Towards Automatic Systems Architecting

From abstract concept to architecture

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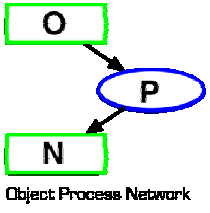


Agenda

- Intro to the Project
- The Current Approach vs. The New Approach
- Applications
- The Hierarchical OPN
- Further Development / Conclusion

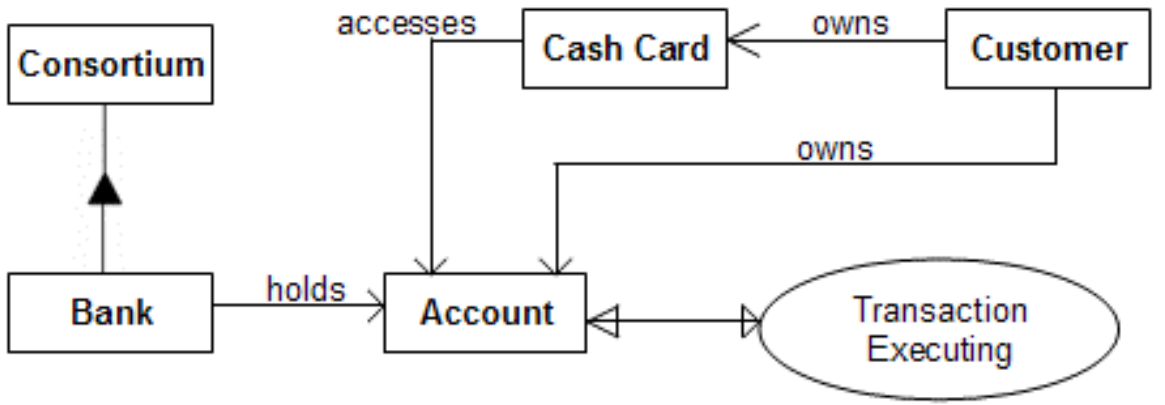
Introduction

- Systems Architecture Domain
  - To Consider ***many options*** when designing a system
  - To be able to model a ***specific solution/architecture*** in an efficient manner
  - Available Languages / Tools :
    - ***OPM***, Structured Analysis, UML, SysML …
    - ***OPN*** (Decision-Support tool)
- Goal:
  - To define a ***new approach*** that allows ***both perspectives*** to be considered

