**Designing a Conference for Women Entering
Academe in the Sciences and Engineering**

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Abstract

Women are underrepresented among faculty in the sciences and engineering. The National Science Foundation's ADVANCE program seeks to address this issue through comprehensive and creative strategies aimed at institutional transformation. Virginia Tech's ADVANCE program (AdvanceVT) hosted a conference for women in the academic pipeline to facilitate their entry into academic careers. This paper discusses our efforts in designing this conference; we hope that it will help to address the relative lack of literature on conference design and provide a starting point for others who are designing conferences. We first introduce four conference design heuristics that emerged during the process of determining what information to present at the AdvanceVT conference and how to present it: (1) undertake requirements elicitation, (2) choose an appropriate modality for presenting information, (3) account for interactions, and (4) emphasize shared interests and traits. We then discuss the application of these heuristics to the first design iteration of the AdvanceVT conference. Included in the discussion of the application of the heuristics are the results of three requirements elicitation activities: an online survey, focus groups, and interviews.

Designing a Conference for Women Entering
Academe in the Sciences and Engineering

It is well known that women are underrepresented in the sciences and engineering. There have been various efforts at the national level to address this issue. As part of one of these efforts, Virginia Tech hosted a conference for facilitating entry and success of women entering academe in the sciences and engineering. In this paper, we describe the application of four design heuristics to our initial conference design effort and the results of requirements elicitation activities.

- Women in Academe in the Sciences and Engineering

Women are not well represented among the faculty of scientific and engineering academic disciplines (Cauble, Christy, & Lima, 2000) . Women who are faculty members cite some of the following reasons for this situation: pressures to balance personal and professional obligations, typically unfriendly professional

culture/environment, and an apparent lack of adequate support networks for social and mentoring activities (Riger, Stokes, Raja, & Sullivan, 1997) . Despite advances made in the numbers of women choosing to pursue science and engineering careers, women continue to be significantly underrepresented in almost all science and engineering fields, constituting approximately 25% of the science and engineering workforce at large, and less than 21% of science and engineering faculty in 4-year colleges and universities. Women from minority groups constitute only about 2% of science and engineering faculty in 4-year colleges and universities (Wyer, 2003) .

- Facilitating the Entry of Women into these Fields

In a move toward amelioration of this trend, the National Science Foundation has established a grant program entitled ADVANCE, which aims to promote an increase in the participation and advancement of women in academic science and engineering careers through comprehensive and creative strategies aimed at institutional transformation. Virginia Tech is a recipient of an ADVANCE grant and has embarked upon a comprehensive, multifaceted program aimed at transforming the university culture. One specific objective of the Virginia Tech program (AdvanceVT) is to offer a conference for women in the academic pipeline to facilitate their entry into academic career tracks. This conference is to be offered in the summer of 2006 and will provide a learning system for women planning to enter academe in the sciences and engineering.

- Designing a Conference to Facilitate Entry and Success

While a lot of literature on conference planning exists, including online manuals, services for purchase, and general books, for example, (Burke, 1976) , we were unable to find any literature specific to conference design. Conference design refers to a part of the much larger task of conference planning and involves determining the following:

- What information to present

- How to present that information

Conference design is a subset of conference planning because it only addresses the content of conference activities. Conference planning takes into account other issues, such as budget, transportation arrangements, catering, etc (Figure 1). While practical conference planning concerns (budgeting, etc.) are consistent across conferences, conference design depends heavily on the specifics of the conference.
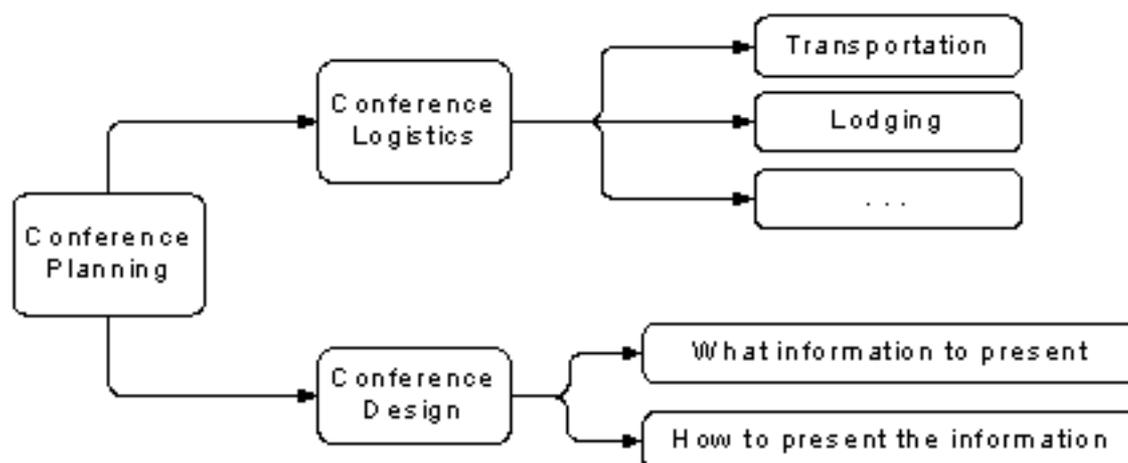

Figure 1 : Conference planning decomposed

We adopted a process-oriented approach to help structure and guide the design of the conference. Many design approaches employ a process; one example is Hix and Hartson's approach to interaction design for computer interfaces (Hix & Hartson, 1993) . The conference design effort proceeded in three major phases: requirements gathering, analysis and design, and outcomes, as shown in Figure 2.
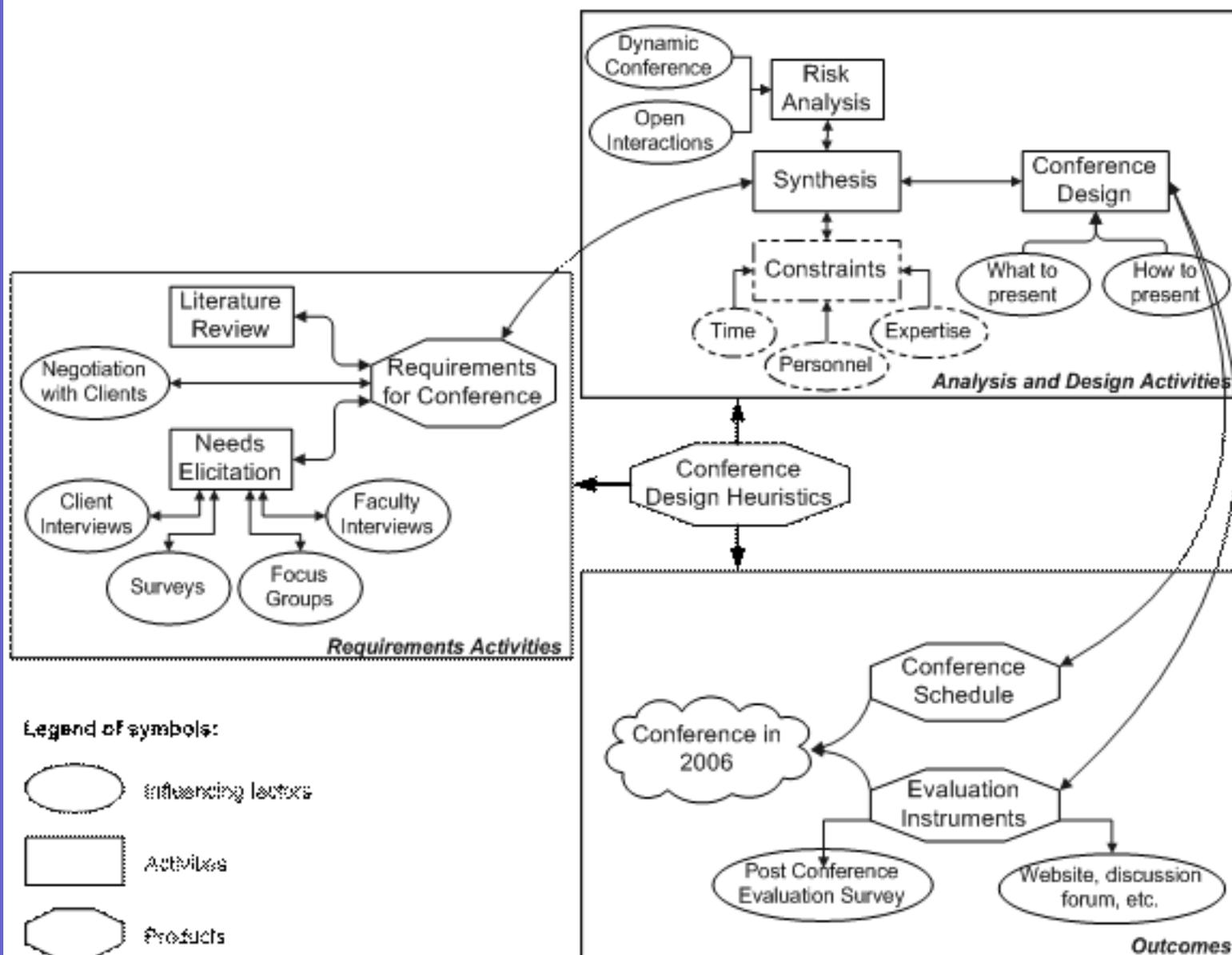
Figure 2 : Process employed in designing the conference

