

**Sustainability and Self-reliance:
Cooperative Approaches in the Design and Development of Housing Components within
Inuit Communities**

by

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A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs
in partial fulfillment of the requirements for the degree of

Master of Design
in
Industrial Design

Carleton University
Ottawa, Ontario

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ABSTRACT

There has been much written on the Inuit housing crisis in the Canadian Arctic. Strains on the existing public housing system are creating health and sociocultural issues within Inuit communities. The North has a high rate of unemployment and there is a need to develop businesses that can allow for a young, but growing population to become more self-sufficient and self-reliant. Sustainable housing for the Arctic is necessary to cut operation costs and give Inuit quality homes for future generations. Energy-efficient fenestration (windows and doors) is a vital component for the northern sustainable house. These topics are explored both in the literature review and in the data analysis process.

The research brought together private and public sector experts from across Canada to generate knowledge-based suggestions which, after convergent analysis, led to the identification of top critical barriers for establishing the development of a northern fenestration system that could be maintained and manufactured within Inuit communities. The study demonstrated how a holistic cooperative approach of multi-sectorial partnerships could be used to assist in the development of a design guideline for an Arctic specific fenestration system. This would allow for further review and exchange by these diverse experts that could lead to future partnerships.

KEYWORDS: Fenestration, sustainability, Inuit self-reliance, cooperative approaches, critical barriers

ACKNOWLEDGEMENTS

TO MOM

Who encouraged me to make my own decisions

A warm thank you to my supervisors

Dr. Thomas Garvey and Dr. Stephen Fai

for encouragement and guidance that drove me to explore

With special thanks to my colleagues Valerie Daley

WonJoon Chung, Lois Frankel, and Bjarki Hallgrimsson

And to the subject experts that made this research possible

Jeff Baker, Oliver Drerub, JP Gladu, Michael Glover

Tim Macleod, Charles Pugh, Wayne Secondcost, and Stephen Thwaites

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PREFACE

The year I was born was the same year that the first permanent year-round Inuit communities were established in the Canadian Arctic. It bothers me that 57 years have passed since the Canadian Government moved these nomadic people into housing that still does not meet to their social and environmental needs. There is an ongoing Inuit housing crisis in the Canadian north. I wondered how I could contribute to help solve this issue.

I am an industrial designer who through his career became an expert in developing energy efficient fenestration (windows and doors) products and technologically advanced volume window production systems. Working with an international multidisciplinary team of designers, engineers, building scientists, production specialists and business people, we have developed products that meet the demands of the worldwide commercial and residential market. However all of these products were for markets below the 60th parallel. Above this circle of latitude live the Inuit, who exist in a climatically and economically changing Arctic.

As a fenestration expert, when I look at a house I see it made up of components that are then combined to make it a home, of which windows are a vital element. Energy efficient window systems are designed around specific components, materials and production systems. Could an Arctic specific fenestration system be developed that can be manufactured with-in Inuit communities? Developing and implementing an Arctic fenestration system could possibly open up the opportunity for northern businesses to be established giving employment and importantly a greater opportunity for self-sufficiency in Inuit communities.

When my advisor Dr. Thomas Garvey introduced me to the book *The Grandest Challenge* by Abdallah Daar and Peter Singer, I found a certain focus. I believed that a similar process as presented in the book, where a coordinated approach of bringing experts together from a variety of fields to establish the critical barriers to a complex problem, could lead to a future solution to the Inuit housing crisis.

• 1 •
INTRODUCTION

There is an Inuit housing crisis in the Canadian North.

This has been a critical problem since the first permanent year-round Inuit community was established in 1957. Research projects on Inuit housing have been conducted for over 40 years. Innovative ideas have been presented.

For example, in the 1973 Man in the North Technical Paper it was suggested that, “The special difficulties of building in the North, in particular: a lack of skilled labor and a short construction season, dictated that in contrast to traditional construction, buildings should be to some extent prefabricated off-site” (The Arctic Institute of North America, 1973, p.115). This illustrates how long these innovative ideas have been considered, and that these same issues are relevant today.

Now after thirty-six years, an Ottawa-based private sector company Kott North developed an innovative prefabricated Structural Insulated Panels (SIPs) system for house construction. This provides for maximum thermal efficiency, ease of construction, and high durability in order to meet the climatic and energy-efficiency challenges of Nunavut (Pulla, 2012). These prefabricated panels were manufactured in Kott’s facility in Ottawa, shipped and then transported by road to northern communities. “Using SIPs meant that the outer shell of a house could be assembled in as little as seven (7) days” (Pulla, 2012, p.51). This identified a successful multi-sectorial partnership and the use of prefabricated systems for house construction. Even with the initial success of the SIPs system, the program has not moved much further from the funding the Government of Nunavut in 2009 received under the Economic Action Plan.

Public sector bodies are currently conducting other research. For example, the Canada Mortgage and Housing Corporation (CMHC) has collaborated with the Nunavut Housing Corporation to promote the design of culturally-appropriate housing across the North, and to construct housing that consumes 50 percent less energy than similar houses constructed to the Model National Energy Code for Houses (Canada Mortgage and Housing Corporation, 2009b). Through this program design charrettes (multi-disciplinary design planning meetings) were conducted in two northern communities. “The Integrated Design Process (IDP) is a holistic approach to building design” (Canada Mortgage and Housing Corporation, 2009a, p.1), which has resulted in two

culturally sensitive energy efficient houses built in the communities of Arviat and to be built in Dawson City in the future.

These cases demonstrate that through these participatory processes between multi-sectorial partners, design solutions can take place. However the issue is that the housing crisis still exists, and the strain on northern public housing is increasing.

Housing affects every aspect of life. This includes work, school, family and social relationships, which in turn impact an individual's mental, spiritual and physical health and well-being. (Knotsch and Kinnon, 2011). There are not enough homes to meet to the demands of the fast-growing young population. Currently the median age of the Inuit is 22 years old. (Statistics Canada, 2006). As these young families increase in size the lack of accommodation and overcrowding become major issues. Often multiple generations are living together under one roof. The lack of housing, or inadequate housing, has far-reaching effects on Inuit socioculture and the health of the entire Inuit community.

Currently the level of northern unemployment is high: 18 percent in Nunavut in 2006, and 32 percent in Nunatsiavut (Canada Mortgage and Housing Corporation, 2008, p.72). This is well above the Canadian average. The Inuit depend on income from multiple sources, such as salaried work, government transfer payments and income from traditional hunting and fishing. The cost of living in the North is significantly higher than in southern Canada. In 2005 the average annual utility cost in most communities was more than double the Canadian average: \$4,328 compared to \$2,148 (Canada Mortgage and Housing Corporation, 2008, p.72). The Inuit often have to rely on government programs to help pay for their high cost of living. For the Inuit to move towards self-reliance and self-sufficiency there needs to be more salaried employment to pay for the distinctive needs in the North.

Energy operating costs are high in the North. These costs are compounded due to inadequate and poorly maintained homes. There is a need for a more sustainable house that utilizes advances in energy efficient systems, components, and technologies that need to be designed and developed for the distinctive harsh environment of the Arctic and the unique sociocultural needs of the Inuit. Energy efficient fenestration (window and door) systems are a vital energy savings component to the sustainable house. "Windows have developed into modern high-tech building elements that continue to move to higher energy efficiency and durability" (Seifert, 2007, p.1). Currently

southern-produced fenestration systems that are being used in northern housing have a short product life, are difficult to maintain, and do not have the required energy performance for the North. Southern-produced fenestration products are produced in high volume production facilities, therefore providing products at competitive prices for southern purchasers. The increased cost of these products in the North is due to the remote geography and existing infrastructure that make the transportation of materials and supplies difficult and expensive (Canada Mortgage and Housing Corporation, 2008). Fenestration products are assemblies of components, and they can be assembled using a wide variety of production processes. These processes are dependent on the materials being used and the volumes required. Windows and doors can be produced in small run production facilities.

1.1 Rationale and Purpose of Study

This research is focused on the development of a northern fenestration system and is based on the following rationale.

- Fenestration systems are an important component to the development of a sustainable house.
- Existing fenestration systems in Inuit communities do not have the energy performance for the harsh Arctic climate. There is a need for a specific fenestration system that can meet the harsh northern environment and the sociocultural needs of the Inuit.
- Fenestration systems can be assembled through a variety of production processes that meet to a target market.
- The road to Inuit self-reliance and self-sufficiency is through the development of northern businesses and employment. This could be achieved through the development of a fenestration business strategy.

1.2 Cooperative Approaches

Only through a multi-sectorial partnership with a cooperative approach will these complex issues be addressed, and an innovative solution be found. “Integrated innovation is the coordinated application of scientific/technological, social and business innovation to develop solutions to complex challenges” (Grand Challenges Canada, 2011a, p.4). Present efforts by private and public sector groups and Inuit communities have been successful in determining the needs of an Arctic-appropriate housing, and there has been development of energy efficient housing prototypes. However the Inuit housing crisis still exists, and it is a complex challenge.

1.3 Research Question and Overview

The research asks the question: *What are the critical barriers to the development of northern fenestration (window and door) systems that can be manufactured and maintained by Inuit communities?*

The research will use a Grand Challenges Canada approach:

- By using experts to present suggestions that, through convergent analysis, will identify ten critical barriers, and
- By evaluating how a cooperative approach can identify the barriers to critical problems.

Future goals and analysis required include:

- Use of the critical barriers to assist in the development of a design guideline for an Arctic specific fenestration system, and
- Investigations on how holistic, cooperative approaches can work to develop Arctic-specific housing components.

Through a review of the current literature, and by assessing secondary sources, the current issues regarding Canadian Arctic housing and technologies for northern fenestration will be identified.

LITERATURE REVIEW

2.1 Inuit Housing Crisis

The first permanent year-round Inuit community was established in 1957. The impact of this change to the Inuit traditional nomadic culture has had repercussions for 58 years. From the beginning there have been efforts by the Canadian government to place the Inuit in Euro-Canadian notions of what housing should be. Presently these northern “houses are inferior, expensive, small, often not provided with services, and above all clearly not constructed with a view to meeting the housing needs of the local population” (Canadian Polar Commission, 2012, p.2). Inadequate housing has direct health impacts on inhabitants due to overcrowding, mold, and poor maintenance. If we do not address this crisis the “inadequate housing is likely to have long-term effects on today’s youngest generation, which may deprive them of their ability to participate fully in the future of their Inuit homelands and Canada” (Canadian Mortgage and Housing Corporation, 2008, p.66).

The Arctic is changing. The effects of a warmer global climate have a reaching effect sociologically and economically on Inuit communities. “Climatic variation has significant impacts on the housing sector. The permafrost is melting, causing settling problems and structural damage to buildings, ... impacting winter roads and ice roads reducing the already narrow window for transporting building materials to isolated communities” (Canada Mortgage and Housing Corporation, 2008, p.70-71). Already seasonal transportation drives the construction process for communities to be limited to a few months in the summer. Higher transportation costs contribute to increasing the price of housing components leading to homes that are not affordable to the Inuit. Over two thirds of northern Inuit live in housing below what Canadian Mortgage Housing Corporation (CMHC) states as the core housing need where homes are acceptable or suitable, adequate, and affordable.

The housing demands are increasing for the fast growing Inuit population. Overcrowding is a major issue, as the average household size typically in Nunavik is 4.1 persons per household, which is well above the average Canadian household of 2.5 persons (Canada Mortgage and Housing Corporation, 2006b, p.67). Today, 30 percent of Inuit households have five or more members compared to nine percent of all Canadian Households (Canada Mortgage and Housing Corporation, 2010a). These strains on the system will become even worse in the years to come as

the young northern population begins having families. In the 2006 census Statistics Canada states 37 percent of the Inuit population is under 15 years old, and the birth rate in Nunavut is the highest in Canada.

To highlight this demand, J. Okalik Eegeesiak (President of the Qikiqrani Inuit Association at the Canada-UK Colloquium: The Arctic and Northern Dimensions of World Issues) said, “to give you an idea of the magnitude of the problem and of costs in Nunavut, the estimated number of houses needed right now to meet to the demands is 4,000. The government estimates that the cost to build a standard, very modest housing unit is about \$275,000. Add to that operating costs, which include electricity cost of 40 to 80cents per kilowatt hour (compared to 5.3cents to 9.9cents in Ontario) with a 20% increase in the works” (Knotsch and Kinnon, 2011, p.34).

Technological advances in housing components can assist in developing low-energy housing and decrease operation costs. These advances are being done both nationally and internationally working towards Northern Sustainable House. This requires that “Northern housing needs to be designed for the local environment, and integrate new, innovative, energy efficient technologies (Pulla, 2012, p.7). This “Integrated design process is a holistic approach to building design” (Canada Mortgage and Housing Corporation, 2009a, p.67).

“There is a need to establish and strengthen collaborative partnerships between federal, territorial and regional governments, NGO’s and industry to undertake a multi-disciplinary research to inform policies and programs to support effective housing options” (Canadian Polar Commission, 2011, p.6).

As the Inuit move more towards self-sufficiency they want a sustainable house that is designed and built by the Inuit, for the Inuit. Can this move even farther forward by the Inuit themselves manufacturing the housing components that will be used to construct a culturally appropriate sustainable home for the Inuit?

Inuit participants, in a Canadian Mortgage and Housing Corporation sponsored Arviat Community and Housing Design Charrette, reiterated this point. “Explore the options of prefabrication building locally over winter season. This could involve using community spaces that are unused in the winter, such as swimming pools” (Canadian Mortgage and Housing Corporation, 2006a, p.6).

2.2 Fenestration Systems

Fenestration systems are one of the most vital energy building components in the development of a sustainable housing system. Fenestration products are in our homes, places of work, retail outlets, schools; they are part of almost every architectural structure we access. In principle windows have a very simple purpose, which is to transmit light into a building, allow us to view out, and supply fresh air to the occupants. As a design feature, “Windows are the most unique element in a building” (Seifert, 2007, p.1). As we attempt to decrease our ecological footprint, the energy efficient home becomes more important. It is critical to explore energy efficient housing component options that would decrease dependencies on fossil fuels.

A fenestration system can reduce operating expenditures for energy, assist in reducing operation and maintenance cost, and create a healthy comfortable environment leading to less sickness and a more positive attitude for residents. Windows supply the daylight to the interior of the home, which connects occupants to the external environment, the weather, seasons, time of day, and gives a sense of orientation and spaciousness. The Inuit perception of light is different than people in the south because of the northern seasonal patterns of no daylight for four months and continuous daylight for one month. In the summer Inuit want to control the natural light entering their homes. In the winter Inuit use light from the home as a beacon to the community. Fenestration design has to take into account the traditional values of the environmentally connected Inuit.

