



concepts & theories

A Systematic Review of the Literature on
Business Adaptation to Climate Change
1 of 4



Network for
Business Sustainability

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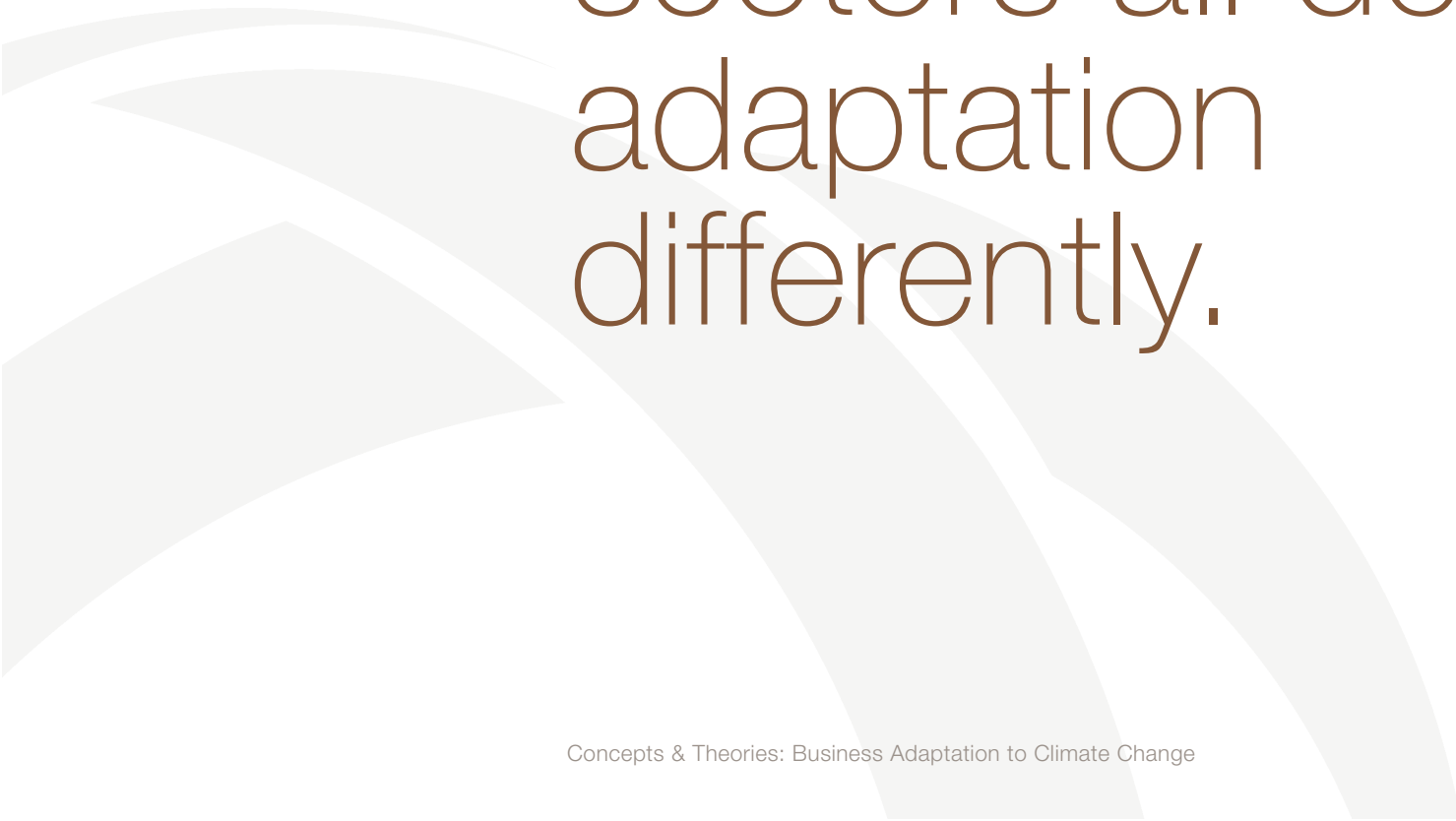
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Business Adaptation to Climate Change
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The public, private
and academic
sectors all define
adaptation
differently.



We need
a common
definition and
multi-disciplinary
theories.

executive summary

Business adaptation to climate change requires new knowledge, capabilities and collaborations.

SUMMARY

There is no common definition of business adaptation to climate change, despite a growing realization that businesses will need to adapt. Some theories exist but further development is limited by a lack of application and empirical work. To prepare their organizations to adapt, managers should openly discuss adaptation within and outside their organization and collaborate with various stakeholders to develop shared definitions and strategies. Researchers must bolster business practice with solid empirical research.

