AC 2012-4714: MIXED METHODS APPROACH FOR MEASUING INTERNATIONAL ENGINEERING, DESIGN, AND TECHNOLOGY STUDENT EXCHANGE PROGRAMS

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Mixed Methods Model Approach for Measuring International Engineering, Design and Technology Student Exchange Programs

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Abstract

With increasing pressures on engineering and technology education programs to prepare students for careers in ever-changing, more complex and global society, the importance of international student exchange becomes an even more significant component of engineering and technology curricula. Utilizing an effective evaluation model to assess the value added impact of these programs is a critical component of the overall assessment of any engineering education program—particularly those employing continuous improvement systems as required by ABET. The purpose of this presentation is to share an evaluation model used to document the impact of international engineering exchange programs and how this evaluation model is being used to assess a FIPSE Atlantis student exchange program between US and EU universities. The evaluation model addresses two key project goals, namely (1) to advance sustainable student exchange between the international participants and their US counterparts and (2) to accelerate the development and support of collaborative cross cultural, multi-disciplinary learning environments focused on innovative engineering, design and technology.

The authors employed a unique process-outcome evaluation design that integrates Stufflebeam's Context, Input, Process and Product Evaluation Model (CIPP) (Stufflebeam, 2002)[8], Kirkpatrick's Four Levels of Evaluation Model (reactions, learning, transfer, and results) (Kirkpatrick, 1996)[5], and Wilder's Model (environment, membership characteristics, process and structure, communication, purpose, and resources) (Wilder Foundation, 2008)[12]. Both qualitative and quantitative methods and measures are being used to evaluate the degree to which the team is accomplishing the project goals. Key measures and their assessment tools that are overviewed in this paper pertain to administration, collaboration and partnership development; curriculum alignment and approval, marketing and recruiting and admission; language gain and development, cultural awareness and sensitivity; faculty development, institutional change and support; academic and intellectual achievement; and sustainability.

The results showed an increase in university collaboration between 2006 and 2011 with most factors exceeding 4.0 on the Wilder 5.0 scale. In particular, 2011 scores showed the greatest growth relative to the history of collaboration or cooperation among the community; an important factor because the institutions do not share a community per se. Significant to this project is the high level of senior or executive administration support and involvement, key factors to making programs sustainable. Student reactions towards the exchange experience and its value to their overall education were very positive. Students indicated they were very confident about living and studying in a non-native language. They indicated they believed that international experience and/or dual degrees would make them more marketable and better prepared to work in a global economy. They shared their belief that curriculum flexibility was an important necessity and that it was being accomplished through the curriculum. Students also stated they appreciated learning in a different education system, developing stronger critical thinking and problem solving skills, and developing a greater degree of independence and self-reliance. Additional and more recent results will be shared in the presentation including how the results are being used to improve the student exchange program.

In this paper the authors present an approach that has wide application for not only assessing international student exchange programs, but all facets of engineering and technology education as an integral component of continuous program improvement.

Keywords: mixed methods, evaluation, exchange student programs

Introduction

This paper describes the evaluation model used to document the impact of a European Union-United States Atlantis grant project awarded by the Fund for the Improvement of Postsecondary Education (FIPSE). The partner institutions included two in Europe, Dublin Institute of Technology (DIT) in Ireland and the Hochschule Darmstadt (H-DA) in Germany, and two institutions in the United States, Purdue University (PU) and Penn State University (PSU). Two goals of the project were to advance a sustainable, full-semester student exchange between the European project participants and their US counterparts and to accelerate the development and support of collaborative cross cultural, multi-disciplinary learning environments focused on innovative Engineering, Design and Technology (DETECT).

To understand why and how the evaluation model was used evaluate the DETECT Project, the authors provide (a) an overall description of the EU-US Atlantis DETECT Project, (b) the project's goals and objectives, (c) the research design, (d) evaluation model, (e) approach to evaluating program impact on student learning, (f) stock and flow model, (g) results, and (h) conclusions.

Description of the EU-US Atlantis DETECT Project

The faculty of Engineering at DIT, Ireland's largest and oldest Institute of Technology, has a history of over 100 years of engineering education based at multi-site campuses. Its Engineering and Technology programs are notable for their applied focus with an enrollment of approximately 5,000 students across six Engineering Schools. H-DA in Darmstadt Germany has close links with DIT. H-DA, founded in 1971, has in excess of 11,000 students, and is internationally recognized for its engineering excellence. PU and PSU, both widely acknowledged as leaders in engineering technology education in the USA, recognize the similarity of their multi-campus Engineering Technology programs and frequently benchmark against one another for accreditation purposes. PU's College of Technology operates a multi-campus Engineering Technology program in Indiana. It serves approximately 5,000 undergraduate students. PSU offers five baccalaureate degrees and 10 associate degrees in Engineering Technology at 12 campuses in Pennsylvania.

Goals

This project had two strategic goals:

1. To advance sustainable full-semester student exchange between the European DETECT project participants and their US counterparts (PU and PSU) and, in parallel, to advance sustainable full semester student exchange between the US DETECT project participants and their European counterparts (DIT and H-DA), and

2. To accelerate the development and support of collaborative cross cultural, multi-disciplinary, Engineering and Technology learning environments focused on innovative Engineering, Design and Technology and to mutually recognize the student learning experiences between partner organizations.

Objectives

To attain the previously stated project goals, the DETECT Mobility Exchange Project team collaboratively established five principal objectives:

1. To support and increase the number of sustainable transatlantic "department" and "school" partnerships across the participating institutions by jointly developing, implementing and sustaining full semester student exchange programs between their respective organizations;
2. To formally mutually accredit learning in partner organizations;
3. To develop the proficiency of students to operate effectively in transatlantic engineering, design and technology exchange environments;
4. To undertake faculty exchange aimed at increasing the number of "department" and "school" partnerships who jointly collaborate on the development of sustainable common innovative engineering, design and technology projects undertaken in cross-cultural, collaborative, multi-disciplinary learning environments by student teams from more than one participating organization; and
5. To share, adopt and disseminate amongst the partners and the wider educational and engineering technology community the sustainable innovative management, learning, teaching and assessment best practices associated with the delivery of the project's strategic goals at the module (course), program and organization level.