The requirements phase consisted of a detailed literature review (Section 2) and a four-pronged elicitation approach (Sections 3 and 4 include information on client interviews, faculty interviews, a survey, and focus groups). At the end of this phase, we had a better understanding of the needs of conference participants. Considerations during the analysis and design phase included participants' needs, meeting the constraints imposed by conference organizers, and considering the risks involved with different design decisions. This design process was aided immensely by the design heuristics and the two guiding questions of what information to present and how to present that information. The outcomes included a detailed conference schedule and evaluation instruments to measure the perceptions of the participants regarding the usefulness of this conference.

The process-oriented approach to conference design is intended to be generic enough to be applied across a variety of circumstances. Within each phase of the approach, however, there are many opportunities to tailor the design process to the needs of a specific circumstance. This paper focuses on the influencing factors, activities, and products that were important for designing the AdvanceVT conference for women pursuing careers in academe.

- 1.1 Conference Design Heuristics

In his book, *How to Solve It* , Polya (1957) defined heuristic as the process for discovering a solution to a problem. More recently, the term heuristics has come to be identified with techniques for searching a solution space quickly to find an adequate or "good enough" solution (for an example, see Nielsen &

Molich, 1990) . The conference design heuristics presented in this paper integrate the two definitions in that they make designers more aware of the design space, which in turn facilitates the search for adequate solutions to issues.

As we were designing the AdvanceVT conference, several important issues emerged that influenced our thinking and decisions. These issues were recorded as they were encountered and then generalized to form the following heuristics for conference design:

• Undertake requirements elicitation - Perform a thorough review of the attendees' backgrounds and expectations.

• Choose an appropriate modality for presenting information - Explore the various possibilities available for disseminating the conference content and select the best subset given the constraints.

• Account for interactions - Consider and leverage the possibilities and opportunities arising from various interactions that are inherent in a conference.

• Emphasize shared interests and traits - Improve the conference content and activities by leveraging the commonalities of the attendees and the characteristics of the domain.

• 1.1 Organization of this Paper

The remainder of the paper is organized as follows: Section 2 presents literature related to each of the four conference design heuristics. Section 3 presents the methods used for requirements elicitation, including information on the survey, focus groups, and interviews. Section 4 presents the results of the requirements elicitation. In Section 5 , both the literature and the requirements elicitation results are applied to create the initial design of the AdvanceVT conference. The final section contains concluding remarks. We hope that other conference designers will find the general conference design heuristics useful. We also hope that the specific results from the survey, focus groups, and interviews will be useful to others designing conferences for the advancement of women in the sciences and engineering.

• Literature Review

Literature related to each of the four conference design heuristics is presented in this section. The works that we cite for previous research come from a variety of disciplines. Our backgrounds are in the disciplines of computer science, industrial systems engineering, psychology, sociology, and women's studies. As we designed the conference, we noticed that many of the approaches to problems in our disciplines were applicable to problems that we were encountering with the conference design. As a result, the references that we cite are from a variety of domains. We believe that this interdisciplinary approach helped us to see the problems through a number of different lenses, which in turn limited the introduction of biases associated with the approaches used by any one given discipline. Although the conference design heuristics are intended to be generic and applicable across a variety of circumstances, we particularly wanted to avoid introducing gender biases given the nature of the AdvanceVT conference. The various models presented in the literature review were originally developed without reference to gender, but we believe that combining them to present a more holistic approach helps to limit gender biases that may exist.

• Undertake Requirements Elicitation

The primary goal of the conference is preparing women for a career in academe and giving them the skills and information that they need to succeed in their first two to three years on the job. Requirements elicitation in the context of conference design is the process of working with stakeholders (conference designers and participants who have different backgrounds, skill sets, understandings, and needs) to draw

out their concerns, needs, and perceptions relevant to the conference goal. The success or failure of any conference is highly dependent on the requirements elicitation process. If the conference designers fail to elicit all that is desired, they cannot possibly organize or create what is wanted.

Sommerville, Sawyer, and Viller (1998) suggest three steps for addressing the concerns of stakeholders (albeit in a different context), which we believe are applicable to conference design. Adapting this approach, the concerns for this conference include:

• Identifying the concerns that affect the design of the conference.

• Deriving a set of questions that will ensure that the information required to satisfy the concerns is collected.

• Eliciting and negotiating requirements to ensure that the conference design satisfies the identified concerns within the constraints.

The requirements elicitation process is not completely driven by the designer; participatory design is common practice in a variety of disciplines. For example, literature in the field of participatory ergonomics suggests that system design is best accomplished by incorporating participation from the personnel most involved in the work system (Haines & Wilson, 1998) . Another example is with the participatory design of information systems (Merkel, et al . , 2004) . In participatory design, the participants are included in the design process early, so that their input helps to drive the design. To get participant feedback, we used surveys, conducted focus groups, and interviewed faculty.

The requirements elicitation process should allow for iteration. In its early stages, a conference design is particularly dynamic. The goals and scope of the conference change as new challenges and limitations are encountered. It may be necessary to repeatedly perform various requirements elicitation activities to account for these changes. The idea of iteration appears in a variety of contexts and disciplines. For example, Boehm and Egyed (1998) recommend an approach for the development of software systems that iterates between requirements elicitation, design, evaluation, and risk analysis. The conference design presented here is a first iteration, and many more iterations are likely before the conference is held.

• Choose an Appropriate Modality for Presenting Information

Eliciting requirements helped determine what information to present, but we still had concerns about the best way to present that information. Literature on discourse theory and learning theories helped generate ideas.

• Discourse Theory

People attend a conference for a variety of reasons, including learning new techniques, methods, and technologies. The conference activities are the necessary link between the attendees and the information that they want to obtain. In terms of Clark 's (1994) work, this link can be considered a conversation that evolves as attendees interact with the activities. The attendees initiate interaction by attending activities, but the interaction represents a joint activity with contributions by both the attendees and the activities. Appropriately supporting this joint activity requires an understanding of two main concepts: the activities as a language and constraints in grounding.

The language for the interaction is the activities in the conference. The language only exists because the conference designers need a way to propose tasks and share information with and obtain information from attendees. The design of activities should ultimately be dependent on the information that the attendees want to obtain. Attendees need not relay their entire mental states, and activities should not require it. Both parties

only need that which is necessary to carry the conversation. The implication for the conference design process is to structure activities to maximize the dispersal of relevant information and minimize time spent on unnecessary information. Such a task is difficult, however, because information that is extraneous to the goals of an activity may be particularly useful in helping participants establish common ground.