“In typical Arctic buildings the windows are responsible for a considerable part of the heat losses, therefore there is large potential for energy-saving by developing and using windows with improved energy performance” (Laustsen, 2006, p.1). These inadequate products have not been designed for the northern climates, and this issue is evident throughout northern nations. Windows that are not manufactured to deal with Alaska’s extreme climate don’t work well there even if they are attractive for other reasons like lower prices. Even well insulated windows can develop problems. Mass-produced windows that might function just fine in the south may fail in Alaska. Blown seals, cracked panes, and warped frames are all signs that windows aren’t up to snuff (Cold Climate Housing Research Centre, 2006).

“Emerging and future fenestration technologies could reduce impacts to ‘zero’ and ultimately provide energy benefits to buildings in the form of daylight, passive solar gains” (Charmody et al.,

p.14). Presently these advanced fenestration systems are produced in technologically advanced, high volume, and environmentally controlled production facilities. Once produced, the finished window squares are then packaged and transported from central North America to the Arctic through extended, expensive, and seasonal distribution systems. These advanced window systems are very expensive and difficult to maintain. Present fenestration products are not appropriate for Inuit communities.

2.3 Passive and Sustainable Options for Northern Housing

Northern housing initiatives are taking place throughout the Arctic. These initiatives are not just limited to Canada; they include other Arctic countries that have Inuit cultures such as, Greenland (Denmark), Alaska (United States), and Siberia (Russia). Developing housing strategies requires multi-sectorial partnerships, and needs to utilize international experiences in developing housing through a collaborative process. This collaboration must, “Involve Northern lifestyles, traditions, and cultures, and be consistent with the long-term goals of sustainable development” (Pulla, 2012, p.i).

The inauguration of low-energy northern housing was built in Sisimiut, Greenland in 2005. This research house is characterized by a highly insulated building envelope, advanced window systems and a ventilation system with heat recovery which should cut energy consumption to half of what became the permissible value in the Greenland building code in 2006 (Rode, C. et al, 2006). The Sisimiut research team took a holistic design approach, “taking into account all relevant functional requirements for the project” (Kjaerbye, 2006, p.2), and bringing together an integrated design team of architects, engineers, contractors and the client, and utilizing the present knowledge and experience (Kjaerbye, 2006). The low-energy house was made as a double house (duplex) for two separate families living in an independent residence. The house incorporated advances in building envelope, heating systems, ventilation systems, solar collectors and windows. As this paper addresses Arctic fenestration products, the focus of research data collected will be the window. As a research house three types of glazing units were utilized. The study pointed out that significant energy flow was through solar gain windows, considerably reducing fossil fuels. Approximately 3,000 liters of oil were saved, with the combination of solar heating and internal heat gain.

Air infiltration and airtightness remained an issue. Through infrared thermography imaging considerable air leakage through the window contributed to the fenestration design and installation. It pointed out that airtightness was an issue that should be addressed giving possible higher energy improvements.

The Sisimuit house demonstrates a holistic approach to developing energy efficient housing for Inuit. Northern Canadian housing initiatives are taking place within the Inuit communities addressing the energy needs, as well as the cultural needs of the community. The current sustainable housing initiative in Nunatsiavut, Inuit lands and Inuit settlements in northeastern Labrador feature a cooperative vision as seen in Figure 1. It is a cooperative approach between economic, social, environmental, and cultural drivers.

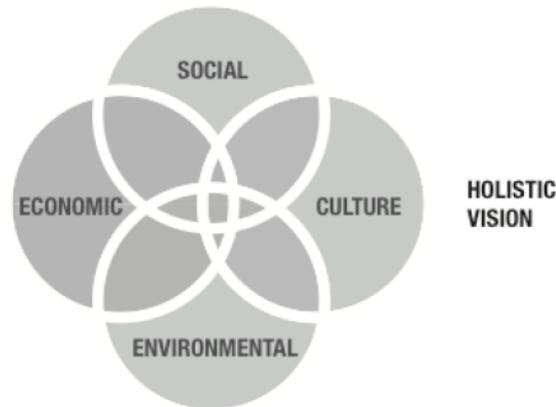


Figure 1. Northeastern Labrador Cooperative Vision

These approaches present the importance of considering Inuit society and the traditions that exist in the culture when developing housing. These housing strategies also have to consider: social housing allocations, supporting vulnerable populations, community planning and development needs, exploring home-ownership incentives, action-oriented research and policy confirming the local housing issues, identifying the current best practices and building partnerships between academic and professional, and government at all levels and across departments (Sheldon and Goldhar, 2008).

Nunatsiavut community sees that Inuit homes require affordable warmth. This could be achieved though energy efficiency. Many of the Canadian studies have been on the development of a low

energy house, including features, “as a well-sealed and very well-insulated building envelope, heat recovery on the ventilated air, use of direct passive solar gain for space heating, low energy use of lighting and low energy use of appliances ... with addition of active solar space and water heating systems and photovoltaic systems for generation of electricity” (Dumont, 2006, p.21). These measures are being presented to northern housing. As bad windows are responsible for a considerable amount of heat loss, good energy performance windows can attribute to heat gain, therefore they are an important component to the passive house.

2.4 Inuit Housing Shortages

Isolated Inuit communities are spread throughout the Canadian Arctic. These small communities have populations of less than 1000 people. Larger communities like Rankin Inlet, Nunavik, have population ranges of 2000 to 2500. The largest populated area is in Iqaluit, Nunavut, which has between 6000 to 7000 people. In total there are only 115,000 people spread over 58 communities. These remote communities will require culturally appropriate housing designs that offer eligibility in rent-geared-to-income or rent-to-own programs (Howard et al., 2012).

Because of this isolation, distribution costs increase the price for maintenance and construction. There is a shortage of labor in these small communities; therefore labor is flown in from outside the community (Canada Mortgage and Housing Corporation, 2006b). This demonstrates that there needs to be a greater emphasis on developing local capacity in order to create northern housing development (Howard et al., 2012).

Through complex negotiations with federal, provincial and territorial governments there have been comprehensive land claim agreements made. “Inuit communities will be benefitting from this with rights to land, cash payments and the establishment of new political and economic entities that ensure these land claim agreements are fulfilled” (Pauktuutit Inuit Women of Canada, 2006, p.5). Presently the Inuit are dependent on government transfer payments for their income, which is almost one third of their personal income. Part-time and seasonal employment often makes up the remainder of the income within the family. Affordable housing has to consider the current and future finances of Inuit households.

Federal Government funding for northern housing through the establishment of trusts that are administered by the provinces and territories (Canada Mortgage and Housing Corporation,

2006b). These programs support the construction of social and affordable housing projects and the development of northern integrated strategies. However even with these strategies the northern housing shortages still exist and are increasing.

One of the key recommendations by the conference board of Canada is “greater emphasis on leveraging multi-sectorial partnerships and expertise when designing and delivering Northern housing programs” (Howard et al., 2012, p.26).

2.5 Inuit Qaujimaqatunqangit

The simple definition of Inuit Qaujimaqatunqangit (IQ) is “Traditional Inuit Knowledge” (Wenzel, 2003, p.1). IQ “encompasses all aspects of traditional Inuit culture including values, world-view, language, social organization, life skills, perceptions and expectations” (Wenzel, 2003, p.3). The government of Nunavut has adopted IQ in its commitments to develop practices and policies that are consistent with the culture, values and language of the Inuit majority (Pauktuutit Inuit Women of Canada, 2006). There needs to be integration of these cultural values in both the design and construction of a house (Howard et al., 2012).

To build relationships and sharing knowledge, partners need to be aware of the IQ and managers of Inuit workers need IQ insight. For example, Inuit cherish independence of thoughts and actions as a natural prerogative. People tend to look away from anyone who seems to aspire to tell them what to do (Briggs, 1970). Related to the previous example, there was no formal authority in Inuit communities. The entire community was responsible for the maintenance of peace and order (Pauktuutit Inuit Women of Canada, 2006).

The most common work performance issues that employers experience with Aboriginal workers are skills, attitudes and behaviors needed for the work place (Howard, et al., 2012). It likely also relates to the understanding of IQ. Non-Inuit work methods emphasize individual effort and competition in contrast to cooperation and the responsibility of the group (Poulin, 2012).

Inuit men participate in a mixed economy where traditional hunting and fishing are combined with salaried work. The ratification of agreements have given the Inuit the opportunity to preserve the economic diversity they developed over centuries, while embedding these agreements allows for the structures required to integrate traditional activities and validates their

culture (Poulin, 2012). Cooperative processes need to build relationships. The different parties should have an understanding of each other's culture.

2.6 Integrated Design Process

The Canadian Federal Government groups through CMHC are currently supporting the development of sustainable housing. Initiatives like Northern Sustainable House (NSH) are intended to demonstrate projects that present different approaches for affordable and local housing that meets the needs and take the interests of future occupants as well as the community and other stakeholders into account (Central Mortgage and Housing Corporation, 2006a). Demonstration projects were developed through integrated design charrettes with the purpose to ensure that all the stakeholders could be part of this integrated process.

An example of a typical charrette was conducted in Arviat, Nunavut. There were approximately 40 participants including staff from Nunavut Corporation's maintenance, design and delivery sections, climate change representatives from the Government of Nunavut's Department of Environment, Arviat community elders and community members, facilitators from the Nunavut Department of Education, representatives for the Arviat Housing Association and the Community Health Center, and technical representatives from Natural Resources Canada (NRCan) (Central Mortgage and Housing Corporation, 2006a). There was no representation from component manufacturers or southern business enterprises. It was felt that this was a holistic approach to building design. The objective was for an integrated design process that would lead to an innovative solution to the Northern sustainable house. From this research two innovative designs were developed in Inuvik, Northwest Territories and Tr'ondëk Hwëch'in. Both examples used standard fenestration products that were imported from the south. The focus of these projects was more on the combination of existing technology to build houses, than the development of northern specific products.

A successful program for the development of appropriate systems was the Kott Group's development for Tuktu (2009), Structural Insulated Panels (SIPs) for a high performance northern building envelope. Nunavut Housing Corporation put out a Request for Proposal (RFP). Through an integrated participatory process, Kott Group developed an innovative factory constructed pre-fabricated panel technology that was transported to the North. Beginning in the summer of 2010, 114 houses were assembled in the summer months in 19 communities in Nunavut. This

demonstrated how northern housing can best be designed, engineered, and delivered in partnership to address the many elements required to support sustainable northern housing (Howard et al., 2012).

The Kott project integrated design processes could apply to other building components, like fenestration systems for the Arctic. By using a cooperative process with multidisciplinary teams of southern businesses, Inuit communities, technology developers and northern governments: well thought out proposals for innovative products could be developed.

2.7 Cooperative Approaches

Developing sustainable northern housing demands a more holistic approach and everyone should participate cooperatively across three theme areas: Sustainability, Private and Public Sector Governance and Inuit Self-reliance.

The Cooperative Approach Diagram in Figure 2 illustrates how the theme areas relate to each other. From the theme areas are the linkages. The two longer linkages represent traditional values and technological advancements. The four shorter linkages represent research needs, economic demands, enablers and specifications. In this section, we will be discussing in further detail how these themes are related.

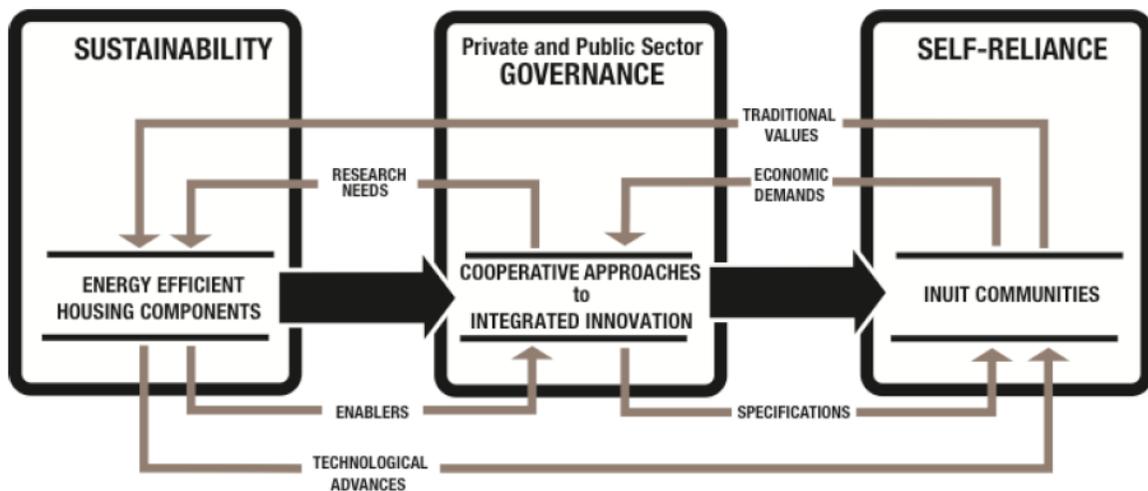


Figure 2. Cooperative Approach Diagram

Theme areas

- **Sustainability:** Sustainable northern housing consumes less energy and is culturally appropriate for the Inuit. Fenestration technologies play a very important energy role in the entire sustainable house. Currently the southern fenestration technologies available are not appropriate for the Arctic environment, or for the Inuit communities. The demands are great for this changing northern environment. These theme areas present the technologies, and production processes that can be incorporated to develop advanced energy efficient fenestration systems.
- **Private and public sector governance:** Governance is a multi-sectorial partnership involving community capacity and the role of lending institutions. Private and public sector governance play an important role by setting standards, and initiating policies to allow for capital investment and for businesses to survive, in order to get the technology developed.
- **Self-reliance:** The Inuit are moving towards more self-reliance and self-sufficiency. Inuit want to live within their own traditional values while also having the product and services that the rest of Canada has. Inuit self-reliance empowers the community to create employment, business, and manage their own lives without the controls that governments place on them. Development of fenestration technologies must consider the sociocultural structure of these northern communities.

Long Links

- **Technological advances:** The technological advances link connects the Sustainability to the Self-reliance component in Inuit communities. There are advanced energy efficient technologies available, but they cannot be applied to the Arctic environment and used by the Inuit people. These advanced technologies have to be modified, re-designed and further developed so that they can be used and manufactured within Inuit communities.
- **Traditional values:** Traditional values are the connecting link between Self-reliance of the Inuit communities to Sustainability. Similar to technological advances, everything from manufacturing to usage has to be considered within their cultural needs within this unique

climatic environment. The Traditional values link is an important link because it reflects on the Inuit's lifestyle, their values, and their needs.

