

SOCIALLY CONSTRUCTED NARRATIVES FOR
EXPLORING THE IMPACTS OF AIR POLLUTANT
INFILTRATION IN BUILT ENVIRONMENTS

By
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A Dissertation Submitted to the Faculty of the
GRADUATE INTERDISCIPLINARY PROGRAM IN ARID LANDS
RESOURCE SCIENCES

In Partial Fulfillment of the Requirements

For the Degree of

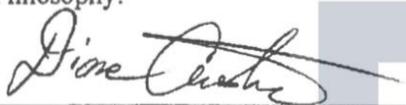
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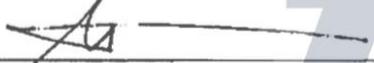
In the Graduate College
THE UNIVERSITY OF ARIZONA

2018

THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

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ACKNOWLEDGEMENTS

This work would not have been possible without the financial support of the Comisión Nacional de Ciencia y Tecnología (CONACyT) in Mexico and its Beca para Estudios en el Extranjero, The Graduate College, the Graduate Interdisciplinary Programs, the Global Change Minor, the Sloan Foundation and the Arid Lands Resource Science Program. I am especially indebted with the late Dr. Teresa Velez since, thanks to her efforts, I was able to pursue my graduate studies. I am grateful to my Dissertation Committee with whom I have had the pleasure to work during this interdisciplinary study. I want to specially acknowledge Dr. Diane Austin, chair of my Dissertation Committee, who has been supportive of my career goals and who worked actively to provide me the protected academic time to pursue these goals.

Nobody has been more important to me in the pursuit of this journey than my children Ana, Gerardo and, especially, Barbara without whose help and unconditional efforts I would not be in this stage. Their optimism, strength, and wisdom inherited from my beloved grandmother Anita are the backbone of my life. I would like to thank my parents, my friends Marylou Myers, Adriana Zuniga, Velina Underwood, Miriam Rojas, Laura and Stephanie McAndrews, Daniela Diamente, Ignacio de los Rosales, Antonio Uribe, Carlos Nagel, David Soren and Elena Parra, who provide unending support and inspiration.

**To my children Barbara, Ana and Gerardo and my father, the four people
for whom I have a purpose in life and to my grandmother Anita who
introduced me to the values of perseverance, love, and optimism.**

“All we need to do is make sure we keep talking”,

Stephen Hawking

(“Keep Talking” Pink Floyd, 1994)

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ABSTRACT

This dissertation is an autoethnographic (self-guided) interdisciplinary process done by an empathetic entity (me) who noted a problem sorting out the effects of outdoor air pollutants that infiltrate indoors from those of other indoor pollutants. This problem is the lack of understanding by architects, planners, and other experts of relevant implications of their lack of attention to the infiltration of airborne dust indoors in the arid regions of Arizona. This systematic process of informed reflections is written in a continuous narrative, and breakouts or Vignettes. Each Vignette corresponds to a topic directly relevant to the research and contains the evidence that answers an inquiry followed by a reflection based on my experience and observations. In the study of arid lands, autoethnographic Vignettes provide an alternative approach for taking a scientific point of view to reveal complex interactions between the natural and built environments for arid regions and other regions that may experience drier and warmer climatic conditions in the future.

INTRODUCTION

This research is a self-guided process based on a social science method called Autoethnography. Autoethnography is a context-conscious qualitative research methodology that incorporates deep descriptions of the evidence and personal reflections (Reed and Danahay, 2009). This method allows in-depth research on a phenomenon, as described by (Husserl, 1970). I adapted it to address my lived experience as a participant observer in the arid region of southern Arizona with the focus being the built environment in its role of providing adequate shelter for the human occupants of this region. In this dissertation, I describe my experience in the PhD program in Arid Lands Resource Sciences at the University of Arizona (UA) as a process of understanding and interpreting informed observations. As for answering: what is the current state of knowledge about the environmental, global change, air quality and indoor conditions that promote the infiltration of airborne dust, and the opportunities to address what I perceived as low interest and lack of clarity in the roles of institutions and decision makers in these areas, this effort is premised on the fact that in systematically communicating our findings during the observation of specific situations, we will reveal gaps that will lead us toward innovation as we try to fulfill our commitment to the well-being of humanity.

Context of the research

My research originated years ago when I was working as an architect in Mexico City. Initiating an inquiry about air quality to solve a family's concern about one of their children with asthma, I aimed to examine and explain the intimate connection between the design and building process and human exposure to air pollution. At that point I thought that the problem was a design and

behavioral problem that could be solved by learning some new strategies and bringing awareness to architects and users. However, during the process I realized connections between building design, the natural environment, and the impacts of outdoor generated pollutants on human health were not even considered, and instead, any efforts to manage indoor air flow were undertaken as a ventilation-temperature control matter. After entering the PhD program, I attempted to discover and reveal unknown factors affecting indoor air quality and identify the variables that determine human risk in the residential sectors in Sonora and Arizona. However, as I reviewed the literature searching for precise data, the list of variables that could affect air quality continuously expanded, and I realized how complicated are the factors related to indoor air quality. Another realization I had during this period was that the built environment is an entity that is constantly updated through technological innovation that becomes standardized and that this change is happening at a different pace than the codes that regulate that environment. All these preliminary observations made it clear that my original inquiry about the relationship between the regional environmental conditions and the indoor air quality was just as part of a greater topic for research, and it is this that my study will explore. Ultimately, I was interested in the environmental, global change, air quality and indoor conditions that promote the infiltration of airborne dust as well as opportunities to address this infiltration. Based on the fact that my small problem had quickly become a complex phenomenon and in the face of climate change more pollutants will be generated outside and may make their way inside, I decided to write my dissertation as an Autoethnography, a systematic process of collecting and reflecting upon data using various methods during four phases, to describe the current state of knowledge about the areas of my concern focusing on what I perceived as low interest from the architecture community and also lack of clarity in the roles of institutions and decision makers in these areas.

The preliminary phase of my inquiry began in Mexico but continued during the early years of my PhD program as I attended classes and read literature on a wide range of topics and participated in an assessment of air quality with the intent of reducing children's exposure to pollutants while in daycare. After the preliminary phase of my inquiry, I concluded that there are many factors that affect indoor air quality and its effect on human health. I also noted that research on the topic is focused mostly on pollutants generated indoors from materials, operations, human and animal activity, and mechanical systems. All of these elements are present in all kinds of geographies. Therefore, the implications of the outdoor conditions remained unclear, and other questions regarding how policy and decision makers are considering (or not) outdoor sources of pollutants rose.

I moved into the middle phase of my research to address what for me were unclear implications of the outdoor conditions and their effect on health, and how these implications are relevant to decision makers. During this phase, I conducted a participant observation at National Conference of the American Institute of Architecture, an independent study in the House Energy Program of the College of Architecture, Planning and Landscape Architecture focused in finding the implications of natural and mechanical ventilations in a residential building in midtown Tucson. I attended to a workshop focused in indoor exposure to dust and the McCrone Institute in Chicago, IL, and to the International Conference Healthy Buildings America 2015.

Based on my conclusions from the above experiences and the findings of a literature review I took a step further and conducted a participant observation at a conference in field-related topic to buildings but that is not focused in architecture: Design-Built Institute of America Conference

2016 which with its goal of bringing more active collaboration of specialist in the design process helped me to be aware of other roles in this process that I was missing while focusing in the perspective of the architects. This phase of my research also included semi-structured interviews with professionals and experts. Using a chain referral (snowball) method, I invited architects, planners, and experts in agencies in different jurisdictions and areas relevant to air quality to participate in interviews. The semi-structured interviews were conducted during an eight-month period from January 2017 to August 2017; a total of fifteen professionals and thirteen experts participated. The interviews consisted of open-ended questions to find 1) the broader concerns of the participants; 2) the responses to direct questions about the environment, climate change, and air quality topics; and 3) the comments after the participants interacted with a visual aid that summarized the major finding in the literature review.

In the final phase of my inquiry, I decided to take advantage of the fact that autoethnography also allows adding field notes and relevant experiences even if they happened before the study were officially begun. This approach allows bringing all sources of information as a form of triangulation of patterns observed during other steps in the process (Buckley, 2015). Using this approach, I was therefore able to utilize knowledge I gained while being immersed in the local society as well as my architectural and planning background and a series of reflections I wrote while completing my coursework to address topics that emerged in the middle phase of my inquiry.

Autoethnographic Vignettes and their utilization

The method of analysis I used for this study is the Autoethnographic Vignette. The Vignette is an analytical and representational strategy through which the researcher records individual events or discoveries and then reflections on each of them. In my writing I connect Vignettes and reflections

as a stream of events (narrative). I use a total of thirty-eight Autoethnographic Vignettes during two of the four phases of my research as an alternative approach for presenting and then reflecting on scientific evidence to increase the general understanding of a socially constructed situation. Examples of socially constructed situations in arid lands would be any phenomena that include a concept or group of concepts that can have different meanings across the population or stakeholders (Husserl, 1970). An autoethnography recognizes the value of the researchers as participants of the observed population, their background and experience in the field and their informed reflections. It also recognizes the value of the process posing human interest as a driver of science, as explained in Easterly-Smith, Thorpe, & Jackson (2008), allowing notes and findings from in and out of the structured methodologies to be brought into the process, and incorporating knowledge from any phase of the research.

Each Autoethnographic Vignette became an analytical strategy to reveal a discovery (Erickson, 1986; Humphreys, 2005). Denzin & Lincoln (1998) claimed that autoethnographic Vignettes are narratives enhanced by the researcher's self-reflexivity (Ellis, 1998). In my approach, the interactions implied in the outdoor and indoor conditions that promote the infiltration of airborne pollutants and the roles of institutions and decision makers in these areas are revealed by merging typical autoethnography with scientific investigation. My analytic units (Vignettes-Reflection) include the evidence and references to my sources in the Vignette and I describe my observations in the Reflection. This interaction becomes a systematic way that highlights paying specific attention to small pieces of information with the purpose of extracting only the parts that contribute to the stream of findings. The stream of finding or narrative starts in the introduction of each phase

and ties all the Vignettes and reflections into one continuous story knitting conclusions from one piece of evidence with the following inquiry.

CHAPTER ONE: PRELIMINARY PHASE

From architecture to social science

As an architect, recognizing the absence of awareness about the elemental role of a building in human health changed my life. I had always believed that architects improved the lives of people. Instead, I realized that my profession ignores human health and equilibrium with the environment as fundamental components of architectural practice.

I begin with a narrative of my initial approach to the gray area between buildings, place, and people. For people in Mexico City (my home town), air and water are top concerns. I grew up thinking that the roots of our problem were overpopulation and social injustice. Now it seems absurd that those topics were constant concerns for me personally but never spoken or even present in the conversations with my clients who were from the middle to upper economic classes. It was not until I volunteered for a research team at the University of Mexico (UNAM) that I was exposed to a different approach.

In the aftermath of the earthquake in 1985, low income housing (and all types of buildings) was for the first time required to meet minimal building standards. UNAM collaborated with the municipalities in the suburban areas of Mexico City to require illegal settlements to become compliant under an amnesty policy. My job consisted in talking with the head of each family and finding out the whereabouts of the household: numbers of family members, ages, genders, education levels, jobs, and so on. In other words, I asked standard demographic survey questions. Some meetings were easy and straightforward; most were, as expected, very difficult since the head of household was normally the husband or other patriarch and he did not feel like sharing

that information with a woman. In some cases, the women of the household were asked to give me some soda and a napkin and then leave the room. The male head of household considered that nothing that we would discuss would concern “Las Viejas” (a Spanish phrase referring to women in a dismissive way).

Because I was not comfortable with that situation, after conducting approximately fifteen meetings in a single week, I asked my supervisor not to assign me to interviews but rather have me measure the buildings and survey the utilities. In addition to my personal discomfort, I wanted to cover other areas of this project in order to have the full experience. I started measuring and surveying utilities and unexpectedly I started interacting with the wives, because who better knows how the house worked? They were asked (by the husbands) to show me where the meter was, where the bathroom was, and so on. That was my opportunity! I started talking with the women as I talked with my wealthy clients, meaning that I wanted to hear their likes and problems instead of merely answering survey questions. In my approach I tried to understand their concerns first; then, I brought up only the parts of the codes that concerned them.

The conversations were more revealing since, instead of leading talks about how to follow rules, the discussion became how each family used their house. They told me how some spaces are not even used in their houses except for reunions during holidays or how important is for the mother to have a view of the street from the kitchen. Most women preferred having a breakfast bar instead of a wall in between the dining room and kitchen; others explained how splitting the three uses of the bathrooms is easier than adding more bathrooms.

After another week, I was a known quantity in the community and one family in particular felt confident in asking me to help understand what the family doctor wanted them to do in order to help their son with asthma. I read the prescription and translated the medical jargon into my own words: no exposure to outdoor pollution (especially plants and animals), watch out for pests and mold and clean all surfaces with antibacterial products, sanitize the bedroom and eliminate carpets, curtains, and other dust catchers. The family and other people present came with a series of solutions: cover the chairs and couches with plastic, use blinds instead of curtains, keep the windows and doors closed and get some fans to circulate the air, keep the dog out, install plug-in insect killers, cut the trees in the backyard, and take off shoes before entering the house.

I heard all that advice while measuring the house. I was concerned but it never occurred to me at that moment that maybe there was a missing piece between what I was doing and this health situation. I was surveying a house for the experts to send instructions on meeting the new construction codes to ultimately save this family in case of another earthquake. However, although earthquakes are bad and destructive, this family was having a problem that could take someone's life as well. I brought that reflection to our staff meeting, and we tried to find a section in the building code where indoor air quality is addressed. We found that in some high-risk buildings operable windows and extractors are required, but not so for single family homes.

We went to the master plan of the municipality and requested the land use map for the neighborhood' we also went around the neighborhood. In other words, we looked for answers to the big problem as well as we for the individual building. Nothing at either scale addressed the prevention of indoor air quality problems.

I came back, and I talked with the whole family of four: the mother, father, and two children. We went over the use of the house, and we found out that the kid with asthma was using the room near the backyard. In addition to the tree and the plants, there was an industrial facility dedicated to manipulating chloride and other chemicals right behind the backyard wall. I was not able to tell if that fact was contributing to their son's health problem and I was not tasked with looking for the causes and solutions for this family's health concerns. Instead, I helped them accommodate the child in a room downstairs that was not exposed to the backyard. They opted to relocate him to the living room which was only used for the annual Christmas Eve dinner with extended family.

I now know the solution to the problem was naïve and the level of research that I conducted was not following any methodology; I was not even aware of the whole context of the health problem. However, the value of this experience was that I made myself aware of a blind spot in the intersection of a house, the architect, the head of household, the planners, the policy makers, and everything in between. There were so many facets to the whole experience: the illegal settlement was situated on a piece of land that was meant to be a residential development even though there was a chemical/industrial business around the corner; the gender inequality; the absence of awareness of the sources of indoor and outdoor air pollution; and the few resources for finding guidance. All of these concerns became the mission of my life today.

At that time, it took some time to find out that the simple solution was to adapt the living room as a bedroom for their son. It took an hour from when the mother and son came back from the doctor's office to when their community gave them a huge amount of advice (some of it worse than the

illness itself). It took a site visit and some reading for me to find out that there are missing pieces in the overlapping roles of decision and policy maker for the built environment. And, even further, I also realized that the problem was affecting this low-income family as it would potentially affect a wealthy family. Nothing in the building codes concerned indoor air quality for residences. I had practiced architecture for ten years without that awareness. After this life changing experience, I was no longer just an architect.

Arid Lands: my entry point to the American Built Environment

I had the opportunity to come to Arizona. Among other plans, I wanted to come to the United States to see how architecture is practiced. I believed that I was coming to a first world country where science and technology are at the reach of one's fingertips -- a place where income is exponentially more equal and where all problems are solved. That was my TV based opinion, my cover magazine idea of American cities. Upon my arrival, the first thing I noted and celebrated was that every structure had a mechanical ventilation system that I believed was a symbol of progress in a developed country. I was amazed by the fact that air filters were so cheap; I assumed that everything was under control. I remembered that case about the child with asthma, and I told myself that I would look for answers. I hoped that I could find a toolkit for Mexico to create codes and standards to control indoor air quality for low risk buildings based on what the US was doing.

My first idea for a proposal (the one that I talked about when I applied to the Master of Planning at the UA and later to the PhD program of Arid Lands Resource Science) was to compare the household management strategies for controlling air quality on both sides of the border. I thought that I could prove how to solve the problem in Mexico. I was interested in evaluating how two

populations face the same environmental issues in two different social realities. That was the beginning of my journey, the process of running into blind alleys during the first four years of my program. I tried to collect most of the related materials from classes and assignments and convert them into a relevant piece to fix the problem I wanted to solve. I explored archaeology, anthropology, geography, global change, architecture, GIS, planning, and public health classes. I also did a stint in the Bureau of Applied Research in Anthropology (BARA) for a semester to engage in air quality assessment working with the Sonoran Environmental Research Institute (SERI).

I learned skills and knowledge that helped me to understand that the equation between air outdoors, indoors, the buildings, and the user is more complicated than a simple comparison of two houses in different countries. Most importantly, I found out that the United States has the same problems regarding indoor air. Although we have codes, standards, technology and research available, people still get sick inside their houses.

No relevant findings, no problem!

I started doubting the relevance of my research. For a time, I felt hopeless because the issues that I faced along that process were not relevant enough to justify a comparison of houses. Among other factors, the cases I wanted to compare needed to be similar so that the results would show a reliable finding. In other words, I needed to find two houses with similar orientation and exposure to pollutants, like families with like behavior, even analogous jobs, academic levels, and ages. Without all those comparable attributes, the results of measuring pollutants indoors in each house would be meaningless. I would not be able to ensure that finding a specific pollutant in one house

is a sign of an environmental exposure. It could also be caused by the migration of pollutants from the person's shoes, the direction of the wind, or the fact that the family in one house is out most of the day versus another being home most of the day.

It was while working in BARA and designing an interactive activity to find out the risks that children face in daycare when I completely accepted the fact that most of the exposure depends on unpredictable factors and therefore a comparison may not prove anything. To assure that my acceptance would not be based only on my perceptions; several critical topics identified in this phase of the research will be addressed with my systematic process based on the Vignettes approach. Analyses for each topic are documented in the next two chapters in the context of outdoor pollutant infiltration and described in schematic figure 1. This figure demonstrates that the regional sources of pollutants are the human-made and natural environment (A); the paths to infiltration (B) including decisions made during design and construction; and the materials, technology, and behavior (C) that expose people indoors. Some approaches used are based on exploration and experimentation while others are based on semi-structured interviews with architects, planners and field experts. The findings are presented in a sequence that corresponds to the actual timeline of each participant observation, experiment, literature review or set of interviews. Therefore, the input to each part of the diagram is included where it was found at different moments along the research progress. Fifteen Vignettes are used in chapter 2 and twenty-three in chapter 3. All thirty-eight together cover areas that were mentioned or brought to my attention from my sources until no new significant findings were identified.

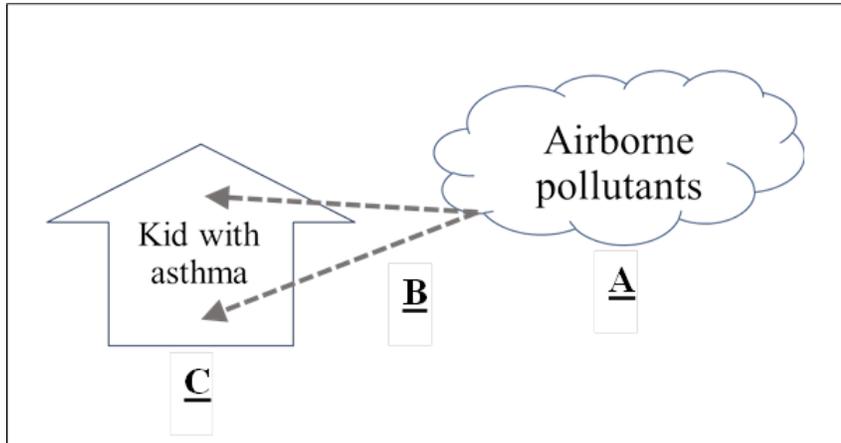


Figure 1 schematic representation of outdoor pollutant infiltration

Going back to my original problem with the child with asthma, I had five questions motivating this research: What is the social responsibility in the practice of architecture? Is indoor air quality a problem that architects can solve? Is there any relationship between the exterior environmental conditions and infiltration of air pollutants? Am I just unaware, or are there few or no sources of guidance for architects to address indoor exposure to outdoor-generated air pollutants? And, who else is involved in this problem? These initial questions and their relationship with each of the three aspects of outdoor-indoor pollutant interface (figure 2) not only expanded my knowledge but generated a series of new questions and potential fields of research.

	Natural and human made environment A	Interaction B	Building C
Chapter 2	v4: outdoor vs. indoor pollutants v5: health impacts v9: arid regions v10: climate change	v1: social justice of architecture v3: the role of architects v7: indoor air experts v8: architect as indoor air expert v15: who should be aware?	v2: sustainability and air quality v6: ventilation systems v11: infiltration v12: passive ventilation
Chapter 3	v20: expected concerns v26: unprompted environmental concerns v27: prompted environmental concerns v28: perceptions of climate change v29: climate change and the region v30: air pollutants (evidence) v31: air pollutants and the region	v16: collaboration teams v17: owners as decision makers v18: traditional versus DBI model v19: overarching professions v22: participants in the research v23: classifying information v24: what concerns architects and planners v25: broader concerns for professionals v35: solutions and perceived responsibility v38: personal experience with air quality	v21: is indoor air a concern? v32: is indoor air quality relevant? v33: context of indoor air concern
INITIAL QUESTIONS	Is there any relationship between the exterior environmental conditions and infiltration of air pollutants?	Am I just unaware, or are there few or no sources of guidance for architects to address indoor exposure to outdoor-generated air pollutants? Who else is involved in this problem? Is indoor air quality a problem that architects can solve?	
		Is there a social responsibility in the practice of architecture?	

Figure 2 Vignettes and their relationships to the three aspects of the outdoor pollutant infiltration and the five initial questions

CHAPTER TWO: MIDDLE PHASE

Explorations and experimentation

Knowing more of what I wanted to measure, I moved into the middle phase of my inquiry. I first needed to know how architects are asked to do their job, how they are educated, and what other professionals are involved in creating, maintaining, and regulating the built environment. I went to the National Conference of the American Institute of Architecture in Denver, Colorado in 2013. I wanted to know what pollutants are in the house and how the mechanical systems affect pollutants and human exposure, so I led an experiment in a house that had access to natural ventilation, evaporative cooling, and air conditioning. Having more doubts than answers, I went to a workshop on dust and household pollutants in Chicago, Illinois in 2014. Finally, before immersing myself in literature review, I presented the result of my experiment in the conference Healthy Buildings America in Boulder, Colorado in 2015. The Vignettes in this chapter are dedicated to explaining the experiences gained through my exploratory efforts.

Exploring is about hitting the road and observing. For me, arriving in the US was too confusing to explore on my own. I was not sure what I was looking for. Buildings were a mystery. I was not able to recognize good from bad, as I used to in my home country. I was ignorant of so much English jargon that I decided to go to one of the sources of information for architects: a national conference. One was announced so I thought that going to it would fast track my investigation. Conferences are planned to satisfy many interests from market and industry to political concerns. A conference is a show-and-tell that displays messages for the average professional in the field. I was exposed to the jargon and to the current trends in the field in a crowd of 25,000 attendees allowing me to participate anonymously. I attended the conference with specific goals in mind; I

wanted to learn how architects were addressing social concerns, what technology was available to address air quality concerns, and what architects and others perceived the role of architects to be.

VIGNETTE ONE: social justice of architecture

The American Institute of Architecture National Conference, Denver Colorado, 2013 is a showcase of architectural products, materials, technologies, and services as well as case studies and key notes on best practices. It is oriented to architects and architectural firms as well as to service providers, contractors and related industries. The sessions I chose to observe how the organizers presented cases involving social justice and post-disaster actions were: **Colorado Legacy Project: LEED-Certified**, this project was financed by Habitat for Humanity and the design process was led by volunteers and the design-build team and it was distinguished by its use of cross ventilation, thermal comfort strategies, sun light management and the house distribution towards best views to the mountains; **Best Practices for Engaging Community after the Joplin Tornado**, the community was seriously affected by a tornado and the emergency budget along with bureaucracy delayed the recovery and in the rush for solving the problem the government proposed a mixed-use building which will put the families to live in condos instead of houses. The people did not accept the proposal and they started a participatory project which develops in seven houses, a memorial and a park. The design addressed the immediate need of

homes and a creative urban design; **Learning from Passive House Design: The Real-World Metrics** was a seminar that talked about housing design that has five components of the Passive House Design applied: superinsulation, passive solar heat gain, air tightness, heat recovery ventilator and a floor plan featuring compact-efficient space usage. These sessions demonstrated how passive design really represents savings on energy use and maintenance. **Post-Occupancy Evaluation of a LEED¹ Platinum Home** was a session focused in demonstrating how providing clients with easily accessible data can change habits and reduce energy use; and how the architect apply the lessons from this process to other projects; and **Habits of Highly Effective Environmentalists** was a session that meant to inspire architects and rise the attention of skeptics in passive design as a way to embrace architecture as the mind behind a human natural living. In each of these sessions, presenters showed emphasis in passive design and its impacts on energy savings for addressing peoples' needs with and without facing disasters.

REFLECTION:

Fortunately, enough, topics in the area of social justice were presented. The presentations gave merit to simple innovations, such as the use of the floor plan in low income housing to give the population better views

¹ LEED: Leadership in Energy and Environmental Design

and increase resiliency by using passive strategies. These topics aroused the attention of many skeptics about passive architecture for post disaster recovery in African-American communities. However, since more emphasis was placed on the opportunities for more street-life for enjoyment and local retail, debates on the benefits and economic opportunities of sustainable solutions started to fade. It was even mentioned that in order for the home to keep serving the user effectively (not just through affordable energy costs), the sustainable goals of the US Green Building Council LEED certification and 2030 challenge would serve as motivations. I disagree somewhat with that since, as a member of both these two groups, I can ensure that most motives are still industry led.

I was looking for the highlights, trends, and topics utilized by an iconic professional membership organization that led the practices involved in the design and building process in the US. This first opportunity gave me a sense that the practices for the built environment are to demonstrate social responsibility by featuring cases where proactive initiatives were successful. The number of concepts I was exposed to allowed me to start overcoming the language barrier. Thanks to the speeches, slideshows, and videos, everything became clearer. I was able to think critically; no longer concerned with the language gap; I started finding myself identifying good practices from bad. As I mentioned in the reflection, some highlighted aspects of sustainable initiatives including the Green Building Council certification process were shown as best practices from social justice and resilience perspectives. However, I remained curious to learn how the conference would treat

applied technology for sustainability and air management. I suspected that all the good aspects of both, technology and sustainability would be featured but, the grey area in between these practices would simply be ignored, and no solutions would be forthcoming.