The Current Approach

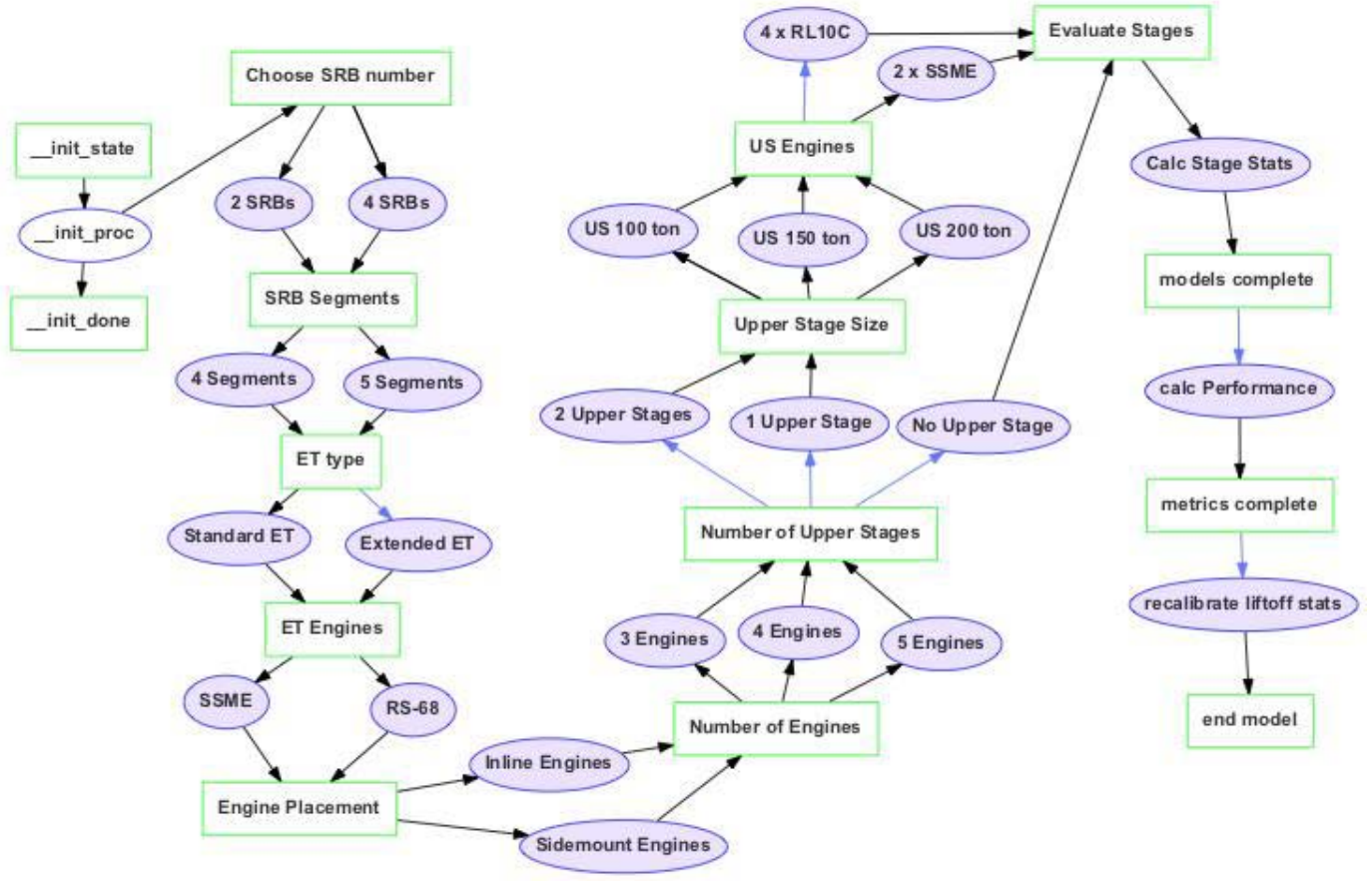
- Currently, decision-support tools are ***completely separated*** from system architecture modeling tools:
  - When ***deciding***: you do not have instruments for a common visual understanding of the system
  - When ***modeling***: you do not have instruments for deciding which way to move forward

- OPM Model:



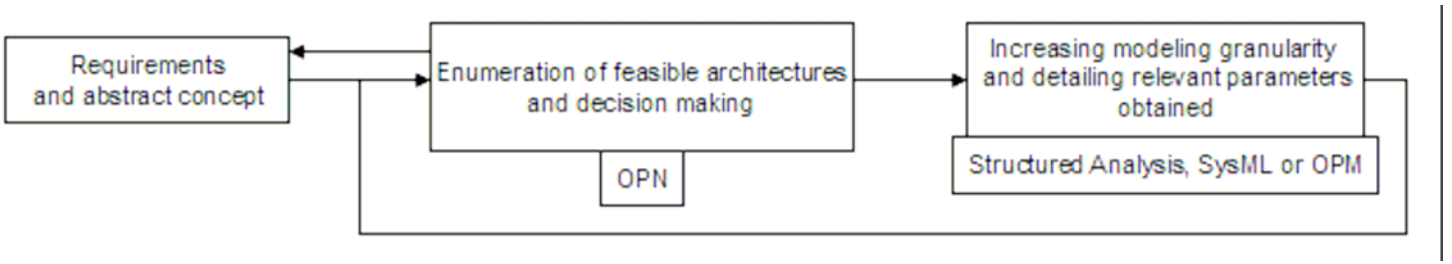
The Current Approach

- OPN Graph (Higher-Lever of Abstraction) :



