An Investigation into Sustainable Building Evaluation Strategies for use within the Canadian Forces and the Department of National Defence

By Dr. Nicholas Vlachopoulos, and Tina Louise Basso

Introduction

The purpose of this paper is to provide a critical analysis of appropriate green building/sustainable development strategies for new construction and large renovation projects, and to examine their suitability for the Canadian Forces (CF) (Green/sustainable will be used to describe the infrastructure under analysis, as the two terms “green” and “sustainable” are used interchangeably in literature). Green building/sustainable development strategies are those which address the environmental, social and economical aspects of a building, in an attempt to lessen the negative impacts of the infrastructure. This investigation outlines the challenges of achieving current mainstream green/sustainable building accreditations due to the unique environments within the CF. These unique environments include infrastructure in the Arctic, isolated areas, and overseas. These challenges require solutions which are specifically designed for implementation within the CF, and not simply solutions which have been “imported” from similar industries. As such, a proposed Department of National Defence (DND) Sustainability Standard is outlined to assist the CF in achieving the objectives of green/sustainable building initiatives without compromising the ability of DND/CF to carry out regular activities. The two research questions that were investigated are:

1. What are the unique requirements of the CF with regards to green/sustainable buildings? (Part 1); and,
2. What should be implemented in a sustainable development strategy for the CF in order to achieve green/sustainable building objectives? What are the constraints of current DND policy, and how can those constraints be overcome? (Part 2)

These questions were investigated in order to illustrate the importance for the DND to consider implementing green/sustainable building strategies that are specific to DND and may be lacking in current rating systems, which would in turn create a Sustainability Standard; one that is more representative of the type of infrastructure DND owns and operates. The recommendations would be used to assist with the development of best practices and policies within DND with regards to green/ sustainable building processes.

The scope of this study looks only at new construction within the CF to provide insight into the DND's decision behind mandating the use of LEED and Green Globes over other rating systems, and to establish criteria that should be included into a building assessment system based on the unique requirement and operations of the DND.

Background

With concern growing in regards to global warming and the depletion of the Earth's resources, a new focus on environmental sustainability has arisen throughout the world. DND is the largest building owner in the federal government by quantity (i.e., number of buildings), holding more than 43% of the federal inventory. Installations exist in every province and territory and are located in 217 cities/municipalities[i]. Under the purview of the Canada First Defence Strategy, over the next 20 years, DND will replace 50 percent

of its existing infrastructure. Considering that the DND holds some 21, 000 buildings, 2.25 million hectares of land, 5 500 km of roads and 3 000 km of water, storm and sewer pipes, it can be said that the activities of the DND will impact the whole of Canada[ii] (**Figure 1**). These impacts may also translate into international concerns, as many of the issues are trans-boundary by nature (i.e. air quality).

Implementing a green building strategy into policy can achieve many savings and if properly designed can achieve many positive results. However, meeting requirements of the 2010 Federal Sustainable Development Strategy (FSDS), and the 2006 DND Sustainable Development Strategy (DND SDS) to achieve accreditation within generic green/sustainable building systems has proven to be a challenge due to the suite of special purpose infrastructure and the nature of CF operations; both domestically and overseas.

<u>Uniqueness of the DND</u>

The following is a list of aspects related to the CF/DND that make it unique from other commercial, office, or industrial facilities. This uniqueness poses many challenges.

a. Infrastructure spans large geographic areas across Canada, including diverse climates and topography;
b. High turnover rates among personnel working on the bases (posting occur approximately every 2-3 years);
c. A wide spectrum of specialized buildings, i.e., simulation centres, defence labs, indoor firing ranges, hangars, washbays etc.;

d. Variety of buildings all on the same base; must be addressed with a uniform rating system;
e. Usage of public funds, requires transparency in spending;
f. Adjacent areas around buildings may be used for training purposes;
g. DND owns a lot of older infrastructure that needs to be replaced efficiently;
h. Building longevity insinuates that the building usage will change over the course of its lifetime;
i. Remote/isolated satellite facilities; and
j. Structure of DND complicated; many departments involved in infrastructure development.

