Article can be accessed online at http://www.publishingindia.com

# An Application of Structural Equation Modelling to Determine the Inclusion of Climate Change Topics in MBA Education

**Purba Halady Rao*, Rahul Pulupudi**, Suman Sen***,**

**Abstract**

In the years to come India would be vulnerable to severe and unavoidable impacts of Climate Change such as Floods & droughts, water pollution and the associated health hazards, prevalence of diseases, the adverse impact on crop production, less availability of food and potable water, heat stress, mass migration, mortality, morbidity etc. To address these impacts of climate change, various strategies, recommendations, and action plans have been discussed across international agencies, government and non-government organizations. All the same the challenge is huge and it is believed that private sector could be equipped and inspired to help in meeting climate change challenges. In this context we have conducted this research to determine if inclusion of climate change education in MBA curriculum would indeed inspire, encourage and equip managers in the private sector to take up the climate change challenge to participate in helping communities survive and build up resilience to adapt to climate change.

**Keyword:** Sustainability, Climate Change, MBA, Education, Empirical, Structural Equation Modeling

## Introduction

### Why Managers need to Know about Climate Change Impacts

In the years to come India will become highly vulnerable to the impacts of climate change. The impacts are varied, unavoidable and severe such as Floods & droughts, water pollution and the associated health hazards, prevalence of diseases, the adverse impact on crop production, less availability of food and potable water, heat stress, mass migration, mortality, morbidity, and the impact on the quality of life (Climate Change Synthesis Report, WMO, UNEP 2001: 35-98). Thanks to research, conferences, media, and international agencies, the general awareness about climate change, its causes, and its adverse effects are widely known in today's world. To address these impacts of climate change, various strategies, recommendations, and action plans have been discussed across international agencies such as the UNFCC, the United Nations Environment Program, multilateral organizations such as the World Bank, the Asian Development Bank, the African Development Bank, and other national and international organizations (Asian Development Bank, Climate Change ADB Programs 2007: 2009). Even though the challenge is huge but addressing the challenge is very much needed.

Thus, given the magnitude of the help required to address climate change impacts, to set up the infrastructure to protect populations from floods as well as health-care systems all over the country, to invest in agriculture, water availability, sanitation facilities, etc.it might be beneficial to involve the private sector, in addition to government support which is present always, in addressing to help build the capacity for the communities affected by such calamities to survive the adversities caused by climate change

Corporate managers throughout the industry have been effective in planning and carrying out successful projects to bring about efficiency from the organizational perspective. It is expected and hoped that if they take it upon themselves in addressing impending climactic disaster, they can be equally effective too, this time with the goal of enhancing resilience and minimizing vulnerability. (http://unfccc.int/adaptation/workstreams/nairobi_work_programme/items/4623.php).

* Great Lakes Institute of Management,Dr. Bala V Balachandar Campus, East Coast Road, Manamai, Tamil Nadu, India. Email: purbarao@yahoo.in

** CEO & Founder,Company: Afterthought Feedback Services Pvt Ltd. City: Hyderabad, Country: India Email: rahulp@studynsurvey.com

*** CFO & Co-Founder, Afterthought Feedback Services Pvt Ltd, Bengaluru, Karanataka, India. Email: suman@studysurvey.com

Thus in the face of any kind of disasters and calamities it is believed that private sector can be catalyzed in helping through their involvement in the wider adaptation and building up resilience of communities. The unique expertise of the private sector, its capacity to innovate and produce new technologies for adaptation, and its financial leverage can form an important part of the multi-sectoral partnership that is required between governmental, private and non-governmental participants. (http://unfccc.int/adaptation/workstreams/nairobi_work_programme/items/4623.php).

In addition to helping communities cope with calamities, corporations could also make their own businesses safe and resilient. During the Chennai floods many auto parts manufacturing units got totally destroyed. If these companies could foresee climate change calamities coming, they could have thought of adaptation measures and built their units at higher grounds.

There is also another reason why private sector should be involved to address climate change(cc) related initiatives. The private sector through its operations generate huge amount of green-house gases that contribute to global warming/climate change. The total greenhouse gas (GHG) emissions from a selection of global 500 companies approximately amount to that of the USA and the EU15 combined. Not only do corporations have a significant climate footprint, but the impact of climate change on the business landscape is already noticeable.( Patenaude, 2011).