The New Approach

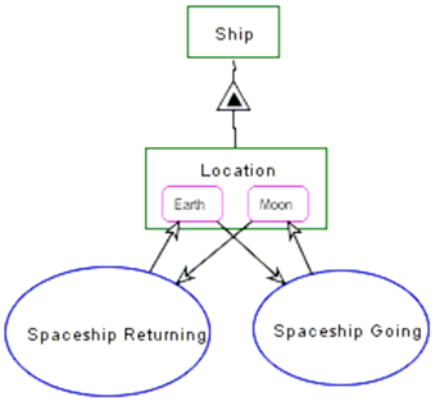
- Association OPM-OPN
  - Model the ***Space of Options*** with OPM
  - ***Systematic Translation*** to OPN
  - ***Results*** presented using ***OPM notation*** (for each architecture)



- That's what we call "Automatic Systems Architecting"

The New Approach – Step-by-Step

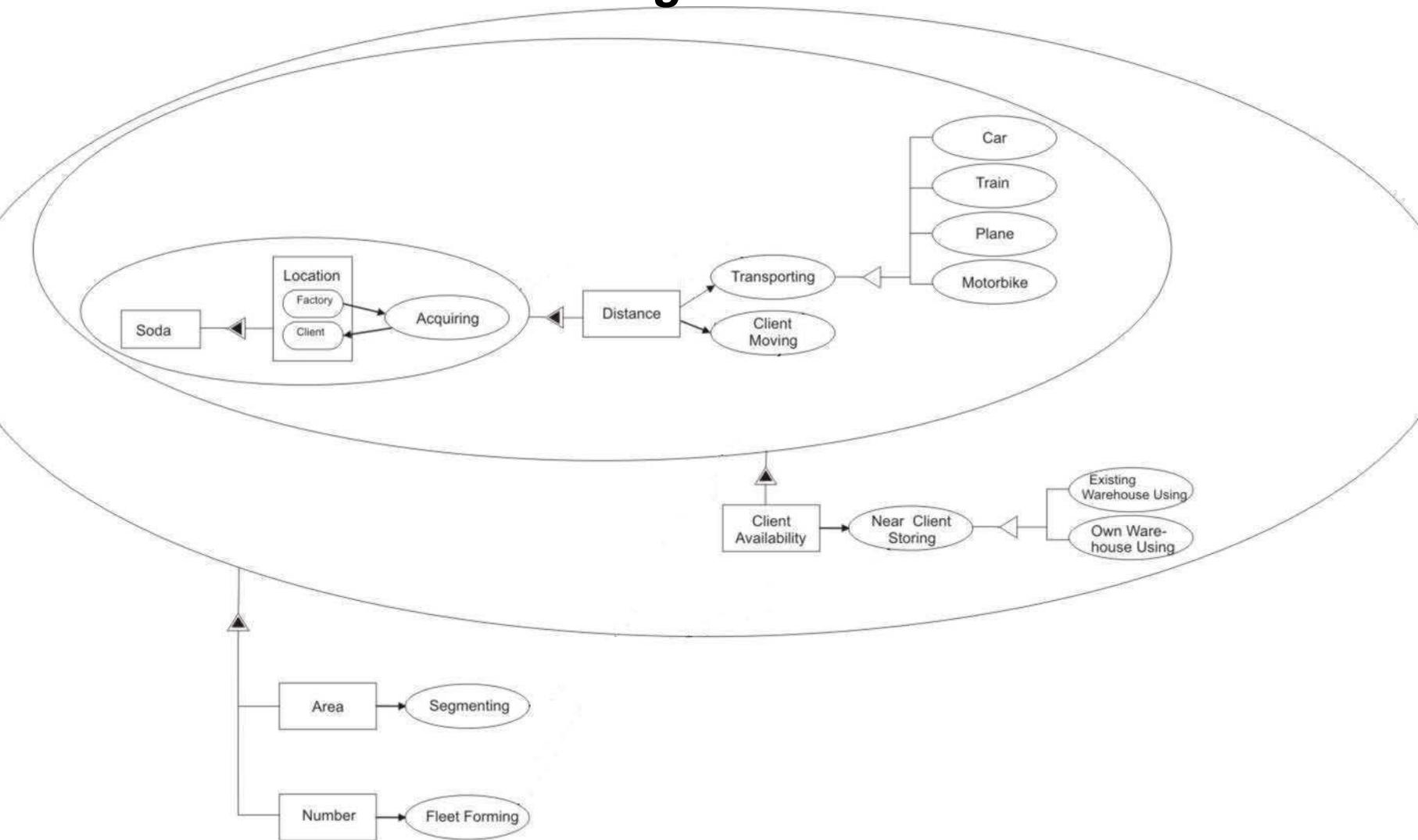
1. Define the ***function*** to be performed by your system.



