CapellaDays
ONLINE 2020

Innovating with MBSE - Medical Device Example

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Siemens
MBSE Evangilist
@LinkedIn

12/10/2020

ALTRAN by Capgemini ESI OBEO THALES

#CapellaDays

Unrestricted

My history with Capella.

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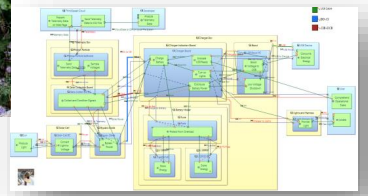
2017 Introduced to Capella, by a customer.

Solar Charger



Shortly after I built my first model….

2018 Siemens and OBEO announced partnership and product based on Capella

SMW System Modeling Workbench

2019 coached middle school students on Capella

2019-20 Introduce SMW/Capella to over dozen companies of various industries.

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One of my biggest challenges: How do you introduce Capella?

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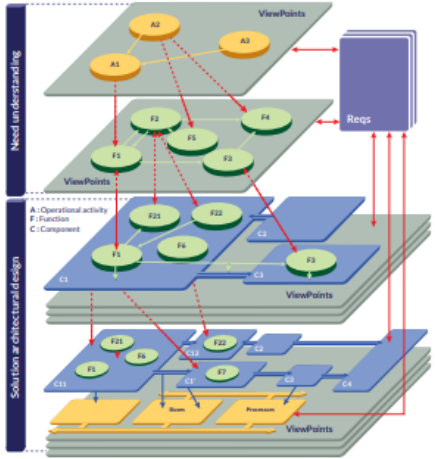
Model Based System Engineering

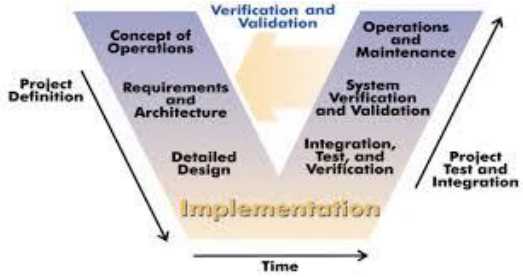


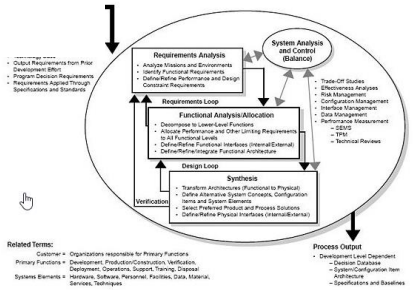
Operational Analysis
What the users of the system need to accomplish

Functional & Non Functional Need
What the system has to accomplish for the users

Logical Architecture
How the system will work to fulfill expectations

Physical Architecture
How the system will be developed and built





Do you really have to understand 50+ years System Engineeing knowledge to appreciate Capella?

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There must be an easier way?

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My answer: Capella is a tool for Innovation

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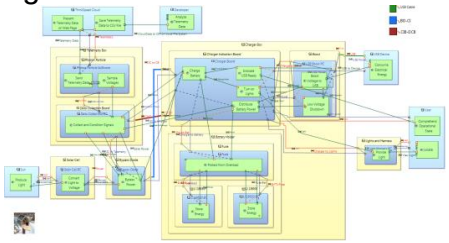
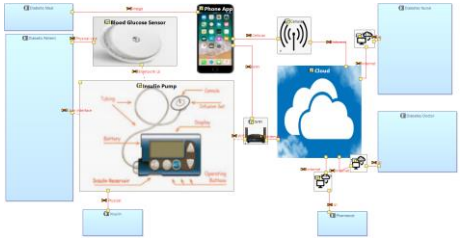
Innovation

Solar Charger



Diabetic Care System



Agriculture Mission Planning System of System

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My argument is that Innovation is goal of all companies and Capella can aid in delivering that goal.

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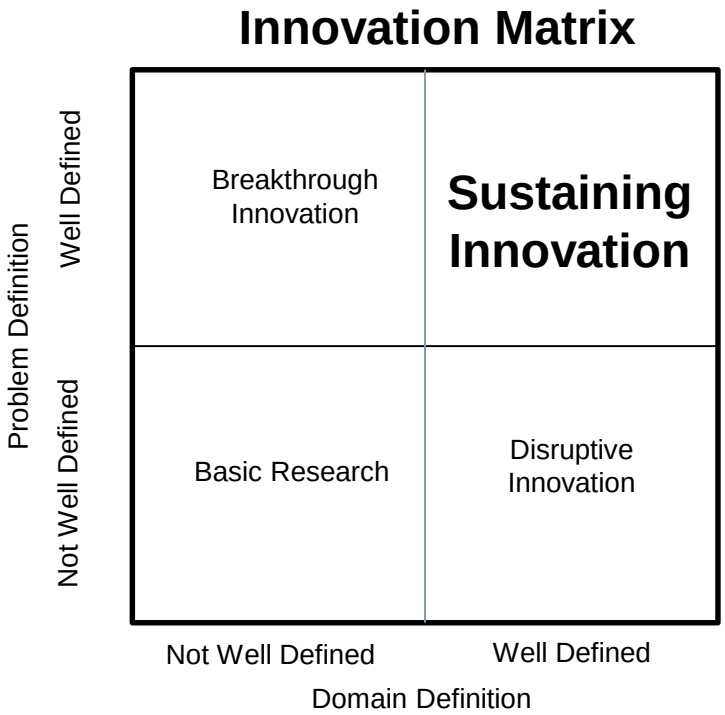

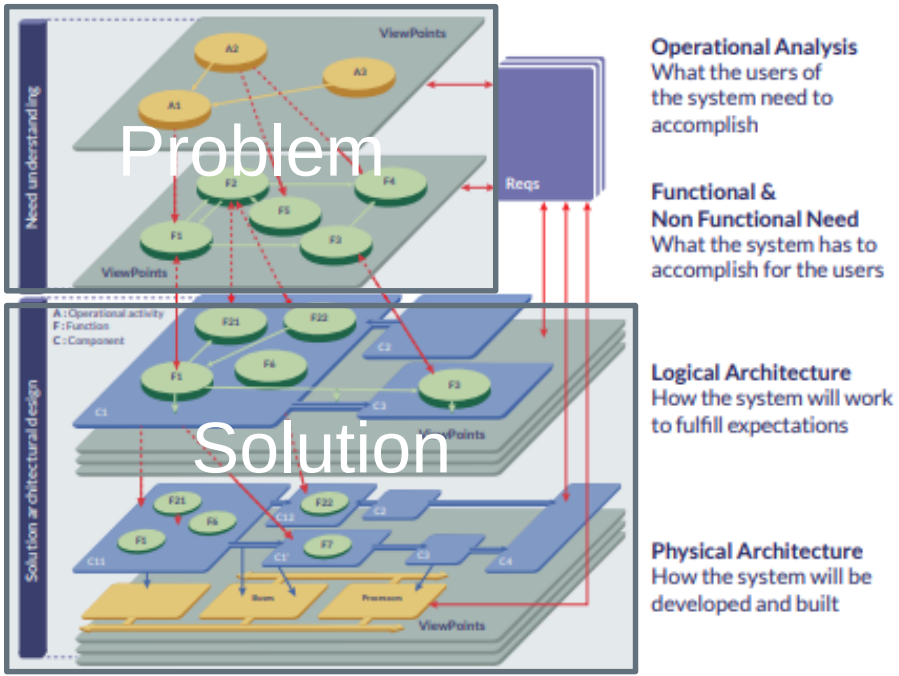

http://www.game-changer.net/2017/05/22/mapping-innovation-with-greg-satell/#.XxnryChKiUk

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This Case Study on MBSE Originated from FDA request to Siemens

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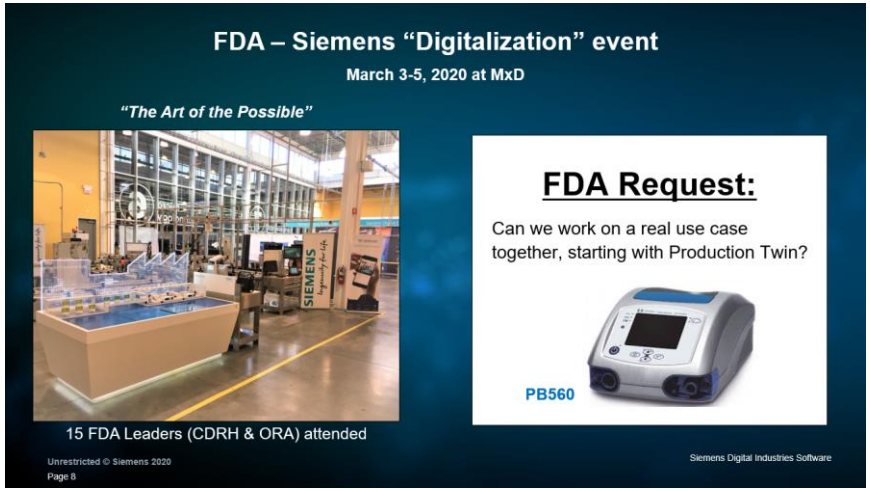

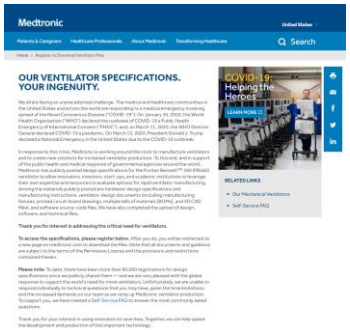

Medtronic PB560 Ventilator

1) **Intelligent Design Control**
   - Requirements, V&V & Risk Management
2) **Design Excellence - Product Digital Twin**
   - Model Based Systems Engineering (MBSE)
   - ECAD and MCAD Design
   - Product Performance
3) **Operational Excellence - Production Digital Twin**
   - Design Transfer (eBOM/mBOM, BOP)
   - Plant and process simulation
   - Production execution
4) **Post-market Surveillance – Performance Digital Twin**
   - Requirements/Performance
5) **Closed-Loop Quality**
   - NCR investigation/CAPA

https://www.medtronic.com/us-en/e/open-files.html

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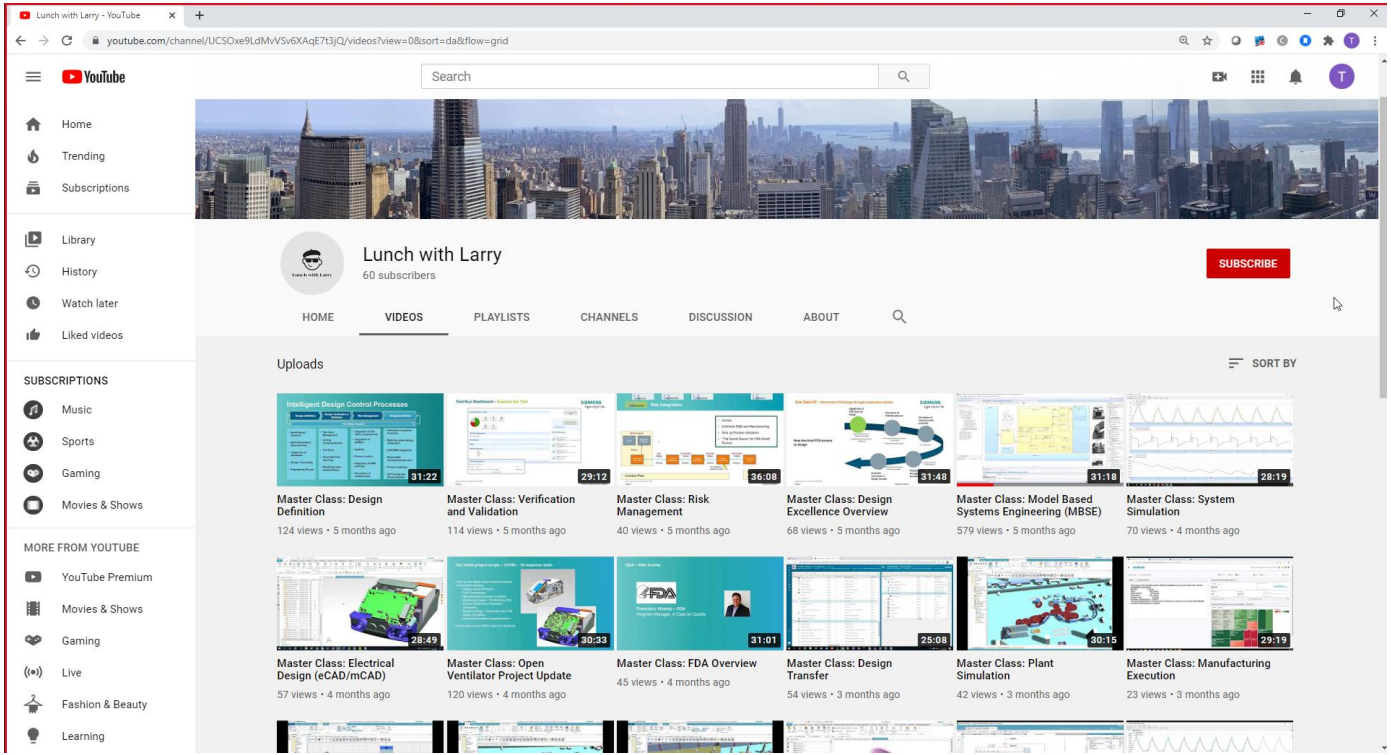
The effort has led to a Design Excellence Series led by my associate Laurence Sampson



