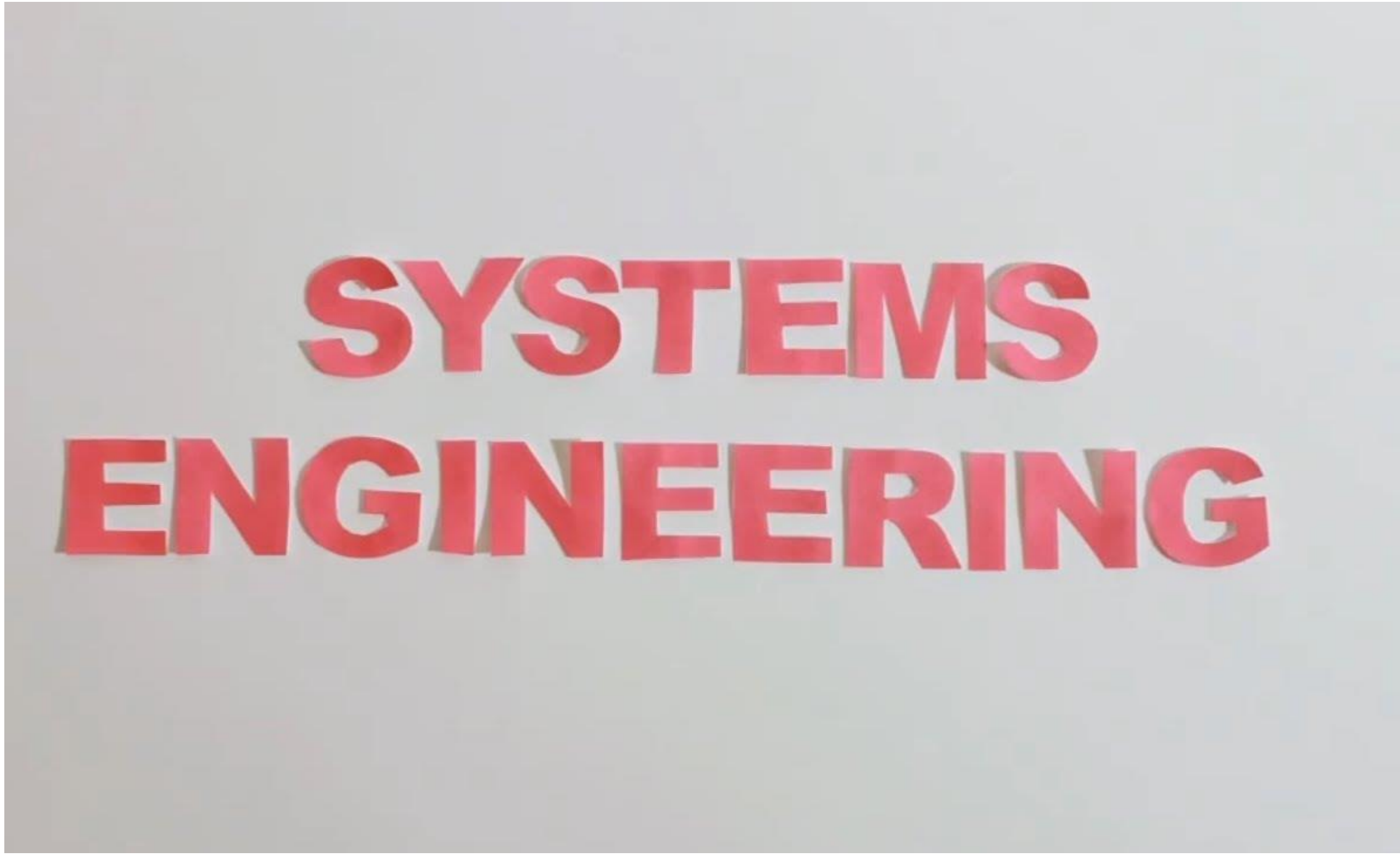
Electrical Engineering and Computer Science Dept
College of Engineering

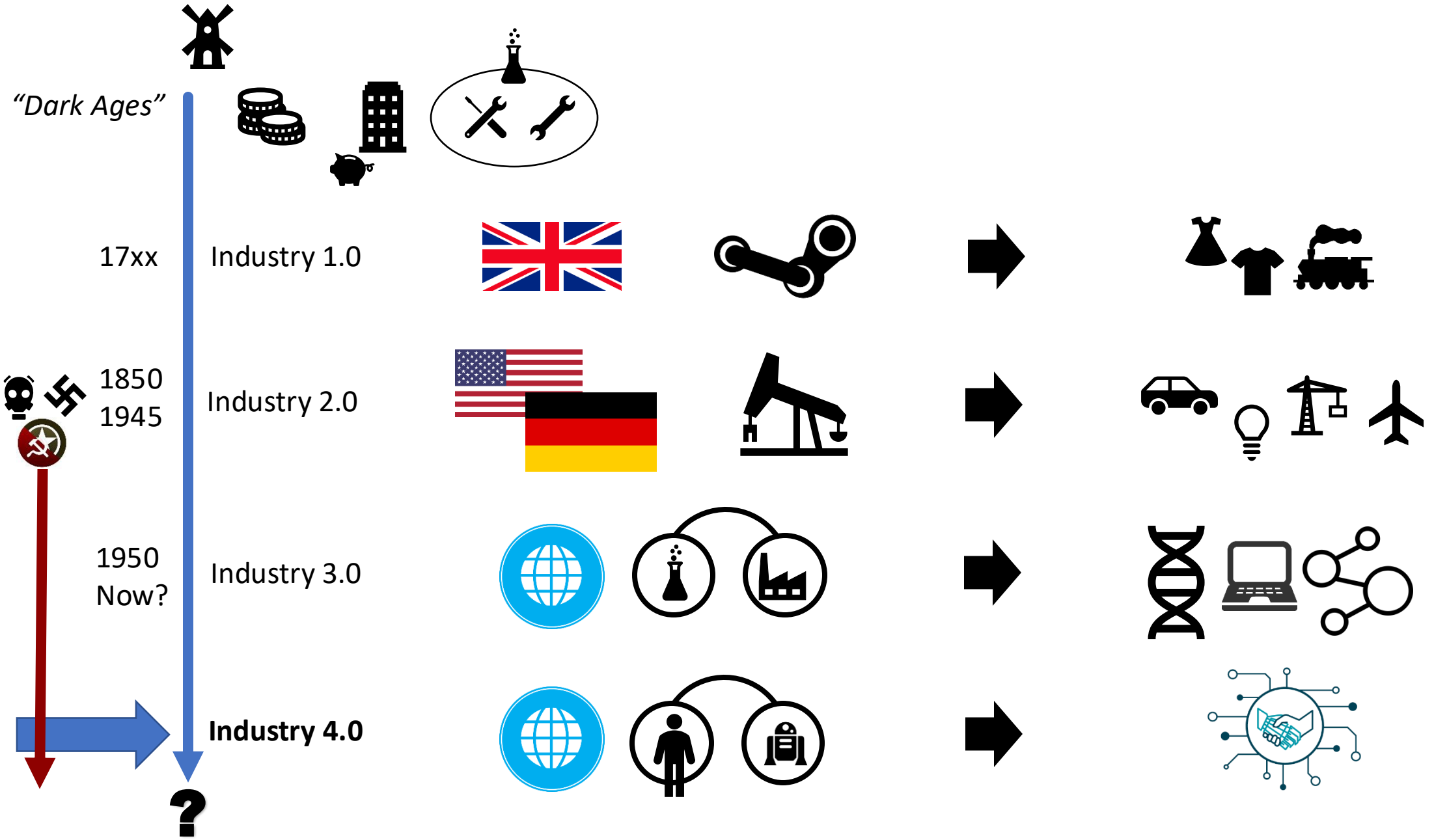
FINAL REMARKS

Prepared by Prof. Christopher Shneider Cerqueira

2025

A little of my research


SYSTEMS
ENGINEERING


"Dark Ages"
17xx
Industry 1.0
1850
1945
Industry 2.0
1950
Now?
Industry 3.0
Industry 4.0
?

Movie: Hidden Figures (2016)
Portraits NASA's Mercury Program (~50s)

Homunculus de Penfield

Making Digital Tangible

The Battle Against the "Pixel Empire"

Digital Content EXPO 2020 Online

November 20 (Fri) 2020, 10-11 am JST

Hiroshi Ishii

MIT Media Lab
Tangible Media

@ishii_mit

ishii.mit

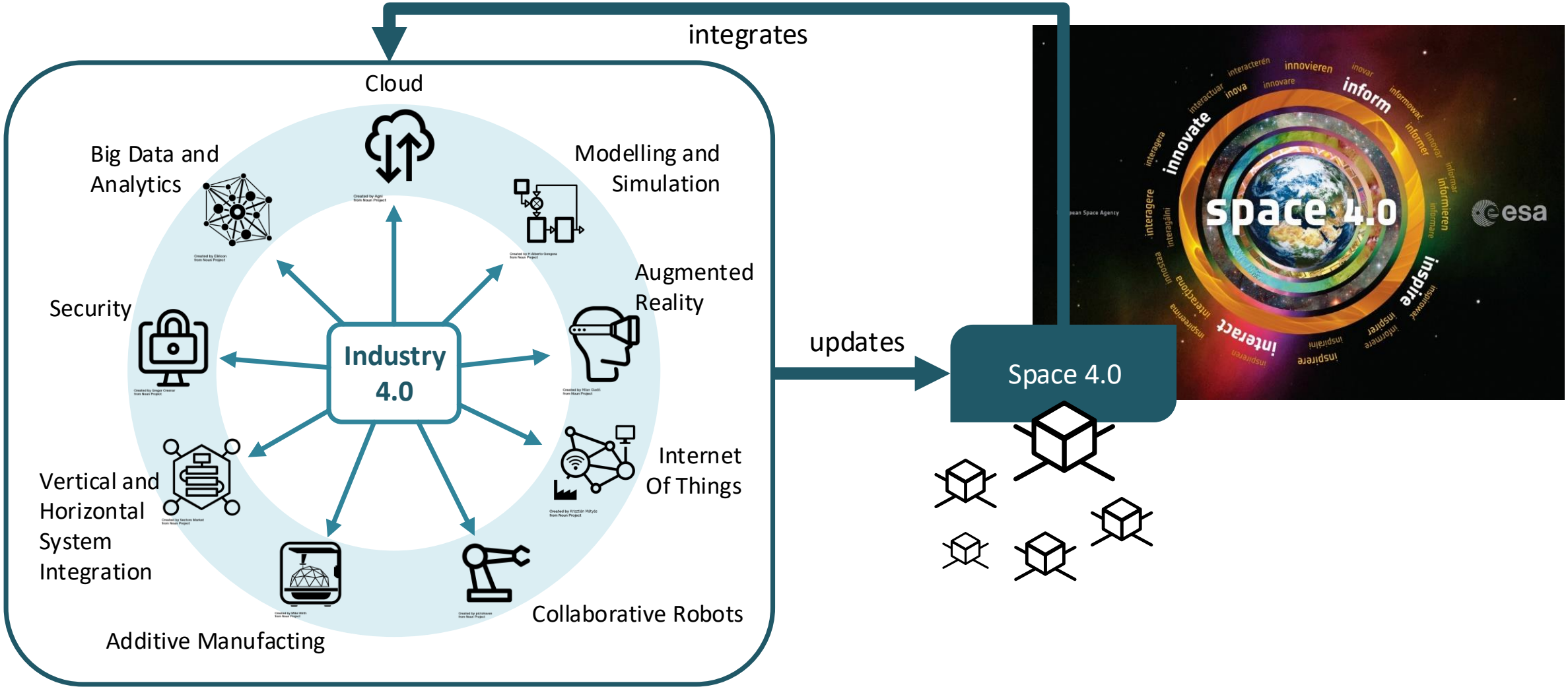
https://vimeo.com/389808503

Photo courtesy of Nobukazu Kuriki

mit media lab

MBSE 4.0

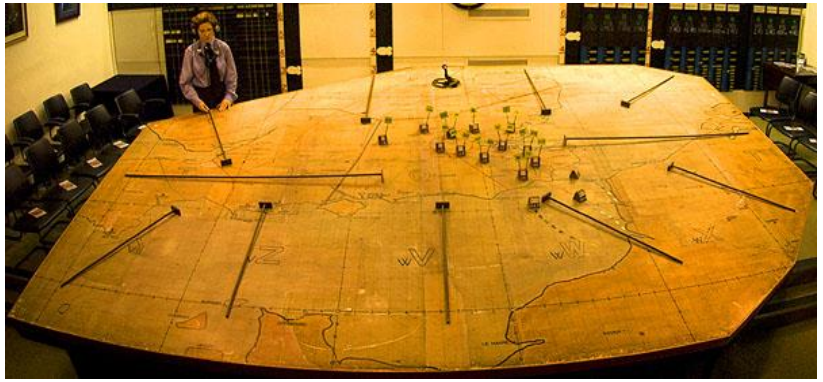
Future Motto: Creative Work Interconnection (INCOSE)



