under consideration work.
• Can help align the team to a common vision while challenging members to push themselves to the highest level of performance possible for the project.
• Can be the catalyst to help the team reach further.

One person does not necessarily have all of these qualities; therefore there can be more than one champion on a project. Sometimes a champion is obvious from the start and is brought onto the project in that role; other times the champion rises to the challenge through the course of the design process. Either way, the impact that the right champion can have is often the difference between getting a project built and achieving design excellence.
Figure 3: Conventional Design Team Organization

Figure 4: Integrated Design Team Organization

Figure 3 shows a typical organizational chart for a conventional design process in which the client’s primary contact is the architect, who coordinates with other team members in a hierarchical structure.

By contrast Figure 4 shows an organizational chart for a typical IDP in which the core team is expanded to include a contractor, IDP Champion/facilitator, and cost consultant. The core team is more closely interlinked with support from specialists as needed.
Once the team’s membership is established, a number of important issues have to be resolved immediately so the team can begin to operate effectively:

- Clear allocation of responsibilities among the team.
- Contracting and reporting relationships between the various participants.
- Fee structure to compensate for additional services such as charrettes or energy modeling.
- Risk tolerance and risk management strategies for the owner and project team members.
- Level of authority required to confirm design decisions that may fall outside of typical technologies or systems.
- Team values or “code of conduct” (e.g. respect, open-mindedness, transparency).
- Communication channels.
- Decision making process.

Fee structures are an important issue. Team members should not be financially penalized for suggesting new or innovative technologies or systems that may bring greater value to the owner. For example, traditional mechanical fee structures are based on a percentage of the mechanical budget; this practice discourages innovative strategies like natural ventilation and passive solar design that can reduce the size and/or cost of mechanical equipment and hence, the related fees.

Figure 5, Capital Cost Tradeoffs, demonstrates how capital costs can be redistributed in order to achieve a green building without incremental cost. For example, the higher cost of a combination of high-performance glazing, higher insulation levels, and operable windows can be offset by the related reduction in or elimination of some mechanical components due to reduced heating and cooling loads.

“An integrated design is a design in which all major components of the building are considered and designed as a totality. Components are not designed in isolation of their effects on other components and systems.” (Coutu, 2003)

“While it is more than possible to achieve green design without using IDP, it is very likely going to cost more and the performance is unlikely to be as high. The reason is that a good process captures synergies and thereby improves performance and reduces costs. Traditional linear design processes rarely capture synergies.” (Zimmerman, 2004)
**TIPS FOR EFFECTIVE FACILITATION**

Effective facilitation can often be the difference between a dynamic, synergistic and effective IDP session and one that falls flat with no real conclusions drawn. The following table summarizes some effective tips and tools for facilitating charrettes, meetings, and workshops. This table was generated from a number of resources including a facilitation workshop led by Charles Holmes of the Wray Group.

<table>
<thead>
<tr>
<th>Tip / Tool</th>
<th>Description</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check-ins</td>
<td>Participants introduce themselves, give personal anecdote, or state goal for meeting</td>
<td>Personalize setting, get on same page, break ice, and set context</td>
</tr>
<tr>
<td>Check-outs</td>
<td>Participants comment on their experiences</td>
<td>Chance to express concluding remarks and achieve sense of closure</td>
</tr>
<tr>
<td>Ice-breakers</td>
<td>Game or activity</td>
<td>Introductions, ease people into group setting, and stimulate discussion</td>
</tr>
<tr>
<td>Team values or Code of Conduct</td>
<td>Establish team’s ground rules with input from all participants</td>
<td>Create common understanding, promote a respectful environment, and provide a means to prevent or resolve disputes</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>Technique for generating ideas in low-risk environment</td>
<td>Generate new ideas, stimulate creative and lateral thinking, get input from everyone</td>
</tr>
<tr>
<td>Parking lot</td>
<td>List to track issues that arise but are off-topic</td>
<td>Keeps discussion focused without forgetting important issues</td>
</tr>
<tr>
<td>Mirroring</td>
<td>Facilitator repeats what a participant has said verbatim</td>
<td>Ensures that people are heard, builds trust, can speed up brainstorming</td>
</tr>
<tr>
<td>Paraphrasing</td>
<td>Facilitator repeats what a participant has said in his/her own words</td>
<td>Ensures that people feel heard and understood, can clarify meaning</td>
</tr>
</tbody>
</table>
## Tips on Facilitation

### Part One

**Resources on Team Building:**


**Resources on Facilitation and Charrettes:**

ICA Associates Inc. (Group Facilitation Training), www.ica-associates.ca

The National Charrette Institute, www.charetteinstitute.org

International Association of Facilitators (http://iaf-world.org)


**Resources on brainstorming and meetings:**

Mind Tools “Brainstorming: Generating many radical and useful ideas” www.mindtools.com

Effective Meetings.com www.effectivemeetings.com

<table>
<thead>
<tr>
<th>Tip / Tool</th>
<th>Description</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-modal learning</td>
<td>Use of different styles of learning and participation, including visual, auditory, and written</td>
<td>Reflects participants’ different learning styles, maximizing learning and input</td>
</tr>
<tr>
<td>Positions versus interests</td>
<td>Facilitator may be able to draw out underlying motives beneath a participant’s position (iceberg analogy)</td>
<td>Highlights common ground between positions that appear conflicting or polarized</td>
</tr>
<tr>
<td>Go-around</td>
<td>Technique of ‘going around the room’ or table one-by-one to hear from everyone. Can continue until everyone has passed, indicating that they have nothing more to add</td>
<td>Ensures that everyone has a chance to speak, and prevents domination of discussion; participants can listen effectively knowing that they will have a turn to speak</td>
</tr>
<tr>
<td>Negative poll</td>
<td>Ask for a show of hands to determine who disagrees with a statement</td>
<td>Can allow for fast decision-making and consensus-building</td>
</tr>
<tr>
<td>Open-ended questions</td>
<td>Broad questions typically beginning with “how”, “what”, or “why”</td>
<td>Encourages participants to share their perspectives</td>
</tr>
<tr>
<td>Probing questions</td>
<td>Questions or statements such as “Can you give an example?” or “Could you elaborate on that?”</td>
<td>Encourages participants to provide more information</td>
</tr>
<tr>
<td>Thumb-o-meter¹</td>
<td>Ask for thumbs up, down, or sideways to indicate levels of agreement</td>
<td>Quick way to get feedback from participants</td>
</tr>
<tr>
<td>Hot dots</td>
<td>A method of prioritizing using adhesive dots: participants are given a certain number of dots to place beside a certain number of choices</td>
<td>Used to get a sense of the group’s collective priorities without making a final selection or decision</td>
</tr>
</tbody>
</table>

1. Source: Alex Wray of Wray Group
Part One

Summary of Phases

This section provides a brief summary of what an IDP can contribute to each phase in a building's life-cycle: Pre-design; Schematic Design; Design Development; Construction Documentation; Bidding, Construction, and Commissioning; Building Operation (start-up); and Post Occupancy (long-term operation). For more detailed information on each design phase, consult Part 2: Reference Manual and Appendix A.

PHASE 1 - PRE-DESIGN

The integrated design process differs from conventional design right from the outset of a project by placing a priority on establishing the goals, core objectives and direction of the project through a visioning session. Pre-design explores the relationships between the project and its surrounding environment to help reveal the optimum choices for the site, the users, and the owner. Site options or site specifics may be analyzed in light of project requirements to uncover opportunities and synergies. Sustainability targets may be set covering a full range of economic, environmental, and social performance criteria. This ambitious beginning requires many experts to be members of the design team at the outset.

### SUMMARY OF SEVEN PHASES OF IDP

<table>
<thead>
<tr>
<th>Process</th>
<th>Coordinate the team:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bring together a diverse and knowledgeable team</td>
</tr>
<tr>
<td></td>
<td>Select an IDP Facilitator or Champion</td>
</tr>
<tr>
<td>Establish a foundation:</td>
<td>Set fees to provide appropriate incentives to the design team</td>
</tr>
<tr>
<td>Plan key meetings:</td>
<td>Charrette preparation</td>
</tr>
<tr>
<td></td>
<td>Host visioning charrette or workshop</td>
</tr>
<tr>
<td></td>
<td>Programming meeting</td>
</tr>
<tr>
<td></td>
<td>Facilities management meeting</td>
</tr>
<tr>
<td></td>
<td>Partnership meetings</td>
</tr>
</tbody>
</table>
Summary of Phases
Part One

Case Study: City of White Rock Operations Building

“This facility, or any facility for that matter, that wishes to be efficient cannot be designed without the use of an integrated design process. Whether you choose to go green or not, this process can save both capital and operating dollars by its very nature of being, which in itself results in the direction of sustainability.”

- Greg Scott
Former Client Representative

<table>
<thead>
<tr>
<th>IDP Outputs</th>
<th>IDP Team Modus Operandi</th>
<th>Key Team Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Visions statement, goals and targets matrix</td>
<td>• Engage and motivate team</td>
<td>• Core team: Client, architect, mechanical, structural, and electrical engineer, and landscape architect</td>
</tr>
<tr>
<td>• Pre-design report including charrette synopsis</td>
<td>• Team building is a fundamental part of kick-off and a priority throughout the process</td>
<td>• Additional team members and stakeholders, including:</td>
</tr>
<tr>
<td>• Preliminary budget including cost of IDP activities such as energy modeling</td>
<td>• Foster creativity and inter-disciplinary thinking</td>
<td>• Contractor (depending on project delivery type)</td>
</tr>
<tr>
<td>• Established communication pathways</td>
<td></td>
<td>• Representative of occupant’s perspective</td>
</tr>
</tbody>
</table>

- Greg Scott
Former Client Representative
PHASE 2 - SCHEMATIC DESIGN

Schematic Design builds upon the vision developed in Pre-design. It is the phase for thinking “outside the box,” for exploring innovative technologies, new ideas, and fresh application methods in working towards the broad goals and objectives set out in Pre-design. Schematic Design allows experts from all disciplines to analyze the unique opportunities and constraints of the building site and to collectively explore synergies between disciplines and with neighbouring sites.

While it is important to keep the scope of investigation broad, goals and objectives must be firmed up. Schematic Design alternatives should be developed based on a synthesis of the entire team’s skills and knowledge. By evaluating them on multiple criteria, the preferred design concept can be chosen.

<table>
<thead>
<tr>
<th>Process</th>
<th>Coordinate the team:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Enhance team cohesiveness and confirm team values</td>
</tr>
<tr>
<td></td>
<td>• Encourage a team mindset supporting creativity and systems-thinking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Establish a foundation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Keep the project’s vision and goals at hand</td>
</tr>
<tr>
<td>• Have clear understanding of site challenges and opportunities</td>
</tr>
<tr>
<td>• Ensure the functional program requirements and its implications for all disciplines are understood</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plan key meetings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Host design charrettes and workshops to brainstorm ideas, develop concepts, evaluate strategies, and refine options</td>
</tr>
<tr>
<td>• Evaluate feasibility and energy impact of technologies / strategies</td>
</tr>
<tr>
<td>• Report on opportunities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDP Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Goals and targets matrix</td>
</tr>
<tr>
<td>• Preliminary energy analysis</td>
</tr>
<tr>
<td>• Preliminary financial estimate</td>
</tr>
<tr>
<td>• Schematic Design report</td>
</tr>
<tr>
<td>• Roles and responsibilities matrix</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDP Team Modus Operandi</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ensure coordination and collaboration between disciplines</td>
</tr>
<tr>
<td>• Develop a clear understanding of synergies and tradeoffs between strategies and systems proposed</td>
</tr>
<tr>
<td>• Foster whole-system and life-cycle design and thinking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Team Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Core team from previous phase</td>
</tr>
<tr>
<td>• Additional team members, including:</td>
</tr>
<tr>
<td>• Energy specialist</td>
</tr>
<tr>
<td>• Cost consultant</td>
</tr>
<tr>
<td>• Certification coordinator</td>
</tr>
<tr>
<td>• Commissioning agent</td>
</tr>
<tr>
<td>• Valuation professional</td>
</tr>
</tbody>
</table>

Case Study: Dockside Green

“The absence of objections during the approvals processes for this project is unprecedented due to several factors, namely efforts to inform, consult with, and include all local stakeholders including the Community Association, neighboring businesses, and environmental organizations. Local First Nations groups were also consulted during the planning process. This improved communication and consultation process, virtually eliminating the typically high cost of approvals, highlights the importance of involving stakeholder groups early, and continuing the dialogue with these groups throughout the development of the project.”

- Carola Bloedorn Windmill Developments
## PHASE 3 - DESIGN DEVELOPMENT

Design Development is a time to firm up and validate choices, resulting in a schematic design concept being selected and approved by the client. All architectural, mechanical and electrical systems are assessed for their expected performance and impact on all other systems as well as on the goals and targets.

<table>
<thead>
<tr>
<th>Process</th>
<th>Coordinate the team:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Engage new specialists (e.g. commissioning agent, outside experts)</td>
</tr>
<tr>
<td></td>
<td>• Promote collaboration amongst team members</td>
</tr>
</tbody>
</table>

| Establish a foundation:         | • Assess feasibility and viability of green building strategies and technologies  |
|                                  | • Use tools to simulate (e.g. energy model) technologies and strategies and assess building performance (e.g. thermal comfort, daylighting, acoustics) |

| Plan key meetings:              | • Design optimization loops maximize synergies between design disciplines         |
|                                  | • Smaller, focused meetings for specific issues                                  |

| IDP Outputs                     | Design Development report including IDP issues such as energy simulation results  |
|                                  | Detailed financial report using life-cycle costing if possible                    |
|                                  | Outline specification with embedded performance criteria                        |
|                                  | Preliminary commissioning report                                                  |
|                                  | Updated roles and responsibilities matrix                                        |
|                                  | Updated goals matrix                                                             |

| IDP Team Modus Operandi         | • Ensure coordination and collaboration between disciplines                        |
|                                  | • Develop a clear understanding of synergies and tradeoffs between strategies and systems proposed |
|                                  | • Foster whole-system and life-cycle design and thinking                           |

| Team from previous phase        | Key Team Members                                                                  |
| Additional team members, including: | • Team from previous phase                                                        |
| • Contractor (sooner if possible) | • Additional team members, including:                                              |
| • Operation and maintenance staff | • Contractor (sooner if possible)                                                 |
| • Materials expert              | • Operation and maintenance staff                                                 |
| • Acoustician                   | • Materials expert                                                               |
| • Client’s marketing representative (if appropriate) | • Acoustician                                                                |
| • Industry and academic experts | • Client’s marketing representative (if appropriate)                             |

### Case Study: Jameson Tower

“It was felt that the Integrated Design Process had the most impact on the Design Development phase. There was a greater efficiency in the overall design because all consultant parties’ work was integrated. With an integrated design approach the architects have even more of a coordination role than normal and this has helped their understanding of the building as a whole.”

– Lee Hallman, Foster + Partners
**PHASE 4 - CONSTRUCTION DOCUMENTATION**

The construction documents (CDs) are prepared based on approved Design Development documents as well as final calculations and specifications. If the project is to be successful, the integration that has been achieved throughout earlier phases must be maintained during this phase despite the high pressure of impending deadlines.

<table>
<thead>
<tr>
<th>Process</th>
<th>Coordinate the team:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Coordinate CDs between disciplines</td>
</tr>
<tr>
<td>Establish a foundation:</td>
<td>• Review performance criteria</td>
</tr>
<tr>
<td></td>
<td>• Integrate green aspects into CDs</td>
</tr>
<tr>
<td>Plan key meetings:</td>
<td>• Host regular meetings to ensure that the impacts of all changes are evaluated</td>
</tr>
</tbody>
</table>

| IDP Outputs              | Project specifications with embedded performance criteria                           |
|                         | Material substitution policy                                                         |
|                         | Tender documents with clear explanation of innovative aspects, contractor responsibilities for green building documentation, training and supervision of trades / subcontractors |
|                         | Commissioning plan                                                                  |
|                         | Updated roles and responsibilities matrix                                            |
|                         | Updated goals matrix                                                                |

| IDP Team Modus Operandi  | Keep open lines of communication                                                    |
|                         | Ensure coordination of activities between disciplines                                |
|                         | Ensure each team member understands his/her responsibilities                        |

| Key Team Members        | Team from previous phase                                                             |
|                         | Additional team members, including:                                                   |
|                         | • Specification writer                                                               |
|                         | • Contractor (sooner if possible)                                                    |
|                         | • Commissioning authority                                                            |

**Case Study:**

City of Vancouver
National Avenue Works Yard

"The project architects and mechanical engineers developed a solution where the radiant panels would be attached to the inside face of the horizontal mullion at approximately 2.2 m above the adjacent floor level. There is a strip of vision glazing above this mullion which provides additional daylighting to the space. The solution included the addition of a sheet of foil-faced insulation to the top of the radiant panel which permitted the panel not only to perform its primary function (mitigation of heat transfer) but also to act as a light shelf, dramatically improving daylight penetration into the space."

- Kevin Hanvey
Omicron
PHASE 5 - BIDDING, CONSTRUCTION, AND COMMISSIONING

In this phase, the main design plans are realized. Many factors must be considered to ensure that the goals of the project are carried through to completion. Qualified contractors are chosen, communication procedures are set in place, and the expanded team works to transform the abstract into actuality.

Special attention is paid to the design intent in working through the inevitable construction-phase changes and adjustments. This work is facilitated through effective interface between disciplines, partial commissioning of systems during construction, final commissioning, and testing and validation. By the end of this phase the team will have achieved a finished, fully functional, and well-commissioned building, ready for occupancy.

Case Study: BC Cancer Agency Research Centre

“We used rigorous methods of risk management. We involved not only Ledcor, but also sub-trades and occupants in brainstorming to stay ahead of problems during construction. We had some spectacular cases of preventing or mitigating change orders. These efforts reduced some change orders that might have cost 2 or 3 million dollars to half a million. We had all the key players at table throughout including architect, engineers, researchers, and the builder. Having the buildability perspective was an important part of the design process.”