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Effort began by developing the model of a Ventilator in Siemens System Modeling Workbench/Capella

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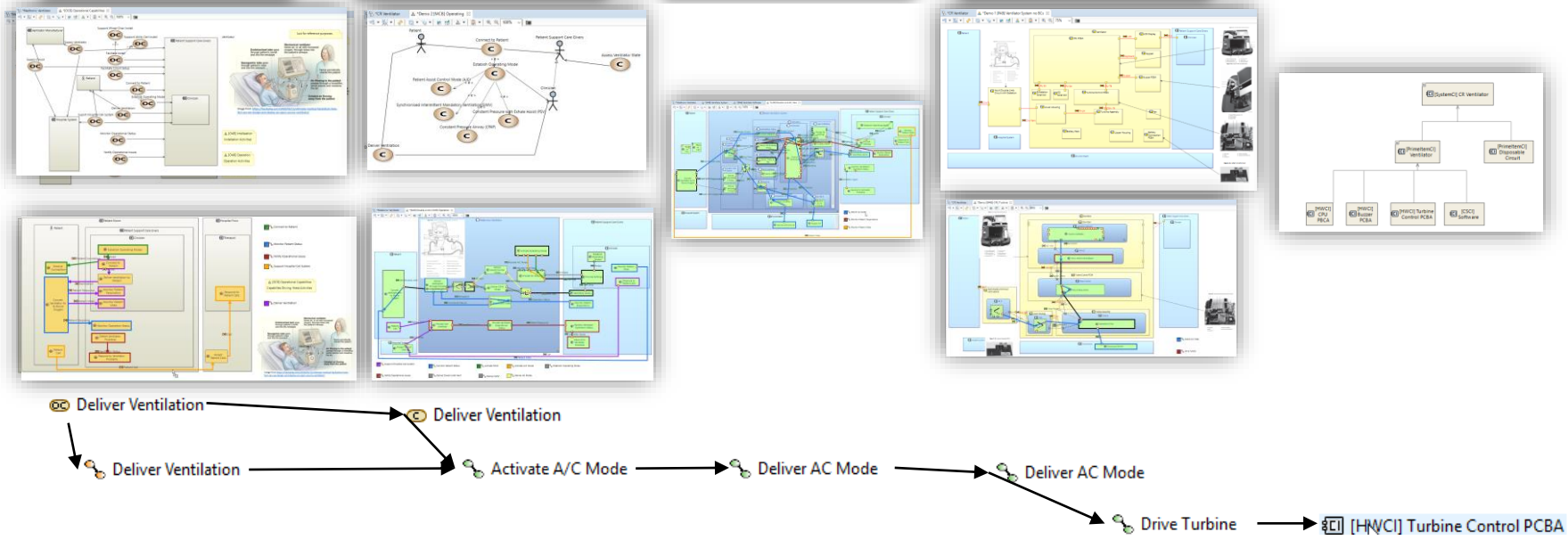
Operational Analysis
Define Stakeholders Needs

System Analysis
Formalize System Requirements

Logical Architecture
Develop System Architectural Design

Physical Architecture
Develop System Architectural Design

EPBS
Formalize Components Requirements



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Ventilator – Operational Capability Diagram

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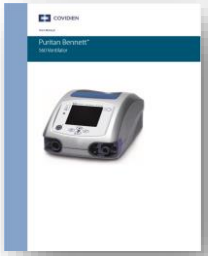
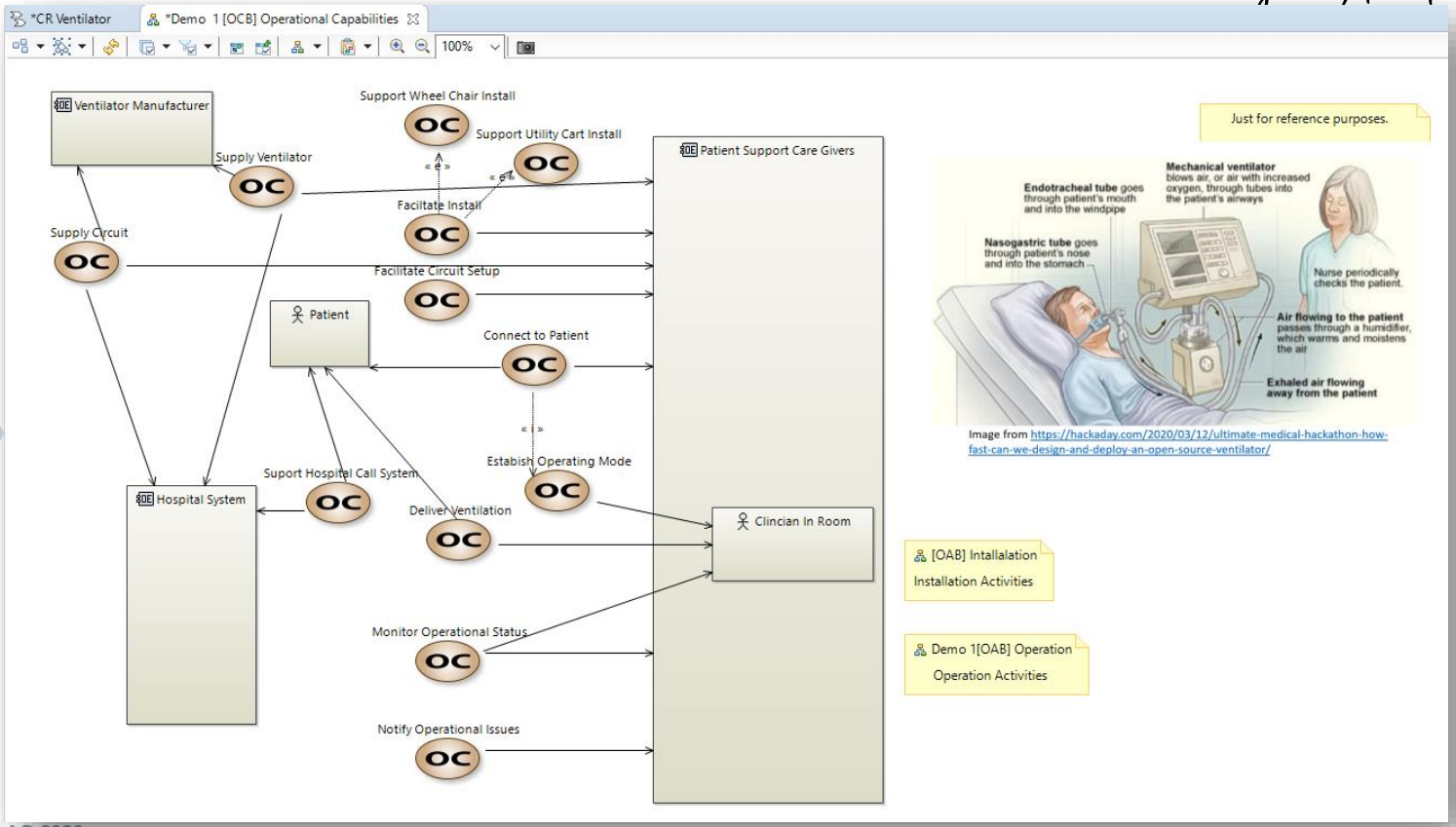
Operational Analysis
Define Stakeholders Needs

User Manual





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Ventilator – Operational Activity

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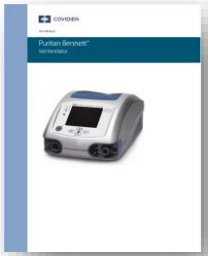
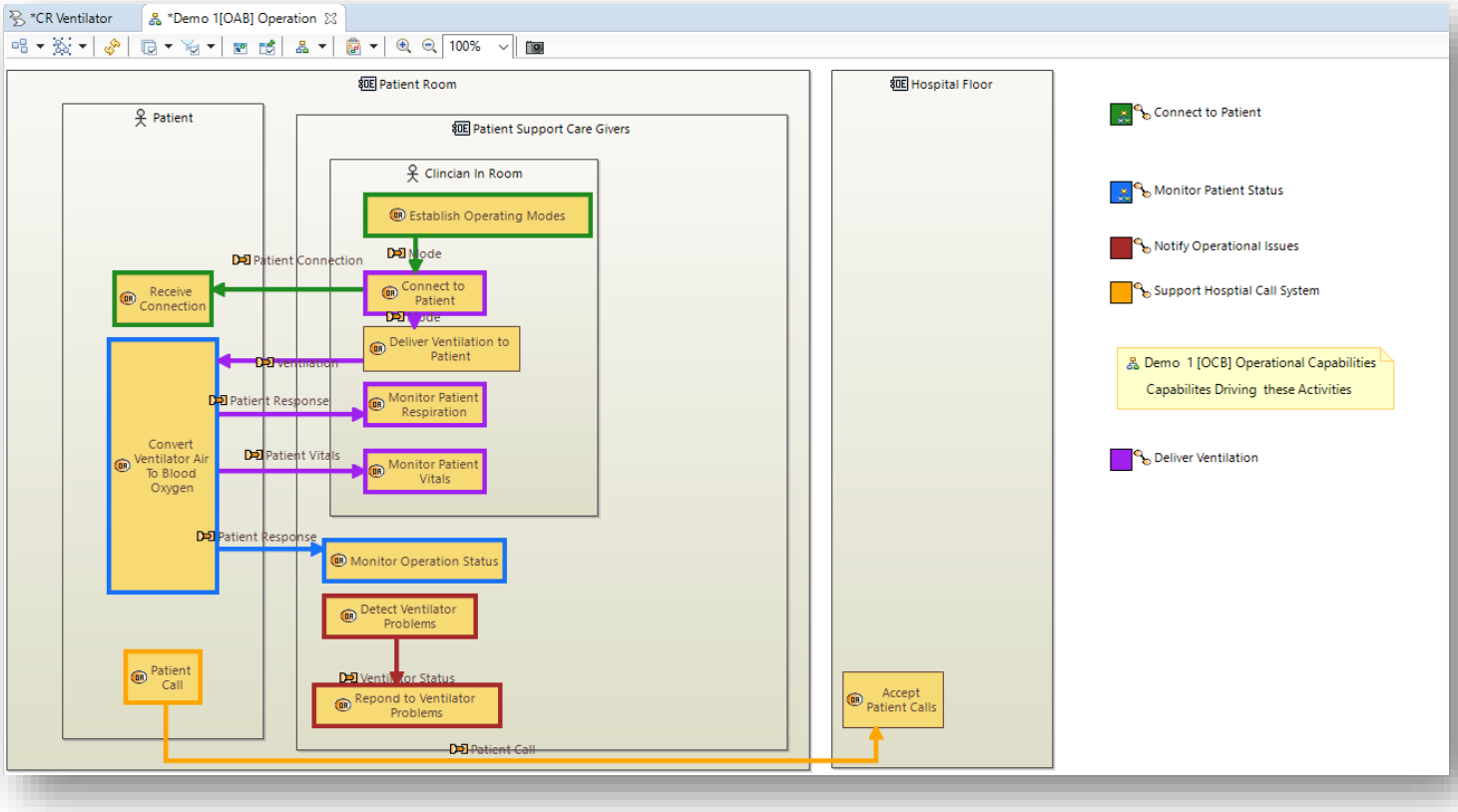
Operational Analysis
Define Stakeholders Needs