BACKGROUND

There is a growing consensus among researchers and policy makers that adaptation is a central strategy in dealing with the impacts of climate change. Adaptation is most commonly described as ‘adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities’ (IPCC).

In 2008-2009 the Network for Business Sustainability commissioned a systematic review to synthesize the current state of research and practice of business adaptation to climate change. This report, the first in a four part series, lays the foundation to this critical topic by describing the definitions, concepts, and theories concerning business adaptation to climate change.

FINDINGS

Two key findings from this study reflect the nascent nature of the topic:

- **No common definition:** There is no agreed upon definition of adaptation or what adapting to climate change will entail for businesses. Sometimes adaptation is confused with mitigation. Academic literature focuses on detailed studies of sector level adaptation strategies and tends to define adaptation in terms of how specific sectors are approaching climate change adaptation.
- **Theories undeveloped:** Theories of business adaptation to climate change are still in a very early stage. Some progress has been made in terms of the organizational learning model and by the tourism sector in their use of potential climate impact scenarios. However, two major limitations are apparent: limited application of existing cross-disciplinary approaches, and limited empirical work upon which to base new theorizations.

IMPLICATIONS FOR MANAGERS

- Bring the adaptation discussion into the mainstream within the firm, the sector, and in multi-sectoral platforms. Develop shared definitions.
- Collaborate with academia, government, and NGOs in the strategy and practice of business adaptation to climate change.

IMPLICATIONS FOR MANAGERS

- Bolster business adaptation practice with definitions and theories based on solid empirical research.
- Develop industry and sector-specific climate impact scenarios, and refine the organizational learning model, and other theoretical models.
- Develop platforms and arenas for cross-disciplinary collaborations between business, governments, and NGOs.

METHODS

A systematic review of multiple and varied resources – from the public sector, the private sector, and academia, dating from 1997 to early 2009 – revealed 201 sources pertinent to business adaptation to climate change. An interpretive narrative synthesis was employed to distil the large volume of varied data into accessible and intelligible frameworks.

OTHER REPORTS FROM THIS STUDY

This is the first report in a four-part series. The other reports are available from nbs.net. Report 2: Current Practices; Report 3: Case Studies and Tools; Report 4: Knowledge Gaps and Future Research; and Study Methodology.

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¹ The contents of this report do not necessarily reflect the opinions of Oversight or Advisory Committee members.

introduction

This report provides a synthesis of definitions and academic theorizations regarding business adaptation to climate change and is comprised of two sections.

There is a growing consensus among researchers and a number of policy makers that adaptation should be a central strategy in dealing with the impacts of climate change. In 2008-2009 the Network for Business Sustainability commissioned a systematic review to synthesize the current state of research on business adaptation to climate change, in order to identify and advance the theory and practice in this field.

Three major questions were explored:

- Are businesses incorporating climate change into their business models and strategies? If so, how? And do differences exist across business units in terms of risks, opportunities, processes, and outcomes?
- Are certain sectors ahead of others? If yes, what drivers account for these differences, and what lessons can the leading industries offer the laggards?
- What tools and processes do businesses use to evaluate the opportunities to be gained from adapting to climate change? Are there any examples of businesses creating a competitive advantage by building adaptive capacity?

Multiple biographic databases and resources were searched – including academic studies, industry reports, think tank research, case studies, and newspaper articles – dating from 1997 to early 2009. We used a standard

process for systematic reviews: definition of eligibility criteria; search for eligible titles and abstracts; selection of titles and abstracts that may be eligible; selection of eligible reports from review of full documents; and data extraction and synthesis of the material into a report. The search revealed 201 pertinent sources. An interpretive narrative synthesis method was employed because we considered it the most appropriate to achieve the overall goals of this systematic review, particularly that of distilling an enormous amount of widely varied data into an accessible and intelligible framework for practitioners seeking to advance best practices and understand new developments in this emerging field of theory and practice. (The detailed methodology is described in a separate document, available from nbs.net.)

The research findings are available in four reports (all available from nbs.net):*

- 1. Concepts & Theories**
- 2. Current Practices**
- 3. Case Studies & Tools**
- 4. Knowledge Gaps & Future Research**

This report, “Concepts & Theories”, provides a synthesis of definitions and academic theorizations regarding business adaptation to climate change. It is comprised of two sections: section 1, Concepts & Definitions; and section 2, Theoretical Models.

*Ethicscan has an extensive slide library called An Educators Resource Tool Kit, which covers climate change for 25 industry sectors or activities.” Link: www.ethicscan.ca/whatsnew/index.html

Section 1: Given contextual variations in sector, region, size of firm, and other factors, there is no one agreed upon definition of adaptation or what adapting to climate change will entail for business. However, there are some emerging commonalities of how governments, the private sector, and academic researchers understand adaptation as it relates to business. Section 1 discusses both direct and indirect definitions of how ‘adaptation’ has been interpreted by these actors, and establishes the Intergovernmental Panel on Climate Change (IPCC) definition as the standard throughout the rest of this report: ‘Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities’. Section 1 also discusses related concepts, such as adaptive capacity, risk, and vulnerability.