– Michael Kennedy
Stantec

<table>
<thead>
<tr>
<th>Process</th>
<th>Coordinate the team:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transition from design to construction team</td>
</tr>
<tr>
<td></td>
<td>Orient and train maintenance, operations staff and occupants</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Establish a foundation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update design intent</td>
</tr>
<tr>
<td>Include specific performance criteria in contract documents</td>
</tr>
<tr>
<td>Develop commissioning plan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plan key meetings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have pre-tender award meeting to discuss green design intent</td>
</tr>
<tr>
<td>Host a green building information session for contractor and trades</td>
</tr>
<tr>
<td>Plan regular site meetings to review design approach</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDP Outputs</th>
<th>Record drawings of the built project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Commissioning reports</td>
</tr>
<tr>
<td></td>
<td>Operation and maintenance manuals including on-going commissioning activities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDP Team Modus Operandi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage core team with contractor and sub-contractors</td>
</tr>
<tr>
<td>Streamline communication procedures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Team Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team from previous phase</td>
</tr>
<tr>
<td>Additional team members, including:</td>
</tr>
<tr>
<td>Project manager</td>
</tr>
<tr>
<td>Contractor (sooner if possible)</td>
</tr>
<tr>
<td>Commissioning authority</td>
</tr>
</tbody>
</table>
PHASE 6 - BUILDING OPERATION (START UP)

This is a key transition phase during which the design team must ensure responsibility for and knowledge of the building is properly transferred to the building’s new stewards: the owner, occupants, and operations staff. This phase is dependent upon completion and documentation of the commissioning that took place at the end of construction.

<table>
<thead>
<tr>
<th>Process</th>
<th>Coordinate the team:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Ensure proper transfer of knowledge between the design team, commissioning agent, building operator, and occupants</td>
</tr>
</tbody>
</table>

| Establish a foundation: |
| --- | --- |
|  | • Provide owner with complete building documentation including commissioning report |
|  | • Develop tools for ongoing monitoring to uphold performance |

| Plan key meetings: |
| --- | --- |
|  | • Host a debriefing session to share lessons learned |
|  | • Educate staff and occupants on the building’s performance and green features |
|  | • Host a project celebration to transfer project to new stewards |

<table>
<thead>
<tr>
<th>IDP Outputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Training and education materials</td>
</tr>
<tr>
<td></td>
<td>• Measurement and verification data</td>
</tr>
<tr>
<td></td>
<td>• Completed commissioning documentation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDP Team Modus Operandi</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Celebrate success</td>
</tr>
<tr>
<td></td>
<td>• Acknowledge the whole team</td>
</tr>
<tr>
<td></td>
<td>• Engage operation and maintenance staff and building occupants</td>
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<table>
<thead>
<tr>
<th>Key Team Members</th>
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**Case Study: University of Victoria Engineering / Computer Science Building**

“Because this building was considered from day one to be a ‘green’ building with the intention of making it an extremely energy efficient structure, and using an integrated design team approach and an independent commissioning consultant, decisions were made knowingly to downsize heating and cooling ventilation systems in favour of high-performance windows. Elemental costs were traded within the total of the project budget. More expensive windows resulted in less expensive mechanical systems, waterless urinals and dual flush toilets have resulted in lower plumbing costs and lower water consumption. The ongoing operating costs for this building will be substantially lower than a conventional building at a conventional construction cost. And the IDP played a major role in making this happen.”

- Terence Williams  
  Busby Perkins+Will  
  (formerly Terence Williams Architect)
PHASE 7 - POST-OCCUPANCY (LONG-TERM BUILDING OPERATION)

Integrated design does not end when construction is complete and occupants have moved in. The IDP seeks to enhance the entire life of the building through effective maintenance and operation, measurement and verification, re-commissioning, and building performance evaluation. The post construction portions of the process provide feedback loops, which facilitate continuous optimization of the building’s performance. In addition, lessons learned from this feedback can trigger small-scale improvements in operation that can bring significant benefits to the occupants and owners alike. Lessons learned can also inform future projects.

Case Study: UBC Life Sciences Building

“For the Life Sciences Building, it was felt that an integrated design process was most important. There were two main things: it shifted the dynamic of the team to focus on sustainability and it also shaped the building. We had a huge issue with a large building program and a relatively small site. Because we were thinking of it in integrated terms, we looked at ‘how can we get daylight in, how can we optimize solar gain, how can we create collaborative spaces, how can we integrate landscaping?’ We came up with a number of building schemes – ‘E,’ ‘O,’ and ‘C’ shapes. We were basically trying to get blocks of building with spaces between them for daylighting. Intuitively we felt ‘E’ was the best shape. Through energy modeling, thermal comfort modeling, and daylight modeling we confirmed that it was the best shape. The building would have looked totally different without IDP.”

- Teresa Coady
Bunting Coady Architects

<table>
<thead>
<tr>
<th>Process</th>
<th>Coordinate the team:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Create a building performance evaluation (BPE) team</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Establish a foundation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Allocate budget for building performance evaluation</td>
</tr>
<tr>
<td>• Ensure monitoring equipment is in place</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plan key meetings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• BPE setup and coordination meetings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDP Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Updated building documentation</td>
</tr>
<tr>
<td>• Building performance evaluation results</td>
</tr>
<tr>
<td>• Continuous monitoring</td>
</tr>
<tr>
<td>• Re-commissioning plan</td>
</tr>
<tr>
<td>• Environmental management program</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDP Team Modus Operandi</th>
</tr>
</thead>
<tbody>
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SUMMARY OF PART ONE

Part One of the Roadmap for Integrated Design Process: Summary Guide has provided a concise but comprehensive overview of IDP as a concept and a summary of the key aspects of IDP at each phase of the building life-cycle. The Summary Guide has hopefully oriented IDP newcomers and helped more experienced participants frame their knowledge more clearly. Part One is intended to be a catalyst to encourage broader adoption of this process that is widely accepted as the best way to achieve high performance (sustainable) buildings while avoiding or minimizing incremental costs.

Part Two takes the reader through the process for each design phase: Pre-design; Schematic Design; Design Development; Construction Documentation; Bidding, Construction, and Commissioning; Building Operation (start-up); and Post Occupancy (long-term operation). Each phase is explained using a consistent structure that covers process activities, output development, helpful tips, case studies, and resources. Part Two also contains a detailed bibliography which directs the reader to additional resources that will aid them through various aspects of IDP. In addition, the appendices provide a series of useful summary tables and the complete case study credits.

The novice IDP practitioner may wish to read Part Two: Reference Manual in full as a more detailed introduction to IDP, while the seasoned practitioner may prefer to consult Part Two periodically as a reference. In either case, it is recommended that the reader refer to the Summary Table in Appendix A as a useful quick reference tool. Keeping in mind that Part One is only an overview, the reader may find it helpful to access the Bibliography at the end of Part Two for useful resources addressing particular aspects of IDP and high performance (sustainable) building design in more detail.
ROADMAP FOR THE INTEGRATED DESIGN PROCESS: PART TWO: REFERENCE MANUAL
This document has been compiled by Busby Perkins+Will and Stantec Consulting for the BC Green Building Roundtable (BC Hydro, Canada Green Building Council, Canada Mortgage & Housing Corporation, Cascadia Region Green Building Council, City of Vancouver, Greater Vancouver Regional District, Lighthouse - Sustainable Building Centre, Natural Resources Canada, Terasen Gas, and Shared Services BC). This document is not intended to constitute or render engineering, architectural, legal or other professional services or advice. Nor is it a substitute for such services or advice from an experienced professional directed to the specific design situation.

While the information in the Roadmap for the Integrated Design Process is believed to be accurate, the BC Green Building Roundtable shall not be liable for damages arising from errors or omissions in this document.

The guide is not intended to endorse or recommend any particular product, material, or service. Users of the document are encouraged to use wise consumer and professional practices when implementing design strategies and selecting technologies.

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Appendix A: IDP Summary Table
Appendix B: Roles of Team Members by Design Stage
Appendix C: Scenario-Based Considerations
Appendix D: Case Study Credits
INTRODUCTION

WHY THIS ROADMAP WAS DEVELOPED

The Roadmap to the Integrated Design Process has been developed for the BC Green Building Roundtable. The BC Green Building Roundtable comprises public sector and non-profit organizations collaborating to advance green building principles and practices within the building industry in British Columbia, Canada, and beyond. Roundtable members currently include: BC Hydro, Canada Green Building Council, Canada Mortgage & Housing Corporation, Cascadia Region Green Building Council, City of Vancouver, Greater Vancouver Regional District, Natural Resources Canada, Terasen Gas, and Shared Services BC. For the purposes of the Roadmap to the Integrated Design Process, the Roundtable also partnered with the City of Seattle. The Roundtable shares the increasingly accepted view that an “Integrated Design Process” (IDP), as defined below, is required in order to achieve high performance (sustainable) buildings while avoiding or minimizing incremental costs.

“The Integrated Design Process (IDP) is a method for realizing high performance buildings that contribute to sustainable communities. It is a collaborative process that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle. The IDP is designed to allow the client and other stakeholders to develop and realize clearly defined and challenging functional, environmental and economic goals and objectives. The IDP requires a multi-disciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives. The IDP proceeds from whole building system strategies, working through increasing levels of specificity, to realize more optimally integrated solutions.”


This Roadmap was developed to overcome the barriers that the Roundtable sees as preventing IDP from being widely practiced. The guide is intended to do so by providing a comprehensive guide for IDP facilitators, as well as novice and seasoned participants. Simply stated, the guide outlines what the integrated design process is, how it works, and how to implement such a process.
HOW THE ROADMAP WAS DEVELOPED

The Roadmap was developed through an extensive literature review of existing best practices, an expert workshop, guidance from the Roundtable, and with input from professionals practicing IDP.

The guide went through much iteration in an attempt to distil the essence of IDP from the wealth of information gathered. The team was mindful of the distinction between IDP and high performance or sustainable building design. Over time the technologies and strategies employed in creating high performance buildings will change, but this will happen independently of the IDP concept. The Roadmap is therefore not intended to be an exhaustive reference for high performance building design strategies and technologies, but rather a concise and comprehensive guide to IDP, the process recognized as the most effective way to achieve such buildings.

The guide also went through much filtering in order to provide the core broadly-applicable themes while addressing some of the key variations on these themes that arise for different project types, sizes, delivery methods, etc. The reader’s judgment is required to recognize aspects that may not be applicable to his/her specific project and to seek additional guidance as needed.

HOW TO USE THIS ROADMAP

The Roadmap has been divided into two sections: Part One: Summary Guide; and Part Two: Reference Manual.

Part One of the Roadmap gives a concise but comprehensive overview of the Integrated Design Process as a concept. It lays out the overall intent of employing an IDP and thus explains why a client, developer or design practitioner would choose to employ such a process. Part One examines the goals, principles, key features, and ideal team composition of IDP, as well as providing a one-page summary for each of the seven design phases covered in more detail in Part Two.

Part Two of the Roadmap outlines what an IDP can contribute to each phase in a building’s life and gives a more detailed overview of the steps to be taken. The typical building lifetime is divided into the following seven phases: Pre-design; Schematic Design; Design Development; Construction Documentation; Bidding, Construction, and Commissioning; Building Operation (start-up); and Post Occupancy (long-term operation). For the purpose of clarity, a consistent structure is applied to all phases, which addresses the following themes:

- How to coordinate a team;
- How to establish a foundation;
- What key meeting can take place;
- Key outputs and process activities;
- The connection between IDP and green building certification programs;
- Helpful tips;
- Case studies; and
- Resources.
In addition, the following appendices provide several useful summary tables as well as the complete case study credits:

- Appendix A is a useful one-page summary chart of the seven design phases and that can be used as a quick reference chart for novice and experienced IDP practitioners.

- Appendix B summarizes the different roles and responsibilities for various core and additional team members throughout the seven phase design process.

- Appendix C was developed in order to address one of the key variations: project type. This summary table offers scenario-based considerations for developer, institutional, owner/occupied and existing building project types for each phase of the design.

- Appendix D provides the full team credits for each case-study.

The two-part structure evolved out of a desire to provide a concise and readable document accessible to both novice and seasoned participants while also covering the depth and breadth of information that was gathered through the literature review and from the experiences of expert IDP practitioners. Part One can easily be read in one sitting to gain an overview and consulted thereafter as a quick reference. Part Two can be consulted periodically as a more comprehensive reference manual.
OVERVIEW

The integrated design process differs from conventional design right from the outset of a project by placing a priority on establishing the goals, core objectives and direction of the project through a visioning session. Pre-design explores the relationships between the project and its surrounding environment to help reveal the optimum choices for the site, the users, and the owner. The particular site is analyzed in light of project requirements to uncover opportunities and synergies. Sustainability targets may be set covering a full range of economic, environmental, and social performance criteria.

This ambitious beginning requires many experts to be members of the design team at the outset.

Outputs
- Vision statement, goals and targets matrix
- Pre-design report including charrette synopsis
- Preliminary budget including cost of IDP activities such as energy modeling
- Established communication pathways

Process
- Coordinate the team:
  - Bring together a diverse and knowledgeable team
  - Appoint an IDP Facilitator and/or Champion
- Establish a foundation:
  - Set fees to provide appropriate incentives to the design team
- Plan key meetings:
  - Charrette preparation
  - Host visioning charrette or workshop
  - Programming meeting
  - Facilities management meeting
  - Partnership meetings
PROCESS

COORDINATE THE TEAM

While a conventional design process would keep the team very small at this phase, an integrated design process broadens the team to include enough consultants to cover all the needed expertise around site treatments, energy use, and daylighting opportunities.

Landscape, mechanical, and electrical consultants, in addition to the architects, are the key experts required at this phase to explore every opportunity around siting and massing. Also valuable may be an energy engineer (preferably one with bioclimatic energy expertise), and an ecologist. If deemed appropriate for the project scope, a commissioning agent can be hired as early as Pre-design but they are typically hired towards the end of Schematic Design.

It is beneficial to engage the whole design team from the outset of the project. Only if all team members share their relevant background information will each of them gain a holistic view of the unique context within which this design will evolve. Input from the client or building owner, building manager and from prospective occupants is also critical at this phase.

It is often helpful during pre-design to select a project “Champion” to motivate the team, to advocate high performance design, and to ensure that the vision and core objectives are maintained throughout the design process. Often this role will be filled informally by someone who is naturally suited to the task. Sometimes the design facilitator fulfills the champion role, but not always. The roles and responsibilities of the project champion are outlined in Part One, in the Integrated Design Team section.

A design facilitator can be hired at this phase to:

- facilitate the charrettes, sharing of information, and goal setting;
- challenge the team to question and go beyond the norms;
- work with the team to build a shared vision for the project; and
- help the team prioritize the building’s performance objectives.

The project architect can also play the role of the design facilitator depending on the scope of the project and size of the team. But when managing a large stakeholder group and design team it usually proves useful to hire an outside design facilitator, who can remain neutral while stimulating and mediating discussions between the design team, user groups, and the client. It is recommended that the team and/or client budget for this additional team member to facilitate large stakeholder and team meetings. The roles and responsibilities of the design facilitator are outlined in Part One, in the Integrated Design Team section.

If a commitment is made to pursue green building certification for the project, the design team should identify the project’s main certification coordinator, who may or may not be the same person as the project champion or facilitator. Each discipline should consider assigning a certification coordinator within their team.
See Part 1: The Integrated Design Team and Appendix B for more information on the roles of individual team members.

**ESTABLISH A FOUNDATION**

Prior to or during the pre-design Phase, the client in consultation with team members can complete the following tasks in preparation for the project:

- Select a knowledgeable team through appropriate Requests for Qualifications, including explicit green building project vision and green expertise requirements. The Request for Proposals (RFPs) should specifically state requirements and give consideration to the level of participation expected of each sub-consultant at each Phase of the integrated design process. Internally, clients can develop criteria and pre-qualified lists to be used for selecting the best qualified consultants and sub-consultants.

- Consider using alternative fee structures, such as a fixed fee for the project instead of a percentage of the whole construction budget to allow trade-offs between mechanical, electrical, and architectural components - for example, spending more money on glazing could reduce the size of cooling equipment. Conventional fee structures can penalize hard work - for example mechanical fees based on percentages of mechanical budgets can penalize a mechanical engineer who finds creative ways to eliminate or reduce equipment (Clark 2003).

- Ensure that fees are fairly set up to ensure that any added efforts required of the design team by the integrated process are accounted for, including charrettes, energy modeling, and additional meetings. Additional fees in the early phases may result in lower spending in later phases, or may simply be necessary to achieve the high level of performance desired.

- Determine a target for the life expectancy of the building.

- Examine any environmental policies or procedures internal to the building ownership or organization that will affect the project. For example, a government agency may have a sustainability plan or environmental procurement plan that may affect decisions on performance goals or product specifications.

- Discuss whether or not there is a desire to pursue green building certification.

- Examine municipal environmental or infrastructure capacity for constraints and opportunities. For example, a municipality may face a capacity problem in water supply or wastewater treatment. And yet this might provide an area of opportunity for the project to investigate alternative system options and the associated cost savings and environmental benefits.

- Set aside funding to perform a Building Performance Evaluation of the building after one, three or five years of operation. This process of seeking feedback on the building after it is completed is often overlooked by clients. However, this evaluation process can facilitate continuous optimization of the building’s performance and provide invaluable feedback to client group and design team.

**Resources:**

- American Institute of Architects, Request for Proposal Guidelines: [www.aia.org/cote](http://www.aia.org/cote)
See Phase 7 for more information on Building Performance Evaluations.

PLANNED KEY MEETINGS

A number of important meetings take place during Pre-design, which set the stage for the success of the project. Keep in mind that the length and number of meetings will vary depending on the project size, scope, and type.