User Manual





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Ventilator – System Mission Capability Diagram

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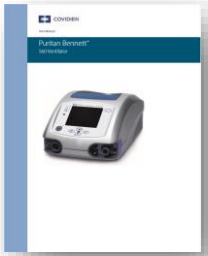
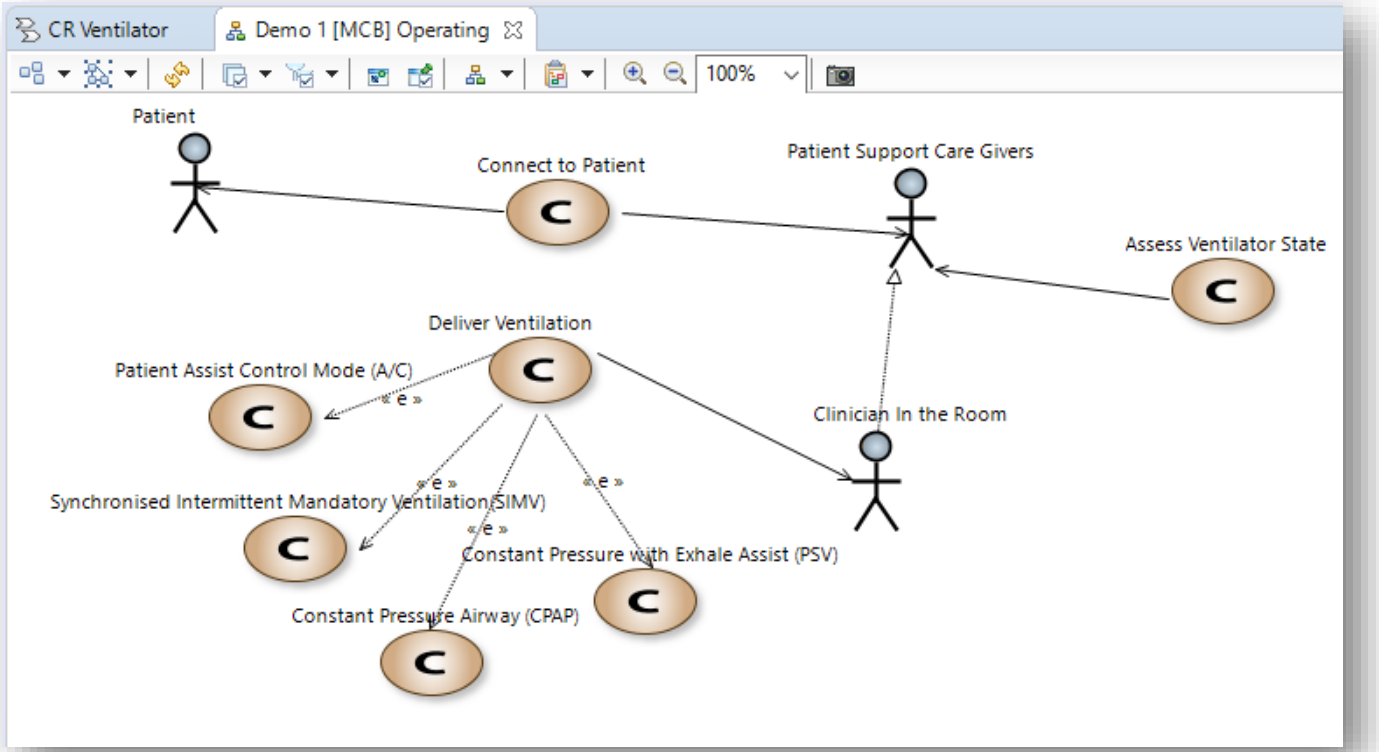
System Analysis
Formalize System Requirements

User Manual





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Ventilator – System Mission Capability Diagram - Connect

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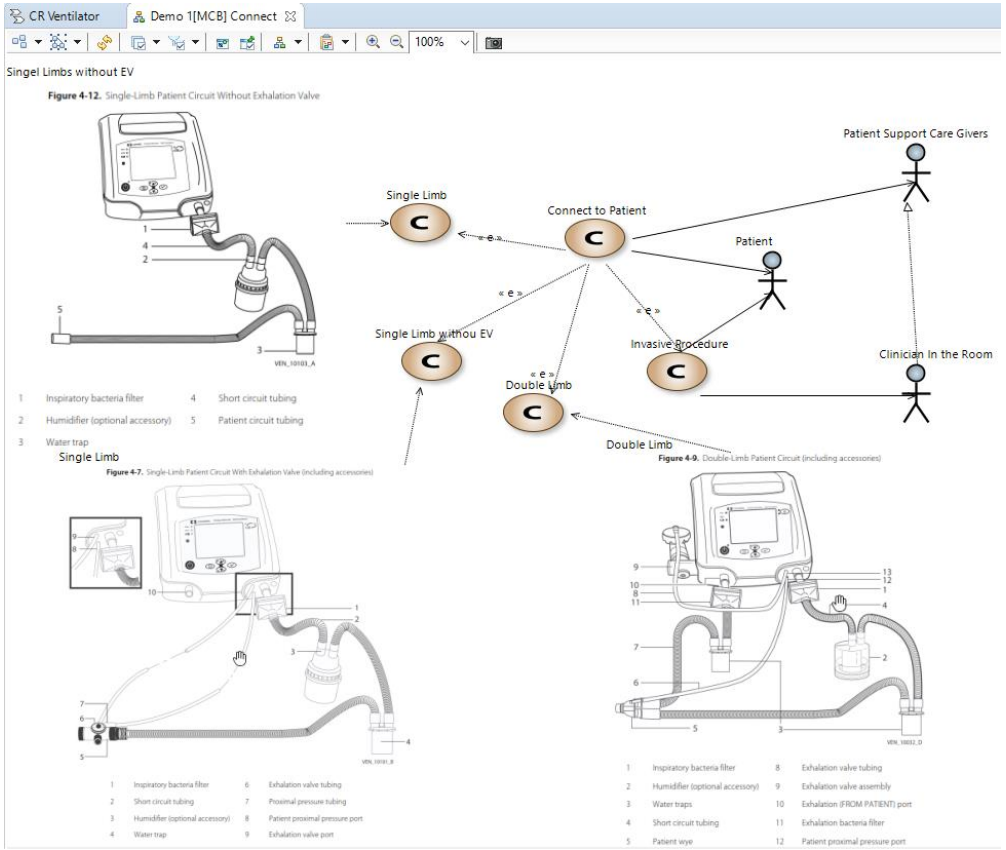
System Analysis
Formalize System Requirements

User Manual



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Ventilator – System Analysis Diagram

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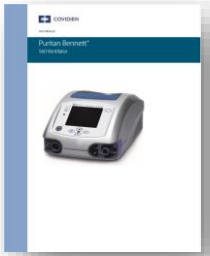
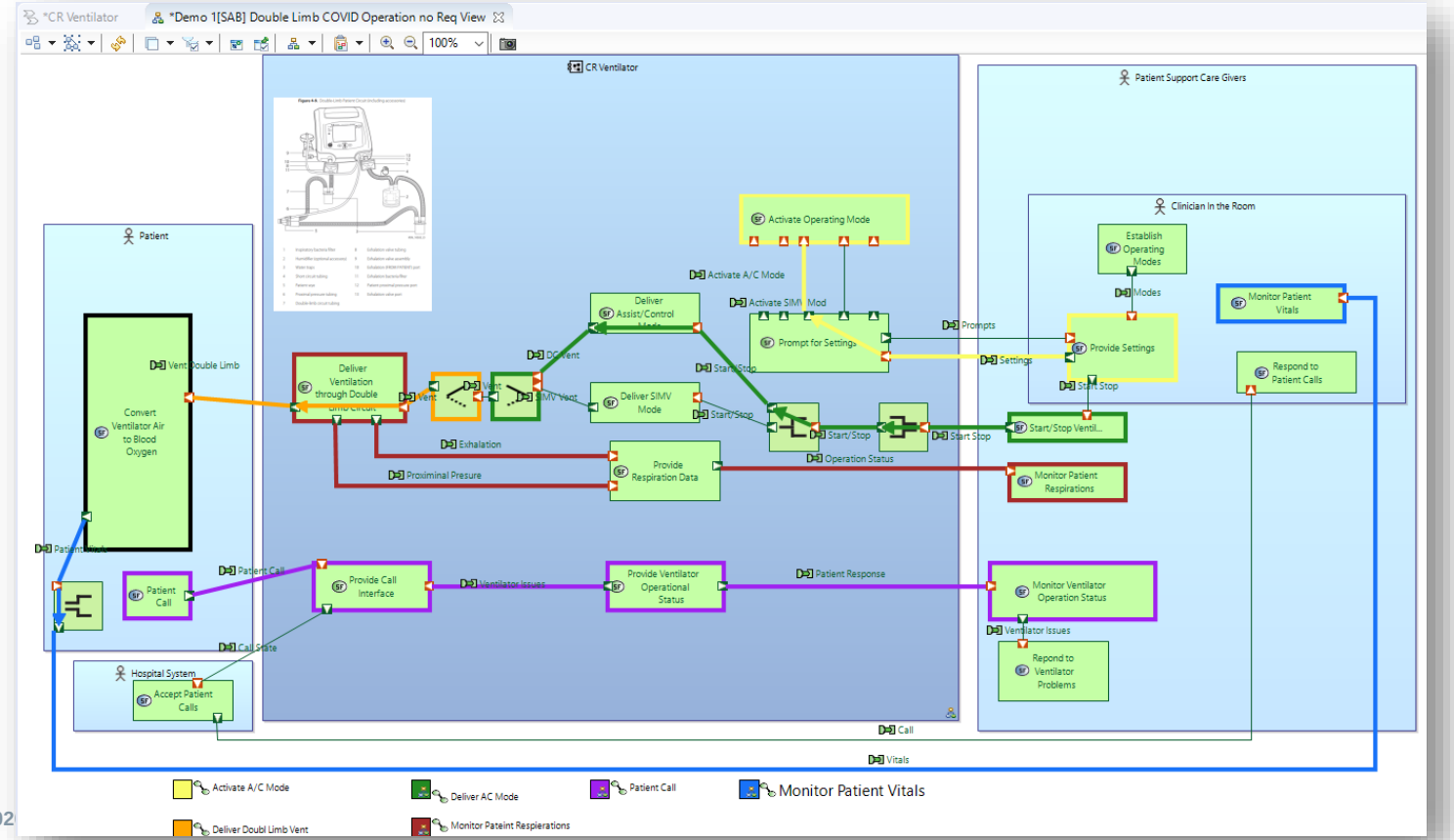
System Analysis
Formalize System Requirements