VIGNETTE TWO: sustainability and air quality

The sessions selected for getting closer to these topics were: **Intrinsic Sustainability: Bioclimatic Design, Performance, and Innovation** the session wanted to demonstrate how to use modeling and simulation software to analyze human connections with nature and how this can save time and offer a more accurate design solution; **Revised Sustainability Guide**, give us the updates of the current Sustainability Guide that the licensed Architects most follow in order to have their projects certified, my interest on it was to know the regulations, policies, advices, around the sustainable projects to applied them into my research and proposed adaptation plan. **Habitat Design Competition: A Case Study in Design, Sustainability, and Affordability** this session focused in the benefits that sustainability has in the occupancy period and how affordability from construction to maintenance is reachable if accurate decisions are made in the design phase; **Air Barriers Are Now Code: How to Meet the Requirements** in this session the presenters discussed how the new requirements of airtight buildings work and what constructions techniques and testing procedures exist to ensure successful outcomes; and **Air Movement**

for Energy-Efficient Comfort in Conditioned Spaces of thermal comfort to building occupants presented low-energy methods to reach comfort through managing air flow in buildings in order to better take advantage of heating and cooling systems. These sessions offered an overview of how the technology applied to make more sustainable and air quality effective design works and it is tested, regulated and measured for success.

REFLECTION:

The AIA² conference offered topics that updated my previous knowledge about the areas and applicability of proven techniques in design, construction, evaluation, and communication skills towards sustainable architecture. The participant observation happened in the two modes of panel presentations that they offer and that are identified as educational and case studies. In either mode, the sessions provided me with a sample of environmental strategies such as cross ventilation design, thermal control, and sunlight management. I believe that the conference was full of messages about the importance of sustainability, in part motivated by the rising concern of global warming as well as the emerging market for services and products that target this problem. These were highlighted as innovative strategies for high performance. The conference featured new software for modeling and simulation as a new

² American Institute of Architecture

direction for better design. Some trends that were presented on the use of software were pointing to the mechanization of more computer based operational processes in building which, contrary to a sustainable design, rely on energy use and new production of new product fabrication. With respect to the goals of this research, I perceived that the innovation related to indoor air quality is believed to be airtight buildings. In my eyes, the more a building relies on people's judgment and maintenance, there is more risk that the expected outcomes will not be forthcoming, especially if the solution relies on energy or water use.

It was also necessary for me to understand the facts that either do or do not support the role of architects as the most influential professional sector in residential buildings. The AIA conference is meant to inform architects and related professionals in many different ways. They offer various topics of interest to the individual, while the keynote speeches are for everyone. Since the audience consists of 25,000 attendees, the plenary sessions are critical. Those are two opportunities to tell people how important architects and architecture are.

VIGNETTE THREE: the role of architects

The keynote presentations were both focused on a motivational message to look at collaboration and participation of other professionals along with architects for addressing the needs and demands of communities for meeting sustainable goals. These presentations were “Design Like

You Give a Damn: by Cameron Sinclair and a speech by General Colin L. Powell, USA (Ret.) about some of the risks and rewards of being a leader.

Cameron Sinclair explored the core passion of the architect and the desire to leave the world better than we found it. He talked about an organization, Architecture for Humanity, and how communities can apply to get their support in urban and rural developments. He also shared how he became a leader in participatory projects in communities in need and/or in emergency. The value of his works are the community involvement; the local materials used in the construction, the observance of future like disasters, and the recognition of local knowledge. The Presentation of General Colin L. Powell, USA (Ret.) was about some of the risks and rewards of being a leader- challenging us to go back to our communities to lead the way forward. Growing up in an African-American community, Powell remembered those moments in his childhood when Grandma, no matter if it was your grandma or not, had the last word about what to eat, when to go home, where the couch goes and how often you wash your hands. He used those memories to exemplify the role of the members of the family as users of finalized buildings, homes, neighborhoods and cities. He emphasized the importance of remembering moments in places like alleys and emergency stairs where most of the life after school is spent and how those spaces are the less beautiful and always last in

importance for real estate, and as result of it, also less important for planners and architects, but not for people.

REFLECTION:

How are architecture and community related? This was the first thing that came to my mind when Sinclair started talking about applying the core passion of architecture to the values of community involvement. Who is the leader behind that idea -- the community doing what is proposed by the architect? Or, are the architects using their skills to make the community participate in their projects? Architecture for Humanity is an organization that brings housing options to underrepresented communities, especially after natural disasters. That made me understand that my first guess was the correct, the architect leads, and the community collaborates, bringing local knowledge.

One of the benefits of this model (besides helping people) is to learn from the participatory process and apply this knowledge to the next project. The architecture team has expertise; they add knowledge to theirs and bring new and stronger backgrounds to the projects that follow. Architects and architecture are presented in their ideal form: a problem solver with locally oriented strategies that serve people in their own context. This is what is called custom architecture and it is by far the more sustainable strategy for me.

General Colin Powell addressed another touching area in the practice of architecture. Architecture is significant in the collective memory and inspires you to look for the picture taking moments where your creation is present in key situations. There was a point during his talk when I started thinking about the ugly spaces in between buildings that normally are not well designed and are left behind as alleys and service areas. Some of these spaces are left that way on purpose since they are areas that are metered, garbage is collected, deliveries are made, and maintenance occurs. Therefore, these places are purposely designed to be ugly so people do not wander around.

Powell's very sentimental keynote address made me reflect. He is a well-known politician who recalled memories from ugly spaces since those places were the background for significant moments in his childhood that apparently drove some of his determination in life. I'm not certain this observation is an accurate depiction/location of his childhood. The significant point is that I made an observation that derived from his address. The audience (including me) was instructed to do our job in architecture keeping the user in mind, because no matter how well we design, people will inhabit those "extra" spaces. I also think that architects should be mindful because the inhabitants will remember even the not well-designed spaces with much love.

Some final notes by presenters in these sessions worked as inspirational take-home messages. One explored the core passion of the architecture and the desire to leave the world better than we found it. Another focused on the significance of memories in seeing buildings as places for people and not for functions. Both were emotional but also strategically designed to touch sensitive fibers of at least some of the more than 25,000 attendees. I think they wanted (for better or worse) to leave the impression that architects are the good guys.

Not only had I absorbed what the American Institute of Architecture wanted me to know; more importantly, my conscience told me to pay attention to these “after-thought” spaces. I was left with the sense that architecture is really paying attention to all aspects of “good practices” in the field. However, I still had to reckon with the sustainability and air management issues of design. I was able to accept the messages from the first and third Vignettes, but the second Vignette still needed work. Are technology and innovation leading to a healthier indoor environment?

I was not satisfied with what I heard. Airtight buildings versus other options (such as passive ventilation) imply contradicting design strategies. Both approaches were widely promoted during the conference; both promote sustainability and wellness. Which one is better for indoor air quality? More knowledge in this specific field was needed, and I looked for a reliable source of answers on the scientific side. I found that the McCrone Research Institute in Chicago (July 2014)

offered workshops on indoor air quality. There was one specifically on House Dust and Indoor Particles that called to me. It was the only one that was focused on the problem in general. The rest of their workshops were too specific and not adequate for my inquiry. Dust was a key word for my explorations.

At this stage, I was under the impression that indoor pollution was always about dust and that outdoor air was at fault. I knew that there were pollutants in outside air that came from combustion, but somehow, I was not aware of their connection to indoor air quality. I believed that the building served as a barrier between the indoors and outside areas and that the gasses from combustion are diluted in the air and went up to the atmosphere. This topic was discussed in three sessions at the McCrone Research Institute workshop that were mostly lectures and discussions followed by a laboratory demonstration. The following Vignettes highlight key lessons I took away from these sessions.

VIGNETTE FOUR: outdoor vs. indoor pollutants

As part of the pollutants present in air, solid particles and liquid droplets can travel long distances depending on their size. In an atmospheric scale, particles can travel from one side of the globe to the other, and some pollutants can even remain stored in the atmosphere for seasons. Air pollution impacts uninhabited and inhabited regions, and health problems have been associated with it in rural and urban environments (Mohammed, 2012). These impacts are receiving more attention since

there are challenging environments around the world (Kulmatov & Hojamberdiev, 2010).

Air pollutants are also known as airborne contaminants from chemical, physical, and biological sources suspended in a gaseous medium (Adams et al., 2015; D. E. Jacobs, Kelly, & Sobolewski, 2007). Airborne contaminants are divided into airborne dusts, sprays, mists, smokes, and fumes such as gases and vapors (WHO, 1999). Indoor air pollutants, according to the Environmental Protection Agency (EPA) in its Statistical Summary of the Buildings and their Impacts, are a matter of exposure to anthropogenic, biological, and outdoor pollutants. Indoor pollutants have been found in average households duplicating (at its minimum) the levels of pollutants outdoors (O. US EPA, 2016). Some anthropogenic sources of indoor air pollutants are: indoor combustion such as cooking, tobacco smoking, and heating devices; cleaning products; personal care products; air fresheners; pesticides; hobbies and bringing home dry-cleaned clothing (Abt & et al., 2000; Escobedo, Champion, Li, & Montoya, 2014; D. E. Jacobs et al., 2007; Kurt-Karakus, 2012; Rashed, 2008).

Focused on human exposure to indoor air quality, the workshop on Identification of House Dust and Indoor Particles was aimed at contributing to a better understanding of how to improve indoor air quality

(IAQ). It described the new rules for sustainable buildings which address IAQ to enhance the comfort of building occupants.

First, the facilitator explained the different types of outdoor and indoor pollutants. Indoor pollutants can be from outdoor sources infiltrated indoors. Infiltrated particles are added to the pollutants from indoor sources that already have been found in average households duplicating (at its minimum) the levels of pollutants outdoors (O. US EPA, 2016).

Under the microscope we observed dust samples. After observing many different samples, the facilitator explained that dust is not a pollutant per se; it is a compound that, due to electrostatic or physical forces, keeps particles of different sources together. These particles can be of different sizes as seen under the microscope. Dust can infiltrate room to room and outdoors to indoor or inside to outside, in air, or even from surface to surface depending on the particle sizes (Abt & et al., 2000; Kearney et al., 2014).

REFELCTION:

Before this workshop, I lumped all air pollutants into a single concept. I never gave them much attention as this topic was either too complicated or too generalized. I never knew the differences between pollutants depending on their source or characteristics. In fact, learning that dust is

not a single, homogenous pollutant but is a compound of particles was a huge discovery. I remember looking at the samples and identifying fibers from cells and thinking of the universe of possible origins of all those small things.

This experience opened my eyes in different ways. Some moments were disappointing as I thought how little my research would contribute to such a complicated field. But later, I decided that my contribution would focus on how the design and filtering technology are incorporated by the professionals in charge. Most importantly, I was still unaware of the whole picture of health impacts related to air pollutants and I was just starting to learn about the nature of dust.

VIGNETTE FIVE: health impacts

The particles small enough to be carried by air are called airborne particles; dust can also have airborne sizes. Airborne dust, according to The Glossary of Atmospheric Chemistry Terms, is a small, dry, solid compound of particles transported by natural forces (such as wind) and by mechanical or man-made processes such as drilling, demolishing, sweeping, or stepping (Calvert, 1990). Classifications of dust vary and can be mineral, chemical, metallic, and organic substances (Adams et al., 2015). According to the Hazard Prevention and Control in the Work Environment, these particles have different impacts on human health whether they are: 1) Inhalable (which describes the fraction inhaled through nose or mouth), 2) Thoracic (which is the fraction that penetrates

beyond the larynx), and 3) Respirable (which are those particles that penetrate to the lungs (Kulmatov & Hojamberdiev, 2010; WHO, 1999).

REFLECTION:

I was overcome with helplessness now knowing that maybe most of the health problems in our society originate from what we breathe. It may sound as if I am exaggerating, but a particle of almost anything can be inhaled and get deep into our internal systems, and there is nothing we can do to avoid it. When we were told to look through the windows of the wind tunnel, I found myself looking at the corners of the laboratory and finding dust. For the inquiry that I was pursuing, testing was irrelevant because it was clear to me that the problem is not creating more filters or even more ventilation technologies to create airtight indoors. The problem is bigger and rests on two solutions: preventing the sources of pollution and planning cities in a way that pollutants cannot reach people or coming up with a way to minimize the impacts.

Again, I had no hope. The sources of pollution and cities are already in place. Maybe this knowledge had to be discovered a hundred years ago in order to help our society. According to this workshop, outdoor particles are not as important as the concentration of indoor sources. Samples from indoor settled dust prove up the assumption that dust has more indoor sources no matter where the house is located. When I was

introduced to the wind tunnel, we were presented with scenarios of different indoor simulated environments in order to prove the effectiveness of capture technology (better known as filters).

It is comforting knowing that there are filters on the market that serve different levels of prevention. We ran tests simulating the infiltration of airborne dust in an airtight capsule. While testing capture technology in a simulated environment in a wind tunnel, filters and air forced thresholds were proven to be the most successful tools for keeping particles from entering indoors. Carpets and rough surfaces, including grass, were found to be effective to control room to room intrusion. Although the filters in all its shapes and characteristics were proven to be effective at catching airborne particles, I found its use limited to controlled environments, in real life, houses are not set up as this laboratory was, therefore, there are opportunities for failures in the ventilation systems, operation of doors and windows. Even carpets and grass areas can be ineffective if are placed differently as in the laboratory.

Participating in this workshop showed me how to identify dust sizes and, in order to avoid health related problems, how to use adequate remediation strategies including capture technologies. The most important lesson was the list of topic-specific resources from three lectures on the introduction to indoor particles and dust. However, two topics that were discussed seemed

unresolved; I thought my inexperience, or even my ignorance, on the topic discomfited me. It took me some debriefing time to realize that the workshop treated dust as the only one indoor pollutant causing health issues, even though we learned that there are other pollutants indoors that come from outdoor and indoor sources.

Also, what if the houses or other buildings do not have the same design and conditions than the one simulated in the wind tunnel? The ventilation systems in buildings are not calibrated nor maintained in the same fashion as in laboratories. I do not blame the workshop for not solving these questions. I simply made the mental leap becoming aware of these other components. I came back from summer break, and I planned an experiment using my own house to test how particles behave in a typical home setting. I added those variables that I could not really understand: a normal house with standard ventilation systems and filtering technology. This experiment: “Case study, observation of the performance of ventilation systems, and the impact on dust deposition in Tucson, Arizona” was designed as an independent study in the House Energy Program in the College of Architecture.

Using a case study, I compared the three most common ventilation systems: evaporative cooling, air conditioning, and natural ventilation. I analyzed the differences in particle deposition and temperature regulation. The house is located in a midtown neighborhood in a ranch-style subdivision in Tucson and divided into areas representing its major use: Private (PR) for bedrooms, Public (PA) for living room, Semi Public (SP) for corridor, Kitchen (KT), and Bathroom (BA). The temperature of each area was taken with and without using each ventilation system to measure the impact. This property has centralized evaporative cooling and air conditioning, as well as

operable windows in all of its rooms (which make the natural ventilation possible). Dust collectors were placed in each area on a surface between three and five feet from the floor, a height where most humans breathe either laying down, sitting, or standing. The collectors were in place for a one-week period.

VIGNETTE SIX: ventilation systems

For testing natural ventilation, the average temperature in the property was 80 degrees Fahrenheit, on September 7, 2014, with all the windows and doors closed. I opened one large window in the living room (east) and two medium windows in each of the rooms across the house (west); after 10 minutes of cross ventilation, the temperature dropped by two degrees. This opening remained open during a week from September 7 to 13, and the collectors showed more deposits in the public areas (PA) and the bathroom (BA), but less in the private (PR) and semi-public (SP) areas, and minimal deposits in the kitchen (KT). After the period using natural ventilation, the collectors showed deposits with higher content of textile fibers and particulates on the private areas and more dirt in public areas.

To test evaporative cooling, the temperature was measured in the property on September 14; while having all openings closed, it was 81 degrees Fahrenheit. The evaporation system was set after 10 minutes with a new filter; the temperature was measured again showing 78 degrees. One week later on September 20, the collectors showed higher concentration of

particles in semipublic areas (SP), less but significant concentration in public areas (PA), bathroom (BA) and in the kitchen (KT), and less in private areas (PR). I also observed that the particles were clustered and darker than the samples from natural ventilation. The evaporative cooling system was turned off for a few minutes until the house reached 81 degrees and turned on until the temperature reached 78 again; the system took double the amount of time compared to when the filter was new.

During the operation of the air conditioning system, I found similarities to evaporative cooling in terms of the distribution of the particles and the difference between the times that the system took with a new filter versus an old filter. I noticed that after one week of use (September 21 to 27) the time for the AC to go down from 80 degrees Fahrenheit to 77 degrees increased from four minutes to nine minutes with the dirty filter.

REFLECTION:

During the use of mechanical systems, the higher collection of dirt was in the semi-public area, showing the corridor being dirtier than the public area. I noted that the deposit of particles was consistent with the location of the intake of the mechanical system from where the air is extracted. I observed that there is a difference between the deposits when using mechanical systems (air conditioner and evaporative cooler) compared to natural ventilation due to forced intake in the central part of

the house. I also noticed when comparing the systems that evaporative cooling combined with old filter resulted in the particles collected were clustered and darker -- maybe due to the presence of humidity -- this finding was not corroborated with any laboratory analysis. However, I know that the more humidity is attached to the particles, then the rate of growing mold and/or bacteria increases (Abt & et al., 2000). Old filters also prevent particles from moving, staying still for longer periods without re-suspension. While using natural ventilation, I found out that the particles were dispersed with the flow of air; forced by the effects of cross ventilation, the particles may have been pushed out instead of being re-suspended as in the mechanical systems.

The conclusion I reached after this case study is that some variables in the ventilation and temperature control framework are not clear. I assumed that further research would have to be done in order to prove that each ventilation system has impacts on particle deposition and human exposure. More testing is needed in order to come to a solution for the need of a healthy, indoor environment with the possibility of an energy responsible ventilation strategy. A hypothesis may consider that natural ventilation and mechanical ventilation techniques can be both adopted in a hybrid system to avoid intrusion of ultrafine and fine particles. A comparison to other cases where physical obstacles and vegetation as well as rough surfaces are in place can be a way to demonstrate whether the particles concentrate differently.

The big question after this study was: what other aspects play a role in the relationship between exposure to particles and people's health besides ventilation systems? Behavior, for example, may change the deposition of particles completely, beginning with what times that a door or window is opened during the day and whether those openings are opened during the operation of the mechanical system or not. Yet, other questions arose related to how the activities of the user impact the number of particles brought indoors. With respect to outdoor generated pollutants in arid regions, this study showed more gaps in the current knowledge about the user's exposure indoors. The significance of this topic increased as the study demonstrated that technologies applied to build environments may be tied to maintenance cost and potential for failure, thereby increasing the vulnerability of people who face manmade risks like losing power (electricity) or water. I took this inquiry a step further. Despite lacking any solid evidence of my assumptions, I wanted to discuss them in a forum where others from similar fields contribute. Then, I would know how wrong or accurate I was. I put my conclusions on a poster and I took it to the conference Healthy Building America, Boulder, Colorado, 2015.

VIGNETTE SEVEN: indoor air experts

The conference was composed of 14 workshops, seven plenaries, 68 podium presentations, and two poster sessions. The topic of the conference was "Innovation in a Time of Energy Uncertainty and Climate Adaptation." The most prevalent individual topics were in the fields of ventilation, indoor environmental quality, climate change, energy, building processes and materials, and the specifics of microbiome, VOCs and SOCs (volatile and surface organic

compounds). A significant principle for the conference attendees and participants was that humans are the first source of indoor pollutants, followed by pets, and next by a combination of outdoor sources, mechanical ventilation (malfunctions, inadequate design, or maintenance), and water. The most favored strategies presented during the conference were: 1) purchase influence in policy changes -- meaning advertise the benefits of better choices to influence the market -- and obligatory regulation of the quality of the products; and 2) search for effective multidisciplinary solutions interacting with planners, architects, engineers, health providers, home owners, etc.

REFLECTION:

The key issues that I identified from the indoor air quality community of researchers were as follows: 1) The low degree of awareness that decision makers had during the process of design, construction, occupancy, and post-occupancy periods of a building; 2) the recognition that humankind comprised a live experiment -- since the solutions came after the damage is done; 3) the need for policies to regulate IAQ instead of the current practice of suing companies who have damaged human health (e. g. asbestos); 4) the cost of quality products versus the use of inexpensive materials to reduce the cost of construction; 5) the need of adaptation for future scenarios (development and climate); 6) the impact of microbes in human health

as well as the observed genetic changes in the microbial community which create new challenges for humans; 7) the behavior of people using the building, including cleaning procedures; and 8) the need of knowing the state-of-art of the indoor air quality awareness among decision makers.

I took home the following message: “A new generation of the built environment will be focused on environmental quality. The success will depend on the multidisciplinary background of the decision makers involved along with their awareness and informed options,” which was the closing remark of the regional chair of the International Indoor Air Quality Association and representative of the Sloan Foundation.

It took me a long time to recognize how broad the topic of indoor air quality was and (at the same time) how difficult it is to control the factors that put people at risk of exposure to dangerous pollutants. It was clear that they all were concerned about the people whose roles are related to how the buildings are designed since they are not aware of later findings on how indoor air has been challenged. The number of fields already researched around indoor air quality is vast and yet, I was an average architect who did not know about it. Something was missing, and they commented on it: awareness and informed decision-making from design to policy making are needed.

VIGNETTE EIGHT: architect as indoor air expert

My presentation was the 4th in the second podium session of July 20th. The topic of the session was Ventilation and my presentation title was “Assessment of the Implications of Natural and Mechanical Ventilation in the Residential Sector.” What I brought to the conference were the results of a preliminary stage of my research that was conducted during my Independent Study. The research question was: Do ventilation systems provide different indoor air quality exposures at home? The presentation was a summary of the method and finding described in the Vignette Six. During my final remarks I added “I just discovered something... but I do not know what it is yet.” I use this phrase to highlight the fact that even after proving that the ventilation systems in this particular house have provided different exposures, I still do not know why. I commented about what, to the best of my knowledge, is a complex problem that faces anyone trying to address IAQ since the many factors involved are not ending up solving or clarifying how sources and exposure can be managed for better outcomes. I showed a parallel framework of the Human Health Paradigm from (Adgate et al., 2000) where I use the pathway of the particles from the source to the human to show the influence of the elements of the buildings on different exposures.

REFLECTION:

My experience as podium presenter was thought provoking since some of the authors I cited in my literature review were present. Although they did not criticize my work, I was aware of the lack of solid evidence in my poster. They celebrated the fact that I was addressing most of the areas that were presented in the sessions during this conference, which encouraged me to keep looking for a solution I could develop. After I finished, the authors of papers that I cited went to meet me and they complimented my work. In general, they said that I hit one important issue by saying that there is a relationship between buildings and exposure and they, too, were concerned about the people whose roles are related to how buildings are designed who are not aware of later findings on indoor air quality. The number of fields I already researched around indoor air quality and the indoor environments should be helping me get closer to addressing the basic human need of being protected. I was very pleased that I recognized that the area is vast; and also that the areas where I had decided to focus prepare myself for my doctorate degree were also relevant topics during the conference.

Thinking about all the variables brought up during the conference, I came back to Tucson to observe what beyond the walls of a building, either looking outdoors or indoors, should be considered before I gave up on finding a solution. I had to move beyond the narrow attention to dust and shifted to focus on the environmental condition of the arid regions in Arizona and the climatic changes that are occurring here. I also needed to do a more systematic investigation of

ventilation systems and of policies and regulations governing indoor air quality. Vignettes NINE to FOURTHTEEN summarize my findings from scientific literature addressing these areas. I focus on the aspects of my research that I found to be most relevant to my overall study.

VIGNETTE NINE: arid regions

Arid regions are characterized by a higher index of evapotranspiration over annual precipitation mean (Bisal & Hsieh, 1966; Parajuli, Ghedira, & Gherboudj, 2011). Also called dry-lands or deserts are situated around the world as a result of atmospheric global wind flows and topography (Lioubimtseva, 2004; Washington-Allen, n.d.). Types of deserts are: Trade-Wind, Mid-latitude, Rain-shadow or cold deserts, and Coastal (USGS, 2015). The Trade-wind deserts are areas of low rainfall and high temperatures brought by blowing dry winds from higher latitudes that dissipate cloud cover. Examples are the Sahara and Kalahari Deserts each one situated in a belt on the equatorial sides of the Horse Latitudes. Mid-latitude deserts are in the poleward of the high-pressure zones also known as subtropical area; occur between 30° and 50° N. and S. The Sonoran Desert is an example of this category being also in the interior drainage basin and far from the ocean. Rain-shadow deserts are formed in areas where tall mountains range block clouds and water precipitate before reaching the leeward side of the mountains. Examples are the Great Basin in North America and Kara Kum in China. Coastal deserts such as the

Atacama Desert are situated in the western edges of continents near the Tropics of Cancer and Capricorn. Arid lands occupy more than 40% of the earth's surface and are densely populated (USGS, 2015; Reynolds et al., 2007) being home of more than 38% of the global population (Miao, Ye, He, Chen, & Cui, 2015). Deserts also experience climatic variations that, along with human activities, lead to its expansion. Dry lands are sensitive to degradation since the combined effect of solar radiation and lack of rainfall promotes evapotranspiration within its small amount of vegetation (Reynolds et al., 2007). The Southwest US is a region with warming temperatures, experiencing severe droughts, and accelerated population growth since 1940 (Lioubimtseva, 2004). Predictions using observations and climate simulations in Expansion of Global Drylands under a Warming Climate anticipate that a climate change scenario, specifically a major expansion of aridity will occur over the Mid-latitude and Trade-wins deserts increasing the risk of water scarcity in high populated areas (Feng & Fu, 2013). Predictions include periods of drought becoming more severe leading to the impossibility to re-fill natural reservoirs and streams impacting the possibility of supporting healthy ecosystems (Lioubimtseva, 2004).

REFLECTION:

Besides the physical characteristics and the sensitiveness of their ecosystems, it is the presence of people in arid regions around the world that is of concern to me. Population growth and the increasing need of urbanized space in any region leads to desertification for urbanization, since urban environments result in a major land cover change including vegetation removal and dehydration of the natural soil. Thus, I assume that population growth plays an important role when the area is already an arid region. Midlatitude deserts lead in population growth and may be, according to my new awareness, a vehicle for exposure to the climate change.

Affording modern life and the increasing demands for food and infrastructure (including water and electric power) exacerbates the damage done to the land and its natural resources. It is urgent that we as a society learn how to prevent the impacts; because all of this is occurring under conditions of global climate change, knowing what the climate change predictions are for this region is critical. If, as I discussed above, air quality in arid regions is already impacted just by their physical characteristics, and human activity can worsen the negative impacts, then a future scenario of what is predicted for the region will help us anticipate some future air quality problems as well.

