Tutorial

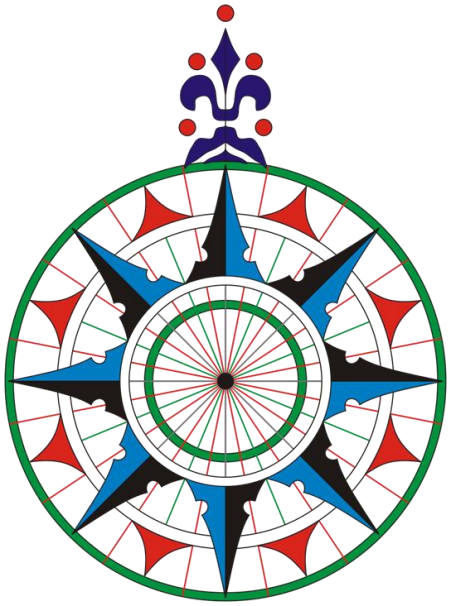
of the 1th online and 14th

INTERNATIONAL CONFERENCE ON AXIOMATIC DESIGN

eventos.fct.unl.pt/icad2021

09:00 (GST) June 23, 2021

Lisbon, Portugal



NOVA School of Science & Technology

Military University Institute

The Wind Rose of Pedro Reinel (1485) inspired the symbol for the ICAD conferences host in Portugal in 2009 and 2014. Once again, ICAD2021 uses a similar symbol.

Please find the complete Wind Rose is on the front page of this brochure for your appreciation. In the navigation chart near the Wind Rose, there is an inscription "*Pedro Reinel me fez*" – Pedro Reinel did me. It is an incredible chart that may enclose an astonishing secret. It shows Europe and the contour of Africa. Surprisingly, turning the chart 180^0, it appears the contour of all coasts of Mexico at the same latitude it really is. The chart is part of the collection of the *Arquives Departementales de la Gironde*, Bordeaux, France. Amazingly it is dated thirteen years before Colombo reach America – and that is another story.

Timetable at Greenwich Summertime (GST)

Central European Summer Time - GST+ 1hour

Iasi, Romania:	GST + 2 hours
Tokyo, Japan:	GST + 8 hours
Seoul, Korea:	GST + 8 hours
Sydney, Australia:	GST + 9 hours
Boston, USA:	GST (–) 5 hours

TUTORIAL ON AXIOMATIC DESIGN

Why Design?

Good designs avoid problems.

In manufacturing, it makes shorter the time between identifying a need and manufacturing a product. A good design reduces the costs of manufacturing, operation, and maintenance.

In organizations, the good design focuses the system on the goal, avoids conflicts, makes processes straightforward, saves money, and avoids casualties. It helps to fix relationships between national or transnational organizations.

Good designs can solve the challenges of Humanity of this century – climate change, desalination, climate control, artificial intelligence, education, health services, democratic systems, all can benefit from good designs.

In operations, it makes the system go to the target. Design can apply to marketing, commercial activities as well as military operations.

Why Axiomatic Design?

Would you accept living in a house built by instinct? So, why accepting the design?

Professor Nam P. Suh developed Axiomatic Design (AD) in the 1970s. "The Principles of Design", his first book on AD, was published in 1990. AD relies on Axioms as mathematics, physics, thermodynamics, the same way economics and social sciences rely on rules.

Axioms give the designer the guidelines to do a good design.

AD has two Axioms: "Maintain the independence of Functional Requirements" and "minimize the information content".

If the design does follow the axioms, the system is stable, allows variations, is simple to maintain and reorganize, and has a high probability of success.

Why a Tutorial?

In three hours, you will go from the basis of AD to provocative examples. You will see examples in engineering, social life, organizations, and international relationships. In the end, you will see the world differently.

Welcome aboard towards a magnificent intellectual experience.

To access the tutorial:
https://videoconf-colibri.zoom.us/j/81070581665?pwd=Yis0WUJwUkd0RGZGSjlaTVJHdmNWdz09

TUTORIAL SPEAKERS

Dr. Hilario Oh

PhD
Researcher of MIT Park Center for Complex Systems (retired)
ohlarry@yahoo.com