Short Links

- **Research needs:** Research needs link connects cooperative approaches to Governance bodies to Sustainability. The research is needed in order to develop energy efficient fenestration systems. The research needs are useful for the public and private sector governance to better estimate the cost of effective and energy efficient systems in order to build sustainable housing components.
- **Enablers:** The Enablers is the connecting link from Sustainability to Governance. The entire process needs to be approached by combining the development of the product with the ability for it to be produced, controlled and managed in the North by the Inuit community. This process will also allow for the private sector to produce and maintain products and take initiatives in developing other components. Enablers must consider this whole infrastructure of the design process, manufacturing systems, materials needed, distribution systems, and storage within the climatic and environmental needs to simplify the manufacturing processes.
- **Specifications:** The Specifications link connects Governance to the Self-reliance. Governance needs to proclaim standardization and specifications of the products for the Inuit considering their needs. The standardization and specifications will help to eliminate future problems and higher costs due to the existence of multiple products and components over an expanded area in the North. Applying standardization and specifications to the products would allow for simpler distribution, usage, storage, management and inventory.
- **Economic demands:** This link connects Self-reliance to Governance. With the high unemployment need for public housing, Inuit communities rely on assistance programs. The North is changing due to global warming, opening of the Northwest Passage allowing for new distribution routes, a growing tourist industry and the discovery of resources. A new economic structure is being developed in the North. For Inuit communities to take advantage of this new economic infrastructure they will need to demand resources to start businesses and train employees for these changes.

METHODS

3.1 Grandest Challenge Approach

The Grandest Challenge approach is based on the Delphi method, which is “a structured way of building consensus among experts, and one that avoids the interpersonal dynamics of meetings” (The Grandest Challenge, 2013, p.39). “The Delphi method is well suited for of consensus building by using a series of questionnaires delivered using multiple iterations to collect data from a panel of selected subjects” (Hsu, 2007, p.1).

The precedent for the Delphi method came from mathematics and is referred to as the Hilbert’s Problems. In 1910 David Hilbert published a set of 10 mathematical problems that expanded to 23. He believed these problems would occupy the attention of mathematicians through the following century. However mathematicians around the world worked towards solving “Hilbert’s problems, and they succeeded in all but two cases” (The Grandest Challenge, 2013 p.38). Even though it took more than a century to solve, and required in some cases computer processing, it demonstrates how the consensus of experts can solve difficult problems.

The Delphi method is based on a series of concrete questions and pinpoints one particular solution. “The Grandest Challenge is a strategic platform that helps to identify critical barriers that, if removed, would contribute to the progress of addressing and solving critical problems. Targeted programs are created to fund teams in order to develop solutions to overcome these barriers and implement strategies to help bring the solutions to scale in order to address the pressing challenges” (Grand Challenges Canada, 2011, p.1). The Grandest Challenge approach is one that brings experts together to address what is termed a ‘critical barrier’, that being the roadblock or bottleneck to solving a specific challenge.

The Grande Challenges approach is to develop “integrated innovation’, or a coordinated application of scientific/technological, social and business innovations to develop solutions to complex challenges” (Grand Challenges Canada, 2011, p.4).

The Bill & Melinda Gates Foundation took on the principle of the Grandest Challenge approach and developed the ‘Grand Challenge in Global Health.’ The Gates foundation awarded monies for

‘out-of-the-box’ ideas and subsequent grants for future research. The Gates foundation would ultimately define a grand challenge as a “specific scientific or technological innovation that would remove a critical barrier to solving an important health problem in the developing world, with a high likelihood or global impact and feasibility” (Daar, and Singer, 2013, p.42).

3.2 Research Procedure

The initial approach to the research entailed the following.

- Selecting eight Expert Research Participants (Appendix H) within the theme areas of sustainability, governance, and self-reliance in the context of the Arctic and the Inuit community.
- Contact via telephone, face to face, and email methods to achieve a preliminary confirmation orally for each contact to participate in the study.
- A document package emailed to each participant containing:
 - Letter of Introduction,
 - Consent Form (Appendix B),
 - Questionnaire (Appendix D),
 - Interview Agenda (Appendix C),
 - Research Diagram (Appendix A),
 - Project Introduction Presentation (Appendix E), and
 - Suggestion Form (Appendix G) to be completed at the end of interview.
- As participants were located across Canada, interviews were conducted either via:
 - Face-to-face contact with researcher at a designated location, or
 - Conference call between the researcher and participant.
- Prior to conducting the research the agenda was presented and reviewed along with the letter of introduction, and the consent form was signed.

3.3 Questionnaire

Once the consent form was completed and received, each participant was asked to answer a questionnaire prior to receiving the Project Introduction Presentation. The questionnaire was designed to assist the researcher in identifying the participant’s awareness of the fenestration system in regards to the focus area of the northern Canada Inuit housing crisis. By reviewing the

results of the questionnaire the researcher could then focus the interview dialogue on the area of expertise of each participant. Participants could also choose to respond in theme areas where they held a general knowledge.

The questionnaire procedure involved the following process depending on the method involved in collecting the answers, either via conference call or in a face-to-face contact situation. It is important to note the participant was not recorded for this phase of data collection.

Conference call method

- Participants were asked to have a hard copy of the questionnaire in front of them.
- The researcher read each question to the participant and documented the participant's answers.
- The researcher would keep the participant focused on the questions presented, controlling any other conversation until the questionnaire was complete.
- The researcher then reviewed the completed questionnaire.

Face-to-face contact method

- The participant was presented with a hard copy of the questionnaire.
- The researcher read out the questions to the participant.
- The researcher documented the participant's answers and kept the participant focused on the questions presented, controlling any other conversation until questionnaire was completed.
- Completed questionnaire was reviewed immediately after completion by the researcher.

3.4 Research Project Introduction Presentation

A 10-minute introduction to the research project was presented to each participant by the researcher in order to outline the parameters of the research study.

3.5 Interview Data Collection

The Interview Questions (Appendix F) were designed to focus the dialogue on the research themes. As the Inuit housing crisis has far-reaching consequences for Canada and for Canadians, often the researcher was required to control and focus the participant on the topic at hand so the

discussion related the critical barriers to the research goal. At the end of the dialog each participant presented 10 suggestions, which were hand recorded by the researcher.

Interview procedure

- Oral dialog between the participant and researcher was audio recorded.
- Interview sessions ranged between 45 minutes to one hour.
- Focused questions were based on theme areas and covered Sustainability, Public and Private Governance, and Self-reliance.

The process encouraged open dialog between participant and researcher, and the discussion allowed for the expert to present their valued opinions in regards to their area of expertise, as well as provide comments in regards to the entire research study.

Completion of suggestion sheet

- Each participant was asked to present 10 suggestions arising from the discussion.
- The researcher documented the suggestions on the supplied document.

3.6 Interview Data Analysis

- The researcher compiled data for each participant and arranged the data into themed areas.
- The suggestions were then analyzed by the researcher using knowledge gained from the literature review and the researcher's personal expertise in the fenestration industry.
- Multiple suggestions provided by participants that presented a singular idea were combined.

3.7 Converging Suggestions

The analyzed results of all participants were then converged into applicable themed areas by:

- Focusing on the familiar between the participant's responses,
- Converging the suggestions into the appropriate themed areas, and
- Refinement of the suggestions into a series of statements.

DATA COLLECTION AND ANALYSIS

4.1 Questionnaire Introduction

The purpose of the questionnaire is to assess the understanding of the selected experts in the different theme areas of Sustainability, Private and Public Sector Governance and Self-reliance with respect to the cooperative approaches in the design and development of housing components within Inuit communities. Experts were selected based on their expertise in one of the theme areas. The questionnaire would identify their overall understanding in the other theme areas and their general knowledge of the northern Inuit housing crisis and their current understanding of Inuit communities.

Evaluation of the questionnaire by the researcher prior to the interview phase of the research would allow for a more focused dialog during this data collection. The participant would not be interviewed in areas that were demonstrated in the questionnaire that they had no comprehension. Questions would allow for very simple answers. There would be minimal discussion between the participant and the researcher. The total time allocated for the questionnaire was a maximum of 10 minutes.

Data collected from the questionnaire was compiled and reviewed to assess suggestions given by each participant at the end of the interview. This data was used in the conclusion and establishing the critical barriers.

Figure 3 presents a compilation of the questionnaire results in one summary data sheet.

QUESTIONNAIRE RESULTS

Questions	Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
1. How would you rate your awareness of the Inuit housing crisis in the Canadian North?	Aware	Good Comprehension	Good Comprehension	Good Comprehension	Good Comprehension	Aware	Aware	Good Comprehension
2. For sustainable Arctic housing which of the three areas do you feel would need to be solved first?	Changes to Governance	Sustainable Technology	Sustainable Technology	Changes to Governance	Inuit Self-reliance	Changes to Governance	Sustainable Technology	Changes to Governance
3. Are you aware of research conducted on energy efficient northern housing?	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
4. How would you rate the importance of energy efficient windows and doors as components to assist in the development of more energy efficient housing?	Very Important	Very Important	Very Important	Very Important	Very Important	Important	Very Important	Very Important
5. Are you aware of any window system technologies that may assist in the development of more efficient housing?	Yes	Yes	No	Yes	Yes	No	Yes	Yes
6. Presently there is no manufacturing of window and door products in our Arctic. Do you feel it is possible that northern production of an Arctic specific window system?	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes
7. Do you support federal government involvement in the development of Inuit businesses in the Arctic?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Do you feel that the Canadian chartered banks support the development of Inuit businesses by offering startup financing?	N/A	No	N/A	N/A	N/A	Yes	N/A	No
9. Do you believe there is a place for Inuit traditional values in the changing Arctic?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10. Do you sense that traditional values are being lost in Inuit culture?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11. Do you feel that self-government and self-sufficiency for the Inuit could be through the development of Inuit small business?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. Do you perceive that today there is adequate training and education bodies in the Arctic to prepare Inuit workers to the changing economic environment of the north?	No	No	No	No	No	Yes	No	No

Figure 3. Compilation of Questionnaire Results

4.2 Analysis of Questionnaire Results

1. How would you rate your awareness of the Inuit housing crisis in the Canadian North?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Aware	Good Comprehension	Good Comprehension	Good Comprehension	Good Comprehension	Aware	Aware	Good Comprehension

Analysis:

People who identified good comprehension are presently working or have had work experience with the Inuit in the Arctic.

2. For future sustainable Artic housing which of three areas do you believe would need to be solved first?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Changes to Governance	Sustainable Technology	Sustainable Technology	Changes to Governance	Sustainable Technology	Changes to Governance	Sustainable Technology	Changes to Governance

Analysis:

The category of self-reliance was not considered by any of the participants, while other categories were equally responded to between the participants. The question is: do they see self-reliance as an issue that needs to be considered or is it not relevant?

3. Are you aware of research conducted on energy efficient northern housing?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
YES	YES	YES	YES	YES	YES	NO	

Analysis:

The one participant identified that his expertise was oriented to housing below the 60° parallel, and had no awareness of efficient northern housing.

4. How would you rate the importance of energy efficient windows and doors as components to assist in the development of energy efficient housing?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Very Important	Important	Very Important	Very Important				

Analysis:

Experts in all fields saw the importance of energy efficient windows for energy efficient housing. Gladu stated he saw the importance due to his own home experience.

5. Are you are aware of any window system technologies that may assist in the development of more efficient housing?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Yes	Yes	No	Yes	Yes	No	Yes	Yes

Analysis:

It was understandable the Gladu had no awareness. The Macleod answer was more of a surprise because of his overall knowledge of the northern building industry. This would be an area that would be further explored in the interview.

6. Presently there is no manufacturing of window and door products in our Arctic. Do you feel it is possible for northern production of an Arctic specific window system?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes

Analysis:

Gladu presented that he had very little understanding of any production systems, as his expertise was not in this area.

7. Do you support federal government involvement on the development of Inuit businesses in the Arctic?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Analysis:

All participants strongly agreed. All stated that this is a given due to the present funding structure for First Nations.

8. Do you feel that the Canadian chartered banks support the development of Inuit businesses by offering start-up financing?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
N/A	No	N/A	N/A	N/A	Yes	N/A	No

Analysis:

There was a limited understanding by the participants and many had never given this any thought. Gladu was asked to elaborate on his response during the interview. Glover and Drerup would also be asked during the interview to elaborate on this answer.

9. Do you believe there is a place for Inuit tradition values in the changing Arctic?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Analysis:

All participants strongly agreed.

10. Do you sense that traditional values are being lost in Inuit culture?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Analysis:

All participants strongly agreed.

11. Do you feel that self-government and self-sufficiency for the Inuit could occur through the development of Inuit small business?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Analysis:

All participants strongly agreed.

12. Do you perceive that today there is adequate training and educational bodies in the Arctic in order to prepare Inuit workers for the changing economic environment of the North?

Twaites	Glover	Macleod	Pugh	Secondcost	Gladu	Baker	Drerup
No	No	No	No	No	Yes	No	No

Analysis:

Gladu believed that there is the opportunity of training in the North. He would be asked to elaborate further during the interview.

4.3 Summary of Analysis

The questionnaire identified that the experts selected were aware or very aware of the Inuit housing crisis in the Canada. From their answers it was felt the study could continue with the selected participants. Amongst the participants there was a general feeling of concern with the Inuit culture and the fact that traditional values could be lost. There was overall agreement that the development of northern businesses could be an important component in Inuit self-sufficiency. However as to what the participants felt what needed to be solved first, there was an equal split between sustainability and governance.

The selected responses did not always relate to the area of expertise by the participant. Most of the participants were aware of research being conducted around energy efficient housing. Surprisingly Baker as an expert in high performance insulating glass, who is involved in the development of energy efficient fenestration systems, was not aware of northern housing research. This may point to the fact that the North American window and door industry is generally not participating in, or aware of, Arctic housing research.

All participants felt that energy efficient fenestration products were important for energy efficient housing. All but one participant believed that there was a possibility for northern production of fenestration systems. However, all participants felt that it was important that the federal government be involved in the development of northern business.

In regards to chartered banks offering start-up financing, many of the participants could not offer comment. Two participant's results indicated they didn't feel that the banks supported start-up financing. One participant stated banks did support financing and the interview then delved further into this issue.

The questionnaire identified that all selected participants had knowledge in the area of study and could contribute to present suggestions.

4.4 Interview Introduction

After the introductory presentation each participant felt inspired to start the dialog. All participants appeared to share a real passion in regards to the subject matter.