Common ground is "the things we know about what is known by the person we are talking to" (Monk, 2003, p. 4) . The theory behind common ground assumes that language in general is a medium for accomplishing some task. Common ground lessens the amount of work that goes into collaborating. If two individuals share common ground, they can make inferences and assumptions and do not require explicit explanation of ideas or activities. Female graduate students and post-doctoral researchers share a great deal of communal common ground by being members of the educational system and develop personal common ground by interacting with one another. Constraints in Monk's terminology are properties of a communication method that affect the grounding process. Monk describes constraints such as visibility, audibility, reviewability, simultaneity, and sequentiality. As an example, supplementing a lecture with printed copies of PowerPoint slides meets the constraint of reviewability; the lecture attendees can review the main points of the lecture at a later date. The activities should consider constraints to maximize the transmission of information.

• Learning Theories

A large number of learning theories exist in psychology. For an overview of various theories for learning and suggestions on how these theories can be applied for education, see Kearsley, 2005 . Jean Piaget's work with theories regarding human thought and knowledge are relevant to this work (Kalat, 1996) . Piaget's theories provide guidance for conference planning in that participants must want to learn the material being presented during the conference and should be actively engaged with the material. For some information, it is appropriate to match information to the attendees' schemas to help them quickly assimilate it. For other information, such as information on confronting gender stereotypes, it may be useful to present the information in a novel way, so that the attendees need to create new schemas to accommodate the information.

In addition to learning theories from psychology, educational theories on learning provide interesting ideas for the design of conference activities. Behavioral learning approaches consist of repeating an action until it becomes automatic. In a discussion of bringing about systemic changes in educational technology, Fishman, Soloway, Krajcik, Marx, & Blumenfeld (2001) identify the most common uses of technology as those rooted in behavioral learning techniques, such as drills.

The constructivist approach to education differs significantly from the behavioral approach. In the constructivist approach, learning is the result of focusing on personal experiences to construct an understanding of the world. Accordingly, learning is no longer the process of memorizing as it is in the behavioral approach, but instead a search for meaning (Soloway, et al., 1996) . Such an understanding of education matches well with a recent report by the National Research Council that indicates that students come to class with their own set of preconceptions of how the world works (Donovan, Bransford, & Pelleginno, 1999) . In addition, the report emphasizes the benefits of a metacognitive approach to grading in which students set their own goals and monitor their progress toward them.

A key to designing activities from the constructivist perspective is providing guidance and avoiding over-structuring. Such an approach is related to Suchman's (1987) theory of situated action. Much like workflow analysis provides a general model for understanding what tasks are accomplished in a business setting without providing the low-level details of how they are accomplished, activities should give attendees a starting point and encourage exploration and inquiry. John Dewey described this approach well with the following quote: "Wherever an activity is broad in scope (that is, involves the coordinating of a large variety of sub-activities), and is constantly and unexpectedly obliged to change direction in its progressive

development, general education is bound to result" (Carroll, et al ., 2000, para. 3) .

- Account for Interactions

After eliciting the requirements and determining what information to present, the order and timing of activities must be determined. One of the difficulties with accounting for interactions is being unsure of how much the conference attendees would interact with one another and what influence those interactions would have on the attitudes, opinions, and choices of the attendees. For example, questions arise, such as: How should we structure the activities in such a way as to maximize learning? How much would the quality and content of an activity on the first day of the conference influence the attendee's desire to participate in related activities on subsequent days?

These higher level problems prompted us to look at the more fundamental issues of human cognition, processing, and memory. Previous work on cognition provided us with the background knowledge and grounding that we needed to better understand our design task.

Cognition is central to the conference design problem because each participant needs to process, remember, and apply the information presented in the future. In this section, we present a brief discussion of the theories related to human cognition as a background for our work. Norman (1993) simplifies human cognition into two very abstract theories. The first hypothesizes that cognition by humans is based on symbolic processing and that this processing is internal to the human. This theory treats cognition as a representation-of-knowledge problem. As a result, the focus of this theory is entirely upon the processing structures of the brain and the symbolic representations of the mind. The second theory provides a more holistic approach that includes the interplay among the human, the general environment, the specific context, and the situations of other involved people. Given the nature of the conference, we were particularly concerned with the latter theory.

There is much previous work that in some way addresses or embodies the more holistic approach. In the field of cognitive science, for example, Ed Hutchins and colleagues developed the concept of Distributed Cognition (Rogers, 1997) . It provides a paradigm for rethinking all domains of cognitive phenomena. Distributed Cognition proposes that cognition is better understood as a distributed phenomenon and that human cognition and knowledge representations, rather than being solely confined to the boundaries of an individual, are distributed across individuals, tools, and artifacts in the environment. Since Distributed Cognition stresses the importance of the individual to the environmental objects (human or otherwise), it is a useful approach for (re)designing socio-technical cooperative environments.

An example from psychology is the work of Albert Bandura on Social Cognitive Theory (Bandura, 1986, 2001) . Social Cognitive Theory was developed out of earlier work by behavioral and social psychologists on Social Learning Theory, which states that cognition serves as a mediator between stimuli received by a human and the human's responses to the stimuli. Social Cognitive Theory extends or augments Social Learning Theory by defining human behavior as the interaction among personal factors, the environment, and behavior. Originally developed to help understand and predict human behavior, Social Cognitive Theory is often difficult to apply because of its complexity.

A more applied example from industrial systems engineering is the Socio-technical Systems Model for work systems. This model, developed by Trist and Bamforth (1951), describes an approach to work system design that encompasses three sub-system elements: technical, personnel, and organizational. Work system design, according to this model, can be optimized through a balanced approach that addresses all three subsystem elements and is called joint optimization. Another example from industrial systems engineering is the discipline of macroergonomics. Hendrick and Kleiner (2002) describe macroergonomics as the design of work systems through attention to the internal environment, the external environment, and the

organizational structure. The internal environment, in general, includes physical and psychosocial parameters. The external environment consists of those elements to which an organization must be responsive, such as political, cultural, and customer attributes.

In the case of the design of a conference to address the advancement of women in academe, the holistic approach provides a structure for considering and, in some cases, anticipating interactions. For example, in terms of the macroergonomics model, the internal environmental factors to be considered would include those psychosocial factors such as cultural and gender schemas, and the external environmental factors would include such things as the university culture, departmental politics, and granting organization policies. A well designed conference would provide activities and events that would allow attendees to develop skills and enhance knowledge of all of these parameters.

- Emphasize Shared Interests and Traits

Depending on the nature of the conference, the attendees may form a particularly diverse group. Designing for diversity presents challenges because it is difficult to account for what could possibly be a wide variety of interests and needs. In this section, we discuss the challenges that we encountered when designing for a diverse group of female graduate and post-doctoral researchers. We dealt with these challenges by emphasizing the shared interests and traits of the attendees.

Even though the attendees of the AdvanceVT conference were all women, they had a large variety of backgrounds and circumstances. The conference was for women from the sciences and engineering, meaning that their academic interests and approaches to problem solving vary considerably. Within their own academic fields, the women had different perspectives: some of the attendees continued with graduate school directly after completing their undergraduate degrees, while others worked for a number of years before returning to academe to earn a more advanced degree. In addition, the women had different living circumstances; for example, some were single, while others had spouses and/or children.

We wanted to emphasize shared interests and traits in our activities to give all conference attendees the opportunity to connect with the material and each other during activities. The benefits of emphasizing shared characteristics are briefly highlighted in Section 2.2.1 in the discussion of common ground. For our particular conference, the major shared quality was easy to identify because it formed the basis for our conference. All of our attendees would be female and either would have already dealt with or would have to deal with gender issues in their academic careers. Therefore, there is a potential for leveraging the experiences of some attendees to provide insights for the whole group.

Females are poorly represented in the sciences and engineering and face a unique set of challenges (Cauble, et al., 2000) . Many of these challenges have been identified through research on Gender Schema Theory, which proposes that the phenomenon of sex typing derives, in part, from gender-based schematic processing--a generalized readiness to process information on the basis of the sex-linked associations that constitute the gender schema. In particular, the theory proposes that sex typing results from the fact that the self-concept itself is assimilated in the gender schema (Bem, 1981) . The influence of the gender schema concept on promotion decisions for women was examined by Lemons (2003) . The study evaluated contextual factors deemed as contributing to procedural justice or the "glass ceiling effect." Contextual factors evaluated included the lack of female role models, gender bias, and limited networking opportunities. We wanted to design our conference activities to directly address many of the contextual factors associated with gender schemas. We describe these factors in the following subsections.