History of Green/Sustainable Buildings

Green Buildings are not a new phenomenon. According to Smith et al.[iii] there were several buildings erected in the 19th and early 20th centuries that integrated sustainable designs. After the Second World War it is believed that due to the abundance of cheap fossil fuel, building style did not reflect energy efficient designs. It was not until the environmental movement of the 1970s that environmentally conscious building designs became the focus.

Under the umbrella of sustainable development, the 1980s brought on a resurgence of green building discussions. The first environmental certification system was introduced in 1990 in the United Kingdom: the Building Research Environmental Assessment Method (BREEAM), and was brought to Canada in 1996. In the U.S., the U.S. Green Building Council (USGBC) introduced its own rating system in 1998: Leadership in

Energy and Environmental Design (LEED). In 2004 the Green Building Initiative (GBI) adapted the Canadian version of BREEAM to create Green Globes and began distributing it in the U.S. market in 2005[iv]. Since that time, various other countries have adopted national Green Building Strategies (**Figure 2**).

Building Rating Systems were created to assess the negative consequences infrastructure has on society by evaluating the infrastructure performance in a number of areas, e.g., energy consumption, waste production, indoor air quality etc, in order to improve efficiency. They are used as a tool to track performance and provide building owners and developers with a guide to assist in building more sustainably. Based on information from the Intergovernmental Panel on Climate Change (IPCC), if the approach to constructing and operating buildings remains as the status quo, there will be major economic and environmental repercussions[v]. Building Rating Systems provide a way for continually updating practices and procedures to ensure continual improvement and innovation[vi]. Green buildings are a term of the past, evolving into sustainable buildings, and the DND should follow suit. The following sections will refer to environmentally, socially, economically, and culturally sound buildings as "sustainable".

<u>Sustainable Development and the Department of National Defence</u>

There are several Directive Orders within the CF that require sustainable, and environmentally friendly activities/practices/procedures within all facilities owned and/or operated by the CF. However, there is one document in particular which contains the necessary requirements to assist the CF with modifying its practices with regards to

new construction of buildings and major renovations. In 2003 the Department of National Defence (DND), in its Sustainable Development Strategy (SDS) 2003, outlined a target (D1) to integrate the green building concept into the design process by having a percentage of eligible new building projects incorporate the green building concept. This target, though vague in nature, was a very important first step towards integrating green engineering into DND. The 2006 version of the SDS has taken the green building objective a step further with strategic commitment 2.1 (SC.2.1). This initiative aims to expand the integration of the green building concept into the total design process by ensuring all new building projects incorporate green building concepts. This latest initiative has set goals for projects valued at over $10 million to achieve a LEED silver or better standard and for projects valued at under $10 million to achieve a Green Globe 3 out of 5 standard or better. Currently there is no available information substantiating the DND's decision to adopt LEED and Green Globes rating systems, aside from the fact that they are widely used in North America.

Research Methods

Triangulation (a type of Mixed-Method Research) is an approach typically used for military strategy, surveying, mapping, and navigational purposes. Triangulation in the realm of social sciences implies the use of multiple methods of research to ascertain a more accurate analysis of social phenomena[vii]**.** Triangulation was specifically useful for this research as it provided the opportunity to gain information about the current status of green buildings within the CF, feedback and recommendations from personnel associated with the issues surrounding green buildings, as well as comparisons to

existing rating systems. This allowed the research to say something important and useful about the status of Green Buildings within the CF. This methodology included the activities associated with the qualitative research design process found in Figure 3.

Triangulation has proven to provide many benefits when attempting to obtain reliable information. Triangulation can assist with eliminating biases, and it allows for a degree of cross-checking[viii]. It is an approach used to refine, broaden and strengthen conceptual linkages, and it allows researchers to approach the subject with perspectives differing from their own perceptions[ix]. A Literature Review was conducted in order to help define relative concepts. It also assisted in the construction of the interview guide and established the set of categories and relationships that the interview must investigate[x]. A document analysis was performed to gain insight into existing sustainable building rating systems, and policy documents were analyzed for ideas that would be most applicable and useful to the CF. The last step in data collection was execution of long/semi-structured interviews, which provided the opportunity for in depth insight into the issues at hand[xi].

