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Towards a Center for Modeling and Simulation: The Case for Jordan

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Abstract. Modeling and Simulation (M&S) has recently become an important area that is pursued by many researchers and practitioners due to the role it plays in understanding complex systems and problems. We have therefore witnessed the establishment of many M&S organizations in the last two decades especially in the more developed world. Less developed countries are starting to recognize the need for such capability especially that the problems they face are not less complex. In this paper, we present a preliminary study towards a business plan for establishing a scientific center for Modeling, Analysis, Simulation and Animation in Jordan (JoSAMA) and the value it can bring to the academic, industrial and governmental communities in Jordan and potentially in the Middle East. This effort was funded by the Fulbright Specialist Program and hosted by the German-Jordanian University, Amman, Jordan.

1 Introduction

It should be clear to everyone by now that information is among the most valuable and critical drivers for decision making and training. In fact, Information Technology (IT) in general has become almost an integral part of life in most of the world. Modeling and Simulation (M&S) is a field that has advanced significantly with the advancement in IT and has shown to be very useful in many applications especially the field of decision-making for complex systems. The Blue Ribbon Panel on Simulation-Based Engineering Science reported that “in the past decade, computer simulation has emerged as a powerful tool; one that promises to revolutionize the way engineering and science are conducted in the twenty-first century” [1].

Computer modeling can be defined as representing real existing (or future) systems or processes using computer software and hardware to develop better and deeper understanding of the behavior of these systems. *Simulation modeling* has become one of the most popular modeling paradigms as it can handle very complex and dynamic systems without making many crude assumptions [2]. Nonetheless, there are other modeling approaches including mathematical, analytical, graphical, and animated methods that may be deemed appropriate or necessary for certain applications at a certain level of fidelity. Such modeling approaches can also fall under the umbrella of *modeling* as they could be integrated into complex (simulation) models.

Experimenting with real systems could be costly, dangerous, and/or time consuming. Modeling systems can therefore become a much less costly alternative compared to the potential consequences of making suboptimal or wrong decisions directly on the real system. Computer simulation emerges as a powerful modeling tool as it mimics the behavior of the real system to enable the users experiment with the

simulated system before experimenting with the real one. The most common and important benefits of simulation include [3]:

- One of the best ways to study complex, dynamic, and stochastic systems
- One can easily run “what-if” analysis
- Does not disturb the real system
- Cheaper than experimenting with the real system
- Time is compressed
- No need for crude assumptions
- Animation gives us insight into what is happening
- Training using computer simulation, animation and Virtual Reality has proved to be very cost effective compared to training on real systems

The return on the investment of modeling a problem or a system may be quite significant given the potential consequences in real life. Over the last a few decades, we have witnessed numerous areas of civilian and military applications for M&S such as Manufacturing Systems and Processes, Logistics and Distribution, Emergency-Response System and Crisis Management, Homeland Security, Computer and Communication Networks, Transportation, Healthcare and Hospital facilities, Space Applications, and Queuing Systems (e.g., Banks, restaurants, parks, supermarkets, stadiums, etc).

The importance of the field is not in question here as it is clear that the area is growing rapidly especially in developed countries. What we argue in this paper is that in developing countries and regions such as the Middle East, the need for such a scientific engineering approach and the capabilities to support this approach both exist but they need to be organized into a viable and sustainable business model like the one proposed here in order to benefit the academic and industrial communities in these regions.

2 Vision and Objectives of the Study

The objective of this paper is to conduct a preliminary study towards a business plan for establishing a scientific center in **Jordan** for **Modeling, Analysis Simulation, Animation, and Visualization (JoSAMA)**. In this paper, we propose an organizational structure for this center and the value it can bring to the academic, industrial and governmental communities in Jordan and the Middle East.

The proposed vision is for JoSAMA to be a center of excellence for Modeling, Simulation, Analysis, Animation and Visualization at both the national (Jordan) and regional (Middle East) levels. The center can potentially be an icon for (i) Modeling complex systems in different areas of applications (ii) Research and development in M&S by bridging the gap between academia and industry (iii) Training to support various industries, and (iv) Creating job opportunities.