Through their manufacturing set up using coal and other fossil fuels, unlimited use of resources like water and electricity, using huge industrial air conditioning units that generate GHGs, non- renewable lighting, non-environment friendly transportation & distribution systems, corporations in the private sector have been major cause of global warming and climate change, whose effects can be felt today. Thus it is of utmost importance that private sector organizations get exposed to the perils of their activities and thereby learn how to use industrial activities which minimize the generation of GHGs and do not further enhance the effects of climate change any more.

The countries that negotiated the Paris deal now have a responsibility not only to talk about addressing climate change, but to help communities recover from the devastation it has already caused and will continue to cause, and enable them to learn how to adapt to future climate impacts and be climate resilient, and minimizing vulnerability.

## Climate Change Concerns in Today's World Mitigation and Adaptation Strategies to Address Them

As is well known, increases in the concentration of GHGs in earth's atmosphere have given rise to global warming with anticipated impacts that are disastrous. These adverse effects of climate change are going to threaten economic growth in many regions like, health and well-being standards of millions of people, food security, availability of clean water and many other aspects of millennium development goals such as poverty alleviation. In order to address the impending crisis associated with the climate change worldwide forums have come up with strategies to implement and combat the impacts of climate change. The strategies thus designed can broadly be categorized as mitigation type strategies, preventing or minimizing the generation of GHGs which cause the climate change, and adaptation types which help communities to adapt to the inevitable impacts of climate change.

Initial initiatives at dealing with the problem of global warming focused on mitigation, that strives to aim at reducing and possibly stabilizing the GHG concentrations in the atmosphere (UNFCCC 1992).However, the increase of GHGs which are already there would continue to cause disastrous impacts which are unavoidable. Thus there is no alternative but to learn to adapt to such impacts and try and reduce the damage to the extent possible, leading to the development of adaptation strategies. In fact, what happened in Chennai required a thorough preparedness system for adaptation of the communities to the unavoidable disasters descending upon them. It is here that the adaptation strategy to help communities adapt/ survive due to the effects of climate change was most appropriate.

These two strategies, mitigation (trying to reduce generation of GHGs which cause climate change) and adaptation-coping with the effects which cannot be avoided anymore), are intricately linked - the more we mitigate, the less we have to adapt (Adaptation to Climate Change, GLCA, 2009).

In today's world, ever since awareness of climate change started growing and policy makers developed initiatives

in addressing the climate change phenomenon, the focus was mostly on mitigation and hardly on adaptation, though it was realized that adaptation was urgently needed too.(Schipper, 2006; Tol, 2005, Klein et al., 2007). Also throughout history, mitigation and adaptation were regarded as two fundamentally different approaches to the same problem,ignoring possible synergies and trade-offs between them.

However, recently in research and in general literature the potentials of combining both approaches have been considered within the scientific community ( Burch and Robinson 2007, Dowlatabadi, 2007, Goklany 2007, Jones, Dettmann, Park, Rogers, and White 2007, Klein et al. 2007, and Swart and Raes, 2007). Also, it has emerged that they need to be integrated because they both influence each other… the more one mitigates, lesser is the need for adaptation.

## Mitigation Strategy

There have been extensive research, seminar discussions, conferences, and international forums on building awareness of mitigation strategies with the objective of reducing the generation of GHGs. (Climate Change ADB Programs, 2007, Joint MDB Report 2008, Munasinghe, 2008).

Some of such mitigation initiatives are as follows: Please see Table 1.

**Table 1: Some Common Mitigation Initiatives at the Individual Level**

| |
|---|
| Preventing/protesting against trees to be cut down, because trees absorb CO2, a green -house gas |
| Planting trees, |
| Using solar lighting system, solar energy is a form of clean energy |
| Using energy efficient lighting, less generation of GHG |
| Switching off lights when additional light is not needed in the room, |
| Using LED based decorative lighting, LED lighting generates less GHG |
| Using system to capture methane gas from landfills,so that methane does not go to atmosphere |
| Using emission free cars, |
| Reducing car trips and reducing consumption of gasoline, |
| etc. |

(reference: Climate change, ADB Programs… Strengthening Mitigation and Adaptation in Asia and the Pacific, 2007)

In addition there are mitigation initiatives at the organization level. These are as follows.

**Please see Table 2.**

**Table 2: Mitigation Possibilities at Organization Level**

| |
|---|
| Using climate change friendly production system and cooling system, which do not generate GHGs. |
| Use input materials which do not produce GHGs. |
| Using cleaning agents which do not generate GHGs. |
| Using boilers which do not produce GHGs |
| Ensuring that buildings have adequate insulation in order to minimize the energy needed for cooling in summer. |
| Ensuring that natural light is used where possible in order to reduce demand for lighting. |
| Using solar energy in production, |
| Producing products which do not generate GHGs upon use by customer. |
| Etc. |

(reference: Climate change, ADB Programs…Strengthening Mitigation and Adaptation in Asia and the Pacific, 2007).