2. Define ***Boundary Conditions*** (BC) to your Problem (they hinder the change from an initial state to a final state).
3. Assign ***Functions*** that "solve" these boundary conditions and the parameters which are important for making a decision to "feed" the OPN model.
4. Show ***Specialization*** possibilities for this solution and how they alter the parameter's values.
5. If necessary, define ***New BC*** to these functions (iterate between 2, 3 and 4).
6. Check ***Architectures*** selected by OPN

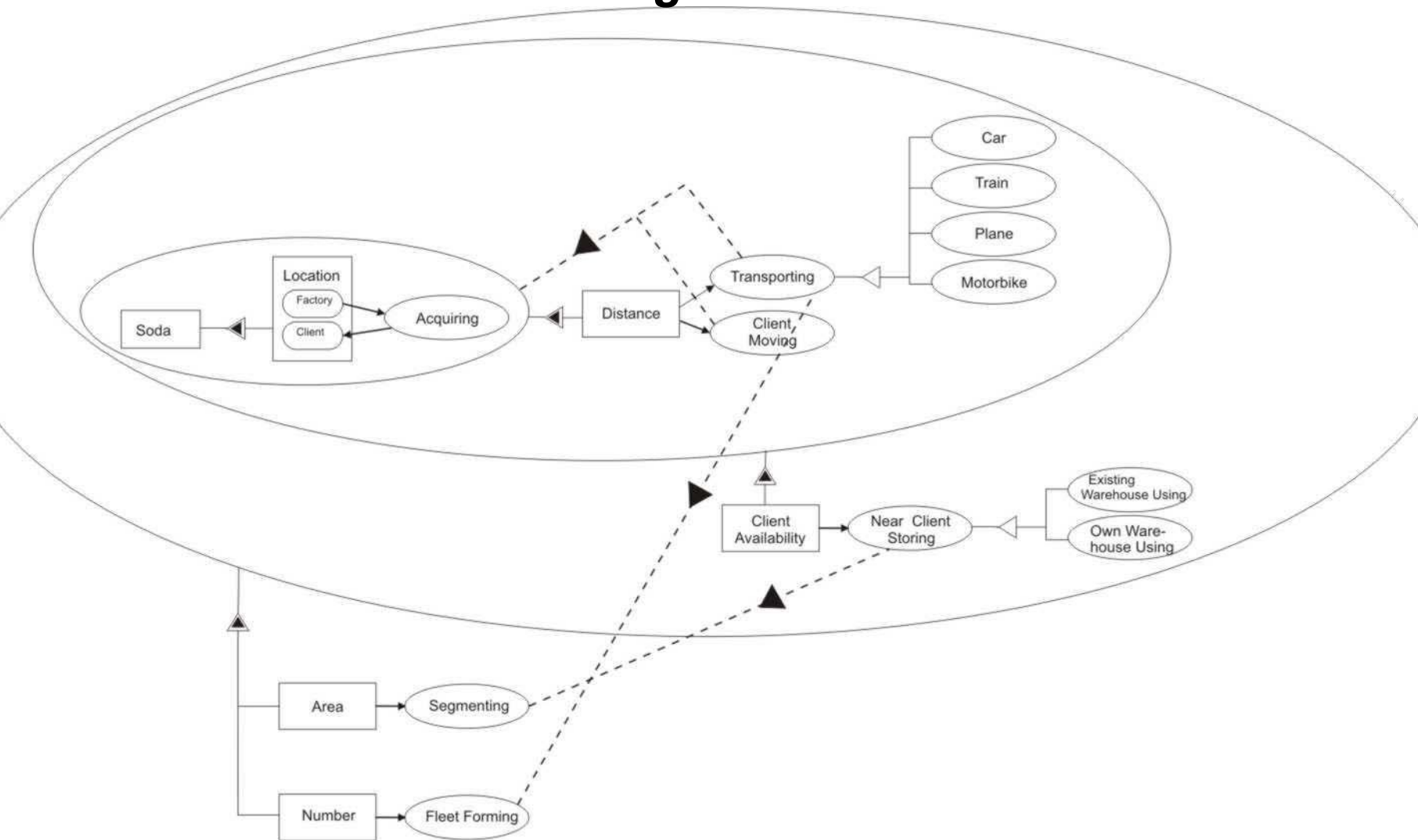
Application 1

– Market of Sodas – ***Logistic issues***



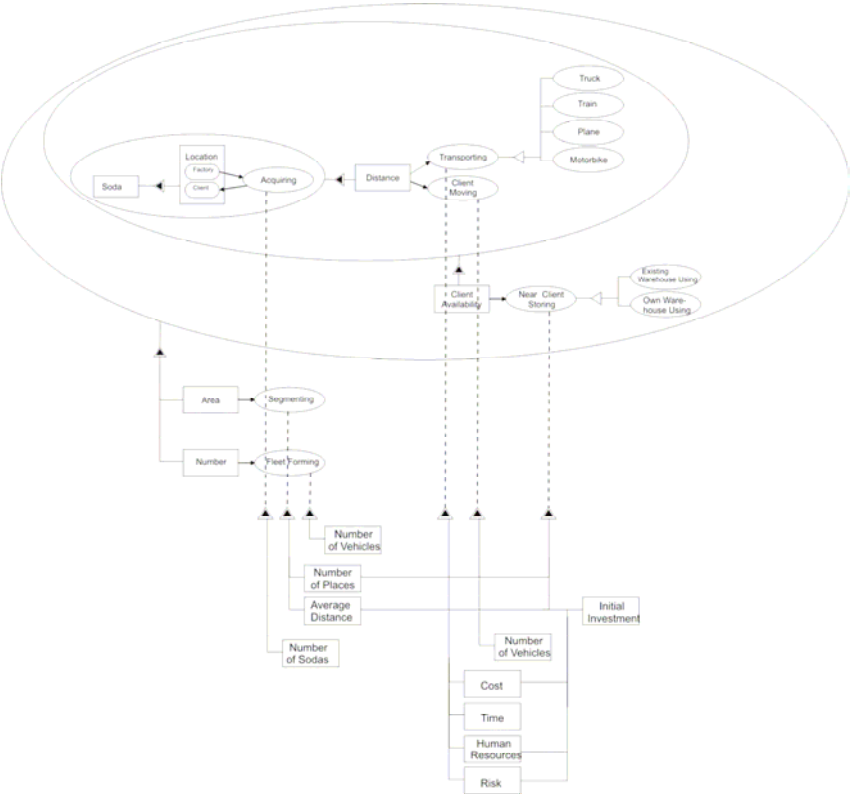
Application 1

– Market of Sodas – ***Logistic issues***



Application 1

- ***Adding parameters*** that will feed the OPN model