3 Why Jordan?

M&S research and consulting communities in developed countries such as those in the U.S., Europe, and Australia have recognized the importance of this field in the last two to three decades and have done significant amount of development in terms of research, software, theory, and the necessary hardware to support M&S needs. This can be easily seen by inspecting the number of books, technical journals, software packages, conferences, consultants, and research centers around the world that arose in the past two decades. To focus on centers similar to some extent to the one proposed here, Appendix A includes a list of existing centers that conduct research, development and consulting in the area of Modeling, Simulation, Analysis and Visualization. In Jordan, and the Middle East, there does not exist a center or an organization that can capture the advancements and momentum in this field to generate products and tools that can benefit the academic and industrial community although the regional demand for such products

exists. At this point, M&S knowledge, technology and research are being transferred and shared around the world, and Jordan has all the criteria to host a successful center in M&S for the following reasons:

1. Jordan has a strategic location in the Middle East to serve the region's needs in M&S. Since the products that will be produced by this center are software, reports, and information that can be electronically transmitted easily over the Internet to any location in the region and worldwide, the physical location may not be of a significant importance. However, being geographically close to clients is very important to maintain good client relations, face-to-face meetings when necessary, conducting demonstrations, and hosting and attending relevant events. Furthermore, neighboring countries that may need the technical expertise of the center (e.g., Saudi Arabia, United Arab Emirates, Qatar, and Iraq) add tremendous value to the business relations. Businesses in Jordan, especially in the IT sector, have been performing great work for neighboring countries like those mentioned earlier.
2. Human capital and talent are arguably the country's most important resource, as it does not enjoy as much of other natural resources. Jordan ranks at 91% literacy rate according to [4] and people in Jordan are highly educated in Engineering, Sciences, and other technical domains. There are currently 30 public and private universities in Jordan, a strong indication of people's awareness of the importance of higher education especially in technical fields given that the population of Jordan is estimated to be a little six million. Among these universities is the German Jordanian University (GJU), the university host of this effort, has strong ties to the industry and universities in Jordan, the Middle East, Europe and the U.S. Appendix B includes a list of universities that offer technical degrees and programs that can support the fields of Modeling, Simulation, Analysis, Animation, and Visualization. Almost all technical departments and programs in these universities teach in English, which makes their interaction and communication with the center and future clients and supporters much easier. Several universities in Appendix B are the result of partnership with leading universities in the U.S.A. and Europe.
3. Jordan is a modern and moderate country that enjoys excellent relations with states and countries in the U.S. and Europe, which can support advancing the M&S field in the Middle East through various funding programs. There are currently several international funding programs that Jordan can benefit from in establishing a M&S center and advancing the field in Jordan. Jordan also enjoys friendly business relations with countries in the Middle East and many of its expatriates work in these countries.
4. Jordan is also considered an attractive educational destination for students from the neighboring countries. Promoting a field like M&S and establishing a research center that will be affiliated with multiple universities will help the universities attract foreign students.
5. The top leadership in Jordan is keen on promoting the human capital and investing in higher education as it is the most precious resource the country has. For a relatively young field like M&S, the potential to attract interest, funding, and investors from the region will create more jobs in a specialized and technically advanced field.

4 Current State of Modeling and Simulation (M&S) in Jordan

The field of M&S is generally young worldwide including the Middle East and Jordan. However, since higher education in Jordan has been a focal point for Jordanians, the country now has many core pillars upon which fields like Modeling, Simulation, Analysis, Animation and Visualization can be founded in a much easier and quicker fashion than other countries in the region. There are currently 30 public and private universities in Jordan (see Appendix B for a complete list), the majority of which offer technical bachelor and masters programs such as Engineering, Computer Science, and Information Technology (IT). Most Engineering colleges that offer Industrial Engineering and Engineering Management teach simulation

modeling and analysis, stochastic processes and statistical analysis for their senior students. Also some Computer Engineering and Computer Science Departments teach simulation-related courses such as Computer Modeling, Computer Graphics, Animation and Parallel Computing.

Jordanian universities, however, do not have academic programs in M&S; however, the technical courses they currently offer can be a very good starting point in establishing the discipline and supporting the center. Establishing a M&S center in Jordan will help generate momentum for this important field to help the country model and solve complex problems in various areas of applications for itself and the region.