Dr. Oh received his BSME from the University of the Philippines, 1960; MSME from Purdue University, 1962 and Ph. D. from University of California, Berkeley, 1967.
After a year of postdoctoral fellowship at UC Berkeley, Dr. Oh joined General Motors (GM) Research Laboratories in 1969 and spent the next 19 years doing R & D in machining of brittle car components; in fracture mechanics application to fatigue of spot welds and rubber components; in signal processing for engine knock detection and in metal forming of car body panels. In 1985, Dr. Oh was called into the GM Car Divisions to deal with quality crisis at GM thus begun his lifelong endeavor at quality. He worked at various stages of quality: as a field engineer working on reliability of products in the field; as a plant engineer solving assembly quality in the plants; as a development engineer developing theory and application of robust design and axiomatic design. In 1996, he joined Silicon Valley Group, a semiconductor equipment manufacturer, as Corporate Vice President in Quality and Productivity. In this position, he worked at the highest stage of quality -the deployment of quality initiatives throughout a corporation.
In 1996 thru 2006, he was invited as Senior Lecturer in MIT Mechanical Department to share his industrial experience with the students. From 2006 to 2012, he was associated with MIT Park Center for Complex System as Research Affiliate.
Dr. Oh teaches robust and axiomatic design through real life problems and case studies.

Professor Cristopher Brown

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Chris studied at the University of Vermont, where he first heard Nam Suh speak about Axiomatic Design (AD) in 1980. Chris worked on mechanical metallurgy, surfaces and ski equipment at Lausanne's Swiss Federal Institute of Technology until 1987. He used AD for product and process development as a senior research engineer at Atlas Copco's European research center, before joining WPI's Mechanical Engineering faculty in 1989.

He started teaching AD to WPI's Grad students in 1990 and founded WPI's Surface Metrology Lab in 1991. He used AD to develop and patent area-scale methods, multiscale geometric analyses of topographies. In US and international collaborations these methods have analyzed food, teeth, dinosaur footprints, archaeological artifacts, pavements, skin replicas, cutting tools, paper, and many kinds of additive surfaces. Area-scale software, developed at WPI and distributed around the world, was sold to Digital Surf in France who sells their own version of area-scale analysis. Chris and his students have also used AD for many things they have patented, including edge sharpness friction testers, and ski bindings, skates, and shoes to help prevent injuries, the latter sparked a startup, Sports Engineering Inc. to commercialize equipment for reducing injuries and rehabilitation in many activities.

WPI hosted the 7th International Conference on Surface Metrology in 2013. Chris has published over a hundred and fifty papers on surface metrology, Suh's Axiomatic Design, manufacturing, and sports engineering. He teaches WPI on-line grad courses on Surface Metrology and on Axiomatic Design several times a year and provides tutorials for industry and conferences.

Prof. Miguel Cavique

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Miguel Cavique is Professor at the Naval Academy. In 2019/2020, he attended the National Defense Course (CDN) of the National Defense Institute (IDN), when he notices the application of Axiomatic Design (AD) to International affairs.

He first contacts AD by 2005 when he applied the theory to the design of Air Conditioning Systems. He is a specialist on air conditioning by the chartered association of engineers in Portugal and a life member of the air conditioning commission. He is a member of ASHRAE.

During his lifelong, he always maintained an academic and industrial career. He ran the department of network design of EDP, supported relational database for the bank industry in IBM, hold an industrial company, and did consultancy on air conditioning design and energy auditing of buildings. He still owns a commercial company, CEST.

He devoted the last decade to developing and applying Axiomatic Design to the design of complex systems – air conditioning, naval systems, and organizations.

Professor Nam P. Suh invited him to be an editor of the Axiomatic Design latest book– Design Engineering and Science.

PROGRAM OVERVIEW

09:00 – 11:15 - Suh's Axiomatic Design - Basic Theory and Methods

Christopher A. Brown
Professor of Mechanical Engineering, Worcester Polytechnic Institute

1. Theoretical Foundations
   1.1. Audacity of Suh's Design Axioms
   1.2. Corollaries and theorems
2. Axiomatic Design Structure
   2.1. Design Domains
   2.2. Hierarchical, Zigzagging Decompositions
   2.3. Physical Integration
3. Generating Axiomatic Design Solutions
   3.1. Design Equations and Matrices, Axiom 1, Independence
   3.2. Ranking Solution Candidates, Axiom 2, Information
4. Creativity, Innovation, and Ethics
   4.1. Importance of Functional Requirements
   4.2. Generating candidate Design Parameters

5. Applications to Military and International relationships

Miguel Cavique
Professor of Mechanical Engineering, Naval Academy Portugal

   5.1. Putting a problem in Domains
   5.2. Need and lack of requirements in operations
   5.3. Strategy according to AD

11:15- 11:30 – Coffee-break

11:30 – 12:30 – Further examples and applications

Hilario Oh
Massachusetts Institute of Technology (MIT)

6. Further theory and applications
   6.1. Math explanation of functional independence
   6.2. Case study: GM ignition switch failure
   6.3. Degeneration of functional independence into functional dependence
   6.4. Sample illustraton: 2-handle faucet
   6.5. Design singularity
   6.6. Case studies: robotic singularity: singularity in a climbing plane

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