## Adaptation Strategy

Adaptation in the context of climate change refers to how communities, groups of people, sectors, regions or even countries develop systems to better cope with the impacts of cc. (Brooks, 2005, Smit et al. 2003, Pielke, 2007) Also in the climate context adaptation is defined as the adjustments in individual groups and institutional behavior in order to reduce society's vulnerability to climate. The adaptation process can be anticipatory and/or reactive, and could be autonomous or planned (Fankhauser et al., 1999; Smit et al., 2000).

Adaptation strategies are often specific to local conditions and are locally relevant action plans aimed at reducing climate-related risks. These action plans are community-based development projects that are meant to promote information sharing, develop early warning systems (to warn of an impending calamity) and preparedness plans, develop more diverse crop strains that can withstand a variety of conditions (heat, drought, salt, etc.), bolster social capital and resilience, increase storage capacity for fresh water by building reservoirs or by recharging aquifers, improve public health infrastructure, and bolster disease surveillance. These strategies would be valuable regardless of the exact impacts of climate change at a particular time or location.

(GEF 2009).

Adaptation strategies are therefore evolved or should be developed looking at the exact nature of vulnerability of the target communities, who are in danger of climate change impacts and suited to help them best adapt to address the impacts… totally specific to local conditions (Kelly and Adger, 2000; Downing, 2001; Turner et al., 2003; Smit and Pilifosova, 2003; Yohe et al., 2003; Adger, 2006).

## Involvement of Corporate Managers to Address Climate Change Concerns

As observed by India last year, when the Chennai flooding happened in Nov/Dec 2015, the city was totally caught unaware as to what to do and were unprepared.

Chennai has always been strongly affected by hazards related to climate change, due to proximity to the coastal zone and the increase of heavy rainfall events during the monsoon season. There have been initiatives to address flooding because this hazard arises most often and affects many people in Chennai. Also it has been noted that resilience could be improved by strengthening adaptation measures, especially in the slum areas that were considered to be the most vulnerable because of the greatest exposure to climate change problems, least resilient and lack of proper drainage system etc. (Potarazu, Sreedhar, 2015), http://www.cnn.com/2015/12/19/opinions/ potarazu-chennai-flooding.

All the same, when the Nov 2015 flooding calamity happened and continued for few weeks, it was felt that if corporate organizations were involved and organized to address such issues, the miseries of communities could have been widely lessened. Also during the floods huge number of manufacturing units of SME category were washed off and endured huge losses in monetary terms. Much of this could have been avoided if proper know-how was available in advance. (Urban resilience to adaptation to climate change in Chennai, 2014).

In the face of this uphill task of combating climate change, the paper proposes to explore if it would be feasible to involve the private sector, over and above governmental and NGO initiatives, in working towards mitigation and adaptation strategies to reduce the generation of GHGs and also help build the capacity for the vulnerable poor to survive the adversities caused by climate change. (Owens, 2000, Pidgeon et al., 2003; Norton and Leaman, 2004). So far, the involvement of the private sector in the climate change issue has primarily been only in the realm of mitigation strategies and carbon trading, where a company reduces the emission level, equates the reduction to what is called a certified emissions reduction (CER), and sells it to countries that need CER. However, though emission saving is achieved at the world level, carbon trading does not necessarily and directly lead to adaptation or reduction in vulnerability for the poor, which might be an urgent need in today's world.( McCarthy et al., 2001).

Also, after policies regarding mitigation and adaptation have been designed, it would be necessary to translate the policies into action plans, implement them in real terms and bring about actual changes in abatement in climate change. (Halady and Rao, 2010). Preclude to this would be enhancing the awareness to the impacts of climate change as well as to initiatives which do exist to address the challenge (Burgess et al., 1998).

For the private sector, especially for small and medium enterprises (SMEs), it is very important to know what exactly to do in the face of cc calamities…how to make their own businesses resilient. While climate change poses a number of risks to vulnerable communities and businesses around the world, many opportunities are unfolding for private companies to implement actions towards reducing risks to their business operations, as well as investing in adaptation action in vulnerable regions in a sustainable and profitable manner.