Literature Review

The Literature Review was conducted in order to provide a background and baseline for this research paper. Definition of relevant concepts were sought out to help provide a clear understanding of the research objectives, and a baseline for the study design. As well, it ensured that there was consistency throughout the report, by establishing definitions of pertinent concepts within the context of this research, i.e., green vs.

sustainable buildings. The literature review examined existing theoretical academic literature on the topics of green buildings, and sustainable buildings, and the relationship between those concepts and rating systems. Search engines and library catalogues were perused using the aforementioned key words.

Document Analysis

The second part of the methodology consisted of an analysis and evaluation of existing green building rating systems. These rating systems included: LEED, Green Globes, DGNB, Green Star, BREEAM, and the Swedish Green Building Rating Tool. The 6 systems used for evaluation were based on:

a. Their prominence within North America (requirement of DND);
b. Usage within countries of similar climate/geography;
c. Second-generation systems;
d. Utilization within Military System; and,
e. International Popularity.

Each of these systems was analyzed based on criteria included in the evaluation categories, types of indicators, weightings, and overall applicability to the CF. **Table 1** provides a cross-comparative analysis of the evaluation criteria thought to be relevant based on the combined results of the literature review, interviews, and observations, and to determine which rating system best addressed those specific criteria or issues. The chosen criteria were based on the applicability and relevance to the CF, as well as whether or not they in fact had a substantial impact on the social, economic, or

environmental aspects of the buildings. Indicators were selected if they said something substantial. These elements of the criteria are then suggested to be used in the Sustainable Development Strategy for the CF. In addition to existing rating systems, other relevant documents were examined for information they provided on the state of green buildings in Canada, as well as the national policies relevant to the federal government.

Long Interview/Semi-Structured Interview

This phase of the methodology consisted of interviews with relevant personnel within the federal government, private companies, and those who have experience or knowledge on the subject of green buildings. 9 participants were members of the CF, 2 DND civilian, 2 independent consultants, 1 LEED member, 1 Green Globes member, and 3 participants from Natural Resources Canada. These individuals can be considered subject matter experts in a particular discipline associated with green buildings. The participants were interviewed to determine how the CF can best achieve its sustainability targets with respect to the construction of buildings. Semi-structured interviews were selected as the mode of information gathering from respondents, due to the complexities and sensitive nature of the research topic, as it still allowed for flexibility in a collaborative communication process.

Between October 2011 and April 2012, 18 interviews were conducted. These included 1 focus group, 4 in person interviews (including the focus group), 12 over the phone interviews, and 2 interview guides e-mailed electronically. Each of the verbal interviews lasted between 25 -60 minutes. In addition to the data collected, the participant's

professional background, setting, and the way in which the questions were delivered were also taken into consideration[xii]. Participants were chosen based on their positions held within relevant government bodies (DND, NRCan etc), or private companies (LEED, GG etc.). As well, using the snowball techniques described by Berg[xiii], several of the participants were selected for interviews based on recommendations from co-workers or industry associates. Following this guide, ensured that:

a. personnel associations and cultural biases were identified;
b. interview procedures were conducted in a way as to obtain as much accurate information from the participant as possible;
c. participants' experience was positive; and
d. the data collected was synthesized and analyzed properly.

Results

This section contains the numerous results from the data that were collected and analyzed as part of this research undertaking. The analysis of the data collected by the triangulation approach[xiv] is divided into two sections, each addressing one of the research questions. These results identify all the major themes reflected by the interviews and supporting literature, regarding the essential components of a DND-specific building rating system, as well as challenges of implementing green/sustainable policies into the CF. These results were compiled based on the researcher's data collected, and research into the specific operations and needs of the DND. In support of this overall objective, the results cited herein are the main results as determined through the rigorous methodology that has been applied in this research study.