User Manual





Ventilator – Requirements into Teamcenter Requirements

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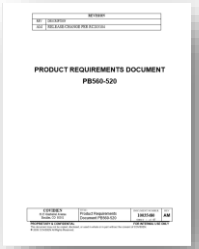
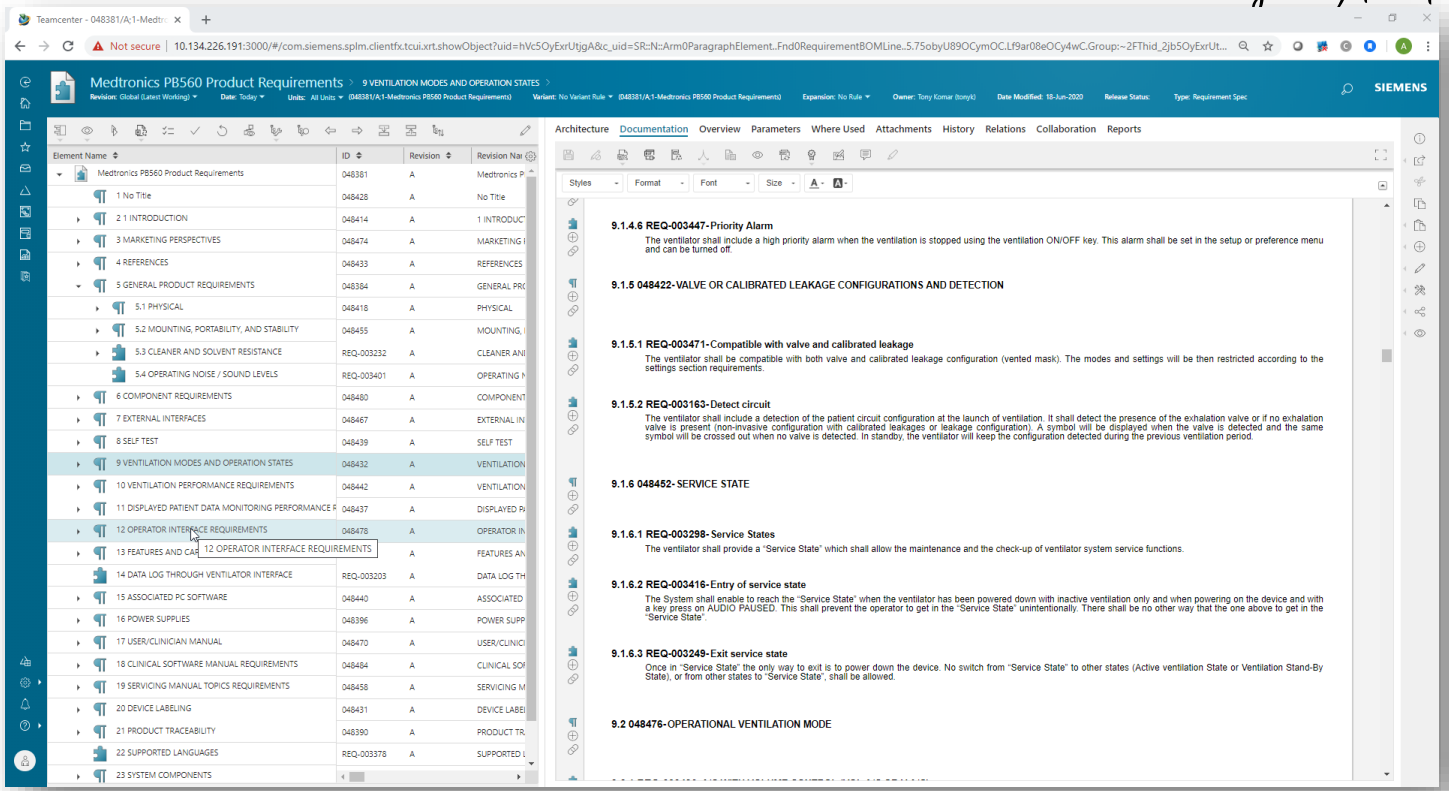
System Analysis
Formalize System Requirements

Product Requirement Document





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Ventilator – System Analysis Diagram with Requirements

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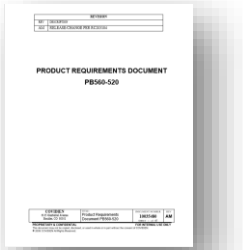
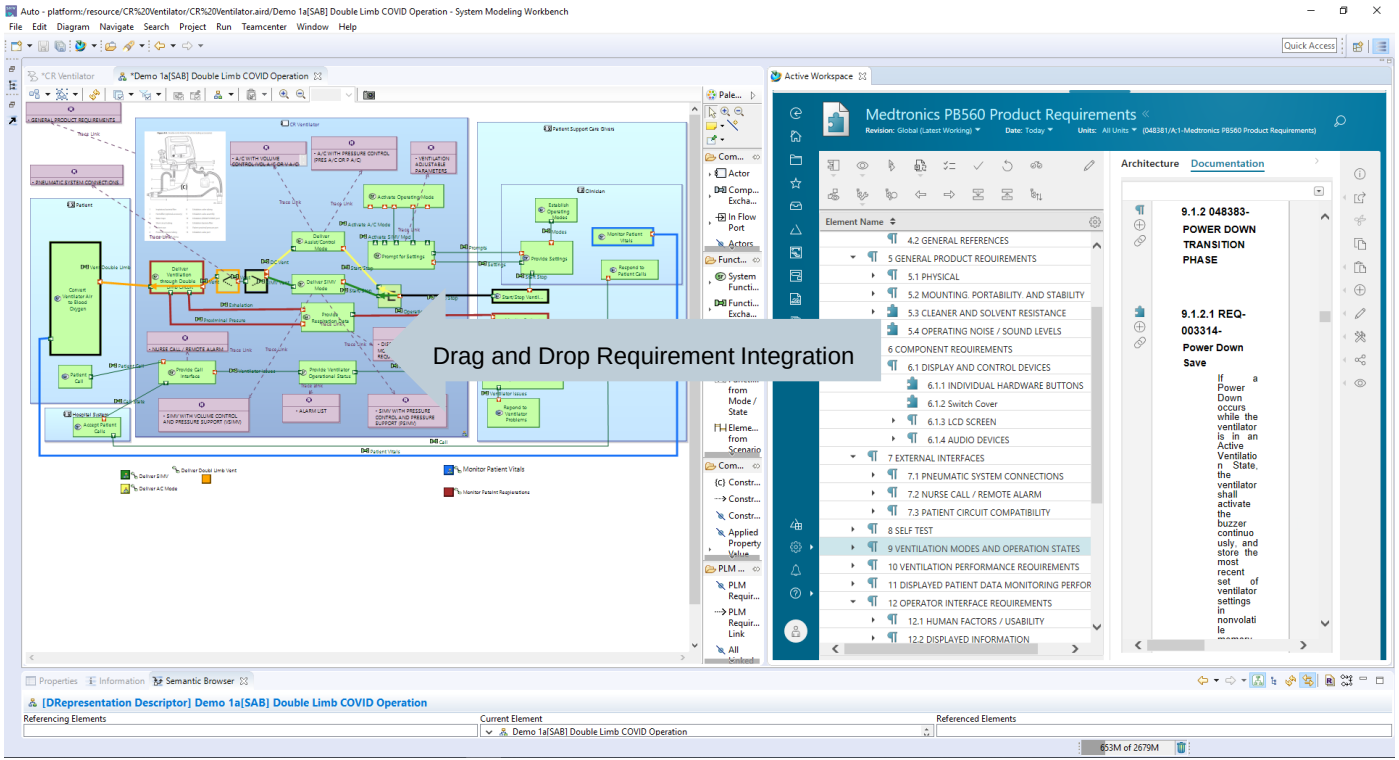
System Analysis
Formalize System Requirements

Product Requirement Document





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Ventilator – System Analysis Diagram

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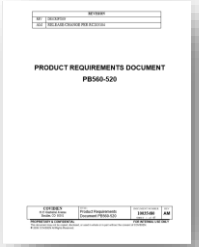
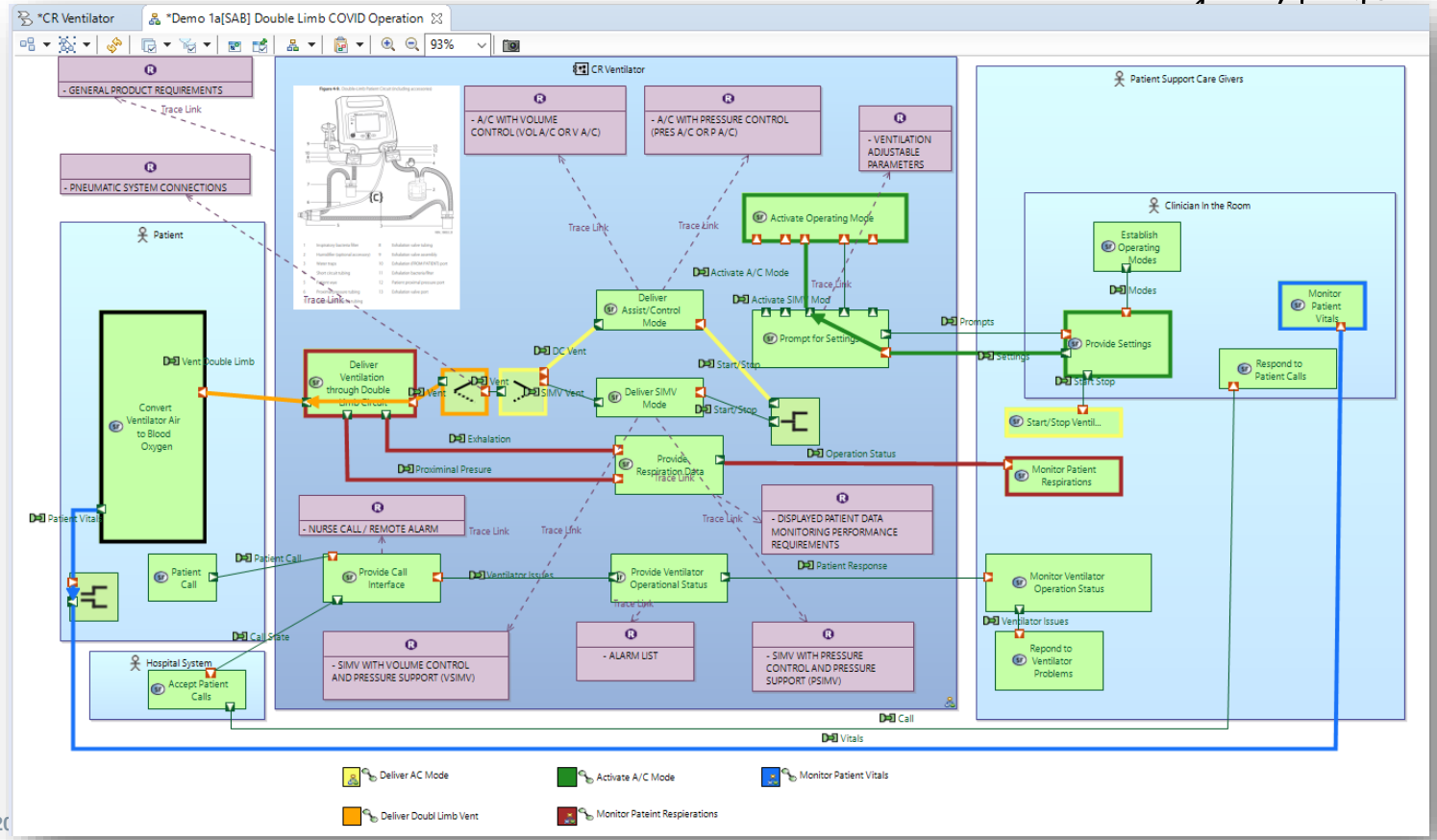
System Analysis
Formalize System Requirements

Product Requirement Document





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Ventilator – Logical Analysis Diagram