Adaptation activities for corporate organizations may thus relate either to ensuring the resilience of business operations, or the provision of technologies or services that assist in the adaptation for vulnerable communities. (http://unfccc.int/adaptation/workstreams/nairobi_work_programme/items/6547.php).

However, a thorough knowledge base and awareness would be needed for building up the mindset of corporate managers,for them to take up planning and preparedness in effective and organized manner. It is believed that such awareness and knowhow could be imparted to the managers' right from the time they take up their educational degrees…perhaps from the MBA days.

## The Role of MBAs and Business Schools

Higher education programs such as MBA should often have an obligation to create campus climate-action plans that address the curricular component of this problem. (Tare, M, 2016, http://www.triplepundit.com/2016/02/how-institutions-of-higher-education-can-address-climate-change/)

The Carbon Commitment (formerly the American College & University Presidents' Climate Commitment or ACUPCC) is such a "high-visibility effort" to address climate change by creating a network of colleges and universities that have committed to neutralize their greenhouse gas emissions and accelerate the research and educational efforts of higher education to equip society to re-stabilize the earth's climate.

The Carbon Commitment seeks to create connections with higher educational institutions in order to carry out two goals: to make an agreement with these colleges and universities that they will commit to eliminate their net greenhouse gas emissions from specified campus operations and to focus on education and the institutions' ability to promote research of sustainability programs and empower the "higher education sector to educate students, create solutions, and provide leadership-by-example for the rest of society".

Being in positions of leadership MBAs have often had the opportunities to not only make decisions that affect entire organizations, but also inspire and mentor others. However, reviews have found that most MBA programs have not seriously addressed the issue of climate change yet in their curricula (Whiteway, Parker, 2013, http://www.educationpost.com.hk/resources/mba/160308-mba-career-help-five-strategic-imperatives-for-digital-brand-building). This needs to be corrected on urgent and immediate basis.

There is considerable influence of business schools on business practitioners. An important proportion of corporate leaders hold a degree in business administration or an MBA. Not only do corporations have a significant climate footprint, but the impact of climate change on the business landscape is already noticeable. Yet, meeting the managerial challenges that climate change brings requires knowledge that is only being imparted moderately in business education and scholarship today.

The knowledge acquired during business studies is also widely applied in practice. Strategic paradigms developed or taught by business scholars such as Porter's Five Forces (Porter, 1979), the Value Chain (Porter, 1985) and the SWOT analysis are being used ubiquitously in the corporate world. Yet, even acknowledging that the managerial challenges that climate change brings requires expert knowledge and it is only being moderately addressed in business education today. (Climate change diffusion: While the world tips, business schools lagPatenaude, G., Global Environmental Change 21, 2011).

## Climate Change Topics in MBA Education in India

Outside India there are some universities that are starting to show an interest in teaching climate change topics in their MBA curricula .Some of these are termed green MBA programs such as Corporate Knights and Beyond Grey Pinstripes.But all the same, these are very few who strive to excel at teaching about the most pressing environmental challenge the world has ever faced, climate change, and how companies can profit by being part of the solution. Looking at executive MBAs, again there are hardly any such programs which cover these topics. http://www.triplepundit.com/2011/03/top-5-executive-education-programs-climate-change/.

Within India Teri University offers academic programs at the Masters level, including, MBA and Doctoral programs on Sustainability and Climate Change. (http://www.teriuniversity.ac.in/).

Their curriculum has the objective to offer MBA program combining traditional MBA structure and topics with climate change and sustainability challenge. They believe that such a curriculum to enable their MBAs would have the strategic leadership to become holistic and competent business leaders with long term perspective which will work alongside the global perspective in the future. (http://www.teriin.org/mba-admission/?utm_source=yellobar_teriu_mba2016&utm_medium=yellobar&utm_campaign=TERIU_mba_yellobar2016#programmes).

To help our country and to help Indians develop resilience against climate change calamities MBAs can take advantage of their business leadership position to make climate change and sustainability a company priority…. both for the betterment of their own operations (protecting against calamities) and reach out and help communities around them. They can use the mastery of strategizing and decision making, which they have acquired in their MBA study, to (a) look within the walls of the factory to climate-change-proof their own operations and (b) to look beyond the walls of the factory to help communities adapt and survive the disaster impacts of climate change. This leads to our research question.

## Research Question

The current research explores what categories of Climate Change topics can be included in the MBA curriculum to make aspiring business leaders aware of possible actions which exist for them to address climate change and also to inspire them take up such initiatives to address climate change.