Research Design

Using a mixed methods model for program evaluation provided a robust technique to assess the quality of program improvement and effectiveness. It provides for integration of both qualitative and quantitative measures to evaluate the degree to which a program meets its established goals and objectives. One can define mixed methods research as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concept or language into a single study" (Johnson & Onwuegbuzie, 2004, p. 17)[6]. The quantitative components of this study included the pre-departure survey results, language learning measures, student evaluations, and qualitative components including the leadership team interviews and faculty interviews. This approach was selected because it allowed for the comparison of pre- and post-survey results and the exploration of other contextual factors that may have impacted the student responses. Looking at responses to survey questions without considering the contextual factors fails to provide the information needed for program improvement. A richer, more meaningful understanding is gained using this approach, especially when the sample size is small, as is the case in this evaluation.

When one type of data set in the mixed methods approach provides a supportive role because the primary data type is not sufficient to address the research questions in the study, this can be referred to as an embedded design (Creswell & Plano Clark, 2007)[2]. As shown in Figure

1, some data collection activities in the study occurred simultaneously and some sequentially. This visual guideline for the mixed method study uses the notation system used extensively in the mixed method literature wherein arrows indicate sequence, upper case letters indicate the method with the greater emphasis, lower case letters indicate the secondary method, and parentheses surrounding a method indicate that the parenthetical method is supporting the other method (Creswell & Plano Clark, 2007)[2].

For example, the student survey evaluating the exchange, a quantitative measure seen near the center of the model, is supported by student interviews and comments, qualitative data. However, faculty input is primarily qualitative and thus the interpretations are primarily based on qualitative data supported by the embedded quantitative survey results.

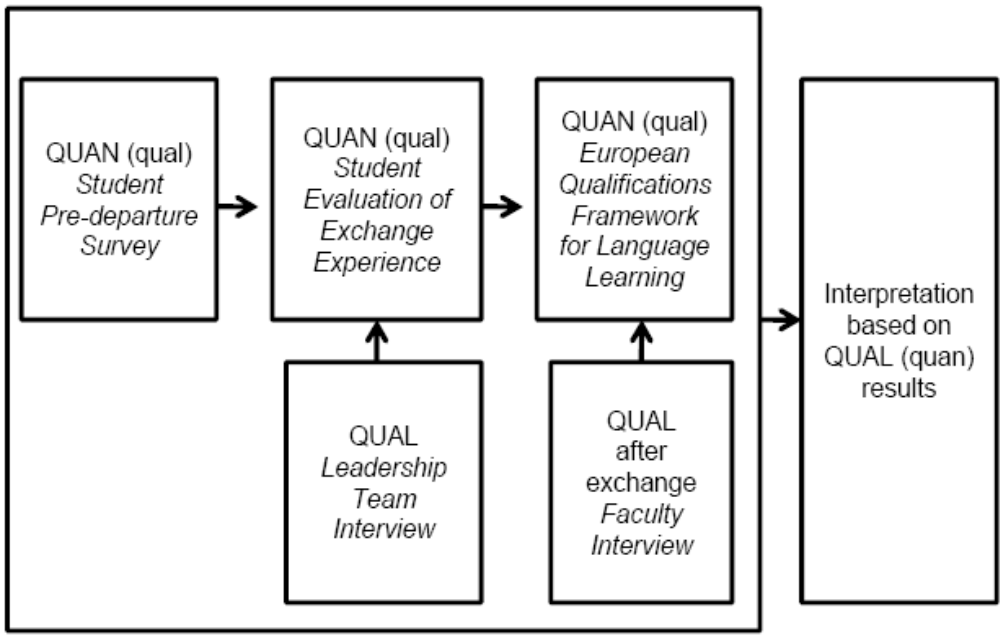

Figure 1. The embedded design of the mixed methods model used to examine the impact of the student exchange program (Creswell & Plano Clark, 2007)[2].

When designing the surveys, the researchers employed quantitative research design techniques to standardize the administration as much as possible. The surveys were administered to students at consistent intervals using a web-based delivery. The qualitative research components were designed to capture the perspectives of the students, faculty and administrators. The collection of information through interviews helped to explain the meaning of the student survey responses and the language test scores. Both approaches were important in order to collect data that represented a full picture of the challenges and benefits related to the student exchange. Embedding qualitative data that explored students' reactions to the exchange into a quantitative design that measures the language learning and increased in cultural experiences provided a more rich understanding of the exchange experience. In cases such as this, when a quantitative design is enhanced by qualitative data, mixed methods research is the stronger design.

Evaluation Model

The evaluation team for the EU-US FIPSE Grant is led by Barnes Technologies International, LLC (BTILLC), which has over twenty-five years experience in conducting third party evaluations. Relative to the EU-US Atlantis DETECT Project, BTILLC collects and reports on data related to the two previously cited goals set out by the EU-US FIPSE Project.

Need for Evaluation

EU-US Atlantis DETECT (Design, Entrepreneurship, Technology, Engineering, Collaboration, Transatlantic) received a four-year FIPSE grant from the U.S. Department of Education to improve and strengthen student and faculty exchange programs between the four participating institutions. The grant proposal demonstrated that these institutions are committed to working together to enhance faculty and student exchanges. These institutions agreed to work together to improve gaps in faculty and student mobility, academic and intellectual achievement, cross-cultural understanding and an increased *weltanschauung* (global perspective). Systematic evaluation was an essential component of this project.

BTILLC's third party evaluation provided an ongoing analysis of all program components that enabled the Project Directors and participants to make timely modifications in any component that was not functioning in an adequate capacity. This analysis was based on program evaluation standards (Rossi, Lipsey, & Freeman, 2004)[7] and protocols for international exchange programs. Standard practice requires a system of continuous evaluation feedback or "closing the loop" to ensure that any modifications made complied with sound standards and protocol. BTILLC's evaluation team filled this need for EU-US Atlantis DETECT by providing expertise in these standards and protocols. BTILLC examined the current participant agreements, procedures, protocols and processes to determine to what degree the current plans provided a comprehensive approach for addressing international faculty and student exchange programs, which is described in the approach for evaluating program development.