Charrette Preparation

Adequate and effective preparation and planning is essential for a successful charrette. This task should be taken seriously and time invested to ensure its success. There are many resources available on this topic. This section outlines some of the key preparatory steps. In preparation for hosting the visioning and goal-setting charrette(s)/workshop(s), the design team should consider the following steps.

Review project assumptions:

- Confirm the client’s intentions, sustainable design objectives, organizational and decision-making structure and values, constraints, and risk tolerance with respect to new technologies such as passive and active solar or natural ventilation;
- Review local and regional regulatory issues in the context of green building;
- For larger scale projects, consult a project master plan or community development plan, which are typically available for campus or neighbourhood developments;
- Review the program of project functions to find areas of flexibility within it. Be prepared to challenge predetermined programming assumptions if they limit opportunities to maximize the sustainable potential of the building (e.g., daylighting);
- Consider using Building Information Modeling (BIM) software instead of traditional 2D drafting programs like AutoCAD. This is a decision that should ideally be made early in the process. BIM is a powerful 3D model-based approach to building design and drawings that has the potential to revolutionize the way buildings are built; and
- Review and refine performance criteria for the site.

Gather site information:

- Gather background site information on topics such as soils, stormwater, topography, vegetation, existing structures, and infrastructure;
- Collect information on the local microclimate, such as sun path diagrams, wind direction and speeds, average daily temperature, design temperatures, shading profile of site, and surrounding topography and features; and

Resources on Charrettes and Facilitation:


The National Charrette Institute www.charretteinstitute.org

ICA Associates Inc. (Facilitation and training workshops) www.ica-associates.ca

Resources on Building Information Modeling (BIM):

www.aia.org
www.autodesk.com/bim
www.gsa.gov/bim
• Prepare large-scale colour site plans (as well as smaller handouts) showing site data and analysis, to expedite the analysis of the site during the charrette.

Propose standards:

• Identify a reference building that can be used as a comparison when modeling the project's energy performance. For a renovation project, the previous three years of normalized monthly energy consumption can be the reference data; and

• Identify green building projects that may set a performance precedent for performance for the project to meet or exceed.

Support decision-making:

• Create a design brief for the workshop and charrettes; and

• Appoint a project champion and/or a facilitator.

**Visioning Charrette or Workshop**

Hold a charrette or workshop to establish a shared vision and determine core objectives and environmental goals for the project. This charrette can include all stakeholder groups and the entire design team. Charrettes can be made more effective with the following measures:

• Kick-start the vision and goal setting charrette with a team building exercise. A well-planned and appropriate ice-breaker will act as a mechanism for establishing strong team ties for the duration of the project.

• Establish “ground rules” on how members will function and respect one another’s opinions. Document these as a set of “Team Values” for future reference. For example, a “business card” with the project vision on one side and team values on the other could be a useful reference throughout the project.

• Build the team’s confidence to think “outside the box” and take risks. In order to foster this atmosphere, the client will need to provide the design team with assurances that they are ready and committed to pursue this path - for example, that they are ready to commit to having their building be greenhouse-gas neutral, or are ready to have their program criteria challenged.

• At the end of the charrette, the design team should establish a matrix displaying the core goals and performance targets. This will be an important reference document that will guide the subsequent Phases of the project.

“Team building is fundamental. If the members feel part of a team and feel they are an important contributor, they have a stake in the project. They take ownership; it becomes ‘their building,’ not just a job, not just another building. They take care of each other and help each other through the process. If they have a sense of ownership of the project and are enjoying it, of course they will do their best to achieve the best results possible.”
- Russ Chernoff
Chernoff Thomson Architects

Programming meeting
- Host a programming meeting to confirm the overall space requirements for building occupants. It is important to consider how the building's program goals align with the green design goals and consider synergies that can be achieved with different uses located in close proximity to each other.

Facilities management meeting
- From the outset of the project it is crucial to discuss operational expectations for the client and the building user groups. Project teams may find it useful to consult maintenance and operations staff throughout the design as they can provide valuable information on maintenance issues related to mechanical systems or interior finishes. Early engagement of these user groups is one of the strategies that differentiates the integrated design approach from conventional design.

Partnership meetings
- Early in Pre-design, identify potential partnership opportunities, for example with neighbouring sites, local utility providers, and government agencies, and meet with them to discuss possible synergies between sites, incentive programs, funding opportunities, or research and development opportunities. These meetings could result in capital funding for infrastructure or for feasibility studies that need to be completed. They may also lead to unexpected synergies (such as an opportunity to capture waste heat from a sewer line).

OUTPUTS
The Pre-design phase sets the tone for the project and helps the team stay unified. Key activities and outputs of the Pre-design process can include the following:

GOALS AND TARGETS MATRIX
As described above, the vision and goal setting charrette(s)/workshop(s) should lead to a matrix identifying the core goals and performance targets, which will help guide the subsequent Phases of the project.

PRE-DESIGN REPORT
IDP specific aspects of a Pre-design report can include some of the following:

- Analysis of neighbouring partnership possibilities (such as waste energy from industrial processes or under utilized parking off-site);
- Synopsis of information gathered for kick-start workshops such as climate data, regulatory constraints, site opportunities and challenges, and case studies;
- Clear definitions of the additional green building roles and responsibilities of team members; and
- Graphic representation of the goals, including those related to budget, schedule, programming, maintenance, sustainability, and building performance.
PRELIMINARY BUDGET
During an IDP, important aspects to consider while developing a preliminary budget can include the following:

- Ensure that the budget includes costs of design and construction of green building measures (such as third party certification, energy modeling, commissioning, and indoor air quality testing costs, if applicable).

- Use life-cycle cost analysis to compare design alternatives. The analysis should include, at a minimum, both the projected annual operating and maintenance costs and the potential long-term savings that will result from better decisions on initial investments.

- Seek advice from a cost consultant with green building expertise. A knowledgeable cost consultant can provide guidance and up-to-date information on the performance and cost of green products, as well as help decision makers see the long-term vision revealed by life-cycle thinking.

COMMUNICATION PATHWAYS
Establishing open and effective means of communication early on can help to build team cohesion and keep everyone on the same page. The most appropriate strategies will depend on the size of the team and scope of the project. Some potential tools to enhance communication include on-line websites or forums, email list-serves, and on-line file sharing.

IDP AND GREEN BUILDING CERTIFICATION

- Practitioners can help clients understand the business case for pursuing green building certification by taking them on a tour of certified green buildings or projects that have similar goals within the region and by gathering relevant case studies and background information on the process. The decision to pursue certification may also be confirmed at the start of Schematic Design once the client has more information on the process, potential costs, and synergies and tradeoffs.

- Host a workshop to understand the implications of your chosen green building certification program. This type of educational seminar enhances the client's, user groups’ and team's knowledge of the process and helps eliminate any misunderstandings about the process, costs, and tradeoffs that may occur throughout subsequent design Phases.

See Part One: Summary Guide for additional information on green building certification programs.
“We were able to make this work because we educated the client on the benefits of sustainable building design through an integrated approach, and the client mandated it as part of the project.”

- Michael Kennedy, Stantec

**TIPS**

- Understand the client’s situation, including their decision-making process, structure, and values, to avoid ideas that will get vetoed later in the process by upper management.

- Because a number of green and sustainable building practices are still relatively new to the industry, allocate adequate contingencies for additional research, analysis, and implementation of options.

- Show clients built examples of projects that illustrate ideas and concepts under consideration. Similarly, introducing current clients to past clients can often be useful in demonstrating the value of the integrated design process, thus increasing their trust in the process.

- Ensure that clients and owners understand that, by taking the extra time at this early phase, it is possible to gain many benefits in operating savings, design elegance, and environmental performance.

- Control expectations. Owners, marketers, and fundraisers may all wish to know as soon as possible what the building could look like; but if a picture is developed too early, people could become locked into a solution that is not optimal.

- Bring experience, not pre-determined solutions. Team members should avoid imposing their own bias or agenda on the design. Doing so prevents the emergence of creative solutions and causes decisions to be made too early, thereby limiting downstream options and restricting the design.

- Host a sustainability 101 seminar to educate client and user groups on what is high performance and green building design, and the benefits of it.
The City set a new standard with the creation of its 661m² operations facility. Everything from environmentally advanced design to renewable energy systems and water conservation techniques did not come to the City by accident. The City had direction to go “green” with the delivery of the new facility but was looking for a process and/or method to accomplish this goal. With the selection of an Architectural firm the direction was set with the team that the facility had to be sustainable and to achieve this was the challenge.

The City was not familiar with an IDP, nor had they heard of LEED. The Architectural team provided the background to assist their client to gain a common understanding of the principles. The City accepted the ideas readily as all disciplines including the City’s representative were represented throughout the design process.

A variety of innovative sustainable strategies have resulted in a reduction in site water use by approximately 90%, a reduction in building and process water use by at least 30%, and a reduction in energy use by 60% better than the Canadian Model National Energy Code (50% better than ASHRAE 90.1-1999).

Case Study: Civic

“...cannot be designed without the use of an integrated design process. Whether you choose to go green or not, this process can save both capital and operating dollars by its very nature of being, which in itself results in the direction of sustainability.”

- Greg Scott
Former Client Representative
OVERVIEW

Schematic Design builds upon the vision developed in Pre-design. It is the phase for thinking “outside the box,” for exploring innovative technologies, new ideas, and fresh application methods in working towards the broad goals and objectives set out in Pre-design. Schematic Design allows experts from all disciplines to analyze the unique opportunities and constraints of the building site and to collectively explore synergies between disciplines and with neighbouring sites. While it is important to keep the scope of investigation broad, goals and objectives must be firmed up. Schematic Design alternatives should be developed based on a synthesis of the entire team’s skills and knowledge. By evaluating them on multiple criteria, the preferred design concept can be chosen.

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<td>• Host design charrettes and workshops to brainstorm ideas, develop concepts, evaluate strategies, and refine options</td>
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<td>• Evaluate feasibility and energy impact of technologies and strategies</td>
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<td>• Report on opportunities</td>
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Resources on green building and whole systems design:


Whole Building Design Guide. www.wbdg.org


PROCESS

COORDINATE TEAM

The architect, engineers, and other core team members work together to determine design and technical strategies appropriate for the project’s unique context.

The design facilitator continues to play a crucial role by:

- Helping the team members feel comfortable thinking outside the box and challenging conventional approaches to maximize potential for synergies;
- Ensuring that no personal agendas dominate the design discussions or process; and
- Leading a design charrette to facilitate cross-disciplinary design, allowing preliminary schemes to benefit from the expertise of all parties and to reflect the interdependency of different building systems.

Specialists such as an energy analyst, cost consultant, and daylighting expert are crucial at this phase to guide early decision-making. Ensure that the specialists’ roles and deliverables are clearly understood by the entire team.

A commissioning authority should be engaged towards the end of this Phase; they will be responsible for reviewing the final schematic concepts and options in light of the client’s project requirements.

It is important during Schematic Design for the team to feel comfortable brainstorming and exploring new ideas together. They must be able to work collaboratively to refine concepts into cohesive schematic designs based on input from all members and in keeping with the vision and goals established in Pre-design.

See Part 1 The Integrated Design Team and Appendix B for more information on the roles of individual team members.

ESTABLISH A FOUNDATION

The project champion and team should establish foundations for Schematic Design by doing the following:

- Ensure the Project Vision describing the intent and goals of the project are documented, shared, and understood by all team members;
- Ensure the Team Values or a Code of Conduct outlining how the team will treat one-another has been documented and distributed;
- Document a clear understanding of the site challenges and opportunities, sometimes referred to as a Site Analysis Report;
- Ensure the functional program requirements and its implications for all disciplines are understood; and
• Develop an Opportunities Report by conducting research to identify funding sources, products, strategies, best practices, and precedents relevant to the project type and site context. Also address any information gaps identified during Pre-design.

**PLAN KEY MEETINGS**

To enhance meetings during Schematic Design, consider the following:

• Keep the vision in mind; have a copy of the Project Vision at hand (for example, include it on agendas or by simply bringing the vision document) in all meetings for easy reference.

• Hold meetings on or near the site or host a site visit. This will improve the team’s ability to visualize and evaluate the project context.

Depending on the project size, team, schedule, and budget, the following are some meetings that may be part of the design iterations.

**Design charrette**

Consider having a third party facilitate a design charrette with the entire project team, and user groups to develop schematic design options. All necessary disciplines should be present, including a cost consultant, contractor, commissioning agent, and other specialists relevant to the project.

• Effective preparation prior to the charrette is essential. Refer to charrette planning resources in Phase 1: Pre-Design for more information.

• Use brainstorming techniques to conceptualize innovative strategies, technologies, and applications. Recognize early any specific requirements (budgetary and other) for implementation of non-standard systems/components.

• Use systems thinking to seek synergies between the project site and neighbouring sites and between components and systems to reduce costs. Do the same with strategies to identify and address risks and conflicts.

• Develop visual representations of alternatives to facilitate communication and understanding between disciplines and for non-technical audience.

• For large projects, consider bringing in other stakeholders (i.e., students, neighborhood groups and others) to brainstorm ideas and to see what innovative ideas are generated.

**Workshops**

Instead of or in addition to a charrette, a number of workshops focused on specific aspects of the building design can be held to explore more specific strategies, technologies, and opportunities. The following is an example set of workshop topics in the order they might be held:

“Extra time for charrettes is offset by less back-and-forth with client later in process.” (Malin 2004)

“It is also impossible to make informed decisions and solve problems fully when they are not considered in sufficient detail. Often it is when alternative solutions are considered at the detail level that breakthroughs are made.” (National Charrette Institute 2004)
Resources on rating systems:
Canada Green Building Council
www.cagbc.org
US Green Building Council
www.usgbc.org
Green Globes
www.greenglobes.com/
International Initiative for a Sustainable Built Environment
GBTool
www.greenbuilding.ca/
International Energy Agency (IEA), Task 23 Multi-Criteria Decision Making Method (MCDM-23)
www.iea-shc.org/task23/
Resource for simulation tools:
U.S. Department of Energy.
www.eere.energy.gov

- Review programming and site
- Orientation and massing
- Structural systems
- Building envelope (daylighting and thermal performance)
- Lighting, acoustics, and thermal comfort design
- HVAC options
- Water and wastewater systems
- Materials selection.

The core team should be present since each topic can affect all disciplines. Specialists can be invited to the charrette or to relevant workshops in order to influence the design.

OUTPUTS
The Schematic Design phase results in a number of design scenarios that are based on cumulative knowledge of the entire project team in keeping with the project vision, goals, and objectives. The following are examples of some of the key deliverables and associated activities that are important to a successful integrated process during the Schematic Design phase.

GOALS AND TARGETS MATRIX
Refine general project goals and objectives developed during Pre-design into measurable performance targets. These can be documented in a goals and targets matrix or report, which will be referenced and refined throughout the process.

- Explore economic, environmental, and social targets, including a discussion around payback tolerance especially for new technologies; and
- Agree upon criteria for evaluation and priorities through weighting factors if applicable. Established evaluation criteria and rating systems such as LEED and Green Globes can be utilized for this purpose.

PRELIMINARY ENERGY ANALYSIS
An energy analysis should be performed to assess options and establish a baseline for comparison.

The US Department of Energy Efficiency and Renewable Energy (EERE) has compiled a comprehensive list of software tools for a variety of purposes including whole building simulation, envelope system comparison, and daylighting analysis.

PRELIMINARY FINANCIAL ANALYSIS
A preliminary cost estimate should be developed and a baseline established. As part of this exercise, consider conducting a life-cycle analysis to assess acceptable returns for alternatives and their associated long-term costs and the operating and maintenance savings. This information can prove to be useful in making the business case for various green building strategies and technologies explored during this phase. In addition, a valuation/appraisal professional can assess the value of other green building measures that are harder to quantify.
SCHEMATIC DESIGN REPORT
The schematic design report is the culmination of efforts during this phase. The following are examples of activities that are typically undertaken during an IDP when developing the schematic design report:

- Evaluate options systematically through energy simulations, daylight analysis, preliminary costing, etc.
- Use a well-defined decision-making process, such as multiple-criteria evaluation, and document results. A rigorous process ensures that all aspects are considered and enhances the team’s confidence.
- Understand and address the risks and rewards of innovative sustainable design strategies and technologies early in the design process. With all new ideas, it is important to hold a meaningful risk discussion with all parties, including the client.
- Refine Schematic Design alternatives through a series of design iterations or "design loops" to integrate feedback from team and specialists. The number of feedback loops will vary depending on the size of the project, but they provide an opportunity for the team’s expertise, and analysis such as energy modeling, to inform the early Design Development.

ROLES AND RESPONSIBILITIES MATRIX
Define responsibilities and assign tasks for subsequent design phases to team members for achieving various design goals and investigating strategies.

IDP AND GREEN BUILDING CERTIFICATION
- Avoid “chasing points.” Instead use the system as a benchmark and ultimately a measuring tool, rather than a planning tool or a rule book for improving the environmental performance of the project.
- Ensure that the certification coordinator and each discipline understand their responsibilities with respect to documenting credits, and that these are accounted for in fee agreements.

TIPS
- Ensure that local authorities, local environmental groups, and other stakeholders are on-board with the design. A building inspector who is unfamiliar with a technology or strategy may refuse to issue a building permit.
- Look for external funding opportunities. Almost all Canadian projects pursuing green strategies are eligible for some level of funding or subsidy. Furthermore, specific systems, such as energy systems, can sometimes be funded by external organizations and leased back to the project.