VIGNETTE TEN: climate change

Human induced climate change, together with natural disturbances, have been seen over the past 50 years (McMichael et al.) causes of the increase on Earth's surface temperature, uncertain availability and distribution of natural resources, especially water and vegetation, and unusual precipitation patterns. The scenario of climate warming, described by projections based on historical data predicts that more events of severe precipitation in shorter episodes (Biagini & Miller, 2013), mainly during the monsoon season, populations along with temperatures that have risen by 1-3 degrees already, will continue to challenge ecosystems and human (Lioubimtseva, 2004). The shorter the rain episodes, the longer the dry seasons, and with them the impossibility of preserving water in natural reservoirs and streams (Barrows & et al., 2014). Carbon dioxide concentration has been building up in the Earth's atmosphere since the beginning of the industrial era, primarily due to the burning of fossil and the clearing of forests. Transportation, industry and energy generation are other sources of anthropogenic emissions of contemporary greenhouse gases (McMichael et al., 2006). Consequently, the effects of climate change are also leading to major exposures to air pollution and its associated health effects.

The effects of climate change are compounded in arid environments that are susceptible to wind erosion due to their fine particle composition

and lack of vegetative coverage (Stovern et al., 2015). Periods with high fine particle concentrations coincide with higher concentrations of metals and metalloids in the atmosphere (Prabhakar, Sorooshian, Toffol, Arellano, & Betterton, 2014). Arsenic, for example, is present in its organic form in groundwater, ores and human induced in irrigation and fertilization of crops and in its inorganic form in pigmentation of textiles and wood treatment, and is a pollutant that represent an important exposure in outdoor and indoor airborne dust, and due to erosion in one hand, and the longer periods that people spent indoors, is one of the pollutants of more concern in the arid region of the Southwest US (Awad, Gibbs, Tarwater, Casillas, & Green, 2013; Chappell, Abernathy, Calderon, & Thomas, 2003).

Simultaneously, I reviewed articles where I found that anthropogenic disturbances significantly reduce the abundance of natural resources (Washington-Allen, 2010) and the magnitude of human impacts make the changes irreversible. For example, anthropogenic land cover changes interacting with periods of drought in places that haven't experienced such combinations before may cause desertification leading the ecosystems to a point beyond their resilience potential for recovery (Houérou, 2002; Reynolds et al., 2007). Disturbances caused by land cover change mainly consist of human-induced vegetation, often requiring irrigation; and urbanization (Brunson, n.d.; Parajuli et al., 2011). The

reduction of native vegetation creates gaps and can change albedo causing warming or cooling of Earth's surface (McMichael et al., 2006).

Climate change projections indicate short but stronger rainstorm and extended dry seasons to come (Lioubimtseva, 2004; Orr et al., 2014). The availability of water in the Southwest US relies in four events associated with the mid-latitude /subtropical location of the Southwest desert: El Niño, which is an increase in sea surface temperature of the eastern equatorial Pacific Ocean, usually resulting in wet winters. La Niña, the opposite oceanic case of El Niño, usually results in dry winters (Sheppard, Comrie, Packin, Angersbach, & Hughes, 1999); the Pacific Oceanic Decadal oscillation (POD), which has been defined as temporal variation in sea surface temperatures for most of the Northern Pacific Ocean (Hutchinson & Herrmann, 2008); and the North American monsoon, which, in the US, is noticeable in Arizona and New Mexico from July through September (McMichael et al., 2006).

The region, as is reported in *The Climate of the Southwest* (Sheppard et al., 1999) will follow a warming trend possibly boosted by anthropogenic interactions (Barrows & et al., 2014).

REFLECTION:

I became aware that disturbances have exacerbated the exposure to air pollution in arid regions in Arizona, due to anthropogenic interactions. There are also natural events that provide a scenario for dust to be released in air and I also understand now that a combination of technological evolution and population-growth needs have pushed our world into a chain of changes in climate and the environment. Humans are exposed to natural hazards that normally the built environment will help avoiding by sheltering people indoors, however, the degradation to our natural environment leads it to fights back (metaphorically) and present new risks such as the exposure to pollutants that get loose on air due to the dehydrations of the surface. Just because people have opportunities provided by technology and innovation to populate deserts, that does not make them livable and, instead, contributes with its sensitiveness.

Clearly, natural and anthropogenic causes of negative impacts, including exposure to pollutants, may be leading to a frightening future scenario for arid lands, and likely areas around the world facing other environmental conditions as well. So, what is next? How prepared are we to withstand warmer and drier conditions? And, what about their impacts on air quality? Because of the certain predictions of a warmer environment, climate change will be experienced indoors as well. Humans will likely spend more time in conditioned spaces, thereby creating more dependency on energy consumption. Going indoors to escape from outdoor conditions will be a way to alleviate the immediate effect of climate change. However, at the same time, that will increase the negative

impacts resulting from the generation of energy. Also, climate change will alter the ecosystems and may then increase chemical pollution due to the use of pesticides and fertilizers. This will be a vicious cycle. I now recognize that outdoor and indoor sources of dust, especially pollution from heavy metals from emissions and agriculture, are a grave concern due to warmer and drier condition.

I also learned that climate change in arid regions will increase our exposure to disturbed land resulting from to food production and distribution as well as to pesticides and fertilizers, mining malpractices, and urbanization. All those acting in concert are causing more erosion and exacerbating suspension of particles easily transported by the wind (Fernando, Klaić, & McCulley, 2012). As I noted in the readings and class notes I made during the workshop at McCrone, airborne dust from outdoor sources can infiltrate indoors and levels are expected to rise with climate change. Especially with respect to the smaller particles (Abt & et al., 2000), the concern about air quality indoors in this region becomes more important. Researchers have learned more about dust as an air pollutant; I have critically analyzed this material in order to define how airborne dust is a specific problem in the indoor air quality in arid regions. The greatest importance of recognizing air as a common resource is, perhaps, that humans have no choice between using it or not. Breathing is necessary and essential. Air is an invisible fluid that in nature is hard to confine and harder to restrict to any particular jurisdiction. Hardin's Tragedy of the Commons (Hardin, 1968) highlights the community use of a public resource. In the matter of air quality, if individuals are deprived the shared resource (for example breathable exterior air), we must find the origin of the deprivation (Hardin, 1968; D. E. Jacobs et al., 2007; K. L. Jacobs & Holway, 2004). However, the way we, as humankind, are approaching this issue is unclear due to multiple reasons that go from material and economic resources to available information and technology. In most of the

developed countries, the trend is to use mechanical systems for controlling the environmental factors that impact comfort and health. I realized I needed to go back and revisit the loose ends of my experiment in ventilation systems and I needed to learn more about what is expected from them in terms of controlling pollutants.

VIGNETTE ELEVEN: infiltration

Mechanical ventilation systems provide fresh air indoors by a combination of recycled air from the same room passed through filtration, and outdoor air. The systems can serve three purposes: heating or cooling the spaces and exchanging the polluted air for breathable air. Therefore, in conditions of extreme temperature and humidity, the health and comfort concerns are solved with mechanical ventilation systems (Aflaki & et al., 2014; Mudarri, 2010). A ventilation system needs special attention during the decision-making process of design to avoid negative effects like discomfort and health issues that could arise if it is not appropriated adequate spacing and operation. One of the undesirable consequences is the Sick Building Syndrome which can be experienced in any income level, size, and time, and space (Joshi, 2008). Consequences of a sick building can also impact the energy consumption and operation of the mechanical system (Dalugoda, 2012). Ventilation systems are separated in four general categories: exhaust, supply, balanced, and natural. The first three are mechanical

systems while the latter is passive. Exhaust mechanical systems have fresh air injected into the house and a de-pressure point (e.g. a window) that, if is not well calibrated, may exacerbate problems associated with infiltration of air pollutants, noise and humidity especially in hot-dry, cold and humid climates (ASHRAE, 2000). Supply mechanical systems work in sealed buildings and are effective heating and cooling the air when are designed in a proper way. Balanced systems or Mixed-mode ventilation are effective but complex strategies to implement that uses mechanical ventilation only when natural airflow is low or to hot/cold (Atkinson et al., 2009; Bjorn, 2002). There is also a generic name for the mechanical systems that provide full control of the indoor conditions: Heating, Ventilation, and Air Conditioning systems (HVAC).

REFLECTION:

The literature review I have undertaken in the relationship between ventilation and airborne dust indoors, which highlights facts that are also used to back up the creation of some buildings codes, may apply to an environmentally responsible design that pays attention to temperature, comfort and supply of fresh air. There are environmental elements that buildings must incorporate in their function and may be solved with mechanical systems. Technological advances have made residential settlements possible under extreme heat and cold

—even to the point that some building are completely disconnected from the exterior. These systems are artificial environments that depend on energy to sustain comfort conditions and demand maintenance and updates.

I recognize that ventilation is a key element in the building process that has to be incorporated from the design phase. One important consideration is that mechanical systems are effective for removing airborne pollutants mostly when the systems are used according to the manufacturer's recommendations. Failing to change filters every month, for example, means insufficient intake of air and no particle removal; the lack of intake forces the system to take in more air from outdoors.

Among the systems I discussed in Vignette ELEVEN, the passive system was mentioned as the one that uses natural air supply which, in some sense, is a system that may be ineffective for addressing the negative effect of outdoor generated pollutants that infiltrate buildings. However, I wondered how the system works.

VIGNETTE TWELVE: passive ventilation

Natural ventilation systems rely on the movement of air through the building forced by the outdoor air intensity and direction, the pressure differences and even the humidity in the environment (Atkinson et al., 2009; Faggianelli, Brun, Wurtz, & Muselli, 2014). The airflow

is conducted from room to room by openings and vents, especially in sensitive areas such as kitchens and bathrooms. For the arid region of the Southwest US, it is possible to have up to 24 hours of natural ventilation from November to March, and from 10:00 pm to 7:00 am during the period of April to October (Chalfoun, 2010.).

REFLECTION:

This option requires an intensive design process and, perhaps more importantly, a closer involvement of the user in the design. As opposed to mechanical ventilation, natural ventilation allows the free movement of airborne particles and, when natural ventilation is well used, the exposure of the occupants to harmful pollutants may decrease since the most dangerous pollutants are generated indoors and, if the system is designed accurately; outdoor pollutants will go through but not settle indoors. Strategies such as vegetation, filters, and a detailed airflow induction design have the potential to manipulate the flow from space to space avoiding pollutants in impacting sensitive areas of the house.

Mechanical ventilation may be seen as the key for fighting pollutants that either were generated indoors or leaked from outdoors and, as I reflected earlier, climate change in arid regions has projected higher temperatures, longer dry seasons, and shorter but severe wet seasons. These factors may impact the performance of ventilation systems because of the higher incidence of airborne dust. If the ventilation system is broken or not working properly, infiltration and indoor

re-suspension represent higher risk for users and will require more maintenance, tune ups, upgrades and energy use. On another hand, natural ventilation without a design process can be a source of infiltration of pollutants as well.

I have already mentioned that when relying only on mechanical systems, reaching safe breathable air and thermal comfort becomes an economic and environmental burden. Therefore, it is my opinion that professionals who oversee design, site, subdivision, scale, structural design, code requirement and aesthetics play a crucial role in determining whether airborne dust is an environmental factor of concern in buildings. They must consider the region's sources of airborne dust even in the low perceived influence of local regulations in the prevention of health impacts of air quality from outdoor sources. They must also utilize the available technology (mechanical ventilation) as the solution for air quality, as well as for temperature control. Assuming that most people involved in the above-mentioned processes operate under codes and guidelines, I must identify the regulatory framework that acts in this region in order to understand their nature and level of concern about air quality.

VIGNETTE THIRTEEN: policies, codes and other guidelines

I consulted the current International, National, and regional codes regarding indoor air quality, and no code was found for Arizona therefore is assumed that the State is following National and International Standards. California does have some regulations that are considered in this review since the western part of the arid region of the US Southwest may be sharing environmental and housing needs and

characteristics with southeastern parts of the California territory. Only The Clean Air Act (using the National Ambient Air Standards), the International Residential Code, the Polluter Pays Policy and the American Society of Heating, Refrigerating and Air-conditioning Engineers consider the fact that outdoors sources of pollutants have a roll in human health, indoor environments and ventilation systems, however, is the International Residential Code the one considering that unhealthy outdoor air impact indoor air (EPA, 2009; Everard et al., 2013; Sherman, 2015). The Polluter Pays Policy and Clean Air Act condemn anthropogenic emissions whereas the rest cite outdoor air as a supplier of fresh air (Everard et al., 2013; D. E. Jacobs et al., 2007). The rest of the guidelines are concern of the interior sources of pollutants and small attention is paid to the environmental outdoor air and its pollutants in terms of contributor to indoor air quality, especially the EPA Indoor air Plus program and the Green Building Codes (Mudarri, 2010). The US Environmental Law, under which the Clean Air Act works, uses the National Ambient Air Quality Standards (NAAQS) established by the EPA to identify outdoor pollutants and their concentrations. It also categorizes Primary and Secondary standards depending on the impact to sensitive populations (primary) or to the public welfare (secondary) (O. of A. and R. US EPA, 2016).

REFLECTION:

The search for codes and guidelines is motivated by the need of understanding the decision-making process from top to bottom. Anticipating that the policy frames the issue, I tried to pay attention to places where policy on indoor air quality would likely be made. I realized that policies about air quality are as diffuse and varied as sources of air pollutants. I conclude that policy making is a difficult topic and that given the state of knowledge in this area and the complexity regarding sources of air pollutants and their pathways into buildings, an answer was not going to come from the policy side. I started understanding that regulations have different motivations. Even if the intentions of all jurisdictions are to address all the factors to prevent problems in air quality, the agencies have different resources, sources and processes involved.

I learned from searching for rules and policies that each author (agency or program) has limited responsibilities. There are no overall rules about air quality that involves the multiple variables that I found, and I do not expect such rules to be developed. Since there are limitations to the effectiveness of each individual rule, then perhaps it was more appropriate to ask: who is the rule maker of all and how do rules come about? I searched for notices, proposed rules, rules and supporting materials, and public submissions in the US government public records (regulation.gov) from 2-22-2017 to 5-22-2017.

VIGNETTE FOURTEEN: public documents

Local, State and Federal agencies have a process that first identifies a “problem” that needs to be addressed by the adoption, amendment or repeal of a regulation. The agencies that demand attention to the “problem” area required to conduct a rulemaking action that involves collecting evidence and the necessary information. Sometimes the rulemaking action includes the public. In general, agencies have discretion whether to include material or sources from its selected sources as well as whether or not include the public. However, the process has to reach all the parties who would be subject to the proposed regulations (Government Code section 11346.45.). The results were 478 documents, from them 400 rulemaking and 78 no rulemaking. A rulemaking document creates precedent in agencies, meaning that maintain a permanent record, and are used to impose regulations. A no rulemaking document could be a proposed amendment that has not been approved, new proposal for a regulation that has not been adopted, or a complementary document that supports an existing regulation. I filtered the results by agency and the EPA was found as the only one talking about air quality. Currently, the EPA has 61 cases are open, 162 closed. The only documents found related to Arizona were:

- Delegation of New Source Performance Standards and National Emissions Standards for Hazardous Air Pollutants for the States of Arizona and Nevada
- Air Quality State Implementation Plans; Approvals and Promulgations: Arizona; Department of Environmental Quality and Pinal County Air Quality Control District

Also, in the EPA air quality report for Arizona, eight out of the 15 counties in the State of Arizona has being marked as “nonattainment areas”, most of them since 1992. Pinal and Santa Cruz counties are reported having both, PM10 and PM 2.5 in an exceeded level from the standards.

REFLECTION:

There are processes in the rulemaking framework that involve collection of evidence and other significant information which sound logical. However, I was concerned that not all the processes include public participation or input and that each agency has the freedom to choose the sources of evidence and information. I also found that since 1992 some counties in Arizona had reached the status of nonattainment areas for excessive account for particles PM10 and PM 2.5. I was confused since I thought I would find more documents filed to fix the problems with PM at the legislative level. It was in a deep reading of

the documents that I found out that a problem only reaches a level of a rulemaking process when the accumulation of evidence is enormous. Justifying the initiation of such a process requires demonstrating that a risk is present, detecting and evaluating the origin of that risk, measuring the extent of the damage, and requiring that the problem will last enough time for the rulemaking process to be completed. The PM10 and PM2.5 present in Arizona's counties would not be subject to any action until the pollutants reached a critical point or violated the code by many times in a set time period. If air quality is bad occasionally (no matter how bad it is or the kind of impacts that may occur) or if the same violation of the code does not happen many times in a year or a season, there would be no action to prevent it. These were shocking findings.

My research faced another blind alley. I understood that air pollution—including dust and the risk of exposure to heavy metal and metalloids—exist in Arizona. But if the concentrations are not significant enough, no actions can be taken by the authorities. If this is true for outdoor air, how can I expect that there should be something or someone that can address concerns about the infiltration of indoor dust, since currently attention to indoor air quality is mostly based on the prevention and remediation of the presence of pollutants from indoor sources. No agencies will be concerned about my concern (and if we are limited in our ability to regulate outdoor air quality, how could we ever regulate the air quality within the built environment?). Therefore, no professionals in the building process will be obligated to pay attention. Even if some of them are aware of the problem or at least open to the idea of being informed about it, there is no way that

these professionals can take action if it is not justifiable. That was my guess at the time. I assumed that maybe I was at a dead end. Still I was encouraged that my research could be a source for information that could bring evidence to a rulemaking process in the future. There are pollutants that originate in the physical conditions of the arid regions in Arizona. There is proof that infiltrated dust is not completely addressed by current innovation for indoor environments. I then needed to explore another sector.

I asked myself who is in the decision-making process for the built environment. I knew that, in the Institute of Architecture, architects were appointed as the leader in these fields because they were architects. In the following Vignettes, I explore what roles are expected to be filled by the professionals with comprehensive responsibilities for the built environment in Arizona.

VIGNETTE FIFTEEN: who should be aware

The American Institute of Builder Designers, since 1950, describes a building designer as the professional that will visualize a design, exploring solutions that join together the client's expectations with the form, scale, balance, structural design, code requirement and aesthetics (AIBD, 2015). Two national organizations have licensing processes to certify building designers: the American Institute of Builder Designers administrated by the National Council of Building Designer Certification and the National Council of Architectural Registration Boards (NCARB); both require a bachelor's degree in Architecture or Architecture-Engineering. For the state of Arizona, the

licensing process is administrated by the Arizona State Board of Technical Registration (<https://btr.az.gov>) or by the local chapter of the American Institute of Architects (AIA). The certified builder designer is entailed to plan, administrate and coordinate the project including the approvals to contractors and consultants (AIBD, 2015).

REFLECTION:

Based on these findings, architects are the licensed professionals that control — if not every step of the process - the contracts as well as organize the people who will be in charge of every process. This is a fundamental aspect of the licensing process and not just egotistical on the part of the architect. It is not that is architects know it all, but they inhabit the most influential role.

The built environment is regulated by codes, standards, policies, recommendations and restrictions; the two professionals that oversee the entire project are the planners and architects. Architects and buildings have a bond; the architect is a specialist in all the implications from design to operation of a building. The other experts have deep knowledge only about their piece, not the whole process. Planners, in that regards, are the specialists in the interaction between built environment and its social, environmental, and economic relationships as well as, interconnectivity, sustainability and reciprocity.

Planners are seen as the regulatory professionals that are consulted for projects to be up to code; they are the advisers, reviewers, and paperwork processors (Measham et al., 2011). Planners should be parallel collaborators with the design and operations by making consensus-based decisions about all elements of a project that interact with the surroundings in different scales such as land use, neighborhood, zoning, comprehensive plans and policies that, in most cases are product of a community demands, research, consultation, and public hearings (Phoenix City of, 2018).

Planning and architecture are key professions which respond to people, culture, and environmental and economic interests. The first commitment for both professionals is research and observation, surveying user and context elements such as community and neighbors' concerns. Ideally, few regulations will be needed if these steps are taken first. However, I perceive, based on my own experience in the practice of architecture, there is a tendency of stepping on other people's roles and responsibilities. We should, instead, strive for an integrated design that results from collaborative teamwork that reflects the best work done after delimitating liabilities and assigning a share of the responsibilities.. The notes from the conferences of the AIA and Healthy Buildings were full of old-school approaches seeking to have more effective design and construction processes in both architectural and planning. These two conferences urged professionals and industries to come up with initiatives to remedy the effects of disasters and/or uninformed

decisions, driven by differences between ranges of actions of other professionals that may be involved.

I found necessary to ask myself a question: why are these professionals necessary? And I remembered some quotes, and even jokes made between architects when trying to explain how architecture is different from art. I also remembered the many times, during design, that I consulted planning materials for solving design problems in my projects. It is said that a construction in a random place is an object; if it is manipulated to have a meaning as a shape it is a sculpture; but, if that construction interacts with people and the culture that contained them, it becomes planned architecture, the ideal combination of both professionals gives a fair and true responsible project interacting with culture and peoples for solving needs comprehensibly. Buildings are so many, seems like we, as society, can think on stopping building new and start re-purposing the current built environments. The awareness we have about the way that sprawl impact our environment is enough for inspiring. We need barefoot professionals that can take the suit off and experience the user perspective again. Architecture and Planning are based on socio-environmental-economic interactions always. Architecture, in one hand, has a social science; being art is an option of becoming art, and planning, in the same sense, started even before sedentary life, when nomad societies were looking for the means of subsistence. In fact, planning is being recognized recently (since 1920) as social scientist in the areas of geography and political science (Caves, Bodner, Simms, Fisher, & Robertson, 2013; Knapp et al., 2014), before it was more about design, transportation, and zoning.

A deeper look at these two professional fields is key for understanding how important the elements of the environment are, including projection on climate change and current trends on public health related to air quality, as well as the regulatory framework that is important at all for decisions made

in the built environment. The opinions, experience and decision-making processes of architects and planners, are relevant to this research because I recognize that architecture and planning have overlapping scopes that work together during the site analysis, before design and applications for permits. Both professions, and their ramifications, work in a transitional zone where the importance of the building in relationship to the context is reciprocal. The overlap embraces socio-cultural, socio-economic, environmental, public health, policy and other aspects.

CHAPTER THREE: THE STRUCTURED INTERVIEW METHOD

After the research I did for Vignette FIFTEEN, when I reflected about who should be aware, I concluded that planners and architects are the two categories of professionals with the necessary scope that embrace from the design of the house, to the site design, to the surroundings and, therefore, I think are qualified sources of information on how elements of the built environment are or can be influenced, or not, by the fact that people may be exposed to air pollution. The decisions and practices related to the built environment are overseen by architects, planners and, ultimately, by officials in agencies in charge of implementing recommendations, standards, codes and policy.

I developed this Chapter Three and its Vignettes to determine under what circumstances are or should outdoor generated pollutants, as potential indoor pollutants, be considered within the concerns influencing the practices of professionals in planning and architecture. I based this phase on semi structured interviews as a way to establish conversations where I could determine the state of knowledge of the participants who responded to my invitation. My intention was to have an instrument that set up a replicable format of a semi structured conversation or interview. I designed a set of questions (see Appendix A) which provided structure but allowed the conversation to be open enough for me to understand the priorities of each individual. The openness of this method also met the goals of my exploratory study by bringing more questions than answers to the observation of the phenomenon under study. By recording conversations with the actors that I identified to be the key professionals for explaining the building process, I would be able to collect diverse perspectives on the same topics. It is in these diversities of possible answers where I could

increase my understanding of why people still face risks from poor indoor air quality in the arid regions of Arizona.

An approach like the one I am using for this research is open to development as findings are generated. Since the goal of an autoethnographic study is to describe a phenomenon through the informed observation of an actor of that same phenomenon, it is uncommon to have a structured objective to accomplish during the process. However, knowing that understanding how decisions are made implied, in my case, the need to talk with professionals in architecture and planning, and anticipating that the conversations could easily veer off on a variety of unknown topics. I needed to limit my curiosity to identifiable goals that I needed to meet in order to keep this research at a reasonable scale that would enable an analysis of the results. The formulation of those goals was a process of preparing me to manage information that may or may not be related to my research. I needed to be prepared to understand the jargon and current trends in these fields and be open to accommodate in my next steps wherever the input from my sources might lead me. That is why it is uncommon in this kind research to have goals or objectives, because in the formulation of objectives it is necessary to have a way to measure the accomplishments as well as to describe the means for getting it done. In this case, I set up three objectives that were more like an outline to follow and established the structured part of my semi-structured approach.

My three objectives were:

- 1] To enhance my understanding of the current priorities and trends in the design and building processes through participant observation in a field related conference.

- 2] To observe trends and patterns in answers to semi-structured interviews within and across architects and planners.
- 3] To complement the findings in the previous Vignettes and reflections with the input from the interview to a group of experts.

First goal: To enhance the understanding of the current priorities and trends in the design and building processes by a participant observation in a field related conference.

Since I already explored who should be included in this research as a source of input, and I concluded that architects and planners should be, to prepare for those interviews I needed next to focus on the design and building process. I wanted to know how the process was being done, and its trends and market-led priorities. For that, I determined a conference would be the best source. In this case and because it was coming at a perfect time for being included in my study to help me meet this goal, I selected the 2016 Design Built Institute (DBI) National Conference hosted in Las Vegas, NV. I choose this conference since not only architects but also engineers and contractors are included, and the mission is to educate the attendees on best practices, lessons learned, noted challenges and emerging trends from design to delivery of the projects. The institute is targeted to a diverse population within the building and construction fields which made it ideal for me to learn, if necessary, new concepts. They highlight the benefits of collaborations, especially economic, by encouraging people to have boards of professionals instead of a single decision maker participated during design, construction and operation phases of buildings. Since it is contrary to what it is indicated in the licensing process for leading the design and construction, I wanted to use this opportunity to get a different perspective from what I had found in the preliminary phase of my

study. I wanted to see if my conclusions about identifying architects and planners for the interviews were appropriate.

VIGNETTE SIXTEEN: collaboration teams

Cutting cost without sacrificing quality was a recurrent message across the conference. The sessions on the first day were: **How Design-Build Principles Saved a Project**. This project of the University of Arizona's old Medical Center in Phoenix was based on the final construction in building trust and collaboration. **Design Excellence in Collaborative Design-Build session**, talked about the importance of clearly defined owners' goals and objectives by moving away from the traditional model and adopting the design-build model. **Reading the Tea Leaves "drivers influencing the market and what professionals and owners can do"**, was a talk about practitioners and owners that claimed that according to a survey targeted to Design Built Institute (DBI) DBIA members, growing prosperity is uncertain; there is an uneven recovery after the 2008 recession; and the energy, industrial and civil infrastructure sectors, and lately residential sector, are demanding prefabricated elements.

REFLECTION:

Since this Institute is not only focused on the architecture or planning fields, participants have a broader understanding of the pros and cons

of the traditional roles of architects and planners as well recognizing to what extent the responsibilities are clear to a diverse audience. During opening remarks and the first keynote, the audience was encouraged to build more, develop new land with better practices based on collaboration, and network to advance the industry. It was said that the architect has no power to dictate or interpret what the owner wants but the architect can add the “sustainability thing” and the aesthetics to the discussion of the rest of the ideas. As an additional benefit of this approach, the speakers mentioned that architects can be destroyed, and their reputation can be ruined if the design is bad; they can be blamed for anything that is wrong but, in this model, all the actors will lower that risk. They stated that there is not a decision that is one-sided between designers-contractors and real estate developers. The presenters thanked the many voices of a wide variety of partners for some important decisions reached including energy reduction goals by thinking outside the box.