Approach for Evaluating Program Development

To study the program development, the third party evaluator, BTILLC, used key aspects of the process-outcome evaluation design as well as those from Stufflebeam's Context, Input, Process and Product Evaluation Model (2002, 2004)[8,9,10,11] (CIPP). The CIPP Model provides a comprehensive approach to evaluating programs, projects, personnel, products, institutions and systems and was selected because of the alignment of the model with the program components. It is built on the assumption that anything that can be evaluated could be successfully evaluated at various stages of its development, context, input, process, and product. Simply put, the CIPP Model focuses on "What needs to be done?", "How should it be done?", "Is it being done?", and "Did it succeed?" In this project, developmental changes were occurring not only within individual students, but also within the maturity of the relationships between educational institution partners and among the faculty traveling to participate in the mobility aspects of the program. BTILLC has successfully used the CIPP Model on numerous third party evaluations of companies, educational projects, and agencies. All data collection instruments used by BTILLC during this third party evaluation were similar to those used on equivalent evaluations.

The measures used for each of the CIPP evaluations are aligned with the CIPP Evaluation Model Checklist[8] developed by Stufflebeam. This checklist is designed for program evaluations to determine long-term, sustainable improvements, a key component of the DETECT Student Mobility Project. The CIPP evaluation model provides an excellent and relevant model for determining the degree to which DETECT is sustainable at end of the grant funding cycle[9].

While the CIPP Model measured the development stages of these relationships within the project, the Wilder survey[12] measured the strength of the collaboration factors. Together these measures provided a multi-dimensional picture of the degree to which the EU-US Atlantis DETECT team accomplished the proposed goals and objectives for their international faculty and student exchange program. Qualitative measures, especially interviews, were used to annually report outcomes to the Atlantis DETECT project team as to contextual/environmental, input/communication, process, and outcome variables that were assessed. These qualitative measures aided the project director and staff in strengthening the program's direction on an ongoing basis. In addition, the third party evaluator used quantitative measures to conduct performance outcomes evaluations of the program's goals and objectives that are reported, as required, to the US Department's FIPSE Program on annual basis. The findings and results of the qualitative and quantitative assessment provided information to the principal investigators regarding how well the program's goals and objectives had been met and guided recommendations regarding what adjustments needed to be made to fill gaps or incongruities in alignment between the program's participants and its components. The evaluation logic model, as shown in Figure 2, was used by the third party evaluator to successfully and comprehensively evaluate the degree to which the EU-US Atlantis participants accomplished the proposed goals and objectives for their FIPSE Grant. These developmental relationships were supported by the overall DETECT program effectiveness and participant benefit was measured using Kirkpatrick Four Levels Model[3,4,5]. This evaluation model focuses on individual changes that occur as a result from participating in the program. The participant reactions can range from a simple, temporary reaction to more advanced changes in content knowledge and behavior to individual impact on systems that benefit others to accounting for sustainability. All components of the logic model align with the four evaluations of Stufflebeam and Kirkpatrick to ensure a robust data collection process to quantitatively and qualitatively measure DETECT's level of success.

The logic model graphical represents how the program evaluation starts with baseline data that feed into a system and drives subsequent activities. The first component of this logical model showed that the third party evaluator reviewed all current existing documents, agreements, procedures and processes used by the four participating institutions for international faculty and student exchange. These factors provided a baseline from which EU-US Atlantis DETECT designed its programs, activities, curricula and credit transfer for its initiative. The comprehensive process-outcome evaluation assessed to what degree the project director and staff: (a) maintained records on how their program is operating; (b) maintained records on the extent to which their program objectives are being met; (c) included specific performance measures in their evaluation plan; (d) made ongoing project information, findings, and products available to ensure the dissemination of knowledge gained from this effort during the grant period.