Resources for funding sources:
The Greater Vancouver Regional District’s BuildSmart: www.gvrd.bc.ca/buildsmart
BC Building Corporation’s Green Building BC www.greenbuildingsbc.com
The Canadian Subsidy Directory: www.mgpublishing.net
The Federation of Canadian Municipalities: www.fcm.ca
Natural Resources Canada: www.nrcan.gc.ca
“The design professionals should be paid on a lump-sum basis or some equivalent that will avoid penalizing them financially for reducing the size and cost of mechanical systems”. (Natural Resources Canada 2005)

“When integrated 3D-2D model-based technology is linked with information, design firms have a faster, higher-quality, richer design process. Risk is reduced, design intent is maintained, quality control is streamlined, communication is clearer, and higher analytic tools are more accessible…We finally can harness the power of computers in a real value-added design process that doesn’t just mimic drafting.” (Davis, 2003)

- Promptly develop communication tools that will facilitate the sharing of information among team members (such as a web-based information exchange process). If no effective mechanism for communication exists outside meetings, the process will suffer or the design budget may be drained by excessive meetings.

- Do not reject proposed strategies too early on the grounds that they might be too costly, overly risky, or in conflict with regulations. The field of high-performance building design is evolving very rapidly, so ensure that you have the latest information before making decisions.

- Think about opportunities to build a case for changing regulations. In addition, synergies between building systems can result in cost savings that may make innovative strategies more cost-effective.

- Effective upfront site planning can reduce site-clearing costs later in the construction Phase by minimizing site disruption, movement of earth, and installation of artificial systems.

- Staying on schedule is an important part of a successful project. The team can help meet deadlines by collectively determining the critical path. Developing a Gant chart during a team meeting can bring to light areas where one discipline’s work is highly dependent on the progress of another.

- Consider using Building Information Modeling (BIM) software instead of 2D drafting technology.
Case Study: Institutional

UNIVERSITY OF VICTORIA MEDICAL SCIENCE CENTRE
VANCOUVER, BC
Status: Completed 2006

A 4,000 square meter building that houses medical teaching and research as part of the UBC undergraduate physician training program. This building comprises the University of Victoria portion of the distributed model in partnership with British Columbia Medical Training. Key features of the building include lecture theatres, laboratories, and gross anatomy lab facilities. In addition, the building provides space for conventional teaching, small group distance education seminars, faculty offices, flexible research labs, and animal care.

“For the Medical Science Centre, we used the “less-is-more” philosophy, whereby we created a robust core infrastructure that the client can “plug and play” within over the life of building. We set up systems and integrated them into the structure in such a way that the users will be able to renovate and make changes in a cost and time-effective manner with minimal disruption. Disruption can be an enemy during the occupied life of a science building.

For example, we designed a services spine down the middle of the building, providing water power, communications, air supply, and other basic services, without fully distributing them. We use a cap-off approach and valves to allow fit-out as it is required. This avoids installing ducts, piping, etc that are certainly not needed initially and may never be required. This is far more efficient, saving money and resources; resources which don’t have to be taken from the earth, manufactured, delivered and installed. As well, it provides the owner with flexibility. As design teams we need to think in terms of designing buildings that will be continually renovated and remodelled over the life of the building, and sometimes even before construction is complete.”

- Russell Chernoff, Chernoff Thomson Architects, 2006

“Practicing integrated design has a big impact on every Phase. One of the interesting impacts from my point of view is bringing together the creative capabilities of all team members, including owner’s representative, engineers, quantity surveyor and other specialists. We try to have everyone contributing their thoughts and opinions on the evolving design and to keep that open throughout the process.”

- Russell Chernoff
Chernoff Thomson Architects
Dockside Green is a 15-acre, 26-building, sustainable, greenhouse-gas-neutral, brownfield development in the heart of Victoria, BC. This project offered a number of opportunities as well as risks for the developer. The design team identified risks and opportunities at the very outset of the planning and design process and shared these with local stakeholders. Through a series of design charrettes, the entire team (developer, design consultant team and contractor) worked closely to develop the design in keeping with the project’s premise of finding the appropriate synergies among the various systems to optimize performance and minimize costs.

"The absence of objections during the approvals processes for this project is unprecedented due to several factors, namely efforts to inform, consult with, and include all local stakeholders including the Community Association, neighboring businesses, and environmental organizations. Local First Nations groups were also consulted during the planning process. This improved communication and consultation process, virtually eliminating the typically high cost of approvals, highlights the importance of involving stakeholder groups early, and continuing the dialogue with these groups throughout the development of the project.

It should be acknowledged that much of the ground work was done by the City through creation of the Development Concept that was approved by Council, and which set the ground work for rezoning. The fact that the Dockside proposal was consistent with this Development Concept played a key role in the accelerated rezoning and subsequent development permit issuance.”

- Carola Bloedorn
Windmill Developments
PHASE THREE: DESIGN DEVELOPMENT

OVERVIEW

Design Development is a time to firm up and validate choices, resulting in a schematic design concept being selected and approved by the client. All architectural, mechanical and electrical systems are assessed for their expected performance and for their impact on all other systems as well as on the goals and targets.

“This is the most critical phase for translating visionary charrettes into “buildable” ideas. This is where the most stress occurs since the risk management, cost issues and team chemistry come to the forefront (while the vision is threatened, the schedule is critical and the project manager is leaning on everyone).”

– Danny Pearl, L’Oeuf Architecture, September 2006

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Process</th>
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<tbody>
<tr>
<td>• Design Development report including IDP issues such as energy simulation results</td>
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<tr>
<td>• Detailed financial report using life-cycle costing if possible</td>
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<tr>
<td>• Outline specification with embedded performance criteria</td>
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<tr>
<td>• Preliminary commissioning report</td>
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<td>• Updated roles and responsibilities matrix</td>
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<td>• Updated goals matrix</td>
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<tr>
<td>Coordinate team:</td>
<td>Establish a Foundation:</td>
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<tr>
<td>• Engage new specialists (eg, commissioning agent, outside experts)</td>
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<tr>
<td>• Promote collaboration amongst team members</td>
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<tr>
<td>Plan key meetings:</td>
<td>• Assess feasibility and viability of green building strategies and technologies</td>
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<tr>
<td>• Design optimization loops maximize synergies between design disciplines</td>
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</tr>
<tr>
<td>• Smaller, focused meetings for specific issues</td>
<td>• Use tools to simulate (eg, energy model) technologies and strategies and assess building performance (eg, thermal comfort, daylighting, acoustics)</td>
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</tbody>
</table>
“Regular stakeholder feedback loops quickly build trust in the process and foster true understanding and support of the outcomes.” (National Charrette Institute 2004)

**PROCESS**

**COORDINATE TEAM**

Every discipline has a role to play at this phase for the team to fully understand the building as a whole and the synergies that can be developed between the various building systems. Co-ordination and communication between the different disciplines is essential throughout this phase. Someone, such as the design facilitator, project champion, or project manager will be instrumental in ensuring ongoing communication.

Consider involving:

- The contractor, building occupants, and operation and maintenance staff in order to develop commitment and identify further opportunities and risks.
- A building controls specialist to provide input on control systems and applicability of them for the project.
- A valuation/appraisal professional to help extract non-traditional financial values and returns associated with green building measures. Ensure that the terms of reference are clearly defined for this scope of work.
- A qualified commissioning agent, if not already part of the team, to review all Design Development documents to ensure they meet commissioning goals.

Encourage the team to:

- Come to meetings prepared with deliverables and issues flagged for discussion and ready to work interactively on materials with other team members.
- Come ready and willing to consider aspects of the design outside of your discipline and to consider all options, no matter how far-reaching they may seem.

Collaboration between disciplines can help to increase the degree to which goals are met through a particular strategy. For example, program layout has implications for daylighting and views.

In order to maximize the efficiency of the process, refer to the individual responsibilities outlined in Appendix B which provides a detailed matrix of member roles and responsibilities for each design phase.

**ESTABLISH A FOUNDATION**

Work completed during Schematic Design forms the foundation for moving forward; ensure the following deliverables are complete:

- Conceptual design options
- Goals, objectives, and targets
- Preliminary energy simulation and analysis
• Preliminary operating cost estimate
• Preliminary list of green materials
• Responsibility matrix for green design items

In addition to the above preparation, investigate green building and other innovative strategies and technologies identified in the Schematic Design Phase for the chosen concept by assessing:

• Their technical feasibility;
• Their economic viability;
• Their ability to meet performance targets;
• Their anticipated incremental design, operating, or capital costs or savings; and
• Their non-monetary impact on operation and maintenance.

See the resources on green building and whole systems design in the Schematic Design section, and in the Reference & Bibliography section.

**PLAN KEY MEETINGS**

During Design Development the core team should work to refine the chosen design based on the results from analysis such as life-cycle costing and energy modeling, and to ensure that goals and targets set in Schematic Design are not forgotten.

Depending on the project size, team members, and schedule this may involve a series of meetings or design optimization loops to review how this information affects the design positively or negatively. In contrast to a conventional design approach, this iterative method allows feedback from all disciplines to be incorporated and synergies between design disciplines to be maximized.

Key considerations for meetings during Design Development:

• IDP meetings are not separate from regular design and team meetings; it is the attitude, approach, and experience that team members bring to the meetings that distinguish an IDP from traditional design.

• Every project is unique, but for large project teams, a meeting every two weeks or once a month may be ideal. It is important that these meetings are scheduled consistently (time and day of week).

• Consider hosting smaller group meetings focused on specific design issues (eg, water, energy, materials etc.).

• As appropriate, include consultants outside the architectural and engineering disciplines, such as an acoustician, lighting designer, thermal comfort expert, control systems specialist, and/ or commissioning expert, in design meetings to ensure there is appropriate consideration of their design requirements or to explore new opportunities.

**Resources on Workshop Schedules:**


Consider inviting industry or academic experts or other stakeholders to specific design area meetings. These outside participants often provide invaluable information not provided through conventional channels of information-gathering. For example, consider inviting a wastewater expert or professor on water ecology when discussing a project’s water and wastewater systems.

**OUTPUTS**

The Design Development phase results in a cohesive, integrated design that confirms and validates design system choices and sustainable design goals for the project. The final output from the Design Development phase can be defined by a number of items such as a formal report, a set of drawings, and project specifications and renderings. Each output will be unique to each project.

The following are examples of some of the key outputs and activities that are important to a successful Design Development phase.

**THE DESIGN DEVELOPMENT REPORT**

When completing the Design Development Report, project teams can consider undertaking a number of the following activities depending on the complexity and scope of the project:

- Perform a more detailed energy simulation to confirm energy performance targets and to optimize the chosen design. Energy simulations will confirm the energy-related benefits of mechanical, electrical, and building envelope strategies.

- Confirm green building strategies. Every project will be unique, but Design Development is the time to confirm how various strategies discussed in Schematic Design combine to optimize the building design and performance. There will be synergies and tradeoffs between systems, products, and design disciplines. Many resources available on green building design offer guidance on how to design green/sustainable buildings, manage stormwater, conserve water and energy, minimize site disturbance, provide for a superior and healthy indoor environment, and specify resource-efficient materials. See resources on sustainable design listed in the Schematic Design Section.

- Recalibrate the numeric goals and targets established in Schematic Design. How the design performs relative to the established goals and targets can be determined through energy simulations, water calculations, etc. This recalibration of project goals will confirm the project’s performance targets established during Pre-design and Schematic Design, as well the project’s certification target, if applicable.

- Address issues such as thermal comfort, daylighting, and acoustics. Studies show that frequently, these issues are not adequately addressed in green buildings but are critical for optimizing the performance of buildings. For more complex projects, use appropriate tools to assess the impacts of innovative design strategies on these parameters. For example, Computation Fluid

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**Resources for modeling:**


- Computational Fluid Dynamic (CFD) Modeling
  - CFD Review www.cfdreview.com
  - CFD Online www.cfd-online.com

- Ecotect daylight modeling software. www.squ1.com

- Integrated Environmental Solutions Ltd. www.iesve.com

- DOE2.com and EQuest modeling tools www.doe2.com
Dynamics (CFD) modeling may be necessary to confirm airflow patterns of a displacement ventilation strategy; thermal comfort and acoustical analysis may be used to inform radiant heating/cooling strategies; and daylight simulations will inform optimum placement of windows, shading, and control devices.

- Explore issues such as commissioning, building monitoring, and measurement and verification of building systems. If the client is interested in tracking the building’s performance to ensure that it will operate optimally, Design Development is the time to start discussing and coordinating these issues with the mechanical, electrical, and commissioning consultants.

**DETAILED FINANCIAL REPORT**

Typically a financial / costing report is completed towards the end of the Design Development phase. Depending on the contract arrangement, this report can be prepared by a cost consultant or a contractor. As part of this exercise, consider conducting a life-cycle analysis to assess acceptable returns for alternatives and their associated long-term costs and the operating and maintenance savings.

In addition, a valuation expert can extract non-traditional value (e.g., potential productivity benefits, reduced churn rates, increased lease rates, reduced fit out costs etc.) associated with green building measures. This information can prove to be very useful in making the business case that balances economic, social and environmental performance criteria for various green building strategies and technologies explored during this phase.

Team members responsible for pursuing outside funding, incentive programs, or partnership agreements with utility providers should report back on the success of applications to the cost consultant and team. This information may inform a decision to pursue a technology (e.g., photovoltaics, wastewater treatment, or co-generation) that may have a higher capital cost or a longer payback period but will result in significant infrastructure or utility savings.

Results of this analysis should be kept to inform possible future performance comparisons between the design case and actual performance two to five years after occupancy.

**OUTLINE SPECIFICATION**

A completed outline specification at the end of Design Development is a very useful document for the subsequent design phase. In completing this specification document, consider the following:

- Use a life-cycle analysis tool, such as Athena Environmental Impact Estimator, to assess the environmental impact of material alternatives.

- Take issues such as embodied energy, emissions, acoustic properties, thermal performance, and resource efficiency into account when selecting materials and systems.

- As appropriate, embed certification requirements in the outline specification.

**Resources on Life-Cycle Costing:**

- Whole Building Design Guide. An all-encompassing electronic resource that provides guidance on green design and life-cycle costing [www.wbdg.org](http://www.wbdg.org)

**Resources on specifications:**

- Construction Specifications Institute (CSI): [www.csinet.org](http://www.csinet.org)
“Very often single components or finishes are added or deleted to meet time or budget constraints without evaluating their impact on total building performance. High-performance green buildings are optimized by including entire building systems, their relationship to one another and what must be done to balance the impact of each system against long-term stewardship and building operation.” (Governor’s Green Government Council 1999)

**PRELIMINARY COMMISSIONING REPORT**

Towards the end of Design Development, the Commissioning Agent will complete a review of the Design Development documents and prepare a preliminary commissioning report. The commissioning agent will require a full set of drawings in order to complete this report. The purpose of this report is to ensure the project team has met the client’s design and operational intent for the project and to determine if certification requirements are embedded in the design if applicable.

See resources on commissioning listed in Phase 5: Bidding, Construction, and Commissioning.

**UPDATED ROLES AND RESPONSIBILITIES MATRIX**

The roles and responsibilities matrix should be updated at the end of Design Development to ensure everyone involved in the project has a clear understanding of their responsibilities. The project manager in charge of updating the matrix should:

- Require project team members to report back on deliverables; and
- Assign new tasks for the next design phase.

This knowledge will assist decisions to be made during the Construction Document Phase and any value engineering exercises.

Refer to Appendix B for a detailed matrix of individual roles and responsibilities for each design phase.

**UPDATED GOALS MATRIX**

The sustainability goals matrix should also be updated towards the end of Design Development to record and confirm performance goals. Map these goals against the green building certification program to confirm the project’s level of certification, if applicable.

**IDP AND GREEN BUILDING CERTIFICATION**

The dependencies between the selected strategies and certification requirements should be documented at this phase. Team members can do the following:

- Determine how to incorporate the certification requirements into their part of the building design.
- Have the certification coordinator re-evaluate points available through the current design and assign responsibility to individual consultants to complete credit documentation.
- Ensure that energy point requirements, daylight factors, water use calculations, and all prerequisites are confirmed by the end of Design Development.
- Have the Commissioning Agent review all drawings for certification compliance.
TIPS

• Produce attractive renderings illustrating high performance building features so that users, marketing staff, and others can become engaged by the project.

• Consider using a commissioning agent from within the owner’s organization. This can be a facility manager or other person with a good understanding of both the organization’s methods of operation and preferences and the characteristics of mechanical and electrical systems.

• Convey to the appropriate level of decision-making authority the complete costs and benefits of the proposed design. It is therefore helpful if the project champion has some decision-making powers or has a close relationship with the client.

• Optimize the number of meetings required by ensuring proper meeting preparation and that communication tools are readily available.
“It was felt that the Integrated Design Process had the most impact on the Design Development phase. There was a greater efficiency in the overall design because all consultant parties’ work was integrated. With an integrated design approach the architects have even more of a coordination role than normal and this has helped their understanding of the building as a whole.

Team building was also seen to be even more important with this process as each party needs to respect the other parties’ input. Mostly the shared goal of designing a sustainable building was the vision that we have all shared. We are only at the Design Development phase at the moment, so there is still a long way to go.

For true integrated design the many different consultant parties should be involved in the design at the earliest Phases. It is at these early Schematic and Design Development phases that the greatest opportunities occur for overlapping of knowledge which can lead to a more integrated design solution.”

– Lee Hallman, Foster + Partners

Case Study: Private Developer

JAMESON TOWER
VANCOUVER, BC
Status: Under Construction

Jameson House is a 37-storey, 34,000sqm tower designed for the heart of downtown Vancouver. Its unique curved shape offers 131 residential suites, retail, and office space. Sustainability has been key to the design strategy throughout. The curved sheer walls provide shade from the low angle west sun and serves as privacy barriers for the residential suites. Careful balancing of energy supply through the development’s mixed use has enabled full advantage to be taken of a central cogeneration plant. It is planned to run on an ecologically friendly primary fuel and combined with absorption cooling to supplement both cooling and electricity requirements for the building.
PHASE FOUR: CONSTRUCTION DOCUMENTATION

OVERVIEW
The construction documents (CDs) are prepared based on approved Design Development documents as well as final calculations and specifications. If the project is to be successful, the integration that has been achieved throughout earlier phases must be maintained during this Phase despite the high pressure of impending deadlines.