Results - Part 1

Part 1 addresses the first research question and presents the results:

1. What are the unique requirements of the CF with regards to green/sustainable buildings?

This first question aims to determine the needs of the CF with regards to a sustainable building strategy. **Figure 4** indicates the proportion of respondents who do not believe that the application of current building rating systems achieve the intended savings, or properly fulfill sustainable building philosophies. Of these respondents, an overwhelming majority are DND personnel. This indicates that within DND, the way in which infrastructure is currently being managed is felt to be unacceptable.

Based on interviews, and supporting literature, the following section describes a series of factors that are believed to be important for inclusion in a DND specific sustainable building rating system. These factors were then compared against current ratings systems, and evaluated by the way in which these rating systems applied that factor. An existing rating system (and subsequent credit/criterion) was selected that best applied each of the factors highlighted through the research (interviews, literature, and researcher's experience). The parameters of the existing rating system credit/criterion selected were based on their applicability to the military, ease of use/implementation, and perceived environmental, social, and economic benefits of that credit.

Based on the conclusions drawn from **Table 1**, it is evident that there is not one rating system that provides DND with all the required factors/ criteria in order to effectively address sustainability within their infrastructure. **Table 2** below, further summarizes the

total number of factors each system was determined to best address the needs of the DND.

Results – Part 2

This section addresses the second research question:

1. What should be implemented in a sustainable development strategy for the CF in order to achieve green/sustainable building objectives? What are the constraints of current DND policy, and how can those constraints be overcome?

Challenges of implementing sustainable building strategies within DND were raised due to the current practice and structure of the CF. Any policies created within DND must account for its unique command structure as it will have a direct influence on operations and influence on all long-term aspects. The command structure is based on making quick and efficient decisions, and when there is a five-year or ten-year sustainability plan, the current structure is limited in terms of addressing that issue, i.e. the posting system. Issues and recommendations to mitigate these issues to make strategies more effective are summarized below in **Table 3**.

The results in Part 1 of this section were used to help identify the most significant building rating problems, as well as to highlight areas that require the most attention in order to minimize the environmental effects of a building. National objectives and legal requirements were also used to showcase the areas of sustainable buildings tools that policy developers and sustainable building users find most important. However,

sustainable building tools cannot stand alone, and must be part of a wider sustainable building policy initiative through the DND.

Conclusions / Contributions

The objectives of this study were to address the following research questions:

Part 1 - What are the unique requirements of the CF with regards to green / sustainable buildings?; and,

Part 2 - What should be implemented in a sustainable development strategy for the CF in order to achieve green / sustainable building objectives? What are the constraints of current DND policy, and how can those constraints be overcome?

Conclusions - Part 1

The unique nature of the CF and its SD policies and practices were fully referred to previously in this report. The results of the interviews of the DND personnel, federal employees and relevant experts also, further defined the unique requirements and policy of the CF in this regard. Examining buildings within a SD framework from the macro (holistically) to the micro-scale (CF specific), the author investigated the development of current sustainable building rating systems and strategies. The author's research has contributed to the examination of current green / sustainable building rating systems and their widespread application. The trends and themes that were thoroughly examined and determined helped contribute to the academic discourse in the field of sustainable buildings assessment. The results (i.e. the most viable and relevant components (or cited factors) of a variety of rating systems in regards to green

building and sustainable development concepts) reiterate the fact that proper critical analysis, and a transdisciplinary approach is required for selecting the most optimal rating system indicators and criteria; especially for use by the CF and DND, with their stated unique requirements. The aim was to tackle and suggest a solution for a 'real-world problem', as the tool should be used to improve the performance of buildings. Scientific knowledge from many fields needs to be collated and analysed in order to extract the most important aspects to be considered in the tool. In addition, appropriate policies and support are required to foster the progress of sustainability strategies. The following conclusions can be drawn from the results of this research:

a. The unique needs of the DND were identified, and investigated on how this uniqueness affects the application and effectiveness of rating systems (summary provided in Table 2);
b. Core, Relevant SD factors / criteria were determined through a thorough, comprehensive and international selection process that could be used as the foundation for a proposed DND sustainable buildings rating systems;
c. A sustainable development framework was established;
d. Areas of improvement, with regards to SD, for DND infrastructure were identified; and,
e. Research addressed shortcomings and proposed sustainable building policy protocol.

