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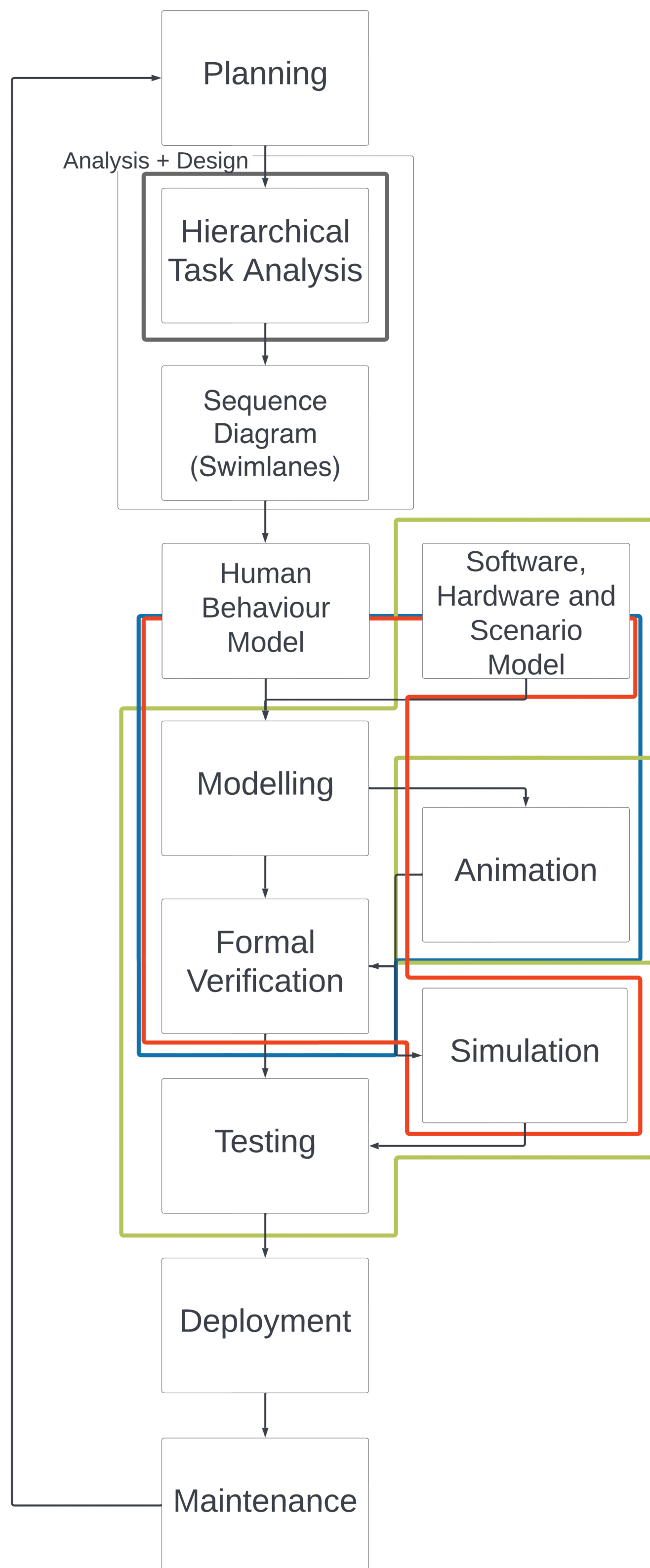
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# Verification of Robotic Systems with Humans in the Loop

## DEVELOPMENT CYCLE

A model-driven engineering approach for development and verification of a robotic system with humans in the loop