The functions are “described” in terms of these parameters

Application 1

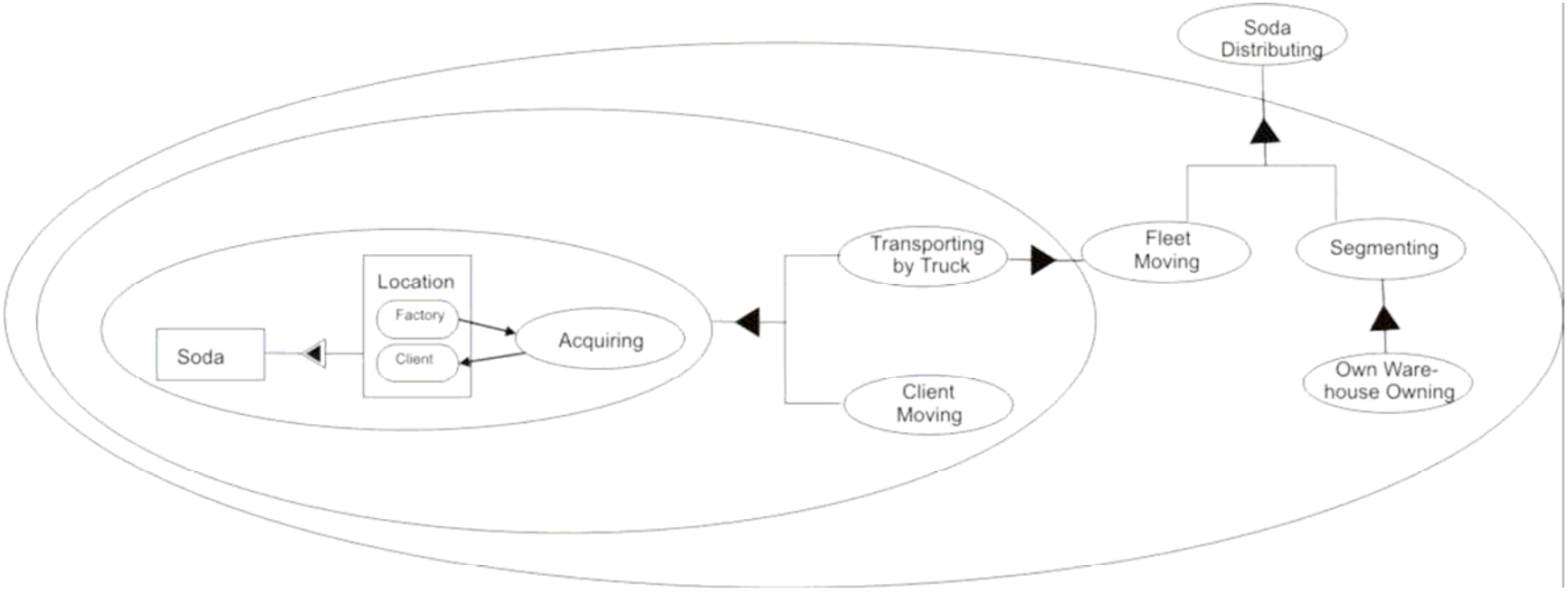
- ***Translating*** the decisions to be made to OPN

- Modeling the ***decisions made*** using ***OPM*** notation

Application 1

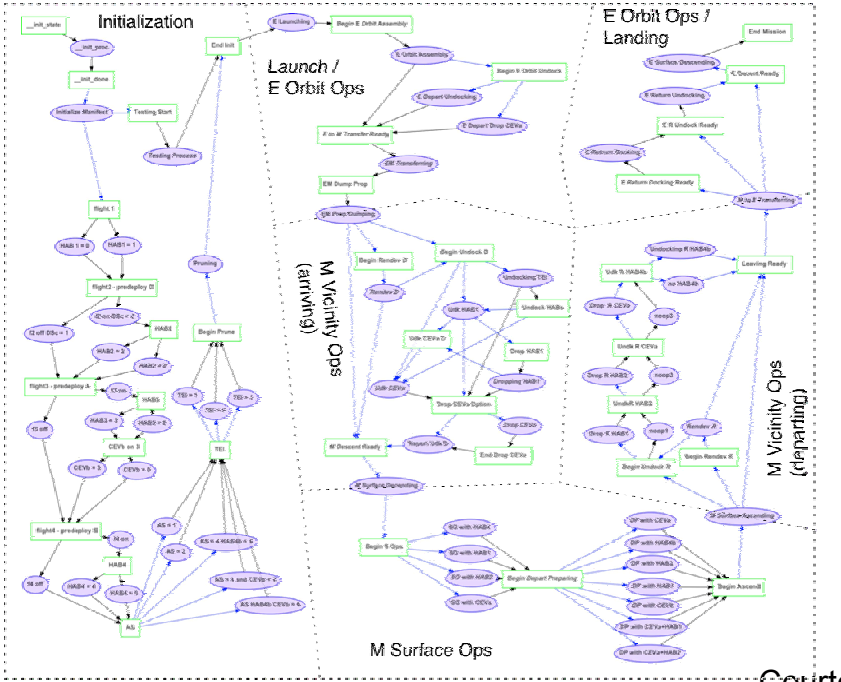
- Eventually, the decisions made can be modeled in the form of the ***actual system*** with OPM

