

# Critical Infrastructure System Security and Resiliency



Betty E. Bringer • Eric D. Muglin • Drake E. Warren



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# Critical Infrastructure System Security And Resiliency

**Igor Linkov, José Manuel Palma-  
Oliveira**



## **Critical Infrastructure System Security And Resiliency:**

*Critical Infrastructure System Security and Resiliency* Betty Biringir, Eric Vugrin, Drake Warren, 2013-04-12 Security protections for critical infrastructure nodes are intended to minimize the risks resulting from an initiating event whether it is an intentional malevolent act or a natural hazard With an emphasis on protecting an infrastructure's ability to perform its mission or function **Critical Infrastructure System Security and Resiliency** presents **Critical Infrastructure Security and Resilience** Dimitris Gritzalis, Marianthi Theocharidou, George Stergiopoulos, 2019-01-01 This book presents the latest trends in attacks and protection methods of Critical Infrastructures It describes original research models and applied solutions for protecting major emerging threats in Critical Infrastructures and their underlying networks It presents a number of emerging endeavors from newly adopted technical expertise in industrial security to efficient modeling and implementation of attacks and relevant security measures in industrial control systems including advancements in hardware and services security interdependency networks risk analysis and control systems security along with their underlying protocols Novel attacks against Critical Infrastructures CI demand novel security solutions Simply adding more of what is done already e g more thorough risk assessments more expensive Intrusion Prevention Detection Systems more efficient firewalls etc is simply not enough against threats and attacks that seem to have evolved beyond modern analyses and protection methods The knowledge presented here will help Critical Infrastructure authorities security officers Industrial Control Systems ICS personnel and relevant researchers to i get acquainted with advancements in the field ii integrate security research into their industrial or research work iii evolve current practices in modeling and analyzing Critical Infrastructures and iv moderate potential crises and emergencies influencing or emerging from Critical Infrastructures

*Resilience of Critical Infrastructure Systems* Zhishen Wu, Xilin Lu, Mohammad Noori, 2020-04-28 With rapid urbanization in developing countries and the emergence of smart systems and integrated intelligent devices the new generation of infrastructure will be smarter and more efficient However due to natural and anthropomorphic hazards as well as the adverse impact of climate change civil infrastructure systems are increasingly vulnerable Therefore future proofing and designing resilience into infrastructure is one of the biggest challenges facing the industry and governments in all developing and industrialized societies This book provides a comprehensive overview of infrastructure resiliency new developments in this emerging field and its scopes including ecology and sustainability and the challenges involved in building more resilient civil infrastructure systems Moreover it introduces a strategic roadmap for effective and efficient methods needed for modeling designing and assessing resiliency Features Includes contributions from internationally recognized scholars in the emerging field of infrastructure resilience Covers a broad range of topics in infrastructure resilience such as disaster assessment civil infrastructure and lifeline systems natural hazard mitigation and seismic protection Includes practical global case studies and leading edge research from several countries Presents an interdisciplinary approach in addressing the

challenges in the emerging field of infrastructure resilience Resilience of Critical Infrastructure Systems Emerging Developments and Future Challenges serves as a valuable resource for practicing professionals researchers and advanced students seeking practical forward looking guidance

**Critical Information Infrastructures Security** Erich Rome, Marianthi Theodoridou, Stephen Wolthusen, 2016-05-17 This book constitutes revised selected papers from the 10th International Conference on Critical Information Infrastructures Security CRITIS 2015 held in Berlin Germany in October 2015 The 18 full and 6 short papers presented in this volume were carefully reviewed and selected from 54 submissions They are organized in topical sections named critical information infrastructure protection critical infrastructure resilience assessment emergency management critical infrastructure preparedness modelling simulation and analysis approaches electric grid protection and resilience and CIPRNet young CRITIS award candidate papers

*The Security of Critical Infrastructures* Marcus Matthias Keupp, 2020-05-05 This book analyzes the security of critical infrastructures such as road rail water health and electricity networks that are vital for a nation s society and economy and assesses the resilience of these networks to intentional attacks The book combines the analytical capabilities of experts in operations research and management economics risk analysis and defense management and presents graph theoretical analysis advanced statistics and applied modeling methods In many chapters the authors provide reproducible code that is available from the publisher s website Lastly the book identifies and discusses implications for risk assessment policy and insurability The insights it offers are globally applicable and not limited to particular locations countries or contexts Researchers intelligence analysts homeland security staff and professionals who operate critical infrastructures will greatly benefit from the methods models and findings presented While each of the twelve chapters is self contained taken together they provide a sound basis for informed decision making and more effective operations policy and defense