- 1.1.1 Lack of Female Role Models

There are a number of notable advances made by female researchers in the sciences and engineering; many

of these advances, however, have not received sufficient recognition. For example, Schiebinger (2002) highlights advances made by female researchers in three areas: medicine, primatology, and archeology. In medicine, research from the 1980s demonstrated that women's health was being negatively impacted by exclusion from medical studies, such as the use of aspirin to prevent cardiovascular disease. The National Institute of Health, however, has since helped to define and improve women's health through studies that not only address female-specific problems, but also include females in the research process. In addition, female researchers have proposed a more inclusive model of women's health that has both a biomedical component and a social component. Primatology has experienced a change in the understanding of relationships between primates. Following World War II, female primates were thought to be entirely submissive to the needs of dominant males. Thereafter, however, female scholars studied matrilineal networks and discovered the cognitive capabilities and competitive tendencies of females. In archeology, female scholars have shown how gender assumptions have influenced the interpretation of findings. A primary example is the priority given to technical advances over social advances.

• 1.1.2 Gender Bias

Gender biases exist for a number of reasons, such as cultural and social stereotypes, and are imposed on women in sciences and engineering, both through internal and external sources. One particular aspect of gender bias became very important as we designed the conference: technology bias. We used a variety of technologies to do requirements elicitation, coordinate among ourselves, and document our work as we designed the conference, and we planned to use a variety of technologies to run the conference and get real-time feedback from the participants. In addition, we planned to use technology to follow up on our efforts after the conference and establish a forum for communication for attendees.

We questioned the effect that the reliance on technology would have on the ability to accommodate and support a diverse group of attendees. Technology keeps the relationship that women have with the sciences and engineering in constant flux. It simultaneously enables and drives research and learning within the sciences and engineering. Previous work describes a variety of sources of technology bias.

Some of the sources are internal. In a work on females' relationships with computers, Turkle (1991) maintains that some competent and skilled individuals, particularly women, do not fear computers, but instead distance themselves from computers because they dislike the idea of a relationship with an object. Their reticence limits their creative capabilities when they do interact with a computer. These individuals value human relationships and the shades of meaning present in human languages.

Other sources are externally imposed. Ormond (1995) provides a discussion of the female relationship with technology in an article in which she argues against the black-boxing of gender and society, a process that she maintains blurs true relationships. In particular, she emphasizes that the source of female oppression in relationship to technology cannot simply be limited to patriarchy, as some feminists may believe. To do so would obscure the real source of subjugation, many widespread and diverse instances of oppression that collectively make an impact. She maintains that the real relationship between gender and technology is constantly constructed and destructed in a series of discourses. Grint and Woolgar (1995) support this idea with an argument that technical capacity is not necessarily inherent in a technology, but that it also results from the various circumstances of its development.

Regardless of the source, the meaning of technological bias is certainly influenced by individual perspectives within the bounds of a society. Attendees came to the conference with relationships to technology that they had developed through their own experiences and circumstances. While it was not a primary goal of the conference to improve these relationships, technology should be used to include and involve attendees and not to exclude them. We wanted the attendees to have a favorable opinion of technology as it was used to support the conference. A variety of works, such as a study by the American

Association of University Women (2000) on the central role of computers in modern life, address the importance of technology. It is imperative that future female academics feel comfortable and competent with technology, so that they can succeed in the technologically-driven fields of the sciences and engineering.

• 1.1.3 Limited Networking Opportunities for Women

A third contextual factor identified by Lemons' work is the lack of networking opportunities for women. The conference design should promote networking among women in the sciences and engineering, as well as networking with women in other fields.

• 2 Requirements Elicitation Methods

Before we could begin designing the conference, we needed to better understand the needs, circumstances, and skills of our target audience. In this section and the following section, we discuss our approach to and the results of our requirements elicitation efforts, respectively. Our requirements elicitation efforts consisted of an online survey, focus groups, and interviews.

• 2.1 Surveys

To get a wide variety of opinions and ideas from women pursuing academic careers, we prepared an online survey and distributed it. The survey was created with Virginia Tech's web-based survey tool (survey.vt.edu). The survey had two separate sections: a multiple choice section and an open-ended question section. The multiple choice section had a total of 18 questions. The first six questions were used to collect demographic information, and the remaining questions were used to ask the participants about various aspects of pursuing a professorship in academe. The three open-ended questions were specifically designed to collect information that would help us choose topics for and plan conference activities. The online survey announcement and link were emailed to graduate students at other universities that had received Advance grants and to the following national mailing lists:

- Women in Engineering Leadership group

- National Association of Minority Engineering Program Administrators

- Women in Engineering Programs and Advocates Network.

A total of 1,026 graduate students responded, of which 97% were female and 66% were graduate students or post-doctoral researchers. Thirty-five percent of the respondents were between 21 and 24 years of age, and 49% were between 25 and 30.

• 2.2 Focus Groups

• 2.2.1 Focus Group Participants

We conducted four different focus groups, lasting between one hour and one and a half hours with between five and seven participants. All participants were current female graduate students in the sciences or engineering at Virginia Tech recruited using targeted listservs. The participants were given ten dollar gift certificates and snacks for their participation. Three of these focus groups were matched based on ethnicity (African-American, European-American, and International), and one group was of mixed ethnicity. The mixed ethnicity group was half Asian-American and half European-American. The international group was heavily Asian with four Asians, two Asian-Americans, and a single European participant. Hispanic/Latina and Native American focus groups have not yet been conducted because of time constraints, but will be held

before the next conference design iteration.

- Focus Group Method

To encourage all participants to participate equally, participants were given index cards and asked to respond to the following three questions:

- What is one positive thing about the prospect of being a female faculty member in higher education in the US ?

- What is one negative thing about the prospect of being a female faculty member in higher education in the US ?

- How would a conference best address these issues?

The main questions asked during the focus groups were created to coincide with issues cited in the literature. The four general questions asked during each focus group were

- What do you find attractive about a career in academe?

- What are your concerns about working in an academic field?

- Why do you think women are underrepresented as faculty in the fields of science and engineering in the United States ? What could be done to change this?

- Tell me about your experiences at previous conferences; what would you like to see at a conference?

- 2.2.3 Focus Group Procedure

All focus groups started five to ten minutes after participants arrived to allow time for food, drinks, and mingling. The moderators started the session by giving an introduction to AdvanceVT, providing a brief description of the conference, and then using the method with the index cards as described in the previous section. Two note takers were present at each focus group. All moderators and facilitators were matched to the respective focus group based on ethnicity. It should be noted that the reliability of the results is limited by the different styles and procedures used by individual moderators.

Three raters were involved in the data collection and content analysis of the findings. These raters developed a coding scheme based on both the literature review and themes that emerged during the focus groups (Krippendorf, 1980) . All focus group discussion content was coded according to these themes and the frequencies were then counted. Only information discussed (and not information that was written on index cards) was included in the frequency counts.

A critical component of content analysis methodology is ascertaining the degree of reliability of the coding to ensure consistency in the interpretation and application of the coding schemes. Two coders each analyzed the set of notes independently and then came together for final coding. The coders spent a considerable amount of time to validate data and decrease the chance of individual interpretations. Having two sets of notes was critical to recovering the missing/vague parts of the focus group data.

- 2.3 Interviews

While the focus groups captured information on what female graduate students thought that they would like in a conference, the interviews provided the other perspective of what professionals wished they had known.

- 2.3.1 Interview Participants

Ten Virginia Tech faculty and administrators were interviewed primarily to get personal accounts of their experiences as working professionals in academe. Nine were faculty members and one was a senior administrator. One of the nine faculty members was male; all other interviewees were female. The administrator was a director of undergraduate studies in the College of Engineering . One of the nine female faculty members was from the humanities; all others were faculty in the sciences and engineering.