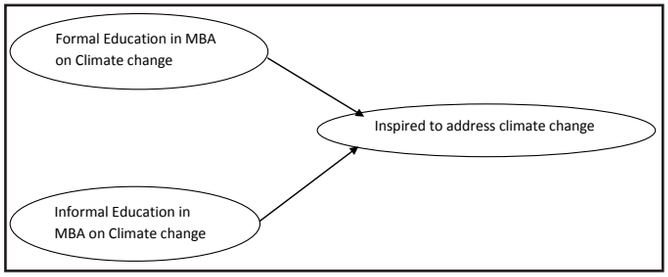


**Fig. 1: Research question: Do Formal and Informal Education in MBA Lead to Inspire Corporate Managers to Address Climate Change Impacts… both in Mitigation as Well as in Adaptation Context**

## The Research Methodology

In the absence of extensive literature and published documents on the topic of MBA education and climate change strategies, it was decided to use a research instrument in the form of a questionnaire and get responses from corporate managers as to their agreement on what categories of topics on climate change could have and should have been included in their MBA curriculum… so that they would have been aware of what initiatives they may pursue, to address climate change and they would have developed an inclination and inspiration to pursue the same.

**Research Instrument… a Survey Questionnaire**

It was proposed that the research instrument, the questionnaire, would present different climate change related topicsto the respondent and ask him/her how important that topic will be to be included in the MBA curriculum.(Formal education on Climate Change).

**These topics would include following items as given in Table 3**

**Table 3: MBA Including Formal Education On**

| |
|---|
| * reasons which caused climate change |
| * negative health impact of cc, |
| * rise of diseases and morbidity impact of cc, |
| * lack of food and clean water due to cc, |
| * impacts of cc such as glaciers melting, sea level rising etc. |
| * impacts of cc on poor, vulnerability of poor, |
| * international agreements on cc, |
| * how important is cc in the global scenario. |
| * different ways to reduce generation of GHGs, |
| * possible organizational initiatives to reduce GHGs, |
| * use electrical systems with reduced GHG generation, |
| * use less power, go for renewable energy, |
| * conserve electricity, water and other resources., |
| * use transportation systems that reduce GHGs, |
| * use solar lighting systems etc. |
| * possible ways to help communities set up systems to address impending impacts of cc. |
| * possible ways to help communities combat prevalence of disease. |

| |
|---|
| * water availability impacts due to climate change |
| * vulnerability of poor due to cc, |
| * possibility of initiatives to help communities adapt to impacts of cc, |
| * ways to build awareness to mitigation strategies, |
| * adaptation strategies such as developing early warning systems, |
| * adaptation strategies such as predicting Rainfall patterns, |
| * adaptation strategies such as helping communities in building resilience, |
| * adaptation strategies to Reducing vulnerability of affected communities, |
| * adaptation strategies such as developing crops which can withstand climatic hazards. |
| * adaptation strategies such as developing Risk management and risk reduction |

In addition, it was also proposed to obtain importance ratings from the respondents on Informal education/ seminars on cc organized by MBA school, MBA school being a green campus, MBA school using solar energy for lighting and/or water heating, MBA School having bio-gas generation plant using kitchen waste etc., MBA School having waste water recycling plant.

## Population, Sampling and Data Collection Method

The empirical research was conducted on a population of MBA students in their last term before graduation. They had work experience between 2-15 years, before they joined MBA. The MBA schools considered for the research were IIM Ahmedabad, Great Lakes Institute of Management, IIM Kolkata, Indian School of Business, IIT Mumbai and Myra School of Business. The survey questionnaire was digitalized by online survey portal called study & Survey. Com. The link was extended to the population of students in these MBA schools.

A total of 95 survey responses were received, with margin of error of 10%.

**Developing constructs on formal education on Mitigation strategies, Adaptation strategies, Impacts of Climate Change, Climate Change relevance and Informal exposure/seminars on climate change.**

In the questionnaire that was constituted as the research instrument, there were items on each of the above themes such as Mitigation strategies, Adaptation strategies, Impacts of Climate Change, Climate Change relevance and Informal exposure/seminars on climate change. The respondents were asked to give their importance ratings on a 4-point likert scale to each of them.

The constructs and the items (exact questions) which constituted them were:

Please rate the aspects of MBA education you feel are important to be included in the MBA curriculum.(Formal education on Climate Change)

## Formal Education on Impacts of Climate Change

Formal education on negative health impact of cc,

rise of disease and morbidity impact of cc,

lack of food and clean water due to cc,

impacts of cc such as glaciers melting, sea level rising etc., vulnerability of the poor, and water non availability impacts of climate change.