Tangible Artifacts

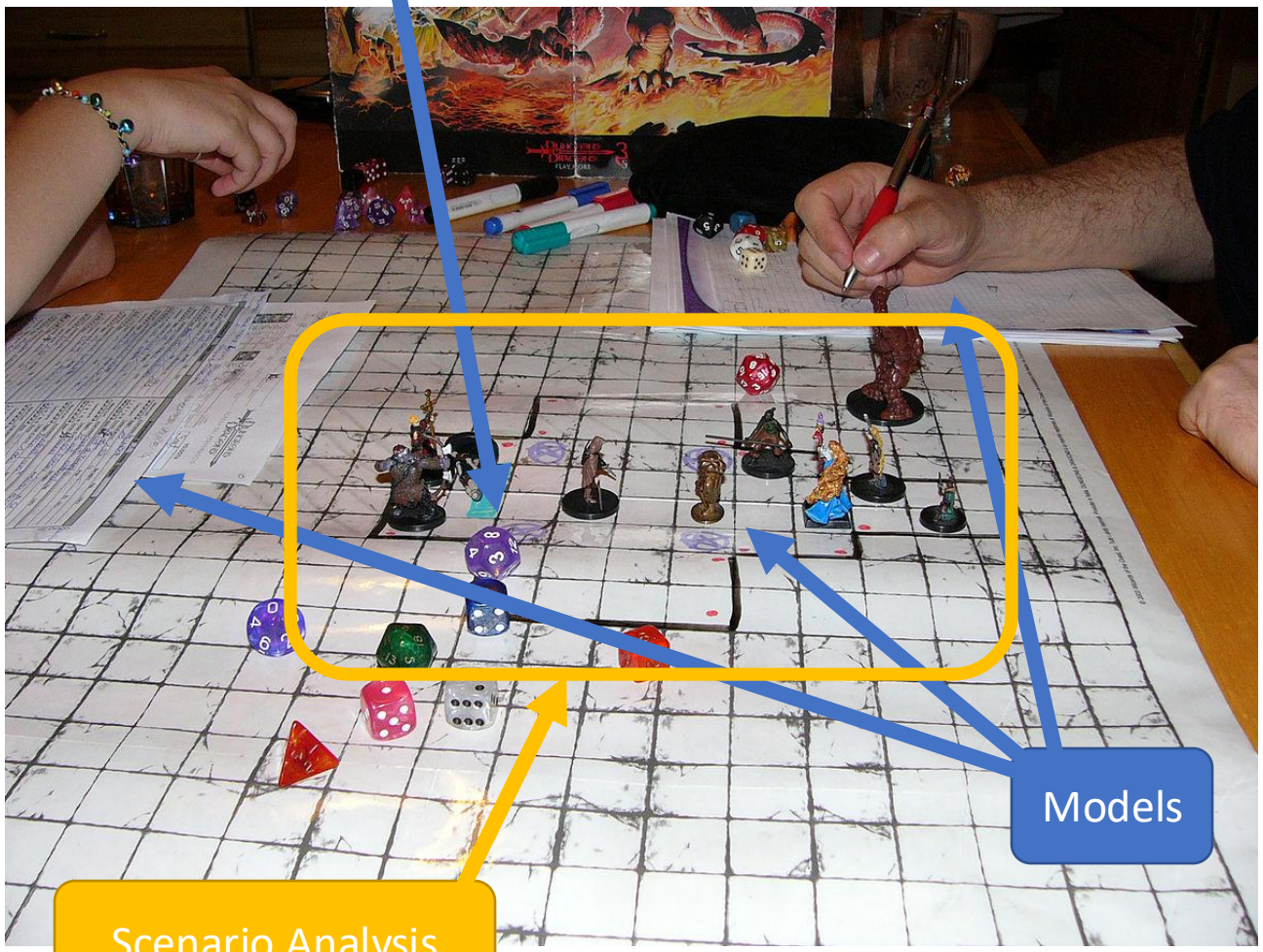
Board game

Sand Table



Tactical Table

Trade Analysis Algorithm



https://en.wikipedia.org/wiki/Dungeons_%26_Dragons

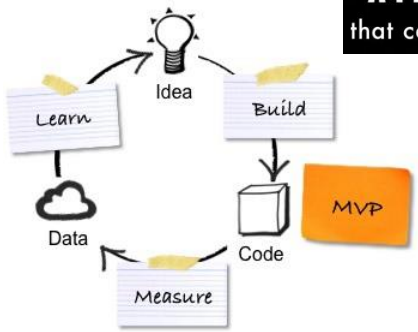
https://www.aerodefensetech.com/component/content/article/adt/features/articles/13944
http://www.projectrho.com/public_html/rocket/spacewartactic.php

Nintendo Labo

https://www.youtube.com/channel/UC9v-Qjh8z-ey6exeadZhcHg/videos

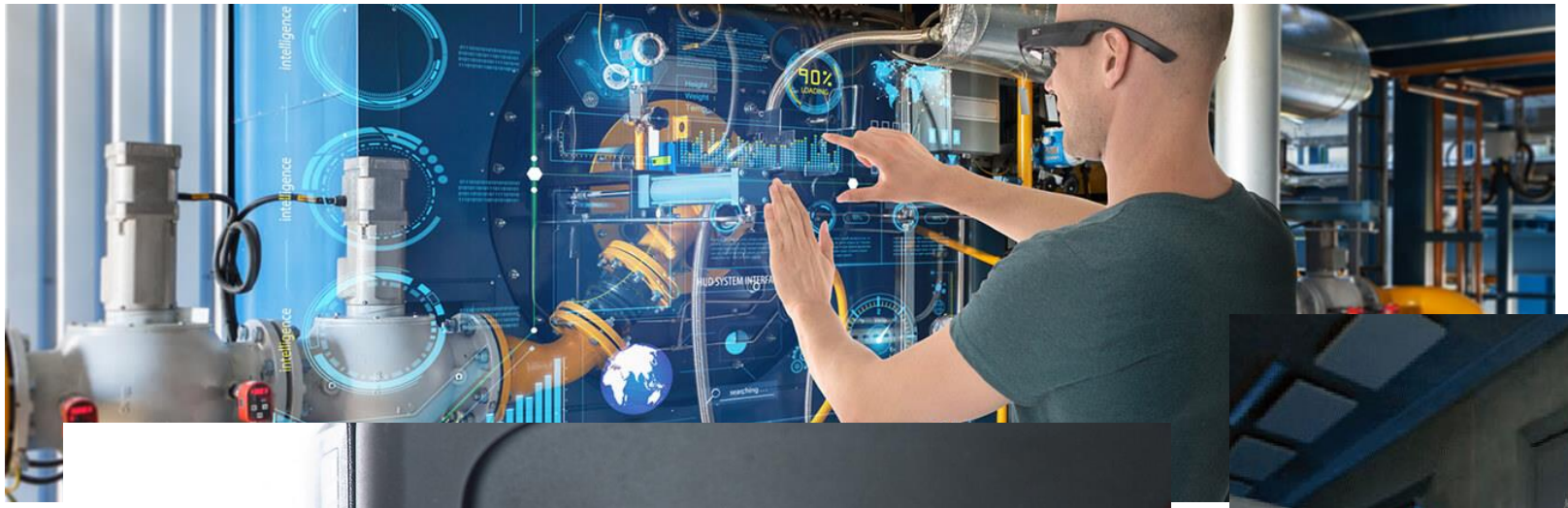
Nintendo Labo

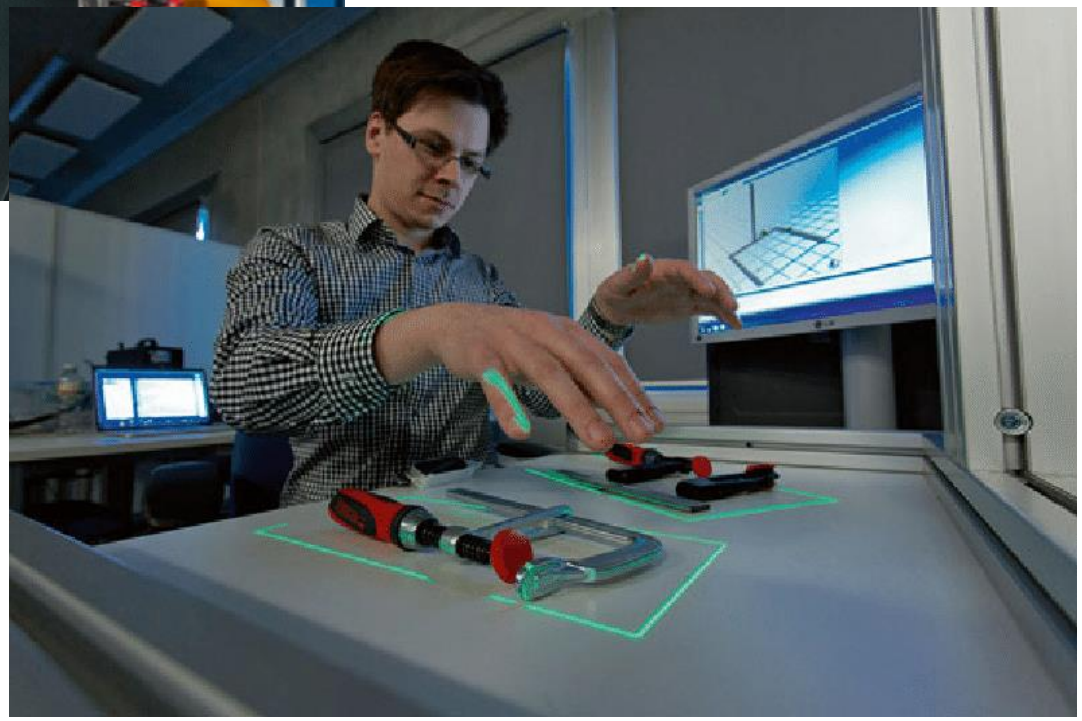
In Engineering, physical artifacts have always been used to handle a model



Nomes “modinha”

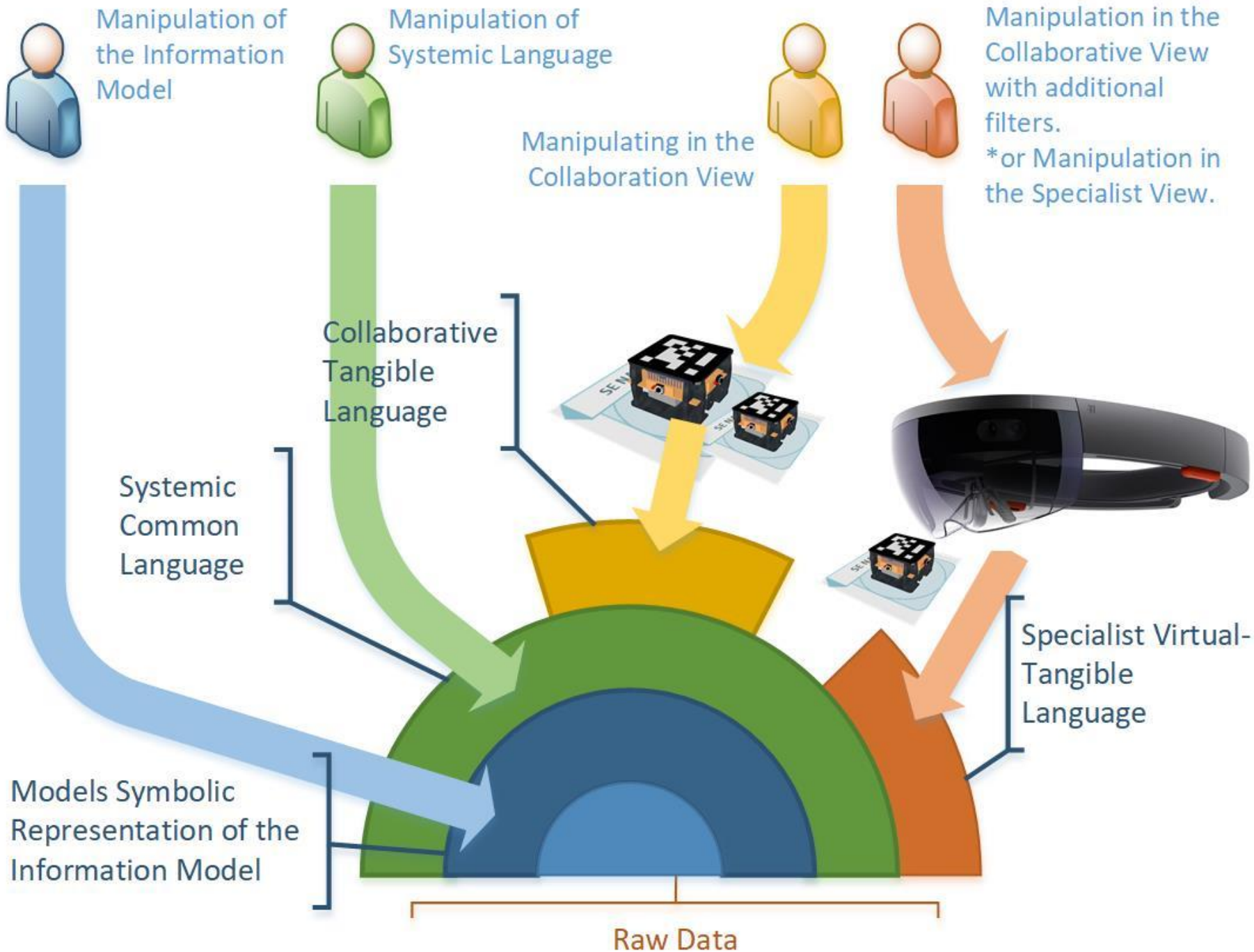
With computing, these artifacts become intelligent





https://blog.teamviewer.com/will-augmented-reality-transform-work/
https://www.researchgate.net/publication/282817636_Ethical_Implications_Regarding_Assistive_Technology_at_Workplaces

You can see acceptance "tests" in the movies...