- 2.3.2 Interview Method

For the interviews, we developed a list of questions that helped to initiate and maintain conversation. We grouped the questions into the following four categories: general understanding of the atmosphere in academe, preparing for an academic career, helping graduate students become faculty, and succeeding as a faculty member. We began by asking the interviewees one or two open-ended questions for one of the general categories, such as, "Knowing what you know now on how to succeed as a faculty member, what would you have done differently to prepare yourself during graduate school?" If the conversation did not proceed for long with such open-ended questions, we probed with more specific questions, such as, "What advice would you give to current women graduate students with respect to succeeding in the first two years in academe."

- Interview Procedure

We conducted the interviews in the interviewees' offices and deliberately kept them informal to encourage the free exchange of ideas. The interviews lasted from 30 minutes to one hour, depending on the schedule of the interviewee. We started the interviews with an introduction to the AdvanceVT project and information on our conference design team and our task. We also informed them that the interview was confidential and that their names would not be associated with their interview transcripts.

We obtained a considerable amount of data from the interviews. Due to the heterogeneous group of interviewees and the informal nature of the questions, the content analysis technique was adapted to the data collected (Krippendorf, 1980) . We separately highlighted the interview transcripts for codes, concepts, themes, or issues that appeared to be important to the interviewees. We then combined, listed, and categorized the codes into clusters to form a hierarchy. Finally, using the hierarchy of codes, we reviewed the transcripts a second time to determine the amount of emphasis placed by interviewees on particular codes and selected important quotes. For the purposes of our conference design task, we were most interested in the major ideas and themes brought up or discussed by the interviewees. As a result, our methods for analyzing interviews are not overly rigorous.

- Requirements Elicitation Results
- 3.1 Surveys

Results from Multiple Choice Questions

The multiple choice survey questions helped us identify several key characteristics of the group of potential conference attendees. First, the group is particularly diverse. More than half of the respondents identified themselves as belonging to an ethnic group other than European-American. In addition, one third of the respondents are married and 13% have children. Second, the group could benefit from a conference similar to the one that we were designing. Two thirds of the respondents have never attended a career-enhancement workshop, and half of the respondents do not have a mentor to help them with pursuing an academic career. Third, the female respondents felt that they did have fewer career-advancement opportunities in academe (46% answered "Strongly Agree" or "Agree") and seem to agree to a lesser extent that minorities have the

same problem (37% respectively). Fourth, the respondents felt competent in terms of skills necessary for obtaining and performing well in a faculty position, including writing CVs, resumes, and research statements and interviewing. One notable exception is that the respondents did not feel competent creating a professional website.

Open-ended Survey Questions

The survey included three open-ended questions. Only a fraction of the participants answered the open-ended questions (234, 121, and 233 responses, respectively). To provide a summary of the responses, we categorized them using the following procedure:

- For each question, we sampled a random selection of 50 answers.

- In each sample, we noted the unique ideas and grouped them to construct general categories.

- We reviewed the ideas and assigned each to one of the categories.

- Unrelated and/or nonsensical answers were put into the "Miscellaneous" category.

The majority of respondents wanted more tools to help them locate existing academic positions, both faculty and post-doctoral. When asked what difficulties they have encountered so far, balancing career and family, as well as discrimination (sexism and racism), were the most frequent answers. Another result from this question is that 4% of the respondents claim that being a female or a minority has made their pursuit easier. The minority students believe that support groups, mentoring and contact with other minority faculty, as well as equal treatment from the entire faculty would make their transition into a predominately White institution easier.

- 3.2 Focus Groups

The Content Analysis revealed the following major themes: Work and Family/Life Balance, Role Models, Industry vs. Academe, Culture, Tenure, Respect, Politics, Interviewing/Negotiating, Networking, Research, and Teaching. The overall frequencies for each theme can be seen in Figure 3.
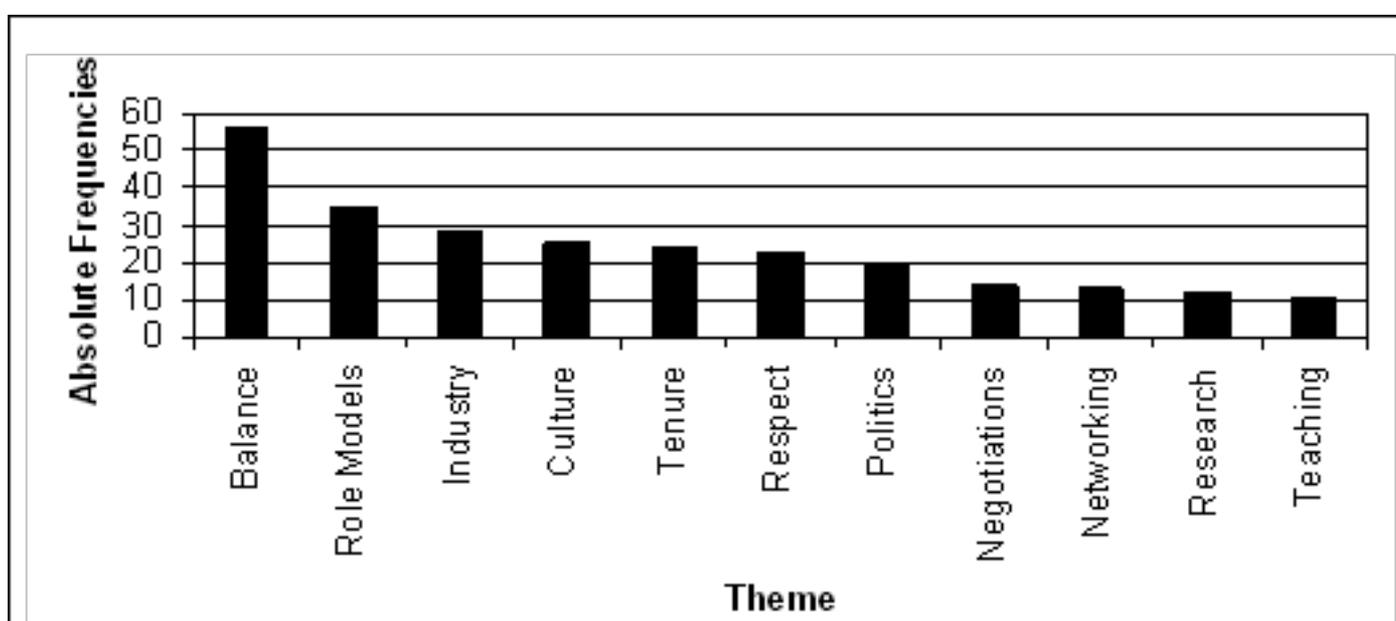

Figure 3 : Theme frequencies from all focus groups

Balance between Work and Family

Balancing work and family was the most frequently occurring theme in all groups except the African-

American group. The participants commented on the difficulties of raising children and managing the tenure process. It was noted that these life events typically occur simultaneously. Childcare, spousal support, and spousal job flexibility were common topics. International group members commented on cultural differences between their own and American cultures. It was noted that in many Asian countries, women are expected to excel at all roles: professional and family. Many comments were made expressing concern over the low likelihood of success in all these endeavors.

In the European-American focus group, the participants discussed whether they can really attain the goal of being successful both in their academic and family lives. One participant said, "Why am I doing this, can you have it all?" Another participant supported this fear with negative examples from her department. She said, "I just can't do it - [I] haven't seen anyone that has done it." One participant mentioned an article about higher divorce rates for tenured females and how tenured females have fewer children. Another mentioned that most females stay at home or go to smaller universities, so that their husbands can be successful.

Role Models

An important theme is the need to see more women faculty in academe. This was the most frequently referenced theme from the African-American focus group and the second most frequent theme overall (behind only family/life/work balance). Participants mentioned that they would like to see examples of women who have the lives that they seek: a successful career and happy family life. Some of them believe that female professors can encourage female graduate students. Some conflicting comments on the role of mentorship evolved from the discussion with some participants saying that they believed this would be helpful and others saying that they had negative experiences with mentorship.