On the industrial consulting front, there are many large and small companies that conduct various types of studies. However, it was not easy to survey which companies are involved in M&S projects. By reviewing the various technical academic programs in higher education institutions, it seems that the academic side can quickly adapt to support the field. On the industrial side, the main challenge is the lack of awareness of M&S importance and the value it can add to their businesses. After meeting with several key personnel at universities and industries, it became clear that the first step to successfully develop the field through this center is to start with a M&S awareness campaign for the industrial and academic communities. It is worthwhile noting that in the past two decades there has been some sporadic M&S activities in Jordan and the Middle East in the form of conferences such as:

- The First Middle East Workshop on Simulation and Modelling, 1999 at the University of Jordan, Amman, Jordan
- The International Middle Eastern Simulation Multiconference, 2008, at Philadelphia University, Amman, Jordan
- International Middle Eastern Simulation Multiconference, 2009, at Lebanese American University, Beirut, Lebanon
- The International Middle Eastern Simulation Multiconference, 2010, Alexandria, Egypt
- International Conference on Modeling, Simulation, and Applied Optimization, 2005, 2007 and 2009 in the United Arab Emirates

5 Short, Mid, and Long-term Objectives

The center must have clear objectives to achieve over its first 7 years and performance measures based on these objectives to track its success. In this section, we define these objectives keeping in mind that such objectives can be modified and refined by the Center Director and Advisory Board upon establishing the center and its bylaws. It is assumed that a Center Director with the appropriate academic background and industrial experience is selected early on to lead the effort and achieve the center's goals and objectives. It is also assumed that sufficient startup fund will be available for the center to have a reasonable level of resources to operate (e.g., space, equipment, personnel, etc). The amount of funds and its potential sources will have to be defined in a formal business plan that can be developed as a next step to this effort.

Short Term Objectives (1 – 2 years)

1. Equip the center with the necessary office and lab space, computer hardware and software necessary to achieve the center's short and mid term objectives.
2. Employ a full time Chief Scientist, a technical M&S simulation developer and an administrative assistant to perform the objectives listed above.
3. Conduct a M&S awareness campaign including developing a web site for the center. The campaign should be executed on two fronts: on the industrial front– the center will promote the field for potential clients, and at the academic front – the center will make the faculty and students

of various universities aware of the effort and encouragement to participate in supporting the center.

4. Run M&S short courses and workshops for various industrial sectors to spread awareness and generate revenue for the center.
5. Secure small and medium size funded project through various sources to demonstrate capabilities and generate more revenue.
6. Recruit at least 12 charter members and 12 corporate members
7. Assemble the Advisory Board members according to the structure proposed later in this paper.
8. Conduct industrial survey to collect information regarding to what extent the M&S tools are used by the industry and what potential areas of application are.

Mid Term Objectives (2 –3 years)

1. Secure major funding for R&D, Training, and Consulting divisions through marketing and competing for major agencies and companies. Acquire more hardware and software to support the projects and center as necessary.
2. Hire more technical staff as needed (Engineers, Simulation Analysts, Computer scientists, IT specialists, etc) to perform project work. The hiring should be consistent with the organizational structure discussed later.
3. Hold semi-annual M&S workshops for a small fee to strengthen the name of the center and establish industry confidence.
4. Participate in academic and industrial local and regional conferences and exhibits and present the work that has been developed at the center so far. Participate if possible in international conferences to keep the staff update with the latest technologies and research.
5. Conduct annual workshops to present successful projects and potential future applications.

Long Term Objectives (5 – 7 years)

1. The recognition of JoSAMA as a premier center of Excellence for Modeling, Simulation, Analysis, Animation and Visualization in Jordan and the Middle East.
2. Establishing a warehouse of M&S products that resulted from previous projects and which can be reusable in future projects.
3. Continuous self-sustaining growth by winning more local and regional consulting and research contracts from local and regional private industries, and governments.
4. Advancing academic research by partnering with different universities to recruit more skilled personnel and remain on the cutting edge of technology. This objective will be further supported by holding international conferences and workshops in coordination with local and international universities.
5. Develop new academic programs (B.S., M.S. and certifications) in partnership with various universities.
6. Stimulate technology-based economic development in Jordan and the region, which should lead to more job opportunities for Jordanians

6 A Proposed Organizational Structure of the Center

The proposed organizational structure in Figure 1 is based on the authors' research and experience with other similar centers in the U.S.A. The center's organizational units and functions are discussed next.