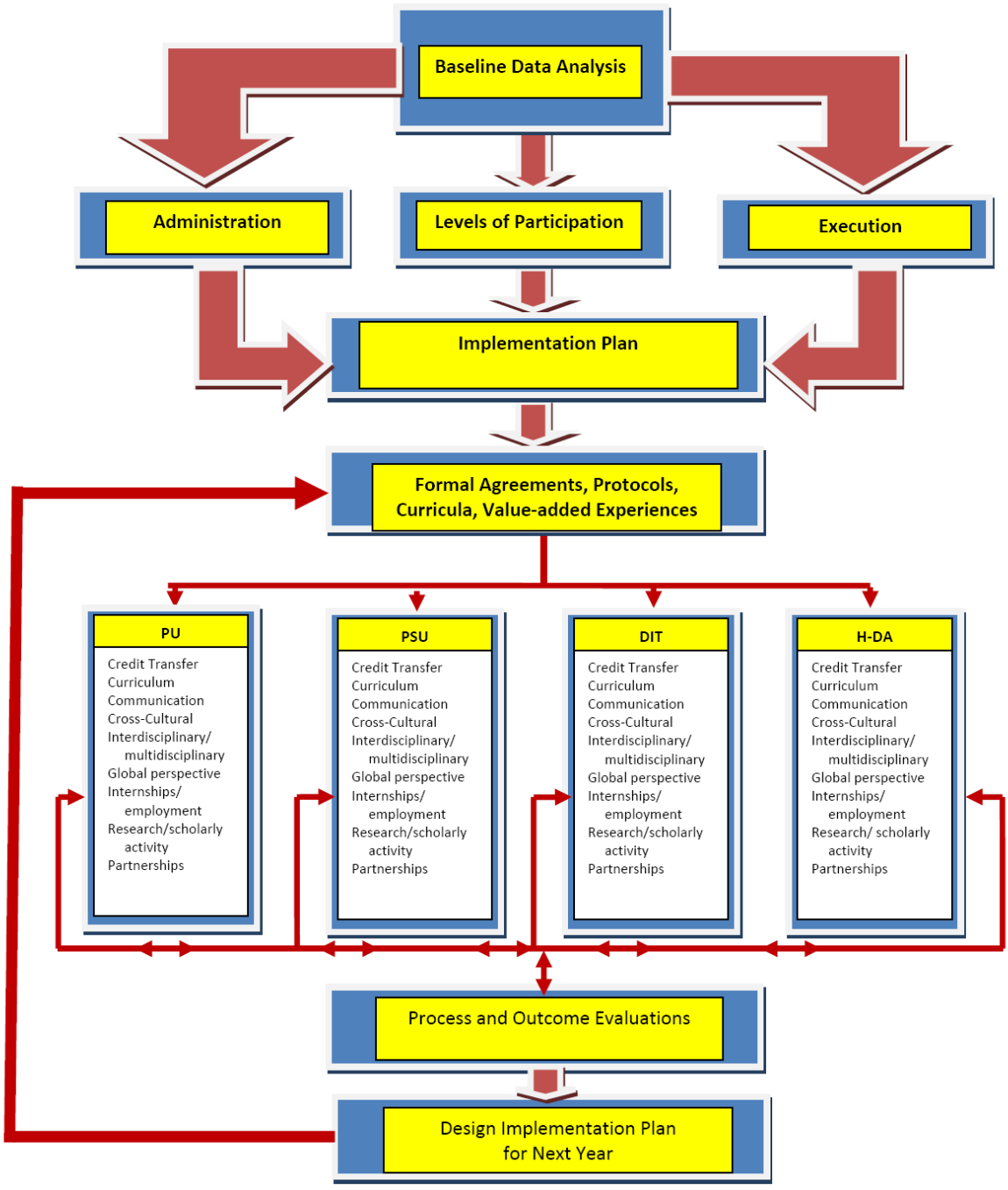

Figure 2. Logic model for project evaluation.

The following criterion were used by the third party evaluator to assess to what degree EU-US Atlantis DETECT designed its programs, activities, curricula and credit transfer for its faculty and student exchange initiative:

- Needs and gaps were identified.
- Goals and objectives responded to the identified needs and gaps.
- Proposed activities were related to and will contribute toward achieving identified goals and objectives.
- Partners were actively and appropriately participating in implementing the project.
- Outcomes and measures for outcomes were presented.
- Resources (such as staff, materials, and training) were allocated in the budget.

Based on the assessment results, EU-US Atlantis DETECT adjusted its first year model to correct for any incongruities or gaps found from the assessment criteria and in alignment between the four participating institutions, specifically assessing language gain, housing, and orientation. Based on the recommendations from the evaluation annual report, the DETECT partners analyzed the recommendations and selected best practice of an institution to address the recommendations of the evaluations annual reports. By process showed continuous improvement throughout the project.

Process and outcome evaluations were conducted on each of the five objectives to determine the degree to which the programs, activities, curricula and credit transfer were meeting the goals and objectives of the EU-US Atlantis DETECT Grant. The results and findings were reported at their required intervals. Based on the third party evaluation results and findings for the each year of the project, the principal investigators and staff developed their Implementation Plan strategy for the next year. As in the first year, the third party evaluator conducted process and outcome evaluations of all aspects of required by FIPSE. The same evaluation plan was repeated for years three and four, a robust method for "closing the loop."

Process-outcome evaluation

The process-outcome evaluation model was used to assess to what degree the EU-US Atlantis DETECT exchange initiative provided a value-added experience for faculty and students. Indications of added value included yearly increases in the number of faculty and students being exchanged amongst institutions, faculty and student mobility, academic and intellectual achievement, cross-cultural understanding, and an increased *weltanschauung* (global perspective). Stufflebeam's four evaluation elements are discussed to explain how they were utilized in the research design to measure the overall success of the DETECT Mobility Exchange Project.

Key variables, based on the goals and objectives of the project and listed in the tables for context, input, process and product, were evaluated for each institution to assess to what degree the EU-US Atlantis DETECT participants were meeting the goals and objectives of their international exchange program. To this end, BTILLC performed the following services:

- Assisted in gathering and developing baseline data as it relates to the FIPSE indicators.

- Assisted in establishing measurable indicators of progress toward the goals outlined in the grant proposal. These indicators included:
- How many students, faculty and departments participated in EU-US Atlantis DETECT.
- The level of the cross-cultural experience and *weltanschauung* (global perspective).
- How many of the identified gaps in the grant proposal were addressed by the end of the project period.
- Participated in monthly videoconferences and report on the progress of the project.
- Attended project conferences held by EU-US Atlantis DETECT.
- Prepared the annual reports.

Context

The context evaluation was addressed in the logic model by the baseline data analysis, administration, levels of participation, execution, and formal agreements, protocols, curricula, value-added experience components. The context evaluation assessed needs, assets, and problems within a defined environment. This phase assessed "What needs to be done?" This phase of BTILLC's third party evaluation focused on assessing the principal investigators' needs and identifying any problems (political or otherwise) of the EU-US Atlantis DETECT Grant. This phase of the evaluation provided the baseline data from which to evaluate the principal investigators' desired outcomes and how well those outcomes were accomplished (Table 1).

Input

Input evaluation assessed the competing ways to achieve the goals specified in the context evaluation and focused on the administration, execution and implementation plan components of the logic model. This phase assessed "How should it be done?" BTILLC evaluated the principal investigators' communication channels, budget sufficiency, merit of project strategy, and the project's work plan. BTILLC also evaluated how the principal investigators recruited and informed the participants and revised plans based on the feedback obtained during initiative (Table 2).

Process

The process evaluation reviewed how the program operates. BTILLC monitored, documented and assessed the program activities. The process indicators included evaluations, checklists, progress reports from the principal investigators and external evaluator, and participant surveys/interviews. BTILLC evaluated how well the principal investigators met the project's timeline, how participants were recruited and informed, how the pre- and post-orientation and debriefing was conducted, the results of EU-US Atlantis DETECT meetings, how the curricula were developed to meet the goals of the exchange program, how well the participants achieve, how communications was handled, how well the participants developed cross cultural understanding and *weltanschauung* (global perspective), and how the principal investigators revised their plan based on the feedback obtained during the project's activities (Table 3).

The process evaluation is reflected in the logic model by the relationships of how the Implementation Plan was executed through formal agreements, protocols, curricula, value-added experiences identified in the institution component of the logic model.