Section 2: Section 2 summarizes studies that engage in a theorization of business adaptation to climate change; discussing articles that summarized and theorized existing theoretical approaches to business adaptation, theories that focus on understanding how businesses are or may be affected by climate risk, and a variety of models used to understand the complexities of the decision making processes by which organizations decide to adapt. Analysis shows that theorizations of business adaptation to climate change are still in a very early stage. Some progress has been made in terms of the

organizational learning model and by the tourism sector in their use of potential climate impact scenarios. However, two major limitations are apparent: limited application of already existing cross-disciplinary approaches to the field, and limited empirical work upon which to base new theorizations.

Overall, Report 1 describes the background of work that has occurred in the area of business adaptation to climate change and sets the stage for the systematic review. It is followed by Report 2, “Current Practices”, which uses the findings of the systematic review to discuss how different sectors and individual firms therein are adapting to climate change.

Taking all four reports together, this study captures the current status of our knowledge on business adaptation to climate change and establishes a foundation for future work by both academic and business communities.

Section 1: concepts & definitions

Section 1 includes both direct and indirect definitions of adaptation to climate change and related concepts, such as adaptive capacity, risk, and vulnerability.

There is no one agreed upon definition of adaptation or what adapting to climate change will entail for businesses or business strategy. This is not surprising considering that adaptation to climate change by business is a relatively new idea, is being interpreted in a wide variety of ways by a wide variety of actors, and is a highly contextual process dependent on sector, region, and size of firm among many other factors. This is complicated by the substitution of other concepts for adaptation in the literature, such as risk and opportunity as they relate to climate change. This is also further complicated by the common conflation of adaptation with the process of businesses ‘adapting’ their strategies to government mitigation policies.

Despite this, there are some emerging commonalities of how governments, the private sector, and academic researchers understand adaptation as it relates to business. In this section, we have synthesized and organized both direct and indirect definitions of how ‘adaptation’ has been interpreted by these actors. We first discuss direct definitions of adaptation in the literature, followed inferred or substituted understandings via other concepts. The IPCC definition is accepted as the standard throughout the rest of this report.

DEFINING ADAPTATION – DIRECT AND INDIRECT DEFINITIONS

The earliest origins and dissemination of adaptation as a concept arose from the Intergovernmental Panel on Climate Change (IPCC), a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment

Programme (UNEP). The IPCC has released a number of scientific reports on climate change (1st Assessment 1990 and 1992, 2nd Assessment 1995, 3rd Assessment 2001, and 4th Assessment 2007).² Scientific evidence in the 2nd Assessment revealed the inevitability of climate change, even in light of mitigation efforts. In 1995, the concept of ‘adaptation to climate change’ was developed and defined in the first ‘Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses’ report. By 2001, the IPCC defined climate change adaptation as ‘Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, public and private adaptation, and autonomous and planned adaptation.’ (IPCC, 2001)³

These types are defined as (IPCC, 2001 in OECD, 2006: 17)⁴:

- **Anticipatory Adaptation**—Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
- **Autonomous Adaptation**—Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- **Planned Adaptation**—Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

²For the purposes of this study, adaptation is most explicitly defined in: IPCC TAR, 2001 a. Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC Third

³ibid.

⁴ibid., see also OECD, 2006 in the bibliography

- **Private Adaptation**—Adaptation that is initiated and implemented by individuals, households or private companies. Private adaptation is usually in the actor's rational self-interest.
- **Public Adaptation**—Adaptation that is initiated and implemented by governments at any level. Public adaptation is usually directed at collective needs.
- **Reactive Adaptation**—Adaptation that takes place after impacts of climate change have been observed.

The origins and classification of climate change adaptation by the IPCC is an important preface to this systematic review, as most of the definitions discussed below either directly or indirectly make use of some or all of the IPCC definitions.

These categorizations are a useful framework in determining how different actors understand adaptation as it relates to business strategy. While we find that government and international organizations tended to have broad-based definitions that covered the socio-economic dimensions of climate change and collective needs, business definitions adhered to the general IPCC

definition but narrowed their focus to risk, opportunities, and rational cost-benefit approaches which can be related to the concept of 'private adaptation' above.

This systematic review contains a wide variety of sources concerned with adaptation as it related to business strategy. The sources can be categorized into three major source types: government and international organization publications, private sector and think tank publications (including think tanks, consortiums, and business associations), and academic publications (consisting of journal articles, dissertations and academic books). Of the 201 studies reviewed, 21 provided a direct definition of adaptation, while all of the studies gathered referred to it, either directly or indirectly, through related concepts. The following sections provide a synthesis and examples of the direct definitions found in each source type category (see Appendix C, 'Findings by Source Type', for details), as well as a synthesis of indirect definitions including risks, opportunities, vulnerability, and adaptive capacity.