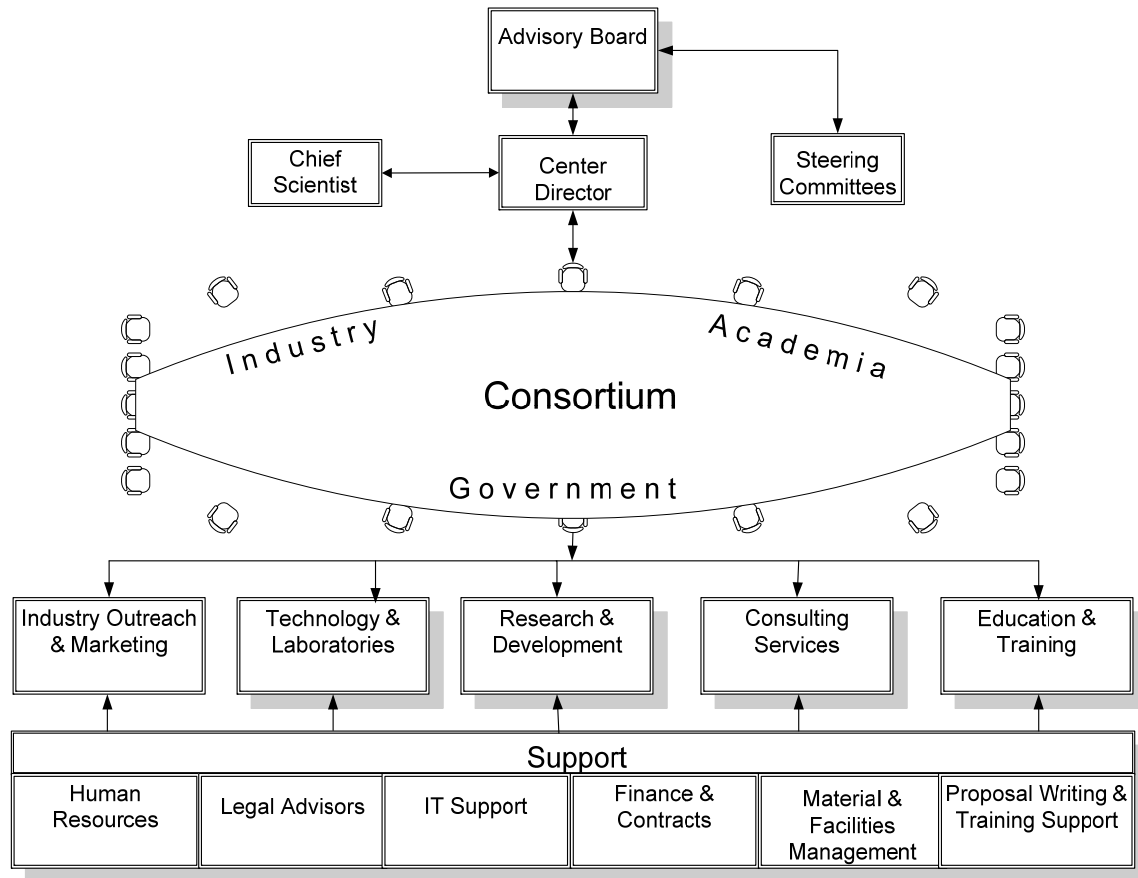


Fig. 1. Organizational Structure of the Proposed Center

Advisory Board

The main purpose of the Advisory Board is to advise the Center Director on various issues including actions and directions that the center should take to accomplish its objectives. The Advisory Board consists of 9 to 12 members, one of which is assigned by the Center Director to be the Board's Chairman. The Board shall be made up of members from large, medium, and small companies depending on their revenue and number of employees. At the discretion of the Center Director, the Board may be augmented by 3 to 6 At-Large members who are invited to participate in Board meetings and activities for a certain period (e.g., one-year) and may serve for consecutive terms. A nomination and an election process by the board members and Center Director will be followed to assign new members and fill any vacancies. The initial Advisory Board can be assigned by the Center Director and a committee of stakeholders.

Steering Committees

JoSAMA can charter committees made up of individuals who are interested in certain aspects of modeling, simulation, analysis, animation and/or visualization. They should also have the necessary expertise to perform tasks assigned to them by the Director and Board, or they may undertake on their own. At least one of the members (preferably the committee chair) needs to be from the Advisory Board. The rest of the members can be from JoSAMA experts mixed with volunteers from outside the center. Committees serve important roles including (a) representing the views and opinions of their respective communities of interest to the Board and (b) using their influence to promote the implementation of resolutions. Using outside committee members is especially important as they can promote outreach and spread awareness about the field and the center.