## Formal Education on Mitigation Strategies

Formal education on building awareness to different ways to reduce generation of GHGs individually, Organizational initiatives to reduce GHGs,

Initiatives to use electrical systems with reduced GHG generation,

use less power,

go for renewable energy,

Encourage organizations to conserve electricity, water and other resources,

Use transportation systems to reduce GHGs,

use solar lighting systems etc.

## Formal Education on Adaptation Strategies

Formal education that there are ways to help communities set up systems to address impending impacts of cc. and combat prevalence of disease.

Initiatives to help communities adapt to impacts of cc,

Adaptation strategies such as developing early warning systems,

adaptation strategies such as predicting Rainfall patterns, helping communities to building resilience,

Reducing vulnerability of affected communities developing crops which can withstand climatic hazards, Developing Risk management and risk reduction

### Formal Education on Relevance of Climate Change in todays' world

Formal education on international agreements on cc, Formal education on how important is cc in the global scenario.

### Informal Education/Seminars in MBA School

Informal education/seminars on cc organized by MBA School

MBA School being a green campus equipped with solar energy, waste recycling etc. MBA School using solar energy for lighting and/or water heating MBA School having bio-gas generation plant using kitchen waste etc. MBA School having waste water recycling plant

### Additional questions

In addition to asking respondents to give importance ratings to each of the above items under each construct, the respondents were also asked the following questions:

*During your MBA was any course offered on:

Environmental Sustainability

Causes and Impacts of global warming/climate change

*Did you take up such a course?

The respondents were also asked

*The Business School where you did your MBA did it have a

Green campus
Solar water heating system
Solar lighting system
Environment friendly waste recycling system
Water recycling system
Bio-gas generation system

Finally, the respondents were asked to what extent they were inspired to take up mitigation and adaptation initiatives as corporate managers.

### Inspired to take up Initiatives to address Impacts of Climate Change.

*D1: How inspired are you to take up initiative to reduce generation of GHG (mitigation)?

*D2: How inspired are you to take up initiative to help communities set up systems to combat impacts of cc(adaptation)?

## Structural Equation Modeling (SEM) to Address the Research Question

In order to explore the research question, if inclusion of climate change related topics in MBA curriculum would inspire them take up initiatives to address climate change, a linear SEM approach was used (Jo¨reskog and So¨rbom, 1993). This approach was applied to explore the causal relationships between the different latent constructs explained in the previous section, such as: Formal Education on Impacts of Climate Change, Formal Education on Mitigation Strategies, Formal Education on Adaptation Strategies, Formal Education on Relevance of Climate Change in todays' world, Informal education/ seminars in MBA School and Inspired to take up Initiatives to address Impacts of Climate Change.

SEM estimates a series of separate but interdependent multiple regression equations simultaneously. The research has drawn upon the theory and the research objectives to determine which independent variable will predict which dependent variable. The proposed relationships were then translated into a series of structural equations for each dependent variable.

The significance of the overall models was determined by the chi-square value, the corresponding degrees of freedom and the associated overall p-value with the significance of 0:05 which would be required to be more than 0.05.

The individual linkages between any two constructs were tested using the critical ratio, which would be required to be > 1.96 for significance at 5% level of significance.

The confirmatory factor analysis, CFA, under the general category of structural equation modeling, was used to validate the conceptual model involving the constructs using AMOS Graphics for Windows, estimating the regression weight of each link (arrow) and the associated significance.

The estimation procedure used was under the maximum likelihood estimation (MLE) procedure, which was known to provide valid results with sample sizes as small as 50. In addition to overall model p-value, the indicator defined as chi-square/degrees of freedom, Goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and root mean square residual (RMSR) were additional indicators used to evaluate the validity of the model.

The Chi square/ degrees of freedom should be < 2 for a good fit.

Several sets of analyses were conducted which included iterations of sets of structural equation models that were run to test variations of the model with alternate paths to assess the importance of aspects of the conceptual model.

The model was designed using IBM-SPSS-AMOS Version 20.0.0(Build 788). The outcome of the structural equations among the latent constructs yielded the results as given below. Please see Table 4.