The skills that I gained as researcher for conducting participant observations were proved valuable at this conference. I remained clear that my objective was not to agree or disagree with what was being presented but to record my notes in the most objective way. At this moment, I was fine. I found some bitterness in comments but in general, the presenters were giving well informed opinions in favor and against the traditional role of the architect. Next day, the situation became

more challenging since what I thought was a good and engaging message the first day, on the second was just repetitive: the architect is not the leader! But who is filling this role?

VIGNETTE SEVENTEEN: owners as decision makers

The following sessions were the options that the DBI offered related to substituting the role of the architect: **I Can't Get No (Dis) satisfaction! Addressing Owners' Qualms About Design**, a session about owners' perspectives and how to ensure the desired project quality. The presenters explained that the criteria can be managed in order to prioritize the owners' likes. **How fast is too fast, San Diego University**, a session featuring the work done on the campus by the owner, builders, architect, consultants, and a peer review team, all working in three stages, holding only three meetings in three months. A round table where **Industry Leaders Discussed the State of the Union**, and the participants provided their comments on the fact that we are in the times of having presidential elections soon and there are many questions for the design and construction industry due to the tax changes proposed by both candidates.

REFLECTION:

The client is always included in every stage but some owners who were present in the sessions confessed that they contracted a third-party architecture firm to observe the process. The presenters explained

that the criteria can be managed in order to prioritize the owner's likes, including contracting external firms. Some shocking statements that were mentioned were personally discouraging to me and my advocacy for green buildings. The presenters continuously referred to suitability as a thing they are required to oversee.

Later, it was proposed that the original three legs of project development and management should be realistic and instead of society, environment and economy, the time-scope-cost model should be implemented to prioritize new metrics: value, innovation and management. The building program defined by the owner typically concerns design, quality and building schedule but, with the orientation of the professionals in these teams, the owners will assume responsibilities such as being active, informed and clear with what they want and when. Following this rationale, some presentations advised the building teams to use standardized or pre-cast products as better and cheaper. These elements provide a predetermined architecture style avoiding customization. They propose real time information to support decision-making through market analysis. They also plan a marketing campaign to attract millennials to the industry because baby boomers are retiring, and generation X did not close the generational gap. It was difficult not to feel attacked sometimes since my core beliefs were up for discussion. Then, a team of students came,

and the presenter introduced them as talented youth who will do follow the DBI principles with all the spirit of collaboration and high skill in communication and technology. However, the use of visual support and plans from the architect and the planner in the team were the focus of their presentation. The simulations were led by the recommendation of the architect only. They confessed that no other member of the team wanted to intervene in the selection of materials, and none felt confident to talk with the owner about technicalities. They passed the list of questions to the architect for him to deal with the owner and bring the message back to them. The initial meetings, as they described, were sessions where they designed without users “we never know who will be using the building”. It was said that right now we have powerful technology, we do not produce documents now we produce models, we used to draw hundreds of floor lands and now we do renders with real life occupational modeling applied. They also said that they do not know how to promote design and construction, the field needs more work on how to promote, that is why the architect led because they have a personality that is powerful but the rest of the professionals still have a huge role which without it the building won't exist. I was starting to feel better and, without losing my unbiased position as observer, I kept following session to session.

The following sessions were even more challenging. My breath was taken away when the master of ceremonies welcomed us to the session where the State of the Union (of the DBI) would be revealed. The first statement was: “the DBI model puts attention in collaborative teams where the leader is the owner and now, by all means, people who present Master or PhD degrees, who are pretentious and unrealistic, membership benefits such as networking are better for a professional in the field than research.” As a researcher, I was getting what I think was the most revealing information about my research: no matter how much we research and procure information for people’s wellbeing, the decision is left to those who make the decision and the decisions are made based on multiple influences around the decision-makers. Technology and innovation were my alternatives to get a new perspective of the design process in the United States. Little by little I have recorded other factors that play significant roles in how the field is managed. Traditional and DBI models help the field produce successful buildings, but the problem is that their intent to fade away the architects and minimize their role has not been completely accomplished as was expressed in reflection of Vignette SEVENTEEN where I noted the following statement: *owners who were present in the sessions confessed that they contracted a third-party architecture firm for observing the process.* Technology is not taking over the field and the delivery methods are not perfect. Human factors, experience and personal contact are still important. Nevertheless, those factors, and the other qualities from each team member involved, have to be understood and promoted for the good of the shared goal. Therefore, I retrieved some of the highlights from the American Institute of Architecture in 2014 and compared them with what I learned at the DBI. Although I was not a well-trained participant observer at the time of the AIA conference, I wanted to crosscheck the major highlights of both conferences.

VIGNETTE EIGHTEEN: traditional versus DBI model

Traditional model

1. Owner: normally contacts a single person to be in charge.

Many times, the owner will have a second or even a third opinion from other owners or other architects.

2. Architect: oversees design, site analysis, researching of regulations, and communication with contractor.

3. Contractor: oversees materials and technology based on the design produced by the architect, contacts other specialist in individual tasks such as: structure design, air conditioning and heating, isolation, electricity, and so on.

4. Planner: official at the city office authorizes each phase of the construction and makes recommendations for following local rules, restrictions and other special requirements.

This traditional model can be described as a model where the design produced by the architect commands the construction and the subcontracted professionals are expected to meet the original idea with minor changes. In this model, the planner is either ignored or subcontracted as a consultant to solve the site design and to address the relevant regulations based on the original idea.

DBI model

1. Owner: the owner hires a DBI team instead of a single person

2. Architect, engineers, planner, financial specialist, attorneys, contractors and others needed comprise the DBI team. All the decisions are made by consensus and everyone is expected to contribute to all phases of the project.

3. Subcontractors: are collaborators for specific areas such as heating, cooling, or others that only have a voice in the team when asked. In other words, they are contracted to solve and provide the specific service as is demanded in the design.

This model is based on the idea that no single individual should have sole responsibility for the work of many players. Collaborative work is encouraged; there is a system for keeping record of everyone's participation and responsibilities. The contracts and executive decisions rely on the owner, and each professional at the table has their say. It is conceptually a dream team for designing a building; however, most of the owners do not have time to learn about each phase of the process and do not have the knowledge about how to make decisions based on many pieces of advice and information. The owners that participated in the DBI conference said that all of them went to a third-party architecture firm to guide the decisions for them.

REFLECTION:

I agree that, traditionally, architects have the ultimate responsibility for a project, which puts the risk for failure very high. Design errors, failure in filing documents, going over budget, schedule delays, mistakes and disputes are inevitable. I understand problems exist; therefore, communication is key and the owner always is the one in command. It is my impression that the traditional approach in which the architect oversees the site analysis, has more opportunities to address externalities like natural disasters, climate change, and social issues; whereas the non-architect approach not only manifest the interest of focusing on business and profits but also it is a collaboration team that pursue effective decisions in consensus. The opportunity I see in the traditional approach is the traditional approach is that during site analysis, the architect can be advice by planners and come with design alternatives. On the other hand, the risk of missing out in awareness about the environmental impacts of decisions, for example, is more challenging in a panel where design decision are discussed by financial specialist and contractors. The need to change the current practice is rooted in the failures and excesses resulting in higher costs in making decisions that looked unimportant from the financial side. I believe that the practice needs to adapt in order to protect people; the ethical practice understands the job and the user. From one person in the audience at the DBI conference, I remember this

statement: “In practice, the owner sometimes does not have the time to learn all of what this model demands. He always will be asking the architect or will hire another architect to explain the drawings and that same architect will have to tell him (or translate) what the rest of the people in the team said.” The DBI panelist responded, “Some architectural firms have succeeded by employing builders and consultants under their management.”

Maybe that is the future: convincing architects to use the DBI model? This is especially true if basically this model reduces the architect’s profits because he is not the chief decision maker anymore. From the architect’s prospective, there is a big risk in doing the design and not ensuring fair payment for the work performed. Drawings can be used without paying. It is okay not to be the leader, because the architect does not have superior knowledge of other team members in their own areas of expertise. But so far, everyone asks the architects about everything; they need to address everything they want in the design. If they do not have the fair reimbursement for doing this, the architects face a huge risk of not being paid. The engineers, in contrast, do the hard job of calculating; they have the responsibility for safety and for preserving the form that the architect draws. They do not have any doubt that they will be paid because no matter what, they will not sign off until they receive their check.

I made these observations after comparing the AIA conference in the preliminary phase and the DBI. The AIA conference is an event that influences decisions and trends in the field. I observed that environmental concerns, passive design strategies, collaborative design teams, sustainable technology, community involvement, air quality, post occupancy evaluations and leadership were all presented in a context of sustainability. They were presented to the membership with examples of real projects facing regulations and challenges such as natural disasters, poverty and energy crises in sensitive communities. There is a battle for sharing the authorship of a building process and a need (according to contractors, consultants and other professionals) to eradicate the selfish figure of the architect from the top of the pyramid in the design and building process, relegating them to be the neglected artist that wants to play with colors, volumes and textures. However, the collaborative team for design and construction that new approaches like the DBI model promote do have a series of downsides. The owners may not trust the process and often hire an external architect advising them along the entire process. New contracting requirements are like insurance for the design and building process; the work is ensured for those who met the required certification process and paperwork required to ensure safety standards are met. The trend on opting for faster, safer, and cheaper options promote standardized design and construction systems which set aside detailed site analyses that may address better options for healthy and energy efficient buildings. The areas of concern for this research were only slightly mentioned in the DBI conference. Environmental topics were just addressed by architects as well as concerns about air quality and climate change. The literature confirms that from the regulatory side the roles and responsibilities are clear. The fact that the architect is the one that drives the attention to

subjective values (such as aesthetics) led the audience to perceive that the DBI model will always keep the role of the architect, when architects are involved, as the one that “talks with the client.” The architect is the one who pursues recognition by agencies in the fields of performance (US Green Building Council for example) and arts. He or she is still the professional with more risk of being substituted in the process or being paid less than the work is worth. On the other hand, planners are always perceived as having the regulatory role but not playing a role during the design and building process. However, they provide the framework beforehand by either regulating or understanding the regulations acting in the area of land use. Traditionally, architects received training in city or urban planning in order to embrace the basics of site-design. It is indeed necessary to require more active participation of planners in the site analysis and construction process, in order to keep track of the urban scale of the projects, including the integration and responsible response to the local characteristics of the land in the urban, environmental, social and normative context. Regulations acting on the specific land are the first considerations before drawing the first line. It is my impression that planners are a last resource instead of a priority and by the time that there is a social or environmental impact, it is too late to cover all the gaps.

Based on my guesses in the preliminary phase, the explorations in the beginning of this research and now, after contrasting the positions of the DBI and AIA conferences regarding the role of the architect and planners, I validate that people in these two professional fields are key informants for my research. In all the previous efforts to identify the key informants, architects and planners seem to have the broader background needed to understand the pre, during and post processes of a building. It is the fact that even with my findings pointing to them as key professionals in these processes and simultaneously their role being subject of debate for groups like DBI, their

perspectives are crucial for my understanding of the extent to which they are able to provide me with the input needed to identify priorities and trends. Their individual practices may bring enough information to evaluate if other groups should be reached or not and even if there is a need for deeper research on other areas of built environment that I haven't address so far.

Second goal: Observe trends and patterns in answers to semi-structured interviews within and across architects and planners to reveal their state of knowledge regarding the core concerns of this research.

Research design

With the semi-structured interviews I had the objective of understanding rather than explaining particular topics using basic introductory questions. I used my networks to invite participants. The process was to send an invitation through my email list without filtering my contacts and then to start relying on chain of referrals (snowballing). The chain referred a total of fourteen participants that, for the purposes of this research I classified as professionals. I received responses from eight architects and six planners. The invitation explicitly targeted professionals from Central and Southern Arizona (Arizonan portions of the Mohave and Sonora deserts). For defining the sample size of the groups of professionals I decided to use "theoretical saturation," meaning that once the interviews no longer brought new or additional insights about the environmental, global change, air quality and indoor conditions that promote the infiltration of airborne dust as well as for opportunities to solve concerns in their practice, no additional participants were interviewed.

The data collection came from two sources. First, I requested a copy of the Resume or Curriculum Vitae in advance since I wanted to know how the professionals present themselves, what are their

priorities as well as how they described their practice. For some participants I visited their social network profiles to complete this task. Secondly, I conducted semi-structured interviews that were divided in three phases. The interview design followed the intention that I had for establishing conversations to understand largely their priorities but with an outline that helped me keep within the scope of my study.

The data analysis method that I choose was “Keywords-in-context” using the coding protocols of NVIVO. The transcribed and written interviews were typed in a text processor and transferred to NVIVO. I coded key-words in context, meaning that I would identify a word used by the participant to make reference to something I asked, and I looked at the contextual components or surrounding words to understand the meaning of the same idea across interviews just as it was described by (Onwuegbuzie, Leech, & Collins, 2012). Using keywords allowed me to code text that, despite the jargon of either profession or field, reflected ideas that belong to the same topic. The data I obtained involved identifiable private information and, therefore, I completed the Human Subject Research process according to the UA Institutional review Board (IRB) requirements. With the intention to offer a secure environment for data and to assure that it would not come into the wrong hands or put subjects at serious risks, I designated an alphanumeric ID code for each participant. After finishing the required document for IRB, I concluded that the professionals should not be told what the interview was about to minimize the chance of biased answers. After I consulted the UA IRB office about this, I was authorized to file a consent form with an explanation that their participation was voluntary and that the subject could withdraw from participation at any time and for any reason. I included a debriefing note revealing the title and objectives of the dissertation research. With it, I gave the professionals the right to delete the interview from the recording device as well as the references and whereabouts from my records.

Developing my interview questions

The design of the questionnaire was challenging and took months for me to get the necessary skills through reading, drafting and piloting in order to get the most concise list of questions that would allow me to open conversations for the participants to provide the answers I needed but without prompting them too much. I was concerned about informing them what the research was about at the beginning because if I did, then they would likely state what they thought I wanted to hear. I did not want to challenge the validity of my research, so I decided to open the interview with “what is your job about?” as well as “what are your priorities and challenges?” I knew from the pilots and from the talks in the conference that if the professionals were not aware of my interest in air quality they would never talk about it unless I asked directly. I also recognized that some topics like environment, sustainability and climate change were not as important to most of the professionals as they are for me, so I didn’t include those topics in the opening either. Later, I thought it would be a good idea to ask about my core topics at some point. Thus, to stimulate conversation, I gave the participants an overview of the findings in my explorations, conferences and literature. These findings that were summarized in a visual aid to see if after being aware of the areas of my concern, the participants would express concerns.

For Professional Participants, I outlined three phases for the interview and I kept a list of seven main topics to be addressed somehow, first waiting for the conversation to bring them in at any point. To meet the objective of defining the current priorities of the professionals, I found it was important to pay attention to all the concepts brought up by the participants even if they were not related to the core concerns of my research. The interviews took an average of one hour each. The

agenda consisted in welcoming the participant, making introductions, requesting that the individual read and sign the consent form and then the interview. The questions that made it possible for me to describe the state of knowledge related to participants' work experience were framed in a way that encouraged the interviewees to talk from their position as decision makers. The interviews had three basic phases:

1. **Broader Concerns:** The first question was always an attempt to get the participant to talk about the most important concerns underlying issues they face at their job. The open-ended question was framed as such so that the participant gave an honest and natural answer and did not feel any pressure to take the conversation in any particular direction. The goal of this conversation-opener dynamic was to know what kind of priorities were on top of the minds of the professionals.

2. **Direct Questions:** After I asked about broader concerns, I started with structured questions that directly addressed the core of my study. This critical process of focusing the conversation on the topics of the research inquiry without forcing the conversation was developed from the early stages of the interview design (proposal). It was necessary to ensure that the interviews were unbiased and strictly focused on collecting as much new knowledge as possible in response to direct questions in the following sequence. If there was not any mention about environment-related concerns in the answer to the broader concerns, then the participant was directly asked about the environmental concerns related to their job. The participant was asked (when needed) to address each concern with detail to bring out more concepts and possible relationships with the goals that the research pursued. In the same way,

questions about global change and air quality were asked directly, unless the participant discussed those concepts at an earlier point. The conversations included potential solutions for their own concerns that could be undertaken either by the participant directly or by another entity. If the participant did not mention solutions, they were directly asked about them.

3. **After evidence:** I showed a visual aid (figure 3) to the participants with a summary of the findings in the literature review in order to motivate the participant to give opinions, bring new concerns, supplement the conversation with personal experiences, mention new solutions and advice about anything that they wanted to address from the material.

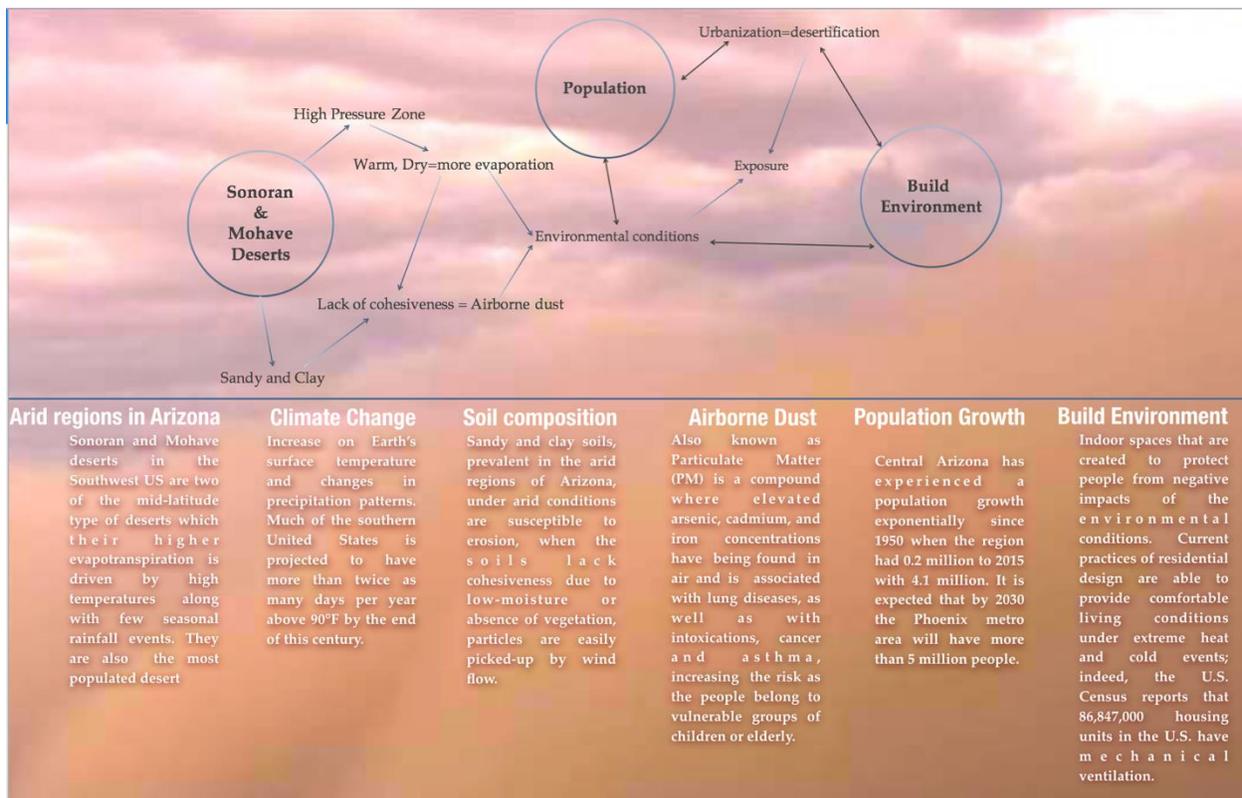


Figure 3 Visual Aide

The outline of the interviews (see Appendix A) incorporated key topics to be covered somewhere along the conversation, meaning that the answers were expected in different moments during the conversation and not in the context of a one by one question-answer interview.

Classifying the information as preamble of the analysis

While setting up the data analysis in NVIVO, I incorporated some organizational tools, one being a classification sheet. It was recommended by the NVIVO experts that the research provide a spreadsheet document with the general classifying (Appendix B) information that one cares about in order to upload it to NVIVO and create links between the information that I would be coding from an interview and the participant's classification information. I did follow the recommendation; however, at this point I was not paying attention to what this classifying information could tell me. I was worried about the content of the interviews; but, purposely, I wanted not to base any finding on gender, age, or so on. After realizing the potential knowledge that I could glean from knowing some more about the participants as persons, I decided to think about how this classification chart should be designed and how to use it.

VIGNETTE NINETEEN: overarching professions

I conducted a total of 15 interviews with 8 architects and 7 planners.

The number of interviews was a result of theoretical saturation where a similar number of interviews in each of the professional fields were completed considering two aspects: different network pathways and,

based on the broader concerns, the absence of new insights in the fields related to the environment, climate change and air quality.

The spreadsheet (figure 4) includes preliminary data for classification purposes (Appendix B). The ID assignment to each participant was in the first column followed by the attributes that allowed making distinctions among the characteristics of the group: Academic Training, Academic Level, Additional Training, years dedicated to the current profession, has worked in other cities, type of interview, Network Pathway, and the short answers to the main concerns of this research which relies on whether or not the professionals addressed these topics when discussing their major concerns: environment, climate change, air quality, indoor air quality, dust and residential sector. Analyzing the short answers (variables) consisted of finding patterns and trends. One landscape architect had 1-3 years working in the field, one architect had 4-10 years only in drafting and design, two architects had 10-20 years and were in positions of greater authority, and 4 had 21 or more years dedicated to their current profession in an either semiretired phase or as consultants. Two planners had 4-10 years as city planners, two had 10-20 years-one in transportation and another in site analysis, and 3 had 21 or more years dedicated to their current profession and working in public offices. Three architects had worked in other countries, four in other states and one only in Arizona. One planner had worked in other countries, one in other states and five only in Arizona.

Participants	Academic Training	Academic level	Additional training	Years current profession	Has worked in other cities	Network pathway
<u>A011317_1</u>	Architec only	Masters	Field-Empirical	1 to 3	Yes other Countries	First contact
<u>A011317_2</u>	Architec only	BA	Field-Empirical	4 to 10	Yes other States	Referred by first contact
<u>A011417_1</u>	Architec only	BA	Field-Empirical	21<	Yes other States	First contact
<u>A020417_2</u>	Architec only	PhD	Field-Empirical	10 to 20	Yes other States	First contact
<u>A032717_1</u>	Architec only	Masters	Field-Empirical	21<	Yes other States	Membership group Architecture
<u>A041417_1</u>	Architec only	BA	Field-Empirical	21<	Yes in Arizona	Referred by first contact
<u>A051217_1</u>	Architec only	BA	Field-Empirical	10 to 20	Yes other Countries	First contact
<u>A082117_1</u>	Architect and Planner	Masters	Field-Empirical	21<	Yes other Countries	Membership Group Green Sustainability
<u>P012617_1</u>	Planner and other	Masters	Field-Empirical	4 to 10	Yes other States	UA
<u>P013117_1</u>	Planner and other	PhD	Field-Empirical	21<	Yes other Countries	UA
<u>P021017_1</u>	Planner only	Masters	Field-Empirical	21<	No	Referred by first contact
<u>P061917_1</u>	Planner and Architect	BA	Field-Empirical	21<	Yes in Arizona	Membership group Planning
<u>P061917_2</u>	Planner and other	Masters	Field-Empirical	10 to 20	Yes in Arizona	Membership group Planning
<u>P062017_1</u>	Planner only	Masters	Field-Empirical	10 to 20	Yes in Arizona	Membership group Planning
<u>P062417_1</u>	Planner only	Masters	Field-Empirical	4 to 10	No	First contact

Figure 4 Classifying information

REFLECTION:

As I mentioned above, I did not ascribe much value to this classification sheet initially. But after taking a look at the patterns I realized that I had made my first findings. First, I was able to define the theoretical saturation by looking at the lack of awareness that the participants showed about my core concepts. I also noted that one architect also had a degree in planning but referred to himself as an architect. Three planners had another career in their background. I found no patterns

in the chronological order when they were interviewed. One planner also had a background in architecture but referred to himself as a planner. In the group of architects, four participants held bachelor's degree, three held a master's degree, and one had a doctoral degree. From the group of planners, one had bachelor's degree, five had master's degree and one had a doctoral degree. Seven architects referred -- either during the interview or their public social media profiles or websites -- to their empirical experience as a main source of expertise after their degree. One architect listed his membership benefit as the source of his additional training.

Reading the information in this classification was revealing information beyond what I expected. I initially wanted to use this tool for organizing my sources of data in NVIVO, but suddenly I was starting to see how responses to these very strict questions would help me to define the theoretical saturation. Therefore, I needed to pay attention to the answers in the columns that addressed my core concerns.

In order to effectively use this chart, I determined a set of short answers that describe not only yes-no but a short context of the answer. I used "Yes" if somehow during the interview the participant directly referred to the self-motivated positive answer. "Yes, indirectly" is an answer for those participants who bring ideas like biking, energy conservation, solar panel use and so on referring to them as their environmental, climate change or air quality concerns but that it is not directly answering the question. "No, never" is for those responses where not even later in the conversation did the respondent demonstrate any concern. "No, yes in follow up" refers to those cases where

the person either didn't realize the importance of these three areas or forgot about them or didn't mention them because they didn't think the research will be guided that way.

VIGNETTE TWENTY: expected concerns

Five architects did not mention concerns related to environment but later in the interview they did, one architect mentioned an environmental concern, one other mentioned the environment indirectly and one didn't mention environmental concerns at all. Five planners did not mention environmental concerns, but they did in follow up, one mentioned it directly and one other mentioned it indirectly. About climate change, within architects seven did not mention it but they did in follow up and one never mentioned it. For planners, climate change never was mentioned in the broader concerns but always was mentioned in follow up. Regarding air quality for architects, seven did not mention it but they did in follow up and one never mentioned it. For planners, five didn't mention air quality but they did in follow up, one mentioned it directly and one mentioned it indirectly.

The highlights in the environmental concerns are focused on three cases where a trend was followed: two people with planning in the backgrounds were the only participants that showed concern about the environment, one directly and one indirectly, also in the environmental concerns, one architect never expressed concern about any of the main

concerns of this research. Another highlight found was the possible connection with the years of experience which, although there are more professionals with more than eighteen years of experience (as confirmed in the curriculum of participant **A051217_1**), the two professionals with environmental concerns and the one without any concerns have long trajectories.

