

Information Assurance: Education at Doctoral Level— *An International Look*

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ABSTRACT

Information is the driving force for the society and development of different kind. Due to the importance of information different organizations, institutions are giving priorities for information affairs. The field of Information is called Information Science. There are few various close disciplines of information viz. Information Studies, Information Management, Information Studies. The emergence and need of Information lead to different subfields and categories of Information Science. Information Privacy and Security is an important concept these days and as a result, this has also become a field of study. Information Assurance is an advanced interdisciplinary field responsible for secure information security and privacy management. Information Assurance in short known as IA. Information Assurance is the extension of Information Security. The field Information Security deals with both computational and manual information security related management. Though, Information Assurance is additionally responsible for dealing legal, managerial and social issues related to Information Privacy and Security. Due to the application and requirement of the Information Assurance, many universities around of the world have started the academic program on Information Assurance not only at Bachelors level but also at Masters and Doctoral level. Universities those who are offering Information Assurance Doctoral program comes with both only research approach and both research-skill (coursework) approach. This paper is a theoretical one but focused on case study related to the PhD and other doctoral degrees in Information Assurance and allied program in International Universities.

Keywords: Information Assurance, IT Management, Privacy and Security Management, PhD-Information Science, PhD Information Assurance, Academic Degrees

Information assurance is a field, study and process of information privacy including security management having manual and computation technology. The field Information Assurance is basically supported by various processes as Information Assurance responsible for the right information and content to the

right people and at right time; so risk management, trust management etc are important issues in this context. In Information Assurance, policy and process are very important and here information may be authentic. The field is closely related with information security so the areas of web, database and network security also fall under the areas of Information Assurance as a whole^{[1],[5],[7]}. So, Information Assurance is responsible for various affairs leading to sophisticated information privacy and security. Due to the need of Information Assurance universities have offered programs in the field majorly MS/MSc degrees; though few have started BSc and Doctoral degrees as well. The degrees and field of Information Assurance are offered as core courses and may be noticed in the doctoral program of Information Assurance in leading international universities.

Objective and Agenda

The current paper is theoretical one and mainly deals with the knowledge gathering in the field of Information Assurance leading to following (but not limited to)—

- ❖ To know about the basics of Information Assurance including its foundation and stakeholders.
- ❖ To learn about the features and characteristics of Information Assurance in brief in the academic context.
- ❖ To know about the Information Assurance related programs available in International universities.
- ❖ To find out the common Information related study with reference to PhD and Doctoral program in Information Assurance and allied field.
- ❖ To find out and analyze the course content and curricula of Information Assurance programs.
- ❖ To learn about the skill and knowledge components of Information Assurance doctoral degree programs.

Information Assurance: Overview

In respect of IT and Computing, Information Security is a valuable name. Securities viz. IT security, Network security, Database security, Web security including Mobile and Cloud Security are fall under the category of Information Security. Information Assurance is another broader area responsible for the managing and assuring kind of contents viz. information, data, and knowledge in different forms. Both the technological and policy solution to information and similar contents security are fall under the area of Information Assurance^{[2],[3],[11]}. Information Assurance as a field of study also emerging internationally, various universities started short term program to long term program on Information Assurance and allied field. Among the managerial areas few important topics are—

- ❖ Foundations of Digital Systems Security
- ❖ Enterprise Security Architecture
- ❖ Enterprise Tools, Concepts and Processes
- ❖ Governance, Quality, Compliance and Ethics
- ❖ Security Management^{[4],[6],[12]}.

However, apart from this few important are include but not limited to the following—

- ❖ *Managing Information in Organizations*
- ❖ *Technology in Organizations*
- ❖ *Information and Society*
- ❖ *Information Organization*
- ❖ *Information and Computing*
- ❖ *Information Policy etc.*

Information Assurance: Characteristics that led to the Development of PhD Information Assurance Programs Worldwide

Information Assurance as a broad and interdisciplinary field of study emerged rapidly and deals with both technological and manual solution in respect of security and privacy. Information Assurance is the need of the hour of each and every organization and institutions^{[8],[10],[13]}. Thus, many universities have started program on Information Assurance leading to Certificate, Diploma, PG Diploma, Masters, Doctoral programs. The following are the example of Information Assurance features and characteristics which help us a lot to learn about the reason for its introduction in academics.

- ❖ Information Assurance is responsible for technological security and manual security both; but additionally, it deals with managerial solutions, policy and guidelines etc.
- ❖ Various security related affairs viz. homeland security includes the cyber terrorism, cyber war etc can get help from Information Assurance and allied field of study.
- ❖ Information Assurance helps in mobile security and related means with technological and manual way.
- ❖ As Information Security deals with all the component of IT Security viz. network's privacy, security, database and its security; so Information Assurance also talks about the managerial and legal affairs of these security components.
- ❖ Information Assurance is responsible for the affairs leading to design, development and implementation and advancement of secure database and information management for sophisticated Information Assurance practice.
- ❖ Cloud security which include trust management and as whole infrastructure management are the core of Information Assurance^{[9],[12],[16]}.
- ❖ Strategies related to the risk management of information and technologies are also the core affairs leading to Information Assurance practice.
- ❖ Malicious attack is an important issue in Information Assurance and thus the prevention and hacking related affairs become important in Information Security solutions.
- ❖ Fraud management systems such as IT Security dependable system development and management are the core of healthy Information Assurance practice.