In the African-American focus group, some participants pointed out to the need for encouragement. One graduate student said encouragement helped her realize that "continued education is possible and [you] can be successful, there are opportunities." Another woman from this focus group expressed her desire to serve as a role model/mentor to other underrepresented students. On the other hand, another student talked about being a role model to women in general and not only to peers. She believed that being a role model to non-minorities "shows that we are supposed to be there, to create acceptance."

Industry vs. Academe

The participants compared industry versus academe in terms of time commitment. Some expressed a preference for academe because of flexible hours, control of research, and the ability to work independently. Others pointed out that faculty flexibility does not translate into reduced workload.

Culture

Across focus groups there was a strong sense that academe is male dominated, and some of the female graduate students found this stressful and intimidating. One African-American woman cited faith as a way to help cope with the stress. The international women had the most cultural concerns because of language barriers. They expressed worry about not being able to get grants because of their writing and also about not being able to join discussions. For example, one international student said, "I cannot understand American cultural jokes. I cannot join discussions. I feel uncomfortable." During the conference they hoped to hear from professionals regarding how much weight is put on grammar when writing proposals and "what makes a bad impression."

Tenure

The issue of tenure was discussed more frequently in the International and Mixed groups than it was the European- and African-American groups. Some participants discussed the length of the process, the amount

of work required, the lack of guarantee of success, and the conflict with childbearing years. One participant thought that the tenure process was difficult, but that "once you get your tenure, it is easier." Others said that they felt it was too distant an issue for consideration at this time or that they did not know enough about the topic to have concerns.

Respect

Participants in the International group communicated that they tend to hold academic careers in high esteem. However, there was a concern that male colleagues would not have much confidence in female scientists' abilities. One participant stated that "When I talk [to] professors in my department, they really think females lack ability in engineering. It is really frustrating, but it is fact. [We] must face reality." Another said, "They [men] are not taking us seriously." In the European-American and mixed focus groups, participants noted that female faculty members are held to a different standard of behavior than are males; they must not be informal or use humor, lest they undermine their own authority. However, the source of the problem is not always male faculty. One graduate student from the mixed focus group described a senior female faculty member who showed a negative attitude to other women in academe, such as, "I had to do it, they have to do it."

Participants in the African-American group described the stress of being a minority in the academic environment. This topic was the third most frequent in their focus group. One African-American woman stated that she was the only African-American in the entire building for a period of time. She said being the "only black, everyone knows who you are, so when I do something bad, I feel pressure." However, she stated that she now feels that she adapted to this and adjusted to the situation after realizing that she is not the only one in this situation.

Politics

Comments concerning the nature of the gender imbalance in academe and university policies to rectify the situation were coded in this theme. There was a general consensus among participants that women are still in the minority. Policies concerning male partner accessibility to paternity leave and access to child daycare were discussed. One of the participants felt that her department tried to hire female faculty to achieve a balance or meet a quota.

Interviewing/Negotiations

Interviewing for a job and issues related to negotiating emerged primarily in the European-American focus group. These participants expressed an interest in conference activities, such as having an opportunity to see examples of resumes, teaching statements, and cover letters. Several participants expressed a need to know more about the process of negotiation once an offer has been issued. Most of the women did not know that they could negotiate for childcare. Those who voiced an opinion had a negative view of current childcare possibilities. There was also a positive belief that this can be changed relatively easily. The fact that the international focus group did not mention negotiations may be related to their culture.

Networking

While this was one of the least frequently occurring themes across the groups, all groups did mention concerns regarding their ability to effectively network with male colleagues. Specifically, several comments pertained to the "informal communication networks" that exist among colleagues who socialize in bars. The participants expressed some discomfort with the notion of socializing in a bar atmosphere in a large group of men, yet they described that this seems to be a norm in their fields. African-American participants described that their ethnicity adds a layer of complexity to this interaction. One participant described discomfort at

being "the only black female among many white men." Participants in all groups described feeling more comfortable in venues where they can network with people more like themselves.

Research

The women in the focus groups had concerns about how to get funding and write grant proposals. One concern brought up during the mixed focus group was that there would not be enough time to do research because they might be assigned less important work than men. One woman said, "They give you a lot of service work. Male[s] don't have to do that."

Teaching

Participants discussed research- and teaching-oriented schools. Some expressed a need to know more about the different classifications. Several mentioned a need to acquire more teaching experience prior to entering a tenure-track position. Some African-American focus group participants expressed concern over cultural differences between themselves and the student body.

Summary

Overall, the expectations of the women regarding the conference were quite positive and encouraging. Most provided specific ideas about conference activities and what they wanted to see in the AdvanceVT conference. These sessions were quite productive in getting feedback from female graduate students from different backgrounds.

- 1.1 Interviews

This section serves as a summary and is not a complete coverage of all the issues expressed by the interviewees. For this paper, we present the results organized by high-level category, followed by supportive subcategories and quotes. The two high-level categories are as follows: summary of interviewees' perceptions and interviewees' advice to women based on their experiences.

Summary of the Interviewees' Perceptions

The interviews provided insights into a wide variety of issues that women face and perceive to be important in academe today. On one end of the spectrum, interviewees expressed opinions on issues ranging from the choices that a woman is likely to face at deeply personal and family levels, such as if and when to have children. On the other end of the spectrum were issues related to professional and academic skills necessary to make it in what is perceived to be a male-dominated arena. We provide a brief summary of the important areas that were addressed by the interviewees in the following subsections.

Importance of mentoring. The interviewees stressed the importance of having a good mentor. They agreed that it is important to work with professors established in a field to develop a broader understanding of and appreciation for the field. Mentors help students learn the unwritten rules and practices of academe and the workplace. The majority were of the opinion that the gender of the mentor is not important.

Importance of networking. The interviewees felt that it is important to network with the top graduate students in one's field. According to one interviewee, "If you don't know them [the top graduate students], you are not one of them." It is also important to have connections because graduate school can be difficult to complete alone. Collaboration and involvement often result in excellent research advances and make for a more engaging experience.

Developing the required skills. One interviewee summed this subcategory up well with the quote, "You want

to distinguish yourself from others - this is what is going to get you a job." The interviewees collectively discussed four basic skills: writing grants, working on projects, teaching, and negotiating. All are important skills, but some of the interviewees pointed out that women most often have the most difficulty negotiating for funding, equipment, and personnel.

Gender bias. The female interviewees felt that biases against women exist and that they themselves had been affected by these biases at least once during their careers. One interviewee even reported, "It is so bad that I [being a woman] have a sub-conscious bias against women." The women reported that these biases manifest themselves in harassment at the work place, being evaluated differently compared to men, and being perceived to be inferior to men.

Personal life issues. Personal life issues include family life, particularly children and spouses. Some interviewees reported that they would not have children because they perceive their careers to be more important. Others mentioned that they had postponed having children until obtaining tenure. One interviewee mentioned that universities are sometimes apathetic with respect to supporting family culture and that it is not possible to "hide being pregnant." As for spouses, some of the interviewees felt that other men often times give more importance to the male spouse's career.

Interviewees' Advice for Women

As mentioned previously, we started the interviews by providing a brief introduction of AdvanceVT and our overarching goal of designing a conference for women considering careers in academe. This helped in keeping the interviews more or less focused on the high-level issue of what women should know to be successful in academe. We provide a brief summary of the advice the interviewees gave in the next few subsections.

Job search issues. The interviewees were of the opinion that different places have different cultures: "The kind of work that is appreciated in different places is different, and one needs to understand how people perceive themselves with respect to that culture." One interviewee encouraged women to find the most women-friendly places to work: "There are misogynistic factors almost everywhere and one has to choose the least misogynistic place."

Academic issues. The interviewees warned against taking on too much before obtaining tenure. A professor should have a minimum "repertoire of courses" that she already has prepared and is easily able to teach. Preparing for new courses takes time that could otherwise be directed toward research and publications. In addition, female academics should be careful and selective about being on committees. It is common for academic departments to ask women to be on committees because of the tendency to want "at least one woman." A tenure track woman should compare herself with the men around her to see the number of committees that they are participating in and should learn to say "no" if she is feeling overextended.