Academic Partners

Technical universities will play a very important role in the proposed center as they will be the source of human knowledge and skill in the field. Very few universities around the world have academic programs that award full academic degrees in M&S. Old Dominion University is one of the few to offer B.S., M.S., Ph.D. and DEng (Doctor of Engineering) in M&S (<http://eng.odu.edu/msgp/>) as well as in various Engineering disciplines with M&S focus. While, the universities in Jordan currently do not offer such degrees, they collectively can offer courses that can become a strong foundation for M&S knowledge-base infrastructure for the center. If the center proved to be successful, it may in turn promote academic programs and degrees for the universities to sponsor in the future.

While the center has to have full time researchers and developers, the majority of the Ph.D. level personnel are going to be recruited from Jordanian universities as part time affiliates where they perform projects and supervise students and researcher at the center. This way, the university faculty can use the center's capacity (name and resources) to pursue projects and conduct more research in collaboration with the center. The incentive for the faculty members to do so will be to advance their research and interface with the industry to apply their knowledge, research and expertise to real-life problems in addition to receiving financial compensation for their work. The center's incentives, on the other hand, include having a sustainable source of knowledge and research, create more products based on the project work performed, and increasing its revenue for future growth and cover its cost. Moreover, the more projects are performed with university professors and researchers, the stronger the academic relationship will be.

In summary, there are mutual benefits for both the universities and the center to collaborate and succeed. This proposed approach to support the center with knowledgeable Ph.D. level professors and researchers has been implemented at almost similar centers including VMASC at ODU, which has been very successful at attracting grants and contracts for both the faculty members and the center. The academic members at VMASC are not limited to ODU where other universities and colleges participate and collaborate with VMASC. The same should be the case for JoSAMA where the partnership should not be limited to one university only.

The proposed center needs to act as a connecting point between academic institutions, government, and the private sector. Not only would all parties benefit from grants and contracts, but they would also enrich the research and knowledge in the field by having the academic institutions participate in offering degree programs and certificates in M&S to support the center's mission and increase their student credit hours. The list of universities that can teach courses and support the center's mission along with some of the relevant programs and courses are listed in Appendix B.

Member Consortium

The Consortium must include members from the Private Industry, Government and Academia. While academic institutions will play a significant role as partners to support the center, they can become consortium members like other members. Organizations from different sectors can become members for a fee that can be decided by the center's bylaws. There should be membership classes (e.g., Gold, Silver, Regular, academic and In-kind memberships) depending on the level of involvement and benefits that a member organization wishes to have. The exact roles and benefits of the members can be specified in center's bylaws; however, in general the members should have an influence on the work areas and applications and should also have access to some of the resources and expertise available at the center. The members will also provide access to the industry and government to help them compete for project work. Their feedback to the Advisory Board via the center director will be an important feedback loop that will help the center remain relevant.

Center Divisions

The center can consist from the following divisions, which are suggested based on the authors' research and experience with other similar centers:

1. Industry Outreach and Marketing
2. Technology and Laboratories
3. Research and Development

4. Consulting Services
5. Education and Training

The previous divisions with the appropriate personnel to run them should cover the project activities and objectives to be achieved by the center.

Support Functions

For the center to function effectively and progress towards achieving its objectives, it needs the following functional areas to support the different divisions and management team:

1. Human Resources
2. Legal Advisors
3. Information Technology Support
4. Finance and Contracts
5. Material and Facilities Management
6. Proposal Writing and Training Support

Conclusions and Future Work

In this paper, we presented a preliminary work on the need to establish a center for Modeling, Simulation, Analysis, Animation and Visualization in Jordan. Such a center can play an important academic and industrial role in the Middle East in a technical field that has witnessed significant momentum in the last two decades. The necessary human talent, geographic location, and demographic makeup, as well as its relations with developed countries, makes Jordan a very attractive for locating such a center. More work is still needed to make the business case however. The next step is to develop a business plan that can be presented to different stakeholder including government, local and international funding agencies, universities, and industries. The plan needs to show that the proposed center is viable and sustainable on the long run. Once finalized, the business plan in conjunction with proposals for funding should next be used to raise enough capital to start the center. The implementation plan can be executed over multiple phases that are consistent with the short, mid, and long-term objectives and timeline as discussed in the paper.