Government of Canada (2007):

Adaptation to climate change is any activity that reduces the negative impacts of climate change and/or takes advantage of new opportunities that may be presented. Adaptation includes activities that are taken before impacts are observed (anticipatory) and after impacts have been felt (reactive). In most circumstances, anticipatory, planned adaptations will incur lower long-term costs and be more effective than reactive adaptations. (NRCAN, 2007: 5)

Government of the United Kingdom (2009):

Adaptation is adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Effective measures directed at enhancing our capacity to adapt (building adaptive capacity) and at minimizing adjusting to and taking advantage of the consequences of climatic change (delivering adaptation actions) are required (Government of the UK, 2009: Online).

Government of the United States of America (2006):

Adaptation is defined in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Planned adaptation..... refers to strategies adopted by society to manage systems based on an awareness that conditions are about to change or have changes such that action is required to meet management goals. The purpose of adaptation strategies is to reduce the risk of adverse outcomes through activities that increase the resilience of ecological systems to climate change stressors. (Environmental Protection Agency, 2006: 1).

Government of Australia (2006):

Adaptation is an adjustment in response that leads to a reduction in risks or a realization of benefits. Risk treatments developed and implemented by an organization in response to climate change can be regarded as one type of adaptation. Because of the long time-scales, climate change risk treatments will usually involve strategic planning and the allocation of new resources. They are thus often distinguished from short term reactive adjustments. Climate change risk treatments can include technological and infrastructure measures, planning, research and education, or a combination of actions (Government of Australia, 2006: 48).

GOVERNMENTS AND INTERNATIONAL ORGANIZATIONS

Literature on climate change adaptation from various governments – such as the Government of Canada (Natural Resources Canada), United Kingdom (UK Climate Impact Program), United States (Environmental Protection Agency), and Australia (Australian Greenhouse Office) – offer definitions of adaptation. Almost uniformly, each of these government sources relies on an exact replication or slight modification of the definition used by the IPCC (2001) (*see Box 1*).

International governmental organizations, such as the European Union and the United Nations in its various branches, also offer definitions of adaptation. These sources too rely on an exact replication or slight modification of the definition used by the IPCC (2001) (*see Box 2*).

Box 2

DEFINITIONS OF ADAPTATION FROM INTERNATIONAL GOVERNMENTAL ORGANIZATIONS

The European Union (2007):

Adaptation aims at reducing the risk and damage from current and future harmful impacts cost-effectively or exploiting potential benefits. Adaptation measures can be anticipatory or reactive. Adaptation applies to natural as well as to human systems. Ensuring the sustainability of investments over their entire lifetime taking explicit account of a changing climate is often referred to as 'climate proofing' (European Union, 2007: 3).

United Nations Framework Convention on Climate Change (2009):

Adaptation is practical steps to protect countries and communities from the likely disruption and damage that will result from effects of climate change. For example, flood walls should be built and in numerous cases it is probably advisable to move human settlements out of flood plains and other low-lying areas..." (Website of the UNFCCC Secretariat in Livena and Tripak, 2006: 7)

United Nations Development Program (2005):

Adaptation is a process by which strategies to moderate, cope with, and take advantage of the consequences of climatic events are enhanced, developed, and implemented. (UNDP, 2005 in Livena and Tripak, 2006: 8)

Government and International Governmental Organizations also define concepts related to adaptation. These include **adaptive capacity**, **risk**, and **vulnerability**.

Adaptive capacity, according to the IPCC, is the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of potential opportunities, or to cope with the consequences of climate change (IPCC, 2001 in OECD, 2006: 17).

Risk is the probability that a situation will produce harm under specified conditions. It is a combination of two factors: the probability that an adverse event will occur; and the consequences of the adverse event. Risk encompasses impacts on human and natural systems, and arises from exposure and hazard. (Australia Greenhouse Office 2003 in Livena and Tripak, 2006: 21). The UNDP identifies climate-related risk as the result of interaction of physically defined hazards with the properties of the exposed systems—i.e., their sensitivity or (social) vulnerability. Risk can also be considered as the combination of an event, its likelihood, and its consequences—i.e., risk equals the probability

of climate hazard multiplied by a given system's vulnerability (UNDP, 2005 in Livena and Tripak, 2006: 21). UNEP 2006 presents a six point typology of climate change risks for business including market risk, operational risks, reputational risks, counterparty risk, political/legal risks, and business risks (UNEP, 2006: 16).