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Process</th>
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<tbody>
<tr>
<td>• Project specifications with embedded performance criteria</td>
<td>Coordinate team:</td>
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<tr>
<td>• Material substitution policy</td>
<td>• Coordinate CDs between disciplines</td>
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<tr>
<td>• Tender documents with clear explanation of innovative aspects, contractor responsibilities for green building documentation, training and supervision of trades / subcontractors</td>
<td>Establish a foundation:</td>
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<td></td>
<td>• Review performance criteria</td>
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<td></td>
<td>• Integrate green aspects into CDs</td>
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<td></td>
<td>Plan key meetings:</td>
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<tr>
<td></td>
<td>• Host regular meetings to ensure full impact of changes is evaluated</td>
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<tr>
<td>• Commissioning plan</td>
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<tr>
<td>• Updated roles and responsibilities matrix</td>
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<td>• Updated goals matrix</td>
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</table>
It is very important at this phase that all team members be aware of their respective areas of responsibility. Each team member should review the construction documents to ensure design intents are reflected in them.

Specific actions may include the following:

- Host regular coordination meetings with the consultant team to ensure there are continuous open lines of communication and that construction documents are consistent.

- Involve a specifications writer, if not already part of the team, who is experienced in preparing green building specification and integrating green building certification requirements.

- The architect, engineering consultants, landscape architect, and interior designers should ensure that all sustainable design features are well documented in the specifications and drawings.

- The certification coordinator should be collecting documentation from the project team ensuring that certification goals continue to be met. A coordinator from each discipline should review their final construction documents and specifications for compliance.

- The commissioning authority can review construction documents at the different phases (e.g., 50 percent, 90 percent) of completion to ensure the client’s objectives and design intent continue to be achieved in the construction documents.

In order to maximize team efficiency, refer to individual responsibilities outlined in Appendix B.

**ESTABLISH A FOUNDATION**

The design team can lay a foundation for the Construction Documentation phase by doing the following:

- Review and update the statement of design intent, particularly the green features, and ensure performance criteria are aligned with the intent.

- Confirm green measures and goals agreed upon during pre-design and schematic design and ensure these goals are integrated into the CDs. Details are often lost or forgotten in CDs due to turnover within team members.

- Gather the results of energy and environmental analysis to confirm design performance.
• Review applicable codes and standards to identify requirements of local, provincial, or federal environmental regulations.

• Review risk-reward issues between designers and contractors associated with new technologies and strategies that may arise during construction. For example, if construction contractors are expected to absorb the incremental risk for the integration of unconventional systems, an allowance may be necessary for rewarding them accordingly.

PLANT KEY MEETINGS
At this phase it is important that changes made by one team member are communicated to all the others and that issues arising from these changes are addressed by the team. Recommended meetings during this phase include the following:

• Typically client review meetings occur at 33%, 66%, and 99% completion. Adjustments to the design are bound to occur during this Phase, so the design team must collaborate closely to effectively incorporate these changes in every detail. Ensure that the full impacts of changes are properly evaluated from a holistic design perspective. For example, the deletion of shading devices can have a significant impact on mechanical system sizing.

OUTPUTS
Key decisions made during this phase result in an accurate, complete, and consistent set of construction and tender documents which specify how to translate the intended design into a physical reality.

The following are examples of some of the key outcomes and activities that can occur during the Construction Document phase:

PROJECT SPECIFICATIONS
Specifications are a key output of this Phase. In preparing the specifications, consider the following:

• Ensure that innovative and unconventional aspects are clearly identified in the specifications, and include as much information as possible on the drawings. Make sure that nothing is left to interpretation, especially when specifying innovative systems.

• Embed environmental performance criteria, and if applicable include certification targets, prerequisites, credit requirements, and documentation requirements in each specification section. This information is typically inserted up front in Division 1 and in subsequent specification sections.

• Identify requirements and expectations related to the construction activities (eg, erosion and sedimentation control plans, construction waste management, and construction indoor air quality procedures).

“The Development of Contract Documents involves translating the Design Development information into formats suitable for pricing, permitting, and construction.” (WBDG Aesthetics Subcommittee, 2006.)
“Contractors also need clear guidance on when and how they can propose product substitutions, and what criteria will be used to evaluate those substitutions. The logistics of substitution requests depend on the nature of the project — especially whether it is a public-sector or private project — and the format used in the specifications. In any case, the Division 1 section that describes the logistics of substitution requests (Section 01630, per MasterFormat) should mention that green considerations will affect decisions, and require documentation of green attributes for any proposed substitutions. Throughout the spec, the technical sections must be explicit about the green attributes that products in each section must have if those attributes are to be used as a basis for evaluating potential substitutes.” (Environmental Building News Vol. 11, No. 17 2002)

- Develop terms of responsibility for the contractor and sub-trades. For example, include requirements for contractors to collect certification documentation (i.e., material safety data sheets showing emission levels of products). In addition, include requirements for commissioning, re-commissioning (one year later), and training and education of operations and maintenance staff.

- Include a requirement for the contractor to maintain accurate records (e.g., a construction diary) throughout the construction process, including as-built drawings, change orders, substitutions, etc. This will help with commissioning as well as with building operations.

- Clearly outline the contractor’s responsibility to educate the sub-trades regarding the project, green building certification goals, and material documentation and tracking processes.

- Clearly define the interface between trades so that responsibilities are not left undefined. This is critical for meeting performance specifications. For example, numerous trades are responsible and liable for an overall air tightness rating and the construction site usually has to shut down for a half day to perform air tightness testing; consequently other sub-trades may not be aware of this inconvenience.

- New specification sections may need to be created; many issues related to high-performance buildings are not covered in the conventional drawing and specification formats.

See also resources on specifications listed in Phase 3: Design Development.

MATERIAL SUBSTITUTION POLICY
Develop an approval process for alternatives. The interrelationship of systems means that changes to the design or products selected must be carefully considered to capture the interactions and benefits between strategies as well as system and product choices made early on in the design.

TENDER DOCUMENTS
In preparing the final set of tender documents, consider the following:

- Ensure that tender documents are very clear on the design intent, sustainability goals, and certification objectives of the project. A separate section of the document should deal with these objectives, but the performance criteria, standards, and forms for submissions should be addressed throughout the documentation.

- Ensure the tender documents outline contractor and sub-trade responsibilities for documentation of green building rating systems.

- Ensure details of innovative technologies and strategies, are clearly conveyed in the construction and bid documents.
COMMISSIONING PLAN

- If not already completed, hire a commissioning agent. A third party commissioning authority plays an important role in representing the client’s needs throughout the project.
- A final commissioning plan should be developed and incorporated into the bid specifications.

See resources on commissioning listed in Phase 5: Bidding, Construction and Commissioning.

UPDATED ROLES AND RESPONSIBILITIES MATRIX

Update the roles and responsibilities matrix at the end of the phase to ensure that everyone continues to have clear understanding of their roles as the project moves forward into the construction phase.

UPDATED GOALS MATRIX

Update the sustainability goals matrix at the end of the Construction Documentation phase to confirm the project’s performance goals and anticipated level of certification, if applicable.

IDP AND GREEN BUILDING CERTIFICATION

The Construction Documentation phase is a critical time to confirm certification calculations and embed requirements in the project specifications. Additional tips include the following:

- It is important to consider certification requirements when developing the construction sequencing plan and specifications. For example, demolition or excavation can occur while construction documents are being completed, which can have an impact on certification requirements for erosion and sedimentation control and demolition waste management.
- Certification costs can be minimized by ensuring that the responsibilities for all documentation required from contractors is explicitly and simply stated in the specifications and construction documents.

TIPS

- Involve and inform the permit authorities; if they are sympathetic and educated about sustainability, the permit process will likely be easier.
- Testing may be required for certain innovative strategies; consider measurement and validation in detail prior to construction.
- There might be a perception on the part of some contractors that high-performance building approaches to construction might be more costly, resulting in higher bids. This can be avoided by pre-qualifying contractors with experience in green design or by providing clear guidance on how costs can be maintained at standard levels.

“As the project proceeds through programming and construction documents, it is necessary to revisit and update the statement of design intent to ensure that the goals of the project remain intact.” (Governor’s Green Government Council 1999)
“The decision had been made to use suspended radiant panels coupled with geo-exchange heat pumps and displacement ventilation as the mechanical system for the project. During construction documentation we collaborated on the placement of the suspended panels in what is an open-ceiling environment. We were having difficulty reconciling the need to place panels near the windows (the primary source of heat transfer) with the need to keep the area near the window as free of visual clutter as possible to optimize daylighting.

The project architects and mechanical engineers developed a solution where the radiant panels would be attached to the inside face of the horizontal mullion at approximately 2.2 m above the adjacent floor level. There is a strip of vision glazing above this mullion which provides additional daylighting to the space. The solution included the addition of a sheet of foil-faced insulation to the top of the radiant panel which permitted the panel not only to perform its primary function (mitigation of heat transfer) but also to act as a light shelf, dramatically improving daylight penetration into the space.”

- Kevin Hanvey
Omicron

CITY OF VANCOUVER NATIONAL AVENUE WORKS YARD
VANCOUVER, BC
Status: Completed 2004

The 12-acre City of Vancouver National Works Yard serves as an Engineering Operations Facility. The project includes an administration centre, a garage and radio shop, parking operations, warehouses, a car wash and a fuelling station. The project was a City of Vancouver’s pilot initiative to promote sustainable design practices. The City’s leadership and level of commitment to sustainable principles is reflected in the design expertise employed and the application of sound environmental building practices, which culminated in two of the facility’s buildings achieving LEED Gold Certification.

To a very large degree, our company was founded on the principles behind the Integrated Design Process (IDP). Omicron is a professional consulting firm that consists of architects, interior designers, engineers and construction managers. The National Avenue Works Yard for the City of Vancouver was delivered in a construction management format incorporating sequentially tendered document packages. Given the project delivery format and the nature of our company’s organization, it’s fair to say that IDP occurred almost continually from project inception through completion. Nevertheless, the radiant panel example demonstrates how IDP benefited the project specifically during the Construction Documentation Phase.
PHASE FIVE:
BIDDING, CONSTRUCTION, COMMISSIONING

OVERVIEW
In this Phase of the project, the main design plans are realized. Many factors must be considered to ensure that the goals of the project are carried through to completion. Qualified contractors are chosen, communication procedures are set in place, and the expanded team works to transform the abstract into actuality.

Special attention is paid to the design intent in working through the inevitable construction-phase changes and adjustments. This work is facilitated through effective interface between disciplines, partial commissioning of systems during construction, final commissioning, and testing and validation. By the end of this phase the team will have achieved a finished, fully functional, and well-commissioned building, ready for occupancy.

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Record drawings of the built project</td>
<td>Coordinate team:</td>
</tr>
<tr>
<td>• Commissioning reports</td>
<td>• Transition from design to construction team</td>
</tr>
<tr>
<td>• Operation and maintenance manuals including on-going commissioning</td>
<td>• Orient and train maintenance, operations staff and building occupants</td>
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<tr>
<td>activities</td>
<td>Establish a foundation:</td>
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<tr>
<td></td>
<td>• Update design intent</td>
</tr>
<tr>
<td></td>
<td>• Include specific performance criteria in contract documents</td>
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<tr>
<td></td>
<td>• Develop commissioning plan</td>
</tr>
<tr>
<td></td>
<td>Plan key meetings:</td>
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<tr>
<td></td>
<td>• Have pre-tender award meeting to discuss green design intent</td>
</tr>
<tr>
<td></td>
<td>• Host a green building information session for contractor and trades</td>
</tr>
<tr>
<td></td>
<td>• Plan regular site meetings to review design approach</td>
</tr>
</tbody>
</table>
“The degree to which the original goals of high performance design remain intact” is dependent on establishing “an atmosphere within which information is shared and questions and recommendations are encouraged.” (Governor’s Green Government Council 1999)

**PROCESS**

**COORDINATE TEAM**

At this phase the core team changes, ceding importance to the construction parties who must work closely with the design team, with input from the owner, as well as future occupants and operators.

Specific team member roles and responsibilities are outlined below:

- The client should help the team ensure that decisions made during previous phases are not lost during a value engineering process.

- The contractor plays an important role at this phase as the key person responsible for translating the design into reality. The contractor will be responsible for providing, for example, the project schedule, green building certification submittals, and a post-construction package with as-built drawings.

- The commissioning authority will review the contractor submittals and the operation and maintenance manual, and ensure that pre-functional testing is performed and deficiencies are remedied. Involving the building operation staff in the functional testing will deepen their understanding of the systems.

- The owner, future occupants, and operators for their part also need to be involved at this phase to review the design intent and ensure that it is fulfilled, as well as to learn how the building functions.

**ESTABLISH A FOUNDATION**

The design team can prepare for the bidding phase by gathering the following:

- An updated design intent and goals.

- Carefully worded Request for Qualifications (RFQs) and Request for Proposals (RFPs):
  - Bidding, negotiation, and contract documents should use language that requires verification and documentation of specific performance criteria and targets during construction, and should comprehensively define special supervision, testing, and commissioning procedures.
  - RFPs and RFQs should clearly indicate the basis upon which bids will be chosen, such as previous green design experience. This will ensure qualified bids and prevent disputes over the chosen bid.

- Preparation of a green building information session for successful contractor and sub-trades.

- A commissioning plan with clear definition of project performance requirements.

See resources on RFPs and RFQs listed in Phase 1: Pre-design.
PLAN KEY MEETINGS
The following meetings can enhance the IDP during this phase of the project:

**Pre-tender award meeting**
Prior to awarding the contract, a pre-tender award meeting can be held to discuss the following with the candidate contractors:

- How the client and design team have taken great care to consider the synergies and tradeoffs between systems, materials, and design strategies. Contractor buy-in and understanding of these aspects is critical.

- The importance of being fully aware and supportive of the design intent and environmental goals. This will foster the contractor’s sense of ownership and pride in the project and may avoid cost-cutting measures that could jeopardize the design. As well, this information session may prevent the contractor from adding unnecessary contingencies.

- Opportunities for price reduction strategies and how savings can be achieved in materials, insurance, and transportation rates, by astute waste management, resource and energy conservation, and on-site recycling, and by sourcing materials locally. In addition, a good contractor can sometimes suggest more efficient or effective ways of reaching the same end.

This type of meeting can help ease the nervousness of the contractor and sub-trades when requesting innovative solutions.

**Contractor meeting**
Upon award of the contract, hold a contractor meeting to review the green building strategies and certification requirements.

**Information sessions**
Consider holding one or more information sessions to educate the construction team on the innovative aspects of the building and any unusual procedures such as certification documentation.

- An information session at the start of construction for contractor, sub-trades, and other construction participants as necessary can ensure full understanding of the design intent, objectives, targets, and interactions between systems, as well as introduce any innovative strategies and technologies.

- Special requirements of the project should be specifically addressed, such as waste minimization, resource conservation, and indoor air quality (IAQ) during construction.

- It is desirable to establish an open and cooperative atmosphere within which questions and recommendations are encouraged to harness the unified knowledge of the team. A cooperative team approach to construction can assist in achieving a smooth contract administration process by minimizing or avoiding disputes.

“Material delivery, construction sequencing and related time- and schedule-sensitive issues should be less problematic in a project that has been designed by a team and bid by interested and educated individuals.” (Governor’s Green Government Council 1999)
Site meetings

Periodic team meetings, bringing together the design team with members of the construction team, should be held to review progress and address issues as they arise.

- Greater involvement of the design team during the bidding and construction process can result in significant cost savings through reduced change orders, more seamless integration of disciplines, etc.
- When reviewing shop drawings, submittals, and alternatives, ensure that suggestions presented are aligned with the design concept and objectives outlined in the project specifications.
- Field reviews should occur on a regular basis and should include the entire consultant team, the certification coordinator, and the contractor to resolve construction issues in a timely manner. The frequency of these meetings will depend on the size and scope of the project, and should be determined at the start of this phase.

OUTPUTS

The bidding, construction, and commissioning phase achieves a major milestone in the life of the project: the physical manifestation of the vision as a fully functioning building. This section outlines some of the key deliverables and associated activities that define the completion of this phase.

RECORD DRAWINGS

It is important to have an accurate record of what was built and of what changed between the “issued for construction” documentation and the final product. Accurate as-built drawings will be a valuable resource for the building owner, operators, and managers over the life of the building. It should be the contractor’s responsibility to:

- Maintain accurate records throughout the construction process, including as-built drawings, change orders, substitutions, etc. This will help with commissioning as well as operation.
- Keep a “construction diary” which can provide a valuable record including documentation of changes and how they were incorporated, results of testing, measurements, and validation. Online tools are available to facilitate collection, storage, and access to this information, for example www.bearriver.com/epeg.html.

COMMISSIONING REPORTS

It has been stated that “commissioning is often misinterpreted to focus solely on testing during the end of the construction phase, but commissioning is actually a collaborative process for planning, delivering, and operating buildings that work as
intended … Commissioning is a holistic process that spans from pre-design planning to post-construction operation and can be thought of as a checks-and-balances system.” (WBDG Project Management Committee 2006)

While commissioning represents only a small part of the total project budget, it can bring dramatic improvements in building operation, occupant comfort, and indoor air quality. Ensuring that systems function properly can reduce energy consumption, future repairs, down-time, maintenance, and reconfiguration and replacement costs. Commissioning can be seen as a value added process that will improve the performance of the project. In the future, commissioning may be required as part of energy labeling programs for buildings. Consider the following tips in preparing for commissioning:

• If there are scheduling and cost pressures, commissioning activities tend to get squeezed. It is important for the project champion or facilitator to be aware of this possibility and the implications.