*Resilient Control Architectures and Power Systems* Craig Rieger, Ronald Boring, Brian Johnson, Timothy McJunkin, 2021-12-02 Master the fundamentals of resilient power grid control applications with this up to date resource from four industry leaders Resilient Control Architectures and Power Systems delivers a unique perspective on the singular challenges presented by increasing automation in society In particular the book focuses on the difficulties presented by the increased automation of the power grid The authors provide a simulation of this real life system offering an accurate and comprehensive picture of a how a power control system works and even more importantly how it can fail The editors invite various experts in the field to describe how and why power systems fail due to cyber security threats human error and complex interdependencies They also discuss promising new concepts researchers are exploring that promise to make these control systems much more resilient to threats of all kinds Finally resilience fundamentals and applications are also investigated to allow the reader to apply measures that ensure adequate operation in complex control systems Among a variety of other foundational and advanced topics you ll learn about The fundamentals of power grid infrastructure including grid architecture control system architecture and communication

architecture The disciplinary fundamentals of control theory human system interfaces and cyber security The fundamentals of resilience including the basis of resilience its definition and benchmarks as well as cross architecture metrics and considerations The application of resilience concepts including cyber security challenges control challenges and human challenges A discussion of research challenges facing professionals in this field today Perfect for research students and practitioners in fields concerned with increasing power grid automation Resilient Control Architectures and Power Systems also has a place on the bookshelves of members of the Control Systems Society the Systems Man and Cybernetics Society the Computer Society the Power and Energy Society and similar organizations

**Sustainable and Resilient Critical Infrastructure Systems** Kasthurirangan Gopalakrishnan, Srinivas Peeta, 2010-04-13 Sustainable and resilient critical infrastructure systems is an emerging paradigm in an evolving era of depleting assets in the midst of natural and man made threats to provide a sustainable and high quality of life with optimized resources from social economic societal and environmental considerations The increasing complexity and interconnectedness of civil and other interdependent infrastructure systems electric power energy cyber infrastructures etc require inter and multidisciplinary expertise required to engineer monitor and sustain these distributed large scale complex adaptive infrastructure systems This edited book is motivated by recent advances in simulation modeling sensing communications information and intelligent and sustainable technologies that have resulted in the development of sophisticated methodologies and instruments to design characterize optimize and evaluate critical infrastructure systems their resilience and their condition and the factors that cause their deterioration Specific topics discussed in this book include but are not limited to optimal infrastructure investment allocation for sustainability framework for manifestation of tacit critical infrastructure knowledge interdependencies between energy and transportation systems for national long term planning intelligent transportation infrastructure technologies emergent research issues in infrastructure interdependence research framework for assessing the resilience of infrastructure and economic systems maintenance optimization for heterogeneous infrastructure systems optimal emergency infrastructure inspection scheduling and sustainable rehabilitation of deteriorated transportation infrastructure systems

**System of System Failures** Takafumi Nakamura, 2018-05-09 This book provides the application of praxes in the field of engineering safety by learning from previous system failures And it addresses the most recent developments in the theoretical and practical aspects of these important fields which due to their special nature bring together in a systematic way many disciplines of engineering from the traditional to the most technologically advanced The authors of these chapters are involved in using the system thinking and system engineering approaches at the scale of increased complexity and advanced computational solutions to such systems The chapters cover the areas such as failure assessment in aeronautical engineering seismic resistance of offshore pipeline engineering electrical engineering critical infrastructure failure and system of system theory