Manipulation of the Information Model
Manipulation of Systemic Language
Manipulating in the Collaboration View
Manipulation in the Collaborative View with additional filters.
*or Manipulation in the Specialist View.
Collaborative Tangible Language
Systemic Common Language
Specialist Virtual-Tangible Language
Models Symbolic Representation of the Information Model
Raw Data

VIRTUAL REALITY FOCUS

Systems engineers as XR pioneers

By Alessandro Migliaccio - 7 June 2023

Crédits photos : DALL·E

XR, or Extended Reality, is expected to become the fourth computing platform revolution after PCs, the Internet, and mobile phones. Enabling the implementation of disruptive use cases that other technologies simply cannot, it is already beginning to impact society across the board, changing the way people consume and interact with information. But many are wondering if XR has the potential to scale. The

Articles similaires

Win your booth for Europe's biggest VR/AR event

Comprehend the uses and the reach of XR at 2025 conferences

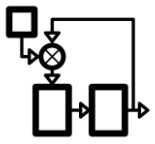
Test the latest generation of VR/AR headsets with IDEM

https://blog.laval-virtual.com/en/systems-engineering-virtual-reality-mbse/

My Research:

Artificial Intelligence

Machine learning
Data Analysis

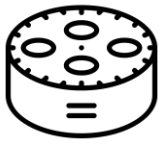


Modelling and Simulation

MBSE
EMF

Internet of Things

Connectivity
HW/SW



Physicality

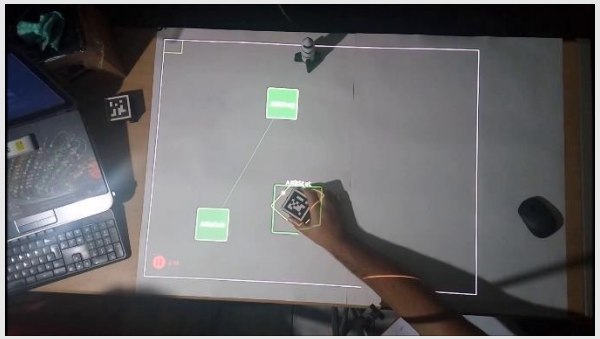
Carboards
Lego
3D Printing

Development of new interaction vocabularies to seek alternatives to make the language of Systems Engineering more natural.

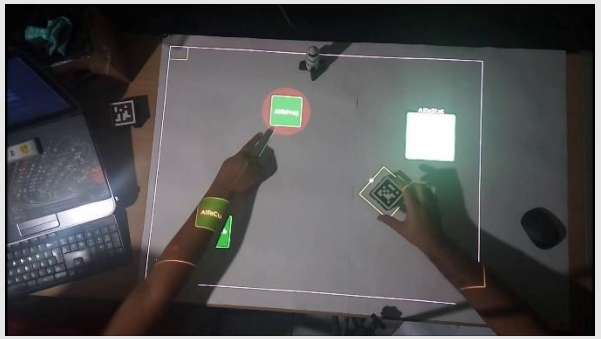
MBSE 4.0

Empowering artifacts as sources of "natural" interactions with models

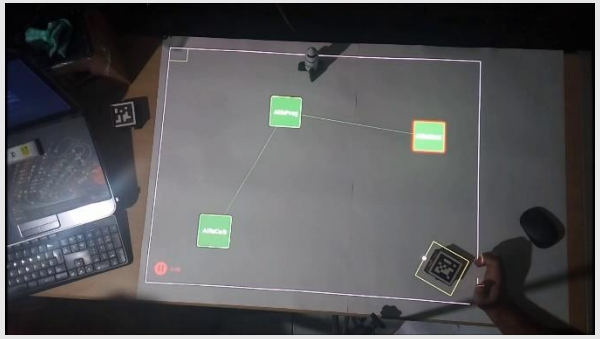
(a) Specialist placing an aura that represents a model to perform discussion



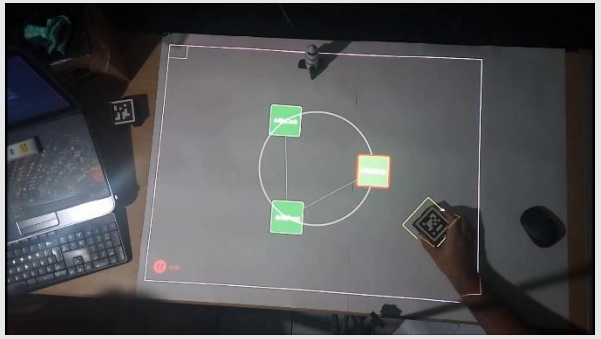
(b) Two specialists discuss the models to decide the coupling

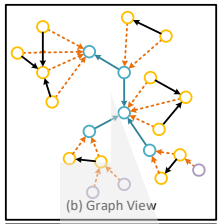


(c) View of the three models coupled.

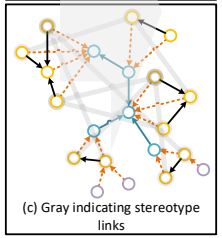


(d) A disc arrangement view to show the connected models.

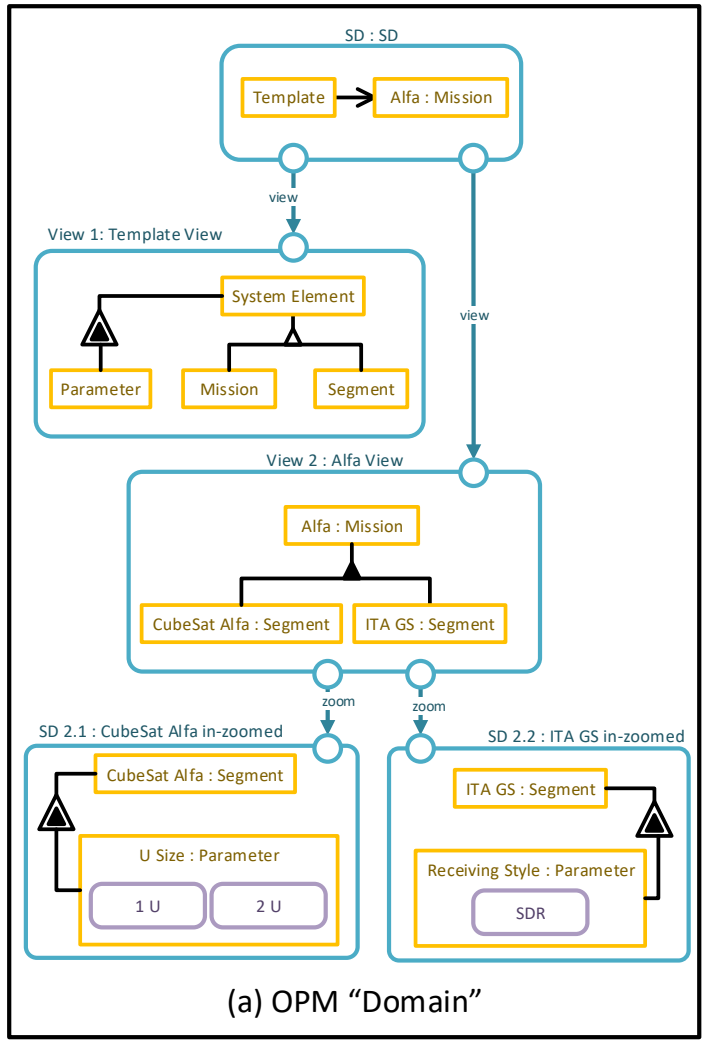




(b) Graph View



(c) Gray indicating stereotype links



(a) OPM "Domain"

What to keep an eye on:

opcloud.tech

OPCloud

Home Features & Uses Testimonials Pricing Contact Us Try It Out

Complex Systems made Simple

OPCloud is a real-time collaborative Web-based environment for Model-Based System Engineering using OPM ISO 19450

Watch

Try it out

OPCloud main features


mbse-capella.org
Capella
WORKBENCH
ARCADIA METHOD
ADOPTERS
COMMUNITY
SERVICES
CONTACT
DOWNLOAD
OPEN SOURCE SOLUTION FOR
MODEL-BASED SYSTEMS ENGINEERING
Eclipse Capella™ is a comprehensive, extensible and field-proven MBSE tool and method
to successfully design systems architecture
Discover Capella
in 2 minutes
The spirit of Arcadia and Capella
in 8 minutes
YOUR INDUSTRIAL-GRADE MBSE WORKBENCH

OMG Standards Development Organization

ABOUT US | GROUPS | CERTIFICATIONS | RESOURCES | SPECIFICATIONS | COMMUNITIES | MEMBERSHIP

ABOUT THE OMG SYSTEM MODELING LANGUAGE SPECIFICATION VERSION 2.0

2.0 • SYSML • SPECIFICATIONS

SysML® — OMG System Modeling Language

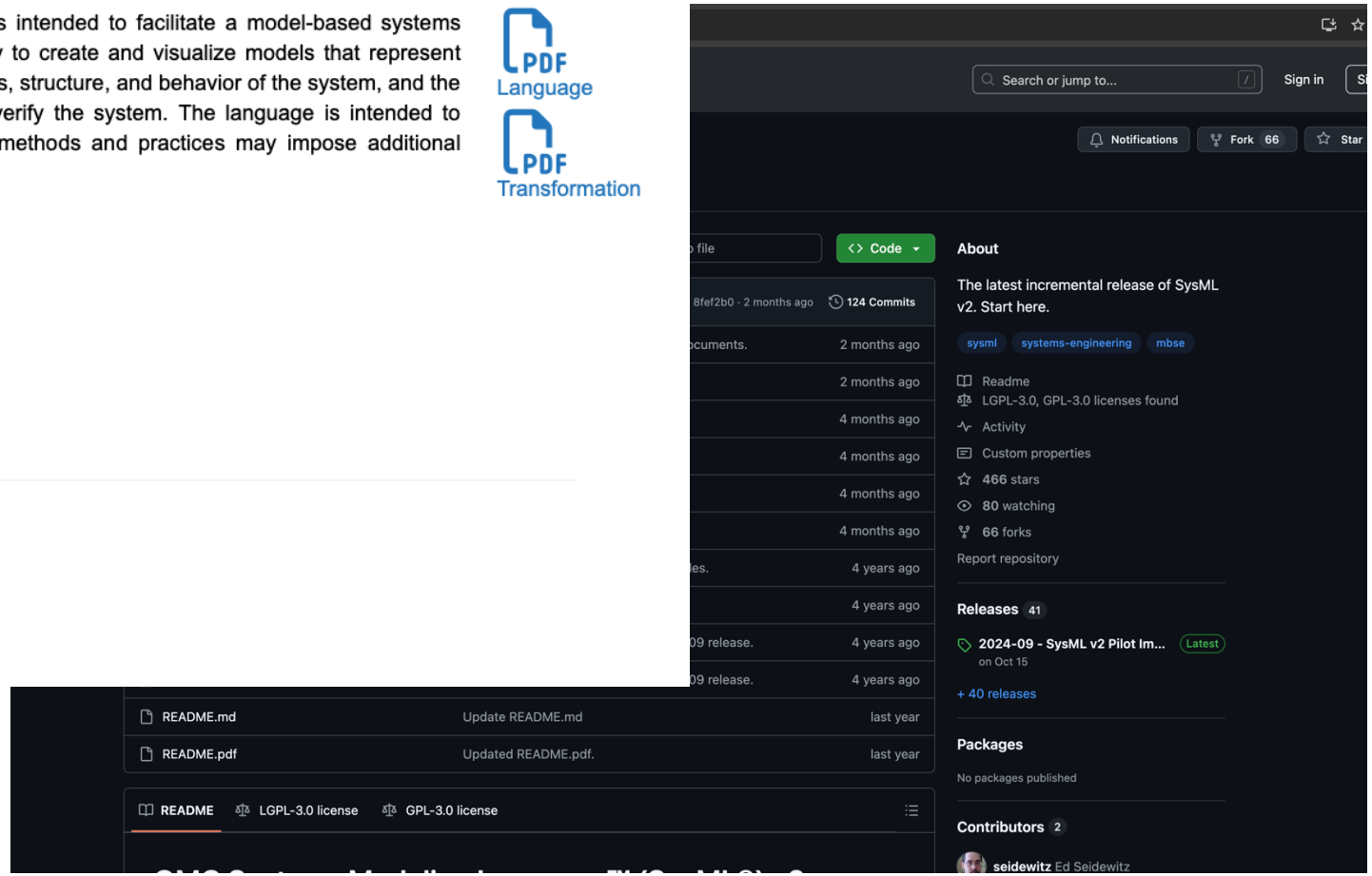
SysML is a general-purpose modeling language for modeling systems that is intended to facilitate a model-based systems engineering (MBSE) approach to engineer systems. It provides the capability to create and visualize models that represent many different aspects of a system. This includes representing the requirements, structure, and behavior of the system, and the specification of analysis cases and verification cases used to analyze and verify the system. The language is intended to support multiple systems engineering methods and practices. The specific methods and practices may impose additional constraints on how the language is used.