## EXISTING TOOLS

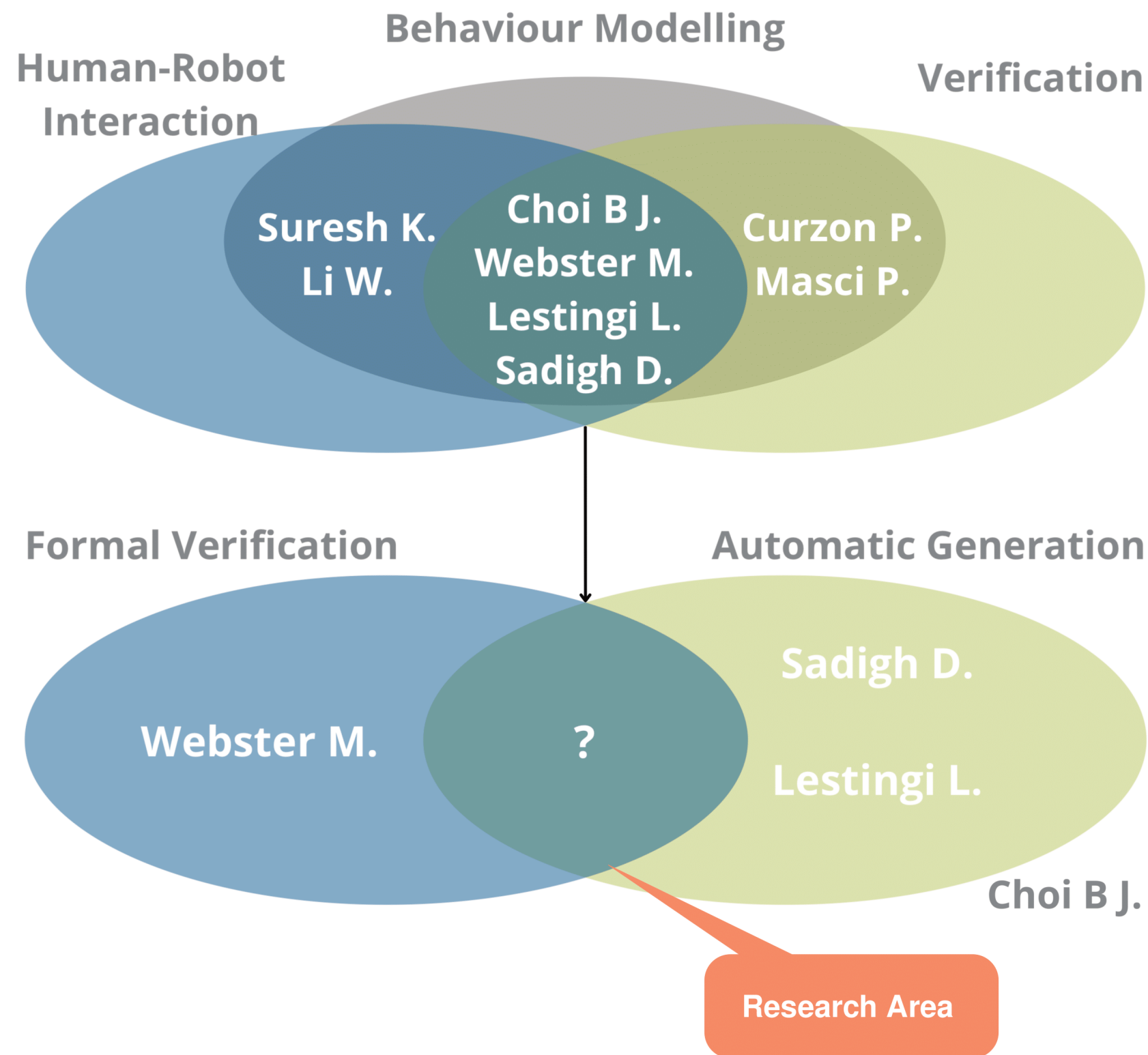
CIRCUS  
IVY  
PVSio-web + PVS  
RoboStar

These tools support the correspondingly coloured elements of the development cycle above



## EXISTING RESEARCH

Verification through formal methods and with an automatically generated model of the human?