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Appendix A: List of Selected Modeling, Simulation, Analysis and Visualization Centers

1. Virginia Modeling, Analysis and Simulation Center (VMASC)

Old Dominion University, Norfolk, Virginia, U.S.A
<http://www.vmasc.odu.edu/>

Mission:

- Engage in collaborative research and development in Modeling and Simulation (M&S) and in Visualization
- Develop the M&S workforce through education
- Provide M&S technical expertise to government and industry
- Stimulate technology-related economic development in Hampton Roads and the Commonwealth of Virginia

2. Institute for Simulation & Training

the University of Central Florida, Orlando, Florida, U.S.A
<http://www.ist.ucf.edu/>

Mission: Advance the state of the art and science of modeling and simulation by

- performing basic and applied simulation research
- supporting education in modeling and simulation and related fields
- serving public and private simulation communities

3. Institute for Advanced Simulation (IAS)

Jülich, Germany
http://www.fz-juelich.de/portal/about_us/institutes_facilities/institutes/ias

The Institute for Advanced Simulation unites Simulation Sciences and supercomputing under one roof. Thus, disciplinary, methodic and technological competences can be combined to manage the future challenges in the Simulation Sciences. It is considered one of the largest research centers in Europe.

4. Center for Advanced Studies, Research and Development (CRS4)

Sardinia, Italy
<http://www.crs4.it/index.html>

CRS4 carries out applied research across a range of scientific and technological areas. Areas of expertise encompass large-scale computational problems requiring advanced simulation techniques supported by High Performance Computing, along with the timely integration of newly emerging Information and Communications Technology. It focuses on problems stemming from natural, social and industrial environments. The center co-operates with Industry, the Academic world and European Scientific Laboratories.

5. International Research Institute for Simulation, Motion and Navigation (SIMONA)

Delft University of Technology, Delft, Netherlands
<http://www.simona.tudelft.nl/>

The objectives of SIMONA include:

- Development of an international research institute in the field of simulation with an advanced flight-simulator and research facilities.
- Research in aspects of safe and economical transport.
- Combining and applying new methods and technologies for simulation and transport.
- Participate in national and international research projects.
- Accomplish collaboration between national and international universities, research institutes and industry.

6. McLeod Institute of Simulation Sciences

California State University, Chico, California, U.S.A.

<http://www.ecst.csuchico.edu/~mcleod/overview.html>

The original goal was to create a self-supporting, ongoing Institute supported in a variety of ways (funds, equipment, visiting personnel) by industry and state and federal contributions. Faculty and student efforts are supported by grants and contracts supporting research and training projects. The intent is to involve as many faculty and students as can be reasonably accommodated based on the space, equipment, and funds available. Activities of the Institute include: Applications of the High level Architecture (HLA), Intelligent software environments for simulation, Programming languages for simulation, Techniques for evaluating the performance of computer simulation systems, High-speed real-time simulation systems and the development of software for engineering education.

7. Modeling, Virtual Environments, and Simulation Institute (MOVES)

Naval Postgraduate School, Monterey, California, U.S.A.

<http://www.movesinstitute.org/>

MOVES mission is to enhance the operational effectiveness of the joint forces and their allies by providing superior training and analysis products, education, and exemplary research in the field of modeling and simulation.

8. Center for Modeling, Simulation, and Analysis (CMSA)

University of Alabama, Huntsville, Alabama, U.S.A

<http://cmsa.uah.edu>

CMSA's work centers on modeling and simulation and systems engineering. CMSA has broad capabilities in both of those disciplines, with special expertise in these areas: Physics-based modeling, Model validation methodologies, Spacecraft propulsion modeling, Simulation interoperability and composability, Discrete event simulation, Mathematical modeling and analysis, Finite element modeling and computational fluid dynamics, Modeling and simulation education, System-level modeling for design analysis and trade studies, Using modeling and simulation in the systems engineering process, Systems engineering methods, and Technical team performance.

9. The Center for Simulation and Modeling (SAM)

University of Pittsburgh, Pittsburgh, Pennsylvania, U.S.A.
<http://www.sam.pitt.edu/>

SAM is dedicated to supporting and facilitating computational-based research across campus. Faculty across the University are using modeling and simulation to further their research. SAM serves as a catalyst for multidisciplinary collaborations among professors, sponsors modeling-focused seminars, teaches graduate-level modeling courses, and provides individual consultation in modeling to all researchers at the University.