The IPCC 2001 defines **vulnerability** as a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. (IPCC, 2001 in Livena and Tripak, 2006: 17). However, vulnerability can also be considered as the underlying exposure to damaging shocks, perturbation or stress, rather than the probability or projected incidence of those shocks themselves (UNDP, 2005 in Livena and Tripak, 2006: 17). The Australian Government identifies vulnerability as the extent to which a natural system or human society is unable to cope with the negative impacts of climate change, variability, and extremes. It depends on changes in climate as well as the sensitivity and adaptive capacity of the system or society (Australian Greenhouse Office, 2003 in Livena and Tripak, 2006: 18).

PRIVATE SECTOR

Literature being produced by the private sector (including think-tanks, consortiums, and business associations) is focused more on how adaptation relates to business and business strategy, and tends towards evaluating and coping with climate risks. Some business definitions of adaptation include opportunities as well as successful adaptation in their conception of climate change adaptation. However, the majority of business discourse on climate change adaptation is concerned with risk mitigation. Most business literature refers to the IPCC definition or a slight modification to it, while also relating to what the IPCC terms ‘private adaptation’.

Very few private sector sources to date define adaptation directly in their own terms. The business discourse on adaptation includes a risk management approach and a cost-benefit approach. For example, the Chartered Accountants of Alberta define adaptation as “taking action to minimize and respond to the effects of climate change. Initiatives in these areas largely originate from a risk management perspective” (Desjardins and Schuh, 2007). The International Chamber of Commerce (Commission on Environment and Energy, 2007) states that:

“the classic definition of adaptation is policy and operational approaches to reduce climate change risk, vulnerability and damage..... [adaptation includes] infrastructure development, human settlements, water provision and new industrial installations amongst others, many of which will be in use for decades into the future. Climate change should be taken into account as part of ongoing planning, development and investment processes.” (Ibid, 2007: 2)

Sullivan et al. (2008) defines adaptation as “actions taken to cope with a changing climate”, with the objective of reducing risk and damage, and exploiting potential benefits. In this frame of reference, public policy and corporate adaptation are trade-offs between the costs incurred in taking action in response to climate change and the potential costs associated with climate change (Sullivan et. al., 2008: 6). The Chartered Accountants of Canada (CAC) (2008) define adaptation as:

“... taking action to minimize and respond to the effects of climate change...for companies, adapting to these phenomena will involve identifying their current and potential impacts on business, reducing vulnerability to them and taking advantage of any potential opportunities they present. Some geographical areas and some industries may be impacted more than others by adaptation issues. Companies will increasingly address adaptation as aspects of their business strategy and risk management. Actions taken to minimize and respond to the effects of climate change will ultimately be reflected in financial statements.” (CAC, 2008: 6)

The vast majority of studies by the private sector take an indirect approach to climate adaptation, tending to frame adaptation in terms of vulnerability and adaptive capacity, risk, and opportunity. The Pew Centre (2004) frames adaptation to climate change in terms of the availability and accessibility to adjustment opportunities. In managed systems, wealth, availability of technology, appropriate decision-making capabilities, human capital, social capital, risk spreading (e.g., insurance), ability to manage information, and the

perceived attribution of the source of stress all contribute significantly to adaptive capacity and the capability of such systems to actively and adequately respond to changing environments (Yohe and Tol, 2002, in Easterling, Hurd, and Smith, 2004: 4). Reactive adaptation is consistent with the concept of resilience defined as the degree to which a system can absorb disturbance and still return to its pre-disturbance steady state (Easterling, Hurd, and Smith 2004: 5). In contrast with reactive adaptation, proactive or anticipatory adaptation is associated with the concept of adaptive

reorganization whereby a system survives disturbance by altering existing relationships or establishing new relationships and components (Holling, 1986 in Easterling, Hurd, and Smith 2004: 5). This reorganization could involve the development of new economic, technological, and political institutions to avert damages, or it could mean taking advantage of opportunities in anticipation of future climate change (Easterling, Hurd, and Smith 2004: 5).

Table 1 summarizes the indirect aspects of adaptation in the business literature.

Table 1 **INDIRECT ASPECTS OF ADAPTATION IN BUSINESS LITERATURE**⁵

RISKS					
Regulatory Risk	Financial Risk	Physical Risk	Litigation Risk	Reputational Risk	Competitive Risk
OPPORTUNITIES					
Enhancing Corporate Reputation		Gaining and Maintaining Competitive Advantage		Technological Opportunities	New Product Development

⁵ Adapted from the ideas put forward throughout KPMG, *Climate Changes your Business*, 2008.