## References

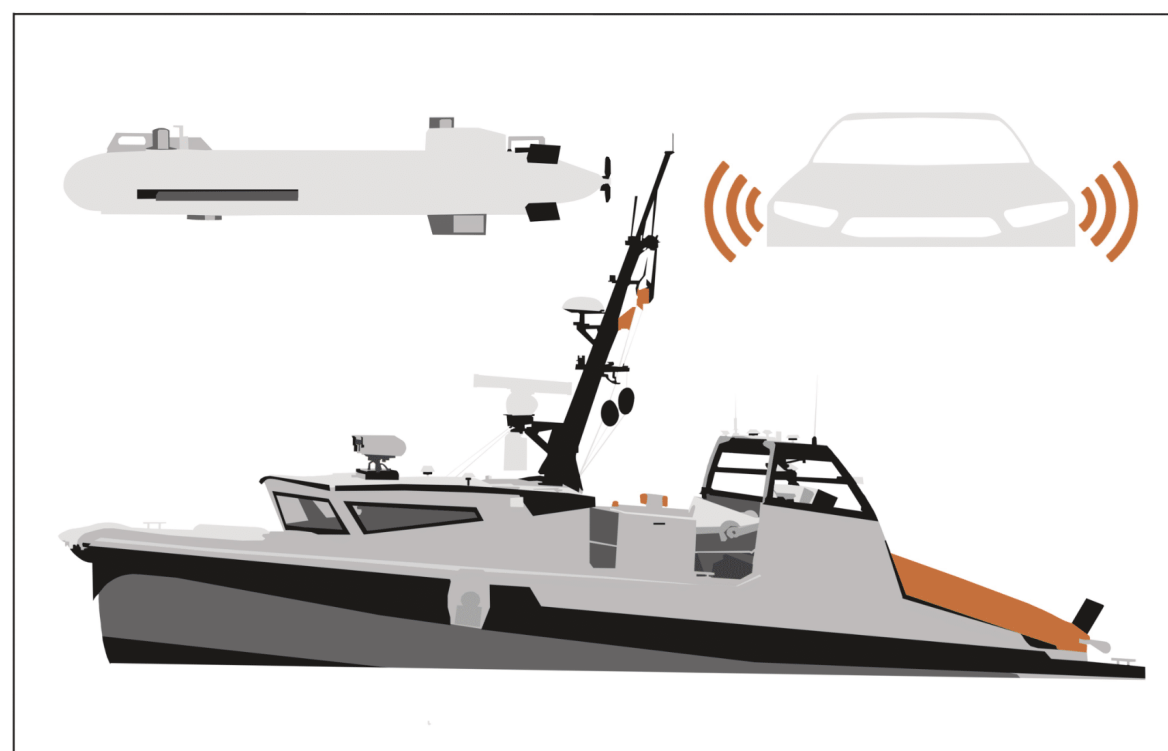


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## PROVING SYSTEM PROPERTIES



A simple example:

*After at most 3 minutes, you have 4 acceptable pictures of the target area*

To prove this property requires knowledge about these system components:

- Hardware
- Software
- Human

Verification of systems with any autonomous element requires the above: *teleoperated systems, human-autonomy teaming, fully autonomous systems*

## BENEFITS OF THE RESEARCH

- A unified, compositional, design and verification approach considering hardware, software and human components of the system
- Automatic generation of artefacts
- Production of rigorous evidence of properties
- Techniques that benefit from rigorous mathematical foundations but do not require mathematical expertise
- Along with the [RAEng Fellowship research](#) undertaken by Mark Chattington creates a combined approach from design and verification through to testing

## CONCLUSION

The following research goals have been developed:

1. An accessible notation for modelling user behaviour
2. A mathematical semantics for the notation
3. A technique for proving properties which depend on human interaction
4. To demonstrate the technology via case studies

## CURRENT WORK

- User needs analysis (Industry interviews)
- UML sequence diagram based notation
- Case study definition