PDF Language

PDF Transformation

Title: OMG System Modeling Language
Acronym: SysML®
Version: 2.0
Document Status: formal ⓘ
Publication Date: September 2025
Categories: Ptc
IPR Mode ⓘ Non-Assert ⓘ

TABLE OF CONTENTS



mbse-syson.org

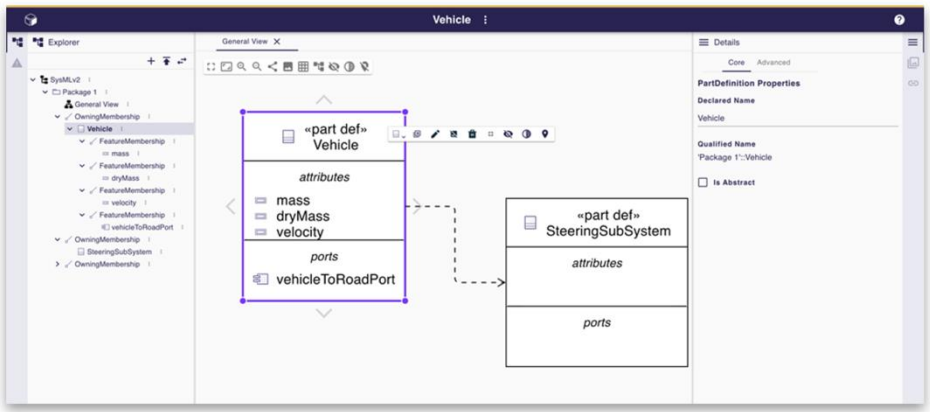
SysON

FEATURES RESOURCES ROADMAP COMMUNITY SOURCE CODE

THE NEXTGEN SYSML MODELING TOOL

Edit SysML v2 models with Eclipse SysON, an open-source and web-based MBSE modeling tool.

GET STARTED STAY TUNED



Standard Compliant

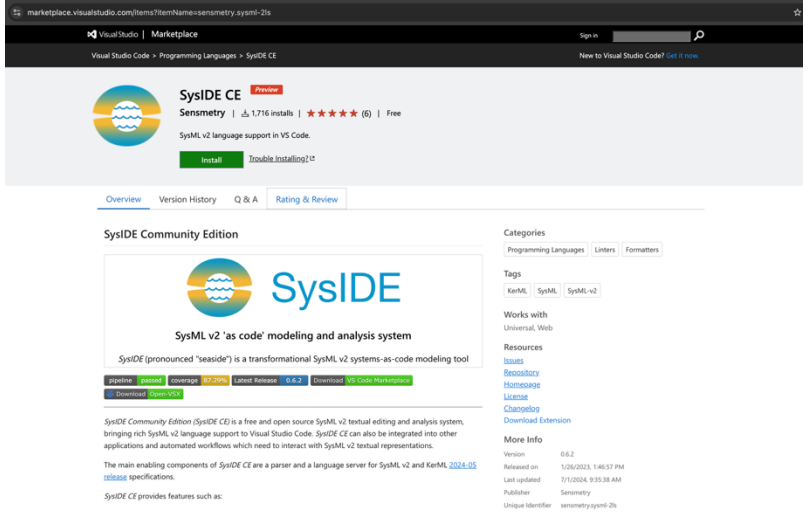
SysON aims at providing an implementation of the OMG's specification **SysML v2**: language concepts, REST API, and interoperability textual format

Web-Based

Graphical, form-based and tabular structured editors that can be used from a web browser, without any specific installation on user's desktop

Open-Source

Hosted in the Eclipse community, SysON aims to catalyze industrial collaboration, accelerate innovation, and foster the adoption of SysMLv2



Learn SysML v2 through the Advent of SysML v2 Challenge! Join for Free

Sensmetry

Syside | Sysand | Resources | Company | Contact

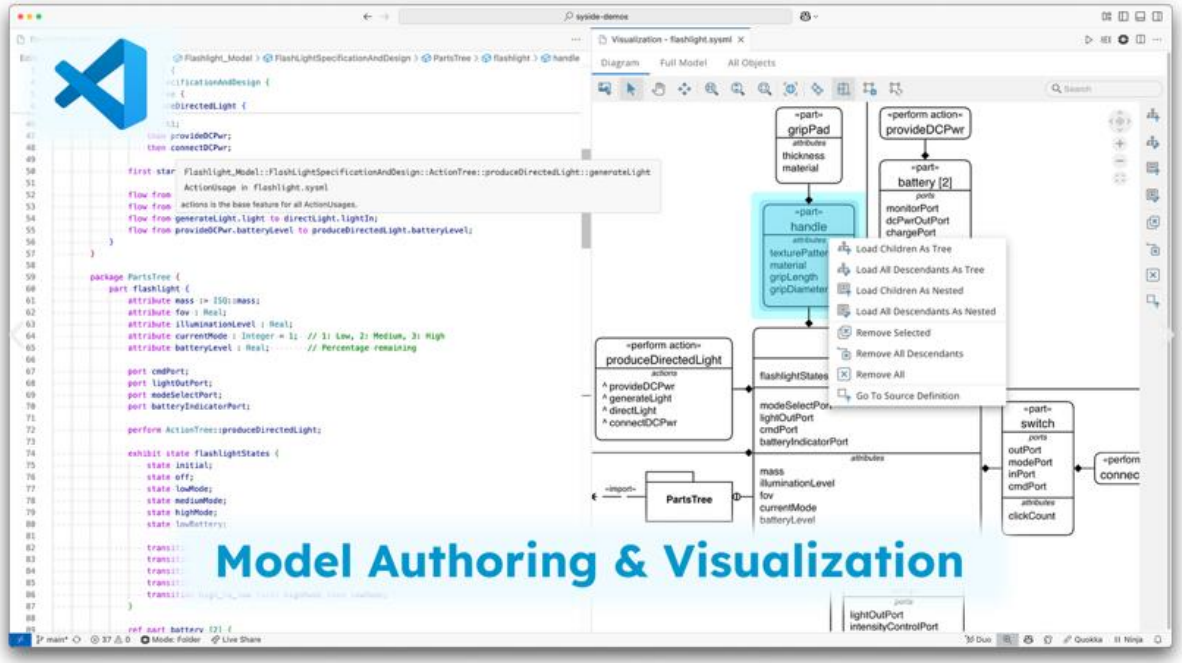
Systems Engineering at the Speed of Code

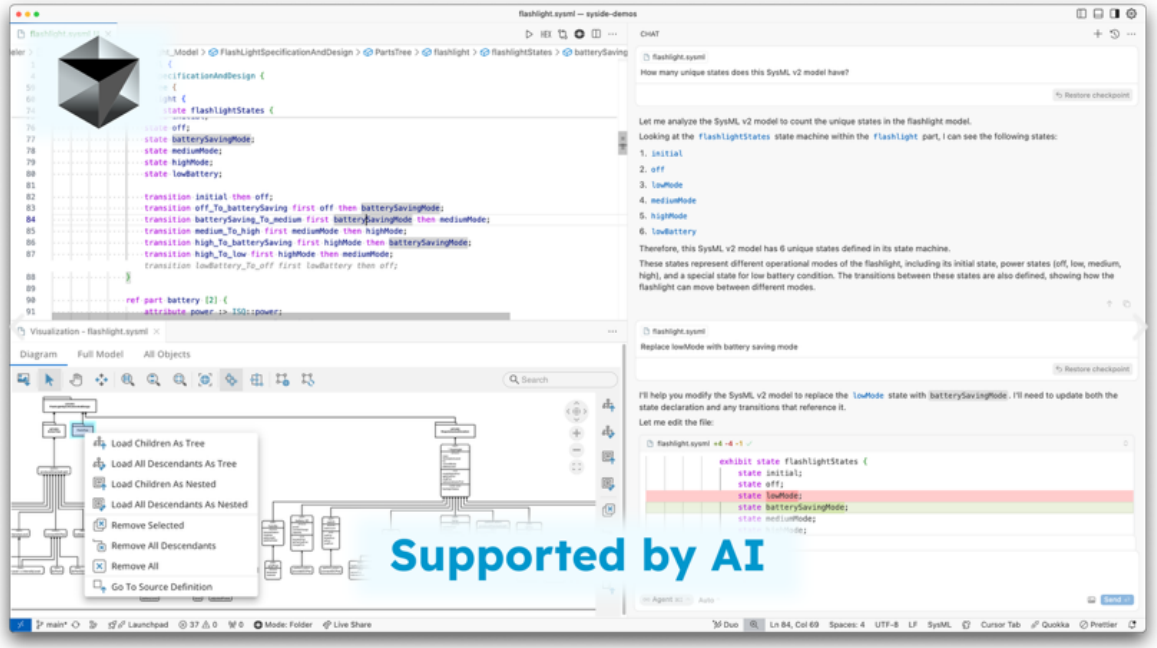
Syside is a comprehensive SysML v2 tool suite for the AI age

Over 10k users
Trusted by thousands and growing every day.

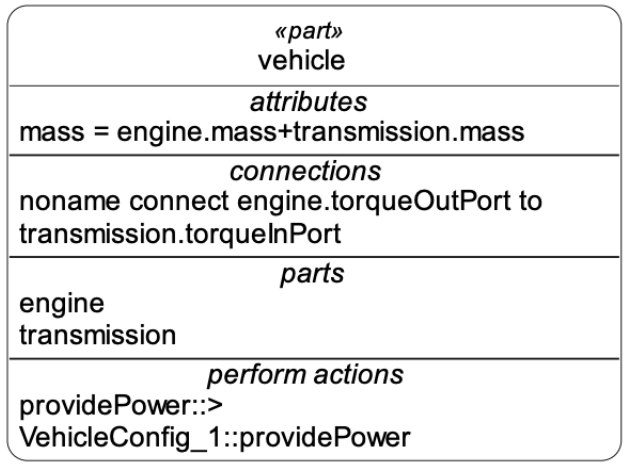
Stellar user feedback
Praised by users for cutting-edge performance and functionality.

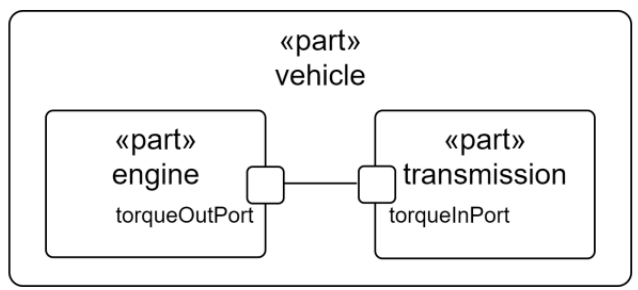
Award-winning
Recognized globally for exceptional innovation.