SUMMARY OF KEY POINTS

- Adaptation has entered the business discourse, but is still being confused with mitigation.
- 21 of the 201 studies reviewed provided a direct definition of adaptation.
- There is no one agreed upon definition of adaptation or what adapting to climate change will entail for businesses or business strategy. The most commonly used definition is the IPCC (2001) definition and derivatives of it.
- Adaptation is interpreted in a wide variety of ways by a wide variety of actors, and is a highly contextual process dependent on variables such as sector, region, and size of firm.
- Adaptation as a concept has been largely dominated by the IPCC's work.
- There is a need for mainstreaming the definition of 'business adaptation to climate change' across the public, private, and academic sectors.

Section 2: theoretical models

Section 2 includes studies which explicitly develop theoretical models to understand the impact of climate risk on business practice and how businesses may adapt.

Our systematic review yielded sixteen studies which engage in a theorization of business adaptation to climate change. These are defined here as studies which explicitly develop theoretical models that attempt to understand the impact of climate risk on business practice, business opportunities created by climate change, and when, why, and how businesses may adapt. Part one, Business Adaptation in Theory, discusses articles that summarized and theorized existing theoretical approaches to business adaptation. Part two, Impact and Risk Models, discusses theories that primarily focus on understanding how businesses are or may be affected by climate risk. Part three, Drivers of Business Adaptation, discusses a variety of models that are being used to understand the complexities of the decision making processes by which organizations decide to adapt.

BUSINESS ADAPTATION IN THEORY: METATHEORETICAL ISSUES

Only two studies reviewed (Hertin et al. 2003; Berkhout et al. 2004a)⁶ offered metatheoretical analyses of how business adaptation to climate change had been conceptualized within a range of literature on the subject. Both studies contend that academic research into adaptation, both theoretically and empirically, is still at a very early stage. Hertin et al. (2003) suggest that theorizations of adaptive behavior are often

oversimplified as a “question of optimal choices between a broad set of clear alternatives made by individuals and firms pursuing their personal interests” (Hertin et al., 2003, p. 280, citing Mendelsohn, et al. 1994 and Mendelsohn 2000).⁷ They go on to argue:

“In other words, [businesses] will adapt once they have experienced the effects of climate change and will then adapt by precisely the amount that maximizes their overall welfare. This approach to explaining adaptation has been much criticised for making invalid assumptions about the nature of climate impacts (Schneider et al., 2000) and for misunderstanding the complexity of decision making by adapting organisations and actors (Kandlikar and Risbey, 2000).” (Hertin et. al 2003, p. 280)

Berkhout et al. (2004) also argue that oversimplification has been a major problem thus far in theorizing adaptation. They state:

“...progress towards developing theoretical understandings of adaptation has been slow (Kasperson et al., 1995; Kelly and Adger, 2000; Folke et al., 2002)⁸. Existing accounts draw on frames, methods and taxonomies borrowed from a range of disciplines including conservation

⁶ Berkhout, et. al. 2004b also collected during the systematic review is a working paper of the final draft reviewed here. We have excluded it here as it is a less nuanced duplicate of the final draft (Berkhout et. al. 2004a).

⁷ Mendelsohn, R., Nordhaus, W. and Shaw, D. (1994). The impact of global warming on agriculture: a Ricardian analysis. *American Economic Review*: 84, 753–771.; Mendelsohn, R. (2000). Efficient adaptation to climate change. *Climatic Change*: 45(3–4), 583–600.

⁸ Kasperson, J., Kasperson, R.E., Turner, B.L., (1995). *Regions at risk: comparisons of threatened environments*. United Nations University Press, NY.; Folke, C. et al., (2002). *Resilience and sustainable development: building adaptive Capacity in a world of Transformations*. Edita norstedts tryckeri AB, Stockholm.; Kelly, P.M., Adger, W.N., (2000). Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic Change*: 47 (4), 325-352.

ecology, welfare economics, and hazards and risk research. Although efforts have been made to develop common definitions and generic prescriptions, especially through the Intergovernmental Panel on Climate Change (IPCC) and in national assessment processes, these have not yet generated a coherent conceptual framework or a clear research agenda (Smit et al., 2000; Parson et al, 2003)⁹. The aim is usually descriptive (for instance, listing the factors that may influence adaptive capacity) or normative (making recommendations about the role of policy in enabling adaptation) rather than analytical. Therefore, it is not yet possible to answer fundamental questions like: What are the attributes of the adaptive capacity of specific communities, organisations and resources? What motivates adaptation processes? What factors determine processes of adaptation?" (p. 3)

Berkhout et al.'s observation that the literature is typically highly descriptive and applies a wide range of taxonomies and methods borrowed from a variety of sources was true of much of the literature reviewed in this study as well, with the exception of the 16 articles discussed in this section. In other words, the conceptual architecture demonstrated in Section 1 is generally the full extent of theory deployed by individuals and organizations attempting to make sense of the how and why businesses are adapting.