Faculty and staff using simulation and modeling at the University come from a wide range of disciplines, including astronomy, biology, chemistry, economics, engineering, health, and medicine. Areas of research include: energy and sustainability, nanoscience and materials engineering, medicine and biology, and economics and the social sciences.

Appendix B: A List of Jordanian Universities that Can Support the Proposed Center

University Name	Relevant Departments	Courses (Course Number)
Ajloun National Private University	New and has the potential to add programs/courses that support M&S	None
Al al-Bayt University	Computer Information Systems	Modeling and Simulation for business (902352)
Al-Ahliyya Amman University	Computer Engineering	Modeling & Simulation (82589)
Al-Hussein Bin Talal University	Computer Engineering	
Al-Isra Private University	Computer Engineering	Simulation & Modeling (404542)
Al-Zaytoonah University of Jordan	Computer Science	Computer Simulation (0102441)
Amman Arab University	College of Computer Science and Informatics	Information is not available
Applied Science Private University	Industrial Engineering	Simulation (803482)
Arab Academy for Banking & Financial Sciences	No programs to support M&S	No courses to support M&S
Arab Open University	IT Department	Various IT Courses
Balqa Applied University	Master Degree in Computer Science	Simulation Methods (501001788)
	Communication & Electronics Engineering	Simulation & Modeling (404542)
Columbia University Global Center: Amman	New and has the potential to add programs/courses relevant to M&S	Currently None
DePaul University in Amman, Jordan	School of Computing	CSC 332 Simulation and Modeling and many other supporting courses
German-Jordanian University	Industrial and Management Systems	Simulation (IE 532)
Hashemite University	Computer Engineering	Modeling & Simulation (408360)
Irbid National University	No information is available about programs	No information is available about courses
Jadara University for Graduate Studies	Computer Science and Information Technology	Modeling and Simulation (501351)
Jerash Private University	College of Engineering	No information is available about programs/courses
Jordan Academy of Music	No relevant programs to M&S	No relevant courses to M&S
Jordan University of Science and Technology	Engineering: Industrial Engineering, Electrical Engineering and several others	Simulation (IE 512), Industrial Simulation (IE751), Modeling and Simulation of Nuclear Reactors (NE472), Modeling, Simulation and Analysis of Physical Systems (ME503)
	Computer and Information Technology: Computer Engineering, Computer Information Systems, Computer Science, Software Engineering	SIMULATION AND MODELING (CPE412), Modeling and Simulation of Business Cases (CIS385)
Mutah University	Industrial Systems Engineering, Computer Engineering, Engineering Management Program, Dept of Information Technology	No information is available about courses
New York Institute of Technology, Jordan	School of Engineering & Computer Sciences with several department s	Systems Simulation (IENG 425), other supporting courses

	including Engineering Management	
Philadelphia University	Computer Engineering	Modeling & Simulation (630573)
		Virtual Reality Systems (630582)
	Mechatronics	Modeling and Simulation (640645)
Princess Sumaya University for Technology	Computer Science	
	Computer graphics and animation	
	Computer Engineering	
	Communication Engineering	Simulation Tools (5244)
Red Sea Institute of Cinematic Arts	Many related programs and courses	Many related programs and courses
Tafila Technical University	Computer Engineering	Modeling and Simulation (0107552)
University of Jordan	Computer Science	Modelling and Simulation (1901352)
	Business Information Systems	Computer Simulation in Business (1903442)
	Industrial Engineering	Simulation, Advanced Simulation, Systems Simulation
University of Petra	Computer Science	
	Computer Information Systems	
	Programming Engineering	
	Computer Information Systems	Computer Simulation (0102441)
	Management Information Systems	Modeling & Simulation (303016337)
	Computer Engineering	Modeling & Simulation (302007547)
	Programming Engineering	Discrete Systems Simulation (301002481)
	Computer Engineering	Simulation and Modeling (CPE412)
		Simulation and Modeling LAB (CPE 412A)
	Computer Science	Simulation and Modeling (CS487)
Yarmouk University	Industrial Automotive Engineering	System modeling and identification (CE 623)
	Industrial Engineering	Simulation (403413)
Zarqa Private University	Computer Information Systems	Simulation by Computer (0306382)
	Programming Engineering	
	Computer Science	