

Uncertainty in Analytic Hierarchy Process Decisions for Manufacturing Systems

Final Report: ADVANCE Incentive Fund Grant

Dr. Valerie Maier-Sperdelozzi

Accomplishments and Outcomes – for example, proposals submitted to granting agencies, papers submitted for publication, or equipment purchased.

The ADVANCE Incentive Fund Grant was used to support one graduate student, Amy Thompson, during the summer of 2004, and she has continued to work with me during the school year. She had previously worked with Dr. Manbir Sodhi, co-PI on this grant, to complete her Master's Degree in May, 2004. During this past year, as a result of this project, she was co-advised by both myself and the other professor as she completed coursework towards her PhD degree, including enrolling in the graduate course that I taught during Spring, 2005. Her work in this class has been submitted for presentation at a conference next February. By the end of spring semester, Amy had decided to turn the exploratory research from this initial funding last summer into part of her PhD dissertation topic, with me as her major professor. The joint vision that we now have for her dissertation links the research from her master's thesis with a new topic from this project that extends my own dissertation work and also with the term project from her classwork in the spring.

A complete literature review was performed for topics related to the Analytic Hierarchy Process (AHP), Fuzzy-AHP, sensitivity analysis with the AHP method, and fuzzy numbers, which all relate to uncertainty in decision making. Several articles were identified that use Fuzzy-AHP at one-level in a hierarchy. No articles or research published in English were identified that showed Fuzzy-AHP applications at more than one level in a hierarchy. Several articles were identified that demonstrate the use of sensitivity analysis with AHP, but these do not incorporate the use of fuzzy logic to determine best alternative selections. A database was created for the articles identified in the literature review. These articles are categorized and organized according to topics, authors, and subject relevance to Fuzzy-AHP. This database is useful for researchers extending upon existing research in Fuzzy-AHP, and will ultimately become a significant portion of Amy's literature review for her dissertation.

Discuss how your accomplishments and outcomes helped to support your research project.

The greatest benefit of this research is the ability to have an additional graduate student and to pursue research that extends my own dissertation research. At the time of the award, I had been in my position at URI for less than one year. I had enough support for only one graduate student, and that person was working on research in a new area where I had secured additional funding through an industry sponsor. I did not have enough funds to offer support to a second graduate student, even though I had many research topics which I wanted to pursue. The summer support and background reference materials were instrumental in helping Amy to decide whether she wanted to work on a research topic in one of my areas of interest. The travel funds helped me to attend a conference which I had never been to before, with a professional society which I had previously not been affiliated with, but which directly relates to this research area. I was able to learn about new opportunities for funding and publication in this area of research.

Discuss what, if any, problems were encountered in the course of the activities funded by the ADVANCE Incentive Fund.

The project lasted much longer than expected, as it ultimately evolved into an ongoing research effort as opposed to a limited 6 month exploratory project. The work that I expected from Amy was not completed before the 6 months proposed to the ADVANCE office, so she continued to work on the project part-time despite the fact that the funding had occurred during the

Summer, 2004 term. Amy has been contemplating her dissertation topic for quite some time, trying to decide whether to continue research related to her Master's thesis with her former advisor, switch completely to a new topic with AHP, pursue new interests of her own related to scheduling or healthcare management, or find some combination of all of these.

Explain the current status of your budget – what did you spend, what did you spend it on? Please document and explain any changes to the budget during the period of funding.

The amount of the grant was \$9000. Initially the student planned to work 30 hours per week, but in the revised budget when the grant was awarded, this was reduced to 20 hours per week. Thus, summer student support and benefits was \$5298.10 in total, as planned. The remainder of the grant was supposed to go toward conference travel, but due to the timing and availability of the award funds, some of the early trips were ultimately funded through other sources. Thus, only \$1408.07 was used towards travel from this grant. As Amy conducted her background research regarding the Analytic Hierarchy Process, the purchase of several books, one of them rare and out-of-print, became necessary, so \$169.44 was used towards this. A small problem occurred when the university controller required special memos in order to process a reimbursement to the student, despite the fact that we had checked with both the ADVANCE office, university bookstore, and purchasing for prior approval since there was no other way to buy this particular rare book except through online resellers who require a credit card at the time of purchase. Ultimately, the reimbursement was made, and we are very grateful to have this book available as a standing reference for this research area. The total amount spent from the grant was \$6875.61 and after discussion with the ADVANCE office at the end of the grant period, it was agreed that the remaining \$2124.39 which was not spent on travel would be released for the benefit of other Incentive Fund grant recipients.

Finally, in an addendum to the report, we would be very interested to hear your suggestions to the Incentive Fund Committee regarding any changes that might be made to facilitate this award program.

Your final report should be sent electronically both to the ADVANCE Incentive Fund Committee via Cathy Roheim at crw@uri.edu and to the ADVANCE office at advance1@etal.uri.edu. We look forward to hearing from you.