Administrative issues. The interviewees had two major pieces of advice for young faculty members. The first is to learn and develop time and people management skills. "Science is not management, and being a scientist does not imply management skills." The second is to get any promises or decisions from the department in writing. "Young people are too trusting. They expect people to abide by their word."

Personality traits. The interviewees discussed a variety of issues concerning personality and the workplace. Most importantly, a professor should "sell her skills, not her personality." Competence in a field and confidence in that competence are the key factors in succeeding.

Summary

The interview process was an enlightening experience and provided us with a rich set of information and

varied insights with respect to the following:

• There is a considerable bias against women in academe. This bias is not as pronounced as in the decades past, but it still exists and manifests itself in various ways. This bias is often concealed or made more subtle because it is considered "politically incorrect" to show bias.

• There are certain gender-based differences in personality traits, communication styles, social behavior, and personal expectations. In other words, men and women have different attitudes, styles, and expectations with regard to professional and academic life.

• People should be aware of and work toward eliminating the biases and the gender differences that exist when it comes to a career in academe.

• Being in the minority, women can benefit from additional support from structures such as social and professional networking, academic and administrative mentoring, awareness of gender biases and differences, and training for general and gender specific skills.

• 2 Application of Results and Heuristics
• 2.1 General Requirements

Some requirements and goals were set for practical reasons by the AdvanceVT committee before the surveys, focus groups, or interviews were conducted. The following were the goals for the conference, general constraints, and the target audience. The conference goals included:

• Prepare the participants for a career in academe by providing them with an opportunity to acquire necessary skills and information that they will need to succeed in their first two to three years on the job.

• Explore the possibility of recruiting new female faculty members for Virginia Tech, preferably minorities.

• Help the participants establish professional and personal support networks.

• Accommodate and, whenever possible, leverage the diverse range of interests and backgrounds of the participants to enhance or empower the total attendee pool.

• Positively portray Virginia Tech and its efforts to increase the number and quality of female faculty in the sciences and engineering fields.

These goals were subject to the constraints that the conference would start on a Friday evening and end on a Sunday afternoon. The location of the conference was fixed and approximately 75 participants could be included.

The target audience included women considering pursuing careers in fields in academe in the sciences and engineering that are within 1-2 years of entering academe. These attendees were a diverse group and had a variety of academic interests, were of various ethnicities, and came from various life circumstances.

• 2.2 Conference Schedule

Table 1 was the conference schedule that we developed for the AdvanceVT organization. This schedule took into account the results of the requirements elicitation process, as well as the constraints set by AdvanceVT. This conference schedule was iteratively reviewed and negotiated until the conference in the summer of 2006. In the following sections, we discuss the influence of the four heuristics on the design of the schedule.

Table 1: Conference Schedule

Friday

Registration

Early arrivals	Preconference events
6:00 pm - 7:00 pm	Introduction/Welcome
7:00 pm - 9:00 pm	Dinner and socializing

Saturday

Keynote speaker and welcome

8:00 am - 8:45 am	Breakfast and recognition
9:00 am - 9:45 am	Keynote speaker

Topic: A positive and successful career in academe
Getting your First Academic Job

10:00 am - 10:45 am	General skills needed [Lecture and role playing]
11:15 am - 12:00 pm	Working environment expectations: Teaching emphasis

Working environment expectations: Research emphasis

[Videos, pictures, active discussion]

12:00 pm - 1:30 pm	Lunch
1:30 pm - 2:15 pm	Interviewing [Active participation]
2:30 pm - 3:15 pm	
1:30 pm - 2:15 pm	Negotiating [Active participation]
2:30 pm - 3:15 pm	
1:30 pm - 2:15 pm	Writing resumes/CVs [Active participation]
2:30 pm - 3:15 pm	

Succeeding in Academe - Part I

3:45 pm - 4:30 pm	Importance of networking [Lecture]
4:45 pm - 5:30 pm	Family and work life balance [Panel discussion]
5:45 pm - 6:15 pm	Open session
6:30 pm - until	Dinner and a social activity

Sunday

7:30 am - 8:45 am	Breakfast and stress reduction seminar (optional)
9:00 am - 9:45 am	Time management [Lecture]
11:00 am - 11:45 am	
9:00 am - 9:45 am	Personnel management [Lecture and role playing]
11:00 am - 11:45 am	
9:00 am - 9:45 am	Money management [Lecture and active participation]
11:00 am - 11:45 am	
10:00 am - 10:45 am	Bringing minority issues and discrimination into light [Panel discussion]
12:00 pm - 1:30 pm	Lunch
1:30 pm - 2:15 pm	Open session

Farewell and good luck

2:30 pm - 3:00 pm	Concluding remarks
3:00 pm - 3:30 pm	Wrap up, survey

- **Undertake Requirements Elicitation**

We devoted a major portion of our time and effort to requirements elicitation. Research suggests that it is important to include participants early in the design process (Section 2.1). We conducted the surveys, focus groups, and interviews to help us better understand the needs and interests of the target group of attendees. The questions and areas of interest for these activities, however, came from a review of Trist and Bamforth's (1951) work with an emphasis on specific issues faced by women wishing to obtain jobs in academe. To prepare female students for careers in academe, we needed to consider the technological, human, and organizational elements of the academic work system to optimize the effectiveness of the conference as a transformative tool. Particularly, we needed to inquire about how these components were particularly altered by and for women. The technological subsystem includes elements of the work system that is higher education, such as grant proposals, tenure review, curriculum vitas, and interview techniques. Personnel subsystem elements to be addressed by the conference include mentoring relationships, work/life balance, informal organization, culture and ethnicity issues, and interpersonal communication. Organizational subsystem elements, such as university governance, departmental structure, and tenure hierarchy, should also be addressed to provide a balanced coverage of the entire academic work system.

- **Choose an Appropriate Modality for Presenting the Information**

The literature review (Section 2.2.2) and the variety of experiences, talents, and interests of potential conference attendees identified during the requirements elicitation helped us to determine that information should be presented using active, hands-on, discussion-based activities. Such an approach not only helps with learning information, but also leverages the knowledge and experiences of each of the participants. Each attendee brought a unique perspective and had something to share and learn from the other attendees in return. To facilitate this fluid exchange of information (which can be considered a conversation), attendees needed to communicate effectively. Active participation formats, such as panel discussions, afforded more communication opportunities between the attendees. This choice was also supported by the literature on learning theories. Active participation forces the attendee to repeat the concept in working memory in order to sustain the discussion. This implicit rehearsal aids learning.

- **1.3 Account for Interactions**

Previous work (Section 2.3) indicated that cognition does not occur in isolation. We could expect a good amount of interaction among conference attendees. This interaction would result in new understandings of and attitudes toward the material presented in conference activities. There is a high likelihood that new areas of interest would emerge and new insights would be gained. We realized that this particular conference would be a dynamic entity. Our experiences with the focus groups helped us realize that we could not anticipate all interactions and account for them beforehand. Many ideas emerged in the focus group as a result of interactions among participants. In some cases, the interactions helped participants realize that they were not alone and that others were experiencing the same problems or successes; in these cases, participants opened up and voiced opinions or shared experiences. For the conference, we needed an approach to design that supported these interactions and leveraged the richness and possibilities arising with such interactions. This made it increasingly evident that the model of a "static" conference with all the information sessions pre-scheduled would not be the most appropriate approach. This understanding led to the concept of dynamic conference design.