  (This OPM model represents an architecture pointed out by OPN)



Applications - Questions

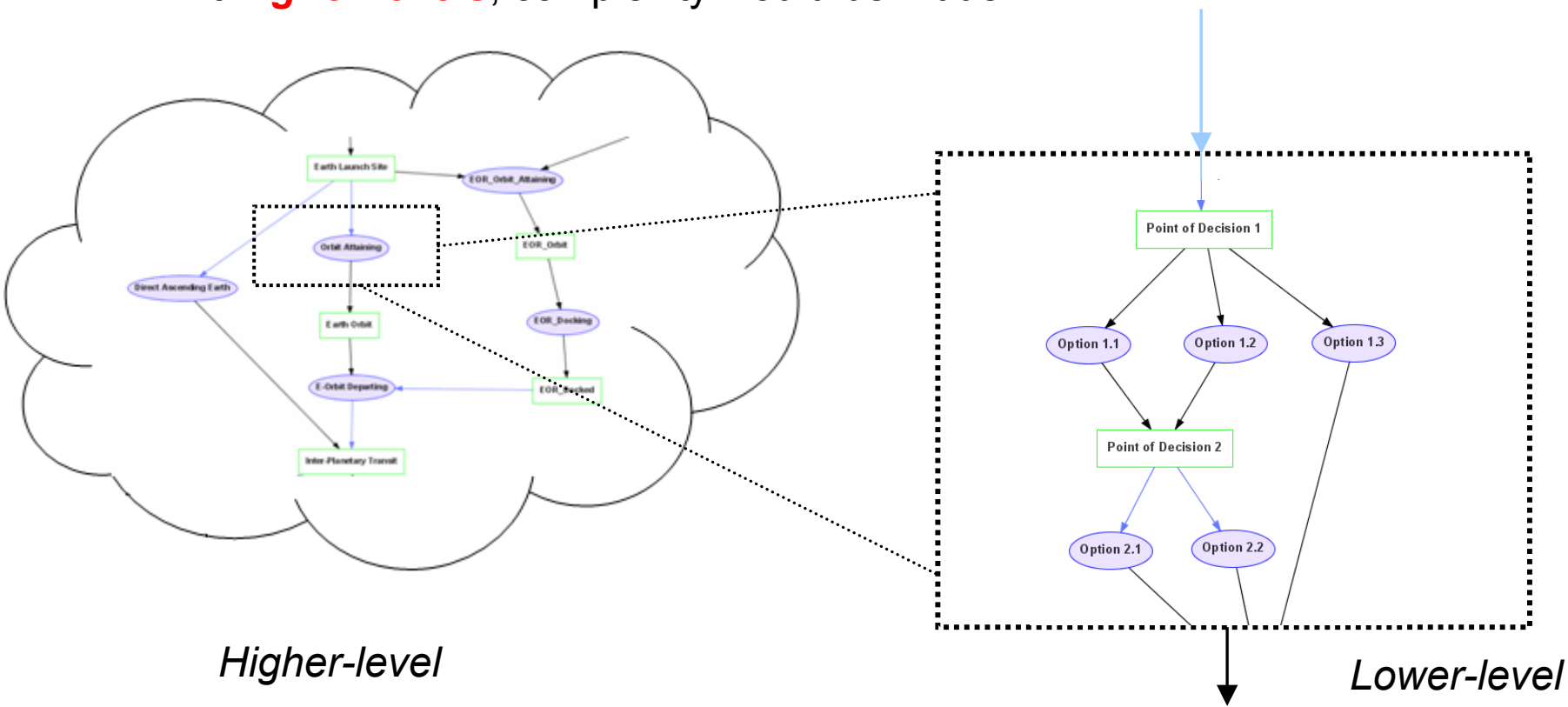
- For a simple application, a ***single*** OPN model may be sufficient to model all the “points of decision” to be considered.
- The ***more complex*** our system becomes, the more difficult it is to integrate knowledge from different domains (i.e. decisions in different areas) in a single OPN model.
- To try to model such a system using OPN current features leads to a model with ***low cohesion*** and ***high coupling***.