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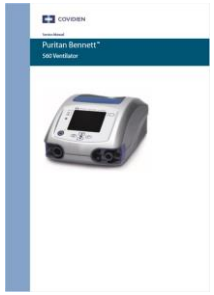
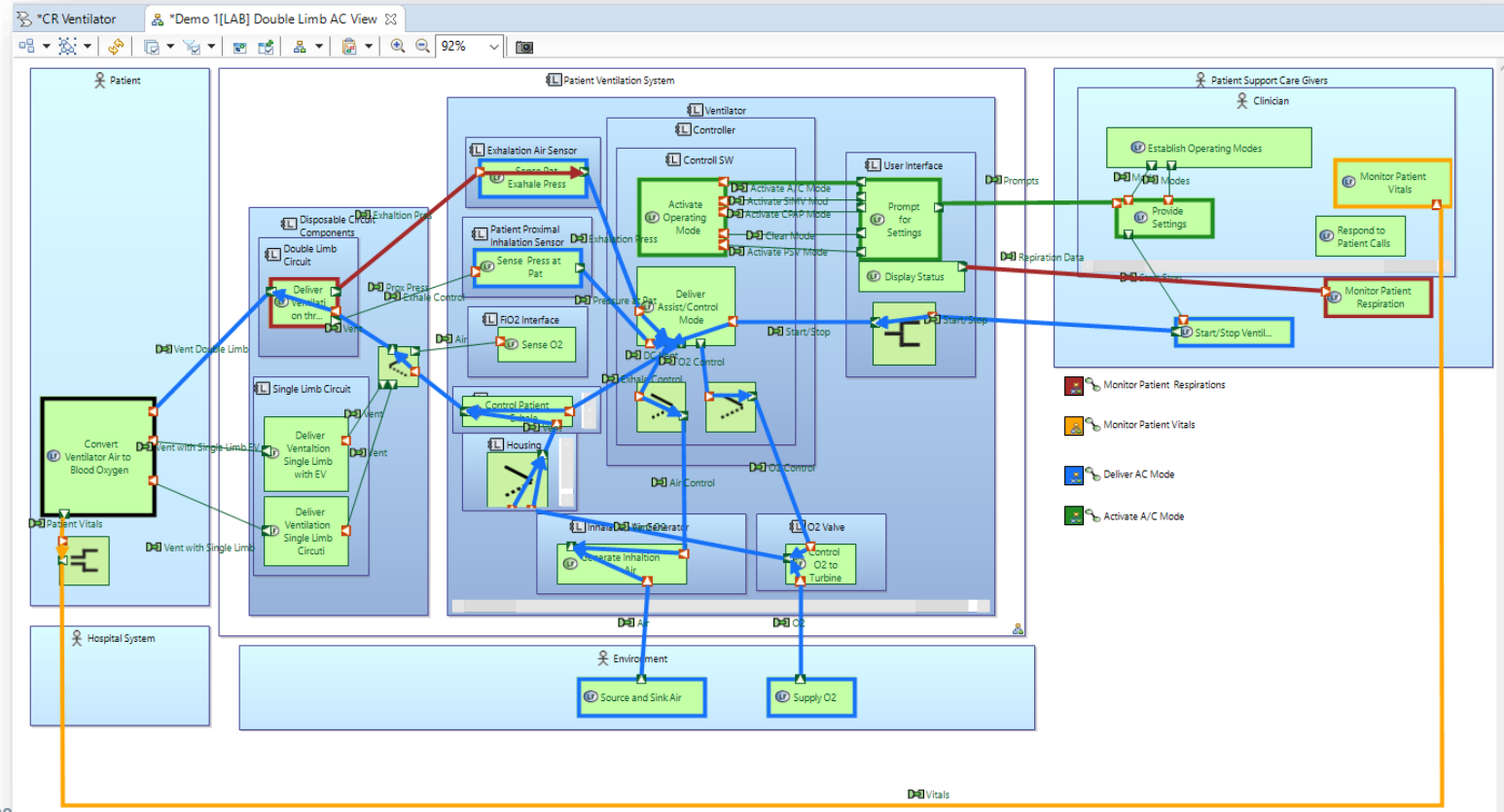
Logical Architecture
Develop System Architectural Design

Service Manual





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Logical Architecture is a usable blue print for simulation with tools like Siemens Simcenter Amesim

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Logical Architecture
Develop System Architectural Design

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Ventilator – Physical Analysis Diagram

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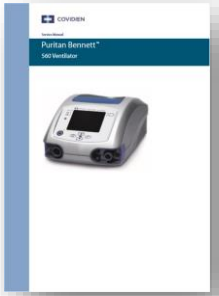
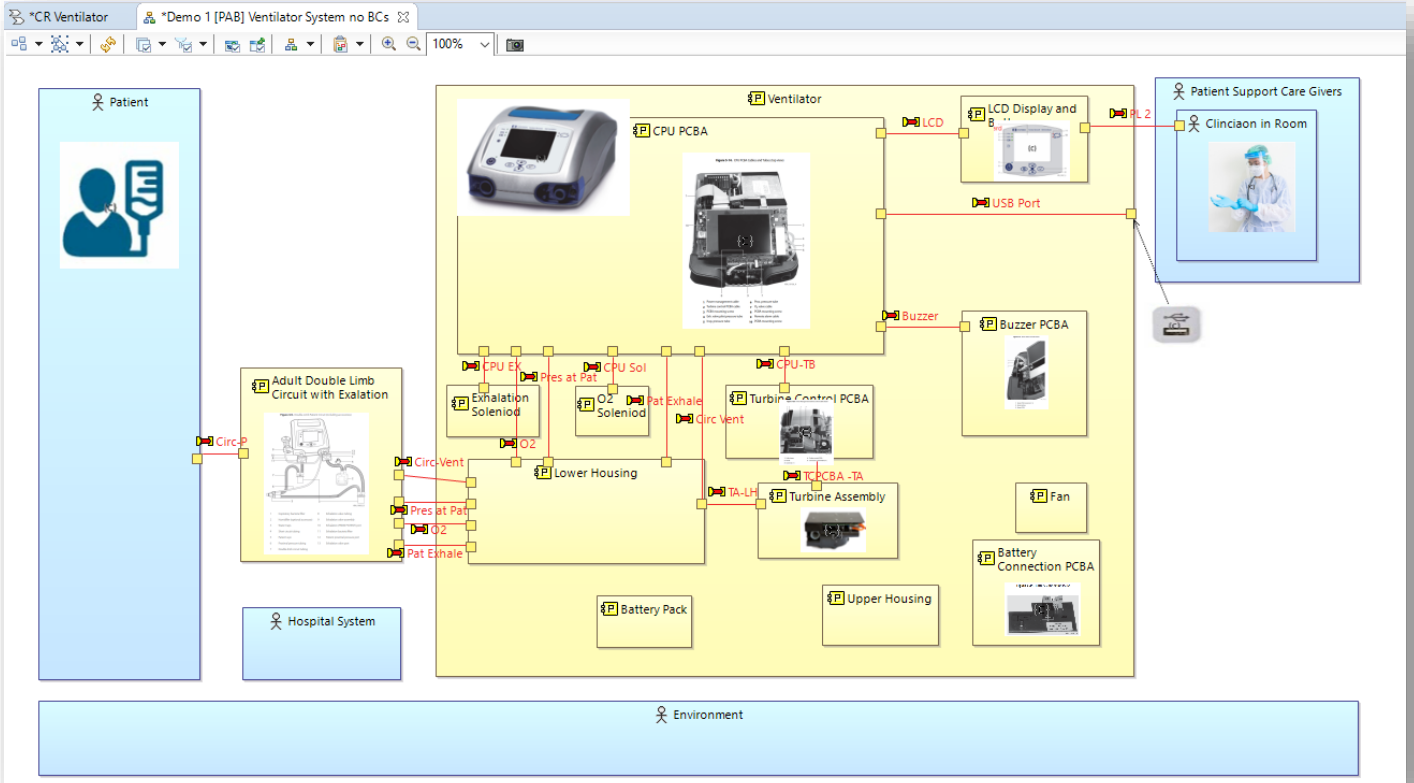
Physical Architecture
Develop System Architectural Design

Service Manual





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Ventilator – Physical Analysis Diagram

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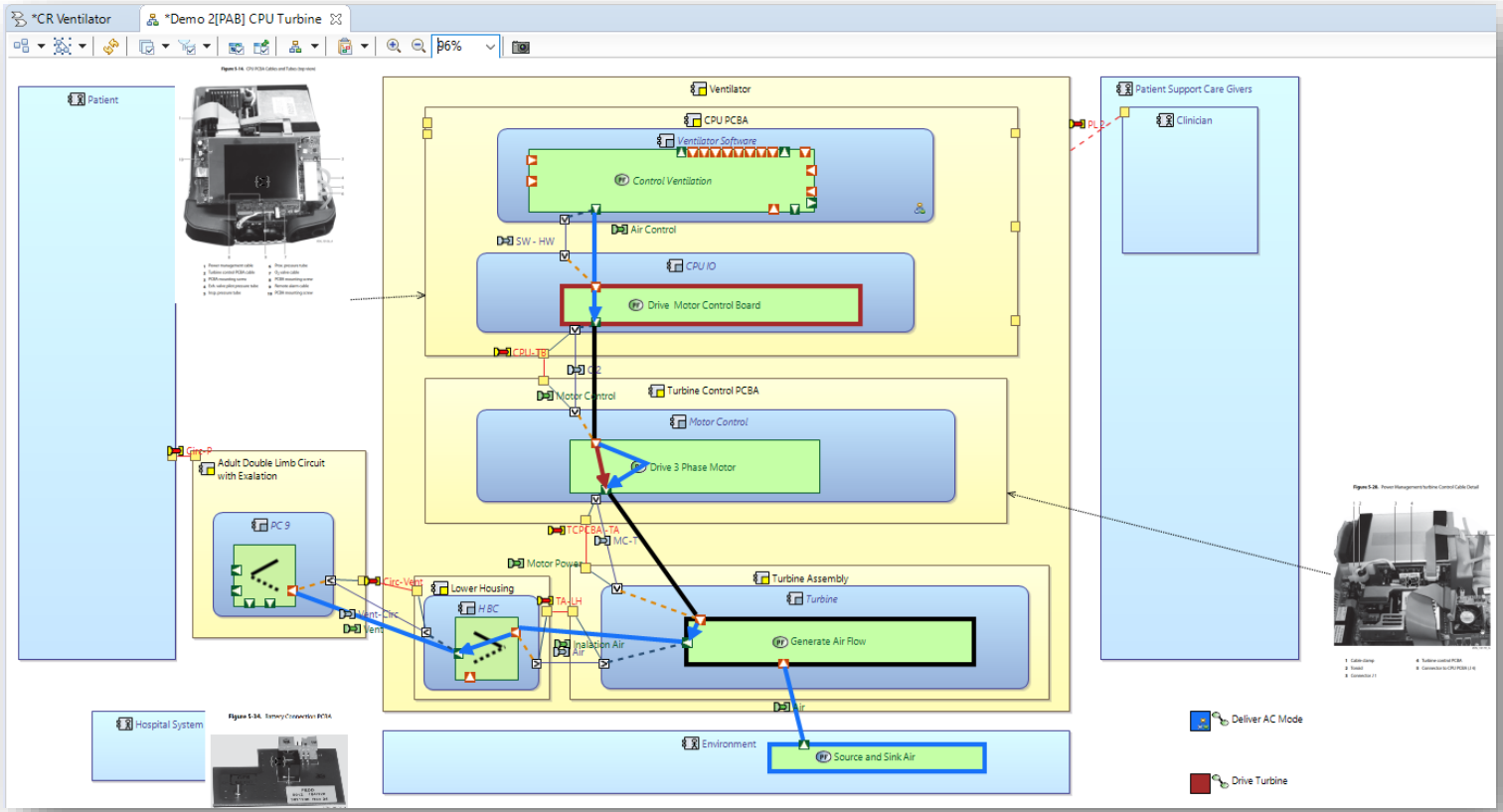
Physical Architecture
Develop System Architectural Design

Service Manual



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Ventilator – Physical Analysis Diagram