REFLECTION:

*By reading the responses to the participants **A051217_1** who never showed interest in environmental topics, and **A082117_1** and **P013117_1** who manifested concern from the beginning I wanted to understand if there was something in what they said that revealed a possible hint about why their responses were outstanding. I know by the conversation with **A051217_1** that there is an understanding of the architect as a commander and the buildings as the best answers to all questions. Those participants were, sometimes, dismissive about things that I considered important like attending to the user's likes but, instead, I found in this particular interview that the priorities as well as the way to practice architecture are subject to the person and the people who hire them. For the cases **A082117_1** and **P013117_1**, my notes reveal that these conversations were academically rich. They cited many documents and sources of their awareness.*

VIGNETTE TWENTY-ONE: is indoor air a concern

About indoor air quality seven architects and six planners never mentioned it, one architect and one planner mentioned it in follow up. Dust was never mentioned by seven architects and six planners, one architect and one planner mentioned in follow up, and that same planner also mentioned indoor air quality in follow up. Residential sector was never mentioned by six architects and five planners, two architects mentioned it directly, one planner motioned it indirectly and one planner mentioned it in follow up. One of the architects who mentioned residential sector directly mentioned dust in follow up and one planner who mentioned residential sector indirectly also mentioned indoor air quality and dust in follow up.

From the professionals who mentioned indoor air quality and dust, the network pathway could be influential either for being first contacts or because of a possible relationship (i.e. student professor) (figure 5).

Participants	Academic Training	Years current profession	Network pathway	Mentioned Indoor air quality	Mentioned Dust
A011417 1	Architec only	21<	First contact	No	No, yes in follow up
A020417 2	Architec only	10 to 20	First contact	No, yes in follow up	No
P013117 1	Planner and other	21<	UA	Yes, directly	No
P012617 1	Planner and other	4 to 10	UA	No, yes in follow up	No, yes in follow up

Figure 5 Indoor Air and dust concern

REFLECTION:

From the professionals who mentioned indoor air quality and dust, the network pathway could be influential either for being first contacts or because of a possible relationship (i.e. student to professor).

Professionals who mentioned residential sector either directly, indirectly or in follow up were indistinctly architects or planners and no other correlation was found, the analysis of the context in which they talked about residential sector informed how the participants defined their concerns.

Considering that the number of participants was very small and not really representative of a population of professionals, the coincidences that I observed were not relevant until I analyzed relationships between the classifications. Then, some more interesting information was present and worthy to observe later after the coding process. At this point, the opportunity to find more variety of findings was more important than comparing groups by gender, age or specific fields within the professions. Ultimately, decision makers can be anyone who interferes in the processes of design and construction. Additionally, even by observing possible patterns in categories like year practicing their profession, that does not mean that the decisions are made differently for air quality, as it is proved in the criteria I selected to define my theoretical saturation.

VIGNETTE TWENTY-TWO: participants in the research

Participants who asked not to be recorded were interviewed in May and June of 2017. Previous interviews were recorded without concern.

Participants who have a professional training as architects have worked in other states and countries while professional who have had training as planners worked locally within the Arizona. Only one professional in planning mentioned climate change as a major concern in their practice and nobody brought air quality as a major concern. No participants with more than twenty- one years in practices choose not to be recorded. All professionals referred by a membership group on planning have only worked in Arizona. Most of the professionals who have only worked in Arizona did not mention the environment as a major concern, while most professionals that had worked in other states or countries did have the environment as a major concern. Professionals who didn't have the environment as a top priority have worked only in Arizona except for one who worked in other country. Only one architect mentioned climate change as priority and one architect never mentioned climate change or air quality as a priority even when asked directly about it. All the rest of the participants but one was concerned after being asked about climate change and air quality (separately) later in the conversation.

REFLECTION:

From this first approach to my data, I started drafting my interpretations starting with the possibility that a concern about touching certain topics might come with social or political pressures in the period where the elections took place in the US in 2017 in the

general population. Maybe that is why the participants who were interviewed after the elections did not want to be recorded. The nature of both professionals of following different commands and drives may be related to the way that each profession approaches the public. Architects have a direct relationship with the owner from design to occupation, clients; while planners normally come in a later stage of the project and do not normally deal with the public directly and they are consulted after the design process already got to a point where most of the decisions are made. It is with planners where adjustments are made in order to meet regulations and get the permits, which for me, is too late into the project. Therefore, it is a possibility that the architects are more likely to say yes to be able to solve or address their own concerns through negotiation, while planners are more rigid in terms of not overstepping their functions. Policy or codes appear to be the most effective strategy for professionals in the fields related to the built environment for mandating safety, wellness, and compliance with the law and the professional standards that most of the times enhance the professional's reputation. Younger professionals may be influenced by current social media and other forms of redistributing recorded materials that might impact their decision to not being recorded. It is a possibility that professionals who stay in the state have more apprehension for their membership in professional associations. I remembered from the conversations that some professionals think the

built environment is not subject to environmental concerns in Arizona and, instead, buildings are solutions to our problems because they may provide with a conditioned space. Meaning that, onto the eyes of some of the participants, Arizona's built environment is not seen as a transgressor to the environment because its reason to exist is to provide shelter. I believe that it depends on the interpretation that they have from my question, the answers may be showing two sides: one where environment concern may sound to some participants as the concerns regarding our dryness and heat; another side would be the one that sees the impacts that the buildings and urbanization make to the environment. Both are important points of view and, ultimately, bring more information to the study.

Climate change and air quality were a concern for most of the responses after being questioned about them. Once I asked about these issues directly, most of the conversations referred to those topics. There is a possibility that the professionals consider the built environment as a solution or an adaptation to the environment and climate change.

The reflections I drafted from the Vignettes above were driven by a simple interpretation of what I saw in the classification chart with the help of some notes that I took by hand during the interviews. Therefore, added to the analysis of the transcripts, I found that questions drafted with the purpose of addressing the key topics related to the environmental conditions implicated in the

infiltration of airborne dust in residential buildings were not a priority for most of the participants (which was anticipated in the questionnaire design). I coded the interviews following the topics drafted in the questionnaire; as I transcribed and coded, I noted two patterns among the responses. One was the presence of comments about personal experiences and two; opportunities that they mentioned were in their hands in order to address concerns. Therefore, I started all over and added nodes to start coding those responses. I began to envision how my nodes would get me to meet my objective. With this new frame of mind, I found other trends including the fact that some participants referred to different scales when talking about their concerns and their proposed solutions.

Analysis from solid sources

After all the interviews were coded, I concentrated all the information that I wanted to analyze in tree tools: a corrected Classification Chart (figure 6), Coding Queries (figures 7 and 8) and Scorecards (figure 9). The Classification Chart now reflected a deeper analysis of the responses. Since in the first version I was reading responses in a very rigorous way (if the professionals did not mention the core concepts naturally I did not count them), now I opened the criteria to incorporate the concerns accounting for the scale that they manifested. The current version (figure 4) shows the concerns that the participant showed only at the individual level. The Coding Queries (figure 7) were created in NVIVO and had all the coded information by participant showing the nodes to which the text is coded to. In the Scorecards I identified and summarized each participants response when they referred to an individual, regional, or macro scales of concerns and solutions (see Appendix C) showing these scales in three ways: 1) a table with the number of occurrences and in what moment did it happen in the interview happened, 2) the Coding Summaries of the

Node Summary (figure 8) where I coded the scales and 3) a concentric doughnut chart showing a summarized version of the findings for visual identification (figure 9).

Participants	Academic Training	Environmental Concerns Individual scale (BE)	Air quality Individual scale (BE)	Climate change Individual scale (BE)
A011317_1	Architec only	Yes, indirectly	No, yes in follow up	No, yes in follow up
A011317_2	Architec only	Yes, indirectly	No, yes in follow up	No, yes in follow up
A011417_1	Architec only	Yes, indirectly	No, yes in follow up	No, yes in follow up
A020417_2	Architec only	No, yes in follow up	No, yes in follow up	No, yes in follow up
A032717_1	Architec only	No, yes in follow up	No, yes in follow up	No, yes in follow up
A041417_1	Architec only	No, yes in follow up	No, yes in follow up	No, yes in follow up
A051217_1	Architec only	No, never	No, never	No, never
A082117_1	Architect and Planner	Yes, directly	No, yes in follow up	No, yes in follow up
P012617_1	Planner and other	Yes, directly	No, yes in follow up	No, yes in follow up
P013117_1	Planner and other	Yes, directly	No, yes in follow up	No, yes in follow up
P021017_1	Planner only	No, yes in follow up	No, yes in follow up	No, yes in follow up
P061917_1	Planner and Architect	No, yes in follow up	No, yes in follow up	Yes, directly
P061917_2	Planner and other	No, yes in follow up	No, yes in follow up	No, yes in follow up
P062017_1	Planner only	No, yes in follow up	No, yes in follow up	No, yes in follow up
P062417_1	Planner only	No, yes in follow up	No, yes in follow up	No, yes in follow up
				* BF= Before Evidence

Figure 6 Classifying Information Updated

<p><Internals\A011317_1> - § 1 reference coded [0.33% Coverage]</p> <p>Reference 1 - 0.33% Coverage</p> <p>responsibly or taking care the use of energy and resources</p>
<p><Internals\A041417_1> - § 4 references coded [0.61% Coverage]</p> <p>Reference 1 - 0.33% Coverage</p> <p>expand their minds about it and instead of just designing a school you can actually change the way the kids learn</p>
<p>Reference 2 - 0.06% Coverage</p> <p>really move forwards</p>
<p>Reference 3 - 0.08% Coverage</p> <p>spark the ideas for change</p>
<p>Reference 4 - 0.15% Coverage</p> <p>we wil design a sustainable building for the client</p>

Figure 7 Coding Query

Classification	Aggregate	Coverage	Number Of Coding References	Reference Number	Coded By Initials	Modified On
Document						
Internals\\A011417_1						
Node						
Nodes\\Before Evidence\\Broader Concerns						
No	0.0529	2				
			1	SB		11/10/2017 10:47 AM
think my concerns right off the bat are to see that the client and I can reach some sort of understanding about what are the things we have in common about what the goals would be for a particular project I assume they are going to walk in the door with some kind of project in mind whether it be their house or something and I want to see my first concern is to make sure we are going to be a good fit psychologically in terms of values in terms of what they are after and what I might be after are the same thing most of them are going to be interested in whether or not I think I can create something that's going to work for them						
			2	SB		11/10/2017 10:49 AM
I think it would just be I get a sense that they they're going to be reasonable and realistic about their sense of what can be accomplished for the budget they would be assuming they are bringing to the table so if they can be realistic and they understand that this is a fairly complicated endeavor it's made maybe in some ways it's the most expensive thing that most people take on their lives so it's I try to figure if they are being sensible and realistic about the sense of the budget they've got						

Figure 8 Node Summary

Summary:

- Client expect as to not go over budget if we go over budget we have to eat the extra cost
- It looks bad to the client because we promised to do the work we signed a contract we would do x, y and z for this amount
- Right now they're trying to bring streets to human scale not just for cars make them for pedestrians, bicycles, transit and our firm is very interested in doing that

Nodes\\Before Evidence\\Scales\\Macro Scale

- And engineering
- They will not inspect air quality or air quality standards

Nodes\\Before Evidence\\Scales\\Regional Scale

- Transportation
- Both transportation and land use consulting and planning
- Government and private but in transportation planning
- Looking at air quality or noise quality or historic preservation

Nodes\\Before Evidence\\Solutions to the concerns

- AE Corn it's probably the largest transportation consulting firm in the world but it doesn't only do transportation it does a lot of water, geology, energy almost anything related to the built environment and working with government and private clients
- we have our own quality control procedures so that when it goes to the client they will not find any embarrassing mistakes or omissions always they'll have comments that's normal and we always have to work that out and we work that into our budget is to get comments from the client and do revisions but we always try to make sure that anything we give them is what they expected and everything they expected and their comments hopefully will be on either minor technical things like grammar or typos or they might be more substitution
- we do calculations we do tables we do maps we use geographic information systems which I'm not trained in professionally but
- we have people in my office who are experts at that so we need to use all those tools and they all need to be checked by someone who was not involved in the original grading
- we have people both within my company and outside it in the agencies we work for who specialize in air quality and air quality modeling
- here we have MAG and Tucson has PAG and I'm not as familiar with PAG, but they are work in similar ways
- I know Arizona pretty well and just ask questions about things that don't seem right to me or just I'm unsure about and they might come back and say 'that's ok' because they know more than I do but I do catch quite a few things when going through those

Nodes\\Before Evidence\\Solutions to the concerns\\Personal Opportunities to solve the concerns

- we do calculations we do tables we do maps we use geographic information systems which I'm not trained in professionally but we have people in my office who are experts at that so we need to use all those tools and they all need to be checked by someone who was not involved in the original grading
- I know Arizona pretty well and just ask questions about things that don't seem right to me or just I'm unsure about and they might come back and say 'that's ok' because they know more than I do but I do catch quite a few things when going through those

Nodes\\VI Direct Questions\\Scales\\Individual Scale

- I may summarize some of the standards in the report but I'm not the one that does the modeling or tracking I don't have the technical training as I've said we do have people in our company who do that
- I've worked on numerous environmental assessments

Nodes\\VII Direct Questions\\Scales\\Macro Scale

- Brush Fire closes down the highway obviously that could be related to climate change
- change in snow level that might require more or less snow plowing and of course the state has limited resources in the winter and they have to budget a certain amount to each area of the state that gets snow

Nodes\\VII Direct Questions\\Scale\\Regional Scale

- governor's office are very much opposed to talking about climate change they either don't believe it exists or don't believe it's human caused or whatever they think it's an attempt by the Chinese to take over the world

Nodes\\VI Direct Questions\\Solutions to the concerns

- I've worked on numerous environmental assessments and also some EIS but I'm pretty much a generalist in my career I've done a little bit of almost anything except modeling in transportation that is not outside of transportation and so I've worked on various EAs and a few EISs not as a technical specialist looking at air quality or noise quality or historic preservation

Nodes\\VI Direct Questions\\Solutions to the concerns\\Personal Opportunities to solve the concerns

- I've worked on numerous environmental assessments and also some EIS but I'm pretty much a generalist in my career I've done a little bit of almost anything except modeling in transportation that is not outside of transportation and so I've worked on various EAs and a few EISs not as a technical specialist looking at air quality or noise quality or historic preservation

P062017_1

	Environmental	Climate Change	Air Quality	Indoor Air quality	Dust	Residential	Broader concerns	Solutions
before			X				X	X
direct	X		X				X	X
after	X	X	X					X

Figure 9 Scorecard Sample

Using these scorecards and keeping the full interview, the Coding Queries and Summaries handy, I began again analyzing the fifteen interviews to determine the individual's state of knowledge by describing the Classifying Information chart (figure 4) and confronting and comparing the responses of those participants that showed a trend or pattern in the responses to Before Evidence, to the Direct Questions and After Evidence. The following Vignettes are about trends observed in the second level of analysis.

VIGNETTE TWENTY-THREE: classifying information

Two participants **A011317_1**, **A011317_2** and **A011417_1** showed environmental concerns at the individual scale indirectly, meaning that they expressed the concerns referring to concepts that are assumed to be environmentally related. Three participants, **A082117_1**, **P012617_1** and **P013117_1** showed direct concerns about environment. **A051217_1**, as it was in the first layer of analysis, never showed an environmental concern not even during direct questions or after evidence. Regarding climate change two cases outstand, **P061917_1** who mentioned it as part of broader concern and **A051217_1** who didn't showed concern about climate change at all. The rest of the input didn't change from the chart 2.1.

REFLECTION:

Taking a second look at the data was not only necessary but also in this case very revealing. Trusting in notes and memories from conversations during the interview was not enough to confirm the participant's input.

As part of the analysis, I started paying attention to details during the interview including coding statements where the participants mentioned concepts like “energy or sustainability” by assuming those concepts described an environmental concern. This Vignette describes one of the moments when the process prompted a new level of detailed reading of the transcripts and understanding of what the participants wanted to tell. It also called for a more responsible interpretation of the context of the answers to avoid guessing what was not clearly said.

Pulling highlights from the statements coded from those participants who showed contrasting or similar answers and level of concerns, I developed a series of Vignettes. As part of the identification of those highlights I looked at the doughnut charts for visual comparison. The first area I wanted to know more about is the broader concerns of those who did not bring up environmental, air quality or climate change topics during the first part of the interview. By looking at the statements and set of key words I would know the state of knowledge of the participants when unprompted to a specific concern.

VIGNETTE TWENTY-FOUR: what concerns architects and planners

From the Coding Queries in the Before Evidence phase, the statements of participant architects mentioned budget or cost. Sustainability and efficiency were also present in the context of keeping the buildings working more than in the context of environmental thinking. **A020417_2** and **A051217_1** expressed concerns of trying to understand what the preferences are or needs of individuals in terms of public

safety, how much the development in cities cost, and how public policy is made for projects within the community. **A032717_1** talked about energy efficient design. **A041417_1** and **P021017_1** used an active tone by assuming that their role is to expand the minds of the people, how to make the community better and have a meaningful impact in the society. Participant **P061917_1** specifically said that <focus on public interaction for addressing the needs of the public> and <that a request of the public processing for the services of the community is relevant> and that <it is perceived that state laws tells you how to conduct things and that planning is it is overly regulatory and so a lot of planners become processors that become paper pushers>.

The following concepts were present in planners and only in one architect: site planning, community or the social dimension of practice, and regulations. While **P061917_2** also manifested that the first that comes across the mind is deadlines.

P062017_1 said that clients expect them to not go over budget because it looks bad to the client and in contrast, **P062417_1** gives people on the neighborhoods the power of stopping decisions they don't agree with and encourage them to reacts when they see that the interpretation of the codes it is not aligns with the solutions the people wants.

REFLECTION:

It is not a surprise that only one planner mentioned cost as a concern since normally, in the architecture practice, the job is tied to what can be done with the available resources. My practice was not any different. I remember making fun of the school projects where there is always a deadline to finish your designs, but cost is never the limit. Some of the professors tell the architecture students not to worry about costs, so they can freely use their imagination. In the real world, that is not possible. It is probably due to the way that architects are educated that in their responses they bring up ideas of being the one that thinks, the one that creates, and the one that makes things happen. A041417_1. For example, talked about changing people's lives using design. Designing has many challenges and ranges of action. It is the dream of all designers to make a change through creating something. This dream is more subjective than scientific; although when the design responds to a need, the subjectivity vanishes. Addressing real needs makes people start processes to find solutions instead of dreams for solving world peace or the world's hunger, poverty, or health. In P061917_2 and P061917_1 there is some of that dreamy perspective in situations which may be not part of their way to practice but instead a response to the pressure of being interviewed.

Deadlines appear as concerns in three responses; time is one of the challenges of managing projects. There are no good managers that do

not prioritize time. Therefore, meeting deadlines was expected as part of this phase; however, one response showed a different point of view. P061917_2 brought up the fact that having experts instead of interns is better due to the time that it takes for him to teach people how to work. Time then is a mayor priority; but, just like budget, it has different dimensions and is probably just part of the routine -- something that is present in all cases whether it is mentioned or not. Maybe those who didn't mention it failed to do so because for them it was a given.

In cases when a plan has to be approved and site planning has to be addressed, the planners know what to do and what the consequences of not doing it right may be. But they all also complain about how they are seen as paper shufflers and not as part of the decision making -- meaning that, at least these participants corroborate my initial guess as partially correct. Planners are not being included although their knowledge and perspective is what links the buildings to the contexts at any scale. A highlight in this Vignette that is worth keeping in mind for the third goal of this phase in the research is the fact that planners seek in the regulations the answer to current problems of all sorts including their application, change, update, and the engagement of people in new or adapted codes.

My research is uncovering new pieces of information that are feeding my original inquiry. Now I start seeing the intricate relationship of the practices of the professionals and intimately understanding that there are answers where they talk about their experience and others where they talk about what they expect to be doing. Since the first part of the interview was not guided, I can understand that the participants were motivated by many factors at the time they answered. Some of them may have had a problem with staff or a deadline to meet; therefore, those were their concerns at the moment. This fact does not invalidate the outcome. For me, this is an opportunity to know more about what are the elements that integrate the state of knowledge that I want to describe. I consider the richness of this phase to be about the different situations that they bring during a conversation. Moving forward with these observations, I noted that participants have unrelated concerns in phases of the interview when the conversation was forced to go to the core concepts. Understanding what is mentioned to be a conflict or an overlapping priority along with the core concepts that this research concerns can be achieved by learning the context of the following Vignettes.

VIGNETTE TWENTY-FIVE: broader concerns for professionals

A011317_1, A041417_1, P013117_1 and P061917_1 brought concerns that did not match the structured questions. Their responses talked about people, population growth and the user experience in buildings. **A041417_1 and P061917_1** gave two different concerns about people, the first said that <people are inherently lazy lots of times they go from the garage in their house and get in their car> **While P061917_1** stated that <we need to build housing at any cost that's all

that matters> and <better planning comes from a need to protect the health and safety of the welfare it originates from this need to take people out of the slums and preventing them from living in tenement housing with rats and no running water>. The same two participants talked about the shape and function of the buildings by stating that the architect said that <developers want to build a quick box or retail here and there that could be in Tucson's or in Kansas City> and the planner said <we talk about how a building looks and that has nothing to do with the safety of the building or the color of the architecture>.

REFLECTION:

Two architects and two planners kept talking about topics that concerned to the first part of the interview. They showed three different perspectives: One when they implied that population growth is the master problem since it pushes for more urbanization and the need for more focus on how to regulate and improve the built environment. The other was suggested when they talked about how people do not do what they are supposed to. The first concern is almost obvious: all problems grow as more people exist because the interaction is more intense as the needs for services and supplies also increase. The second and third concerns describe how the professionals feel social pressures lead their concerns. On the one hand the fact of more housing to bring people out of social conditions like poverty and unsafety which, although buildings

help, it is more a problem of administration and, then later, the same participants point to developers and designers as being guilty for building boxes that can host any activity and isolate the use from the place and even from meeting their function due to prioritizing aesthetics. These are perspectives that reminded me of the topics in the previous Vignette when some participants felt that design is a creative process. Thinking that people do not know how to use a place that was originally designed for serving people is like using shoes wrongly sized and expecting our feet to adapt. Cities and buildings are then more artificial than I thought.

It is understandable that some professionals look at a growing population as the main problem for the world. I am concerned that some participants think that the built environment is an independent creation that exists for a purpose and that purpose does not include the users' needs. Going back to the original inquiry of this research, if the building is not protecting the people, then why do we have a building at all? The main uses of a building are for protecting people and their assets from the outdoors. (I consider the word "outdoors" to mean everything that may jeopardize the integrity of that people and their assets.) It could be to protect against climatic events or earthquakes or thieves. Holding on to that description, why is it that a person (according to the few participants who mentioned this) would not know how to use a building? Maybe buildings are evolving beyond the simple initial use? Is dealing with uncertainty is making design so universal as to standardize the spaces and use mechanical systems for lighting, ventilation, noise, and so on a better option? Here, the question will be what other perspectives are expressed by the participants. Maybe the

responses from those who initially expressed concerns about the environment provide a different way to understand this role?

VIGNETTE TWENTY-SIX: unprompted environmental concerns

Four architects and three planners talked about environmental concerns without being prompted and they expressed them in four different contexts. **A011317_1**, **A082117_1**, **A011317_2**, **P013117_1** and **P012617_1** made statements that imply that the environment is subject to energy production, however only **A011317_1** mentioned it in the context of the use of natural resources and only **P013117_1** in the context of pollution generation. In this context, only **A011317_2**, **A041417_1** and **P013117_1** talked about the harsh condition in Arizona and only **P061917_1** referred to the life indoors as to have a social impact. **A011317_2** was the only participants bringing health as a concept related to not incorporating the natural environment as priority for the built environment. **P013117_1** and **P012617_1** used sustainability as a concept related to the environment which refers also to the social and economic side. **A041417_1** mentioned Hispanic architecture as a way to exemplify a way to respond to the context and climate.

REFLECTION:

A common topic among the general public relates energy production to environmental concerns and some professionals stated that in these

responses. It is a connection, however, that I am not sure is consciously done or is just a made-up idea that people repeat. I am not negating the relationship of these two topics, but it is a concern for me if the people who use this connection do not really know how they are related. Is it that they think about the impacts of energy production? Or, is it that the energy is needed to solve environmentally-caused problems like excessive heat? Both are worthy to keep thinking about and to address in future studies. As referred by some of the participants, the use of natural resources for solving our needs indicates that appreciation of nature is important since they mentioned feelings of some shame or regret for the damage done to our environments including generation of pollutants. Three participants mentioned the harsh conditions of Arizona as a problem which I found somehow disappointing, I believed that these concerns will be the top one, but I understand that it is maybe too obvious for some people. Getting used to a constant situation is not difficult to imagine and it is indeed a possibility. Two more responses made me happy and, at the same time, made me think about people using generalizations in certain connections like health and sustainability since they were made without much excitement (compared to other comments by the same participants). The reference to the Hispanic architecture as a good example of adapted model to the context of Arizona's climatic conditions made by one participants was a fortunate

comments that may inspire more research about its accuracy and effectivity in current times.

There is not just one way to be concerned about the environment. After reading the above Vignette, I found that architects and planners address the interaction of the natural and built environment in different ways that can be from the social, environmental, economic, health, and ethical points of view. This amplitude of concepts was only possible, in support of the method I choose, thanks to the open-ended question I used as an icebreaker. I found particularly beneficial the fact that if I do not introduce my true research question to the participants, they will be following their own interpretation of environment, not mine -- just as in this Vignette. In my head, the interaction between the two environments is especially important from a health point of view. Maybe if I did not opt to not mention it, I would not have the outcome described above. In order to contrast these outcomes and to be more informed about the answer to the question when asked directly, the following Vignette will address those answers to the direct question about their environmental concerns at the individual scale. I took this decision based on the need of avoiding generalizations and focusing more on what the participants care and can solve directly.

VIGNETTE TWENTY-SEVEN: prompted environmental concerns

The participants offered responses that involve architectural elements, technical considerations, and environmental strategies applicable to the body or to the operation of the buildings; all were mentioned by **A032717_1**, **A082117_1** and **A011417_1** along with the concept of budget. Some comments were about green buildings as well as passive and controlled temperature. **A011417_1** mention this to be flexible for

what the people bring to the project and that the negotiations are about how to make the client's ideas possible using appropriate materials and keeping an eye to how the heating and cooling of the building impact energy use. This last concern between temperature control and money was also present in **A032717_1** who talked about passive ventilation to take advantage of fair exterior temperature when possible. **A051217_1** said that architect should forget about the exterior because that is why we are needed, to provide protection and also mentioned the cost of strategies.

REFLECTION:

Some answers were nonspecific and rather superficial where no deep knowledge about the environmental strategies was present.

I found curious that only one participant talked about attending what the client wants in terms of design, the rest were explaining about how they convince people (the client) and how they show their contribution setting themselves as an example. This concept of convincing is present in the academic and empirical education of an architect. One of the most difficult to fix behaviors of an architect is the one we use to communicate our ideas which, first of all, we always try to announce as our own and unique idea; we always defend the authorship of what we say and, in my case, this was the most stubborn attitude I have inherited from my formative phase in this field.

The last comment that I identify in these responses is budget. The participants linked the idea of a response to the environment as a burden and as a matter of a discussion. This is a frustrating feeling when you have so much passion for aesthetical or environmental fields because for a given reason those aspects are not a priory and therefore, the cost become burden.