<u>Conclusions- Part 2</u>

This research incorporated the relevant concepts of SD by addressing the components of the sustainability which highlights the applicability of these frameworks to the built environment, and their usability for practical purposes. The cited factors that were chosen and fully substantiated by the author have the potential to become the standard through which SD can be not only evaluated, but practised through implementation. It also illustrates the potentialities for the framework to be used as a design tool, aiding in the mobilization of these concepts of sustainability from policy into practice. Obtaining sound feedback and input to the CF and the DND, can, in turn, be introduced at the Federal Level. This can be accomplished through the creation of a DND specific Sustainable Building Strategy. Policies which aim to progress the use of sustainability concepts within infrastructure practices should use these concepts when designing policy, not just for the design of infrastructure itself. The current CF LEED and Green Globes policy certainly has its shortcomings in this regard. This research has illustrated the need to re-evaluate the method of policy creation within the DND, to include more relevant and further reaching concepts of sustainability.

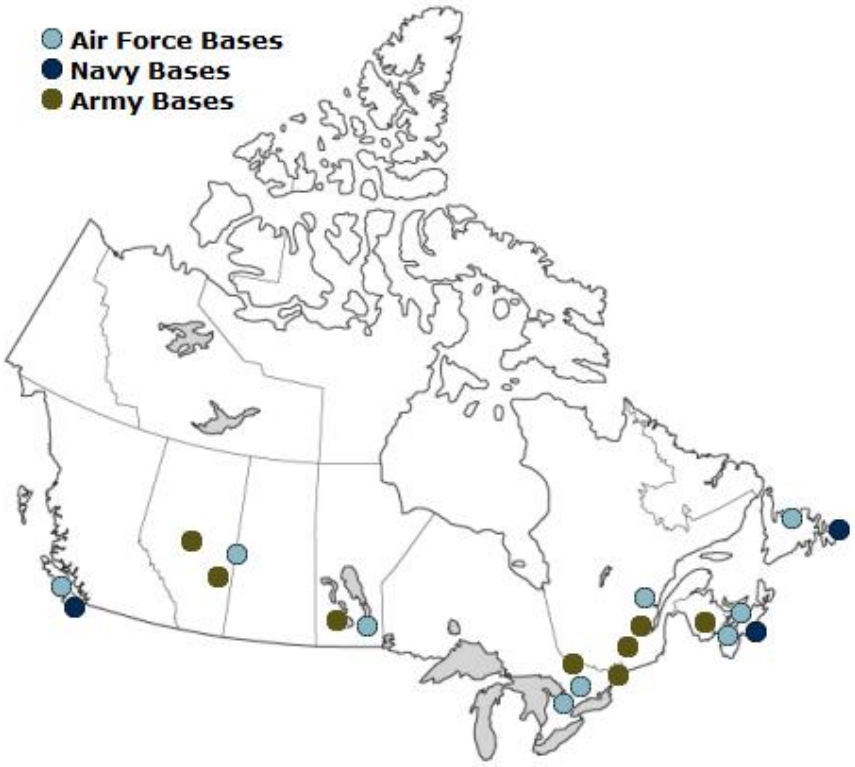

Figure 1: Current Infrastructure Projects for the DND
(Source: National Defence and the Canadian Forces, 2012)