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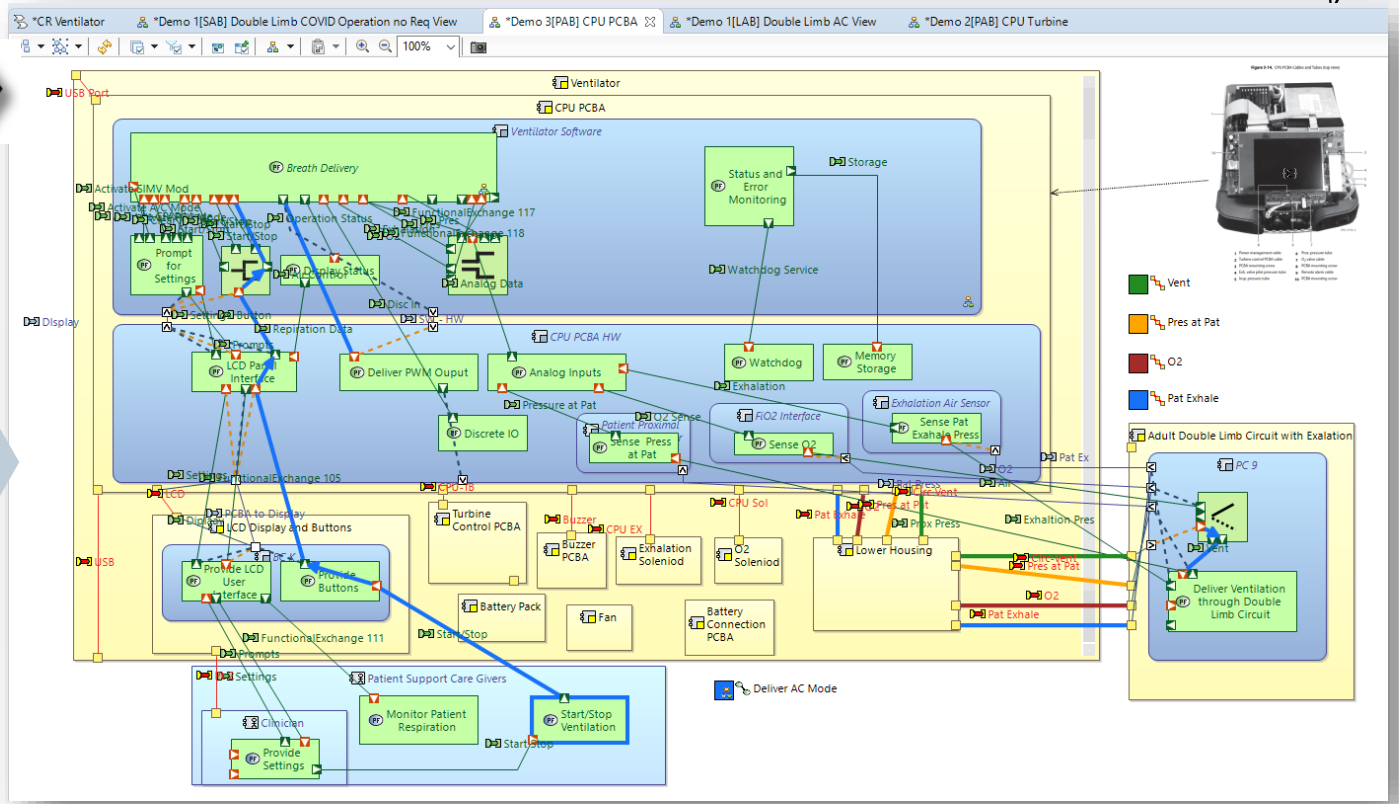
Physical Architecture
Develop System Architectural Design

Service Manual



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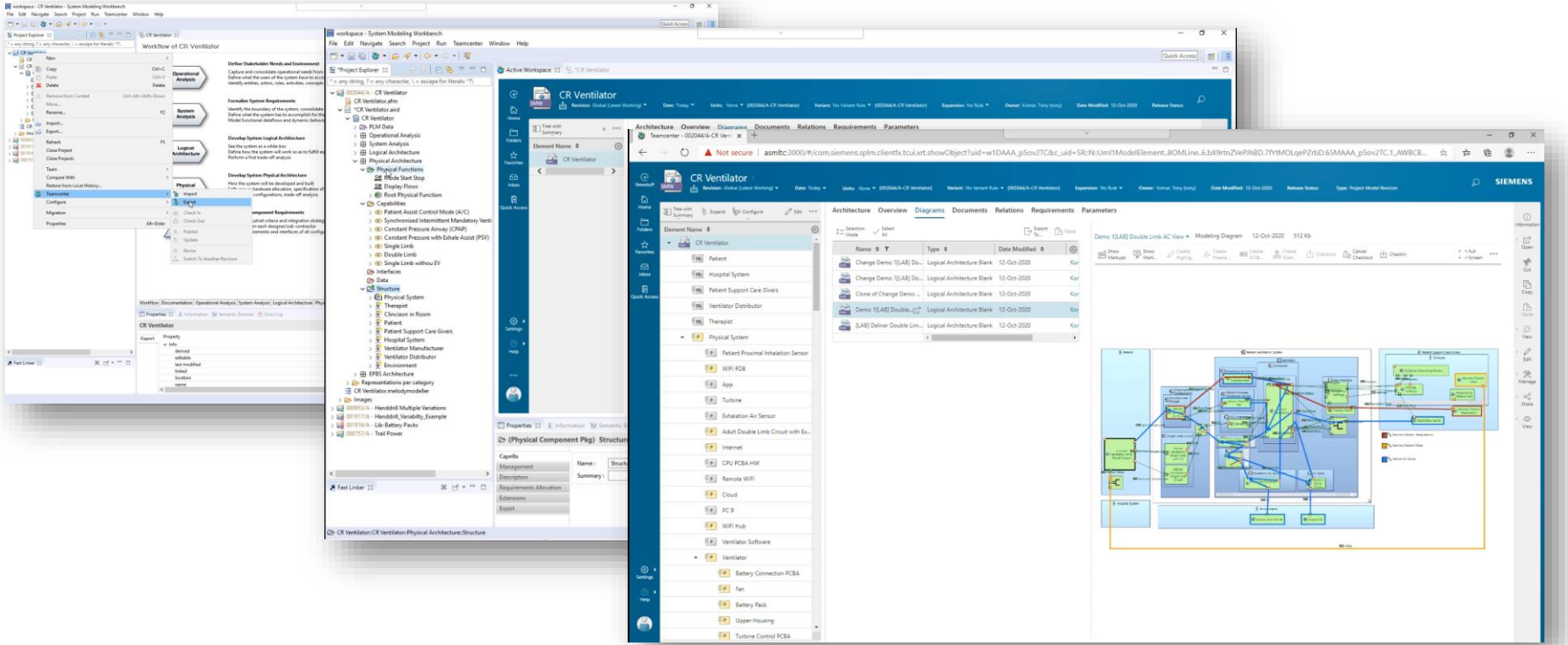
Information can then be published in Siemens Teamcenter PLM system and be viewed by wider audience.



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We understood the problem, we understood the solution.

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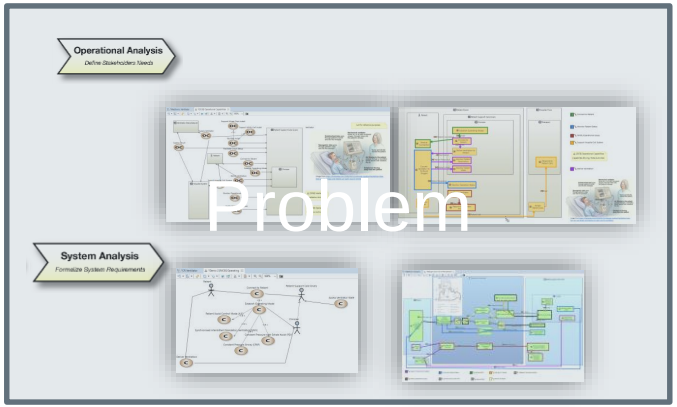

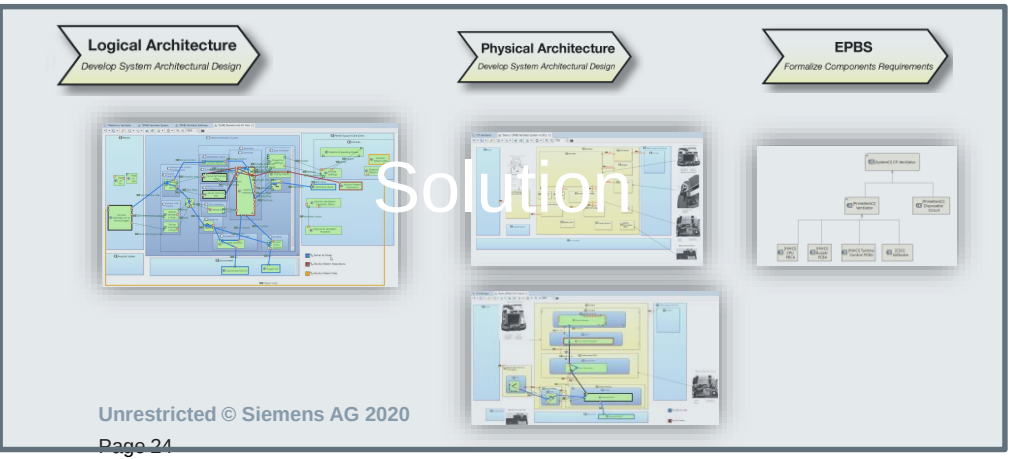

Innovation Matrix

Problem Definition \ Domain Definition	Not Well Defined	Well Defined
Well Defined	Breakthrough Innovation	**Sustaining Innovation**
Not Well Defined	Basic Research	Disruptive Innovation

Where is the innovation?

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We needed a idea, and that led us to...

Jeff Franco – Respiratory Therapist

www.wmh.org

COVID-19 has introduced new problems

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Ventilator – Operational Activity – Incorporating Remote Operation

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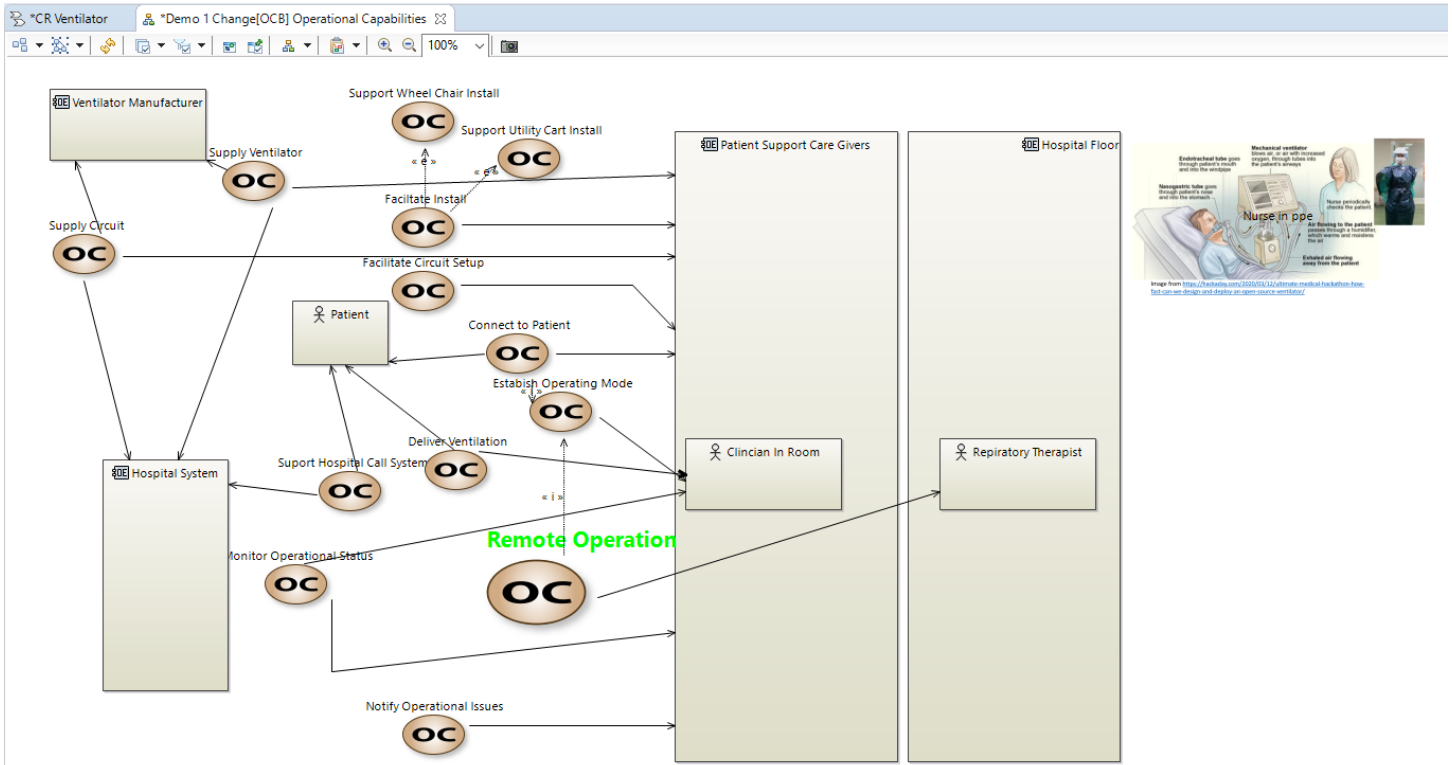
Operational Analysis
Define Stakeholders Needs