I do not believe that this is a sign of ignorance whatsoever. At this point the interviews were still in the phases that, although I asked about their environmental concerns already, they still do not know what my purpose for the interview is. They do not know my level of understanding in this matter so, maybe they hesitated in giving details or avoided using technical jargon as a courtesy to me. This is possible, and yet it questions my methods somehow. I don't know at this point whether the rest of the participants limited their answers to make my life easier. I tried to interact professionally; my conversations were as clear as possible to communicate the idea that I knew what I was looking for. However, in my everyday life and in the professional side of my routine, I have had moments where people tried either to explain too much as to say the least possible because they notice that I am not a native speaker.

Another concept that I found in these responses was about the professionals convincing instead of communicating and the concerns about environmental strategies for the built environment to be a burden. I think this is what the professional thinks and, therefore, this section will be connected to the Vignette dedicated to solutions later on. Now, it seems necessary to address climate change in a broader way. I want to know how it is perceived at all scales. However, only one participant

mentioned climate change in the three scales, so those answers will be analyzed below along with the one participant who mentioned climate change without being prompted.

VIGNETTE TWENTY-EIGHT: perceptions of climate change

In the INDIVIDUAL SCALE **A041417_1** said that <was interesting I was the only architect on the committee for climate change in the City Council>. In the REGIONAL SCALE **A041417_1** talked about this region needing to balance the use water for landscaping because of what it does to improve our climate in create reduce our micro climate and the need of a mitigation plan for the city of Tucson and the region since climate doesn't stop at the city limits, also remembered that Tucson was hot when it was over a hundred and five <when I was a kid and now it's over a hundred and ten getting up to a hundred and fifteen>. **P0619171_1** said that in Arizona we have a <very short vision of the future on an environmental level any type of climate change in this type of climate> and that we also need to look at the past since < there's past civilizations here in the state that have left because probably it became inhospitable> At the MACRO SCALE **A041417_1** showed awareness about what is happening in our climate with more extreme conditions and **P0619171_1** though that we need more integrated, walkable and livable cities to work in because of the climate and that globally the climate sort of forces us to stay indoors, losing social interaction.

REFLECTION:

The responses from A041417_1 imply an active but rare role in a climate change forum where the participant mentioned being the only one in the four years that was actively involved in it. This is not a surprise, I know that there is lack of awareness and involvement and the classifying chart for this research is an example as well. Looking to the three scales of this participant's responses side by side, it looks like the knowledge is there. The participant knows the implications of facing climate change for Tucson. On the other hand, P0619171_1 showed only regional and macro scaled concerns, but those responses came before being prompted, which I appreciated. This participant showed concern about the lack of vision of the future in Arizona making references to how past civilizations lived in the same climatic conditions and that is part of the lessons I want to learn from responses and documentation. If one person is aware that somehow the challenges we face now were faced by others before, we may have hope. In a macro scale these participants showed concerns about the climate pushing for a more static living confined indoors due to the changes and the fact that the patterns are less predictable, and I agree, that is why these pinions matter to me, being condemned to be indoors can expose people to other risk while trying to run from severe weather events.

I noted lack of awareness and pro-action from architects and authorities when talking about climate change. How can the message be sent to other professionals and authorities, so they will address current and future harsh conditions? Maybe the responses at the regional scale will offer insights into how the local conditions are seen and their context. The regional scale, as was explained in the rationale behind the scales, is the one that will connect ideas with the available solutions presented by experts further on.

VIGNETTE TWENTY-NINE: climate change and the region

The responses can be clustered in five topics, water availability, the city, warming temperatures, consequences of the bad habits, and mitigation. **A011317_1**, **A011417_1** and **A041417_1** addressed concerns of the availability, use and management of water. **A011317_2**, **A011417_1**, **A020417_2**, **A041417_1** and **P061917_2** expressed concerns about high temperatures, being aware of the Heat Island Effect, the global warming trends and how the built environment is not responsive to the orientations that work better for avoiding excessive solar exposure in order to reduce or mitigate the adverse effects of solar radiation in heat gain. The city was described as a problem and as a negative outcome of development in **A011317_2**, **A011417_1** and **P013117_1**. The consequences of urban life on climate change brought up by these individuals were air pollution, carbon footprint, auto dependency and land use change. **A041417_1**, **P021217_1** and **P062017_1** complained about how the authorities' *failure to act* towards mitigation, adaptation,

and resilience plans. The participants expressed concern about not knowing if there is something done at all and they also seen the political aspect as a threat to emerging plans.

REFLECTION:

This is an expected first concern when living in the desert. I guess that even if they are not completely informed, just by knowing that we are settled in a desert, water is on everybody's mind. But in fact, in the context of the question about climate change, it is comforting knowing that some professionals are conscious about how the built environment depends upon and impacts water resources. I was not expecting that they identify urban life as one of the problems causing climate change, being that all the participants are involved in the building industry somehow. A041417_1, P021217_1 and P062017_1 touched a topic that I thought will be more recurrent in the responses. I expected most of the professionals would complain about how the authorities are not acting to create and follow mitigation, adaptation and resilience plans.

At this point I am keeping in mind the fact that the participants have so far ignored the objective of this research. I have found not only responses of all kinds and scales, but I am remaining aware of cautionary behaviors that are possibly present in the way that the participants answer. The following Vignettes analyze responses that were given after I showed the visual aid (figure 1).

Once again, I think that analyzing the individual scale will give a better idea of how much they react after interacting with the visual aid.

VIGNETTE THIRTY: air pollutants (evidence)

One planner and one architect had individual concerns about the environment and two perspectives are noted. **A032717_1** mentioned using grey water in his house which saves money and incorporating smart landscaping, rooted in the traditional European-American landscape architecture, for protecting from dust. **P013117_1** mentioned that dust is a real problem and that he has battled against it. This participant mentioned the impact of relying in mechanical ventilation, the health implications and the fact that the houses are not protecting the user as they are supposed to. It <is it more of an inconvenience than an aesthetic or economic issue> he mentioned when talking about how design plays a role in preventing dust indoors, but he also mentioned how expensive is when the mechanical systems are not well maintained or designed.

REFLECTION:

From A032717_1 I can identify that this participant immediately remembered a house that has passive and active environmental strategies. With one project, in this case his house, the participant told me how the materials, the water management and the dust infiltration

are controlled through design. This participant was aware and has worked with the natural environment, comfort, sustainability and dust in mind but none of these topics were brought up without my prompting in early stages of the interview. This case may confirm, somehow, that the participants moderated their speech as they perceived that their audience empathized with them or understood them. From P013117_1 I see how, relying on his background and membership in the American Society of Heating Refrigerating and Air-conditioner Engineers (ASHRAE) makes him aware of how the ventilation systems are flexible and supposed to work towards better indoors. This is something that normal people do not know. When it comes to technical decisions, most of the designers and clients would rather follow instructions than actually argue about effectiveness.

There is some degree of confirmation that the core concerns of this research are, in fact, important to other professionals. Even if this research could prove this guess statistically, the second part of the equation still is “so, what?” Sharing similar concerns or awareness do not make a real change, unless the problem is addressed by jurisdictions in the form of discussion, campaigns, policy, and other regulatory and action taking efforts. The regional scale has the mission, as used in previous Vignettes, of filtering those topics that could be brought up later on when addressing the responses from experts. The following Vignette analyzes those cases that showed regional concerns about the environment and climate change.

VIGNETTE THIRTY-ONE: air pollutants and the region

About the ENVIRONMENT, **A032717_1** acknowledged the Sonoran Desert as being more vivid in Tucson than when you're in Phoenix because in Phoenix < it's sort of just a hot dry version of any American city >. **A011317_1** expressed a pretty high concern about the requirements already in place but also that a big change would need to happen to go beyond the initial requirements. **A082117_1** reflected upon the need for creating awareness for people to know how restoring the natural environment could be beneficial in many ways, and part of that is their health and comfort priorities <even if it's on a desert jungle, a house with trees doesn't get very high, in fact, that house will be ten degrees cooler than the one across the street that's all asphalt, it makes a big difference, it's healthier >. **P012617_1**, speaking about plants or trees, suggested not using non-native plants because that creates more dust through spores. Also about dust, **P013117_1** showed that he understands that the nature of dust in cities is a relationship between the environment and urban planning < Can the city mitigate, not itself as a source but, be resilient against dust as a problem? How do you design a city this is to protect people? This isn't going to be in the house itself >. He sees the answer in better urban forest to catch or filter out some of the dust from homes and residences so there might be areas that are less affected by dust storms. **P061917_1** recognized that certainly planning,

the building and engineering codes as well as me (in the research side) could do more to conserve water and could do more to reduce urban footprint. He had a moment in which he took a deep breath and, as a way say how to make it happen, he added <how building looks has nothing to do with safety>.

REFLECTION:

Some responses pointed to urbanization as a major problem, rather than water availability and management. In some responses, I perceived some vague arguments that sounded more as guesses and not as truly thoughtful answers. That was expected even though I designed the interview to reveal the objective at the end of the interview. However, even if the responses were made up to please me, the target of their assumptions is what I wanted to learn -- what do they perceive is the problem? That is what is going to be in their heads when they set about tackling the next project. They will be working on projects later and if there are no answers to their questions from those that they perceive as responsible, then they will take no action. These seven participants are looking at the city, county, and state level to provide tools for catching more water, providing more vegetation, dealing with higher temperatures, and controlling dust generated outdoors.

Back to the findings on the classification chart in its two versions, I remember that air quality was not among the priorities of the professionals. The same thing happened with indoor air and dust.

VIGNETTE THIRTY-TWO: is indoor air quality relevant

In the INDIVIDUAL SCALE **A011317_1** and **P013117_1** expressed concerns about bacteria in the dust particles and even mentioned personal problems <I directly experienced tight chest and burning eyes and other symptoms that are associated with air pollution>

At the REGIONAL SCALE **A032717_1**, **P061917_1** and **P013117_1** said they think that people started getting sick due to air and the problem with dust, in particular in the Sonoran Desert, while **P012617_1** and **P021017_1** noted that population growth means more people equals more smog.

In the MACRO SCALE, **A011317_1** and **A011317_2** said that global warming and the air pollution are starting to influence the way construction happens but we still spreading pollution. **A020417_1** said that outdoor air quality is typically cleaner than indoor air quality and as we keep making our houses more energy efficient we make our houses also a little more toxic. Only **P012617_1** talked about windy weather helping to spread smog out and help cleaning, while **P013117_1** looked at the dry soil as a factor that can increase dust potentially and urbanization as directly contributing to global climate

change. P061917_1 brought up agriculture as a field that typically has no regulations and noted that it is permitted for them disturb the fields, letting the dirt fly up everywhere.

REFLECTION:

The individual scale showed health concerns. The participants saw the health risk, and they even recited personal experiences which may be crucial for creating conciseness somehow. I would think that more than one participant has had personal experience with air or respiratory problems, but those problems have not yet emerged in the conversations. The regional scale brings the problems of population growth in two senses, the health risks and the implications of more people, more cars, larger cities, and more anthropogenic pollution including dust, and these are hints or notes to consider in thinking about how to collaborate with cities, for example, regarding awareness and regulations and even community action. As expected, the macro scale brought more generalized concepts. However, I celebrate that wind as a physical factor that is entirely tied to air and air quality was mentioned though that has not been brought up before, not even in literature I read. Two important factors that were indeed in literature before were the dryness of the soils and disturbances like those made by agriculture. I suggest that participants, as a small representation of their professional fields, bring hope to my research since topics that I considered and some that

I had not were mentioned somehow. There is room for informing more their responses, there is a possibility that the vision they have about things in general can be better or different which will be, at the end, the way to help them be more responsive about the concerns in this study.

I was disappointed for a moment. Air quality did not spark attention the way I expected. I wondered whether I used a complicated academic language that intimidated the participants and made them reluctant to talk more even if they knew something related to air quality. However, as the participants keep talking, more detailed comments were made. Considering that the participants now knew the purpose of the research, logic dictates that maybe they would put more emphasis on what I explained to be my concern. The following Vignettes will demonstrate this effect on the responses.

VIGNETTE THIRTY-THREE: context of indoor air concern

A011317_1 and **A032717_1** cared about respiratory diseases caused by dust from outdoors but also from materials and failures in the air conditioning systems. **A011317_1**, **A011417_1**, **A041417_1**, **P013117_1** and **P012617_1** believe that impacts of indoor air quality are a matter of improper design and that dust gets into the building because of failures in the ventilation systems. They think that there are strategies like barriers and cross ventilation that can be effective.

A020417_1 is sure about outdoor air quality being typically cleaner than indoor air quality since it is more diluted than the concentrated indoor

air. But, **A011417_1** also noted that indoor air controls are about attending to maintenance and filtration. Contrary to this thought, **P012617_1** commented that we should live our lives stay away from areas we don't need to be.

Two different opinions were **A011317_2** saying that < we need to cover the ground> to avoid generating dust and **A082117_1** saying that there are other operational problems that can be as simple as <the gardening personnel coming out with the blower and blow[ing] the yard>.

REFLECTION:

Health was a concern and the participants who expressed concerns brought both, dust and indoor generated pollutants, to the discussion. This confirms that at the top of most people's mind is the fact that we are used to hearing about indoor pollutants as the iconic problem indoors. However, it is comforting that some participants are not aware of dust as a health problem as well. Design and building operation elements were mentioned by four architects and two planners. They mentioned design techniques like barriers, land cover, and cross ventilation -- which are passive strategies. They did not talk much about mechanical ventilation. Again, some responses sounded more like a rephrasing of what I told them; but, the richness of the answer is in their interpretation of what they understood to be the question.

There was a change with respect to the responses to direct questions. They brought up the reliance on mechanical systems in the direct questions; but now that they know the overall intent of the research, the responses were more focused on providing input that addressed all the fields I touched. I informed them about the impact of energy use and generation, the sources of outdoor air pollution for the region as well as the health effects. Once again, the regional scale will be analyzed in order to find the topics related to the local agencies.

VIGNETTE THIRTY-FOUR: regional concerns

A011317_1 was concerned about dust in this region and its impacts on the performance of solar panels. **A011317_2**, **P021017_1** and **P012617_1** are worried about ground cover to avoid dust generation since, just as **A0327717_1** observed that the air quality in Arizona <has gotten a lot worse> which adds up to what **P013117_1** talked about with regard to land development practices affecting dust levels in this region. **P061917_1** stated that we could do a lot of things through the codes.

REFLECTION:

Local condition concerned some of the participants. The physical characteristics of the region that generate dust were present in their responses. They mentioned the effects of urbanization. They sought solutions related to filtering the air with vegetation or land cover. Others made comments about being more conscious about the location of houses within the city. They identified the effects of desertification in

dust generation; building and energy codes were also mentioned as a way to support planning. This is a much narrowed list of concerns compared to what I expected to have after presenting the evidence. However, it is, at the same time, complicated enough to bring more questions.

Indoor air quality concerns were identified at the individual and regional scales; once the planners and architects were aware of the implications of the local conditions, they related health effects and the role of the built environment to design and codes. The follow up should analyze the solutions that they provided. The next three Vignettes present solutions for the broader environmental and indoor air quality, looking for strategies that will make sense for the participants when exploring effective ways to address the core concepts of this research.

VIGNETTE THIRTY-FIVE: solutions and perceived responsibility

From the non-prompted concerns at the regional scale, **A051217_1** and **P061917_1** commented that regulations and the need to get permits make the process inflexible. They also noted that opportunities for more creative zoning based on changes from the community regarding the environment. When facing regional environmental concerns **A011317_1** and **P012617_1** tied the solutions to efforts in energy efficient design and sustainable design as a way to flow with the surroundings as opposed to create our own nature. **A082117_1** and **A041417_1** proposed planning and zoning changes and enforcement

while trying to get people involved. **P062017_1** perceived both transportation and land use as areas within jurisdictions that may be modified to address air quality.

With regard to the solutions for indoor air quality, here are the most revealing quotes: **P012617_1** <I would have to say just the way we develop and live our lives, stay away from areas we don't need to be>. **P013117_1** <understand to what degree a home does protect against the outdoor dust and how does the dust get into the house then third I'll be interested in ways of mitigating that which could range from filtration systems to I'm not sure what else>, **A011417_1** < just adding filtration to the buildings, I don't know if that's much of a tradeoff>, **A011317_2** <full ground cover either organic or inorganic>, **A020417_1** <cleaner mechanical systems indoor air quality> and <more green space so we do harm ourselves by not understanding how ecosystems can coexist>, **A051217_1** <It is about having staff to keep the indoors clean, if there is dust, well clean it> and **A011317_1** < we need an active or passive system and provide cross ventilation in the design or proposal but I have never been told or required to pay specific attention to this>.

REFLECTION:

For broader concerns, regulations may be seen as a way to obligate people and jurisdictions to pay attention. Maybe if an action is not

required by code there is no need to address the issue. Making a case to an owner regarding using resources for addressing non-mandatory codes is always challenging. Remembering previous Vignettes where budget and deadlines were mentioned to be major concerns overall, thinking about non-mandatory issues that cost money and time will surely fail. The second part of this Vignette shows the need for community engagement in the process of raising awareness. As was discovered in the literature review, people can speak up and get the attention of the community and local agencies and officials bringing them all the way to a policy making process, if is well documented, or at least, a local code or recommendation.

Not much change is noticed when talking about environmental concerns where zoning and building codes and regulations, green building strategies, community and officials involved in changes to current awareness and decision-making processes were mentioned as solutions. When it comes to indoor air quality, the solutions are not seen to be external, not much attention is paid in codes, and more attention is paid to ventilation systems and design.

The information that can be deduced from the Vignettes created for the second goal of this chapter – revealing the state of knowledge regarding the core concerns of this research using the phases of the interviews and the scales as a way to understand the context of their responses – helped identify

the obstacles and miscommunication between the rules and regulations, the professionals involved, and the real needs of the design and building process. I emphasized those cases where the scales highlighted a connection with sectors that may have been either responsible or assumed to be responsible for attending roles within the practices of architecture and planning.

The low concern that the participants interviewed described about environment, climate change or air quality as aspects of their jobs pointed to the possibility that the acting regulations, budget, and deadlines are the most influential factors in decision making for the built environment. It was generally understood that the participants in the interviews perceived themselves as capable of solving specific concerns by identifying the implications of a problem (in this case air quality). Although, I cannot ensure that the results represent the general description of how decisions in the built environment in Arizona are made, it is clear for me that I needed to explore ways to address the miscommunication between the professionals' concerns and perceived solutions. Here is when the voice of people whose work is to design, apply and reinforce regulations is important.

Third goal: To complement the findings in the previous Vignettes and reflections with the input from the interview to a group of experts.

The semi-structured interviews with experts had the objective of expanding my understanding of how their offices work on a range of topics or situations related to indoor air quality based three motivations: contrast my findings in Chapter Two regarding how regulations act in the areas of indoor air quality; add additional notes to the answers from participants; and understanding their roles within their organizations. With this input, I would be able to know more about what is and what is not considered important for them. The sample size in this case followed as simple count

of at least one expert from each jurisdiction level within the State, one non-profit, and one membership group. I set up these simple criteria while being aware that talking with all the roles in each agency in order to know specific information will be impossible and maybe even not necessary. Few participants may provide the opportunity to learn whether something was missing from previous steps in my research for learning the state of knowledge regarding the impacts of outdoor pollutants indoors, in this case, from the random people in institutions known for caring about well-being of the community.

I began with informants who on the website of their agency/office were most likely to be in the area that oversees indoor air quality. Using chain referral, some participants came from unexpected sources since some people forwarded my invitation to people in other agencies or offices who they thought were able to respond according to their function and experience or with more availability of time. The chain referral reached a total of thirteen officials: two from the Pima Association of Governments (PAG), one from Pima County, one from the American Society of Heating Refrigerating and Air-conditioning Engineers (ASHRAE), one from the City of Tucson, one from the Sonoran Institute, one from the City of Phoenix, one from the city of Chandler, one from the Tucson Emerging 2030 District, one from the US Green Building Council (USGBC), and one from the Association of Environmental Sciences and Studies (AESS), who all together will be identified for the purposes of this research as *experts*. The participants were invited via email explaining the overall research goals and objectives.

The interview consisted of a questionnaire only including direct questions about the core concerns of this research (See Appendix D) and a set of questions after the experts were shown the evidence of environmental conditions and change (figure 3).

Classifying chart for experts

The Classifying chart for experts (figure 10) included preliminary data. The ID code assigned to each participant was in the first column followed by the attributes that allowed me to make distinctions among the characteristics of the group: Academic Training, Academic Level, Additional Training, years dedicated to the current profession, has worked in other cities, and type of interview. During the process of identifying this preliminary information, I noted that, these participants do not represent the whole mission and role of their agencies or institutions. Differently to what can be said about the *professional* participants, where there were two well defined groups (architects and planners); the *experts* have different roles and range of action which does not allow me to come with conclusions. However, there were highlights that had to be commented and reflected upon. First, I noted that four participants: **E062017_2**, **E062817_2** and **E082817_1** decided to drop the interviews after the first phase but, allowed me to keep their classifying information. **E062117_1** was a case where both wanted to use his advice and comments as an educator in sustainability at graduate level since during the interview that I found that our conversation stepped away from the outline and we were talking about my research instead. His comments fed parts in this document where I described some of the characteristics of the architecture and planning fields. In the other cases, I followed the standard procedure stipulated by Human Subjects stipulation and I did not ask any explanation about the reason they dropped which also prevented me from making any assumption. The attributes were named after those

characteristics that will provide context for their answer later on and were answered based on notes, websites with their public information, and information gained during the interview. In the following Vignettes, I reflect upon the insights I got from the interviews with *experts* that enlighten me with new or different knowledge of what the previous pieces of my research have not provided.

Participant	Agency	Connection with Air Quality	Connection with Indoor Air Quality	Concerned or Aware of Climate Change	Capable to decide on Air Quality
E012017_1	PAG	Direct	Somehow under the umbrella	Yes	Yes but addressed if comanded
E012517_1	PAG	Direct	Not directly but plays a role	Yes but addressed if comanded	Yes but addressed if comanded
E041217_1	Pima County	Not directly but plays a role	Direct	Yes but addressed if comanded	Yes but addressed if comanded
E060117_1	ASHRAE	Secondary area	Direct	Yes	No but want to
E060217_1	City of Tucson	Not directly but plays a role	Not directly but plays a role	Yes	No but want to
E061917_1	Town of Florence	Somehow under the umbrella	Not directly but plays a role	Yes but addressed if comanded	No but want to
E062017_1	Son Inst	Somehow under the umbrella	Not directly never considered	Yes	No but want to
E062017_2	City of Phoenix (dropped)	Secondary area	Not directly but plays a role	Yes but addressed if comanded	No but want to
E062117_1	ASU-Chandler (dropped)	Somehow under the umbrella	Secondary area	Yes	Yes but addressed if comanded
E082317_1	USGBC Loc F AZ	Somehow under the umbrella	Somehow under the umbrella	Yes	No but want to
E062817_1	AESS in process	Not directly never considered	Not directly never considered	Yes	Yes

Figure 10 Classifying Information from Experts

VIGNETTE THIRTY-SIX: experts and regional concerns

From the Broader Concerns section of the interviews to *professionals*, the most common topics revealed that it is the perception of some professionals that the people at all relevant jurisdictions do not pay attention to actions not required by a code. Also, *professionals* expressed concerns about making a case to an owner regarding using resources for solving non-mandatory codes and the need for community engagement in the process of awareness.

The *professionals* expressed environmental concerns about zoning, building codes and regulations, green building strategies, community and officials involved in changes to current awareness and decision-making processes were mentioned as solutions .People and jurisdictions may pay

attention but maybe because an action in not require in a code then, there is no need to address the issue.

For climate change and air quality, the highlights were: climate change and air pollution are due to, carbon footprint, auto dependency and land use change; population growth is of concern in two senses: the health risks, and the implications of more people since the more cars and larger cities, more anthropogenic pollution including dust. Specific concerns were: the effects of urbanization in vegetation or land cover; location of houses within the city; building and energy codes; and the need of community engagement in the process of awareness.

REFLECTION:

Overall, concerns and solutions pointed to strategies that would result in decisions being made in a more effective way. Key issues were budget and deadline priorities, so regulations that justified the use of more money and time were needed in order to deal with the owners or people in higher positions within their firms. This justification process was needed for any decision, whether it be aesthetic, operational, technical, sustainable, or as a way to address health risks.

The input from the professionals points to the need of deeper understanding of the regulatory framework governing the built environment. In Chapter Two, Vignettes Thirteen and Fourteen I addressed the fact that I could not find codes rooted in Arizona's conditions for air quality and at

that point, my guess was that our region is following State or Federal regulations, meaning that those acting regulations are based in describers of a macro scaled problem that in generalized for the whole country. The professionals were asking for codes and regulations on land use, air quality, climate change preparedness, and environmental responsibility and if the input from experts is not optimistic about locally inspired regulations being possible then, a major problem may be reveled soon. In anticipation of the following Vignettes dedicated to the responses from experts in air quality, I found it necessary to provide deeper descriptions of the regulatory framework.

As explained in Vignette Thirteen, a Code provides specific requirements that must be met to achieve an objective such as a certification. For example, building codes are followed in order to get a certification of operation or occupancy. I wonder if the professionals have this description in mind when asking for codes as a way to make best practices mandatory. Is there some misinterpretation or lack of understanding on how a code is built within the regulatory frameworks? I looked for a description of a Code and I found that Codes, in a more comprehensive description, according to the (Phoenix City of, 2018) could have two scales: 1) complete statement of the law in a given area, or 2) a collection of rules of practice set by a company or governing body. In this case, building and zoning codes correspond to the description number two. Locally, a code is built by collecting building standards after community discussion and it is complemented by an enforcement mechanism (Phoenix City of, 2018). Land Use, on the other hand, is not mandated only by codes. Land Use affects individuals and communities and is a critical factor in meeting overarching goals. Therefore, land use planning is a policy instrument and may contain codes and standards (White, 1979). Therefore, the professionals may be looking in the right direction. The more specific the codes, the more effectively the Land Use may react to the local

needs. Here is one component that the professionals are maybe missing: as part of the community, they can add to the knowledge of codes and policies. The community engagement and participation that they are calling for includes their own participation and the viewpoint of a practitioner in architecture or planning would enlighten non-addressed areas of the acting regulations.

Understanding now that the professionals may not be aware that their expertise can provide input for rulemaking processes to address their concerns, it is time to explore the possible areas where that expertise may be useful in the areas of concern in this research. The *experts'* responses when asked to discuss environmental regulations, climate change and air quality showed assumptions that may be used responsibly since, although they were sure about describing their personal and institutional roles in these areas, they do not represent the institution as a whole.

As expected due to the eclectic group of experts that I interviewed, some individuals offered impersonal responses. I needed to be prepared for some signs of good-will, meaning that, being these groups told in advance about my research interest, it is reasonable that they would have some ideas prepared. I needed to hear those messages closely. They talked about development of plans which includes finding funding for those plans to take place; alignment to upper-line-of-command rules and expectations since, as it is exposed in the classification chart, most of them respond to commands and few on personal and conscious motivations; improvement and innovation in technology to provide better life style; and their role on promotion of best practices and planning. Certainly, my guess in Vignette Thirteen was close to reality so far, the institutions have limited responsibilities, at least from the two first messages where availability of funding and alignment to upper level commands are a soft form of an announcement for me not to blame them if their input does not bring the information that I wanted from them.