The researcher performed a quick analysis of each questionnaire allowing for focused dialog in the area of the participant's expertise. The questionnaire identified any categories that a participant did not want to comment on because of lack of understanding. Generally, however most participants were prepared to be able to add to the discussion in all theme areas.

Prior to proceeding with the interview participants were informed that an audio recording was to take place, and these tapes are available for review. Participants had a tendency to delve into other subject matter, based on a personal or professional interests, however the interview questions assisted in keeping the focus on the subject matter of the research.

Dialogue generally ranged from 45 minutes to one hour. Face-to-face interviews stayed focused, while conference call interviews were more difficult to manage in terms of time and remaining focused on the subject matter.

After the dialogue participants were asked to present their 'Top 10' suggestions. The researcher assisted in focusing the responses, and suggestions were voiced within 10 to 15 minutes. The researcher wrote down the suggestions on data sheets. The participants "Top 10" suggestions were then read back to the participant to ensure clarity had been captured on the content.

4.5 Interviews

Each participant interviewed is identified with the following information: background statement, summary of any open dialog comments that were thought to be notable, and a list of individual suggestions (listed as stated). Following that, there is a critical analysis grouped into the three themed areas.

4.5.1 STEPHEN THWAITES

Background

Thwaites is Principle of Thermotech Fiberglass Inc., developer and manufacturer of high-performance, energy efficient fenestration systems. He has produced window systems for commercial applications in the Canadian Arctic and is a fenestration consultant for Enbridge, Saving by Design Charrettes, helping companies to reduce operating cost through energy efficient fenestration systems.

Dialog

Presently Thwaites is not aware of any of any new Arctic housing development and feels it is long. He strongly feels that another southern window solution will not work in the North. He also sees that a fenestration system is an integral piece to the development of a passive house.

Suggestions

1. A robust Arctic specific window designed that is simple in construction with minimal components. Recommend an inswing fenestration system using compression weather seals to decrease exterior air infiltration.
2. Arctic specific building components designed around the specific climatic conditions of the North. Because of the desert climate there is no need for moisture barriers as required in southern Canadian windows.
3. Appropriate lineal materials for frames and sash plus use of suitable Insulated Glass Units that allow for year round exterior storage. Materials can be processed immediately from storage.
4. Winter fenestration production could be in a heated facility of less than 1000 square feet.
5. Production systems developed around the fenestration design and the Inuit work habits.
6. Production workers trained through a skilled mentoring program. Managers knowledgeable in all production processes and must be able to teach the skills needed for each stage of manufacturing.
7. Due to seasonal distribution, lineal and glass having properties allowing for Arctic outdoor storage life for many years. Yearly air transport hardware, adhesives, seals, and sealants due to their small size and weight.

8. Through using a simple hand assembly production process less energy than a typical automated vinyl window production system which uses hot plate welding and high energy expending robotic machinery.
9. Use of standardization of window sizes and styles. This would allow for local sealed unit production and repair from standardized cut-glass sizes.
10. Costs of an Arctic appropriate window would be close to the cost of a non-appropriate southern volume produced that would require the higher costs of northern distribution.

Analysis on Sustainability

- Currently southern produced windows are not giving the thermal performance or product lifespan needed for the Arctic. Due to the high cost of distribution, the windows are not being repaired with appropriate materials. The discussion with Thwaites identified that the window must be thought of as a full assembly. You can't just look at one element; you need to take a holistic approach that considers the economic, social, cultural, and environmental elements.
- Development of a specific window system for the Arctic and public housing should have simple minimal component construction for ease of assembly and less materials to inventory: and an inswing window system that uses compression weather seals to decrease exterior air infiltration, similar to a casement operator with simpler components. There is a need for less dependency on mechanical action of the hardware for closure.
- The window system must be constructed from specified materials to deal with the extreme cold such as pultruded fiberglass profile with low thermo coefficient of expansion.
- A lineal co-efficient of expansion and contraction is required to allow for year-round exterior storage.

Analysis on Governance

- The principle of standardization for the fenestration design, and the different components of the system, is required. The First Nation sustainable development standard expresses the same ideas, which are more related to the house, but could relate to fenestration products. These ideas include:
 - Defining and understanding cost-effective housing (fenestration),
 - Choosing and integrating design standards and specifications,
 - Constructing code standards and regulations,
 - Standards for regulating construction (manufacturing),
 - Standards for inspecting, and

- Standards for maintenance.

Analysis on Self-reliance

- Small volume production of fenestration products during winter months is feasible because of the traditional activities of hunting and fishing slowing down. Workers are then available during that time period.
- There is a need to explore the options for constructing prefabrication-building components in the winter season in unused community facilities.
- A full window production could be done in an area of approximately 1000 square feet, utilizing hand assembly processes to produce 600 to 1000 units in a four-month period.
- Window production workers are typically trained through a mentoring process. In most cases a skilled, knowledge manager in all areas of window manufacturing could train the workers in a day or less. The jobs developed do not require specialized qualifications.

4.5.2 CHARLES PUGH

Background

Pugh is presently the Manager Community Development, Technical, Nunavut Housing Corporation. He has worked throughout the Arctic and presently works in a smaller Inuit community of Cape Dorset, Baffin District, Nunavut where the housing crisis is a major issue within the community.

Dialog

The population in Cape Dorset is estimated to be around 1150, where 93 percent are Inuit. Presently there are about 250 public housing units, which are managed and maintained by the Nunavut Housing Corporation. Government assistance programs are required for the Inuit to survive due to the high rate of unemployment.

Suggestions

1. A focus is needed to put people to work.
2. Specific fenestration system design for the northern people.
3. There would be a need for local people to participate to the development of a fenestration business.

4. Canadian sovereignty of our northern lands is through the Inuit. Their pride and ownership is important and this can be improved through work, giving them a better life, a life closer to the one they see in southern media.
5. Develop trusting relationships with government and business people.
6. Work that allows Inuit to remain true to their traditional values.
7. To keep people working higher product cost would be justified. Currently the cost of subsidies to support the people would be better spent on keeping the people working.
8. Require federal government support to push new business forward.

Analysis on Sustainability

- There needs to be development of a northern specific window system that is designed specifically for the Inuit and their climatic and social requirements.

Analysis on Governance

- The Federal Government needs to implement programs that foster cooperative approaches that would develop trusting relationships between the Inuit, governments and business people.
- To develop a northern fenestration system, strategies would need to be put in place that allows for the Inuit to partner and participate with private sector businesses.
- A northern produced window system with a higher product cost could be justified if you are providing employment for the Inuit. Current subsidies that are allocated to support the Inuit could be better spent on creating work, and developing businesses to allow the Inuit to work.

Analysis on Self- reliance

- Businesses and government need to be supportive of a mixed economy, therefore allowing for flexible work scheduling so that the Inuit can practise their traditional values of hunting and fishing.
- Pride through ownership by implementing work programs will lead to the Inuit obtaining their own homes and moving away from public housing.

4.5.3 WAYNE SECONDCOST

Background

Secondcost presently is the Manager, Community Development, Maintenance, Nunavut Housing Corporation. He is responsible for the maintenance of Cape Dorset public housing units. He has personal experience working and dealing with Inuit housing crisis within defined yearly budgets.

Dialog

He attempts to bring a quality home life to the Inuit within an over strained infrastructure. Secondcost personally sees the effects in shortages in housing on the Inuit people. He sees the frustration of Inuit leading to outburst of anger and damage to their residence.

Suggestions

1. To have a northern small volume fenestration system it must be cost effective.
2. First there needs to be money to allow for the construction of new Inuit housing.
Overcrowding is the major problem.
3. Do to the high cost of maintenance there is a need for a more a durable fenestration system.
The most expensive maintenance cost is for glass replacement.
4. There is a need for a specific Inuit fenestration product, but there is a concern on how much it would cost to develop.
5. Due to the high electrical cost Inuit homeowners do not use air ventilation systems, opening windows for exterior air circulation, windows then freeze open causing cold air infiltration. There is no concern by the Inuit for cold air infiltration because they do not pay for heating fuel. Nunavut Corporation pays for these heating costs out of their yearly budget. There is a need for energy efficient house considering all the issues around the Inuit social milieu.
6. Use local materials for the construction of northern housing.
7. There needs to be a way to put the local population to work.
8. Unavailability of insulating glass units due to their high cost of being imported and limited period for distribution causes long periods where the windows are not functioning properly. There is a need for northern high performance insulating glass unit production.

Analysis on Sustainability

- There is the need for the development of a fenestration system specifically for the Inuit that meets the present public housing and retrofit market requirements.

- Development of well-designed Arctic-appropriate fenestration systems with higher energy performance can reduce heating costs.
- A specific northern fenestration system would be made-up of minimal components allowing for simple assembly with fewer components to maintain and inventory.
- Insulated glass units are expensive in the North due to high cost of distribution of southern manufactured products. Because of the once-a-year delivery damaged glass units are not maintained for long periods. These delays cause increases operational costs because the damaged units have poor energy performance. Insulated glass units are often replaced with poor thermal performance units, causing a strain on the heating systems resulting in higher operational cost.
- There is a need of insulated glass production in the North. Small volume production systems exist that can produce high quality insulated glass units. A business case is needed to evaluate this opportunity.

Analysis on Governance

- Standardization of a northern fenestration system will reduce distribution cost, aid in maintenance and energy efficient systems.
- There is a requirement for long-term thinking. Current government budgets are based on:
 - Yearly spending that just keeps the existing infrastructure working, and
 - Development of appropriate northern fenestration systems that requires long-term thinking approaches that recognize the potential cost reduction of energy efficiency and decreased maintenance.
- Government needs to be in support of energy efficiency systems as it is the government that is paying for fuel cost for Inuit public housing. The Inuit are not responsible for heating fuel.

Analysis on Self-reliance

- Energy efficient housing design must be based on the social milieu of the Inuit.

4.5.4 MICHAEL GLOVER

Background

As a trained architect Glover has always been interested in fenestration. He has extensive experience in northern housing both in private and public sector. He is known in the window industry as the guru of insulating glass technology. Glover is the founder and developer of Super Spacer produced by Edgetech IG, known as one of the best warm edge spacers in the world.

Dialog

As a member of teams who have worked on northern housing in the 70's and 80's Glover voiced concern that the housing crisis has always been a sociological problem. There have been many different solutions over the last 30 plus years to develop an Arctic energy efficient housing, which have not moved forward because of lack of public sector support.

Suggestions

1. There is a need for better northern housing design. Building envelope panel technology must be developed for new and existing buildings possibly giving the walls an R-value of 100.
2. Northern Fenestration production cannot be alone; there is also the need for wall panel and wall systems production, all which could be manufactured in the same factory during the winter months.
3. Standardized of a fenestration system allowing for northern window assembly and insulating glass production.
4. There is the need for robust window system to deal with the harsh environment.
5. Housing components built by the Inuit developing a sense of pride, which leads to economic development and inspiration to be trained.
6. An appropriate northern fenestration design that takes in account the sociological and climatic conditions of the Arctic.
7. Use of solar control systems that are part of the overall window design.
8. Government support to setup the overall infrastructure like subsidizing and training workers, assisting in distribution, etc.
9. For a fenestration system developed for the North there is a requirement for upfront cash flow. Increase subsidies to housing authorities through public sector investment.

10. Need to decrease the high cost of shipping finished goods through the development of a northern housing, which allows components to be manufactured and assembled by the Inuit.

Analysis on Sustainability

- An entire building infrastructure of better northern housing that is energy efficient needs to be developed. This system should also be used to upgrade the energy efficiency of existing building envelopes.
- Fenestration systems development must run parallel the development of the energy efficient building envelope.
- Insulating wall panel technology is a vital component to the future well-insulated building envelope.
- There is a need for technologically advanced energy efficient fenestration systems that are solely designed around climatic and societal conditions of the North.
- The use of solar control systems will lead to better quality of life for the Inuit through control of light transmission and summer solar gain.
- Winter component manufacturing does not have to be a stand-alone production system involving solely making fenestration products. Other component like wall panels could be produced in the same facility.
- Fenestration components like pultruded fiberglass profile and standard insulated glass units can be transported once a year, inventoried outside, and then brought in for winter assembly. Finished assembled windows can be stored outside waiting to be installed during the summer months.

Analysis on Governance

- Through public and private support, the development of a standardized northern fenestration system will:
 - Reduce the distribution costs through uniform sizing and packaging,
 - Allow for better inventory control due to less components to be stored and purchased,
 - Require less production training of workers because of a repetitive, familiar assembly process, and
 - Result in familiar window installation into the building envelope resulting in less preparation needed to the structure of the house.

- There needs to be private sector involvement in management and development of a northern fenestration business. To initiate private sector involvement there has to be an increase in subsidies for public sector involvement to encourage and support the long-term northern development.
- The Federal Government cannot be considered only as a bank that distributes funding. It needs to support the setting-up of an infrastructure for:
 - Assisting in developing of cost-effective distribution channels,
 - Developing training and education programs for workers and homeowners,
 - Encouraging home ownership through programs that parallel employment and long-term homeownership loans, and
 - Providing economic assistance for the development of northern-specific components.

Analysis on Self-reliance

- The design and development of a robust fenestration system must survive in the harsh environment of public housing. Any design has to consider the sociocultural impacts of the Inuit living in public housing.
- Flexible production scheduling considering a mixed economy and the Inuit pursuit of their traditional values.

4.5.5 TIM MACLEOD

Background

Trained as a skilled tradesperson Macleod has had years of experience working in the northern construction industry. He has considerable experience in the development, design and construction of Arctic housing. Macleod has worked in both public and private sector agencies in the development of Arctic housing. Presently he is managing both residential and commercial properties in the Arctic.

Dialog

Macleod has been working for years to find an appropriate solution to the northern fenestration problem, so far nothing works. He states that 95 percent of the Inuit in Iqaluit live in public housing. For a fenestration system to work in public housing it must be twice as tough as the existing systems.

Suggestions

1. Nothing works now in both windows and doors. There is the need for a fully designed fenestration system for the Arctic and Inuit.
2. Durability of the fenestration system is the key issue. Southern produced windows don't last.
3. For northern fenestration production to work there is a need for a system that meets to the time wishes of the Inuit workers. Flexibility in which days Inuit want to work and the number of days of the week they will work. Need to train 20 workers for 5 positions.
4. Durability most heat loss is due to windows not closing because of ripped weather seals and broken window hardware.
5. Private sector involvement for a fenestration system, there has to be a business case. Public sector support would be through training and startup costs.
6. Issue with smaller Inuit communities not large enough to produce their own windows and high cost of distributing the window from larger communities is increase because the need to transport by air.
7. Appropriate window component materials allowing for year round external storage.
8. Development of solar gain system to control internal overheating in fall and summer. There is a need for solar shading systems.
9. Development of an inswing windows due to moisture build up on the outside face of the window causing existing casement windows to fail and not open or close properly.