Since the publication of these two articles (Hertin et. al., 2003 and Berkhout et. al., 2004), there has been a push to develop more analytical and explanatory approaches to business adaptation. These studies are reviewed below.

⁹Smit, B., Burton, I., Klein, R.J.T., Wandel, J., (2000). An anatomy of adaptation to climate change and variability. *Climatic Change*: 45, 223-251; Parson, E.A. et al., (2003). Understanding climatic impacts, vulnerabilities, and adaptation in the United States: Building a capacity for assessment. *Climatic Change*: 57 (1-2), 9-42.

IMPACT AND RISK MODELS – HOW WILL CLIMATE CHANGE AFFECT BUSINESS?

Potential Climate Change Scenario Modeling

One method that researchers are using to study the potential impacts of climate change on business is through the application of climate change scenario models derived from scientific/meteorological forecasting to behavioral analyses of business decision making and consumer reaction. Seven studies we reviewed employed this type of analysis, all of which were specifically focused on the tourism and recreation sector, where it appears that the relationship between the sector and weather can more easily be modeled under current and historical conditions.

Five of the scenario based studies, which are developed by research teams led by or including Daniel Scott (McBoyle, Mills, and Scott., 2003; Scott and Jones, 2006; Scott and Jones 2007; Scott et. al 2006; Scott et. al 2007) focus on the potential impact of climate change on the Ontario Ski Industry, Golf Participation in the Greater Toronto Area (GTA), the ski based tourism industry in Eastern North America, the Quebec Ski Industry, and the Canadian golf industry, respectively. The other two studies focused on the Scottish tourism

industry (Yeoman and McMahon, 2006) and the Australian ski industry (Hennessy et. al, 2008) In each study, climate change forecasts projected over particular intervals (typically 30 year periods, e.g. .2020s, 2050s, 2080s) are related to particular climate sensitive variables (season length, golf rounds played, resources needed for snow making, film making on location, etc.) of which relationships to climate change have already been established through historical modeling.

While these scenarios are useful in modeling potential risks or opportunities to business, their contribution to understanding how and why businesses may adapt to them is limited thus far. With the exception of two studies focused on snowmaking as a technical adaptation (Scott et al. 2003; Hennessy et al. 2008), adaptive behavior is only discussed as an area for further research or it is assumed that businesses, supplied with the appropriate information, may shift business practice. Gössling and Hall (2006) have also critiqued this scenario-behavioral based model for being weak on a number of grounds, namely that climate scenarios are constantly shifting thus making projections potentially irrelevant, and that the relationship between weather and tourist flows is often viewed as a determinate relationship.

Vulnerability Approach Modeling

Another method that researchers are using is a vulnerability based approach. One study reviewed employed this approach (Belliveau et al. 2006). Based on an implicit critique of the limitations of the scenario based approach described above, the vulnerability approach embeds the potential impacts of climate change within a multi-exposure analysis. This approach includes highly variable political, economic, institutional, and biophysical conditions [see diagram here, p. 369]. As opposed to a “top-down” application of potential scenarios, a vulnerability approach stresses “bottom up” qualitative investigations of human decision making in the face of a changing climate, seeking also to capture dynamic adaptation processes.

Belliveau et al.’s (2006) study of multiple exposures in the grape industry in the Okanagan Valley, British Columbia employs such a vulnerability approach.

They utilize a qualitative interviewing process with open-ended questions designed to inductively draw out the risks and opportunities as perceived by grape growers, and then compare these to climate data and projections, as well as political, institutional, and economic data. They find this method allows them to uncover, in particular, risks that are not discussed in scenario based approaches.

Adaptation in relation to vulnerability of farmers is discussed using the concept of ‘adaptive capacity’, which is modeled in terms of short term (tactical) and long term (strategic) planned reactive and anticipatory shifts in practice to threats such as colder, wetter seasons, extreme heat, frost, pests, and low tourism. These shifts in business practice are part of a ‘built in’ adaptive capacity for farmers who are constantly shifting business practice in relation to the variety of pre-existing risks.

DRIVERS OF BUSINESS ADAPTATION – WHEN, WHY, AND HOW DO BUSINESSES ADAPT?

Adaptation as Behavioral Response

Only one study reviewed (Mendelsohn, 2000) theorizes the relationship between climate risk and business adaptation as one governed by the self-interest of business organizations. Mendelsohn develops a formal static economic model which assumes that ‘private adaptation’ will occur in climate sensitive sectors of the economy when the costs of inaction outweigh the costs of adapting, and conversely, when potential economic benefits outweigh the investment costs for taking advantage of them. He develops this primarily through modeling potential opportunities in the agricultural sector due to new crop varieties made possible by variations in temperature (see diagram available [here](#) or [here](#), p. 589).