I learned from chapter two that policies in air quality are made based on exposure of vulnerable population and, with it, there is a bar set at a limit where the agencies consider that the exposure is high enough to be a violation of a code or standard. What I did not know at that time is that, according to E012017_1 and **E012517_1** from the county level, when a violation of the code happens, that triggers actions to solve the problem as well as to make people aware of the health impacts. I wonder about two things: what if a pollutant is present barely under the limit but for longer periods of time. Will the impact be measured? And, how are those limits set up if, as I already reflected, the implication on the generation of pollutants is uncertain. I cannot imagine that the monitoring stations have the technology to measure all the pollutants; in fact, they measure Particulate Matter (dust) and divides in two categories only (large and fine) and Volatile Organic Compounds (VOCs) which have their major sources in urban environments and agricultural fields. What about all the other known and unknown pollutants originated outdoors in arid regions, the source of my concerns? These experts also suggested different approaches to different concerns. For example, I could see that in those cases, attention to climate change is paid only if commanded; and if the agency did not fund it, then not at all <it is unfortunately, especially in the political situation that we're in right now, we need to show scientific evidence that there is a problem first and then we can work together to come up with the best solutions> Their procedures are to encourage remediation and develop plans including creating handouts or flyers addressing prevention and human health. Big problems with, what I can call, superficial solutions. I found disturbing that, at least in the hands of these experts, they expressed maybe fair knowledge but about limited areas of air quality and that their actions comes down to a flyer as a way to remediate. I needed to remember again, these responses do not represent the role of the entire institution but, I know now that awareness campaigns are instruments use by the county.

It seems more difficult now to meet the expectations that the professionals talked about: regulations that justify the use of money and time and technology applied to buildings; and, with them, planning and the development of strategies. This information raised a larger concern about the uncertain political context which might impact the available funding and engagement on climate change and sustainable strategies. Now, I need to take a look to the cases where the *experts* mentioned solutions. Even from their limited scope, I need to pay attention to other possible actions that came up in the heat of the conversations.

VIGNETTE THIRTY-SEVEN: solutions from experts

E012017_1 and **E012517_1** described that their agencies follow the instructions and guidelines of the federal government. The county works on air quality issues as required by the Environmental Protection Agency. The county also works with the State of Arizona Department of Environmental Quality through an environmental quality advisory council. As for partnerships, they work with community organization to put their plans on place. **E041217_1** has only 2 supervisors; he has freedom of decisions but little chance to influence people since he has direct contact with people in the process of receiving permits or certificate for their buildings. **E060117_1** shared that ASHRAE³ has departments dedicated to buildings and homes that have great influence in developing codes and standards for air quality as well as energy

³ American Society of Heating, Refrigerating, Air-conditioning Engineers

performance. **E060217_1** reported that the city follows county, state and federal programs and regulations. They partner with local community organizations, businesses and other cities. They have worked with the IRS⁴ to allocate benefits and incentives. **E061917_1** mentioned that in city planning there is a focus on public interaction. In city planning the municipality develops, redevelops and provides services to the community. <In Arizona the counties have air quality offices and then they also work under the umbrella of the state air quality department and then, of course, they work under the federal umbrella, but local communities particularly smaller ones don't do much in the way of air quality it's usually at a higher level >. **E062017_1** described that city officials, planning staff directors of non-profits and funders are interested in funding urban design resiliencies sustainability solutions trying to champion best practices evolution and adoption of those best practices and for that, they have an advisory panel. **E082317_1** said that coalitions like the 2030 Districts and USGBC track carbon emissions and all of that needs to be aligned by the County and the Association of Governments for being able to know what the latest alerts act for air quality. Partnerships with non-profits for community development related to environmental programs and educational programs certainly are part of their line of action.

⁴ Internal Revenue Service

REFLECTION:

Some responses, as noted at the beginning of this section, can be influenced by the role they played within their institutions and others may be more individual. None of them can speak from their entire institution but somehow, the revealed information on how they operate brings new fields, for example: the experts from the county level agencies count on the federal and state level agencies to define their range of action. No plan or project can be started if it is not within the criteria defined for the use of funds and staff. It is also dependent on the interest level of people and community organizations in order to go ahead with locally identified needs. But they only get help if the actions are within, again, the criteria defined by the upper line of command, in this case, the Environmental Protection Agency, the Arizona Department of Environmental Quality, and the Environmental Quality Advisory Board. There is a participant in the county level whose work is not in planning or development but, instead, is approving certificates. Here, I found that there is more latitude in terms of advising and adopting more conscious strategies directly with the public, including planners, architects and contractors for new and existing buildings. Those experts from agencies that are industry led (like the US Green Building Council, the 2030 Districts and the American Society of Heating and Air-conditioning Engineers), stated that they rely on each other as partners and act as an

independent membership based and directed. The city level participants see the non-profits and the community as key partners.

I could not find a connection between what the experts explained and what the professionals expect. There are some ways for engaging them in actions to propose change together. However, there was also uncertainty in the groups of professionals and experts, since as expressed by them, the political context and the difficulties that come with available funds have created obstacles that end up forcing people without strong wills to hesitate from developing ideas that will solve non-mandatory concerns for their practice or role. I wonder again about if it is there for addressing the concerns raised by professionals? I found that indoor air quality and dust (particulate matter) were issues unrelated to the specific duties of the participants from the County level. Health is a concern for this particular office within the County agency only if the exposure occurred outdoors.

One other finding in this phase adds up to my set unknown concerns and solutions, economic incentives were mentioned as a way to motivate people to look for solutions of air quality issues. The problem is that the link described between incentives and air quality is energy production, since it is seen as one of the sources of carbon releases to the atmosphere. Therefore, this finding does not shrink the already long way to find common knowledge about the impact of outdoor generated pollutants coming indoors. Dust, as I mentioned in the literature review, is a matter of particles small enough to be picked up by air and could be a side effect of erosion, lands disturbances, agricultural and mine malpractices and desertification. The incentives then should be in those economic activities that happen in a larger scale. It should target those involved in disturbing the land like developers, agriculture sectors, mining, agencies that oversee water

management and everything else that has been pointed out as a product of urbanization, including climate change, and not only in energy production and transportation.

In the industry led organizations like USGBC, LEED and ASHRAE, ventilation is poised as the solution (this was also mentioned in the literature review as well). The actions that these participants can take are maybe more realistic maybe because they are committed to their membership, however, depending on how influential are those groups, they have partnerships with governmental agencies which may influence their original commitment. In general, those organizations have also more impact in the market since their membership provides good feedback and statistical significant data for business and service providers on their sectors. They may motivate advancement technology and adoption of design tools in order to reduce accumulation and exposure to dust.

Professionals and experts can contribute to develop better codes and even new or better ways of communication, the problem is how to address a common interest if they all have different motivations and scopes? I went back and looked at one more aspect to give me more contexts before delivering a conclusion. The personal experiences mentioned by participants of the two groups are pieces of input that may bring the human scale and, being the spontaneous comments, in which they may acknowledge aspect of concerns and tangible solutions that, may come as a user of a building instead of as a specialist in buildings/build environment. I had, at this point, the feeling that in some conversation there were moments of epiphany in participants of both groups. In those moments they saw the indoor air quality and dust as a first-hand problem. The importance of this vignette relies in the fact that it is maybe a point where people who work for buildings may

remember that they use buildings as well and therefore, some of the decision they made in the regular basis can be benefited with this perspective in addition to their normal course of decision making.

VIGNETTE THIRTY-EIGHT: personal experience with air

A011417_1 has all kinds of allergies to dust and, pollen. **A032717_1** has seen cases where people in air tight buildings started getting sick. He heard a story about a baby less than two years old who was sleeping in a crib in her bedroom and the parents had had a fire in their fireplace and they went to bed and didn't put out the fire. What happened was that there wasn't enough heat to push the carbon dioxide out of the chimney so in a normal house what happens it just leak the carbon monoxide would leak out of the house but, this is an air tight dry wall house and they cracked open a window next to the baby's bed and the carbon monoxide had come across the floor and gone into her room and out the window and suffocated her. On the expert side, **E041217_1** tries to keep carpets out of his home and uses the swamp cooler to clean the air. **E060117_1** said that, psychologically, making people feel cool in the summer time when it is hot outside is wrong. Comfort is maybe different for others emotionally because we are trained to think that the house is supposed to make us feel cold when it is hot. It makes us not tolerant of that natural phenomenon. He is allergic to dogs. **E061917_1** his friends and family both have experiences with asthma and allergies beyond

seasonal. He believes there's a strong correlation with dust in particular in the Sonoran Desert environment. He mentioned that non-native Arizonans typically bring plants that were not native to the region and start presenting more issues to them and then we get these horrible monsoons that kick up the dust. **E062017_1** his stepson is really affected by air pollutants. He thinks that heat and air quality are horrible and in thirty or forty or fifty years from now what does the southwest look like it could be a ghost town. **E062817_1** when I was born there were two point five billion people and now there are seven point four so the only thing you and I have to work with is how to reduce the impact per person or impact per dollar of income because we can't deal with population at least immediately maybe in five to eight years as we begging to bring people more aware we can say <alright we also need to start thinking about population>; **E082317_1** he suffers from severe allergies as well as other people in the family. He said <is no doubt in my mind that human health is a top priority to be focused on>.

REFLECTION:

Although these cases are not meaning a full range of health effects from exposure to dust, I wanted to know whether the participants in this research have had any personal approach to the core concerns that I am bringing to their knowledge and see if, in their professional capacity, they have missed the opportunity to be their own source of motivation to

be more active about it. The cases above tell a story of exposure to bad design and bad maintenance procedures to their mechanical systems. Both, design and lack of maintenance are, to me, the product of not having awareness of the physics of air dynamics and/or the idea that people must operate the systems in the house.

The experts, maybe without knowing, explained how they have worked out some air quality issues, whether it is because of their job, their advocacy, their economic interest or their personal motives. As a result, I have collected a series of new findings. I also detected that there is, on the one hand, value in acting in top-to-bottom approaches to solutions, but once they reach the local level these focused actions may enter a rocky road; on the other hand, bottom-up approaches may be more effective in coming up with collaborative plans and even incentives for closing the gap between natural and built environments. All these collaborations are currently happening but not yet in the field of my concern, and it is because of the interactions among the many factors that the knowledge about it is vague and no one has addressed it, until now.

CHAPTER FOUR: THE FINAL PHASE, A PROCESS OF BRINGING MY LIVED EXPERIENCES INTO THE RESEARCH

Central to Autoethnography is conscious attention to the role of the researcher as an active participant in the inquiry. Looking at how I perceive and understand the social, economic, and political influences on Arizona's built environment adds up to explaining how I, as a professional and expert, contribute to this research. Furthermore, this phase has given me the opportunity to document the challenges in the region and will provide context to future inquiries. The observations in this section include the explorations that I made around those questions that the approaches I documented in the previous chapters have not yet answered. There were loose ends that the conferences, the literature, the workshops, the experiments, and the interviews did not respond to and it is my turn to bring them into this discussion in order to inform myself and my audience. In the following paragraphs come my reflections while living in Tucson, some from early courses and class notes and others from additional readings that I did to complement the knowledge already shared in this dissertation.

Living in Tucson, Arizona; a window to American cities

Upon arriving to Tucson in 2008 and living initially close to the west frontage of the I-10 and St. Mary's, the first impression was that Tucson seemed dirty, abandoned, and with no people walking in the streets. The expectations of a first-world city changed while living a few blocks away from downtown; the deterioration of the neighborhoods was evident. Coming from Mexico and based on my interpretation of the American life, a long time needed to pass in order to understand that the social composition of the US -the major power of the world- includes people with needs,

problems, diseases and poverty, with money or without it, with education and without it, just like the rest of the world. It was difficult, on the other hand, to understand why the streets were in bad shape, why they have deteriorated shopping centers that were empty most of the time, and single-family houses with fences that barely protect against trespassers. In contrast, I noticed the apparent good shape of parks, apartment complexes, and the downtown. The process of knowing more about how the city works took time. Every day since then, the critical eye of my academic and professional background in architecture and planning has looked to all the interactions between people and their environment.

Appreciating the beauty of the desert, including the dirty roads and absence of some sections of sidewalks, was also about time. The admiration for the natural environment came as the understanding of the water demand for green grasses and citrus trees started to explain why some aesthetic preconceptions are not a priority.

Natural environment contrasting with the built environment

Observing the way that animals and plants survive the heat in summer indicate that life in this region is possible by innovating strategies for adaptation. When it comes to human-oriented strategies, the concern about not harming nature always pops, and it is about critically observing daily human behavior to see how far our adaptation has become an invasion. Societies have exaggerated the use of the techniques to substitute natural conditions and have developed endless ways to create artificial environments to bring comfortable living conditions, regardless of the exterior conditions. Built environments in a desert imply a contradiction, in fact. In Arizona, the people are conscious about the lack of water and the risk of exposure to heat, however, the

available solutions for solving their concerns are based on isolating the human activities from the exterior and then relying on mechanical ventilation and irrigation, just to mention a few. Heat-being the most common concern in everyday talks, warnings, and marketing- is obviously the first driver of the interaction between natural and built (human-made) environment. It is so integrated to the daily routine that people forget that they are fighting with a condition that will never change, unless it is for the worse. Few groups, especially retirees, find traveling to colder regions a prompt solution. "Snow birds", who are called this because they travel to Arizona to escape from winter in the North and East regions of the US, sparked my curiosity about how it is that people prefer affording two houses to live in decent conditions through the year. "Why is that so easy?"

Environmental strategies validated in history

The book *Arizona: A History* by Dr. Thomas Sheridan (1995) discusses how, in this region, people travelled seasonally since ancient times: the semi-nomadic groups followed climatic cycles to protect their people from extreme weather while monitoring water and food (wild animals and plants) availability. This strategy is not affordable or feasible for everyone in current times, not only for economic reasons, but also because social systems have historically led humans to settle. Again, the observations about why people live here led to a closer look into how historical people could afford living here and even overpopulating the region. Part of the generalized knowledge that- not only historians and scientist have proven but also people bring as a concern- is that with every conquest, every trade-route, and every migration, the exploitation of natural resources comes along. People also identify the cities as places of multiple interactions that are not limited anymore to providing people with only basic needs of food, security, shared services, and infrastructure. In regions that experience extreme weather, like the arid regions of Arizona, the

human-made environment has become an artificial oasis. Oasis, according to the National Geographic Society (2018), is an area made fertile by a source of fresh water in an otherwise dry and arid region; in essence, it is the presence of water either naturally or forced, and is what makes the development of human-made environments possible. Water is the second most common concern I hear every day. If surviving in the heat implies forcing water into our urbanized settings, if the atmospheric conditions prevent water to naturally accumulate in this region; what is the real reason that we are living here? The answer is evident: here in the desert, as it is over a lake in Mexico City, in the mountains or in the glaciers, humans have developed the technology for survival. Technological advances allow humans to live by adapting the environment to their practical needs and have succeeded in giving people a shelter in different ways. Thanks to the fact that Arizona has a combination of natives and migrants who followed different motivations, the strategies for adaptation have succeeded; however, as the population has become larger, people's needs have also changed, and the economic pressures have taken over as priority.

Native and Hispanic architecture revival

As a way to get a closer understanding of how the people in Arizona started to handle the environmental conditions from the beginning, I did some research in archeological documents, finding that ancient populations in Arizona developed their settlements and infrastructure motivated by land control, hierarchy, religion, and a growing population -which also included the need for a reliable food and water supply. The Hohokam culture, ancestors of the Pima and Tohono O'odham peoples (Sheridan, 1995), developed strategies to overcome water stress and high temperatures. They created an urban development where their experiences as hunters and gathers contributed to their critical planning of water channels, food storage, agriculture, pottery, and

architecture (Fish, Fish, & Reid, 1996). Pit houses, which were the most common prehistoric dwellings, consisted of a structure dug into the ground for the earth to act as isolation to keep the indoor warm during winter and cool during summer (Noble, 1991). Even then, when land use change seemed to be harmless compared to the contemporary implications of it, documented archeological findings coincide with science when describing that the earlier societies in this region faced depletion of natural resources and dry periods. Experts think those events might have been the factors of migration and loss of population due to health deficiencies (Cordell, Linda, 1997), meaning that deserts are sensitive regions that can soon be facing similar events.

Historic preservation and Colonial/Mission revival architecture are often times difficult to distinguish. Locally developed strategies by different people of prehistoric groups were used since 1150 AD, until Hispanic architecture and planning arrived as a mixture of military and faith expansion; bringing a different version of passive adaptive technology to the region (Sheridan, 1995) influenced by the Arabic heritage of more than 700 years of Arabic occupation in Spain. The elements of the Hispanic architecture are still in place in neighborhoods like Barrio Viejo in Tucson or Old Town in Scottsdale. Squared houses around patios, transitional spaces between the street and the house, water fountains, and sunken floors, among other design elements of Arabic-Hispanic urbanism and architecture are present. Few standing buildings of this style remain original while are substituted by the neo-Hispanic or revival which normally lack on design and are merely an imitation of the style that did not meet the function. One of the first places that I visited to understand the role of Hispanic architecture and planning in the region was San Xavier del Bac. The mission has an atrium, a patio, a deep thermal mass in the exterior and interior walls, and an urban presence due to its contrasting aesthetic, just to mention a few environmental

strategies that the building features. Maybe because it is protected by the Tohono O'odham administration of that area, the building and its urban significance are still valid. In contrast, other buildings of similar importance like San Agustin Cathedral, Fort Lowell, or even our Old Main, have elements that are missing or substituted by overlapping priorities like car-oriented urbanism.

Arizona cities have a taste of different styles. I can visually identify native-inspired styles as well and Hispanic or colonial revival styles. Those styles are seen in houses, shopping centers and apartment complexes among its predominately urban population. It is noticeable that the countryside is giving up land to highways and commercial land in the form of outlet malls and car dealers. The elements of the "Historic Preservation" officially in an ordinance adopted in 1972 are more a sign of patriotism than used for their operational advantages. One examples of how nostalgia is perceived to be more important than the advantages of the original design are residential developments that look like Hispanic houses thanks to the prefabricated elements, and that, in order to preserve the identity, do not allow solar panels, antennas or up-ground cisterns. I wonder how much of today's way to develop cities came from the east coast.

Eastern urban principles and economic pressures

Somehow, Native and Hispanic infrastructure, either original or influenced-by, seems to dominate the region. In contrast, the visual and organizational presence of Jefferson's urban principles (Westward expansion 1803) and the processes of annexation of the Mexican and the reminding native territories (1848) that brought along the Federal Style (Golay, 2003). The Federal Style inspired in the classic architecture and urbanism is still present in universities, major banks, some Christian temples and in governmental buildings. The Industrial Revolution featured the arrival of

transcontinental transportation (railroad in 1880) as well as the social mistreatments to non-Europeans as a side effect of the Manifest Destiny (Golay, 2003), both important influences of the urban development of the Arizona territories. Speaking about mistreatments to segments of the society, other major urban events that brought wealth, exploitation of natural resources, and social fractures in history were mining and the urban renewal program in the US under the Housing Act of 1949, or Slum Clearance (Schwab, Schwab, & Schwab, 2018; Sheridan, 1995).

Mining since the Gold Rush in 1849 and the discovery of copper in 1954 led to a boom in the local population. People moving here needed to expand routes exploiting natural resources. The generated profits were that important that no environmental concerns were above. Deforestation, land disturbances, water pollution, air pollution, and long-lasting environmental impacts to the site and its surroundings happen. Silver, gold and especially copper exploitation was the reason to invest in the region, bringing again a series of social and cultural changes. Copper value and importance raised since the Industrial Revolution, demanding a long and stable workforce, and bringing Europeans and Chinese people to the area (Sheridan, 1995).

The Housing Act of 1949 was a beautification program for all American cities (Fairbanks, 2016). At that time, the goal was to display the American society as clean, organized, and adequately distributed; however, the real consequences were displacement and discrimination practices in the urban planning of the cities that made people be allocated in certain neighborhoods according to their ethnicity and economic status. These consequences are still happening today (Schwab, Schwab, & Schwab, 2018).

Cheap houses and neighborhoods are exposed to mining sites or around airports, industrial zones and, major highways. Better-looking neighborhoods -in sites with panoramic views and greater

access to quality infrastructure- are taking over nature for the benefit of few people. In the meantime, larger populations face more risk, with less quality of life, restricted space to allocate changes in their individual and community spaces, and low-quality infrastructure. Everyday conversations address this disparity, and, in some cases, people feel that there is a way to afford quality options. For solving the demand to afford quality neighborhoods, developer respond with like Rancho Sahuarita, Sun City, Vail, Casa Grande, and Havasu, places that are an alternative for what they can pay. These suburban examples also contribute to sprawl, their need of infrastructure and services open the door to new development that share the cost of those expenses and then, the buffer is quickly filled up.

Other urban influences that also make the idea of an American identity evident are the Military facilities and the Convention Centers. Military Facilities across the US demand -after World Wars I and II- easy-to-use, easy-to-build and easy-to-access developments that guarantee an effective surveillance too. It is understandable that much of the reasons behind these planning strategies are the need of a modular design that keeps the costs predictable, the standardization of elements that serve people of the same rank or status anywhere in the country equally and a way to plan changes, expansions, maintenance, and operations from far away and with anticipation. Tucson's Convention Center is still in the memory of the people as a big and aggressive invasion of modernity over the Hispanic neighborhoods that were pushed to the west side of the I-10, maybe following the beautification programs. So far, it is perceived as an imposition of the American modernism oriented to lucrative events and pleasant places to see from the bureaucratic offices that usually surround them.

Other urban influences and the American identity

Two remarkable urban and architectural influences of the post-WWII time are The Garden Cities -normally oriented for middle and middle low-income families, allocated in midtowns, and characterized by curved streets, showing landscapes with its Modern Ranch style houses with vaulted ceilings and exteriors of stucco or brick (Evans, 2016)-; and the federal program called Mission 66, which was a response to the massive visitor boom to National Parks across the US that provided contemporary facilities to the National Park Service, which also became emblematic and institutionalized (French, n.d.). Mission 66 for historic preservation work in a very effective way for preserving existing development and not allowing intrusion of any element or external influence but sometimes is holding back new, clean and sustainable technologies, like solar panels and water collectors, much needed to preserve the National Parks.

It is difficult not to recognize that another major characteristic of the contemporary built environment, defined as the most important element of any building under Arizona's extreme weather, is the mechanical ventilation system. First, the swamp cooler around 1930, an invention of Martin and Paul Thornburg, professors at the University of Arizona (Mojave, 2013), but originally invented by Egyptians in (Culer, 2018). Later, it was after WWII that refrigeration started to be used, not only for preserving food and goods, but also for air conditioners (Culer, 2018).

Standardized living

The interests of having access to a building as fast as possible having the buildings be easy to adapt and easy to fix, push the building industry into standardization. Standardizing means to make consistent, comparable, uniform and bring into line; it means to have a regime or to determine properties to complete a function. The benefits are: flexibility for developers, authorities, and enterprises to change the layout of the building and even of the neighborhood with few economic impacts and in a short time. More rigid models like concrete, adobe, steel and other construction techniques do not allow flexibility and are aimed to be for uses that will last longer (convention centers, official offices, universities, some industry, some corporations, especially those that become landmarks). Standardized building and planning have their benefits and problems. Facing the reality, making the management of the design and construction faster and with multiple options of adaptation to externalities is effective. Most of the small buildings of any use commercial, residential, and even educational are simple, modulated, and aligned to an urban grid. In contrast, more rigid systems based on brick, concrete, steel and other construction techniques that do not allow flexibility are aimed to be for uses that will last longer.

In the same way that urban and suburban centers have distinctive elements such as golf courses, convention and business centers, modern downtowns, community pools, shopping malls, and well-categorized residential neighborhoods, buildings also have distinctive elements. Depending on the style that the building was inspired on, the elements vary. As a way to illustrate the observations about standardized buildings while visiting and living in Arizona, I collected some common describers of familiar buildings:

- What is a Hopi house? Hopi houses are organized in clusters and have several rooms interconnected- a lot of them away from the exterior to protect private rooms and storages

from exterior conditions-, have stairs in the exterior interconnecting different levels, and use the roofs for looking around, sleeping during hot seasons, and even cooking.

- What is a Hispanic house? Hispanic houses have transitions, outdoor spaces for contemplation and for buffering the house from what happens in the exterior, partitions and thermal mass, decorative plants pots, stone floors, patios, and rooms organized from public to private.
- Catholic temples are tall, massive, have towers and big doors ,and feel fresh inside.
- Victorian houses, beyond fancy decorations, are houses with multiple thresholds and have a rigid schedule that divide the houses according to who will be using it. These models featured private, public, and semipublic areas that are separated. It is also noticeable that spaces that are meant to be used by servants have even a different access and less of a nice view.
- What is a mobile home? And, how are different from modern-Ranch houses? A rectangular small building with large living-room, two to three bedrooms, one or two restrooms, a kitchen, and central swamp cooler. The difference is, the mobile homes are raised, are made of fiberglass and drywall, and the conditioned air comes from the floor. The Rach style is made out of red bricks and the mechanical ventilation is on the roof.
- What is a loft? A large space with a restroom, a kitchenette, heating, and cooling.
- What is an office/industrial park, and what is a box-store? They are cubes of different sizes with modular partitions, large parking lots, sometimes have private restroom, sometimes are shared, are airtight, and have heating and cooling.

With this small sample, it is noticeable that later models feature flexibility and conditioned spaces.

With the intention of making the contemporary models efficient, they all are standardized models

that in its attempt to make easy to build, maintain, and operate, miss important elements that would make them resilient instead of adapted. In a dramatic scenario of future hotter and dryer condition in Arizona, what is going to happen to indoor spaces that rely on electricity for refrigeration and ventilation? Or, what if those spaces rely on the use of water for their operation? A resilient built environment will survive only if it has the elements to afford extreme conditions. Extreme condition is not limited to heat and lack of water. Currently, we need to expect fires, floods, and pests. A future scenario of a hazardous indoor environmental quality is possible since there are buildings that lack of adequate ventilation in the absence of electricity or water.

Planning and buildings are adaptations to natural environment and are based on innovative technology in ancient times. Maybe not being aware of the term “sustainable” but, knowing that the best way to use local resources included the availability of water, and passive strategies.