Analysis on Sustainability

- The analysis stated that there is a need for a fully designed fenestration system for the Arctic and Inuit.
- Research on homes has demonstrated that the use advanced fenestration technology can provide substantial energy benefits to the building.
- Solar gain should be managed through blinds and solar control Low-e. These systems have to take into account the seasonal patterns of the Arctic.
- Use of higher performing insulated glass units gives better R-values in the winter months.
- The use of northern specified component materials, like pultruded fiberglass profiles are simple to fabricate. Materials like pultruded fiberglass can be stored outside and are not affected by the cold temperatures because of having a lower thermal co-efficient of expansion and contraction. Vinyl profiles are a common window frame material that become very brittle in the cold and break easily therefore cannot be stored outside in the winter.

- Air infiltration is an issue in the Arctic; a passive home requires airtightness. Window hardware that does not allow for proper closure causes air leakage around the perimeter edge of the window sash. Existing hardware is not designed for the northern climatic conditions. An inswing window would allow for proper closure due to interior compression along with a simple cam locking system. Existing inswing systems, like turn and tilt are too expensive and require a very stable structure.

Analysis on Governance

- Private sector involvement requires a good business case. Inuit communities are ready to partner with corporations who can help develop these business opportunities. The business case has to be specific to the Arctic and Inuit. It cannot be based on a southern business model.
- There is a need for public sector support through initiating programs for upfront development cost and support for training programs. Publicly supported bodies such as Economic Development Corporations could administer these funds. It is essential that Inuit have capital funds to support new businesses.
- Isolated smaller communities have components flown in making it difficult to transport finished insulating glass units because of increase pressure differential.

Analysis on Self-reliance

- Developing a durable fenestration system that can meet to the harsh environment of public housing will lead to better energy efficiency because windows are functioning as designed.
- A northern fenestration production system must adhere to the time wishes of the Inuit workers, in regards to the number of days to work. There has to be an understanding of the Inuit mixed economic approach of the pursuit of traditional practices of hunting and fishing combined with salaried work. Managers must be trained and understand the Inuit culture, and traditional values.
- Broken glass is an issue in public housing maintenance. Replacement of insulated glass units is a constant pressure in public housing.
- Programs must be developed to allow the Inuit to own their own homes. This would give them both a pride of ownership, and a feeling of self-sufficiency.

4.5.6 JP GLADU

Background

Gladu is presently the President and CEO for the Canadian Council for Aboriginal Business, an organization that bridges the gap between mainstream corporate sector and the Aboriginal community. His organization works toward the improvement of economic self-reliance for Aboriginal communities.

Dialog

Mr. Gladu sees that trust has been fractured within this country; people need to engage to build trust. The housing crisis is an opportunity for this engagement to take place and move the participants out of their silo's, cooperating together to solve this problem.

Suggestions

1. For a fenestration production to work in the Arctic it has to make economic sense.
2. For northern businesses to be developed they need to be driven by the Inuit with corporate partnerships. Government's role is to empower business development.
3. Government must be the catalyst of change and must think beyond the present day policies of funding in one-year cycles.
4. Developing relationships, the rebuilding of trust between government and Inuit communities is vital to the success of any northern business.
5. Find ways to build self-worth by empowering the Inuit through development of business will bring long-term health to the northern community.
6. Lenders need to lower their value expectations, seeing their return on investment in 20 to 30 years.
7. To develop a northern fenestration business all the participants need to be around the table including the lenders. There needs to be a holistic approach.
8. There is a need for initiatives to be put in place to allow for Inuit ownership of businesses and housing. Pride of ownership will have a positive lasting result on the Inuit community.
9. Inuit Economic development corporations will drive businesses and be true to the communities' value sets. These corporations must have the funding resources to move new projects forward.

Analysis on Sustainability

- Mr. Gladu had no comments in this theme area.

Analysis on Governance

- For northern businesses to be developed they need to be driven by the Inuit with corporate partnerships. There needs to be a holistic approach.
- All the stakeholders need to be able to participate in the development process. Through this process all the stakeholders benefit.
- In developing multi-sectorial partnerships you use the knowledge and expertise of many and take these groups out of their silos to work together.
- Government's role is to empower business development. Government is the catalyst for change and it has to set new policies.
- Both government and business, lowering their value expectation and seeing the return-on-investment in 20 to 30 years, need longer-term thinking.
- Remove the obstacles for growth. First there has to be access to financing. Currently personal saving is used to finance northern business. If there is no work then there are no savings.
- Developing relationships, the rebuilding of trust between Inuit communities and government. Programs like the Canada Mortgage and Housing Corporation design charrettes demonstrated how partnerships could work, but the suggestions that came out of these charrettes needs to be implemented.

Analysis on Self-reliance

- Initiatives need to be put in place to allow for Inuit ownership of businesses and housing.
- Empowering the Inuit will give them a feeling of self-worth through the development of Inuit businesses.
- Inuit Economic Development Corporations will drive businesses and be true to the communities' value sets. These corporations must have the funding resources to move new projects forward.

4.5.7 JEFF BAKER

Background

Baker is a leader in the energy analysis of fenestration systems, specializing in the Insulated glass units and glass. Presently he is the Chair of the National Fenestration Council (NFRC), Vice-chair of the Canadian Association (CSA) A-440 on window performance, and Vice-chair North American task force on harmonizing United States and Canadian window energy standards.

Dialog

Mr. Baker specializes in the performance of the insulating glass unit (IG). He feels that the technological advances in IG would have the major effect on energy performance of the window assembly.

Suggestions

1. There is a need for an optimized insulating glass unit and glass design developed that meets to the extreme temperatures of the Arctic. Temperatures range from -40°C to $+20^{\circ}\text{C}$, compared to the southern temperature ranges of -20°C to $+20^{\circ}\text{C}$.
2. Build insulating glass units with a life span of 20 years. The initial higher unit cost will pay-off over the long term do to decreasing the requirement to replace lower quality insulated glass unit as often.
3. There should be insulation glass production in the North because of shipping issues with transporting at higher elevations from the mean sea level causing pressure differences within the air space of the insulating glass that cause unit failure due to air leakage.
4. Using spacer bar systems that allow for small shop production that uses hand tools and spacer bar is backed with hand applicator sealants.
5. The need for standardization of the entire window assembly. For the Arctic it makes sense because simpler to manufacturing, maintenance, inventory and distribution.
6. There is no pride of ownership presently because the Inuit have no ties to the product.
7. Use of appropriate materials that are specified for the northern elements and forceful use.
8. The fenestration system designed around maintenance. There is no insulated glass unit being produced that are durable enough and can resist the abuse giving in the North (Only security gazing could work but you give up thermal performance). Window system should be designed to facilitate simple replacement of insulating glass units and use of high thermal performing insulating glass.

9. Not appropriate window styles presently being used. European turn and tilt would be more appropriate but expensive and difficult to maintain.

Analysis on Sustainability

- There must be an optimized insulating glass unit developed that meets to the extreme temperatures of the Arctic. Presently insulating products are not designed for the thermal performance demanded in the North. Fenestration products must have a longer life span of 20 years this will decrease the current need to replace failed lower quality insulated glass units.
- The fenestration system should be designed around ease of component replacement for simplified maintenance enabling the repaired window to have optimal thermal performance.
- The use of a higher performance insulating glass unit as a major component to the window benefits by reducing heat loss and utilizing solar gains.

Analysis on Governance

- Standardization of the entire system including the IG would have consequences in reducing costs in distribution, inventory, maintenance, and would also assist in manufacturing because glass could be cut to size in the south and transported in smaller sizes.
- The North American insulating glass industry is for larger southern markets and is producing cost-effective products that meet to environmental and technological requirements of that market. However the window industry is not aware of the unique requirements of the Arctic both socially and environmentally. This could be an interesting focus for a southern fenestration business, and a good testing ground for high-performance fenestration systems.

Analysis on Self-reliance

- The Inuit have no ties to the public housing unit they reside in. It is but a residence in an overcrowded space. The development of businesses and employment will allow individuals to finance and then purchase their own homes, which would lead to a pride of ownership.
- Use of appropriate spacer and glass technology that allows for simple hand assembly of units using standard cut to size glass. Training would be minimal for these small shop production systems.
- Housing components have to be durable. Issues like overcrowding in public housing put strains on any system. Materials and processes have to be specified for the northern environment and use in public housing.

4.5.8 OLIVER DRERUP

Background

Drerup has been involved with the R2000 Project since its inception. He held the position of Coordinator of Technology for the Canadian Homebuilders Association from 1987-1990. A sought after lecturer, public speaker and facilitator, Oliver was one of the founders to Kott Group in the development of the Structural Insulated Panels (SIPs) for the walls, floor and roof assemblies for the Nunavut Housing Corporation.

Dialog

Drerup feels that for Canada to keep its sovereignty in the arctic there has to be long-term strategies to support the Inuit.

Suggestions

1. The Arctic cannot supply its own needs therefore it must be supplied. Relationships must be structured around an acquisition process and has to be cooperative with all participants.
2. The parties need to work with in the principle of 'Indemnification for Doing'. People should try to make the North better for the Inuit but insured what they are doing is good and seen that the effort is in the best interest of the Inuit.
3. The standards for any component in the North have to be very high. Nothing in the Arctic is useful, unless it is designed for the North.
4. The 'Tyranny of Choice', having multiple products and systems available will not work in the North. One focus product is required and it cannot be chosen based on cost.
5. One company has to take on the challenge, developing a product for the North that utilizing the technological advances and then supplying the components to the North for assembly and maintenance.
6. There has to be longer term planning, payback, and investment, with the development of an Arctic supply chain.
7. Request for Proposal (RFP) has to be by the participants of the project and developed cooperatively. Example of how the Nunavut Housing Corporation initiated the RFP for northern housing, not based on a federal government template.
8. From the start there has to be a cooperative approach of all participating parties.
9. The technology is available, it's not the issue; it is the implementation of this technology.

Analysis on Sustainability

- The technology is available to develop an energy efficient fenestration system. It is how to implement this technology that demands cooperative approaches.

Analysis on Governance

- The northern present and future economic opportunities will be based on the natural resource exploration and production. Presently the Inuit cannot supply their own needs. They have to be supplied with goods from southern Canada. The private sector must recognize that there has to be a cooperative process with the Inuit in regards to this acquisition. There needs to be approaches for the development of relationships between the participants.
- The standardization of building components. Oliver stated it well with, 'The Tyranny of Choice.' The multitude of products and systems available does not work in the North; cost will increase to maintain multiple systems. There must be focus on one fenestration system that meets the Inuit and Arctic needs. The standards for that fenestration system must be high to deal with the harsh use and environment.
- The adoption of long-term thinking. The northern time frame is different. Businesses, government, investors must be conscious of the fact that there needs to be time frames set in years not in months.
- The Federal Government role must move to be more of an enabler, developing partnerships rather than administering funding based on its yearly targets.

Analysis on Self-reliance

- Assembly of a window system can occur in the Arctic. Because of the technological complexity of developing an energy efficient system it would require one company to take on the challenge. There would have to be ways to make this system economically viable for that company.

4.6 Categorization of Suggestions

In the first stage of this analysis the participant’s suggestions were reviewed and then collated into the three theme areas: sustainability, public and private sector governance and self-reliance. Upon analysis of the chart data, links were observed between the different themed areas by individual analyzed suggestions, implying multi-sectorial connections.

Data was then reviewed to determine the links and similarities to the participant’s responses. Often within one of the participants suggestion the material would cover two or more of the theme groupings. The researcher then would rate the material into the theme areas as ‘primary suggestions’, identified with a check mark and ‘secondary suggestions’ with a circle. Linkages would be represented with a curve line.

Within the self-reliance theme area there emerged a consistent suggestion that was focused on fenestration production systems and Inuit working in manufacturing. A sub grouping to self-reliance was established in the data sheets identified for the purpose of this analysis categorized as ‘P’ for production.

Eight charts were developed based on theme grouping. There was no assignment of participant’s names.

Legend:

S – Sustainability **G** – Governance **SR** – Self-reliance **P** – Production

Suggestions: Participant A	S	G	SR	P
Suggestion 1 - A robust Arctic specific window designed that is simple in construction with minimal components. Recommend an inswing fenestration system using compression weather seals to decrease exterior air infiltration.	✓		○	
Suggestion 2 - Arctic specific building components designed around the specific climatic conditions of the North. Because of the desert climate there is no need for moisture barriers as required in the south.	✓			

Suggestion 3 - Appropriate lineal materials for frames and sash plus use of suitable Insulated Glass Units that allow for year round exterior storage. Materials can be processed immediately from storage.	✓			
Suggestion 4 - Winter fenestration production could be in a heated facility of less than 1000 square feet.			○ ☺	✓
Suggestion 5 - Production systems developed around the fenestration design and the Inuit work habits.			○ ☺	✓
Suggestion 6 - Production workers trained through a skilled mentoring program. Manager/s knowledgeable in all production processes and must be able to teach the skills needed for each stage of manufacturing.			○ ☺	✓
Suggestion 7 - Due to seasonal distribution, lineal and glass having properties allowing for Arctic outdoor storage life for many years. Yearly air transport Hardware, adhesives, seals, and sealants do to their small size and weight.	✓ ☺	○		
Suggestion 8 - Through using a Simple hand assembly production process less of an energy than a typical automated vinyl window production system.			○ ☺	✓
Suggestion 9 - Use of standardization of window sizes and styles. This would allow for local sealed unit production and repair from standardized cut-glass sizes.		✓		
Suggestion 10 - Costs of an Arctic appropriate window would be close to the cost of a non-appropriate southern volume produced that would require the higher costs of northern distribution.	✓ ☺	○		