Results for Data Analysis by Structural Equation Modeling

**Table 4: Measures of Goodness of Fit**

| *Chi-square/degrees of freedom* | = | *0.826* |
|---|---|---|
| Overall model p-value | = | 0.936 |
| GFI | = | .892 |
| NFI | = | .893 |
| CFI | = | 1.000 |
| AGFI | = | .840 |
| RMSEA | = | 0.000 |

The Maximum likelihood estimates are as given in Table 5

**Table 5: Maximum Likelihood Estimates: Regression Weights: (Group number 1 - Default model)**

| | | | *Estimate* | *S.E.* | *C.R.* | *P* |
|---|---|---|---|---|---|---|
| formal education on CC impact | <--- | informal education on CC | .532 | .220 | 2.414 | .016 |
| formal education on adaptation | <--- | Formal education on impact of climate change | .779 | .183 | 4.251 | *** |
| formal education on adaptation | <--- | informal education on CC | .536 | .203 | 2.642 | .008 |
| formal education on mitigatation | <--- | formal education on | .994 | .198 | 5.009 | *** |
| formal education on world | <--- | adaptation | .784 | .188 | 4.165 | *** |
| Inspired to address CC | <--- | formal impact education | -.294 | .333 | -.884 | .377 |
| Inspired to address CC | <--- | formal world education | .171 | .114 | 1.499 | .134 |
| Inspired to address CC | <--- | informal education on CC | .307 | .269 | 1.143 | .253 |
| Inspired to address CC | <--- | formal education on mitigation | -.351 | .201 | -1.744 | .081 |
| Inspired to address CC | <--- | formal education on adaptation | 1.034 | .488 | 2.118 | .034 |

Based on the Maximum Liklihood Estimates, their significance levels and critical ratios, the following significant links emerge.

## Significant Links in the Final SEM model as observed above

(1) Informal MBA education on Climate change → Formal MBA education on Climate Change Impacts.

(2) Formal MBA education on Climate Change Impacts → Formal MBA education on Adaptation strategies

(3) Formal MBA education on adaptation → Formal Education on Relevance of Climate Change in todays' world

(4) Formal MBA education on adaptation strategies → Formal MBA education on Mitigation strategies

(5) Informal MBA education on Climate change → Formal MBA education on Adaptation strategies

(6) Formal MBA education on Adaptation strategies → Inspired to take up Initiatives to address Impacts of Climate Change.

From the results it emerges that Informal education in the MBA school regarding the campus being equipped with conservation initiatives, climate change and renewable energy initiatives as well as seminars/workshops organized on climate change, lead to formal education on climate change impacts being included in the curriculum.

The informal system of education also leads to formal education on adaptation initiatives being included in the curriculum, which again leads to Relevance of Climate Change Education in Today's world.

**The only construct which directly leads to MBAs being inspired to address climate change concerns is formal MBA education on adaptation which however is impacted by Informal MBA education on Climate change.**

The results therefore indicate that in order to get the private sector/corporate managers inspired to take up initiatives to address climate change, MBA education should include adaptation topics in the MBA curriculum, which has direct link to them taking up such initiatives. At the same time, one observes the indirect link which informal education on climate change has on inspiring managers to take up initiatives to address climate change… and encourage MBA schools to also organize seminars/workshops on climate change in the campus. Also this informal education would essentially require campus being climate change friendly, use conservation systems, waste recycling systems, bio gas generation systems and renewable energy such as use of solar energy wherever possible.

Hence the link to private sector/corporate managers get inspired to take up initiatives to address climate change, starts with informal education that would essentially require campus being climate change friendly, etc. This finding is of tremendous value because it tells all MBA campuses to start becoming Climate Change & Sustainability friendly that will inspire outgoing managers to be inspired.

## References


Adger, W. N. (2006). Vulnerability. *Global Environmental Change,* 16(3), 268-281.

Asian Development Bank. (2007). Climate change ADB programs: Strengthening mitigation and adaptation in Asia and the Pacific.

Brooks, N., Adger, W. N., & Kelly, P. M. (2005). The determinants of vulnerability andadaptive capacity at the national level and the implications for adaptation.*Global Environ. Change,* 15, 151–163.

Burch, S., & Robinson, J. (2007). A framework for explaining the links betweencapacity and action in response to global climate change. *Climate Policy,* 7(4), 304-316.

Dowlatabadi, H. (2007). On integration of policies for climate and global change. *Mitigation and Adaptation Strategies for Global Change,* 12(5), 651-663.

Downing, T. E. (2001). Climate Change Vulnerability: Linking Impacts andAdaptation. Report to the GoverningCouncilofthe UnitedNationsEnvironment Programme. Environmental Change Institute, Oxford, UK

GEF. (2009). *Facilitating an international agreement on climate change: Adaptation to climate change*.