**Safety and Reliability. Theory and Applications** Marko Cepin, Radim Bris, 2017-06-14 Safety and Reliability

Theory and Applications contains the contributions presented at the 27th European Safety and Reliability Conference ESREL 2017 Portoro Slovenia June 18 22 2017 The book covers a wide range of topics including Accident and Incident modelling Economic Analysis in Risk Management Foundational Issues in Risk Assessment and Management Human Factors and Human Reliability Maintenance Modeling and Applications Mathematical Methods in Reliability and Safety Prognostics and System Health Management Resilience Engineering Risk Assessment Risk Management Simulation for Safety and Reliability Analysis Structural Reliability System Reliability and Uncertainty Analysis Selected special sessions include contributions on the Marie Skłodowska Curie innovative training network in structural safety risk approaches in insurance and finance sectors dynamic reliability and probabilistic safety assessment Bayesian and statistical methods reliability data and testing organizational factors and safety culture software reliability and safety probabilistic methods applied to power systems socio technical economic systems advanced safety assessment methodologies extended Probabilistic Safety Assessment reliability availability maintainability and safety in railways theory big data risk analysis and management and model based reliability and safety engineering Safety and Reliability Theory and Applications will be of interest to professionals and academics working in a wide range of industrial and governmental sectors including Aeronautics and Aerospace Automotive Engineering Civil Engineering Electrical and Electronic Engineering Energy Production and Distribution Environmental Engineering Information Technology and Telecommunications Critical Infrastructures Insurance and Finance Manufacturing Marine Industry Mechanical Engineering Natural Hazards Nuclear Engineering Offshore Oil and Gas Security and Protection Transportation and Policy Making

**Critical Infrastructure Protection, Risk Management, and Resilience** Kelley A. Pesch-Cronin, Nancy E. Marion, 2016-12-19 Critical Infrastructure Protection and Risk Management covers the history of risk assessment critical infrastructure protection and the various structures that make up the homeland security enterprise The authors examine risk assessment in the public and private sectors the evolution of laws and regulations and the policy challenges facing the 16 critical infrastructure sectors The book will take a comprehensive look at the issues surrounding risk assessment and the challenges facing decision makers who must make risk assessment choices

Critical Infrastructures Resilience Auroop Ratan Ganguly, Udit Bhatia, Stephen E. Flynn, 2018-02-21 This text offers comprehensive and principled yet practical guidelines to critical infrastructures resilience Extreme events and stresses including those that may be unprecedented but are no longer surprising have disproportionate effects on critical infrastructures and hence on communities cities and megaregions Critical infrastructures include buildings and bridges dams levees and sea walls as well as power plants and chemical factories besides lifeline networks such as multimodal transportation power grids communication and water or wastewater The growing interconnectedness of natural built human systems causes cascading infrastructure failures and necessitates simultaneous recovery This text explores the new paradigm centered on the concept of resilience by approaching the challenges posed by globalization climate change and growing urbanization on critical

infrastructures and key resources through the combination of policy and engineering perspectives It identifies solutions that are scientifically credible data driven and sound in engineering principles while concurrently informed by and supportive of social and policy imperatives Critical Infrastructures Resilience will be of interest to students of engineering and policy

*Space Infrastructures: From Risk to Resilience Governance* U. Tatar,A.V. Gheorghe,O.F. Keskin,2020-04-17 Space critical infrastructures represent an interdependent system of systems consisting of workforce environment facilities and multidirectional interactions These are essential for the maintenance of vital societal functions such as health safety security mobility and the economic and social well being of people and their destruction or disruption would have a significant impact on society as a whole In all 79 nations and government consortia currently operate satellites with 11 countries operating 22 launch sites Despite creating new challenges this multi actor environment offers opportunities for international cooperation but making the most of these opportunities requires a holistic approach to space critical infrastructure away from strictly defined space technologies and towards understanding the resilience of complex systems and how they are intertwined in reality This book presents papers from the NATO Advanced Research Workshop ARW entitled Critical Space Infrastructure From Vulnerabilities and Threats to Resilience held in Norfolk Virginia USA from 21 22 May 2019 The ARW brought together representatives from academia industry and international organizations in an effort to deepen scientific and technological understanding of space critical infrastructures and explore the implications for national and international space security and resilience It examined space as a critical infrastructure from a multidisciplinary perspective in accordance with NATO s Strategic Concept The 29 chapters in the book are divided into six sections covering space infrastructure governance cybersecurity risk resiliency and complexity emerging technologies such as block chain artificial intelligence and quantum computing application domains and national approaches and applications Managing the Complexity of Critical Infrastructures Roberto Setola,Vittorio Rosato,Elias Kyriakides,Erich Rome,2017-02-10 This book is open access under a CC BY 4 0 license This book summarizes work being pursued in the context of the CIPRNet Critical Infrastructure Preparedness and Resilience Research Network research project co funded by the European Union under the Seventh Framework Programme FP7 The project is intended to provide concrete and on going support to the Critical Infrastructure Protection CIP research communities enhancing their preparedness for CI related emergencies while also providing expertise and technologies for other stakeholders to promote their understanding and mitigation of the consequences of CI disruptions leading to enhanced resilience The book collects the tutorial material developed by the authors for several courses on the modelling simulation and analysis of CIs representing extensive and integrated CIP expertise It will help CI stakeholders CI operators and civil protection authorities understand the complex system of CIs and help them adapt to these changes and threats in order to be as prepared as possible for mitigating emergencies and crises affecting or arising from CIs *OECD Reviews of Risk Management Policies Good Governance for Critical Infrastructure Resilience* OECD,2019-04-17 Critical

infrastructures are the backbone of modern interconnected economies The disruption of key systems and essential services such as telecommunications energy or water supply transportation or finance can cause substantial economic damage This report looks at how to boost critical infrastructure resilience in a dynamic risk landscape and discusses policy options and governance models to promote up front resilience investments