Figure 4. Categorization of Suggestions: Participant A

Suggestions: Participant B	S	G	SR	P
Suggestion 1 - The Arctic cannot supply it own needs therefore it must be supplied. Relationships must be structured around an acquisition process and has to be cooperative with all participants.		✓		
Suggestion 2 - The parties need to work with in the principle 'Indemnification for Doing'. People should try to make the North better for the Inuit but insured what they are doing is good and seen as the effort	✓	✓	✓	✓

is in the best interest of the Inuit.				
Suggestion 3 - The standards for any component in the North have to be very high. Nothing in the Arctic is useful, unless it is designed for the north.		✓		
Suggestion 4 - The Tyranny of Choice, have multiple products and systems available will not work in the North, it is lost. One focus product is required and it cannot be chosen based on cost.		✓		
Suggestion 5 - One Company has to take on the challenge, developing a product for the North in the utilizing the technological advances and then supplying the components to the North for assembly and maintenance.		✓		
Suggestion 6 - Longer term planning, payback, investment, supply chain development, etc.		✓		
Suggestion 7 - Development of Request for Proposal (RFP) has to be by the participants of the project and developed cooperatively. Example of how the Nunavut Housing Corporation initiated the RFP for northern housing not based on a federal government template.		✓		
Suggestion 8 - From the start there has to be a cooperative approach of all participating parties.	✓	✓	✓	✓
Suggestion 9 - The technology is available, is not the issue; it is the implementation of this technology.		✓		
Suggestion 10 – Federal Governments role must change to enable the development of partnerships between all sectors and participants. Government cannot be a bank, administrating the distribution of funds.		✓		

Figure 5. Categorization of Suggestions: Participant B

Suggestions: Participant C	S	G	SR	P
Suggestion 1 - There is a need for better northern housing design. Building envelope Panel technology must be developed for new and existing buildings possibly giving the walls close to an R-value of 100.	✓			

Suggestion 2 - Northern Fenestration production cannot be alone, there is also the need for panel and wall systems production, all which could be manufactured in a factory during the winter months.	✓			✓
Suggestion 3 - Standardized Fenestration design allowing for northern window assembly and insulating glass.		✓		
Suggestion 4 - Robust window system.	✓		○	
Suggestion 5 - Housing components built by the Inuit developing a sense of pride, which leads to economic development and inspiration to be trained.			✓	○
Suggestion 6 - An appropriate northern fenestration design that takes in account the sociological and climatic conditions of the Arctic.			✓	
Suggestion 7 - Use of solar control systems that are part of the overall window design.	✓			
Suggestion 8 - Government support to setup the overall infrastructure like subsidizing and training workers, assisting in distribution, etc.		✓		
Suggestion 9 - For a fenestration system developed there is the requirement for upfront cash flow. Increase subsidies to housing authorities through public sector investment.		✓		
Suggestion 10 - Need to decrease the high cost of shipping finished goods through the development of a northern housing to which components are developed, manufactured and assembled by the Inuit.	✓	✓	✓	

Figure 6. Categorization of Suggestions: Participant C

Suggestions: Participant D	S	G	SR	P
Suggestion 1 - To have a northern small volume fenestration system it must be cost effective.	✓			
Suggestion 2 - First there needs to be money to allow for the construction of new Inuit housing. Overcrowding is the major problem.		✓	○	
Suggestion 3 - Do to the high cost of maintenance there is a need for a more a durable fenestration system. The most expensive maintenance cost is glass replacement.	✓		○	

Suggestion 4 - There is a need for a specific Inuit fenestration product, but concerned with the cost of development.	✓	○		
Suggestion 5 - Due to the high electrical cost Inuit homeowners do not use air ventilation systems, opening windows for exterior air circulation, windows then freeze open causing cold air infiltration. There is no concern by the Inuit for old air infiltration because they do not pay for heating fuel. Nunavut Corporation pays for these heating costs out of their yearly budget. There is a need for energy efficient house considering all the issues around the Inuit social milieu.	✓	○		
Suggestion 6 - Use local materials for the construction of northern housing.		○		
Suggestion 7 - There needs to be a way to put the local population to work.			✓	○
Suggestion 8 - Unavailability of insulating glass units do to their high cost of being imported and limited period for distribution causes long periods where the window is not functioning properly. There is a need for northern high performance insulating glass unit production.	✓	○		

Figure 7. Categorization of Suggestions: Participant D

Suggestions: Participant E	S	G	SR	P
Suggestion 1 - A focus need to put people to work.			✓	
Suggestion 2 - Specific fenestration system design for the northern people	✓		○	
Suggestion 3 - There would be a need for local people to participate to the development of a fenestration business.			✓	
Suggestion 4 - Canadian sovereignty of our northern lands is through the Inuit. Their pride and ownership is important and this can be improved through working giving them a better life, a life closer to the one they see through southern media.		○	✓	
Suggestion 5 - Develop trusting relationships with government and business people.		✓	✓	

Suggestion 6 - Work, allowing the Inuit remain true to traditional values.			✓	
Suggestion 7 - To keep people working can see that a higher product cost would be justified. Currently the cost of subsidies to support the people would be better spent on keeping the people working.		✓	✓	
Suggestion 8 - Require federal government support to push new business forward.		✓		

Figure 8. Categorization of Suggestions: Participant E

Suggestions: Participant F	S	G	SR	P
Suggestion 1 - Optimizing the Insulating Glass Unit and glass design to meet to the extreme temperature of the Arctic. Temperature range of -40°C to +20°C compared to the southern temperature ranges of -20°C to +20°C.	✓			
Suggestion 2 - Build IG units with a life span of 20 years, higher unit cost will pay off over the long run do to higher replacement cost in the North because of the use of shorter life span units.	✓	○		
Suggestion 3 - Insulation Glass Unit (IGU) production in the North because of shipping issues with transporting at different higher elevations from mean sea level causing pressure differences within the air space of the IG that cause unit failure do air leakage.	✓			○
Suggestion 4 - Using spacer bar that allow for small shop production, using hand tools, spacer backed with hand application sealants.	✓			○
Suggestion 5 - The need for standardization of the entire window assembly. For the Arctic it makes sense because simpler to manufacturing, maintenance, inventory and distribution.		✓		
Suggestion 6 - There is no pride of ownership presently because presently the Inuit have no ties to the product.			✓	
Suggestion 7 - Use of appropriate materials that are specified for the northern elements and forceful use.	✓			○

Suggestion 8 - There full system designed around maintenance. There is no IG units being produced that are durable enough and can resist the abuse giving in the North. (Only security gazing but you give up thermal performance). IG and window system should be designed to facilitate simple replacement of IG and assembly of a thermal performing IG.	✓		○	
Suggestion 9 - Not appropriate window styles presently being used. European turn and tilt would be more appropriate but expensive and difficult to maintain.	✓			

Figure 9. Categorization of Suggestions: Participant F

Suggestions: Participant G	S	G	SR	P
Suggestion 1 - For a fenestration production to work in the Arctic it has to make economic sense.		✓		
Suggestion 2 - For northern businesses to be developed they need to be driven by the Inuit with corporate partnerships. Government's role is to empower business development.		✓	✓	
Suggestion 3 - Government must be the catalyst of change and must think beyond the present day policies of funding in one-year cycles.		✓		
Suggestion 4 - Developing relationships, the rebuilding of trust between government and Inuit communities is vital to the success of any northern business.		✓	✓	
Suggestion 5 - Find ways to build self-worth by empowering the Inuit through development of business will bring long-term health to the northern community.			✓	
Suggestion 6 - Lenders need to lower their value expectations, seeing their return on investment in 20 to 30 years.		✓		
Suggestion 7 - To develop a northern fenestration business all the participants need to be around the table including the lenders. There needs to be a holistic approach.		✓	✓	
Suggestion 8 - Their needs to be initiatives put place to allow for Inuit ownership of businesses and housing. Pride of ownership will have a positive lasting result on the Inuit community.		✓	✓	

Suggestion 9 - Inuit Economic development corporations will drive businesses and be true to the communities' value sets. These corporations must have the funding resources to move new projects forward.		✓		
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Figure 10. Categorization of Suggestions: Participant G

Suggestions: Participant H	S	G	SR	P
Suggestion 1 - Nothing works now in both windows and doors. There is the need for a fully designed fenestration system for the Arctic.	✓		○	
Suggestion 2 - Durability of the fenestration system is the key issue. Southern produced windows don't last.	✓		○	
Suggestion 3 - For northern fenestration production to work there is a need for a system that meets to the time wishes of the Inuit workers. Flexibility in which days Inuit want to work and the number of days of the week they will work. Need to train 20 workers for 5 positions.		✓	✓	
Suggestion 4 - Durability most heat loss is due to windows not closing because of ripped weather seals and broken window hardware.	✓			
Suggestion 5 - Private sector involvement for a fenestration system, there has to be a business case. Public sector support would be through training and start-up costs.		✓		
Suggestion 6 - Issue with smaller Inuit communities not large enough to produce their own windows and high cost of distributing the window from larger communities is high because the need to transport by air.		✓	○	
Suggestion 7 - Appropriate window component materials allowing for year round external storage.	✓			✓
Suggestion 8 - Development Solar Gain control system to control internal overheating in fall and summer. There is a need for solar shading systems in summer for light and solar gain control.	✓		○	
Suggestion 9 - Development of a inswing windows due to moisture build up causing existing casement windows to fail and not open.	✓			
Suggestion 10 - Simplicity in maintenance, Insulated glass unit must be replaced from the inside with simple and durable placement system.	✓		○	

Figure 11. Categorization of Suggestions: Participant H

4.7 Analysis of Participant's Suggestions

After the data analysis of participant's suggestions and links, similarities in responses were detected. There were 76 suggestions presented by the eight participants. For primary suggestions there was a close balance in all the theme areas. There were 11 instances where more than one primary response was given to a suggestion. This demonstrated close to an equal balance of suggestions in the three theme areas. Participant suggestions then would support the importance of collaboration between the theme areas. The totals follow.

- Sustainability - 32 suggestions
- Governance - 27 suggestions
- Self-reliance - 28 suggestions

Secondary suggestions of self-reliance had the highest suggestions with 18 and governance with eight. Sustainability had zero secondary suggestions. This suggests that self-reliance is linked to the primary suggestions in the other theme areas. Governance also is relevant in the other theme areas. The importance of the linkages between the different theme areas was demonstrated through this analysis.

Figure 2 presents the Cooperative Approaches Diagram showing how sustainability and self-reliance are linked through technology and traditional values. This analysis demonstrated this with the largest linkage grouping of 17 linkages. The participants illustrated that these two theme areas are closely tied and that the product development is linked with the user.

The second highest linkage is under governance with self-reliance with 12 linkages: again close ties between these two theme areas. There were 9 linkages between sustainability and governance.

In conclusion this analysis demonstrated the important fact that all theme areas are linked together. The participants demonstrated that there are important linkages, first between sustainability and self-reliance, secondly between governance and self-reliance, and finally sustainability and governance.

4.8 Convergent Diagram

Once the participant's individually analyzed suggestions were compiled and placed into the theme areas patterns emerged that were similar to the Cooperative Approaches Diagram. Analyzed information aligned to the three areas of sustainability, governance, and self-reliance and it also supported the connections to the theme areas. Further analysis would support changes to the Cooperative Approach Diagram.

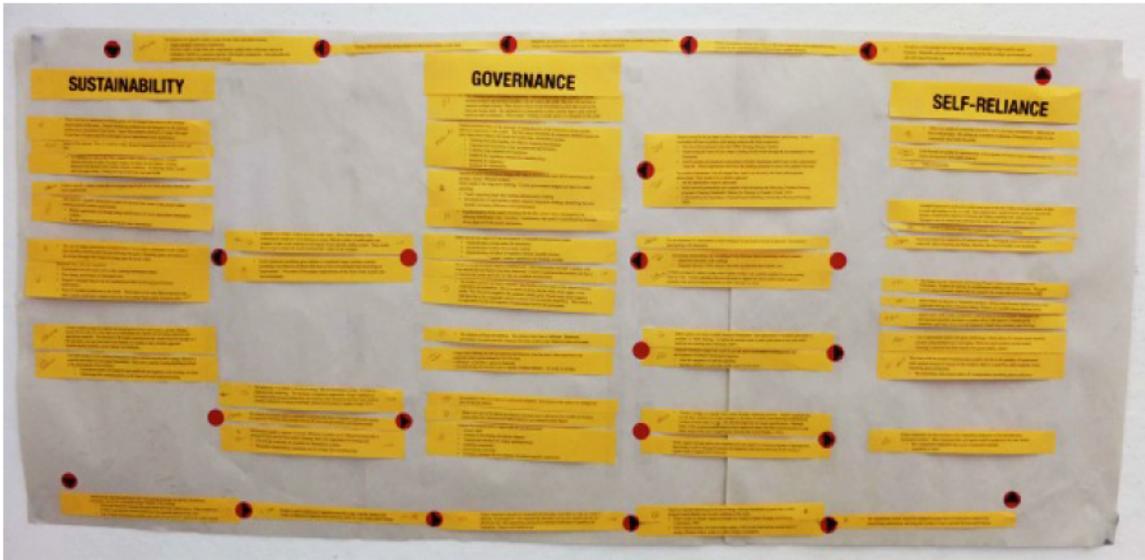


Figure 12. Collaborative Work Sheet A



Figure 13. Collaborative Work Sheet B

4.9 Analysis of Suggestions Converged

This section presents a series of 14 analysis findings across a wide range of topics. In every case they highlighted an important understanding gained from the discussions with the subject experts.

Arctic specific fenestration design

- An Arctic specific fenestration system must be energy efficient and must meet the sociocultural milieu of the Inuit. The system should be of simple construction, using a minimal number of components that can be assembled and maintained with a limited amount of equipment by individuals with limited training.

Fenestration system components

- The components required for the Arctic specific fenestration system are.
 - Higher performance insulated glass units,
 - Insulated glass unit replacement from the house interior using a durable glass positioning and clasp method,
 - Standard cut to size glass (no northern cutting of glass),
 - Solar gain control systems with appropriate Arctic Low-e coatings in the insulating glass unit and use of solar shading devices to allow for operator to control visible light transfer,
 - Airtightness through the development of an inswing fenestration system with a simplified operating hardware utilizing compression weather seals designed to eliminate air infiltration,
 - Robust window hardware to withstand harsh use, and
 - Components to be specified for longer product life cycle through the use of the durable framing, sealing and hardware components.

Window frame and profile material

- Frame and profile materials should have a low thermal coefficient of expansion.
- Fenestration production should be done by a simple lineal cut to the length system with a manual corner assembly. Transportation possibilities are once a year so there is a requirement for a year-round external storage of profiles, allowing the holding of inventory.

Design based on sociocultural factors

- The fenestration system developed for the Arctic must consider that most of the Inuit population presently live in public housing and the system must allow for ease of maintenance.
- Moisture control is achieved through ventilation by means of the operation of window hardware. Interior heat build due to solar gain creates a requirement for solar control to be a component of the fenestration assembly. This would also benefit the Inuit due to their unique seasonal patterns.
- As low-energy sustainable housing has to be developed to decrease the operating cost and lesson the impact on the northern environment, fenestrations systems development should parallel the development of the building envelope. This could be taken further by enabling Inuit communities to have winter production of fenestration systems and prefabricated insulating wall panels as well as allowing summer assembly of the house from these manufactured components.