Water and environmental consciousness

In arid regions around the world, people developed their settlements following socio-economic pressures, and none of them have been weak enough to surrender to the lack of available water. Human population in any region leads to desertification for land cover change including vegetation removal and dehydration of the natural soil (Hu et al., 2013). These anthropogenic disturbances reduce the abundance of natural resources (Washington-Allen, 2010) and, depending on the magnitude, its impacts make it irreversible. Some of the most common activities that impact sensitive areas consist on human induced vegetation, water management for irrigation, and the development of human settlements, also known as urbanization (Brunson, n.d.; Parajuli et al., 2011). Arizona's renewable sources of water varies season to season, therefore, delivery systems have been constructed to ensure its adequate delivery. This natural resource is being restricted in

large areas since it is been stored in reservoirs along rivers like Salt, Verde, Gila and Agua Fria. Almost all the surface water in Arizona is been turned into a managed system and not a naturally delivered resource anymore. Not only is wildlife being affected by these decisions, but also countryside population as it is pushed to move into communities that are served by the municipal infrastructure. In a similar way, water from the Colorado River and groundwater, even the reclaimed water are systems that, in order to be effective, contribute to the increase of the urban footprint. Such large investments of natural, human, and economic resources should be planned to serve as many people as possible in a safe and effective manner, which makes its negative impacts justifiable. Ideally, responsible professionals, communities, and officials will look for the equilibrium between the place, people, and profits where all the economic and social forces will wait for the environmental side to lead, just like in the origins of the human settlement when climatic patterns dictated the way that the society lived. Observing our acting climatic forces is crucial to moderate or manage our decisions, especially those that tend to be permanent like buildings. Sadly, that is not what happens, sometime even social aspects like community identity obstacles the economic and environmental sides (Rancho Vistoso or White Mountain) of subdivisions, where solar panels or water harvesting technology is prohibited due to community restrictions, some of them being about aesthetics. There is a need to understand that priorities should not been based on aesthetics, instead, adequate water management is what directly provides the region with the possibility of growing its economy, offering quality of life, and affording to have mining, irrigated agriculture, and population (ADWR, 2016).

Sustainability, smart city models, low impact development standards, and the Green Building Industry are being included in the cities' planning across the U.S. In some cases, the environmental consciousness succeeds, and the strategies fix existent problems that the built

environment caused to nature and human health; however, in other cases, it is a way keep building, but in a green way. Green buildings are not always equal to sustainable buildings; the triangle defined by the triple bottom-line of sustainability <economy, society and environment AKA *place, people and profits* > is flexible since the sides of the triangle stretch as other shrink.

SUMMARY AND FINAL REFLECTIONS

This study began when I came upon a problem of a child with asthma and led me to a new field of research based on a sequence of observations where I found multiple tensions and critical gaps in the options that decision makers have for providing us with an adequate indoor conditions.

Chapter ONE is focused on the preliminary phase of the research, specifically when, in the role of a practicing architect in Mexico City, I became aware of the lack of awareness and resources for architects to address exposure to environmental pollutants indoors. I learned that there is not just one way to approach the built environment; there are interactions between socio-cultural as well as socio-economic, environmental, public health, and policy factors and —turning my attention to these interactions which challenged me while trying to address the special needs of building users in a low-income housing project— I initiated this research with five questions: Is there a social responsibility in the practice of architecture? Is indoor air quality a problem that architects can solve? Is there any relationship between the exterior environmental conditions and infiltration of air pollutants? Am I just unaware, or are there few or no sources of guidance for architects to address indoor exposure to outdoor-generated air pollutants? And, who else is involved in this problem? Those questions persisted as I moved to Arizona and entered the PhD program in Arid Lands Resource Sciences at the University of Arizona. While seeking possible answers to these questions in Mexico City and in Arizona, I noted that, although in the United States we have better codes, standards, technology and research available, people still get sick inside their houses. As I looked for answers, the initial five questions rose in number; by the end of this preliminary phase, I had begun reflections about air being a common resource and there being no distinction between who will and who will not be affected by pollutants. Though the health impacts are difficult to

prove, they are happening. Something else that became clear to me in this phase is that people see indoors as protective spaces. The responsibility for providing that protection is in the hands of users, architects, planners and policy makers, roles that I began to pay attention to while conducting participant observation.

The second chapter of my dissertation is dedicated to the middle phase where explorations and experimentation took place. By collecting information from participant observation, experiments and a literature review, I came to understand that ventilation and temperature control technology applied to the built environment may be seen as the way to address indoor air quality exposure. However, its effectiveness is tied to maintenance costs and the potential for this technology to fail increases the vulnerability of people when facing manmade risks like losing power or not providing adequate maintenance. I used Autoethnographic Vignettes in this phase to inspire reflections that determined the next steps in my self-guided process. These Vignettes trace how I acquired additional knowledge from specialists in indoor air quality and architects about how outdoor air pollutants are perceived and that helped me realize that more attention has been paid to indoor generated pollutants over other sources like infiltrated pollutants from outdoors. From the many new considerations about ventilation systems and air quality and while analyzing information I learned from sources like the American Institute of Architecture, the specialist in indoor air from Healthy Buildings and the McCrone Center, and the experiment where I observed the deposition of dust using the three ventilation systems, I was made to back up and ask myself...what other aspects play a role in exposure to particles and their effects on people's health besides ventilation? The implications of the outdoor conditions and whether policy and decision makers are aware of outdoor sources of indoor pollutants was still unclear. Even if some of those

groups were aware of the problem or at least open to the idea of being informed about it, I realized there is no way that these professionals can take action if it is not justifiable.

I assumed that maybe I was at a dead end. Still, I looked at peer reviewed articles and reports on a range of topics such as outdoor air pollution—including dust and the risk of exposure to heavy metals and metalloids. Such pollution is present in arid regions of Arizona, but I confirmed that if the concentrations are not significant enough, no actions can be taken by the authorities. These were shocking findings. If this is true for outdoor air, how can I expect that there should be something or someone that can address concerns about the indoor infiltration of pollutants generated outdoors since, currently, attention to indoor air quality is mostly based on the prevention and remediation of the pollutants generated from indoor sources. No agencies will be concerned about my concern (and if we are limited in our ability to regulate outdoor air quality, how could we ever regulate the air quality within the built environment?). In other words, attention to indoor air quality is mostly concerned with problems generated by the building itself; the protective space is not meeting the expectation and, instead, is bringing additional risk! What I observed in my own experiments and in conferences gave me more questions than answers. I remember looking at the samples collected during the comparison of ventilation systems in my own house and thinking of the universe of possible origins of all those small things. I was becoming discouraged but realized that this is not a case we can forget about just because the variables are getting more numerous and the problem is getting more complicated to define. It is, instead, a moment to remember that if the future will require us to rely more in indoors to escape from exterior conditions, we need to know more.

In Chapter THREE I describe how I shifted the direction of my inquiry and emphasized identifying the people involved in decision making who can better inform the design and building process. This structured phase began when I stepped out of my comfort zone to conduct participant observation at a conference where the role of the architect was severely questioned. The Design Build Institute (DBI) poses the owner as the leader of a design team. However, owners who were present in the sessions I attended confessed that they contracted a third party architecture firm to observe the process. I realized that even the question of who was in charge would not have a straightforward answer. Though the design-build process challenges the role of the architect, I believe that the traditional practices need to adapt in order to protect people; the ethical practice is to focus on understanding the job and the user to address the problem I am investigating. I value the collaborative approach of the DBI. Unfortunately, the trend of opting for faster, safer and cheaper options promote standardized design and construction systems which set aside detailed site analyses that may lead to better options for healthy and energy efficient buildings that can manage indoor infiltration of outdoor air pollutants.

Besides acknowledging the contribution of this collaborative approach to design, at the DBI conference I was able to confirm that architects, planners and owners, who all are users as well, take on the overarching roles in both traditional and collaborative projects. I moved forward to address my earlier observations about how complicated it is to try and address non-evident concerns (like infiltrated air pollutants from unknown sources and their impacts on health) by conducting interviews with architects and planners to understand what they think, their priorities and solutions while doing their jobs. During the interviews, architects and planners pointed out the need for deeper understanding of the regulatory framework that governs the built environment. At

this point I already knew that there are different rules for different actions. However, these professionals drew my attention to codes and regulations on land use, air quality, climate change preparedness and environmental responsibility and pointed out where the codes and regulations do not exist. During the conversations, some of the professionals were able to see themselves as building users. As they asked for guidance, some of the professionals realized that they are one of the informed sources of the input that they are looking for. The architects and planners and, later, the group of experts in air quality who I also interviewed, responded to the visual aid about climate change and air quality I presented and provided deeper detail about their concerns. The participants expressed concerns and talked about having experiences at the individual scale (themselves or the people closest to them), even referring to health issues with air quality, but those comments came only until after our discussion of this as a problem and that it may be in their hands to be solved.

From the conversations with the group of experts from different offices, agencies, membership groups and non-profits, I reflected about how instead of focusing on rules and regulations the public administration offices in cities and counties and groups like the US Green Building Council (USGBC) may be more successful with their awards and certifications that can motivate good practices. In fact, there are places like Washington, DC and Arizona that have achieved their LEED (Leadership in Energy and Environmental Design) certification through the USGBC and, with that, are committing to improve and grow in a sustainable and resilient way (<https://new.usgbc.org/leed-for-cities>). Therefore, if groups like the USGBC or ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers) can influence future plans for entire cities and administrations to adopt their standards, efforts to promote research and

advanced technology and design may be most successful if they are taken up by groups such as these.

To complete my inquiry, I reflected on the knowledge I gained in the 10 years living in Arizona as a resident and student but with the architectural and planning background I brought with me from Mexico. Some of the topics I addressed in Chapter FOUR include how standardization is seen as a way to build faster and how socio-economic growth and the obsession of projecting beauty and wellness is prioritized over solving socio-environmental problems in the built environment. In contrast, wildlife habitats, ancient and Hispanic architecture, and recent environmental consciousness can serve as major sources of strategies for surviving in hot and dry environments and for developing adaptation plans and resilient built environments. While the solutions that I found in local wildlife, and ancient and Hispanic architecture (as well as recent efforts towards environmental consciousness) offer sources of inspiration and education for the current decision makers, it is clear that we have not learned the lessons they have to teach us. Our environments are changing, and the arid regions are, in many senses, the areas that will face the worst conditions. Observing the natural responses to change may push decision makers to focus more on external environmental conditions, such as air quality, and come up with strategies that help people survive in hot and dry environments.

Based on what I have learned in the four phases of this study, I have come to realize that no matter how much we research and make technological advances for people's wellbeing; there are other influences on the decision makers that will mean that important topics will not be addressed if there is not a request to do so. This may be a way to put the responsibility on unidentified "others".

Still, the concerns from the indoor air quality experts indicated that the degree of awareness in decision makers is crucial and extensive research and proven technology has to come in order to avoid “using humans as live experiments” (indoor air specialist at the Healthy Buildings Conference.). In the next section, I address key areas for future research.

PROPOSED FUTURE RESEARCH

The arid lands of Arizona and the current socio-environmental conditions, including the impacts of climate change and its prediction into the future, constitute, altogether, an “objective reality” that this study is not aiming to change in the near future. The phenomenon of concern in this study is situated in this objective reality (in this place and this moment) and it is a “socially constructed reality” where decision makers have different understandings about air pollutant infiltration. That reality is subjective and embedded in complex situations that this study targets to explore. As evidenced in the Vignettes from participant observation, the experiment on ventilation systems, literature review and interviews with professionals, proving impacts on health and the identification of the source of pollutants are difficult to achieve. As I learned in interviews and participant observation while living in Arizona, cost, time, and commodity are priorities for the owner/users and the building industry. According to my research, awareness and informed decision-making from design to policy making are needed.

In the meantime, global change is happening. A crisis may come and locking people up indoors due to high temperatures may be seen as a solution for the arid regions. If so, attention is needed in indoor air because continuing to wait for policy to protect us is unacceptable. In the Vignettes about policy, I identify how the air quality topic crosses multiple levels and jurisdictions and may

need an identifiable and significant group of people to be seriously affected for this problem to be addressed; current decisions are made using human experiments waiting to demonstrate that a problem is happening. It is imperative for decision making and design strategies to take into account current projections of climate change and its impacts in the near and distant future in Arizona's arid regions. Regions that are currently experiencing a desertification process due to urbanization or water scarcity will also be affected. We have to have people prepared to address the implications of the interaction between the natural and built environment in order to face local and global future demands including health risk reduction.

My dissertation is designed as an exploratory study and therefore leads to many questions. These questions lay the groundwork for future research.

1. Finding the best way forward to address the question of indoor infiltration of outdoor-generated air pollutants is a process of looking at effective strategies that are already addressing related areas, for example: technology and innovation applied to temperature control. Future research should focus on these technologies.
2. More explorations are needed to find how organizations such as the USGBC and ASHRAE design their strategies and generate their standards and which strategies could provide models for addressing the indoor infiltration of outdoor-generated air pollutants.
3. There are multiple ways the natural and built environments interact to impact humans. This study focused on the exposure to air pollutants and how that is likely to change given climate change. Future research can expand this understanding to other forms of interaction.

4. Focusing on the expected knowledge and responsibilities of decision makers in all types of design and construction approaches as well as in the regulatory framework, more efforts are needed to define areas of specialization within collaborative, integrative and architect-led teams.
5. In-depth research into each aspect of the outdoor-indoor pollutant interface as these relate to the critical inquiries analyzed in the Vignettes is required to cover all the areas that the sources pointed out to be a conflict.

This study can be described as a snowball that initially addressed observations for how a problem of exposure to outdoor pollutants can be avoided and, while exploring the impacts of the air pollutants indoors, it found multiple factors playing a role in the lack of awareness of decision makers in the design and building processes. It is due to these variety of interactions that this study needed to be addressed by an autoethnography that helped me understand the different motivations and concerns that decision makers have regarding air pollutant infiltration, including my own and using my background to interpret the data from all my sources. The complexity implied in the intersection of disciplines of the decision makers requires understanding the roles that others play; it also demands identifying conflicts and motivations as well as differentiating solutions from hopes. The subjective nature of those processes demanded me to observe and analyze the data using a systematic process of Vignettes and reflections that revealed new variables for future inquiry.

My explorations were done with the intent to have my problem addressed by key decision makers: owners/users, architects and collaborative teams. They must be aware and, based on their needs

and priorities, demand improvement in technology and innovation. The indoors are already attended by temperature control, filtration and even automatization. Technology can tilt the balance and can produce affordable and effective alternatives for reducing exposure. That is why this study was designed to speak to those individuals and groups that influence the design and building processes, and whose decisions may impact the user experience in harsh environments like the arid regions of Arizona. These new approaches point to a collaborative approach, and it could be beneficial, if not crucial, for others to be aware of how the findings in my study were enlarged phase by phase bringing more details, challenges, new findings and different interpretations.

This dissertation made me aware of an array of issues while I was looking for only one explanation rooted in a very intimate problem for a family with a child with asthma. I found multiple tensions between perceptions of what policy and technology can address, as well as critical gaps in the priorities that people in charge have for providing us with a resilient built environment. It is because of this new and larger set of variables that this study contributes to science and arid lands by opening up other inquiries that would come from other scholars and from myself. My methodology was used to responsibly conduct a process aimed at understanding the phenomena that professionals and experts must confront in addressing the implications of infiltrated pollutants indoors in the arid regions. Thanks to my systematic approach, this self-guided process was prevented from being purely subjective but still offered an alternative to traditional science.

APPENDIX A QUESTIONNAIRE FOR PROFESSIONALS

1. *Broader concerns when doing your job*
 - a. *Any concern*
 - b. *Environmental concerns*
 - i. *Concerns about a specific characteristic of the region*
 - c. *Climate event or climate change concerns*
 - d. *Air pollution or quality concerns*
 - i. *Indoor air quality concerns*
 - ii. *Concerns about dust*
 - e. *Opportunities to solve your concerns*
 - f. *Comments on residential sector*
2. *The concerns changed working in different places*
3. *How air pollution could be a special concern*
 - a. *How can you manage air pollution problems*
 - b. *Personal experience with air pollution*
 - c. *Has your job required paying attention to indoor air quality*
4. *Have your job required paying attention to air quality*
5. *Can you job be influenced by air quality problems*
6. *Comments after interacting with visual aid*
 - a. *The information changed the perception*
 - b. *Information that will improve the visual aid*
 - c. *Mentioned new ideas or actions in response to visual aid*
 - d. *Comments about dust*
 - i. *Comments about outdoor dust*
 - ii. *Comments about indoor dust*
 - iii. *Comments about airborne dust*
7. *Personal problems or experience with air quality*
 - a. *Personal experience with air quality influencing professional decisions*

APPENDIX B CLASSIFYING INFORMATION FROM PROFESSIONALS

Participants	Academic Training	Academic level	Additional training	Years since profession	Has worked in other cities	Network pathway	Type of Interview	Environmental Concerns Individual scale (BE)	Air quality Individual scale (BE)	Climate change Individual scale (BE)	Mentioned Indoor air quality Individual scale (BE)	Mentioned Dust Individual scale (BE)	Mentioned Residential sector Individual scale (BE)
A011317_1	Architect only	Masters	Field-Empirical	1 to 3	Yes other Countries	First contact	Recorded & Confidential	Yes, indirectly	No, yes in follow up	No, yes in follow up	No	No	No
A011317_2	Architect only	BA	Field-Empirical	4 to 10	Yes other States	Referred by first contact	Recorded & Confidential	Yes, indirectly	No, yes in follow up	No, yes in follow up	No	No	No
A011417_1	Architect only	BA	Field-Empirical	21<	Yes other States	First contact	Recorded & Confidential	Yes, indirectly	No, yes in follow up	No, yes in follow up	No	No, yes in follow up	No, yes in follow up
A020417_2	Architect only	PHD	Field-Empirical	10 to 20	Yes other States	First contact	Recorded & Confidential	No, yes in follow up	No, yes in follow up	No, yes in follow up	No, yes in follow up	No	Yes, directly
A02717_1	Architect only	Masters	Field-Empirical	21<	Yes other States	Membership group	Recorded & Confidential	No, yes in follow up	No, yes in follow up	No, yes in follow up	No	No	No
A041417_1	Architect only	BA	Membership benefit	21<	Yes in Arizona	Referred by first contact	Recorded & Confidential	No, yes in follow up	No, yes in follow up	No, yes in follow up	No	No	No
A051217_1	Architect only	BA	Field-Empirical	10 to 20	Yes other Countries	First contact	Written & Confidential	No, never	No, never	No, never	No	No	No
A082117_1	Architect and Planner	Masters	Field-Empirical	21<	Yes other Countries	Membership Group Green Sustainability	Recorded & Confidential	Yes, directly	No, yes in follow up	No, yes in follow up	No	No	Yes, directly
P012617_1	Planner and other	Masters	Field-Empirical	4 to 10	Yes other States	UA	Recorded & Confidential	Yes, directly	No, yes in follow up	No, yes in follow up	No, yes in follow up	No, yes in follow up	No
P013117_1	Planner and other	PHD	Field-Empirical	21<	Yes other Countries	UA	Recorded & Confidential	Yes, directly	No, yes in follow up	No, yes in follow up	Yes, directly	No	No
P021017_1	Planner only	Masters	Field-Empirical	21<	No	Referred by first contact	Recorded & Confidential	No, yes in follow up	No, yes in follow up	No, yes in follow up	No	No	Yes, directly
P061917_1	Planner and Architect	BA	Membership benefit	21<	Yes in Arizona	Membership group	Recorded & Confidential	No, yes in follow up	No, yes in follow up	Yes, directly	No	No	No
P061917_2	Planner and other	Masters	Field-Empirical	10 to 20	Yes in Arizona	Membership group	Recorded & Confidential	No, yes in follow up	No, yes in follow up	No, yes in follow up	No	No	Yes, indirectly
P062017_1	Planner only	Masters	Membership benefit	10 to 20	Yes in Arizona	Membership group	Written & Confidential	No, yes in follow up	No, yes in follow up	No, yes in follow up	No	No	No
P062417_1	Planner only	Masters	Field-Empirical	4 to 10	No	First contact	Written & Confidential	No, yes in follow up	No, yes in follow up	No, yes in follow up	No	No	No, yes in follow up

APPENDIX C SCORECARDS FOR PROFESSIONALS

P062017_1

	Environment	Climate Change	Air Quality	Indoor Air Quality	Dust	Residential/Proximate Concerns	Solutions
before	Individual Regional Macro		X X			X X X	X X X
direct	Individual Regional Macro	X X	X X			X X X	X X X
after	Individual Regional Macro						

Summary:

- Nodes\Before Evidence\Scales\Individual Scale**
 - Client expect us to not go over budget if we go over budget we have to eat the extra cost
 - It looks bad to the client because we promised to do the work we signed a contract we would do x, y and z for this amount
 - Right now they're trying to bring streets to human scale not just for cars make them for pedestrians, bicycles, transit and our firm is very interested in doing that
- Nodes\Before Evidence\Scales\Macro Scale**
 - And engineering
 - They will not impair air quality or air quality standards
- Nodes\Before Evidence\Scales\Regional Scale**
 - Transportation
 - Both transportation and land use consulting and planning
 - Government and private but in transportation planning
 - Looking at air quality or noise quality or historic preservation
- Nodes\Before Evidence\Solutions to the concerns**
 - AE Com It's probably the largest transportation consulting firm in the world but it doesn't only do transportation it does a lot of water, geology, energy almost anything related to the built environment and working with government and private clients
 - we have our own quality control procedures so that when it goes to the client they will not find any embarrassing mistakes or omissions always they'll have comments that's normal and we always have to work that out and we work that into our budget it to get comments from the client and do revisions but we always try to make sure that anything we give them is what they expected and everything they expected and their comments hopefully will be on either minor technical things like grammar or typos or they might be more substitution
 - we do calculations we do tables we do maps we use geographic information systems which I'm not trained in professionally but we have people in my office who are experts at that so we need to use all those tools and they all need to be checked by someone who was not involved in the original grading
 - we have people both within my company and outside it in the agencies we work for who specialize in air quality and air quality modeling
 - here we have MAG and Tucson has PAG and I'm not as familiar with PAG, but they are work in similar ways
 - I know Arizona pretty well and just ask questions about things that don't seem right to me or just I'm unsure about and they might come back and say 'that's ok' because they know more than I do but I do catch quite a few things when going through those
- Nodes\Before Evidence\Solutions to the concerns(Personal Opportunities to solve the concerns**
 - we do calculations we do tables we do maps we use geographic information systems which I'm not trained in professionally but we have people in my office who are experts at that so we need to use all those tools and they all need to be checked by someone who was not involved in the original grading
 - I know Arizona pretty well and just ask questions about things that don't seem right to me or just I'm unsure about and they might come back and say 'that's ok' because they know more than I do but I do catch quite a few things when going through those
- Nodes\Direct Questions\Scales\Individual Scale**
 - I may summarize some of the standards in the report but I'm not the one that does the modeling or tracking I don't have the technical training as I've said we do have people in our company who do that
 - I've worked on numerous environmental assessments
- Nodes\Direct Questions\Scales\Macro Scale**
 - Brush fire closes down the highway obviously that could be related to climate change
 - change in snow level that might require more or less snow plowing and of course the state has limited resources in the winter and they have to budget a certain amount to each area of the state that gets snow
- Nodes\Direct Questions\Scales\Regional Scale**
 - governor's office are very much opposed to talking about climate change they either don't believe it exists or don't believe it's human caused or whatever they think it's an attempt by the Chinese to take over the world
- Nodes\Direct Questions\Solutions to the concerns**
 - I've worked on numerous environmental assessments and also some ES but I'm pretty much a generalist in my career I've done a little bit of almost anything except modeling in transportation that is not outside of transportation and so I've worked on various EAs and a few EIS not as a technical specialist looking at air quality or noise quality or historic preservation
- Nodes\Direct Questions\Solutions to the concerns(Personal Opportunities to solve the concerns**
 - I've worked on numerous environmental assessments and also some ES but I'm pretty much a generalist in my career I've done a little bit of almost anything except modeling in transportation that is not outside of transportation and so I've worked on various EAs and a few EIS not as a technical specialist looking at air quality or noise quality or historic preservation

APPENDIX D QUESTIONNAIRE FOR EXPERTS

- Direct Questions before evidence
 - What are the responsibilities in your job position/department/agency
 - How the decision-making process works in your office
 - Can you directly influence decisions
 - What are the Environmental concerns in your office/agency and what is the approach used to solve them
 - What are the climate change concerns in your office/agency and what is the approach used to solve them
 - How air quality fits within the responsibilities of your office/agencies

- After evidence
 - Comments after interacting with the evidence
 - Have you have air quality related problems or experiences

APPENDIX E CLASSIFYING INFORMATION FROM EXPERTS

Participant	Agency	Academic Training	Additional training	Years dedicated to current profession	Has worked in other cities	Type of Interview	Network pathway	Connection with Air Quality	Connection with Indoor Air Quality	Concerned or Aware of Climate Change	Capable to decide on Air Quality
E012017_1	PAG	Planner and other	Training	10 to 20	Yes in Arizona	Recorded & Confidential	Referred by first contact	Direct	Somehow under the umbrella	Yes	Yes but addressed if commanded
E012517_1	PAG	Planner and other	Training	10 to 20	Yes other States	Written & Confidential	Referred by first contact	Direct	Not directly but plays a role	Yes but addressed if commanded	Yes but addressed if commanded
E041217_1	Pima County	Architect and Planner	Certificate	10 to 20	Yes other States	Recorded & Confidential	Referred by first contact	Not directly but plays a role	Direct	Yes but addressed if commanded	Yes but addressed if commanded
E060117_1	ASRAE	Architect and other	Membership benefit	21 <	Yes in Arizona	Recorded & Confidential	UA	Secondary area	Direct	Yes	No but want to
E060217_1	City of Tucson	Other related	Certificate	21 <	Yes in Arizona	Recorded & Confidential	Membership group Architecture	Not directly but plays a role	Not directly but plays a role	Yes	No but want to
E061917_1	Town of Florence	Planner only	Training	10 to 20	Yes in Arizona	Recorded & Confidential	Membership group Planning	Somehow under the umbrella	Not directly but plays a role	Yes but addressed if commanded	No but want to
E062017_1	Son Inst.	Architect and other	Training	10 to 20	Yes other States	Recorded & Confidential	Membership group Planning	Secondary area	Not directly never considered	Yes	No but want to
E062017_2	City of Phoenix (dropped)	Planner only	Conferences	10 to 20	Yes in Arizona	Written & Anonimous	Membership group Planning	Secondary area	Not directly but plays a role	Yes but addressed if commanded	No but want to
E062117_1	ASU-Chandler (dropped)	Architect only	Certificate	21 <	Yes other States	Recorded & Confidential	Membership group Planning	Somehow under the umbrella	Secondary area	Yes	Yes but addressed if commanded
E082317_1	USSRC for FAZ	Other related	Training	4 to 10	Yes other States	Recorded & Confidential	First contact	Somehow under the umbrella	Somehow under the umbrella	Yes	Yes but addressed if commanded
E062817_1	AESS in process	Other related	Conferences	21 <	Yes other Countries	Recorded & Confidential	Membership Group Green Sustainability	Not directly never considered	Not directly never considered	Yes	Yes
E062817_2	Anonimous (county level)	Other related	Training	4 to 10	Yes other States	Written & Anonimous	First contact	Direct	Secondary area	Yes but addressed if commanded	Yes but addressed if commanded
E082817_1	EPA (dropped)	Other related	Training	4 to 10	Yes other States	Written & Anonimous	Referred by first contact	Secondary area	Secondary area	Yes but addressed if commanded	Yes but addressed if commanded

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