**Critical Infrastructure Resilience and Sustainability Reader** Ted G. Lewis, 2023-08-29 Critical Infrastructure Resilience and Sustainability Reader Identify and protect critical infrastructure from a wide variety of threats In Critical Infrastructure Resilience and Sustainability Reader Ted G Lewis delivers a clear and compelling discussion of what infrastructure requires protection how to protect it and the consequences of failure Through the book you ll examine the intersection of cybersecurity climate change and sustainability as you reconsider and reexamine the resilience of your infrastructure systems The author walks you through how to conduct accurate risk assessments make sound investment decisions and justify your actions to senior executives You ll learn how to protect water supplies energy pipelines telecommunication stations power grids and a wide variety of computer networks without getting into the weeds of highly technical mathematical models Critical Infrastructure Resilience and Sustainability Reader also includes A thorough introduction to the daunting challenges facing infrastructure and the professionals tasked with protecting it Comprehensive explorations of the proliferation of cyber threats terrorism in the global West climate change and financial market volatility Practical discussions of a variety of infrastructure sectors including how they work how they re regulated and the threats they face Clear graphics narrative guides and a conversational style that makes the material easily accessible to non technical readers Perfect for infrastructure security professionals and security engineering firms Critical Infrastructure Resilience and Sustainability Reader will also benefit corporate security managers and directors government actors and regulators and policing agencies emergency services and first responders

***Resilience and Risk*** Igor Linkov, José Manuel Palma-Oliveira, 2017-08-01 This volume addresses the challenges associated with methodology and application of risk and resilience science and practice to address emerging threats in environmental cyber infrastructure and other domains The book utilizes the collective expertise of scholars and experts in industry government and academia in the new and emerging field of resilience in order to provide a more comprehensive and universal understanding of how resilience methodology can be applied in various disciplines and applications This book advocates for a systems driven view of resilience in applications ranging from cyber security to ecology to social action and addresses resilience based management in infrastructure cyber social domains and methodology and tools Risk and Resilience has been written to open up a transparent dialog on resilience management for scientists and practitioners in all relevant academic disciplines and can be used as supplement in teaching risk assessment and management courses

**Strengthening Critical Infrastructure Resilience by Identifying and Redressing Recurring Gaps and Systemic Barriers** Russell E. Bowman, 2016 This dissertation explores the concept of disaster resilience in the context of homeland security in general and critical



infrastructure in particular as assessed at local and regional levels It features two related but distinct research foci 1 identifying and exploring recurring resilience gaps and 2 identifying and exploring systemic barriers that allow such gaps to emerge or to persist It employs content analysis and cross case synthesis of 33 in depth case studies generated by the Department of Homeland Security's Regional Resiliency Assessment Program RRAP In so doing this research also explores the ability of and challenges with using the concept of resilience as an operational construct for reducing all hazards risk and improving homeland security more broadly Building on the work of those who study the resilience of communities and critical infrastructure assets and systems especially with respect to their interaction with the communities and larger systems within which they are situated this dissertation validates prior research by applying similar analyses to new data i e the RRAP case studies In brief the RRAP data suggest that four recurring resilience gaps exist across many if not most infrastructure sectors and geographic regions Specifically these include 1 a dependence on energy aggravated by an insufficiency or complete absence of back up power systems 2 the fact that response and recovery plans and planning seldom include all relevant stakeholders necessary to address known hazards in a comprehensive manner 3 the presence of numerous single or critical points of failure and 4 a related lack of redundancy insufficient system capacity or both that diminishes the resilience of many infrastructure systems Additionally this dissertation's analysis of 33 RRAP Resiliency Assessments affirms the prevalence of five systemic barriers to improving resilience 1 the nation continues to face significant shortcomings in emergency response and recovery coordination efforts at the regional and cross regional levels 2 there is a widespread lack of visibility or understanding of how critical infrastructure components are inter connected and how systems are dependent or interdependent on one another 3 there is a dearth of important critical infrastructure information beyond dependencies and interdependencies that is available to cognizant authorities and operators either because they do not understand why they should seek or insist on gaining access to information that would resolve certain unknowns or because those in possession of relevant information are reluctant to share it 4 there are insufficient incentives and funding in particular for investing in resilience and 5 efficiency is often valued over ensuring continuity of function Drawing on these findings this work explains how there is clear benefit to adopting a systems based function focused view of resilience that is hazard agnostic It also suggests the importance of further study concerning the barriers that underlie resilience gaps to facilitate broader understanding of the challenges we face and proposes a framework for divining and analyzing linkages between common gaps and barriers In closing this dissertation suggests ways to further exploit the DHS program that is the focus of this research the necessity of sharing subsequent DHS Resiliency Assessments more widely and the related need to make the RRAP data on which the program's assessments are based more accessible to researchers