We define dynamic conference design as an approach to design that emphasizes the importance of interactions among conference attendees. A dynamic conference design is developed with change in mind. The conference should evolve as the sessions progress to best fit the needs of conference attendees. Figure 4 illustrates the progressive narrowing of conference activities with time as inputs are collected from participants. The narrowing indicates not a loss of content, but the refinement of content to better fit the interest and needs of the participants. As an example, the conference may include one or more open activities toward the end of the conference, the content of which is negotiated upon by the attendees. This structure allows the attendees to take an active role in deciding what they want and perceive to be important. Such activities would also have the benefit of being useful for finalizing unresolved issues or clarifying topics that many participants did not understand in earlier activities.
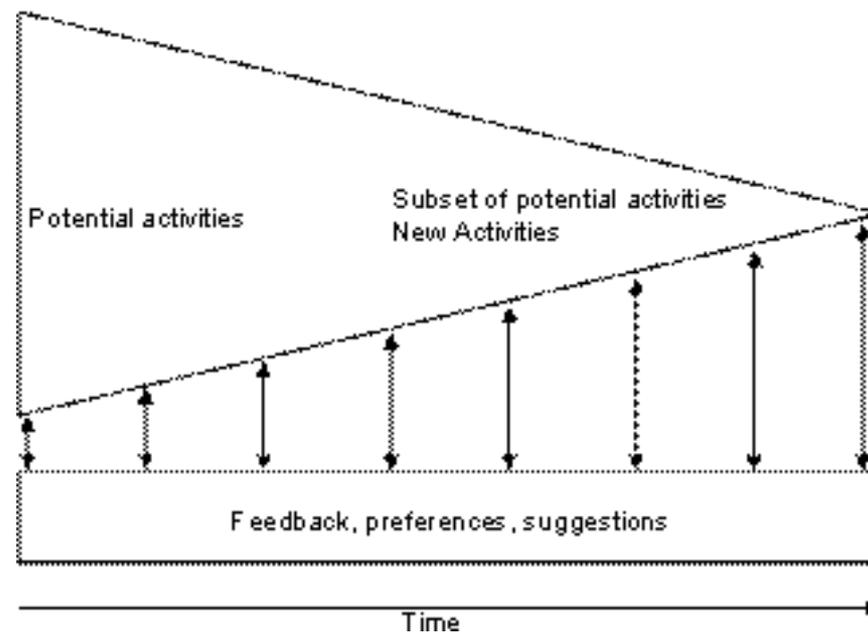
Figure 4 : Dynamic conference activity selection

A dynamic conference has the potential to be very useful for attendees, but it requires a great deal of effort on the part of the conference designers. The designers not only have to develop alternative activities, but also provide a forum for real-time feedback from attendees. Depending on the nature of the conference, such demands on the designers may or may not be reasonable. Given the goals of this conference and the characteristics of attendees, a dynamic conference design appeared to be a reasonable solution to ensure that the participants got the information that they want and need. For conference designers with few resources or less time to prepare, the amount of involvement may be overwhelming.

The large demands on conference designers and the process of tailoring the content of the conference as it proceeds make dynamic conferences somewhat of a risky venture. Risk analysis is a common theme that is well documented in many disciplines (see Moses, 1995 , and Budgen, 1992 for examples). Risk analysis in terms of conference design involves anticipating possible breakdowns, estimating their costs, and developing mitigation strategies. For example, for the AdvanceVT conference, a large component of risk analysis involves establishing the areas of expertise and time limitations of the individuals who run the conference. The variety of content that can be offered and the ability to dynamically change content are directly dependent on the designers' ability to anticipate the profiles of these individuals' expertise and time limitations.

After developing the concept of a dynamic conference, we began to brainstorm on how to apply the concept to our particular situation. More specifically, we knew that we wanted to design for interactions, but we were not sure of specifically how to go about doing it. Brainstorming and reviewing the literature helped us develop two particular approaches. The first approach consisted of removing unnecessary information and the second approach consisted of removing constraints.

The motivation for the first approach was the fact that we had a large amount of information on a wide variety of topics that we believed would be useful to the participants, but only one weekend to present it. We developed a general approach after reviewing literature on supporting users who have to deal with vast amounts of information while using computer systems (Lueg, 1998) . Lueg proposed that reducing the size of the information available to a user based on a set of heuristics derived from user behavior supports situated action (Suchman, 1987) . For example, consider a computer user presented with vast information content, such as news during an interaction session; a system may slowly filter away unimportant information from the user interface as time progresses to provide the user with more information that is relevant to the task at hand. This approach contrasts with many other approaches in which systems try to find the information that is important to the user instead of removing unimportant information. The heuristics to filter away unimportant information are derived by observing the user over a period of time and recording the information that is not accessed.

As applied to this conference, this approach consists of narrowing the focus of the conference as it progresses. We propose using the relative frequencies of themes from the focus groups to determine which topics have a higher probability of being more interesting to attendees; for example, conference attendees may be particularly interested in workshops and talks related to balancing professional and personal life. In addition, designated conference designers will attend activities and observe attendees reactions and contributions. These designers will be intimately familiar with the planned conference activities and will be able to assess what information did not seem to be perceived as necessary or important by the attendees and how that information relates to future conference activities. For example, because our conference was intended to help female graduate students and post-doctoral researchers succeed in faculty positions, several potential activities related to the mechanics of working as a faculty, including workshops on writing curriculum vitas and grants, were possible candidate topics. If we found that the attendees were already comfortable with these activities, more time was devoted to other issues, such as confronting gender stereotypes, etc.

The second approach developed as a result of Zacklad's (2003) work on the design of computer supported cooperative work systems. Zacklad defined structurally open situations as those within which participants can greatly influence both the structure of the task and the structure of the group participating in the task. Within these situations, cooperative activities occur that are oriented toward achieving a certain goal, but the means for attaining that goal are not completely formalized. The attendees are, therefore, minimally constrained by the structure of the activity.

If we treat a dynamic conference as a structurally open situation, then the various interactions among attendees at some level constitute cooperative activities. We wanted to provide a forum for these cooperative activities that provided a basic structure to encourage interaction, but that did not limit the expression of the interaction. One idea was to use what we define as social affordances, artifacts in any space physical or virtual, which invite and facilitate social interaction among the participants in that space. We planned to have a number of such social affordances in the form of different refreshment stands, each labeled with a different topic. The topic provided the basic structure for initiating conversations, but it in no way limited the conversations. The basic topics can be themes from the focus groups and topics considered important by interviewees. Also, at these refreshment stands, we wanted to have a number of kiosks with computers with systems for collecting feedback on completed and upcoming activities. As mentioned previously, another idea was to have a number of blank sessions toward the end of the conference. The content for these sessions would be decided on by the attendees either through direct conversation with conference designers or through inputs from the kiosks.

- 1.1 Emphasize Shared Interests and Traits

The literature (Section 2.4) and the results of our requirements elicitation process indicated that there was a

need for more role models and networking opportunities. Our conference design needed to highlight the accomplishments of women in the sciences and engineering to identify role models. The most direct method of doing this was a workshop or presentation on leading female researchers and teachers. Another idea was placing a series of posters of accomplished women from a variety of fields in the rooms in which activities were to be held. This idea could be extended by including brief paragraphs summarizing the accomplishments made by these women and references to appropriate literature in the conference correspondence, on the conference website, and in the conference discussion forums.

Other ideas for leveraging shared interests included using social affordances, such as public kiosks, conference forums, and large displays to convey general information. To promote networking among women in the sciences and engineering, we worked with another team of graduate students to develop a set of post-conference tools. These tools included discussion boards, listservs, forums, and surveys. The women who would attend the conference would meet and exchange ideas and discuss experiences, and we wanted to continue to support these exchanges after the conference.

In addition to encouraging networking and the exchange of ideas among women in the sciences and engineering, we wanted our conference design to promote "cross-pollination" (Ulaby & Calder, 2002) . Women who are successful in other fields, such as law or business, have valuable perspectives and insights that may transfer well to women pursuing academic faculty jobs in the sciences and engineering. To enable this networking, our conference design included workshops led by accomplished female professionals from fields outside of the sciences and engineering.

• 2 Conclusion

The underrepresentation of women in academe in the sciences and engineering can potentially be alleviated through conferences that help women enter these fields and be successful. Designing any conference can be a challenge, and issues to consider include requirements elicitation, presentation of information, accounting for interactions, and emphasizing shared interests and traits. We hope other conference designers will find both the conference design heuristics and the results specific to the AdvanceVT conference useful when undertaking their own conference design efforts.

Acknowledgements

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