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Ventilator – Operational Activity – Adjust Ventilator Operational Processes

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Operational Analysis
Define Stakeholders Needs

Remote Operation

OC

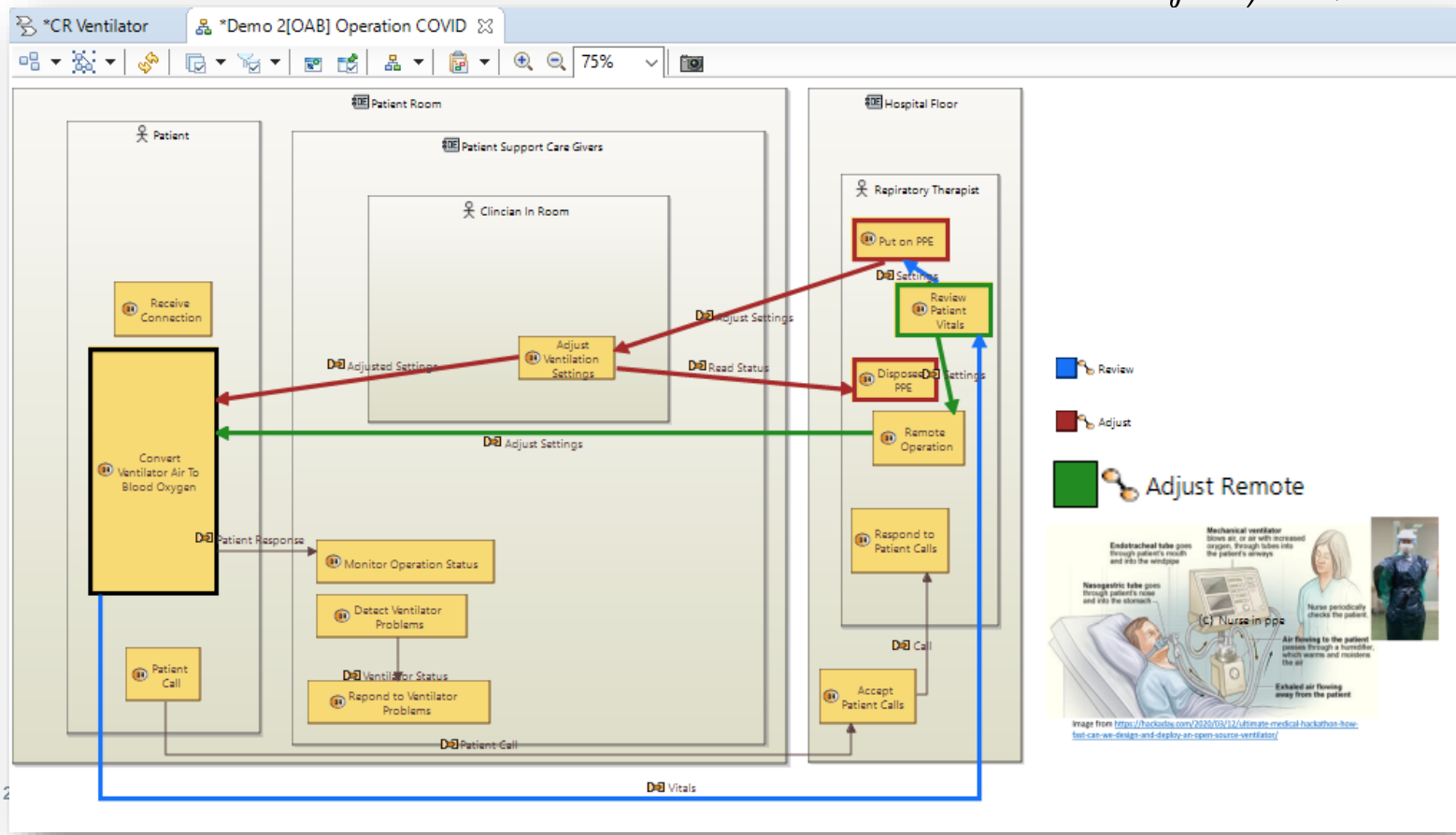

Image from https://hackaday.com/2020/03/12/ultimate-medical-hackathon-how-fast-can-we-design-and-deploy-an-open-source-ventilator/

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Ventilator – System Analysis – Remote Operation and Remote Monitoring Functional Chains

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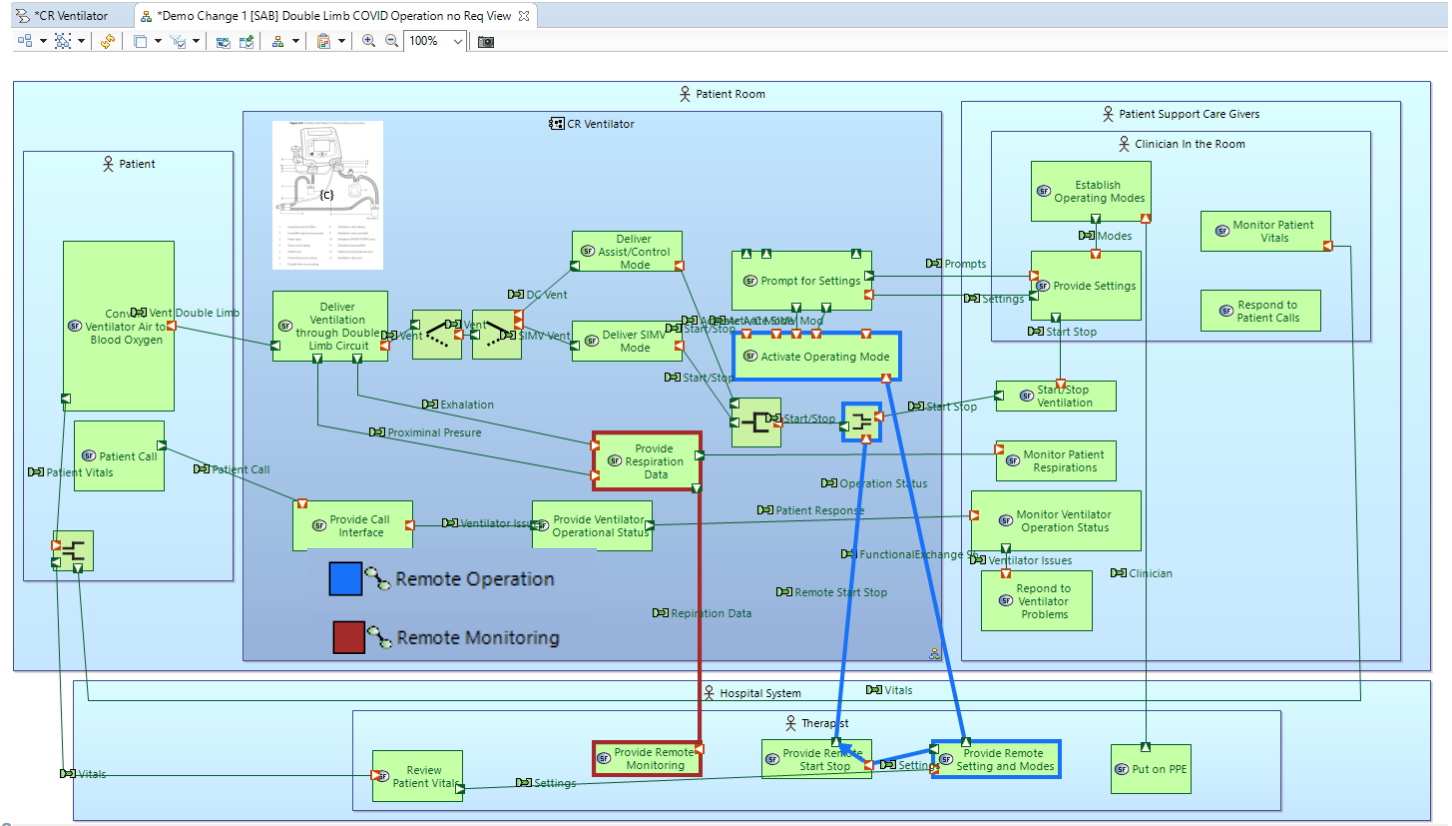
System Analysis
Formalize System Requirements

Adjust Remote



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Ventilator – Logical Analysis Diagram – Explore Concept to deliver Remote Operation and Remote Monitoring

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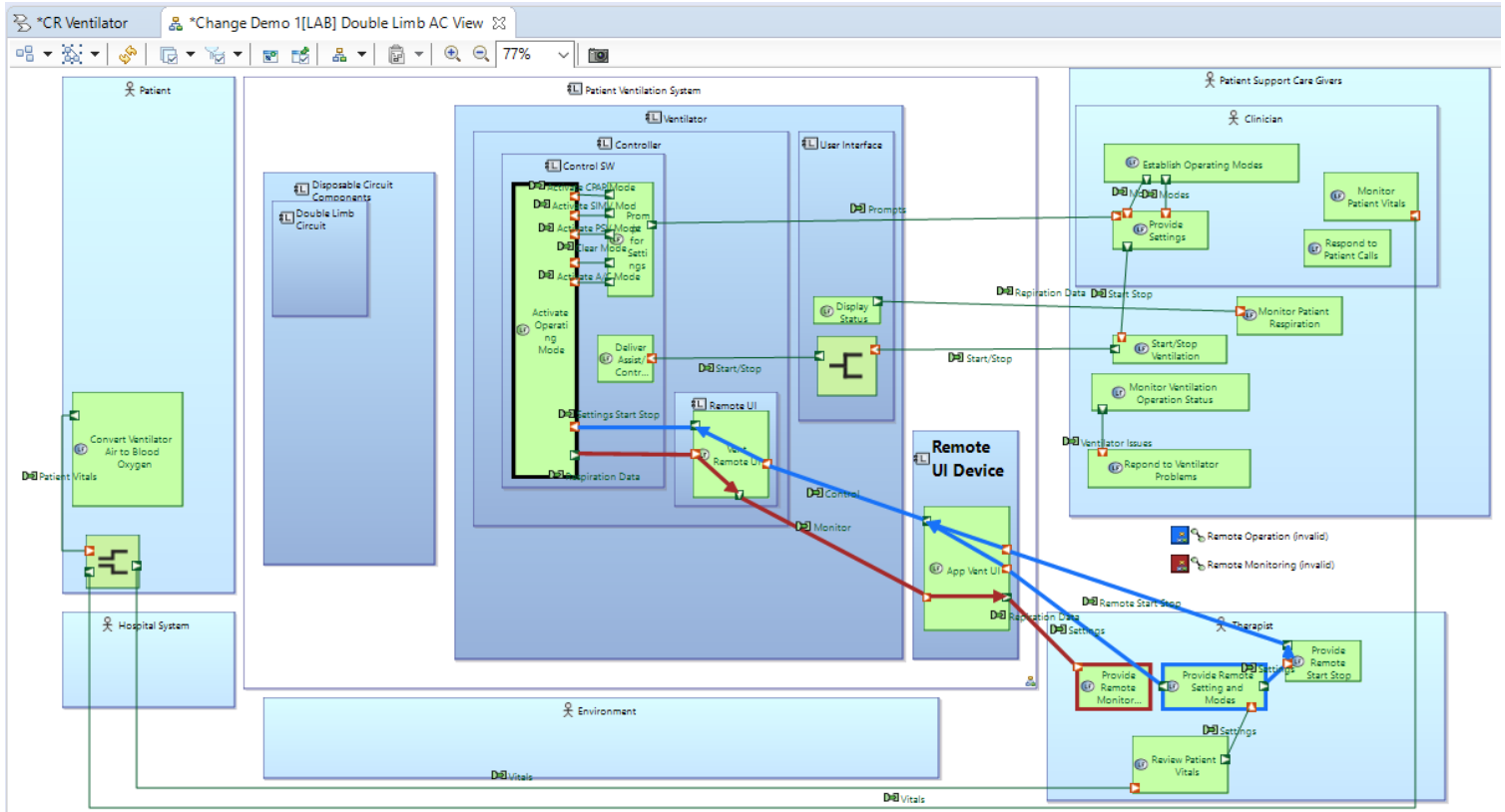
Logical Architecture
Develop System Architectural Design