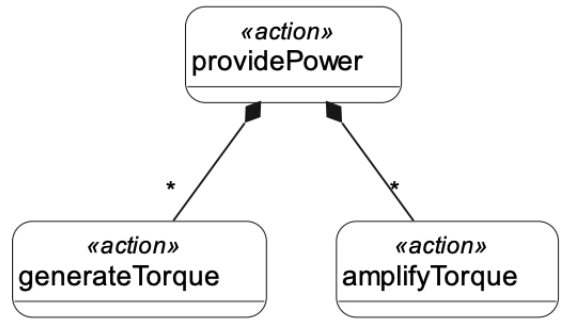




```
part vehicle{
    attribute mass = engine.mass+transmission.mass;
    perform providePower;
    part engine{
        attribute mass;
        port torqueOutPort;
        perform providePower.generateTorque;
    }
    part transmission{
        attribute mass;
        port torqueInPort;
        perform providePower.amplifyTorque;
    }
    connect engine.torqueOutPort to transmission.torqueInPort;
}
action providePower{
    action generateTorque;
    action amplifyTorque;
}
```







openmbee.org

OpenMBEE

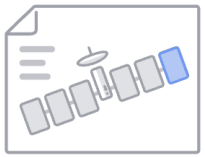
Home About Contribute Participate Projects Community Events

Connected engineering information for a connected world

OpenMBEE (Open Model Based Engineering Environment) is an open source collaborative engineering system. It enables engineers to work in the language of their choice and easily share and document their work across other tools.

Edit once, use everywhere

OpenMBEE Components

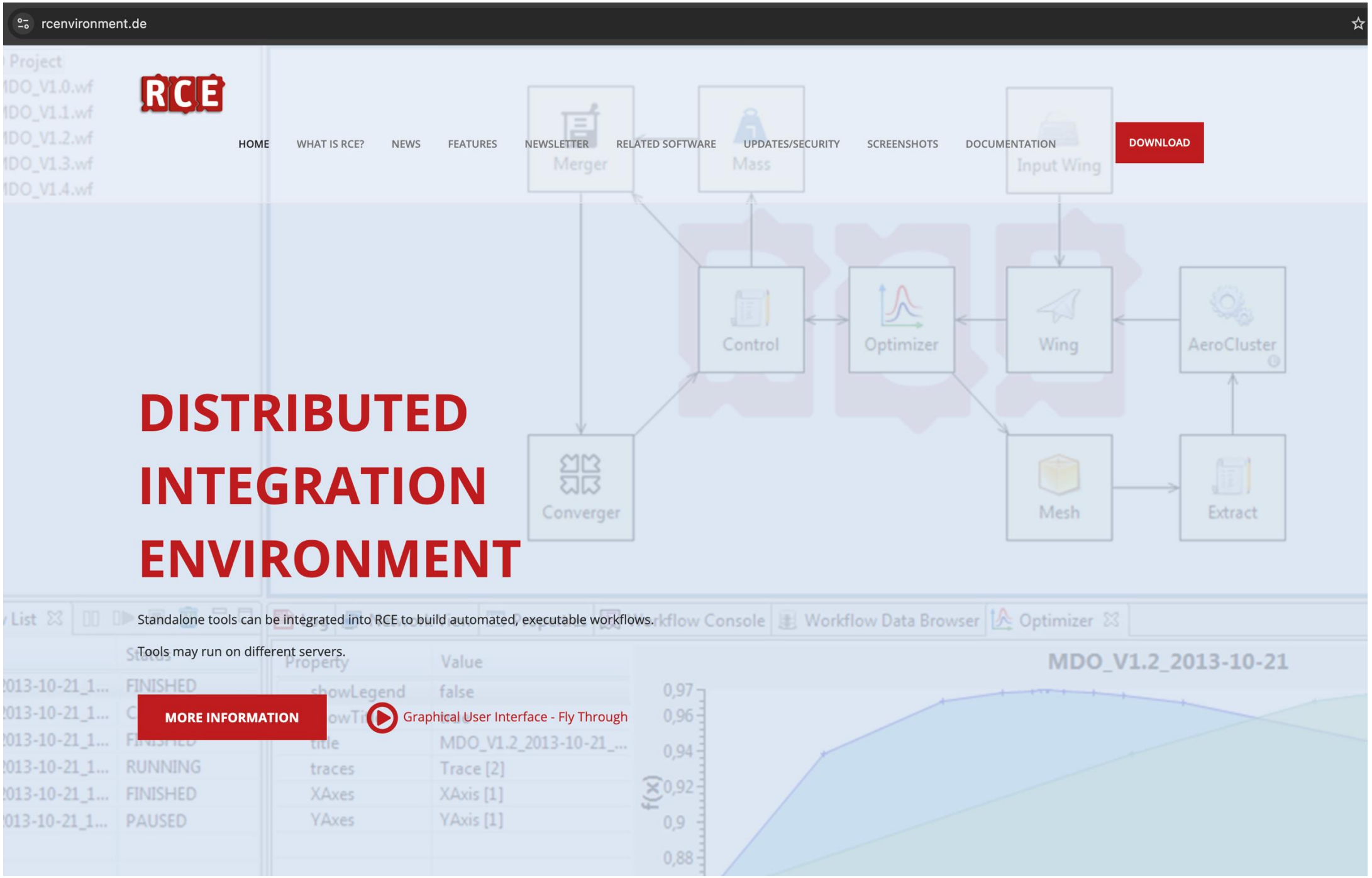


Model Development Kits

Model Management System

View Editor

OpenSE Cookbook


rcenvironment.de
RCE
HOME
WHAT IS RCE?
NEWS
FEATURES
NEWSLETTER
RELATED SOFTWARE
UPDATES/SECURITY
SCREENSHOTS
DOCUMENTATION
DOWNLOAD
DISTRIBUTED INTEGRATION ENVIRONMENT
Standalone tools can be integrated into RCE to build automated, executable workflows.
Tools may run on different servers.
MORE INFORMATION
Graphical User Interface - Fly Through
Merger
Mass
Input Wing
Control
Optimizer
Wing
AeroCluster
Converger
Mesh
Extract
Workflow Data Browser
Optimizer
MDO_V1.2_2013-10-21

iils.de/en/

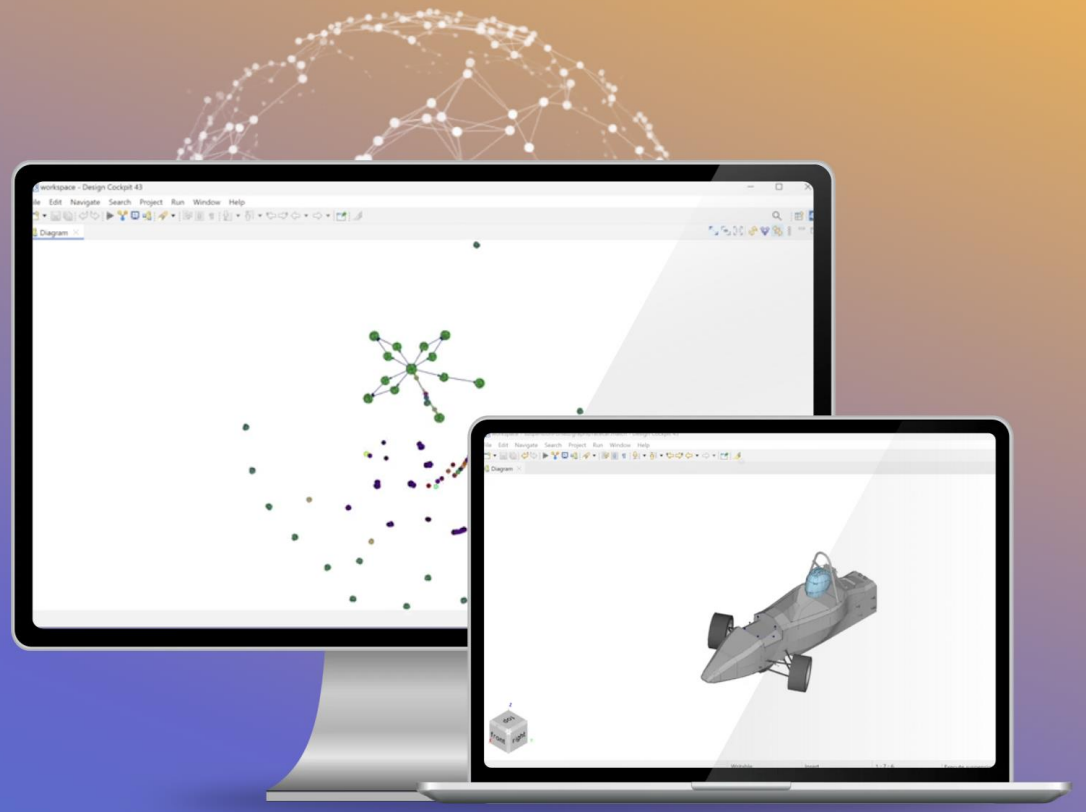
IILS Technology Solutions Services About Contact Us → De

GRAPH-BASED DESIGN LANGUAGES & DESIGN COCKPIT 43®

Total Engineering Automation

Accelerate your engineering processes with the revolutionary *Graph-based Design Languages* and the powerful *Design Cockpit 43®* software tool suite. Describe complex engineering products and design processes holistically and fully automate the generation of consistent engineering models.

Get Started →



spicy-se.com

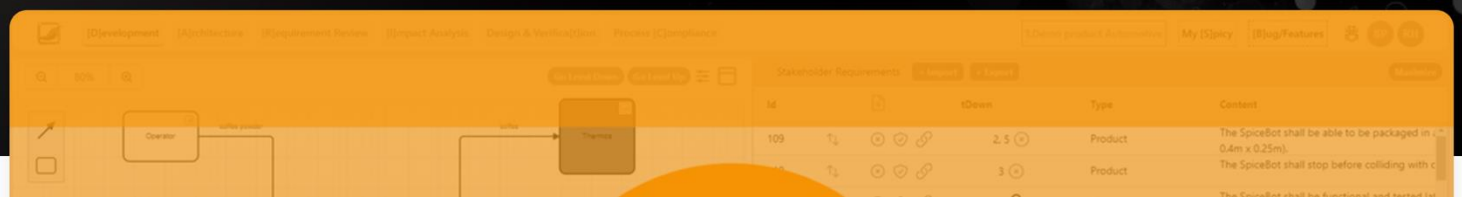
HOME FEATURES TEAM CONTACT

TRY SPICY NOW

No more ISO26262 nightmares!

All your ideas in a single platform. Easily accessible by your whole team.

TRY SPICY NOW!



We use cookies to ensure you g
the best experience on our web

mathworks.com/products/system-composer.html

MathWorks Products Solutions Learn Company Help Center Get MATLAB Sign In

System Composer

MAJOR UPDATE

System Composer

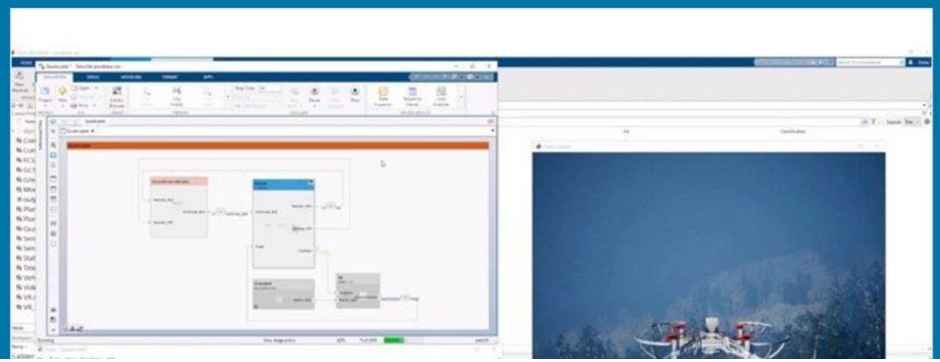
Design, analyze, and simulate system and software archi

Get a free trial | View pricing

Have questions? Contact Sales.

System Composer enables the specification and analysis of architectures for model-based systems engineering (MBSE) and modeling of software architectures. You can allocate requirements, refine an architecture model, and design and simulate in Simulink.

System Composer lets you directly author architecture models consisting of components, ports, connectors, and interfaces, import them from other tools, or populate them from the architectural elements of Simulink designs. You can describe your system using multiple architecture models and establish direct



mathworks.com/products/sysml.html

MathWorks Products Solutions Learn Company Help Center Get MATLAB Sign In

Software Support

SysML Connector

Import SysML models into System Composer

Request support package

The SysML Connector Product Support Package bridges external SysML environments and System Composer, enabling system designs to transition into MATLAB and Simulink. You can import SysML artifacts from the XML Metadata Interchange (XMI) 2.5.1 format. This integration facilitates the import of SysML models, including activity diagrams (behavior of system functions) and sequence diagrams (discrete data exchanges between system components).

You can directly connect imported system models in System Composer to Simscape, Simulink, and Stateflow designs, creating fully simulatable and testable architectures. Also, you can import SysML requirements and links into Requirements Toolbox to establish traceability and provide a means for further decomposition from system models to source code.