Industrial Control Systems Security and Resiliency Craig Rieger,Indrajit Ray,Quanyan Zhu,Michael A. Haney,2019-08-29 This book provides a comprehensive overview of the key concerns as well as research challenges in designing secure and resilient Industrial

Control Systems ICS It will discuss today's state of the art security architectures and couple it with near and long term research needs that compare to the baseline It will also establish all discussions to generic reference architecture for ICS that reflects and protects high consequence scenarios Significant strides have been made in making industrial control systems secure However increasing connectivity of ICS systems with commodity IT devices and significant human interaction of ICS systems during its operation regularly introduces newer threats to these systems resulting in ICS security defenses always playing catch up There is an emerging consensus that it is very important for ICS missions to survive cyber attacks as well as failures and continue to maintain a certain level and quality of service Such resilient ICS design requires one to be proactive in understanding and reasoning about evolving threats to ICS components their potential effects on the ICS mission's survivability goals and identify ways to design secure resilient ICS systems This book targets primarily educators and researchers working in the area of ICS and Supervisory Control And Data Acquisition SCADA systems security and resiliency Practitioners responsible for security deployment management and governance in ICS and SCADA systems would also find this book useful Graduate students will find this book to be a good starting point for research in this area and a reference source

**Critical Infrastructure** Wesley A. Bernardes, 2013 Critical infrastructure are those assets the loss of which would result in great harm to the nation's security economy health and safety and morale They include assets necessary to generate and distribute such basic goods and services as electricity drinking water telecommunications banking and finance etc Resilience refers to the ability of a system to resist absorb recover from or successfully adapt to a change in environment or conditions The Critical Infrastructure Task Force has argued that government policies encouraged employing greater defences such as surveillance equipment guards etc around these assets but did less to encourage efforts that would allow assets to continue operating at some level or quickly return to full operation if attacked Such efforts might include increasing redundancies such as having multiple backup power generation capability or designing more robust systems for the future such as using more hardened concrete for stronger fixed facilities This book discusses the concept of resilience in the context of critical infrastructure and homeland security It also identifies and discusses issues related to the evolution of policy and programs at the Department of Homeland Security DHS that are meant to or could promote the resiliency of the nation's critical infrastructure

**Critical Infrastructure Protection: DHS Efforts to Assess and Promote Resiliency Are Evolving but Program Management Could Be Strengthened ,**

This book delves into Critical Infrastructure System Security And Resiliency. Critical Infrastructure System Security And Resiliency is a crucial topic that must be grasped by everyone, from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Critical Infrastructure System Security And Resiliency, encompassing both the fundamentals and more intricate discussions.

1. This book is structured into several chapters, namely:
    - Chapter 1: Introduction to Critical Infrastructure System Security And Resiliency
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  3. In chapter 2, this book will delve into the foundational concepts of Critical Infrastructure System Security And Resiliency. This chapter will elucidate the essential principles that need to be understood to grasp Critical Infrastructure System Security And Resiliency in its entirety.
  4. In chapter 3, the author will examine the practical applications of Critical Infrastructure System Security And Resiliency in daily life. This chapter will showcase real-world examples of how Critical Infrastructure System Security And Resiliency can be effectively utilized in everyday scenarios.
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  6. In chapter 5, this book will draw a conclusion about Critical Infrastructure System Security And Resiliency. The final chapter will summarize the key points that have been discussed throughout the book.
- This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. This book is highly recommended for anyone seeking to gain a comprehensive understanding of Critical Infrastructure System Security And Resiliency.

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