Fankhauser, S., Smith, J. B., & Tol, R. S. J., 1999. Weathering climate change:some simple rules to guide adaptation decisions. *Ecological Economics,* 30, 67-78.

Goklany, I. M. (2007). Integrated strategies to reduce vulnerability and advanceadaptation, mitigation, and sustainable development. *Mitigation and Adaptation Strategies for Global Change,* 12(5), 755-786.

Halady, I., & Rao, P. (2010).Does awareness to climate change lead to behavioral change?, *International Journal of Climate Change, Strategies and Management* (UK: Emerald).

Jones, R. N., Dettmann, P., Park, G., Rogers, M., & White, T. (2007). The relationship

between adaptation and mitigation in managing climate change risks:a regional response from North Central Victoria, Australia. *Mitigation and Adaptation Strategies for Global Change,* 12(5), 685–712.

Kelly, P. M., & Adger, W. N. (2000). Theory and practice in assessingvulnerability to climate change and facilitating adaptation. *Climate Change,* 47, 325-352.

McCarthy, J., Canziani, O. F., Leary, N. A., Dokken, D. J., & White, K. S. (2001*). Climate Change*: *Impacts, Adaptations and Vulnerability in Developing Economies,* World Bank, Washington, DC.

Munasinghe, M. (2008). *Addressing the Sustainable Development and Climate Change Challenges Together: Applying the Sustainomics Framework.* Procedia Social and Behavioral Sciences, 41(2010), 6634-6640.

Norton, A., & Leaman, J. (2004). *The day after tomorrow: Public opinion on climate change.*

MORI Social Research Institute, London.

Owens, S. (2000). Engaging the public: Information and deliberation in environmental policy.

*Environment & Planning A,* 32, 1141-1148.

Pidgeon, N., Kasperson, R. E., & Slovic, P. (2003). *The social amplification of risk,* Cambridge University Press, Cambridge

Pielke, R. A., Prins, G., Rayner, S., & Sarewitz, D. (2007). Climate change 2007: Lifting the taboo on adaptation. *Nature,* 445(7128), 597–-598.

Porter, M. E. (1979). How competitive forces shape strategy. *Harvard Business Review,* 57, 137-145.

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance.* Free Press, New York.

Potarazu, S.(2015). Chennai floods a climate change wake-up call for world. Retrieved from http://edition.cnn.com/2015/12/19/opinions/potarazu-chennai-flooding/index.html

Schipper, E. L. F. (2006). Conceptual history of adaptation in the UNFCCC process. *Review of European Community & International Environmental Law,* 15(1), 82-92.

Smit, B., Burton, I., Klein, R. J. T., & Wandel, J. (2000). An anatomy of adaptation toclimate change and variability. *Climatic Change,* 45(1), 223-251.

Smit, B., & Pilifosova, O. (2003). From adaptation to adaptive capacity and vulnerability reduction. In: Smith, J.B., Klein, R.J.T., Huq, S. (Eds.), *Climate Change, Adaptive Capacity and Development.* Imperial College Press, London., UK, 51-70.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environ. Change,* 16, 282-292.

Swart, R. J., & Raes, F. (2007). Making integration of adaptation and mitigation work:

Mainstreaming into sustainable development policies? *Climate Policy,* 7(4), 288-303.

Tare, M. (2016). *Climate Change and Sustainability in the curriculum. Institute for Sustainability and Global Impact at the University of Texas at Arlington*

Tol, R. S. J. (2005). Adaptation and mitigation: Trade-offs in substance and methods. *Environmental Science and Policy,* 8(6), 572-578.

Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., Eckley, N., Kasperson, J. X., Luers, A., Martello, M. L., Polsky, C., Pulsipher, A., & Schiller, A. (2003). *A framework for vulnerbility analysis in sustainability science.* Proceedings of the National Academy of Sciences 100, 8074-8079.

United Nations Climate Change Conference.(2009). Retrieved from https://en.wikipedia.org/wiki/2009_United_Nations_Climate_Change_Conference.

UNFCCC. (1992). *Poverty and climate change: Reducing the vulnerability of the poor.*A contribution to the eighth conference of the Parties to the United Nations Framework Convention on Climate Change.

Yohe, G., Strzepek, K., Pau, T., & Yohe, C. (2003). Assessing Vulnerability in the context of changing socioeconomic conditions: A study of Egypt. In: Smith, J.B., Klein, R.J.T., Huq, S. (Eds.), *Climate Change, Adaptive Capacity and Development.* Imperial College Press, London.