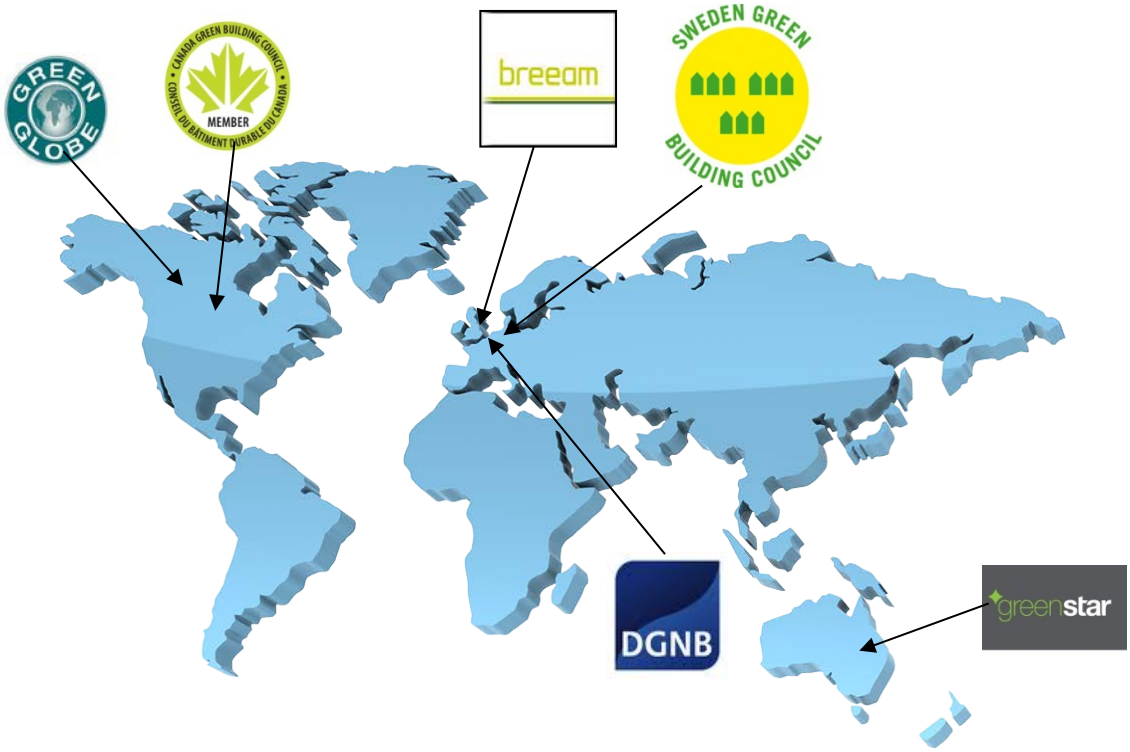

Figure 2: Selected Green/Sustainable Building Systems around the world

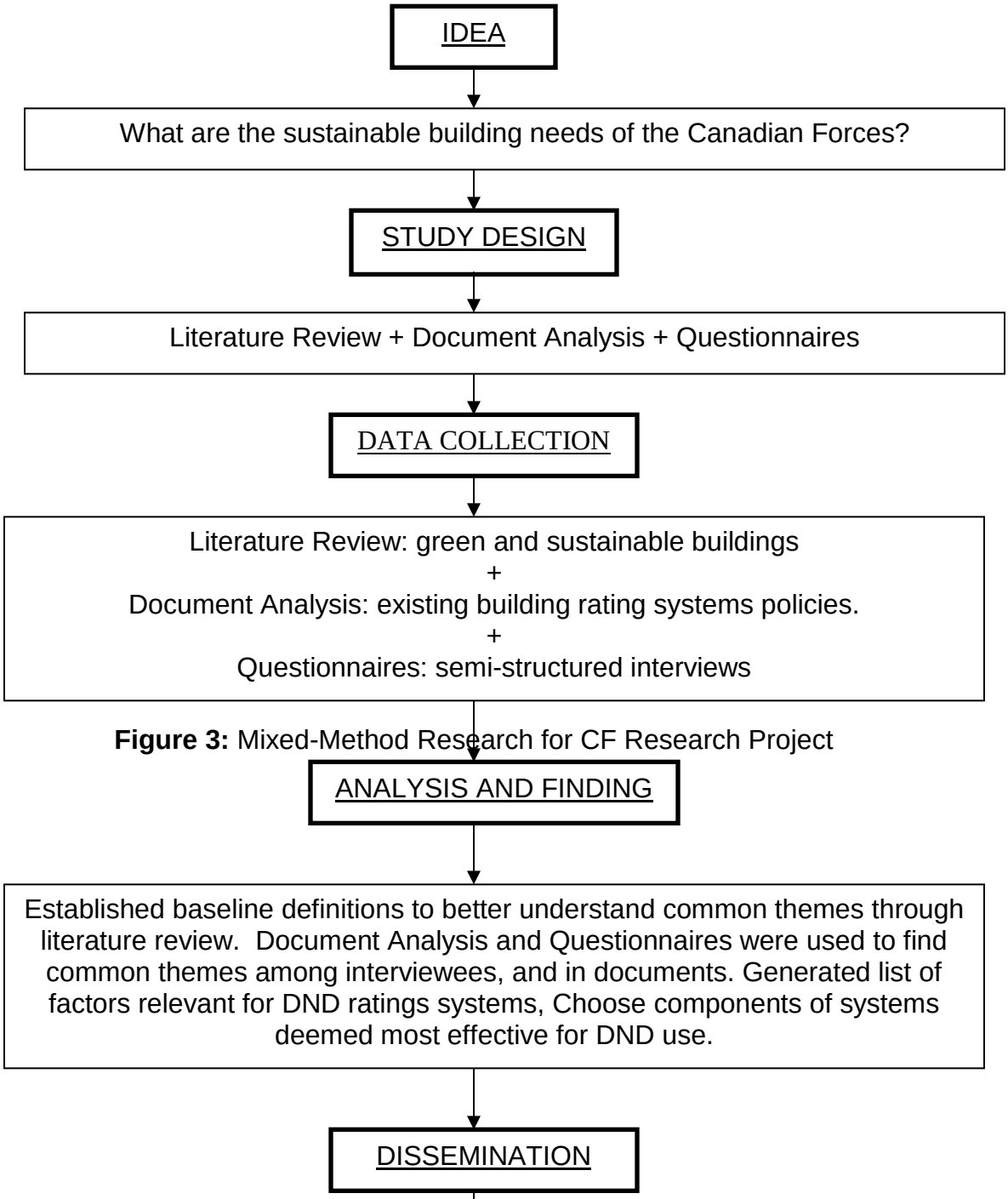

Figure 3: Mixed-Method Research for CF Research Project

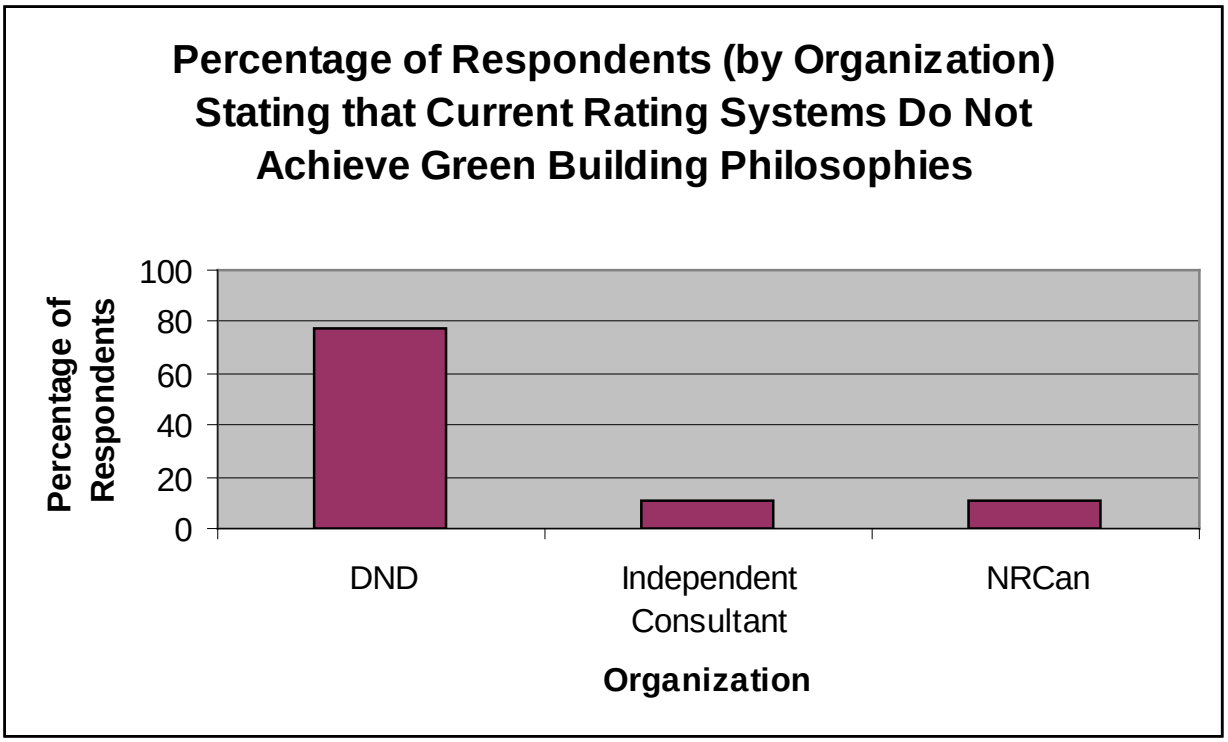

Figure 4 : Percentage of Respondents (by Organization) Stating that current Rating Systems do not Achieve Sustainable Building Philosophies

Table 1: Evaluation Factors to be Included in the proposed DND Sustainable Development Rating System.

Factor	Rating System of Choice
Administrative	
Flexibility of Criteria	Green Globes
Performance vs. Prescriptive indicators	Green Globes
Third-Party Verification	All
Integrated Design Process	BREEAM
Lifecycle Analysis	DGNB
Greenhouse Gas Emissions	
Reduction in Energy Usage in Buildings	BREEAM
Vehicles: Reduction of GHG from Vehicle	LEED

Emissions	
Encouragement of Virtual Meetings	N/A
Water Quality	
Reduction in Water Usage	Green Star
Human Health Consideration of Water	Swedish Rating Tool
Wastewater Management	Green Star
Materials and Resources	
Waste Reduction	DGNB
Recycling/Separation of Operational Wastes	BREEAM
Green Procurement	Green Globes