Adaptation as Organizational Learning

A small number of studies (n=3), mainly derived from the Tyndall Center’s 2004 ADAPT project (denoted by *), have begun to theorize business adaptation to climate change as an ‘organizational learning’ process (Berkhout et al. 2004a; Arnell and Delaney, 2006*; Pelling et al. 2008). Theories of organizational learning draw on behavioral studies of organizations. They are primarily concerned with “how organizations learn from direct experience, how they learn from others, and how they develop conceptual frameworks for interpreting that experience” (Levitt and March, 1988:13 in Berkhout et al. 2004)¹⁰.

Berkhout et al (2004a) developed a four stage model (see diagram available [here](#), p. 9) which integrates adaptation as an element in traditional organizational learning by business. Within this model, they note a number of key problems related to adaptation. Stage 1, ‘Signalling and Interpretation’, seeks to understand when and why businesses acknowledge climate risk as a threat or opportunity to business practice. They argue that organizations may find it difficult to recognize and interpret climate change stimuli. External pressure and expert advice may be essential in many cases. Stage 2, ‘Experimentation and Search’, examines how businesses typically take on a ‘trial-and-error’ approach to incorporating climate risks into existing routines. They argue that given the ambiguity of climate change stimuli, it is unlikely that most businesses will adapt through a ‘trial and error’ method. Stage 3, ‘Knowledge Articulation and Codification’, involves internal discussions within business concerning adaptation options, the selection of options, and their codification within business practice. They argue that businesses may have difficulty in incorporating adaptation options into existing routines, and may have to create new routines. Stage 4, ‘Feedback and Iteration’, is the end of the learning cycle in which the business assesses the effectiveness of the adaptation option, typically by way of some performance measure. They argue that most adaptation may not provide the performance feedback that is typical of business learning, as the feedback may be largely indirect (i.e. through customers, regulators, creditors). This organizational learning model was developed and tested through a number of empirical case studies in the UK housing and water sectors (Berkhout et al. 2004, 2006; Arnell and Delaney, 2006).

¹⁰ Levitt, B., March, J.G., (1988). Organizational Learning. Annual review of Sociology: 14 319-340.

Pelling et. al. (2008) also developed an organizational learning model that considers the broader social context in which organizations make decisions, and are influenced. They propose an analytical framework for understanding the adaptive capacity of an organization through the lens of ‘6 adaptive pathways’ (see diagram available [here](#), p. 873, or [here](#), p. 14). This organizational learning model is tested through three case study examples of a local agricultural business and two government organizations in Wales, UK.

Belief in Climate Risk and Business Adaptation

Bleda and Shackley (2008) developed a theoretical model using a computer simulation of how businesses

develop an organizational “belief” in climate change. Their primary assumption is that businesses will first adopt a “belief” in climate change, and then make moves to adapt to it only when they become cognizant of potential or real changes to competitiveness. The model—which can be appropriated by both business and researchers—allows users to plug in different types of variables, specific to business and market type, and provides the ability to see under what circumstances a business may or may not develop an organizational belief in climate change (see diagram [here](#), p. 520).

SUMMARY OF KEY POINTS

- Theorizations of business adaptation to climate change are still in a very early stage.
- Most literature in the area does not go beyond simple definitions or taxonomies borrowed from the IPCC or other sources.
- Potential climate impact scenarios have been utilized by those in the tourism and recreation sector to understand possible changes in demand for services. These are very limited though, and make a number of assumptions regarding climate and tourist behavior that may be proven false.
- Vulnerability approaches may be a way of overcoming some of these deficiencies.

- The organizational learning model is the most developed attempt thus far to understand how, why, and when organizations will adapt—the next step is for field researchers to refine this model through empirical research.
- The major limitation thus far in theorization has been twofold: limited application of already existing cross-disciplinary approaches to the field, and limited empirical work upon which to base new theorizations.

Report 2, “Current Practices”, uses the definitions and theories discussed in Report 1 to understand the findings of the systematic review and describes how different sectors and individual firms therein are adapting to climate change.

references

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Total number of studies with direct definitions: 21

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An exhaustive list of references for the entire study (Reports 1-4) is available in the study [Methodology report](#).

about the network for business sustainability

MISSION

The Network for Business Sustainability enables business sustainability by fostering collaboration between industry and academia.

VISION

We envision a world where Canadian enterprises contribute to prosperous economies, healthy ecosystems and strong communities.

OBJECTIVES

1. Build and grow a community of researchers and practitioners of business sustainability.
2. Develop a database of state-of-the-art business sustainability knowledge that is relevant to practice.
3. Create opportunities to develop new knowledge that spurs innovation in enterprises.

ACTIVITIES

The Network funds projects to move knowledge between the communities of research and practice, organizes events that bring the members of those communities together, and enables ongoing interaction and knowledge exchange through online tools.

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