Product (Outcome)

The product evaluation focused on program results, connecting outcomes with the other measurements taken in the earlier areas of evaluation. The product evaluation is identified in the logic model as the process and outcomes evaluation component. BTILLC evaluated how well the EU-US Atlantis DETECT project succeeded. The *outcome indicators* included a review of the Implementation Plan, response to time line, pre-orientation, de-briefing sessions, exchange experience, cultural and global perspective and the revised Partnership Agreements with the institutions (Table 4). The CIPP elements were integrated with Kirkpatrick's Four Levels to evaluate DETECT's impact on student learning.

Approach to Evaluating Program Impact on Student Learning

The Kirkpatrick (1996)[5] model was used to evaluate the program effectiveness over time. This model is based on four levels of evaluation, with each level representing a different measure of the effectiveness of the educational program. The first level of evaluation measures initial reactions to the program, the second level captures the actual learning, the third level reports changes in behavior due to what was learned in the program, and the fourth level looks to detect the term impact as a result of changed behavior. The authors have successfully used this approach on numerous third party program evaluations of company programs, educational projects, and agency impact, and the data collection methods used during this third party evaluation have been used in similar evaluations. Each of the evaluation measures were analyzed based on short-term, intermediate, and longer-term outcomes. The results were used to identify changes that: are logically expected as result of the project's activities; are within the sphere of influence of the project; and are generally accepted as valid by the various stakeholders of the FIPSE Atlantis DETECT Program. Ongoing feedback from the evaluators to the project leaders enabled the project directors to make adjustments to continually improve the project implementation.

Level I – Reactions evaluation measured how participants in the FIPSE Atlantis DETECT Program reacted to it. It attempted to answer questions regarding the participants' perceptions. Did the team members feel they accomplished the FIPSE Atlantis DETECT Program goals and objectives? Were the FIPSE Atlantis DETECT Program goals and objectives meaningful to the students and faculty? How did participants react to their experience?

Level II – Learning evaluation assesses the extent to which participants have advanced their skills, knowledge, or attitude. Methods of evaluation for Level II include both formal and informal evaluations, team assessment, and self-assessment.

Level III – Transfer evaluation assesses the change in behavior that has occurred during the development and implementation processes due to the FIPSE Atlantis DETECT program. What do participants do differently now? How do others see participants' productivity as improved? Did the new learning transfer into new behaviors?

Table 1

Context Measures

Goals and Objectives	Evaluation Question	Data Sources
Advance sustainable full-semester student exchange between the European DETECT project participants and their US counterparts (PU, PSU) and in parallel to advance sustainable full semester student exchange between the US DETECT project participants and their European counterparts (DIT, H-DA).	What is the nature of the formal agreements?	Memorandum of Understanding (MOU) Non-Disclosure Agreement (NDA) Letter of Intent (LOI) Letter of Endorsement Letters of Support Study Abroad Approval Form (Mutual Accreditation) Bilateral Socrates Agreement Diploma Supplement Arrangement of tuition and fees Consortium leadership team Arrangements for credit transfer
	What is the nature of the program?	Number of mobility and non-mobility PU and PSU students exchanged Number of mobility and non-mobility DIT and H-DA students exchanged Number and range of P and S faculty exchanged Number and range of I and G faculty exchanged Number and range of departments participating
Accelerate the development and support of collaborative cross cultural, multi-disciplinary, Engineering and Technology learning environments focused on innovative Engineering, Design and Technology and to mutually recognize the student learning experiences between partner organizations.	What is the nature of the formal agreements?	MOU NDA LOI Letter of Endorsement Letters of Support Study Abroad Approval Form European Credit Transfer System (Mutual Accreditation) Bilateral Socrates Agreement Diploma Supplement Arrangement of tuition and fees Consortium leadership team
	What is the nature of the cross-cultural learning experience?	Number and types of experiences
	What is the nature of the trans-Atlantic learning experience?	Number and types of experiences
	What is the nature of the interdisciplinary, multidisciplinary learning experience?	Number and types of experiences
	What is the nature of the weltanschauung (global perspective) learning experience?	Number and types of experiences

Table 2

Input Measures

Goals and Objectives	Evaluation Question	Data Sources
Advance sustainable full-semester student exchange between the European DETECT project participants and their US counterparts (PU, PSU) and in parallel to advance sustainable full semester student exchange between the US DETECT project participants and their European counterparts (DIT, H-DA).	What are the levels of communication used between participating institutions?	E-mail Web CT Blackboard Adobe Connect Telephone Video-conference Facebook YouTube .mobi RSS Twitter Flickr Etc.
	What was the nature of multinational internships/employment?	Number of students and departments participating Student interview Orientation leader interview Faculty interview
Accelerate the development and support of collaborative cross cultural, multi-disciplinary, Engineering and Technology learning environments focused on innovative Engineering, Design and Technology and to mutually recognize the student learning experiences between partner organizations.	What are the levels of communication used between participating institutions?	E-mail Web CT Blackboard Adobe Connect Telephone Video-conference Facebook YouTube .mobi RSS Twitter Flickr
	What was the nature of the pre-departure orientation?	Student interview Orientation leader interview Faculty interview
	What was the nature of the post debriefing?	Student interview Orientation leader interview Faculty interview

Table 3

Process Measures

Goals and Objectives	Evaluation Question	Data Sources
Advance sustainable full-semester student exchange between the European DETECT project participants and their US counterparts (PU, PSU) and in parallel to advance sustainable full semester student exchange between the US DETECT project participants and the European counterparts (DIT, H-DA).	What methods were deployed to enhance participation?	Method inventory
	What were the measures of collaboration?	Exploratory leadership visits Short-term faculty exchanges Short-term student visits Accredited common student projects at module level Full semester accredited student exchange Benchmarking and sharing best practice Increasing the # of joint papers Innovative joint module development Full semester faculty exchange Joint program development
	What techniques were used to orient faculty and students?	Student interview Orientation leader interview Faculty interview
	What techniques were used to debrief faculty and students?	Student interview Orientation leader interview Faculty interview
Accelerate the development and support of collaborative cross cultural, multi-disciplinary, Engineering and Technology learning environments focused on innovative Engineering, Design and Technology and to mutually recognize the student learning experiences between organizations	What methods were deployed to enhance participation?	Method inventory
	How were cross-cultural learning experiences integrated in the exchange program?	Student interview Orientation leader interview Faculty interview
	How were trans-Atlantic learning experiences integrated in the exchange program?	Student interview Orientation leader interview Faculty interview
	How were interdisciplinary, multidisciplinary learning experiences integrated in the exchange program?	Student interview Orientation leader interview Faculty interview
	How were *weltanschauung* (global perspective learning experiences integrated in the exchange program?	Student interview Orientation leader interview Faculty interview
	How were transatlantic study plans executed?	Student interview Orientation leader interview Faculty interview
	What methods were used to enhance multinational internships/employment?	Student interview Orientation leader interview Faculty interview