Hence, Information Assurance is the need of the hour in the organizations, institutions of different kind whether profit making, non-profit making. Initially, only private institutions were interested in Information Assurance but gradually other Government institutions and organizations are also led to its necessity in the organizations.

Information Assurance and Similar Educational Programs

Due to the broader (combines with both technological and manual information security affairs) and interdisciplinary approach and concern of Information Assurance, the following nomenclature are also popular for the field viz.—

- ❖ Information Assurance and Security
- ❖ Information and Cyber Security
- ❖ IT Security and Information Assurance
- ❖ Information Assurance and IT Management
- ❖ Information Technology Management and Privacy etc.^{[13],[15],[16]}.

Most of these type of programs are available in different levels in Western countries and many developing countries are doing well for the promotion of the field.

Information Assurance Program at Doctoral Level: A Case

Information Assurance is offered in different level of education, which we already learned. However, among the fields most popular and available is Masters and comes with nomenclature of ‘Science’.

Among the popular universities offered the programs include but not limited to following (please refer Table 1)—

Table 1: List of universities offering Masters programs

Name of the Program
Davenport University
Nova South Eastern University
Sam Houston University
Florida Institute of Technology
George Mason University
Embry-Riddle Aeronautical University
FAIRLEIGH DICKINSON University
King Fahd University of Petroleum & Minerals
Hampton University
University of Central Missouri
Southern Utah University

The universities offering PhD programs come with the two approaches, in first one university offers only Research work leading to the degree; in another approach degree only after completion of prescribed Coursework and Research work. Here it is worthy to note that, the coursework having different features viz. General Specialization, Concentrate based Specializations viz. Security Policy/ Network Security/ System Security etc. The details have been depicted in Table 2.

Table 2: List of universities offering Doctoral programs in IA

Universities	Degree	Papers/ Courses
Northeastern University	PhD Information Assurance	Core Courses Fundamentals of Computer Networking or Digital Communications Software Vulnerabilities and Security Network Security or Cryptography and Communications Security Security Risk Management and Assessment Cyberlaw: Privacy, Ethics, and Digital Rights Any One Track Track: Network Security Wireless Network Digital Signal Processing Track: System Security Computer Systems Or Computer Architecture Software Security Practices Track: Policy Security Management Security and Resilience Policy Electives (Any 4) Managing Software Development Machine Learning Information Retrieval Applied Probability and Stochastic Processes Fundamentals of Computer Engineering Information Theory Research Methods Or Empirical Research Methods Dissertation Dissertation 1 or Dissertation Continuation (Final)
The University of Dallas, Texas	PhD Information Assurance	Detailed Curricula not shown in the website

Universities	Degree	Papers/ Courses
Capella University	PhD Information Assurance & Cyber Security	<p>Research Processes, Theory, and Practice in Information Technology</p> <p>PhD Dissertation Research Seminar Track 1</p> <p>PhD Dissertation Research Seminar Track 2</p> <p>PhD Dissertation Research Seminar Track 3</p> <p>Foundations of Research, Scholarly Literature, and Theory in Management</p> <p>Survey of Applied Research Methods</p> <p>Quantitative Research Techniques</p> <p>Advanced Qualitative Research or Quantitative Research Techniques 2</p> <p>Leading Information Technology Strategic Planning in Complex and Global Environments</p> <p>Guiding the Implementation of Information Technology Policies and Processes</p> <p>Innovating Information Technology Life Cycle Management Processes in a Changing Environment</p> <p>Advancing Research in Information Technology Management</p> <p>Information Technology Consulting Practice Seminar Or</p> <p>Teaching Practice Seminar in Information Technology Education</p> <p>Specializations</p> <p>Network Security Advances</p> <p>Enterprise Security Risk Management</p> <p>System and Application Security Advances</p> <p>Assurance Controls and Compliance Management</p> <p>Security Governance and Management</p> <p>Doctoral Comprehensive Examination</p> <p>Dissertation Courseroom</p>