Standardization of an Arctic fenestration system

- Currently there are too many options for window systems in the North. The standardization of an Arctic-appropriate fenestration system would decrease the number of products required, reducing the high cost of holding inventory, as well as costs for manufacturing, distribution and training. A competitive bidding process would be conducted on a standardized component production, expanding the market and potentially making the development of the product components more feasible.

Small volume fenestration system assembly

- Technologies are currently available to design and develop a standardized fenestration system that can be winter fabricated/assembled, and can meet Arctic market demands. These systems would use hand assembly with minimal equipment in both fixed and temporary facilities of 1000 square feet or less. With a mentoring process, employees would require less training on assembly and the finished products can be stored externally, opening up production space.

Mixed economy management approach

- Business managers must recognize Inuit traditional values when developing employment structures. With an understanding of the sociocultural milieu of the Inuit, management can develop production and work scheduling that account for inevitable delays due to Inuit

participating in their traditional activities. A more cooperative approach will provide employment to the Inuit and allow businesses to better plan production objectives.

Long-term thinking

- Value expectations are longer in the North. The public and private sector must recognize that the northern time frame to see a return on investment will not be in months but in years.
- However the importance of securing Canadian sovereignty of the North is through the Inuit.
- Providing access to long-term financing will help remove obstacles and allow for growth, which will help develop Inuit self-reliance.

Inuit pride through ownership

- Implementation of programs that provide for Inuit business development and home ownership will empower the Inuit and provide a feeling of self-worth. Corporations need to understand that working together to allow for development of Inuit businesses and building employment will have a mutual benefit of expanding markets and enabling the Inuit to purchase their own homes. An important outcome is the pride that would emerge.

Rebuilding of trust

- Governments need to foster these cooperative approaches to rebuild trust between Inuit communities, governments and business.

Federal government as an enabler

- Federal government can be the catalyst of change. Their support is needed in developing these partnerships by creating programs and services that bring these groups together. Rather than having government act as a bank, it should act as enabler: promoting private sector partnerships, assisting research, training workers and encouraging Inuit ownership. In short government needs to empower the private sector to allow northern business development.

Start-up funding

- Northern economic development corporations need to be start-up funding institutions. Access to capital by the Inuit should be administered via a sympathetic and culturally aware body.

Professional private sector management

- The role of an established window and door producer is to validate the economic feasibility for the development of fenestration system. Established window companies have the technological know-how to develop Arctic and Inuit-specific systems. A northern fenestration business should be started by a qualified private sector business with product and production knowledge as well as ensuring management has a sociocultural understanding of the Inuit in order to manage and train workers.

Holistic business approach

- Developing multi-sectorial strategies that involve all stakeholders is the approach required within the Arctic environment. Cooperative approaches in fenestration system development and implementation will lead to solutions that are holistic, and have a relationship to the entire northern housing crisis.

4.10 Limitations of Study

During the data collection it was important for the researcher to keep the participant directed on the topic presented. Because of the passion the participants had for the subject matter there was a tendency for them to discuss matters within their area of expertise that did not relate to the research study.

As the participants were dispersed through out Canada face-to-face meetings were only possible with 50 percent of interviewees. Conference call interviews took more time and participants tended to discuss more matters not related to the research. Direct interaction with the participant allowed for a more focused interview.

During the filling out of the questionnaire queries were asked by the participants when the question did not relate to their expertise or understanding. There should have been a category to allow participants to answer not applicable (N/A).

Under the Grandest Challenge approach experts were brought together to further discuss and develop the critical barriers. In this research study this was not possible due to the costs of transportation and time the experts would have to allocate from their professional activities to conduct the discussion.

CONCLUSION

5.1 Holistic Cooperative Approach

Analysis of the research material presented findings that lead to an advancement on the original ‘Cooperative Approach Diagram’ (Figure 2) and the development on it into the new ‘Holistic Cooperative Approach Diagram’ (Figure 14), which demonstrates a more holistic approach to the development of an Arctic fenestration system.

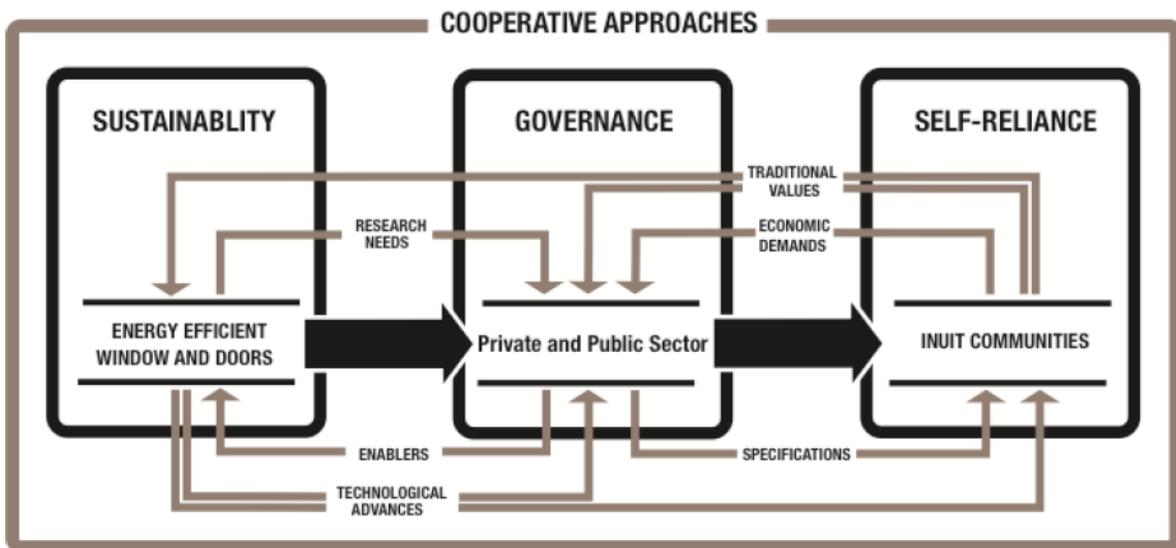


Figure 14. Holistic Cooperative Approach Diagram

Cooperation holds the key to achieve the desired results for a holistic approach. Where originally the focus of cooperation was centered within the governance theme and then linked outward to the others, it is now the all-encompassing feature binding all three themes together.

What this means is that the connectors to and from the different theme areas have changed. Technological advances in energy efficient windows, that originate in sustainability, don't just link to self-reliance, they also link to private and public sector and businesses as well. This means that the private and public sector need those technological advances to be able to apply them to move the products and system to the Inuit communities.

A very similar approach applied to the other side of the new Holistic Cooperative Approach Diagram shows that there has to be an understanding of the traditional values by all of the participants of the holistic approach. This requires that the traditional values move from self-reliance to both sustainability, as well as going to the private and public sector governance. For example understanding the Inuit traditional values and incorporating them into a mixed economy approach to business will lead to production strategies that fulfill the needs of business and employees that come from the Inuit community.

Another key finding that comes out of this approach is that enablers play an important role to make the holistic approach possible. Enablers have to come from the private and public sectors sector. This means that enablers move from the private and public sectors, and go to the research and development of fenestration systems. As a result, the research needs will go from the energy efficient window and doors to private and public sector to implement the system in the northern market context.

Economic demands always have a public attribute due to the specific environment of the North. This requires that the economic demands go from the Inuit communities to the private and public sector. On the other hand, the specifications will go from private and public sector to the Inuit communities so that appropriate energy efficient and sociocultural fenestration systems can be implemented in the Inuit housing. There has to be a holistic cooperative approach to allow for the participation of these multi-sectorial partners to develop an appropriate Arctic fenestration system.

5.2 Critical Barriers

Given that cooperation holds the key to achieve the desired results for a holistic approach, and given that the summary of expert opinions suggests this is possible, our first steps should be to move immediately toward eliminating the first ten critical barriers determined by this research. They are converted here from barriers to steps that can be acted on.

1. Rebuilding of trust between government, corporations and Inuit communities.
2. Private and public sector programs to encourage and enable Inuit ownership of homes, as well as programs to educate on homeownership, to further develop Inuit pride.

3. Programs that enable the cooperative approaches between all parties for Arctic development and the need for business management approaches around understanding the importance of traditional values in mixed-economy Inuit communities.
4. Understanding and accepting of the longer timelines in the Arctic, leading to long-term approaches for northern development.
5. Standardization of Arctic fenestration systems and the creation of standards that are linked and run parallel with the development of Arctic sustainable housing.
6. Policies and funding to enable Arctic fenestration research development.
7. Established fenestration southern business sign-on with technological know-how to drive the product development and Arctic assembly business forward.
8. Development of an Arctic specific energy efficient fenestration system to reduce energy consumption when combined in a holistic approach to the development of passive housing leading to reduce operational cost.
9. Small volume fenestration system assemblies that can be winter fabricated/assembled with minimal equipment in both fixed and temporary facilities of 1000 square feet or less, and with finished products that can be stored externally for opening up production space.
10. Development of a specific window design around the sociocultural milieu of the Inuit that would increase product life and decrease maintenance costs, leading to a better quality of living standard.

5.3 Future Development

At the end of the interviews participants asked, 'What is next?' The ideal outcome would be for the participants of the study to be together in a room to discuss the critical barriers and action items presented. This would allow for further review and exchange by these diverse experts that could lead to future partnerships, and help move the project forward.

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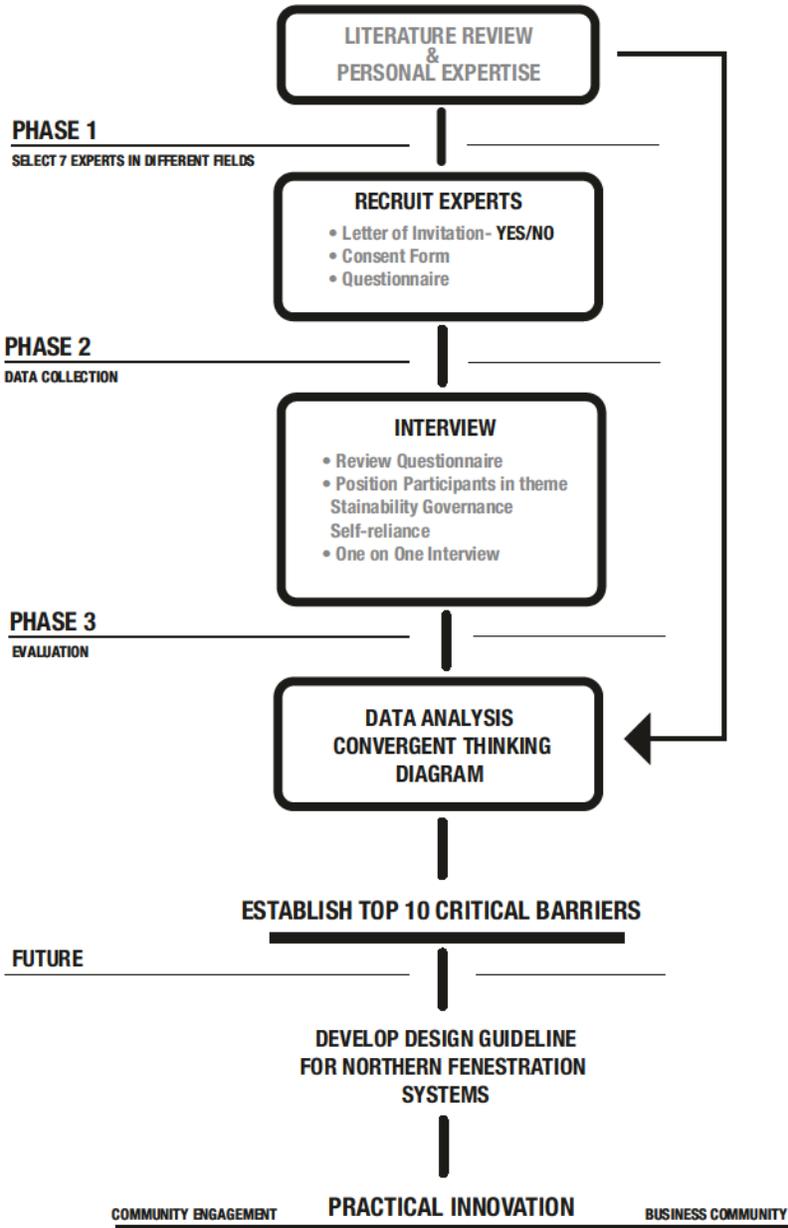
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APPENDIX A
Research Diagram

RESEARCH

? SUSTAINABILITY AND SELF-RELIANCE: COOPERATIVE APPROACHES ON THE DESIGN AND DEVELOPMENT OF HOUSING COMPONENTS WITH-IN INUIT COMMUNITIES



APPENDIX B Consent Form



CONSENT FORM

Title: **Sustainability and Self-reliance: Cooperative Approaches in the Design and Development of Housing Components Within Inuit Communities**

Date of ethics clearance: _____

Ethics Clearance for the Collection of Data Expires: _____

I _____, choose to participate in a study on cooperative approaches in the design and development of housing components with-in Inuit communities. This study aims to identify the critical barriers to the development of northern fenestration (window and door) systems that can be manufactured and maintained by Inuit communities. The researcher for this study is Stephen Field in the School of Industrial design, Master of Design in the Department of Engineering at Carleton University.

The first phase of study is initiated by a questionnaire presented to you. After completion the researcher will review the data. This will assist in classifying the interview questions. The second phase of the study involves a 30 to 60minute interview. With your consent, interviews will be audio-recorded. Once the recording has been transcribed, the audio recording will be destroyed.

You, as the participant, will be asked questions in your area of expertise. The interview will not cause any risk to you as the participant. You can decline from answering any questions during or to end the study.

You have the right to end your participation in the study at any time, for any reason, up until April 24, 2015. You can withdraw by phoning or emailing the researcher or the research supervisor. If you withdraw from the study, all information you have provided will be immediately destroyed.

All data will be stored on a password-protected computer. All hard copies will be in a secure locked cabinet at the School of Industrial Design.

Once the project is completed, all research data will be kept for five years and potentially used for other research projects on this same topic. At the end of five years, all research data will be securely destroyed. (Electronic data will be erased and hard copies will be shredded.)

If you would like a copy of the finished research project, you are invited to contact the researcher to request an electronic copy, which will be provided to you.