SysML v2 Support

The SysML Connector package supports SysML1.x. MathWorks plans to support the Object Management

SIEMENS

EN Log in

Digital Industries Software | Software & products | Solutions & services | Industries | Training & support

Teamcenter | Overview | Solutions | Case studies | News | Teamcenter X | Trials

PLM Software > Teamcenter > Teamcenter solutions > MBSE

TEAMCENTER

MBSE: Model-based systems engineering

Product development without integrated architecture is like building without blueprints. System integration can consume as much as half of your program's resources. Start using model-based systems engineering (MBSE) early on for continuous integration.

Contact Sales | Plans and pricing

FORRESTER

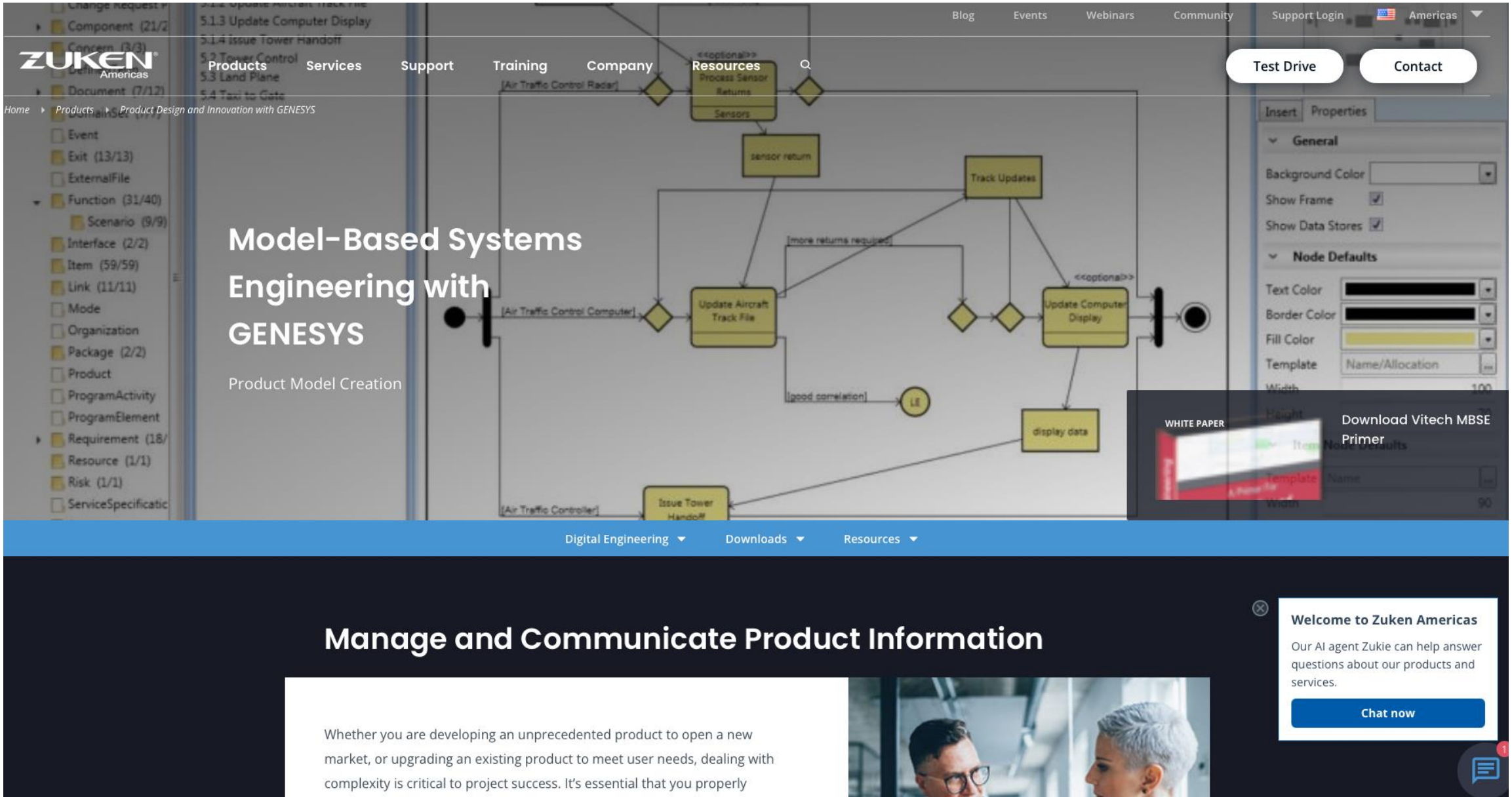
Calculate the value of PLM on the cloud

Forrester Consulting study - The Total Economic Impact™ of Siemens Teamcenter X

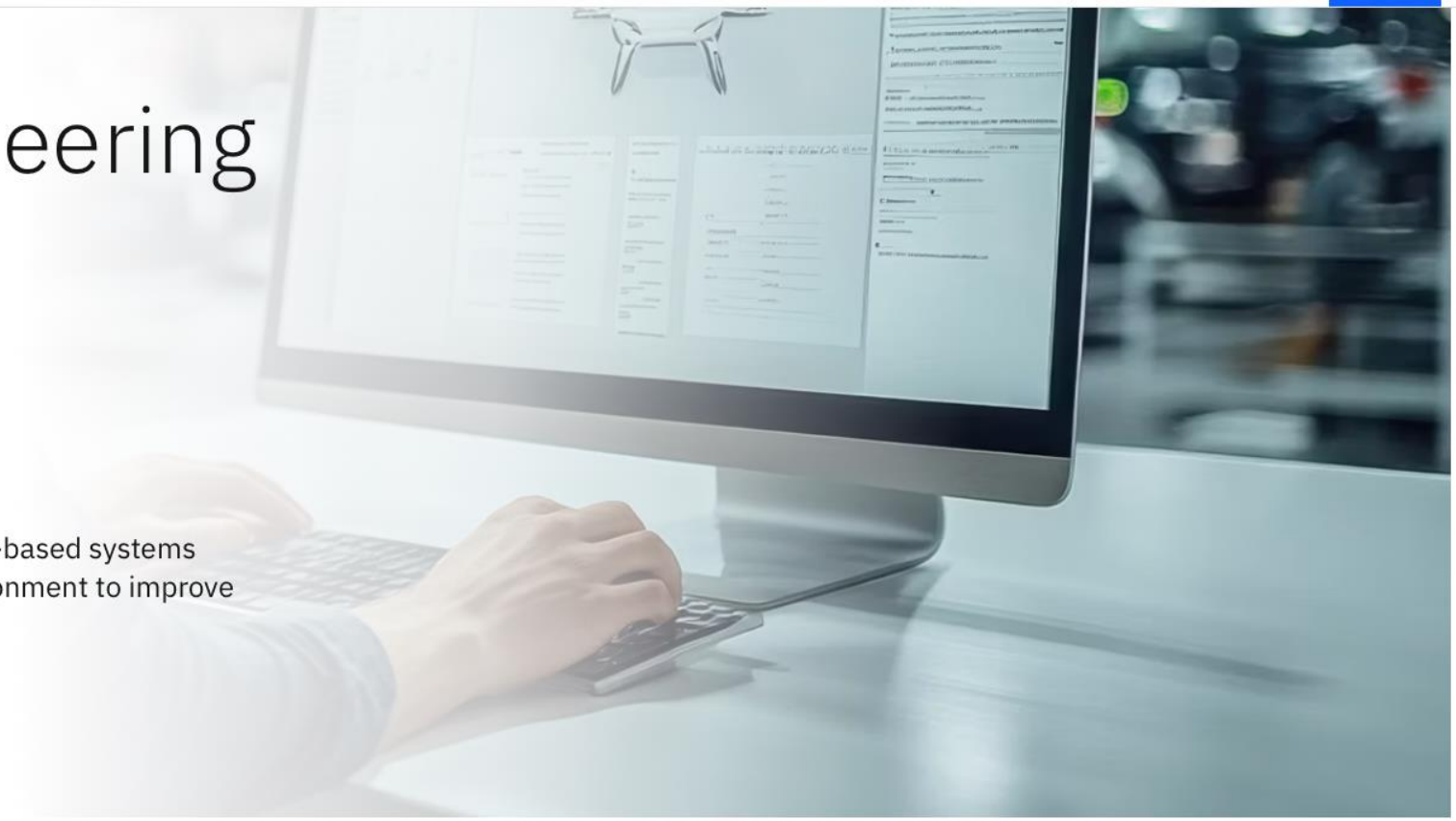
Try it now

Start integrated. Stay integrated.

Integrate product architecture with system models, requirements and parameters inside product lifecycle management (PLM) to drive the entire product development process.


Blog
Events
Webinars
Community
Support Login
Americas
ZUKEN
Americas
Products
Services
Support
Training
Company
Resources
Test Drive
Contact
Home
Products
Product Design and Innovation with GENESYS
Model-Based Systems Engineering with GENESYS
Product Model Creation
WHITE PAPER
Download Vitech MBSE Primer
Digital Engineering
Downloads
Resources
Manage and Communicate Product Information
Whether you are developing an unprecedented product to open a new market, or upgrading an existing product to meet user needs, dealing with complexity is critical to project success. It's essential that you properly
Welcome to Zuken Americas
Our AI agent Zukie can help answer questions about our products and services.
Chat now

IBM Engineering Rhapsody Designer



Provides a collaborative, model-based systems engineering development environment to improve product

Book a meeting

Overview

IBM Engineering Rhapsody Designer uses Systems Modeling Language (SysML) and Unified Modeling Language (UML)—all within a MBSE (Model-Based Systems Engineering) environment. It helps you adapt to changing customer requirements, improves

3SL

About Cradle Products Resources Support Buy Contact Login

Announcing Cradle-7.7 - start your free trial here

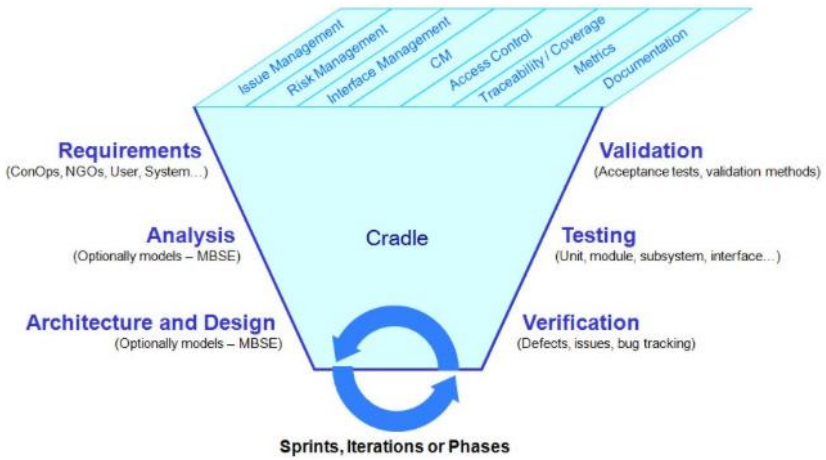
Cradle Overview

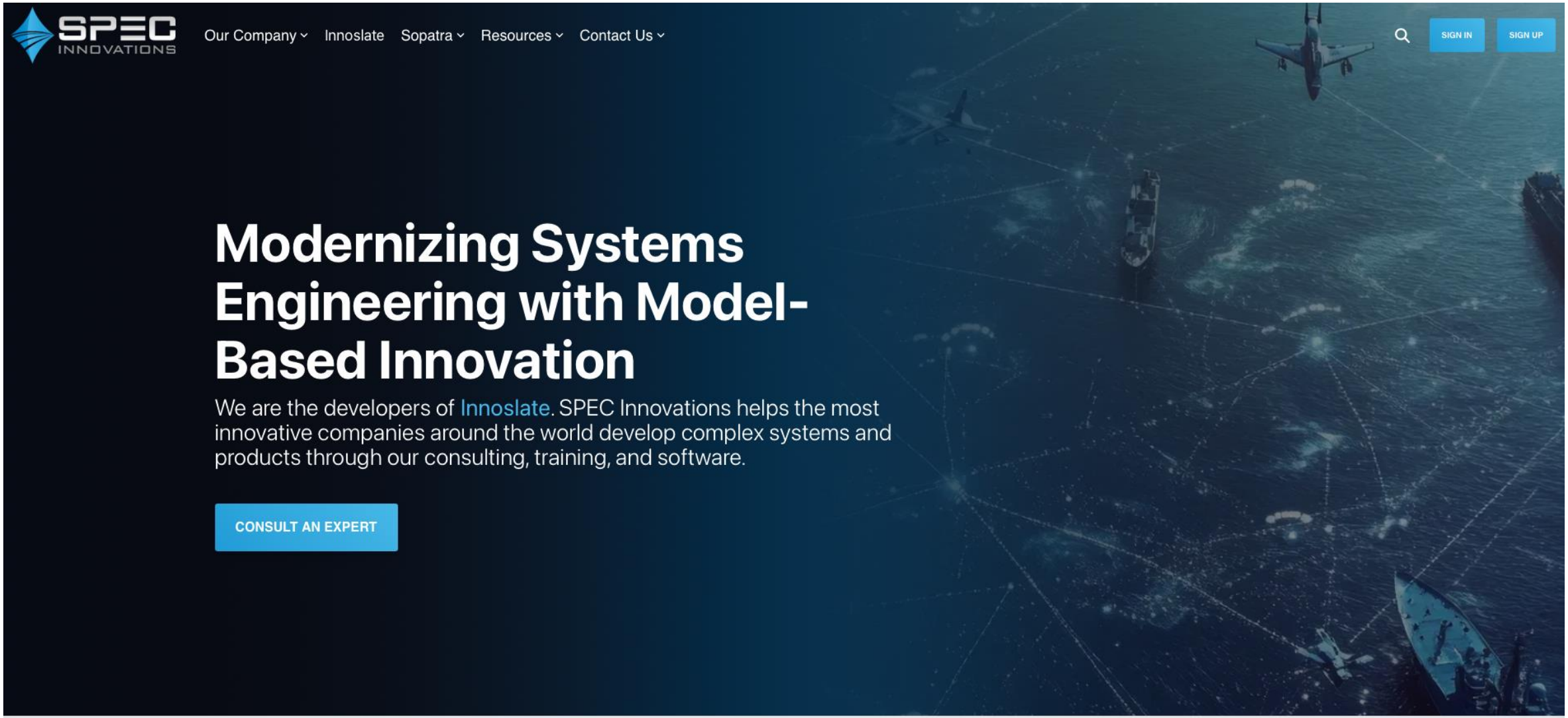
What is Cradle?