Universities	Degree	Papers/ Courses
The State University of New York	PhD Information Science (Information Assurance)	<p>Core Courses (10 Cr)</p> <p><i>Managing Information and Technology in Organizations</i></p> <p><i>Information and Society</i></p> <p><i>Information Organization</i></p> <p><i>Information and Computing</i></p> <p><i>Information Policy</i></p> <p>Research Courses</p> <p><i>Research Seminar Sequence</i></p> <p><i>Annual INF Research Conference</i></p> <p><i>Research Design in Information Science</i></p> <p><i>Additional Research Tool Requirement</i></p> <p>Information Assurance Courses (6 to 7 Courses)</p> <p>Dissertation</p>
The University of Maryland	PhD (Accounting & Information Assurance)	Detailed Curricula not shown in the website
Colorado Technical University	Doctor of Computer Science (Cyber Security & Information Assurance)	<p>Total 100 Credit</p> <p>Core Courses</p> <p>Current Topics in Computer Science and Information Systems</p> <p>Information Assurance</p> <p>Futuring and Innovation</p> <p>Foundations of Digital Systems Security</p> <p>Enterprise Security Architecture</p> <p>Enterprise Tools, Concepts and Processes</p> <p>Governance, Quality, Compliance and Ethics</p> <p>Security Management</p> <p>Area Courses</p> <p>Four 4- Credit courses</p> <p>Research Courses</p> <p>Principles of Research Methods and Design</p> <p>Qualitative Research Methods</p> <p>Quantitative Research Methods</p> <p>Doctoral Research I: Principles of Research and Writing</p> <p>Doctoral Research II: Annotated Bibliography</p> <p>Dissertation Research Process</p>

Universities	Degree	Papers/ Courses
		Doctoral Research III: Dissertation Literature Review Doctoral Research IV: Dissertation Methods Doctoral Research V: Dissertation Introduction Doctoral Research VI: Dissertation Findings Doctoral Research VII: Dissertation Discussion and Conclusion Doctoral Research VIII: Dissertation Conclusion Doctoral Symposium I Doctoral Symposium II
University of Fairfax	Doctorate in Information Assurance	62 Credit Core Courses Information Security Systems and Organizational Awareness Legal and Ethical Practices in Information Security Information Security and Organizational Change Business and Security Risk Analysis Certification and Accreditation Specialized Courses Cloud Cyber Security Cyber Security Insurance forensic Evaluation and Incident Response Management Strategic and Technological Trends in Information Security Research Topics in Information Security Research Methods Courses Research Foundations Qualitative and Quantitative Analysis Security Program and Implementation: Quantitative Application Legal and Ethical Management in Information Security: Qualitative Application Feasibility Problem Driven Research Designing Solutions to InfoSec Problems Dissertation (1 to 6 Steps)

Here, it is worthy to note that many universities have Information Assurance specialization as its nomenclature whereas in some universities it is offered within broad discipline viz. Information Science e.g. The State University of New York (SUNY), offers Ph.D. Information Science (Information Assurance). Though, whether direct nomenclature on Information Assurance or as specializations few components are must be offered as research based viz. Dissertation/ Thesis, Research Methods Session/ Seminar etc. Apart from the academic or traditional Doctorate, few are started as Industrial Doctorate and among these important university and degree is University of Fairfax with Doctorate in Information Assurance with General/ Specialization/ Research based sufficient Courses on Information Assurance.

Issues and Challenges

Information Assurance is an interdisciplinary domain and deals with interdisciplinary skill sets and among these few important includes—

- ❖ Management
- ❖ Social Sciences
- ❖ Legal Studies
- ❖ Policy and Forensic Sciences etc.

So introducing Information Assurance curricula means challenge of integrating the field and discipline. It means the planned organizations and institutions should initiate proper infrastructure of availability manpower within the organization or should collaborate with other allied/ peer institutions and organizations. As Information Assurance is a broad field so the researchers and students need to learn about different areas and section of Information Assurance viz. IT Security/ Information Security or May policies on Information and Computing Security etc. The developing countries normally offered Ph.D. in general and broad field viz. Ph.D.- Information Science/ Information Studies/ Information Management/ Computer Science/ Information Technology etc thus, initiation of specialization of computing security area little difficult and challenging in terms of manpower development, availability of infrastructure, initiative of the organization, collaboration with the institutions etc. Information Assurance is much broader than Computer Security so it needs the challenges of the faculty members to gather new broad/ skill/ knowledge.

CONCLUSION WITH SUGGESTIONS

The field Information Assurance needs to start in other educational institutions and universities around the globe. It is noted that the universities offering different approaches as the Information Assurance education program. There may be little challenges in direct or full-fledged specialization thus initially Ph.D. program may be started as a Information Assurance in other allied programs like Information Science/ Information Studies/ Information Management/ Computer Science/ Information Technology. Additionally, if the university is ready to offer as full-fledged specialization in Information Assurance then its different sub areas may be offered as nomenclature viz. Ph.D.- Information Assurance (IT Security)/ Ph.D.- Information Assurance (Information Security)/ Ph.D.- Information Assurance (Cloud Security/ Web/ Network Security) or Ph.D. may be offered in Managerial and Social areas of Security and here

degree may be offered as PhD- Information Assurance (IT Security Policy)/ PhD- Information Assurance (Cyber Laws) etc. Industrial tie ups may be an additional and important initiative for coursework learners if they are interested to work in industries and organizations.

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