Page 1 of 2

**This document has been printed on both sides of a single sheet of paper.
Please retain a copy of this document for your records.**

The ethics protocol for this project was reviewed by the Carleton University Research Ethics Board, which provided clearance to carry out the research. Should you have questions or concerns related to your involvement in this research, please contact:

REB contact information:

Professor Louise Heslop, Chair
Professor Andy Adler, Vice-Chair
Research Ethics Board
Carleton University
511 Tory
1125 Colonel By Drive
Ottawa, ON K1S 5B6
Tel: 613-520-2517
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Researcher contact information:

Stephen Field
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Carleton University
Tel: 613 878 0258
Email: Stephen.Field@carleton.ca

Supervisor contact information:

Thomas Garvey
School of Industrial Design
Carleton University
Tel: 613 520
Email: Thomas.Garvey@carleton.ca

Do you agree to be audio-recorded: Yes No

Signature of participant

Date

Signature of researcher

Date

APPENDIX C
Interview Agenda



INTERVIEW AGENDA

MDes - MASTER OF DESIGN

Research Title:

Sustainability and Self-reliance: Cooperative Approaches in the Design and Development of Housing Components within Inuit Communities

Researcher: **STEPHEN FIELD**

PHASE 1

- Presented for signing by participant
 - i) Consent Form
 - ii) Letter of Invitation
- Agenda of Interview activities

PHASE 2

- Introductions
- Review of Consent Form and Letter of Invitation
- Questionnaire to be completed by participant
- Slide presentation of research objectives
- Interview and discussions - **30 to 45 minutes**
- Suggestion form completed by interviewer participant
- **CONCLUSION**

THANK YOU

APPENDIX D Questionnaire

QUESTIONNAIRE



MDES Research:

Sustainability and Self-reliance: Cooperative Approaches in the Design and Development of Housing Components Within Inuit Communities

PARTICIPANTS NAME _____

CONTACT INFORMATION _____

1. How would you rate your awareness of the Inuit housing crisis in the Canadian North?

Check one

NO KNOWLEDGE AWARE GOOD COMPREHENSION

2. For sustainable Arctic housing which of the three areas do you feel would need to be solved first?

Check one

SUSTAINABLE TECHNOLOGY CHANGES TO GOVERNANCE INUIT SELF-RELIANCE

3. Are you aware of research conducted on energy efficient northern housing?

Check one

YES NO

4. How would you rate the importance of energy efficient windows and doors as components to assist in the development of more energy efficient housing?

Check one

MODERATELY IMPORTANT IMPORTANT VERY IMPORTANT

5. Are you aware of any window system technologies that may assist in the development of more efficient housing?

Check one

YES NO

6. Presently there is no manufacturing of window and door products in our Arctic. Do you feel it is possible that northern production of an Arctic specific window system is possible?

Check one

YES NO

7. Do you support federal government involvement in the development of Inuit businesses in the Arctic?

Check one

YES

NO

8. Do you feel that the Canadian chartered banks support the development of Inuit businesses by offering startup financing?

Check one

YES

NO

9. Do you believe there is a place for Inuit traditional values in the changing Arctic?

Check one

YES

NO

10. Do you sense that traditional values are being lost in Inuit culture?

Check one

YES

NO

11. Do you feel that self-government and self-sufficiency for the Inuit could be through the development of Inuit small business?

Check one

YES

NO

12. Do you perceive that today there is adequate training and education bodies in the Arctic to prepare Inuit workers to the changing economic environment of the north?

Check one

YES

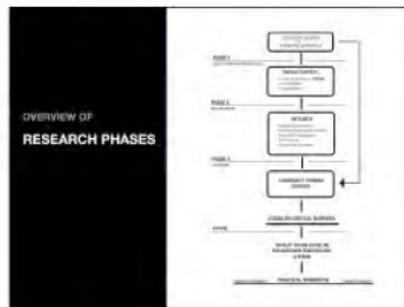
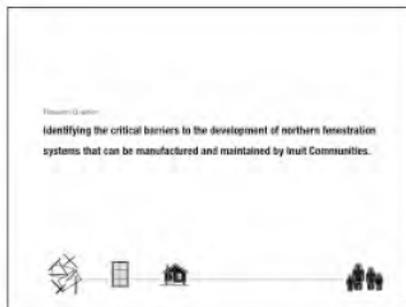
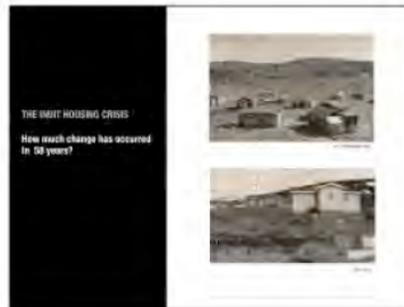
NO

Thank you

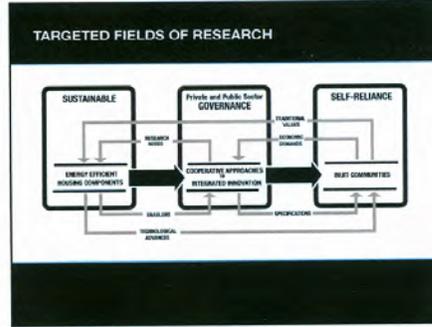
APPENDIX E

Project Introduction Presentation

15-04-28



ASSEMBLING A GROUP OF EXPERTS FOCUSING ON THE MISSING PIECE



SUSTAINABLE

- Passive housing for the arctic
- Energy efficient technologies
- Net Zero home
- Net Gain windows
- Production technologies for the north
- Appropriate building materials
- Seasonal distribution
- Training of Inuit workers
- Innovation in design and materials

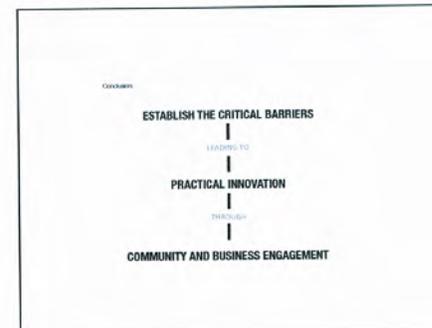
GOVERNANCE

- Multi-sectoral partnerships
- Inuit community capacity
- Role of lending institutions
- Inuit economic development
- Employers - employment
- Public and private sector in the construction industry
- Economic development

Igloolik, Nunavut

SELF-RELIANCE

- Inuit home ownership
- Inuit culture connection with light
- Lower operation costs through energy efficient systems
- Mixed economy
- Incentives for entrepreneurship
- Traditional values considered in work
- Self-sufficiency through Arctic production and maintenance
- Innovation in design and materials



APPENDIX F

Interview Questions



INTERVIEW

MDES Research:

Sustainability and Self-reliance: Cooperative Approaches in the Design and Development of Housing Components within Inuit Communities.

PARTICIPANTS NAME _____

CONTACT INFORMATION _____

Interviews will be conducted on one-on-one bases, between participant and interviewer. Discussion will be focused around the points presented in the theme areas of Sustainability, Public and Private Sector Governance, and Self-reliance. The focus of the interview will be through the analysis of participant answers of the introductory questionnaire. All discussion points will be read to participant by interviewer. Open discussion will follow.

Discussion Points

SUSTAINABILITY

Housing and Fenestration

- What do you feel are the major roadblocks to the development and implementation of an Arctic passive house?
- Are you aware of any research in Arctic housing?
- What relation do you see in NET-Gain window systems to a NET-Zero house?
- Are there appropriate fenestration technologies for Arctic housing and are they available?
- What do feel are the key technological requirements that must be considered in the development of Arctic fenestration technologies.
- Upon the review of the discussion points on fenestration system technologies, what do you feel are the barriers to the development of a northern fenestration system?

Production

- How do you relate fenestration system technologies to fenestration production system technologies?
- Do you feel that a fenestration system could be produced in a small volume production in the Arctic?
- What are the technologies that you feel are suitable to manufacture fenestration systems in the Arctic?

- What would you see as the production bottlenecks to manufacturing of an Arctic fenestration system?
- Your thoughts on the integration of simple technologies and innovation an Arctic fenestration system
- Your thoughts on seasonal distribution as a production system consideration in fenestration design and system production in the Arctic.
- Areas of focus for the training of employees in a fenestration production system to meet to quality control of a fenestration system?
- Upon the review of the discussion on the ability to manufacture in the north, an Arctic fenestration system, what do you feel are the barriers to the development of this system?

GOVERNANCE:

- Your thoughts on the leveraging of multi-sectorial partnerships and expertise when developing northern fenestration systems and Arctic passive housing
- What support would be needed to initiate a fenestration system with-in an Inuit community?
- What are your thoughts on developing local capacity on the development of a northern fenestration system?
- How could Inuit communities increase their involvement in the development of a fenestration product and production system?
- What do you see as the role of lenders in supporting the development of an Arctic fenestration system?
- Are there avenues to allow the involvement of private, public and the Inuit communities in developing building component systems in the Arctic?
- Could you see the development of a fenestration system technology and production system driving economic development with-in Inuit communities?
- Upon the review of the discussion on the development of a northern fenestration product and production systems; what do you feel are the barriers to the development of this system?

SELF RELIANCE

Home Ownership

- Is there consideration for Inuit traditional values in the current fenestration design?
- What do you see as the issues with current fenestration design in the existing Arctic housing systems?
- How can Inuit contribute to lowering housing operation costs?
- What alternative energy technologies are you aware of?
- Do you feel there is adequate home training given to the Inuit residents on home ownership?
- Does home ownership instill a sense of pride leading to a sense of self-sufficiency through ownership?
- What consideration should be considered in the development of passive solar systems?

Northern Production and Constructing Industry

- Is there consideration in the Inuit traditional values to employment in the north?
- What is your opinion on winter production of housing components within the Inuit community?
- Can a mixed economy exist between traditional values and employment-producing fenestration systems?
- What steps would be required to develop this mixed economy?
- Are there adequate incentives to allow communities to develop self-sufficiency through the development of housing component production?
- What are some of the incentive required to allow for northern production to be initiated?
- Upon the review of the discussion of the development of a northern fenestration product and production systems; what do you feel are the barriers to the development of this system?

APPENDIX G
Suggestion Form



PARTICIPANTS ADVICE

Stainability and Self-reliance: Cooperative Approaches in the Design and Development of Housing Components within Inuit Communities

Tim MacLeod

General Manager, Nunastar Properties Inc. As skilled trades-person Tim has had years of experience working in the northern construction industry. Tim is currently managing both residential and commercial properties. He has considerable experience in the development, design and construction of Arctic housing. Tim has worked within both public and private sector agencies in the development of Arctic housing.

Study Goal:

Identifying the critical barriers to the development of northern fenestration (window and door) systems that can be manufactured and maintained by Inuit

Suggestion 1

Suggestion 2

Suggestion 3

Suggestion 4

Suggestion 5

Suggestion 6

Suggestion 7

Suggestion 8

Suggestion 9

Suggestion 10

Thank You

APPENDIX H

Expert Research Participants



JP Gladu

Mr. Gladu is presently the President and CEO for the Canadian Council for Aboriginal Business, an organization that bridges the gap between mainstream corporate sector and the Aboriginal community. Working to improve the economic self-reliance of Aboriginal communities. JP is an Anishinaabe from Thunder Bay, with a passion for his community, his culture and traditions Mr. Gladu brings the past, present and future to the table, moving corporate Canada and Aboriginal business toward sustainable partnerships and shared economic prosperity.



Stephen Thwaites

Mr. Thwaites is the principle of Thermotech Fiberglass Inc., developer and manufacturer of high-performance, energy efficient fenestration systems. Stephen specializes in designing and producing custom window and door systems that can be manufactured in small volumes for customers throughout North America. He has fabricated window systems for commercial applications in the Canadian Arctic. Mr. Thwaites is a fenestration consultant for Enbridge, Saving by Design Charrettes, helping companies to reduce operating cost through energy efficient fenestration systems.



Charles Pugh

Charles Pugh is presently the Manager of Community Development, Technical, Nunavut Housing Corporation. Charles has worked throughout the Arctic and is presently works in the smaller Inuit community of Cape Dorset, Baffin District, Nunavut where the housing crisis is a major issue within the community. Charles focus is in working with Inuit to supply housing within the defined community needs and sociocultural requirements.



Tim Macleod

Trained as a skilled tradesperson, Mr. Macleod has had years of experience working in the northern construction industry. He has considerable experience in the development, design and construction of Arctic housing. Mr. Macleod has worked in both public and private sector agencies specifying suitable technologies for Arctic housing. Tim feels there is no fenestration system on the market that is appropriate for the Arctic and the Inuit. Presently Tim is managing both residential and commercial properties in the Arctic.



Jeff Baker

Jeff Baker is a leader in the energy analysis of fenestration systems, specializing in the Insulated glass units and glass. Chair of the National Fenestration Council (NFRC). Vice-chair of the Canadian Association (CSA) A-440 on window performance. Vice-chair North American task- force on harmonizing United States and Canadian window energy standards. As a consultant Jeff works throughout North America testing and developing insulated glass systems for a wide variety of window and door companies.



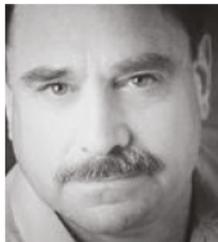
Michael Glover

As a trained architect Mr. Glover has always been interested in fenestration. He has extensive experience in northern housing both in private and public sector. In the 70's and 80's Michael participated in various Northern housing programs through his involvement with Canadian Mortgage and Housing Corporation, National Research Council of Canada and Arctic Institute of North America. Mr. Glover is known in the window industry as the guru of insulating glass technology. He is the founder and developer of Super Spacer (Edgetech IG), known as one of the best warm edge spacers in the world. Michael is currently involved in the development of technologies around smart house energy efficient systems.



Wayne Secondcost

Wayne Secondcost presently is the Manager Community Development, Maintenance, Nunavut Housing Corporation. In Mr. Secondcost position he is responsible for the maintenance of northern public housing. Wayne works very closely with Inuit. He has personal experience working and dealing with Inuit housing crises within defined yearly budgets.



Oliver Drerup

Mr. Drerup has been involved with the 'R2000 Project' since its inception. He held the position of Co-ordinator Technology for the Canadian Homebuilders Association from 1987-1990. A sought after lecturer, public speaker and facilitator. Oliver was one of the founders to Kott Lumber in the development of the Structural Insulated Panels (SIPs) for the walls, floor and roof assemblies of Arctic housing for Nunavut Housing Corporation. Oliver has extensive experience working on Arctic Housing understanding the unique cultural and environmental requirements of the North.