• Commissioning is intended to prevent a rushed building hand-over at the end of construction. Commissioning tests should be completed, corrective measures taken, if required, and acceptable performance of systems should be confirmed.

• A report should be prepared after partial and final commissioning to document protocols and results from commissioning of systems.

• Partial and final commissioning functions should be performed by the contractor and sub-contractors according to the terms set out in the bid specifications and construction documents.

• Targets for operation, function, and energy performance should be confirmed.

OPERATION AND MAINTENANCE MANUAL
To ensure the building operates according to the design intent, the contractor must develop a comprehensive operation and maintenance manual with input from the design team if necessary. The manual should include a clear description of green building design features, their intent, how they relate to the building as a whole, and their operational interdependencies. The manual should also describe effective maintenance and operation procedures whose early implementation can minimize occupant complaints and system failure. Re-commissioning or on-going commissioning activities should be included in this manual. In addition, consider the following in developing this manual:

• Include preventive maintenance schedules and on-going commissioning.

• Avoid concentrating the knowledge of how the building operates to a single individual; make sure the building could still be effectively maintained and operated if key staff members were to leave their jobs.

Resource:
www.gvrd.bc.ca/buildsmart

Resources for collaborative software programs:
Primavera Software: www.primavera.com/industry/ec/index.asp

Pacific Edge Software: www.pacificedge.com/product/project_mgmt.asp

Project Planning Tools Software: www.projectplanningtools.org/

Resources for job site recycling:
IDP AND GREEN BUILDING CERTIFICATION

- Host a contractor workshop to review roles and responsibilities of the contractor. During this workshop, provide the contractor with templates for securing information from sub-trades. Contractors working on certification projects typically tend to appoint one staff member from their team to oversee the documentation process throughout construction. The LEED for Contractor’s Guide created by the Greater Vancouver Regional District is a useful tool for contractors working on LEED projects.

- During each site meeting, include green building certification as an agenda item and discuss construction progress against the rating system.

- Ensure that substitute materials comply with the certification program’s criteria and the project’s performance requirements; any changes in products that do not comply with these criteria can affect the final certification.

TIPS

- Avoid pressure from contractors, vendors, and suppliers to use substitutions they are familiar with; educate them to ensure the design intent is not compromised.

- Savings and even earnings can be achieved through reuse or sale of reusable or recyclable materials and debris removed during demolition. This also reduces landfill dumping fees and associated hauling charges.

- Consider making contractor payments dependent on the commissioning agent’s verification of system performance that complies with design and construction documents.

“As contractors become more familiar with construction waste management techniques … construction waste management becomes not only cost competitive but less expensive than landfilling.” (FEE & WBDG 2006)

“BCBC’s Vancouver Island Technology Park saved more than $600,000 by salvaging/recycling over 99 percent of the construction waste generated by the Park’s redevelopment.” (Northey 2002)
Case Study: Owner / Occupied

BC CANCER AGENCY RESEARCH CENTRE
VANCOUVER, BC
Status: Completed 2005

The $95 million BC Cancer Agency Research Centre is the first newly constructed health care or laboratory building in Canada to attain a LEED Canada Gold ranking. It is designed to perform 50 percent better than the Canadian Model National Energy Code, resulting in anticipated savings of $380,000 per year. Sustainable design measures, for example, included heat recovery off of the laboratory exhaust air, high-performance, low emissivity windows, dual flush toilets, waterless urinals, and a construction waste management program that resulted in a 98 percent diversion rate.

“The success of this project is a testament to the clear vision of the BC Cancer Foundation and BC Cancer Agency Research Centre users, this articulation of the vision by the design team and the craftsmanship of the builders and all who combined an inspired architectural design, advanced building systems, and sustainable design in this world class facility.”

- Blair McCarry, Project Engineer, Stantec, 2006.

“We used rigorous methods of risk management. We involved not only Ledcor, but also sub-trades and occupants in brainstorming to stay ahead of problems during construction. We had some spectacular cases of preventing or mitigating change orders. These efforts reduced some change orders that might have cost 2 or 3 million dollars to half a million. We had all the key players at table throughout including architect, engineers, researchers, and the builder. Having the buildability perspective was an important part of the design process.”

– Michael Kennedy
Stantec
PHASE SIX: BUILDING OPERATION

OVERVIEW
This is a key transition phase during which the design team must ensure responsibility for and knowledge of the building is properly transferred to the building’s new stewards: the owner, occupants, and operations staff. This phase is dependent upon completion and documentation of the commissioning that took place during construction.

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Process</th>
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<tbody>
<tr>
<td>• Training and education materials</td>
<td>Coordinate team:</td>
</tr>
<tr>
<td>• Measurement and verification data</td>
<td>• Ensure proper transfer of knowledge between the design team, commissioning agent, building operator and occupants</td>
</tr>
<tr>
<td>• Completed commissioning documentation</td>
<td>Establish a foundation:</td>
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<tr>
<td></td>
<td>• Provide owner with complete building documentation including commissioning report</td>
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<tr>
<td></td>
<td>• Develop tools for ongoing monitoring to uphold system performance</td>
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<td></td>
<td>Plan key meetings:</td>
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<tr>
<td></td>
<td>• Host a debriefing session to share lessons learned</td>
</tr>
<tr>
<td></td>
<td>• Educate staff and occupants on the building’s performance and green features</td>
</tr>
<tr>
<td></td>
<td>• Host a project celebration to transfer project to new stewards</td>
</tr>
</tbody>
</table>
The commissioning agent and the owner must ensure that knowledge is transferred to building occupants and operators, particularly the maintenance staff, to ensure effective use and operation of the building.

Ultimately however, the owner and the building operators are responsible for ensuring that the appropriate operations and maintenance practices, as determined by the commissioning agent, are in place so that the benefits gained from commissioning continue over time.

ESTABLISH A FOUNDATION
The design team can prepare for the building operations phase by doing the following:

- Confirm completion of functional performance testing.
- Ensure end-of-construction commissioning of the building is completed and documented and that recommendations from commissioning report are acted upon.
- Obtain from the contractor a full set of as-built drawings and warranty conditions for commissioned equipment.
- Develop tools for ongoing monitoring to uphold system performance.

PLAN KEY MEETINGS
Meetings that happen during this phase are most important for transferring of knowledge from the design team to the building operations and maintenance staff as well as building occupants.

Provide training and education for building operations and maintenance staff on how to operate and maintain the building systems. The importance of training must not be under-estimated. Substantial operating savings can be realized through effective on-going commissioning and correct operation.

**Debriefing Session**
Once the building is occupied, host a debriefing session with the entire consultant team, client and contractor to discuss what went well, what didn’t work, and how the process can be improved. This type of feedback session is invaluable for the entire team to improve their design process.
**Project celebration**

During this phase, the owner and design team should take the time to celebrate success of the project to show occupants and operators what a special and forward-thinking project they are now the stewards of.

**OUTPUTS**

Effective operation of a high-performance building represents the culmination of a successful Integrated Design Process, ensuring decreased environmental impact of the building and continued cost savings year after year. During the building’s entire operating life financial benefits are experienced, such as reduced utility bills, lower maintenance costs, reduced churn rates, and improved occupant productivity.

The following activities and deliverables can be produced during this phase:

**TRAINING AND EDUCATION MATERIALS**

It is important to educate occupants on the building’s features – how it operates and the impact their behaviour can have on its performance – and also to assign clear responsibility for building operation and maintenance. This information can be communicated through the development of education and training materials. Examples of successful training and education materials include:

- a brochure,
- a case study summary of the building,
- a building tour, and
- extensive signage throughout the building to highlight various strategies and features.

Appointing a champion is an important component of developing an education program for building occupants. This individual can be accountable for engaging various players (staff, occupants, and owner) into taking responsibility for ongoing building performance.

**MEASUREMENT AND VERIFICATION DATA**

Verification of performance is an important aspect of the iterative nature of an integrated design process, learning from “real-time” operational experience. During building start-up, ensure that the necessary systems and monitoring procedures are in place to facilitate the measurement and verification strategy developed and coordinated during Design Development and Construction Documentation phases. Data can be severely skewed without taking into consideration the education of users (not just the building operators and managers).

The following approaches can help in documenting this strategy:

- Consider implementing a centralized building management system that will make equipment and systems respond to occupancy patterns to reduce energy consumption and associated costs when occupants are not present.

“Perhaps the most essential component of operation and maintenance is training. Unless building operators and managers are given the skills to perform quality operation and maintenance practices, there is no hope that a building will continue to perform optimally. As with all training, instruction should be structured to meet the needs of building operator staff. Training session topics ideally should be specified in the bid documents.”

• Collect operational data to assess the building’s performance (e.g., energy and water consumption). This can be used to track improvements, optimize building operation, and troubleshoot problems.

• Implement an environmental management system such as ISO 14001. This can be formal or informal, depending on the organization’s needs and philosophy.

See Phase 7 Post Occupancy (Long-term) for greater detail on building performance evaluations.

**COMPLETED COMMISSIONING**
Commissioning has traditionally been restricted to the construction phase of a project, but IDP and green design principles suggest that the commissioning contract should include a review of the operation one year after construction. Soon after construction, a plan should be established to monitor these on-going re-commissioning activities.

This re-commissioning will increase the likelihood of ongoing energy savings, fewer system deficiencies, reduced need for equipment replacement, better indoor air quality, and therefore reduced occupant complaints and increased productivity.

**IDP AND GREEN BUILDING CERTIFICATION**

• The certification coordinator will be responsible for finalizing any outstanding questions or information and then making the submission for certification. For example, the project may have to wait for results from the indoor air quality testing prior to submitting the application.

• The certification coordinator should ensure that the client receives the certification plaque and that this event is celebrated.

**TIPS**

• Clear documentation of new and innovative “green” technologies and strategies, including operating manuals, will be invaluable for the client over the life of the building by ensuring that operation occurs in accordance with the design intent.

• Be sure to acknowledge the whole team clearly in all publicity materials and when submitting for awards – if the team worked in an integrated way, acknowledgement should go to everyone.

• Involve the operations and maintenance staff and occupants in post-commissioning and measurement/verification procedures that are conducted. This inclusiveness will increase occupant understanding and provide an opportunity to celebrate the magnitude of energy savings they are achieving.
Because this building was considered from day one to be a ‘green’ building with the intention of making it an extremely energy efficient structure, and using an integrated design team approach and an independent commissioning consultant, decisions were made knowingly to downsize heating and cooling ventilation systems in favour of high-performance windows. Elemental costs were traded within the total of the project budget. More expensive windows resulted in less expensive mechanical systems, waterless urinals and dual flush toilets have resulted in lower plumbing costs and lower water consumption. The ongoing operating costs for this building will be substantially lower than a conventional building at a conventional construction cost. And the IDP played a major role in making this happen.”

- Terence Williams
Busby Perkins+Will
(formerly Terence Williams
Architect)
OVERVIEW

Integrated design does not end when construction is complete and occupants have moved in. The IDP seeks to enhance the entire life of the building through effective maintenance and operation, measurement and verification, re-commissioning, and building performance evaluation. The post construction portions of the process provide feedback loops, which facilitate continuous optimization of the building’s performance. In addition, lessons learned from this feedback can be used not only for future projects but also to trigger small-scale improvements in operation that can bring significant benefits to the occupants and owners alike.

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Process</th>
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</thead>
<tbody>
<tr>
<td>• Updated building documentation</td>
<td>Coordinate team:</td>
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<tr>
<td>• Building performance evaluation results</td>
<td>• Create a building performance evaluation team</td>
</tr>
<tr>
<td>• Continuous monitoring</td>
<td>Establish a foundation:</td>
</tr>
<tr>
<td>• Re-commissioning plan</td>
<td>• Allocate fees for building performance evaluation</td>
</tr>
<tr>
<td>• Environmental management program</td>
<td>• Ensure monitoring equipment is in place</td>
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<td></td>
<td>Plan key meetings:</td>
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<tr>
<td></td>
<td>• BPE setup and coordination meetings</td>
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PHASE SEVEN: POST-OCCUPANCY
PROCESS

COORDINATE TEAM

Ideally, the owner or developer will commission a Building Performance Evaluation (BPE) to gain invaluable feedback on the building performance.

The BPE team can be made up of a combination of the following people:

- Design team members (architect and engineers)
- Occupants and/or stakeholders
- Building operators
- Academic group with interest in the results
- External BPE consultant
- Original commissioning agent
- Thermal and acoustic experts

Engage the building occupants and operators so that they take responsibility for the long-term performance of the building. A well-delivered BPE will empower users to improve their building.

Design professionals have a responsibility to ensure that their designs are operating properly. This responsibility should be upheld through effective commissioning, extending into the post-occupancy phase.

The team is also encouraged to continue to submit for awards (e.g., to local architectural institutes or magazines) to celebrate the design team’s success. This information should be communicated to building occupants to assist in improving their understanding of the building and their sense of stewardship towards it.

ESTABLISH A FOUNDATION

Evaluating a building after construction is not standard practice, but when a building performance evaluation is undertaken, it is typically directed by the building owner. In order to perform a successful BPE, the building owner should consider the following:

- Appropriate fees and resources are allocated for the investigation. Consider including the BPE in part of the design fee agreement as a separate hourly task. In this way, the design team has already committed to participating in a long-term evaluation of the building. This avoids administrative time later to set up new fee agreements, but leaves the scope and effort open to discussion.

- Adequate monitoring and metering equipment has been incorporated during design and construction; for example, without sub-meters it becomes very challenging to assess the energy and water performance of a building.

- An evaluation team is needed. It may be a third-party organization or a consultant such as the Centre for the Built Environment (CBE).

- Ensure everyone involved understands the goals of the evaluation.
PLAN KEY MEETINGS
Meetings to plan BPE and re-commissioning efforts should involve occupants, operators, and other stakeholders to take advantage of their collective knowledge.

Building Performance Evaluations can be coordinated one, two, or five years after the building is completed, depending on the amount of funding available.

OUTPUTS
The BPE activities can be used to educate building occupants, the design team, and the owners as to how well the building is performing. The following are some deliverables and associated activities that are important to a successful integrated design process during the occupancy phase.

UPDATED BUILDING DOCUMENTATION
An ongoing record of additions to the building and function is a valuable resource for owners and operators seeking to maintain their facility. Procedures should be put in place to ensure that changes to the building are documented.

BUILDING PERFORMANCE EVALUATION (BPE) RESULTS
A building performance evaluation, also referred to as a Post-Occupancy Evaluation (POE) or a Facility Performance Evaluation (FPE), "is a continuous process of systematically evaluating the performance and/or effectiveness of one or more aspects of [a building] in relation to issues such as … functionality, productivity, and sustainability. [Such evaluations are] generally intended to convey the characteristics of buildings that work well and best, and focus on the ones that should not be repeated in future designs of buildings." (Zimring et al 2006).

A BPE can be a powerful tool for maintaining energy performance, making decisions related to maintenance, purchasing, redesign of space, or measuring the impact of design on productivity and performance. This kind of evaluation should be considered after the first year of operation. Activities included in such an evaluation can include the following:

- Conduct an occupant survey, interviews with operations staff, measurement, and data collection.
- Interview entire design team regarding the design intent of the project.
- Synthesize and interpret the findings.
- Make results available.
- Develop strategies to respond to results.
- Feed lessons learned into the next building cycle.

CONTINUOUS MONITORING
Certain components of green buildings require constant modest monitoring through long-term service contracts; for example, a “living machine” wastewater treatment system needs on-going attention to ensure that the organisms are alive and functioning as they should. It is critical that the finances for this continuous monitoring and commissioning are built into the annual operations and maintenance budget. Otherwise sound risk-proof sustainable strategies become failed case studies and take the green movement backwards many years.

Resources on building performance evaluation:

- The Usable Buildings Trust:  www.usablebuildings.co.uk
- Whole Building Design Guide:  www.wbdg.org/design/fpe.php
- The Centre for the Built Environment:  www.cbe.berkeley.edu/
“Maintaining a building’s intended functions requires knowledge and attention ... Nearly every building starts to decline shortly after the building contractor or commissioning agent departs.” (Environmental Building News, Dec 2005)

**RE-COMMISSIONING PLAN**
A re-commissioning plan may consist of the following:

- Perform a one-year re-commissioning. The design team should be responsible to check that all systems are working correctly.
- Ensure that energy and water metering data are being collected in a meaningful way.
- Review monthly utility bills for unexpected changes in building energy use.
- Use energy tracking software to analyze building energy use.
- Establish an indoor air quality program for the building.
- Track all maintenance, scheduled and unscheduled, for all equipment. Periodic review of these documents will indicate when equipment requires tune-up or replacement.
- Update building documentation to reflect current building usage and any equipment change-outs.
- Assess operator training needs annually.
- Ensure building occupants/tenants and maintenance staff are briefed on a regular basis.

Re-commissioning will increase the likelihood of ongoing energy savings, fewer system deficiencies, reduced need for equipment replacement, better indoor air quality, and therefore reduced occupant complaints and increased productivity.

**ENVIRONMENTAL MANAGEMENT PROGRAM**
Developing and implementing an overall environmental management program is also an option for the building. This can include the following:

- Develop a green operation and maintenance policy that includes a recycling program, an environmentally preferable purchasing strategy, a pest management and ground keeping program and environmentally friendly cleaning procedures.
- Develop Tenant/Occupant Improvement Guidelines explaining the importance of high-performance building design. Provide guidance for new tenants when they design or redesign their space.
- Identify ways to remind people about the special features of the building. This will help them develop a sense of stewardship towards the building. For example, a report on building performance measures, and how it compares to a standard building, could be shared with occupants and staff on a regular basis. Another strategy is to use visible educational displays.
IDP AND GREEN BUILDING CERTIFICATION

- An innovation point might be available for including preparations for a building performance evaluation within the design documentation, including a contract in place to carry out the work.

- Consider a certification program specifically geared towards existing buildings, such as LEED-EB, BOMA Go Green, or Green Globes.