Cradle is a tool to load, create, inter-link and publish information for all stages in a systems engineering project using agile, iterative or phase-based approaches and using any process. It is completely user-definable, scalable, flexible and secure. It can be deployed locally in your organisation or project, deployed to remote sites or partners, or delivered through SaaS from any private or public cloud.

Cradle can support all your requirements management and systems engineering work in one tool, including:

- Load information from external sources
- Manage needs, user stories, requirements and a product backlog
- Analyse the user needs, optionally with models (MBSE)
- Define the design constraints
- Define the architecture, optionally with models
- Create the design, optionally with models
- Define and track tests, issues and defects at all levels
- Manage user acceptance and system validation
- Conduct traceability and coverage analyses across all information in the entire lifecycle or any part of it
- Publish documentation with user-defined layouts and templates
- Manage work breakdown structures and user task lists, record actual progress, and link bi-directionally to project planning tools
- Reuse and share information between projects

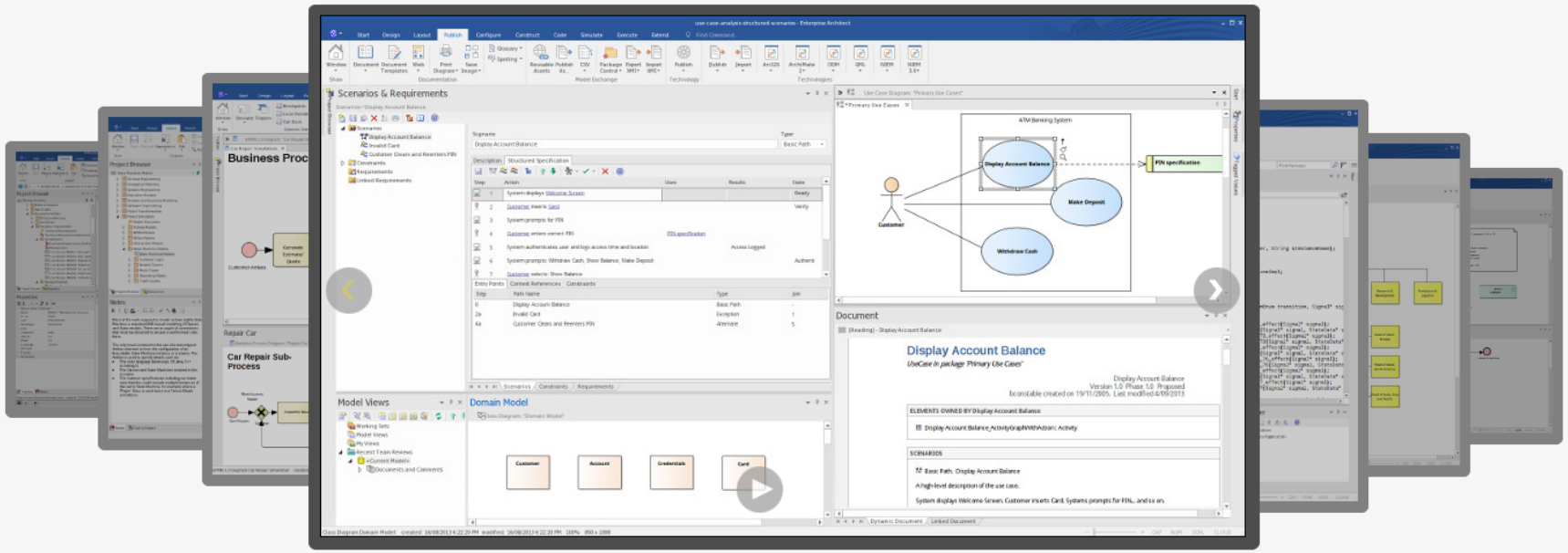



SPEC INNOVATIONS
Our Company
Innoslate
Sopatra
Resources
Contact Us
SIGN IN
SIGN UP
Modernizing Systems Engineering with Model-Based Innovation
We are the developers of Innoslate. SPEC Innovations helps the most innovative companies around the world develop complex systems and products through our consulting, training, and software.
CONSULT AN EXPERT
Our innovative customers include:

Enterprise Architect

Fast Intuitive Modeling & Design

The perfect enterprise wide solution to visualise, analyse, model, test and maintain all of your systems, software, processes and architectures. Enterprise Architect is the ideal platform to help you to stay in control of your workspace, support your colleagues and team, enable collaboration and build confidence within your most complex projects.



Model how users interact with systems

Download Buy Now

Book a Demo

Introducing Windchill Modeler 10: What's New and Noteworthy

August 31, 2023

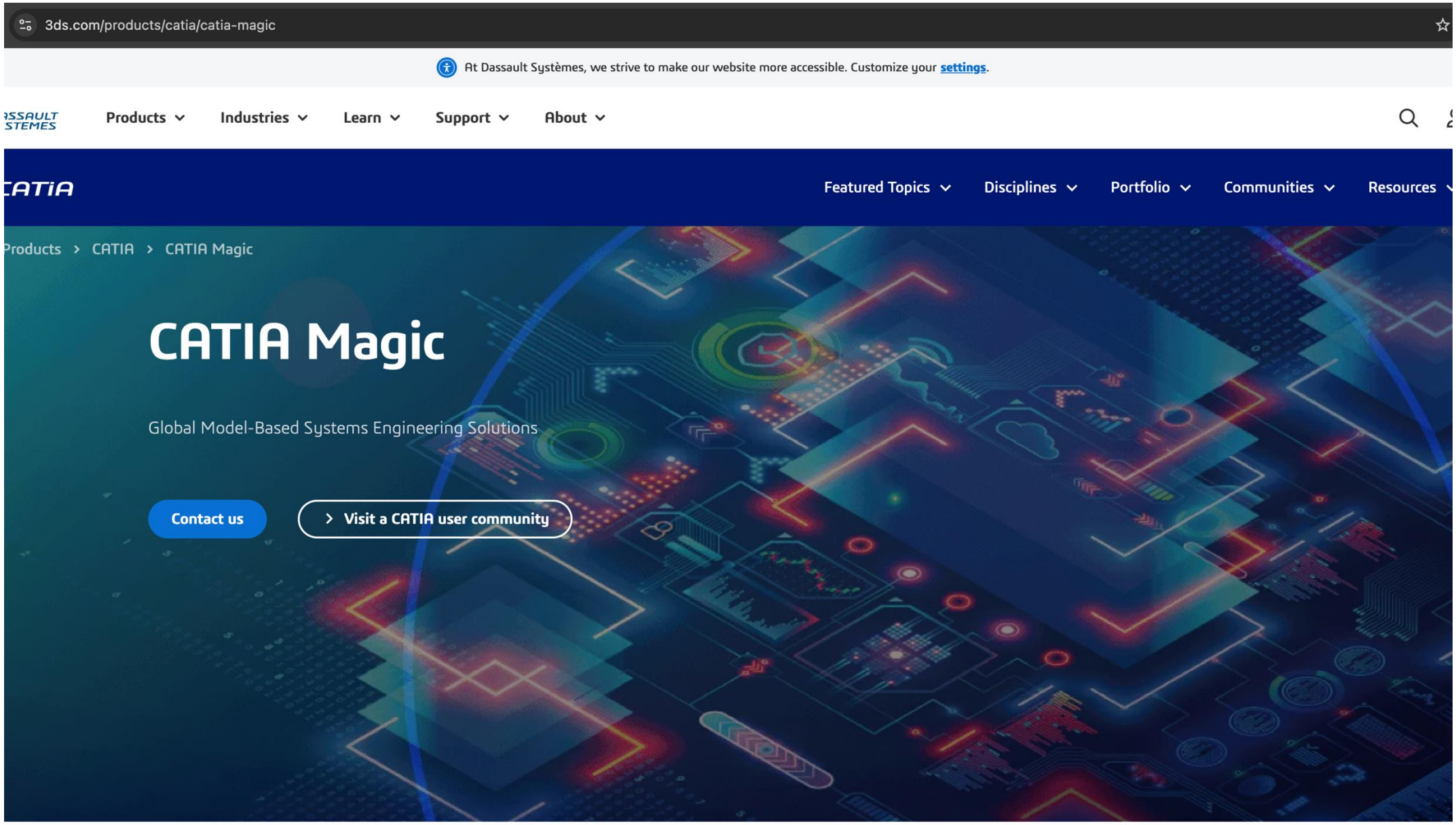
Hanna Taller

Share

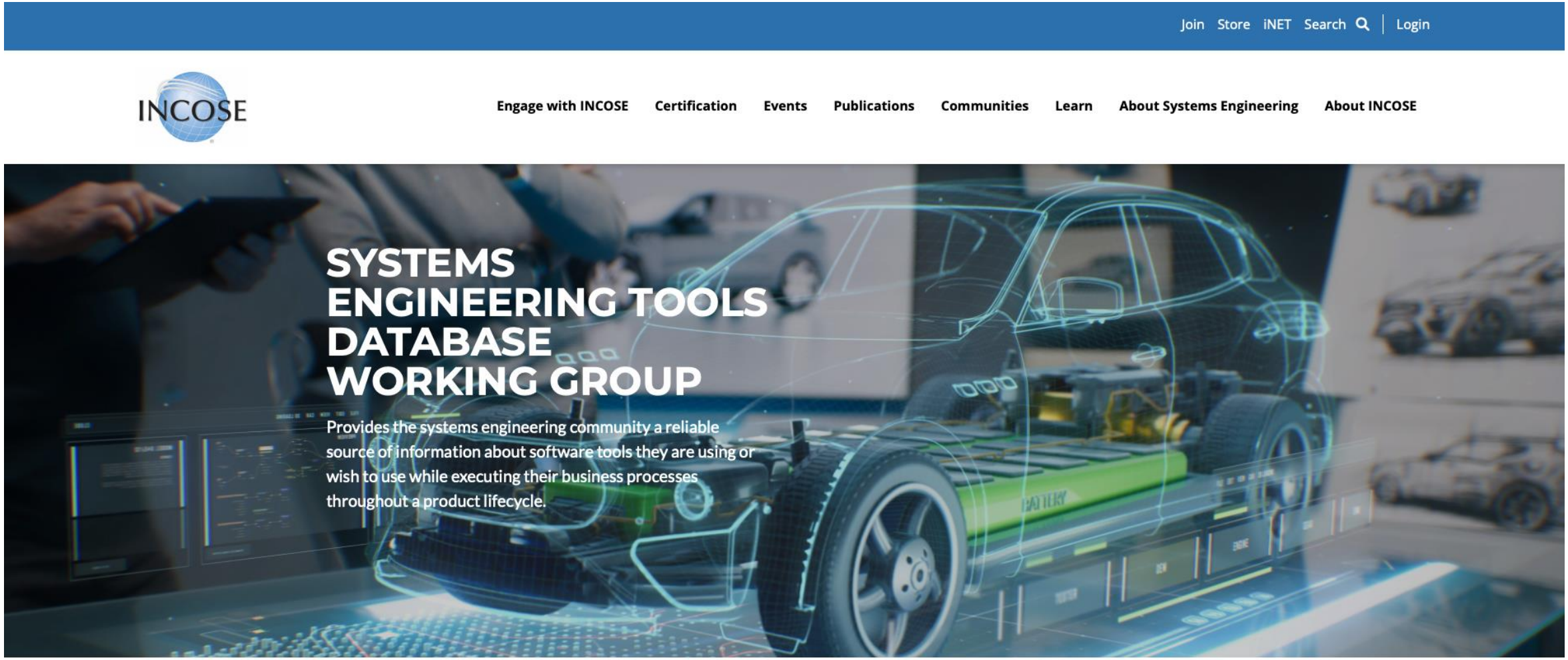
We're happy to announce the release of Windchill Modeler's new version: Windchill Modeler 10. Keep reading to find out what's new in this version!