Remote Operation

Remote Monitoring



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Ventilator – Physical Analysis Diagram – Made some decisions on implementation

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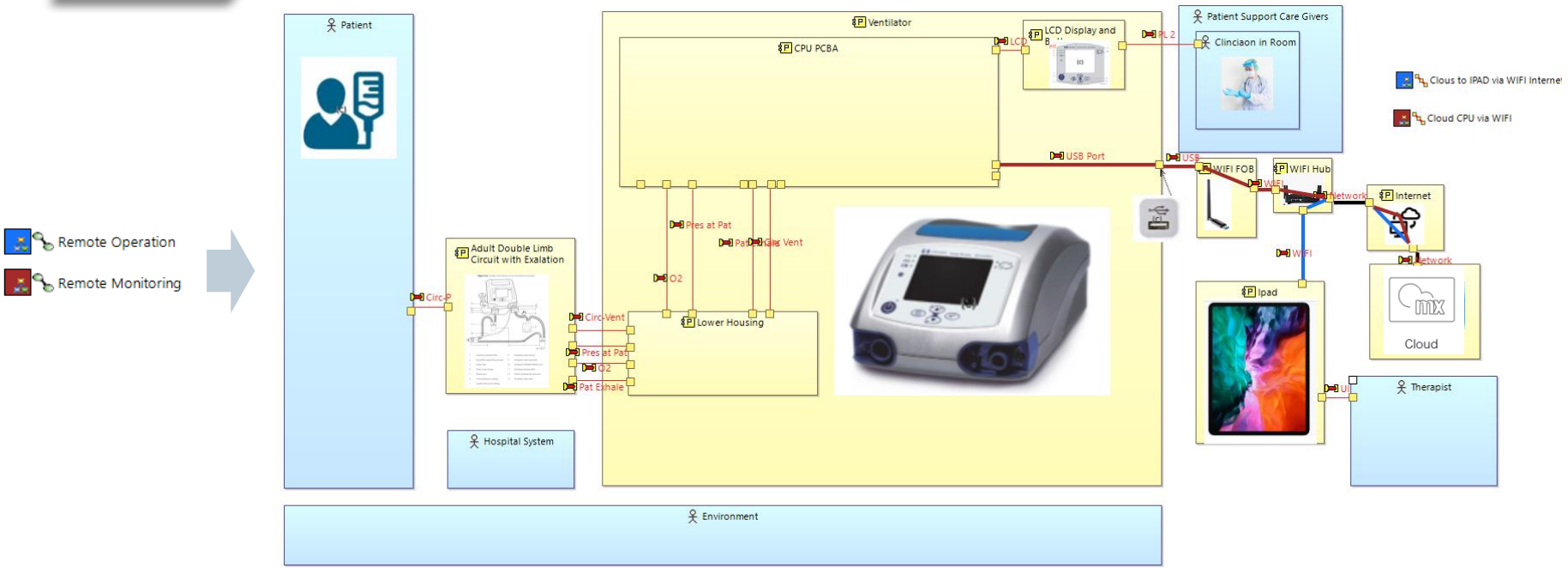
Physical Architecture
Develop System Architectural Design



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Ventilator – Physical Analysis Diagram – Allocated functions to the implemented components

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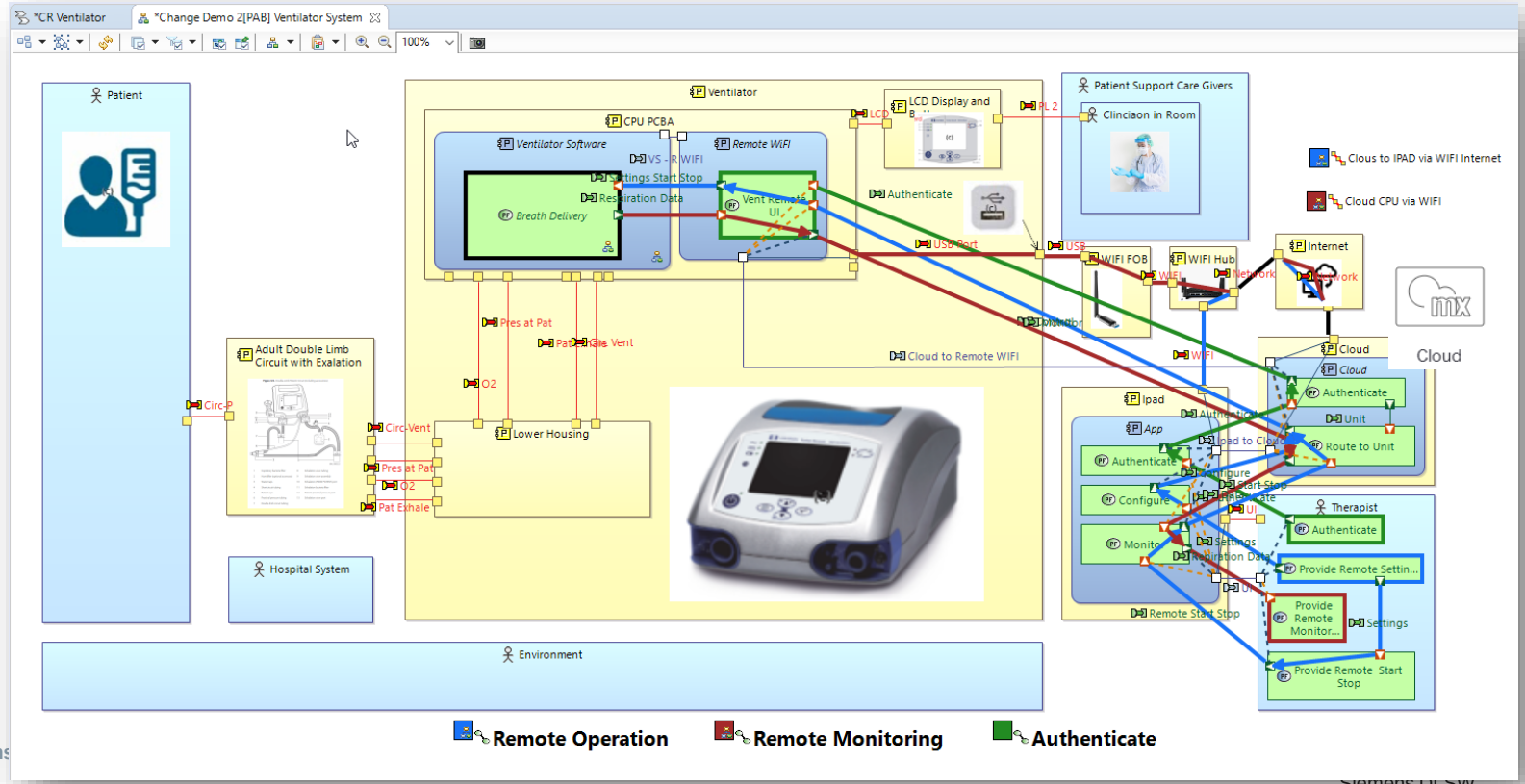
Physical Architecture
Develop System Architectural Design

Remote Operation
Remote Monitoring



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Capella is a tool for Innovation

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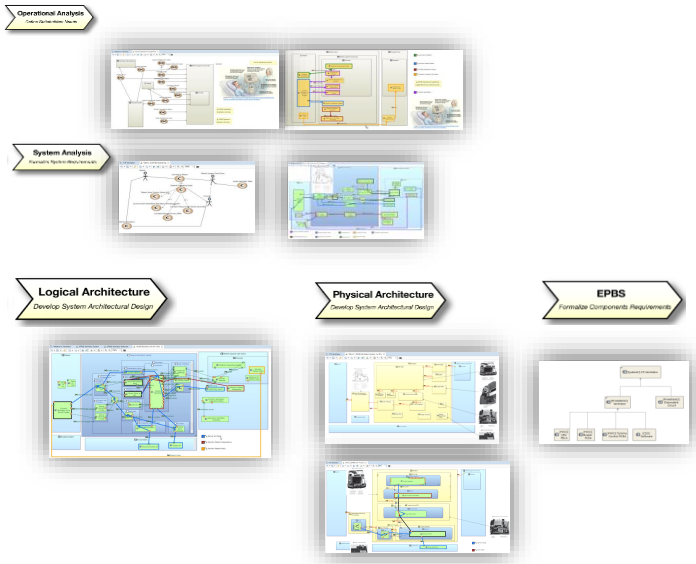
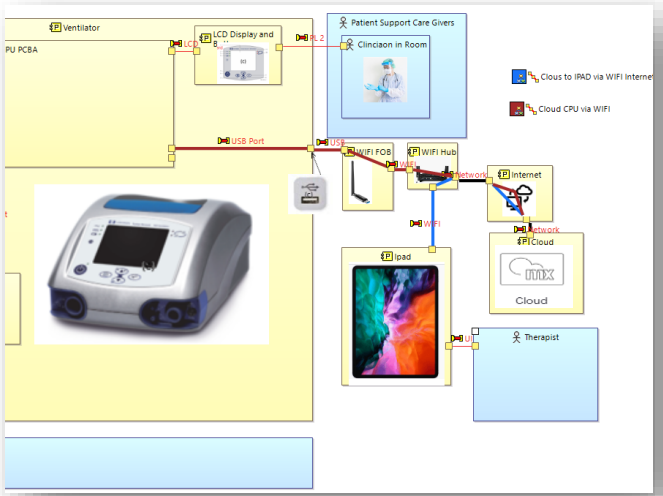
Assists in understanding a problem and design



It uncovers a gaps In understanding

Innovative Solution



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Hopes for today's presentation

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- You will be able to promote Capella as a tool for innovation
  - It allows you to develop an understanding of the problem you can share with other.
  - Provides a means to help you methodically develop a solution that will lay blueprint for design.

- The model I shared can bring forth new solutions
  - May this case study help fill some gaps

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Thank you

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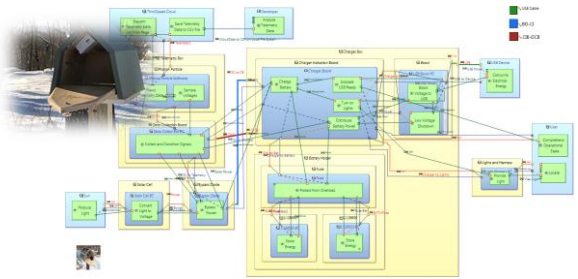
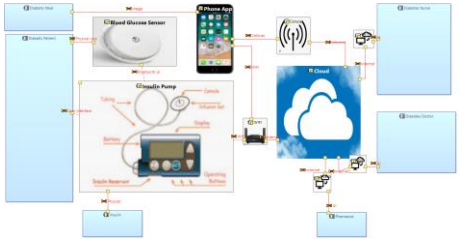
Solar Charger



Autonomous Missioning Planning

Diabetic Care System



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Successful Capella Landing on a CNES Operational Use-Case

Artal / Magellium

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