TIPS

- Evaluations of building performance can be used to improve design practice, repeat successes in future projects by both the same or different owners, and avoid repeating failures. This feedback is much faster, more accurate and more formalized than unsubstantiated anecdotal stories - often the only information that a design team receives.

- Positive results from evaluations can be used for marketing purposes.

- Consider the benefits of a BPE not just for operational efficiency but also for owner-occupant and owner-consultant communication, which can benefit greatly because information exchange is formalized and conducted in a non-threatening way.

- Ensure that the BPE is carried out before major reworking is done to the building so that the energy consumption estimated for the original design is a good baseline for comparison with actual data. Future design changes can be re-evaluated once they are complete and then compared against this initial evaluation.

- Clearly assign an individual to spearhead the ongoing BPE monitoring and incorporate that role into the terms of their employment contract.

- A BPE can save money by identifying problems and providing an opportunity for their resolution, increasing building performance and occupant satisfaction.

- For retrofit projects, or when an owner is interested in improving the ongoing performance of a new project, consider using other rating systems (e.g., LEED for Existing Buildings, BOMA Go Green etc.) to ensure the building performance remains optimal.

Resources on rating systems for existing buildings:


The University of British Columbia Life Sciences Centre is a 550,000 square foot research-oriented academic building located in Vancouver. The facility is also the new home of the UBC Medical School and associated anatomy teaching labs designed for an expanded class size of 350. In addition to laboratories and faculty offices, it is designed to accommodate 110 principal investigators and their staff; two large auditoria provide lecture space for seven hundred students. The building is configured around two large five-storey atria that are fully skylit to allow daylighting of all spaces adjacent to them. The building accommodates 2900 persons, including principal investigators, research assistants, graduate students, medical students and professors, facilities, and administration staff.

"It [IDP] continued right through to the end. We had integrated design team meetings even after we sent in the LEED submission package. We help each other answer the questions. Sometimes a submission had not been accepted and someone else might say "do this" and it would solve the problem. The project has had seven different close-outs; it had to be phased because it is such a large development. We continued to work as team to make sure that none of objectives got lost during the complicated delivery process.

People have been working on the building for over a year while it has been under construction, and we managed to maintain a high level of performance due to IDP."

- Teresa Coady
Bunting Coady Architects

Case Study: Institutional

UBC LIFE SCIENCES BUILDING
VANCOUVER, BC
Status: Completed 2006

The University of British Columbia Life Sciences Centre is a 550,000 square foot research-oriented academic building located in Vancouver. The facility is also the new home of the UBC Medical School and associated anatomy teaching labs designed for an expanded class size of 350. In addition to laboratories and faculty offices, it is designed to accommodate 110 principal investigators and their staff; two large auditoria provide lecture space for seven hundred students. The building is configured around two large five-storey atria that are fully skylit to allow daylighting of all spaces adjacent to them. The building accommodates 2900 persons, including principal investigators, research assistants, graduate students, medical students and professors, facilities, and administration staff.
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F


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K


L


M


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## APPENDIX A
### IDP SUMMARY TABLE

Appendix A is a useful summary chart of the seven design phases that can be used as a quick reference chart for novice and experienced IDP practitioners. This chart summarizes key activities, outputs, IDP team "modus operandi" and key team members.

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<tbody>
<tr>
<td><strong>Key Process Activities</strong></td>
<td>Coordinate the team:</td>
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<td>Coordinate the team:</td>
<td>Coordinate the team:</td>
<td>Coordinate the team:</td>
<td>Coordinate the team:</td>
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<tr>
<td>Bring together a diverse and knowledgeable team</td>
<td>• Enhance team cohesiveness and confirm team values</td>
<td>• Engage new specialists (eg, commissioning agent, outside experts)</td>
<td>• Coordinate CDs between disciplines</td>
<td>• Transition from design to construction team</td>
<td>• Ensure proper transfer of knowledge between the design team, commissioning agent, building operator and occupants.</td>
<td>• Create a building performance evaluation (BPE) team</td>
</tr>
<tr>
<td>Select an IDP Facilitator and/or Champion</td>
<td>• Encourage a team mindset supporting creativity and systems-thinking</td>
<td>• Promote collaboration amongst team members</td>
<td>• Establish a foundation:</td>
<td>• Orient and train maintenance, operations staff and building occupants</td>
<td>• Coordinate CDs between disciplines</td>
<td>• Establish a foundation:</td>
</tr>
<tr>
<td>Establish a foundation:</td>
<td>• Keep the project's vision and goals at hand</td>
<td>• Assess feasibility and viability of green building strategies and technologies</td>
<td>• Update design intent</td>
<td>• Develop commissioning plan</td>
<td>• Assure design re-use and impacts of site challenges and goals at hand</td>
<td>• Develop a foundation:</td>
</tr>
<tr>
<td>Set fees to provide appropriate incentives to the design team</td>
<td>• Have clear understanding of site challenges and opportunities</td>
<td>• Use tools to simulate (eg, energy model) technologies and strategies and assess building performance (eg, thermal comfort, daylighting, acoustics)</td>
<td>• Include specific performance criteria in contract documents</td>
<td>• Plan key meetings:</td>
<td>• Ensure full impact of any changes are evaluated</td>
<td>• Provide owner with complete building documentation including commissioning report</td>
</tr>
<tr>
<td>Plan key meetings:</td>
<td>• Ensure the functional program requirements and its implications for all disciplines are understood</td>
<td>Plan key meetings:</td>
<td>• Develop commissioning plan</td>
<td>• Have pre-tender award meeting to discuss green design intent</td>
<td>• Plan regular site meetings to review design approach</td>
<td>• Develop tools for ongoing monitoring to uphold performance</td>
</tr>
<tr>
<td>Charrette Preparation</td>
<td>• Host design charrettes and workshops to brainstorm ideas, develop concepts, evaluate strategies, and refine options</td>
<td>• Plan key meetings:</td>
<td>• Plan key meetings:</td>
<td>• Host a project celebration to transfer project to new stewards</td>
<td>• Plan key meetings:</td>
<td>• Host a debriefing session to share lessons learned</td>
</tr>
<tr>
<td>Programming Meeting</td>
<td>• Evaluate feasibility and energy impact of technologies and strategies</td>
<td>• Design optimization loops maximize synergies between design disciplines</td>
<td>• Host a debriefing session to share lessons learned</td>
<td>• Educate staff and occupants on the building's performance and green features</td>
<td>• Plan regular site meetings to review design approach</td>
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</tr>
<tr>
<td>Facilties Management Meeting</td>
<td>• Report on opportunities</td>
<td>• Smaller focused meeting for specific issues</td>
<td>• Host a project celebration to transfer project to new stewards</td>
<td>• Hand over project to new stewards</td>
<td>• Plan regular site meetings to review design approach</td>
<td></td>
</tr>
<tr>
<td>Partnership Meetings</td>
<td>• Vision statement, goals and targets matrix</td>
<td>• Goals and targets matrix</td>
<td>• Project specifications with embedded performance criteria</td>
<td>• Record drawings of built projects</td>
<td>• Plan key meetings:</td>
<td>• Host a debriefing session to share lessons learned</td>
</tr>
<tr>
<td>Output</td>
<td>• Pre-design report including charrette synopsis</td>
<td>• Preliminary energy analysis</td>
<td>• Material substitution policy</td>
<td>• Commissioning reports</td>
<td>• Plan key meetings:</td>
<td>• Educate staff and occupants on the building's performance and green features</td>
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<tr>
<td></td>
<td>• Preliminary budget including cost of IDP activities such as energy modeling</td>
<td>• Preliminary financial estimate</td>
<td>• Tender documents with clear explanation of innovative aspects, contractor responsibilities for green building documentation, training and supervision of trades/subcontractors</td>
<td>• Operation and maintenance manuals including on-going commissioning activities</td>
<td>• Plan key meetings:</td>
<td>• Host a project celebration to transfer project to new stewards</td>
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<td></td>
<td>• Established communication pathways</td>
<td>• Schematic Design report</td>
<td>• Preliminary commissioning report</td>
<td>• Completed commissioning documentation</td>
<td>• BPE setup and coordination meetings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vision statement, goals and targets matrix</td>
<td>• Holes and responsibilities matrix</td>
<td>• Updated roles and responsibilities matrix</td>
<td>• Updated goals matrix</td>
<td>• BPE setup and coordination meetings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Goals and targets matrix</td>
<td>• Responsibilities matrix</td>
<td>• Updated goals matrix</td>
<td>• Updated building documentation</td>
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<tr>
<td></td>
<td>• Preliminary energy analysis</td>
<td>• Updated roles and responsibilities matrix</td>
<td></td>
<td>• Building performance evaluation results</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Preliminary financial estimate</td>
<td>• Updated goals matrix</td>
<td></td>
<td>• Continuous monitoring</td>
<td></td>
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<tr>
<td></td>
<td>• Schematic Design report</td>
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<td></td>
<td>• Re-commissioning plan</td>
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### IDP SUMMARY TABLE cont.

|---------------------|---------------------------|-----------------------------|------------------------------------|---------------------------------------------|-----------------------------|------------------------|
| IDP Team Modus Operandi | • Engage and motivate team  
  • Team building is fundamental part of process kick-off and priority throughout the process  
  • Foster creativity and interdisciplinary thinking | • Ensure coordination and collaboration between the various disciplines  
  • Develop a clear understanding of synergies and tradeoffs between strategies and systems proposed  
  • Foster whole-system design and life cycle thinking | • Ensure coordination and collaboration between the various disciplines  
  • Develop a clear understanding of synergies and tradeoffs between strategies and systems proposed  
  • Foster whole-system design and life cycle thinking | • Keep open lines of communication  
  • Ensure co-ordination of activities between disciplines  
  • Ensure each team member understands his/her responsibilities | • Engage core team with contractor and sub-contractors  
  • Streamline communication procedures | • Celebrate success  
  • Acknowledge the whole team  
  • Engage operation and maintenance staff and building occupants | • Engage staff and building occupants  
  • Foster stewardship  
  • On-going communication  
  • Celebrate and share success |
| Key Team Members | • Core team: client, architect, mechanical, structural, and electrical engineer, and landscape architect  
  • Additional members and stakeholders including:  
    - Contractor (depending on project delivery type)  
    - Representative of occupant’s perspective  
    - Building operators (if possible)  
    - Additional specialists such as ecologist, energy engineer, etc | • Core team from previous phase, and  
  • Additional members including:  
    - Energy specialist  
    - Cost consultant  
    - Certification coordinator  
    - Commissioning agent  
    - Valuation professional | • Team from previous phase, and  
  • Additional members including:  
    - Contractor (sooner if possible)  
    - Operation and maintenance staff  
    - Materials expert  
    - Acoustician  
    - Client’s marketing representative (if appropriate)  
    - Industry and academic experts | • Core team from previous phase, and  
  • Additional members including:  
    - Specification writer  
    - Contractor (sooner if possible)  
    - Commissioning authority | • Core team from previous phase, and  
  • Additional members including:  
    - Project manager  
    - Contractor  
    - Commissioning authority | • Core team from previous phase, and  
  • Building Performance Evaluation team members such as:  
    - Acoustician  
    - Thermal comfort specialist  
    - Commissioning agent |
|                     |                           |                             |                                    |                                             |                             |                        |
### Appendix B

#### Roles of Team Members by Design Phase

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<tr>
<td><strong>CORE TEAM MEMBERS</strong></td>
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<tr>
<td>Client or Owner’s Representative</td>
<td>• Hire motivated &amp; experienced team.</td>
<td>• Work with team in decision-making processes.</td>
<td>• Help team make decisions that confirm goals &amp; reflect life-cycle thinking.</td>
<td>• Help the team ensure that decisions made in previous stages are not lost with value engineering process.</td>
<td>• Ensure that the owner &amp; users become involved &amp; excited about progress of project.</td>
<td>• Coordinate operations staff and user training.</td>
</tr>
<tr>
<td>Project Manager (PM)</td>
<td>• Work with the client to kick-start the project and coordinate the team.</td>
<td>• Ensure effective communication between team.</td>
<td>• Help the team stay on schedule and on budget.</td>
<td>• Help the team stay on schedule and on budget.</td>
<td>• Help the team stay on schedule and on budget.</td>
<td>• Ensure a seamless handover to the client. N/A</td>
</tr>
<tr>
<td>Architect</td>
<td>• Ensure that other consultants are part of early consultations, especially on building form &amp; programming.</td>
<td>• Work with the design facilitator to schedule charrettes early to gain maximum benefit.</td>
<td>• Coordinate strategies and help to present cohesive information on pros and cons of design solutions.</td>
<td>• Ensure all sustainable design features are well documented in specs &amp; drawings so contractors can easily follow requirements.</td>
<td>• Work with the contractor to ensure compliance with new strategies/technologies.</td>
<td>• Participate in user and operations staff training to ensure proper handover.</td>
</tr>
<tr>
<td>IDP Facilitator / Champion</td>
<td>• Work with PM and architect to set up initial goal setting workshops.</td>
<td>• Facilitate workshops.</td>
<td>• Ensure that adequate documentation is provided so the team can remember their deliverables &amp; goals.</td>
<td>• Continue to facilitate workshops – evolve the format to reflect the progress of the design process.</td>
<td>• Work with the contractor to ensure compliance with new strategies/technologies.</td>
<td>• Participate in user and operations staff training to ensure proper handover.</td>
</tr>
<tr>
<td>Structural Engineer</td>
<td>• Consider impact of structural choices on form &amp; massing.</td>
<td>• Consider the impact of structural choices on daylighting potential, materials' environmental impacts (i.e., fly ash content), etc.</td>
<td>• Provide input into life-cycle and durability discussions.</td>
<td>• Ensure that durability requirements, materials selections, and construction methods reflect sustainable goals.</td>
<td>• Work with the contractor to ensure compliance with new strategies/technologies.</td>
<td>• Participate in user and operations staff training to ensure proper handover.</td>
</tr>
<tr>
<td>Mechanical Engineer with expertise in energy analysis and simulation (may need to be more than one person)</td>
<td>• Provide feedback on impact of massing &amp; orientation on mechanical systems and energy performance.</td>
<td>• Work with the design team to find climate-specific opportunities &amp; features that could assist the building operation.</td>
<td>• Help the team consider new options.</td>
<td>• Provide input into or perform life-cycle calculations and energy use calculations &amp; discussions.</td>
<td>• Work with design team to refine system choices to stay within the established energy targets.</td>
<td>• Perform simulations to examine thermal comfort and daylighting performance.</td>
</tr>
<tr>
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<td></td>
<td>• Provide input into or perform life-cycle calculations and energy use calculations &amp; discussions.</td>
<td>• Work with design team to refine system choices to stay within the established energy targets.</td>
<td>• Ensure that equipment selections, adhesive choices, materials selections, and construction methods reflect sustainable goals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Work with design team to refine system choices to stay within the established energy targets.</td>
<td>• Perform simulations to examine thermal comfort and daylighting performance.</td>
<td>• Prepare and submit compliance model as required.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• Help the team to understand how the local micro-climate can help to reduce the energy impacts of the building.</td>
<td>• Ensure that equipment selections, adhesive choices, materials selections, and construction methods reflect sustainable goals.</td>
<td>• Quantify energy impact of changes during construction.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>• Assist with setting an energy benchmark for the building through simulations.</td>
<td>• Continue to facilitate workshops – evolve the format to reflect the progress of the design process.</td>
<td>• Participate in user and operations staff training to ensure proper handover.</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>• Help the team understand the differences between simulation model and actual data.</td>
<td>• Ensure that equipment selections, adhesive choices, materials selections, and construction methods reflect sustainable goals.</td>
<td>• Engage in IDP studies including evaluating differences between simulation model and built environment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Work with the team to understand differences between Modeled &amp; actual data.</td>
<td>• Work with operations staff to understand energy optimization options.</td>
<td>• Work with owner to execute monitoring and Building Performance Evaluation (BPE).</td>
</tr>
</tbody>
</table>

Appendix B summarizes the different roles and responsibilities for various core and additional team members throughout the seven phase design process.
APPENDIX B
ROLES OF TEAM MEMBERS BY DESIGN PHASE cont.