Focusing on SysML

Systems Engineers utilize systems modeling as a cost-effective way to explore and document complex system characteristics. By testing and validating system characteristics early, models enable a timely understanding of properties and behaviors, enabling rapid feedback on requirements and design decisions. This model-based systems engineering (MBSE) approach is recognized by the International Council of Systems Engineers (INCOSE) as the application of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing



Next Gen Systems Engineering Solutions



https://www.incosewiki.info/Model_Based_Systems_Engineering/index.php/MBSE_Tools
https://www.incose.org/learn/se-laboratory

Dr. Alejandro Salado · 2º
Systems Engineering | Engineering Strategy | Enterprise...
Tucson, AZ
5 mil seguidores
61 conexões em comum
Enviar mensagem | Ver perfil completo

Derek Cabrera · 1º
Faculty at Cornell University
Ithaca, NY
8 mil seguidores
14 conexões em comum
Enviar mensagem | Ver perfil completo | Conheça meus serviços

A/Prof Timothy Ferris · 1º
Associate Professor of Systems Engineering at Cranfield...
Greater Oxford Area
Experiência: Cranfield University, Cranfield Univeristy e mais 1
34 conexões em comum
Enviar mensagem | Ver perfil completo

Tim Weilkiens · 2º
MBSE'ler, Executive Board Member oose, Founder MBSE4U,...
Stadt Hamburg
6 mil seguidores
91 conexões em comum
Enviar mensagem | Ver perfil completo

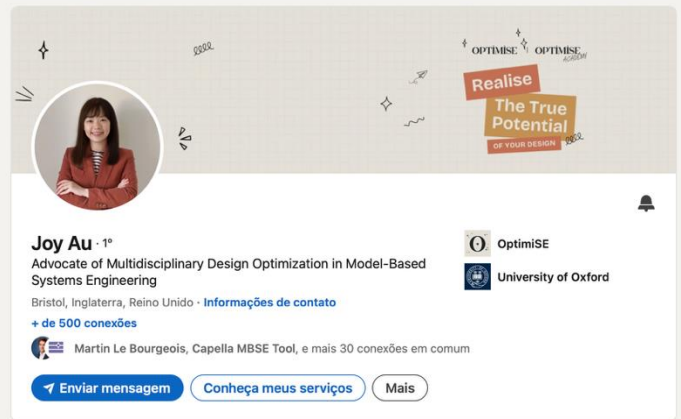
Dov Dori · 1º
Professor, Head, Enterprise Systems Modeling Lab, Technion,...
Haifa District, Israel
5 mil seguidores
72 conexões em comum
Enviar mensagem | Ver perfil completo

Derek Hitchins · 1º
Professor, Retired.
Weston-Super-Mare
653 seguidores
32 conexões em comum
Enviar mensagem | Ver perfil completo

Stéphane Lacrampe · 1º
Talks about MBSE - Capella - SysON - Open-source. Obeo...
Comox, BC
Experiência: ObeoSoft Canada Inc, INCOSE Canada Chapter e mais 7
301 conexões em comum
Enviar mensagem | Ver perfil completo

Dan DeLaurentis · 2º
Vice President of Discovery Park District Institutes & Bruce...
West Lafayette, IN
Experiência: Krach Institute for Tech Diplomacy at Purdue, Systems Engineering Research Center (SERC) e mais 2
4 conexões em comum
Conectar | Ver perfil completo

Ali Raz, Ph.D., CSEP · 1º
Assistant Professor of Systems Engineering | Assistant Directo...
West Lafayette, IN
Experiência: George Mason University, Naval Postgraduate School e mais 4
38 conexões em comum
Enviar mensagem | Ver perfil completo



Joy Au · 1º
Advocate of Multidisciplinary Design Optimization in Model-Based Systems Engineering
Bristol, Inglaterra, Reino Unido · Informações de contato
+ de 500 conexões
Martin Le Bourgeois, Capella MBSE Tool, e mais 30 conexões em comum
Enviar mensagem | Conheça meus serviços | Mais

OptimiSE
University of Oxford

inicial

da internet

ntas

ogia

a pop

e TV

o Reddit

as

sa

idades

or do Reddit

r/systems_engineering · há 8 meses
Rhedogian

Change My View: Model Based Systems Engineering in 2024 is at best overhyped, or is at worst actively dying

I know the title is a little controversial but I feel like this conversation needs to be had now within the community. For the past couple of years I've felt like more and more of a scam salesman trying to push this MBSE stuff onto people, and at this point it feels like it's time to let the reality of the situation have it's time in the light.

About me:

- Systems engineer for 5 years with a focus on MBSE
- Have done straight MBSE since undergrad and through my MS degree as well (BS/MS Aerospace Engineering)
- Currently holding the OCSMP-MBI certificate
- Have used Cameo almost exclusively, as well as quite a few different 3rd party integration suites (Syndeia, SBE Vision, Excel, etc.)
- Have attempted to push SysML in at least three different industries (commercial aerospace, automotive/tech, DoD aerospace)

My breaking point with letting go of MBSE has come pretty recently, and I've done my best to remain hopeful in the concept despite my doubts, but at this point I'm no longer confident in MBSE's ability to be a transformational force in system design as it's been sold.

As it sits currently, MBSE has turned into another boutique silo of information that is squirreled away in a program that looks like it's out of 1992 and is impossible for a new user to quickly pick up and start using to generate useful engineering artifacts. It requires a team of bona fide experts to even set up and begin using the tool properly, and also more trained experts to effectively use the SysML modeling language to try and derive some value out of the language and process.

What I've learned is that no actual engineers (meaning, the ones who design and build the actual product) really care about MBSE or what it's trying to do. Whereas MBSE practitioners and salespeople try to pitch it as a single source of truth methodology where all engineers can derive their SE material from the model, in practice, unless a design engineer is forced to log into teamwork cloud or cameo collaborator by upper management, they really don't care about the contents of the model since they're already effectively managing their own content in their excel sheets/visio diagrams/JIRA. Sure this is a problem, but I don't think MBSE is currently at a place where it can be solved without, effectively, data duplication.

The program I'm on currently has put its full backing into an MBSE effort all the way from upper management support to being a requirement on the statement of work. And we're STILL at the point where no engineering is being done in the model (by decree of our very well-intentioned and forward looking chief engineer) and the model is really only being used as high quality documentation so that the customer has an easier time snooping at our architecture. This

r/systems_engineeri... Unir-se

Systems Engineering
Our mission is to foster a collaborative space where professionals, students, and enthusiasts can come together to discus...

Mostrar mais

Pública

8,5 mil Membro · **2** Online · **Top 8%** Classificação por tamanho

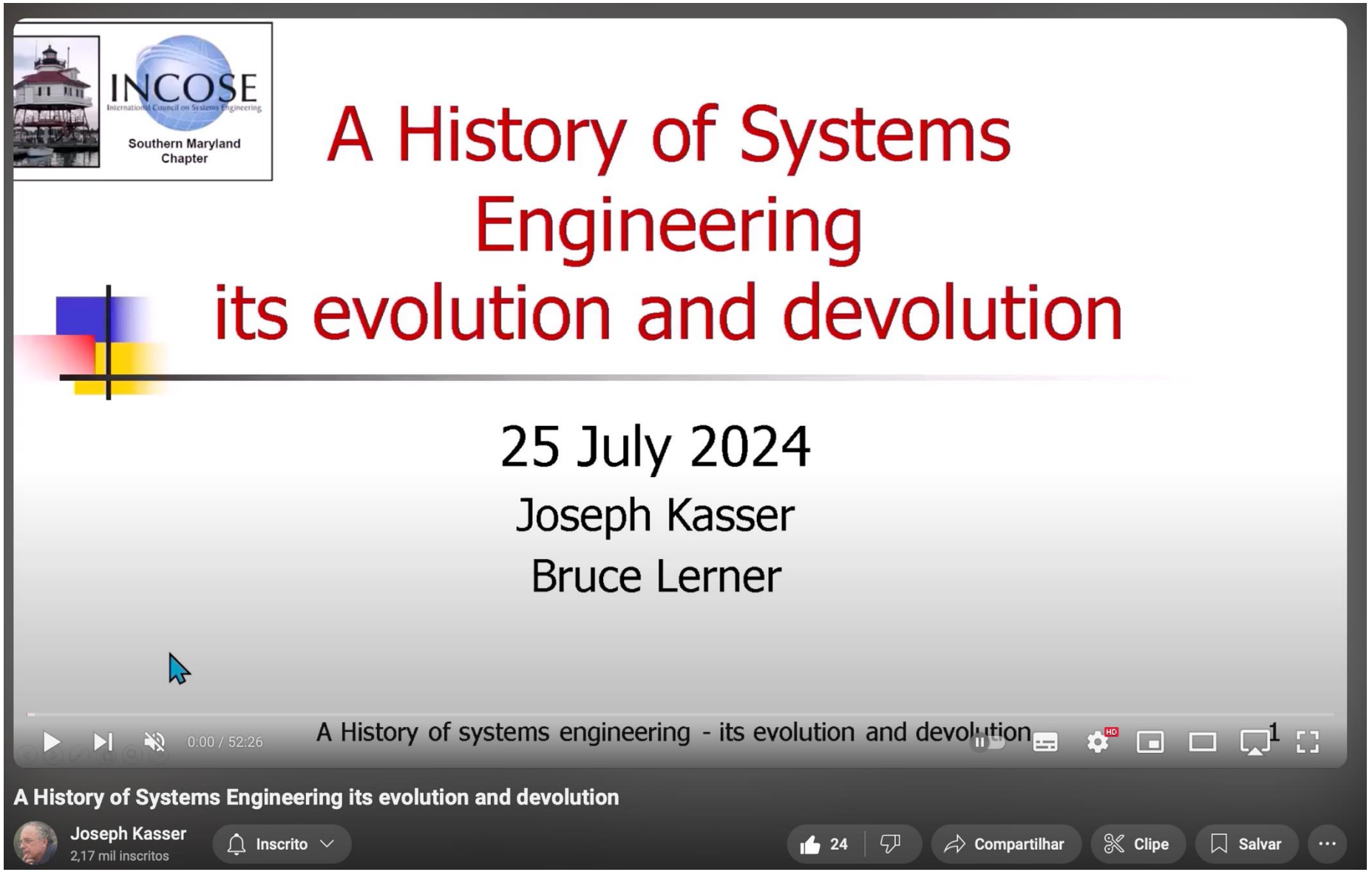
s

r/Helldivers
My perspective as a software engineer– or why there is no AFK timer or queueing...
779 upvotes · 350 comentários

r/europe
Two Romanian mountain climbers are first ever huma...
ekantipur
549 upvotes · 126 comentários

r/devops
Our team has been forced into using git cherry-pick in order to promote changes ...
126 upvotes · 68 comentários

r/formula1
[OT] Former Minardi F1 driver and Le Mans ace Gianmaria...
twitter
232 upvotes · 17 comentários



https://www.youtube.com/watch?v=Gmnc-78TUuM

https://www.linkedin.com/feed/update/urn:li:activity:7258889946621476864

Final Considerations

Course Goal

- Students will gain the foundational knowledge and tools related to architecture design and implementation of complex and large-scale engineering systems, covering architecture modeling, selection, analysis, decision-making.

Learning Outcomes

1	Explain the role of the system architecture process in the overall systems engineering design process.	✓
2	Create physical, functional, operational, and interface system architectures based on initial system requirements and allocation.	✓
3	Construct actual systems architectures by building on existing standardized or industry-based architecture frameworks.	✓
4	Formulate architecture decision problems.	
5	Select the optimized system architectures from the available system architecture trade-space.	

Prof. Dr. Christopher Shneider Cerqueira

EECS / COE / ERAU

christophercerqueira@erau.edu
christopher@cscerqueira.com.br

Room LB-359

*"With the **passage of time**, the psychology of people **stays the same**, but the **tools and objects in the world change**. Cultures change. **Technologies change**. The principles of design still hold, but the way they get applied **needs to be modified** to account for new activities, new technologies, **new methods of communication and interaction**."*

Don Norman

"THE DESIGN OF EVERYDAY THINGS, Revised and Expanded 2013's Edition"

Prof. Dr. Christopher Shneider Cerqueira
christophercerqueira@erau.edu
christopher@cscerqueira.com.br