Table 4

Product Measures

Goals and Objectives	Evaluation Question	Data Sources
Advance sustainable full-semester student exchange between the European DETECT project participants and their US counterparts (PU, PSU) and in parallel to advance sustainable full semester student exchange between the US DETECT project participants and their European counterparts (DIT, H-DA).	How successful was the exchange program?	Academic achievement (course success/papers/conferences) Multinational Internship/employment Number of students participating per year Number of faculty participating per year Number of departments participating per year Partnerships created Joint faculty research/scholarly activity Enhanced social skills Enhanced *weltanschauung* (global perspective Increased trans-Atlantic learning Increased multi-cultural understanding
Accelerate the development and support of collaborative cross cultural, multi-disciplinary, Engineering and Technology learning environments focused on innovative Engineering, Design and Technology and to mutually recognize the student learning experiences between partner organizations.	How successful was the exchange program?	Academic achievement (course success/papers/conferences) Multinational Internship/employment Number of students participating per year Number of faculty participating per year Number of departments participating per year Partnerships created Joint faculty research/scholarly activity Enhanced social skills Enhanced *weltanschauung* (global perspective Increased trans-Atlantic learning Increased multi-cultural understanding

Level IV – Results evaluation measures the final results that occurred because of process used by the FIPSE Atlantis DETECT leadership team (Kirkpatrick, 1996)5. How is the partnership improved?

To gain further insight as to how and why BTILLC utilizes an integrative approach of Stufflebeam and Kirkpatrick, BTILLC's stock and flow model will be described.

Stock and Flow Model

The stock and flow model is used to convey the relationships and dynamic interactions of components of a system. It is a modeling technique for designing, interpreting, and discussing complex problems and the behavior change of a system. BTILLC used stock and flow modeling to study the relationships and dynamic interactions between Stufflebeam's CIPP and Kirkpatrick's Four Levels models of program evaluation with the program outcomes and instruments used to assess them. This model is presented in Figure 3.

Arrows indicate the direction of the relations. The stock and flow model highlights the efficiency of using one instrument to measure more than one outcome. Faculty interviews, for

example, provided data for examining four of the program outcomes. Note that the Stufflebeam/Kirkpatrick evaluation models are housed in the same block and that the relationship with outcomes is bidirectional, indicating that all levels of evaluation are used to inform the outcomes over the period of the activity. All components of the Stufflebeam and Kirkpatrick models are integrated into all instruments and are designed to discern the degree to which the project outcomes were accomplished. Also, all levels are used to interpret the meaning of the results, which are described in the next section of the paper.

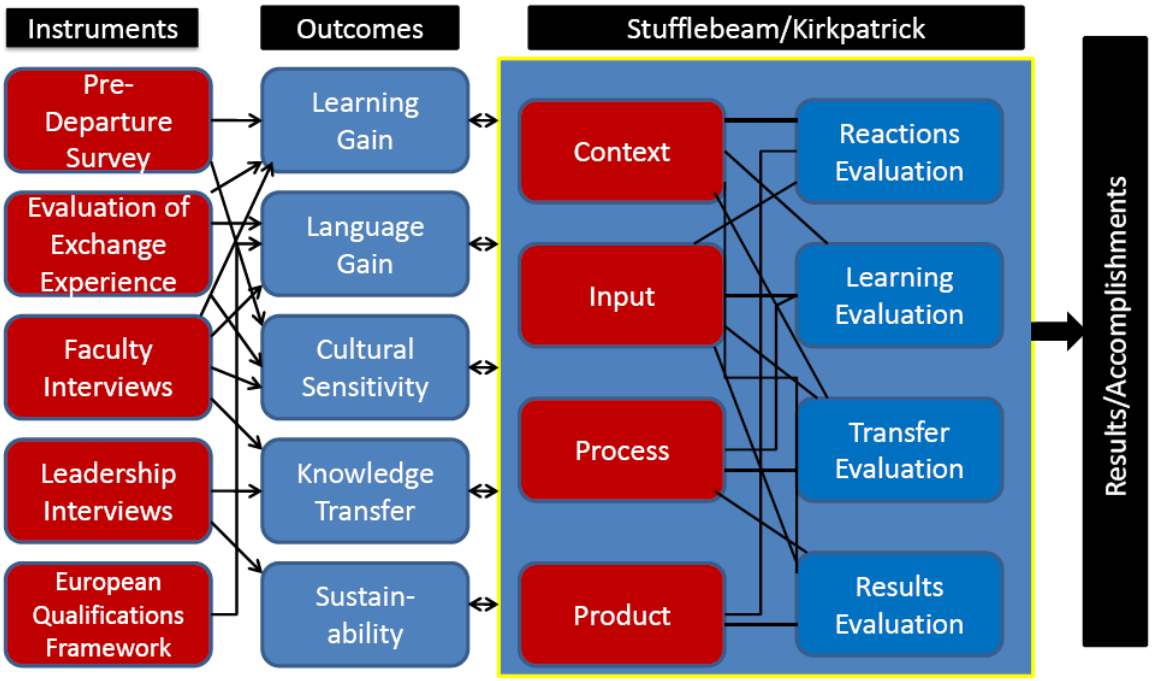

Figure 3. Stock and flow model indicating the relationships between the instruments, outcomes, and evaluation models.

BTILLC's stock and flow model that integrates Stufflebeam and Kirkpatrick is supported by the work of Galloway (2005) and Kaufman and Keller (1994) when they call for not just using Kirkpatrick's model four levels being used alone, adding a return on investment level. The return on investment level addresses sustainability, thus integrated with Stufflebeam's CIPP Model provides a more in-depth data collection process, "closing the loop." Understanding to understanding the degree to which sustainability is reached is crucial to understanding how the program will survive after the funding runs out.