Recycling e-waste	N/A
Indoor Environmental Quality	
Air Quality	LEED
Indoor Temperature Controls	BREEAM
Odourless and Low Emissions Products	Green Star and LEED
Acoustic comfort	BREEAM
Indoor Design	DGNB
Views	LEED
Lighting Controls	LEED
Site Selection	
Regional Consideration	DGNB
Environmental Integrity of the Site	BREEAM
Location to Amenities	DGNB
Security	N/A
Social/Cultural Aspects	
Cultural Sensitivity	DGNB
Social Impact on Adjacent Properties/ Architecture	Green Globes and DGNB
Operation/Maintenance/Education	
Monitoring	N/A
Commissioning	BREEAM
Education	N/A
Employee Awareness	Green Globes
Training	BREEAM
Flexibility of Building Use	DGNB
Measurement and Verification	DGNB
Building Durability	DGNB
Economics	
Life Cycle Cost Analysis	BREEAM and DGNB
Innovation	
Innovation	All

Table 2: The total number of factors each system most effectively addressed.

Rating Systems	Number of Factors
LEED	**5**
Green Globes	**5**
GreenStar	**3**
BREEAM	**9**
Swedish Building Rating Tool	**1**
DGNB	**11**

Table 3: Issues and Required Actions for DND Building Management Plans

Cited Issue	Action Required
Short-term polices regarding sustainable development	Consideration of high turn-over rates, and long-term budgets.
Lack of ownership and accountability	Requirement of executives and directors to have their end of year assessments affected if they are not implementing sustainable practices.
Lack of spending on pilot projects and research and development	Long-term budgets.
Lack of Training and Education	Ensure clarity of policies and provide training programs to ensure proper execution of tasks.
Lack of Communication	Creation of policy must consider all factors of building design and user group requirements. Communicate requirements to all levels and between departments (green building policies should be shared between Environment and infrastructure).
Unclear Objectives	Ensure all parties understand terminology and concept in policies and plans. Requirement of consistent monitoring and re-evaluation of policies.
Not flexible	Create a policy flexible enough to include both large and smaller infrastructure projects.
Lack of incentives	Provide Incentives for managers and

Cited Issue	Action Required
	directors to implement sustainable building strategies.

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