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<tbody>
<tr>
<td><strong>Electrical Engineer</strong></td>
<td>Provide feedback on impact of massing &amp; orientation on electrical systems &amp; lighting/ daylighting options.</td>
<td>• Provide input into the discussions on glazing performance, energy targets, and other building components that will impact electrical systems.</td>
<td>• Provide input into life-cycle calculations and energy use calculations &amp; discussions.</td>
<td>• Ensure that equipment selections, materials selections, and construction methods reflect sustainable goals.</td>
<td>• Work with the contractor to ensure compliance with new strategies/technologies.</td>
<td>• Participate in commissioning &amp; training of user and operations staff to ensure proper handover.</td>
</tr>
<tr>
<td><strong>Green Design Specialist</strong></td>
<td>Bring broad knowledge of green design strategies to the table.</td>
<td>• Help team identify potential green design strategies.</td>
<td>• Direct team to green design resources.</td>
<td>• Review specifications to ensure design intent still met.</td>
<td>• Deliver or participate in contractor and sub-training on green design and certification.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Civil Engineer (with expertise in water and wastewater systems)</strong></td>
<td>• Provide input into site-specific opportunities regarding water conservation, reuse and treatment.</td>
<td>• Work with the team to integrate water treatment options &amp; landscape choices into building design.</td>
<td>• Help the team to ensure that the building design complements the water management plan and vice versa.</td>
<td>• Ensure that sustainable design features are well documented in specs &amp; drawings so contractors can easily follow requirements.</td>
<td>• Work with the contractor to ensure compliance with new strategies/technologies.</td>
<td>• Participate in user and operations staff training for any unusual features to ensure proper care.</td>
</tr>
<tr>
<td><strong>Facilities Manager or Building Maintenance Staff Representative</strong></td>
<td>• Work with design team to note all building requirements and wishes as soon as possible.</td>
<td>• Participate fully in design workshops. Use these opportunities to express opinions on the building and lessons learned from operating other buildings.</td>
<td>• Continue to participate in design workshops. Know design documents as needed.</td>
<td>• Continue to provide reviews as needed.</td>
<td>• Help the team to work within facility standards but allow them to still meet the project goals.</td>
<td>• Participate in training of other facilities personnel to ensure they understand how their issues were represented during design.</td>
</tr>
<tr>
<td><strong>Cost Consultant (with green design expertise)</strong></td>
<td>• Assist team to set realistic budget, bearing in mind current market conditions.</td>
<td>• Help the team to understand what choices may help keep costs under control.</td>
<td>• Assist team with life-cycle-cost analysis.</td>
<td>• Review final bid documents with the design team.</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Landscape Architect</strong></td>
<td>• Provide input into site-specific opportunities relating to habitat preservation or restoration, indigenous plantings, green roofs, etc.</td>
<td>• Work with the team to integrate landscape choices into building design.</td>
<td>• Help the team ensure that the building design complements landscape features and vice versa.</td>
<td>• Ensure that all sustainable design features are well documented in specs &amp; drawings so contractors can easily follow requirements.</td>
<td>• Work with the contractor to ensure compliance with new strategies/technologies.</td>
<td>• Participate in user and operations staff training for any unusual features to ensure proper care.</td>
</tr>
<tr>
<td><strong>General Contractor or Construction Manager</strong></td>
<td>• Depending on procurement process, engage in the project as early as possible to provide a perspective and discussion around how to get things done as well as what will be done.</td>
<td>• Help design team to understand constructability issues associated with site &amp; specific program requirements.</td>
<td>• Work with the design team to accurately cost differences in construction methods, materials, etc. based on current market conditions.</td>
<td>• Take charge to ensure that green strategies are executed &amp; documented by all sub-trades.</td>
<td>• Work with the design team to ensure that a smooth handover to facilities staff is possible.</td>
<td>• Work with CIP to show them special construction methods used, etc.</td>
</tr>
<tr>
<td><strong>Green Design Specialist</strong></td>
<td>• Bring broad knowledge of green design strategies to the table.</td>
<td>• Help team identify potential green design strategies.</td>
<td>• Direct team to green design resources.</td>
<td>• Review specifications to ensure design intent still met.</td>
<td>• Deliver or participate in contractor and sub-training on green design and certification.</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Appendix B Part Two
### APPENDIX B

#### ROLES OF TEAM MEMBERS BY DESIGN PHASE cont.

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<td><strong>ADDITIONAL TEAM MEMBERS</strong></td>
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<td><strong>ADDITIONAL TEAM MEMBERS</strong></td>
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<td><strong>ADDITIONAL TEAM MEMBERS</strong></td>
<td><strong>ADDITIONAL TEAM MEMBERS</strong></td>
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<tr>
<td>Ecologist</td>
<td>• Work with the design team to find natural opportunities &amp; features that could impact or be impacted by the building.</td>
<td>• Help the team consider new options: for example, even dense urban contexts have roots, atria and ground plane connections that would benefit from an ecologist.</td>
<td>• Work with the team to help them answer any questions regarding the impacts of site conditions on the building.</td>
<td>N/A</td>
<td>• Work with the operations team to help them ensure compliance with long-term on-site ecosystems.</td>
<td>• Involved in BPE studies including evaluating differences between ecosystems before and after construction.</td>
</tr>
<tr>
<td>Occupants’ or Users’ Representatives</td>
<td>• Work with the design team to note all building requirements and wishes as soon as possible.</td>
<td>• Participate fully in design workshops. Use the opportunities to express opinions on building.</td>
<td>• Continue to participate in design workshops.</td>
<td>N/A</td>
<td>• Visit site to observe building taking shape.</td>
<td>• Work with the BPE team to help them understand how the building is working – both the good &amp; bad.</td>
</tr>
<tr>
<td>Building Program Representative</td>
<td>• Work with the design team to note all building requirements and wishes as soon as possible.</td>
<td>• Participate fully in design workshops. Use the opportunities to express opinions on programming needs.</td>
<td>• Continue to participate in design workshops.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Planning / Regulatory Approvals Agencies Representatives</td>
<td>• Work with the design team to help them meet the intent of the codes while working to decrease the project’s impact on local infrastructure.</td>
<td>• Keep working with the team to meet the project &amp; municipal goals.</td>
<td>• Keep working with the team to meet the project &amp; municipal goals.</td>
<td>• Keep working with the team to meet the project &amp; municipal goals.</td>
<td>N/A</td>
<td>Lessons learned from BPE inform code revisions.</td>
</tr>
<tr>
<td>Interior Designer / Materials Consultants</td>
<td>• Consider the impact of the program &amp; project goals on material &amp; finish choices.</td>
<td>• Work with rest of team to meet goals around daylighting &amp; material selection as well as goals for the look &amp; feel of spaces.</td>
<td>• Help with life-cycle cost analysis to determine impact of durability choices, material sources, etc.</td>
<td>• Ensure that sustainable design features are well documented in the specifications &amp; drawings so contractors can easily follow requirements.</td>
<td>• Work with the contractor to ensure compliance with new strategies/ materials.</td>
<td>Participate in commissioning &amp; user and operations staff training to ensure proper handover.</td>
</tr>
<tr>
<td>Lighting or Daylighting Specialist</td>
<td>• Help the team to understand impact of orientation &amp; massing choices on daylight &amp; lighting design.</td>
<td>• Start working with daylight modeling or analysis to help team understand impacts of choices.</td>
<td>• Complete full daylighting analysis to ensure that glazing choices &amp; sizes, etc. will allow the team to meet energy &amp; performance goals.</td>
<td>• Work with the contractor to ensure compliance with new strategies/ materials.</td>
<td>Participate in commissioning &amp; user and operations staff training to ensure proper handover.</td>
<td>Participate in BPE.</td>
</tr>
<tr>
<td>Soils or Geotechnical Engineer</td>
<td>• Provide input into site-specific opportunities or concerns with systems and technologies that the design team may consider.</td>
<td>• Work with the team to help them answer any questions regarding the impacts of the site’s conditions on the building.</td>
<td>N/A</td>
<td>N/A</td>
<td>• Work with the design team to help them work with the contractor to ensure compliance with new strategies/ materials.</td>
<td>N/A</td>
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**ROADMAP FOR THE INTEGRATED DESIGN PROCESS: REFERENCE MANUAL**
## APPENDIX B

### ROLES OF TEAM MEMBERS BY DESIGN PHASE cont.

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<tr>
<td><strong>Commissioning Agent / Authority</strong></td>
<td>N/A</td>
<td>• Work with the design team &amp; owner to ensure that the project goals are being incorporated into the design documentation.</td>
<td>• Provide review functions as required to ensure proper integration of needs &amp; requirements. (Typically at 50%, 90% of CDs.)</td>
<td>• Continue to provide review functions as required to ensure proper integration of needs &amp; requirements.</td>
<td>• Review select contractor submittals.</td>
<td>• Ensure that sufficient time is allowed for hand-over training &amp; commissioning activities.</td>
</tr>
<tr>
<td><strong>Marketing Expert</strong></td>
<td>• Work with the design team to help them understand local market conditions.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Surveyor</strong></td>
<td>• Provide input into site-specific opportunities or concerns with systems and technologies that the design team may consider.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Valuation / Appraisal Professional</strong></td>
<td>N/A</td>
<td>• Seek discounted insurance premiums based on sustainable design features.</td>
<td>• Help the team understand and extract the value of various green design features.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Controls Specialist</strong></td>
<td>N/A</td>
<td>• Provide input on implications of different control strategies.</td>
<td>• Work with design team to maximize building efficiency through effective controls.</td>
<td>• Ensure controls specifications meet design intent.</td>
<td>• Ensure control systems are working according to the design intent.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Members of the Community</strong></td>
<td>• Work with the design team to ensure that concerns &amp; opportunities are heard.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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*APPENDIX B – Part Two*
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<tr>
<td><strong>Developers</strong></td>
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<tr>
<td>▪ Require marketing materials early on in the design process to marketing and selling the project.</td>
<td>▪ Justify the additional time spent in this stage will be paid off in reduced coordination during the construction documentation phase, and more importantly, in fewer miscommunications during construction.</td>
<td>▪ Involve a construction manager in design development discussions; this may reduce capital cost and improve the viability of green strategies.</td>
<td>▪ If multiple, staged tenders are considered, ensure that certification requirements such as the erosion and sedimentation plan are in place early as part of the first site-clearing operations.</td>
<td>▪ If a development is being built in stages, great value can be gained from soliciting feedback and suggestions from the contractor and trades on how to improve the design or construction methods.</td>
<td>▪ Ensure successful ownership transfer by helping the new owners understand the features and opportunities offered by the high-performance building.</td>
<td>▪ Seek occupant feedback, especially on green features, can help with marketing information and pro forma decisions for future projects.</td>
</tr>
<tr>
<td>▪ Consider, instead of producing too many firm renderings of the building at this stage, represent the goals of the project graphically, capturing imagination without tying the project team to a specific shape or form too early.</td>
<td>▪ Address low risk-tolerance; the IWP may reveal solutions. For example, at the Vancouver Island Technology Park (VITP) the municipality would not approve waterless urinals because they were not yet CSA approved; however, the developer absorbed the risk by making a commitment to replace any fixtures that fail.</td>
<td>▪ Provide evidence demonstrating that institutions with a proven commitment to sustainability experience increased interest and enrolment from students or prospective employees. This information may be valuable as final decisions are made.</td>
<td>▪ Some institutions are required to have “Fixed Prices,” which precludes, by definition, contractors’ pre-contract participation in an IWP unless they are willing to volunteer their time. (Murray McKinnon, Ledcor Construction 2005).</td>
<td>▪ Ensure that the green strategies of the building.</td>
<td>▪ Ensure that the terms of contract for unionized operational staff are not in conflict with procedures outlined in the maintenance and operations manuals.</td>
<td>▪ Use information collected from Building Performance Evaluations as a benchmark for other buildings, particularly if the organization or operations staff are responsible for multiple buildings.</td>
</tr>
<tr>
<td>▪ Ensure that the key pre-design steps are not by-passed as Pre-design and schematic design stages are often rolled into one stage for developer clients.</td>
<td>▪ If a development is being built in stages, great value can be gained from soliciting feedback and suggestions from the contractor and trades on how to improve the design or construction methods.</td>
<td>▪ Provide evidence for public sector facilities such as universities and hospitals, on improved occupant health, performance, and comfort resulting from green building design strategies (RICS. 2005. Green Value).</td>
<td>▪ This can be resolved by involving someone with construction management experience who can provide costing and logistical expertise regarding the construction process.</td>
<td>▪ Ensure that successful ownership transfer by helping the new owners understand the features and opportunities offered by the high-performance building.</td>
<td>▪ Seek occupant feedback, especially on green features, can help with marketing information and pro forma decisions for future projects.</td>
<td></td>
</tr>
<tr>
<td>▪ A charrette is not usually included in developer’s chosen process; however, a charrette can have several advantages including reduced rework later on, a surge in pre-sales, and increased public support.</td>
<td>▪ Educate the marketing team regarding the construction documentation process.</td>
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**APPENDIX C**

**SCENARIO-BASED CONSIDERATIONS**

Appendix C provides additional scenario-based tips and considerations for private developers, institutions, and owner-occupied client projects, as well as renovations.
APPENDIX C
SCENARIO-BASED CONSIDERATIONS cont.

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<tr>
<td>Private Owner / Occupied N/A</td>
<td>• Convey to the client the potential energy cost savings of different measures. This is important for decision-making since they will be directly affected by utility costs. Up-front building and design costs may represent only a small fraction of the building’s life-cycle costs.</td>
<td>• Present the impacts on comfort and productivity of different design strategies, such as daylighting, as they are especially important for owner-occupied buildings and should be understood by the client. The cost of staff salaries often represents the largest portion of annual operating costs.</td>
<td>N/A</td>
<td>• Facilitate site visits for the owner, occupants, and operations and maintenance staff during construction. This will increase their sense of ownership of the building and improve their knowledge of the systems. Occupants will be more willing and able to operate the building according to the design intent, for example by using operable windows to maximize the effectiveness of natural ventilation.</td>
<td>• Consider programs to document operational benefits (e.g., reduced energy consumption, churn rate, and absenteeism rates) to ensure that successes can be repeated on future projects and less successful strategies improved upon.</td>
<td>• Celebrate energy savings (over a defined base case) on an annual basis to remind/inform occupants of the energy-efficient nature of the building. This will retain the enthusiasm for and knowledge of the building, which are key to its successful operation, as new staff and occupants inhabit the building.</td>
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Renovation
• Document current practices and energy consumption to provide a baseline for comparison.
• Re-examine the building program and functions to improve the efficiency and effective use of space, and to learn from the experience of existing operations and maintenance staff.
• If the occupants will be the same, take advantage of their knowledge of the successes and deficiencies of the existing facility. Involving the existing occupants will increase their sense of ownership of the facility and help to develop appropriate strategies and technologies.
• Investigate funding opportunities specific to renovation projects.
• Identify and assess project constraints associated with a retrofit project. With an integrated approach, constraints can foster creativity, unifying the design team in finding holistic and synergistic solutions.
• Take advantage of existing on-site materials. For example, the architect and engineers could collaborate to reuse existing windows by adding glazing to the inside to improve daylight penetration.
• Make sure that the as-built drawings are accurate.
• Consider the fine details of the potential renovation earlier than with a new construction. The detailed knowledge of contractors and sub-trades will be essential to the success of the renovation, so these parties should be involved early. Their knowledge of installation methods can help to make the solutions more cost-effective. Collaborative discussions will be important.
• Quantity predicted energy and operating cost savings to support the capital cost of upgrades.
• If not already part of the core team, involve someone with practical hands-on knowledge of construction practices to resolve potential constraints.
• Keep owner and occupants intimately involved during the final stages to ensure that the design intent is still reflected through changes.
• It may be possible to transfer heating, ventilation, and air conditioning systems from the old building to the new one, which may represent only a small fraction of the building’s life-cycle costs. In the long run, the cost of staff salaries often represents the largest portion of annual operating costs. Consider transferring existing heating, ventilation, and air conditioning systems from the old building to the new one, which may represent only a small fraction of the building’s life-cycle costs. In the long run, the cost of staff salaries often represents the largest portion of annual operating costs.
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• Celebrate energy savings (over a defined base case) on an annual basis to remind/inform occupants of the energy-efficient nature of the building. This will retain the enthusiasm for and knowledge of the building, which are key to its successful operation, as new staff and occupants inhabit the building.

• Monitor and measure changes in comfort, productivity, and O&M costs.
• Survey the occupants as to their experience with the building before and after the renovation including comfort, usage patterns, and program changes. This information can be used to inform future projects.
• Monitor “before and after” to verify the contractor’s compliance with sustainable design requirements.
APPENDIX D
CASE STUDY CREDITS

P. 13
CITY OF WHITE ROCK OPERATIONS BUILDING
Owner: City of White Rock
Architects: Busby Perkins+Will
Structural: Fast+Epp
Mechanical: Stantec
Electrical: Acumen
Landscape: Wendy Grandin
Location: White Rock, BC

P. 21
UNIVERSITY OF VICTORIA MEDICAL SCIENCES BUILDING
Owner: University of Victoria
Architects: Chernoff Thompson Architects
Structural: Read Jones Christoffersen Ltd.
Mechanical: Hirschfield Williams Timmins Ltd.
Electrical: Robert Freundlich & Associates Ltd.
Landscape: Don Vaughan Landscape Planning & Design
Location: Victoria, BC

P. 22
DOCKSIDE GREEN
Owner: Windmill Developments / VanCity Enterprises
Architects: Busby Perkins+Will
Structural: Read Jones Christoffersen
Mechanical: Stantec
Electrical: Stantec
Landscape: PWL Partnership Landscape Architects Inc.
Location: Victoria, BC
P. 30

OWNER: JAMESON DEVELOPMENT CORPORATION
Architects: Foster + Partners in partnership with Walter Francl Architecture
Structural: Halcrow/Yolles
Mechanical: PHA Consult/IMEC
Electrical: Bridge Electric
Landscape: PWL Partnership Landscape Architects Inc
Location: Vancouver, BC

P. 36

PROJECT NAME: CITY OF VANCOUVER NATIONAL WORKSYARD
Owner: City of Vancouver
Architects: Omicron
Structural: Omicron
Mechanical: Omicron
Electrical: Omicron
Location: Vancouver, BC

P. 43

PROJECT NAME: BC CANCER AGENCY RESEARCH AGENCY CENTRE
Owner: BC Cancer Foundation
Architects: IBI & Henriquez in partnership
Structural: Glotman Simpson
Mechanical: Stantec
Electrical: Rada
Landscape: Durante Krueke Landscape
Project Manager: Stantec
Location: Vancouver, BC

P. 49

PROJECT NAME: UNIVERSITY OF VICTORIA COMPUTER SCIENCE BUILDING
Owner: University of Victoria
Architects: Busby Perkins+Will (formerly Terrence Williams Architects)
Structural: Peterson Galloway Ltd.
Mechanical: Hirschfield Williams Timmins Ltd.
Electrical: Applied Engineering Solutions Ltd.
Landscape: Vaughan Landscape Planning & Design
Location: Victoria, BC

P. 56

PROJECT NAME: UBC LIFE SCIENCES CENTRE
Owner: UBC Properties Trust
Architects: Diamond & Schmitt Architects Inc. in joint venture with Bunting Coady Architects
Structural: Read Jones Christoffersen
Mechanical and Electrical: MCW Consultants
Energy Consultant: G.F. Shymko & Associates
Landscape: Phillips Farevaag Smallenburg
Location: Vancouver, BC