Results

Language Gain

Rudimentary language competency is imperative when studying in a non-native language country. Conversational language fluency is not the same as being able to speak and read technical or scientific content in another language. Some students were fluent in another language, while others were not. Some students studied another language, but indicated that they did not speak it well. Language gain was measured using self-reported data from the student

pre- and post-surveys and supported with scores from the *European Qualifications Framework for Language Learning* test (Council of Europe, 2001)[1]. The *European Qualifications Framework for Language Learning* provides a measure of student language abilities based on their level of fluency. This test is given after students engage in a three week intense language course, followed by a weekly session during their exchange. Interviews with faculty provided further evidence that students gained in language proficiency as a result of the exchange program. There were three aspects of language assessed: (a) comfort reading technical and scientific literature; (b) capability of orally explaining technical and scientific literature required for course work; and (c) capability of writing technical and scientific concepts required for course work.

Half of the DETECT exchange students indicated they were not confident in their ability to read technical and scientific literature in a foreign language. Only one student responded that the student felt very confident in their ability to read technical and scientific literature in a foreign language. Six students indicted that they were comfortable reading technical and scientific literature required for my course work. The other two students reported that they were very comfortable reading technical and scientific literature required for my course work. Six students indicted that they were capable of orally explaining technical and scientific concepts required for my course work. The other two students reported that they were very capable of orally explaining technical and scientific concepts required for my course work. Six students indicted that they were capable of writing technical and scientific concepts required for my course work. The other two students reported that they were very capable of writing technical and scientific concepts required for my course work. All students received passing scores on the *European Qualifications Framework for Language Learning.* The passing scores are based on the degree of progress students make during their term of study.

Cultural Sensitivity and Global Awareness

Student life experiences are crucial to the success of exchange programs. It is important that students live with other international students and are encouraged to experience the cultural and historical sites of the exchange city and country. Students should also be encouraged to become active in campus activities, clubs, and sports. The evaluation included data collection on several indicators of increased cultural competency: (a) expanding knowledge of the geography, economy, history and culture of my hosting city, state, and country; (b) the types and quality of cultural excursions and experiences; (c) level of comfort interacting with students from other countries; (d) expressed appreciation of other cultures; and (e) demonstrated appreciation of global issues, concerns, problems and trends. The student reported pre-departure survey and evaluation of student exchange survey data provided quantitative data on these topics. However, data from the rich qualitative reports from faculty interviews enriched the meaning of the numerical results reported by the students. Faculty were able to provide anecdotal evidence from their personal interactions with students before and after exchange experiences.

Overwhelmingly, the students from the four participating institutions indicated that the best component of their exchange experience was their interaction with students from so many countries. The students and faculty indicated that these interactions began with their host orientation and continued throughout their exchange through various Office of International Program activities, housing arrangements and coursework. The students also indicated that the

hosting faculty was extremely helpful in sharing cultural and global perspectives with them. Faculty reported that students were receptive. With the exception of one student, a sophomore and the youngest student who has participated in the DETECT/Atlantis exchange program, all the students explored their host city and traveled extensively to other cities, states and countries during and/or before or after their exchange. For the most part the students traveled on weekends or university holidays with other students from their home institution, or in the case of PU and PSU students, they sometimes traveled together. Some students traveled with exchange students from other countries they had met during their exchange. Interestingly, the students from DIT and H-DA felt more comfortable using public transportation than the PU and PSU students, a fact directly contributed to their previous experiences with city living in their home communities or their previous travel experiences. The PU and PSU students also indicated that they were initially shocked with the nature of co-educational housing (including coed bathrooms) and the freedom it allows. For example, at H-DA, the students living in residence housing control the housing, while the university controls the housing at PU and PSU. Students being exchanged also experience a different campus environment. At PU and PSU, the DIT and H-DA students experience a campus environment as opposed to the urban environment to which they are accustomed. The converse is true for the PU and PSU students. However, these factors did not take away from their overall experience and appreciation of their exchange.

Content Knowledge Gain

In addition to making gains in language proficiency and cultural competency, students were expected to increase their understanding in the content of the engineering courses. Student responded to items on the *Student Evaluation of Exchange Experience* instrument addressing several aspects that impacted student learning outcomes: (a) interaction with the hosting faculty, including approaching them with questions about coursework; (b) the level of instruction; (c) appropriateness of content; (d) effectiveness of laboratory equipment and experiences; (e) how well the balance of lecture, lab, and class requirements suited learning style; (f) how successful students were in coursework; (g) the content knowledge gained from the coursework; and the grades earned in courses.

Evaluation of this component was enhanced by the rich mixture of qualitative and quantitative data addressing the context and the process of the program. Investigations into the course of study within each program (context) allowed evaluators to consider environmental factors when formulating the survey questions. Then the evaluators designed an interview protocol that could provide further elaboration to construct a more meaningful and informative assessment of the program.

All students, regardless of their institution, experienced a different type of learning environment during their exchange. Higher education structures in the United States and Europe are different. In the United States, students register for classes and are expected to attend those classes. Students are required to attend labs, do homework, write papers, take tests and examinations. In Europe students do not have to register for classes, attend classes or labs. The student's entire grade is based on the final examination.

The PU and PSU students experienced a system at DIT and H-DA where the weight of the grade is determined by the final examination in a course. There are fewer labs, no required

textbooks and a lack of continuous feedback though routine homework and periodic tests; thus a highly independent learning culture. The DIT and H-DA students experienced just the opposite experience in the U.S. - routine homework, required textbooks and labs, periodic tests, and a final exam that was averaged in with other course requirements. The PU and PSU students experienced not being required attend class, while the DIT and H-DA students experienced required class attendance.

Interestingly, the students indicated that the courses were either about the right level or more difficult than at their home institution. The PU and PSU students indicated that not having routine homework and tests, with only a final exam at the end of the course, made them a little uncomfortable. Conversely, the DIT and H-DA students were not used to having homework and periodic tests. All the students indicated that the laboratory experiences were different than at their home institution. Interestingly, the DIT and H-DA students indicated that instruction was more structured than the more independent structure of their home institution. Some students pointed out that the technology and terminology being taught at H-DA was at a much higher level than at their home institution, but not at such a level that they could not manage the content. However, they indicated that the professors were very available and helpful to them with their studies. The students also stated that as the semester evolved they felt more at ease with the way courses were conducted at their host institution. The students indicated that it helped having other exchange students from their home country in their courses. Some of the PU and PSU students indicated that it was somewhat hard fitting in with the hosting institutions students because those students for the most part were studying as a cohort. Regardless of instructional differences or the nature of the courses, the students overall indicated they were satisfied with their academic experience during the exchange and that it did not jeopardize their completion pace at their home institution.

Transfer of Knowledge

The transfer evaluation assesses the change in behavior that has occurred as a result of the exchange experience. These data were be collected by the faculty at the home institutions when students return for the final semesters of their program. Students amply demonstrated their ability to apply what they learned during their exchange in capstone experiences and other final projects. Evaluators and faculty will be analyzing the performance of students who participated in the exchange and comparing those results to those of students who did not. They will be looking especially for competencies related to cultural competencies and language gain.

Administrative Plans for Sustainability

One of the important components of this project was to create a plan to sustain the program. Information from the evaluation describing how the program supports student learning and faculty opportunities for international collaboration can be used to leverage future funds. Success in these areas was achieved, in a large part, as a result of what assessors refer to as closing the loop. As contextual needs were identified and gaps in input or processes were realized, the evaluators shared this information with program directors. The leadership team then addressed these issues and immediate improvements were made. This cycle of continual improvement supports and sustains programs by making them more efficient and by increasing the impact on student learning. Areas in which early feedback from the evaluator served to

improve the program included (a) changes in the ways students are prepared by their home institution for the exchange experience before departure, especially with explanation of what to expect from the hosts; (b) revisions in the ways hosts are oriented to the previous experiences of the exchange students; (c) housing arrangements; (d) greater attention to language competency.

The mixed-methods evaluation model identified areas in which the institutions were doing well and some areas in which further work needed to be done to optimize the benefits of the exchange program. Looking at student survey responses, faculty interviews, and project documents, the evaluator found that some fine-tuning needed to done in (a) course alignment, offerings and credits; (b) the level of involvement of department faculty not in the initial project development team; (c) equity in cost amongst institutions, especially in light of the weakness of the US dollar in the current market; and (d) varying levels of institutional support, including release time for faculty. Overall, the logistics of maintaining meeting records and functionality of correspondence and communications process was found to be satisfactory.

The DETECT partners have established a very strong working relationship that, in the evaluator's opinion will sustain the project beyond the life of the FIPSE funding. The partners are working hard to establish measures that will sustain the DETECT initiative. The institutions recently signed a new MOU to extend this initiative well beyond the life of FIPSE funding. They are working internally to secure additional funding for student stipends and to increase faculty exchange and research, including efforts beyond the original DETECT departments. DIT and PU are working to establish relationships to secure corporate funding with mutual international corporations for the initiative. DIT and PU have established a dual degree masters program that was a direct result of the DETECT project. There continues to be commitment from executive administration at all institutions. All three universities have continued to exchange students beyond the grant funding to the point that is becoming part of each department's curricula. The institutions are looking at other opportunities that will carry the DETECT project to the next level of its evolution.

Based on these results, key conclusion and accomplishments were drawn about the DETECT Mobility Exchange Project.

Conclusion

The EU-US Atlantis DETECT program has been very successful. Their key successes are listed as accomplishments by each objective in Table 5. Using a mixed methods model for program evaluation provided a robust technique to assess the quality of program improvement and effectiveness. It integrated both qualitative and quantitative measures to evaluate the degree to which a program met its established goals and objectives. Integrating Stufflebeam's CIPP Model with Kirkpatrick's Four Levels program evaluation models allowed the independent evaluators to comprehensively examine the program's efficiency and results in light of their proposed goals and objectives.

Table 5.

Project Accomplishments

Objective	Accomplishment
To support and increase the number of sustainable transatlantic "department" and "school" partnerships across the participating institutions by jointly developing, implementing and sustaining full semester student exchange programs between their respective organizations.	Improved the student selection process Improved the post-departure and host orientations Improved the curriculum alignment between institutions Got more involvement from the International Program Office Conducted routine planning meetings Increased the number of visits between participating institutions Overwhelming support and participation from institutional administrators, including visits to partner institutions by executive administrators Overwhelming financial support outside of grant funding from all partners Signed new MOU to extend the initiative Started establishing relationships to securing corporate sponsorships with mutual international companies Increased faculty mobility
To formally mutually accredit learning in partner organizations.	DIT and PU established a dual degree masters program Joint faculty exchanges and sabbaticals Established research projects outside of DETECT Project that were triggered by DETECT
To develop the proficiency of students to operate effectively in transatlantic Engineering, Design and Technology exchange environments.	Student and faculty interviews support this objective Numerous student and faculty exchanges amongst participating institutions that were outside the formal exchange of this project Encouraged students to become involved in sports and clubs to enhance their cultural experience
To undertake Faculty exchange aimed at increasing the number of "department" and "school" partnerships who jointly collaborate on the development of sustainable common innovative Engineering, Design and Technology projects undertaken in cross-cultural, collaborative, multi-disciplinary learning environments by student teams from more than one participating organization.	Each participating institution has exchanged faculty either within or outside the bounds of this project Key administrators have also visited each institution Each institution is working with faculty in other departments within their respective institutions to explain the EU-US Atlantis DETECT initiative to get them involved in the project More faculty were involved with visitations to partner institutions which facilitated joint presentations, lectures and research
To share, adopt and disseminate amongst the partners and the wider Educational and Engineering Technology community the sustainable innovative management, learning, teaching and assessment best practices associated with the delivery of the project's strategic goals at the module (course), program and organization level.	The EU-US Atlantis DETECT team also presented a paper describing student perspectives to the American Society of Engineering Education in Austin in July 2009 Several cross-institution research initiatives have been or are being developed as a result of visits to partner institutions Joint faculty lectures Working on several papers to be disseminated in appropriate research and practitioner journals

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