Courtesy of Simmons, Koo, Crawley

The Hierarchical OPN

- But what we need is ***high cohesion*** and ***low coupling!***
- ***Solution***: The Hierarchical OPN
- The recursivity presented in the new approach would be defined in ***lower levels*** OPN models.
- At ***higher levels***, complexity would be hidden.



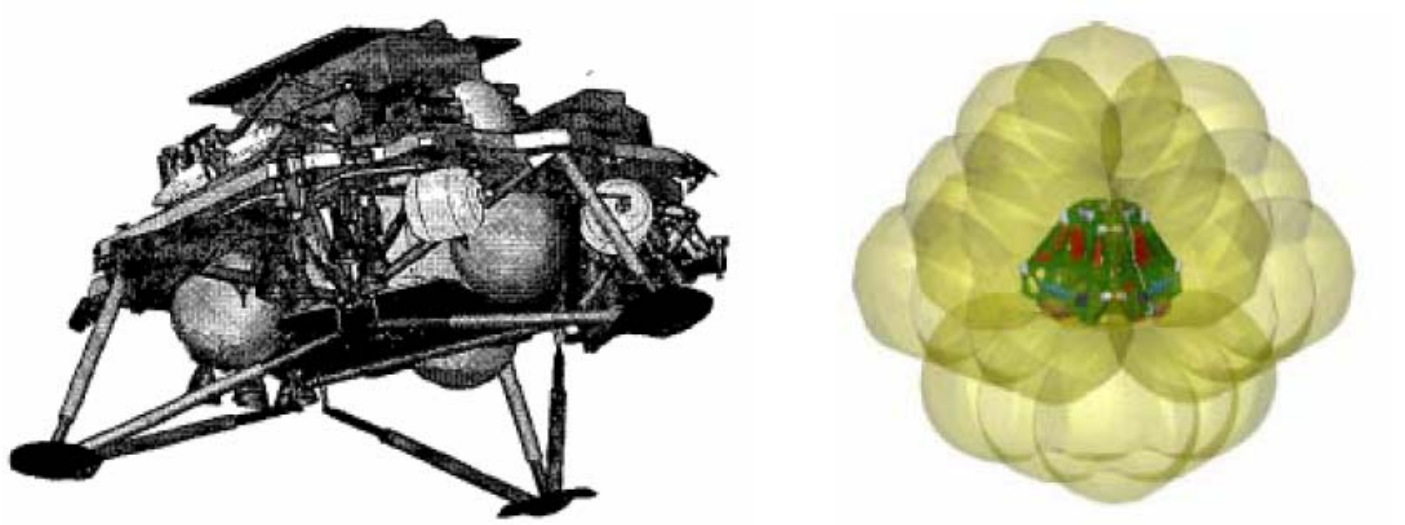
The Hierarchical OPN

- Pros:
  - To allow the ***design of complex systems*** (that involves experts from multiple domains) using OPN tool.
  - To provide ***higher cohesion*** and ***lower coupling***

- The New Approach:
  - Tool that integrates OPM with Hierarchical OPN
  - Note: When ***different notations*** are been used, one should to ***translate*** all of them to ***OPM***. We've verified it's quite easy translation between SA, OPM, SysML, UML

Application 2

- ***Lunar Lander*** (Under Development)
  - This example will show:
    - Exactly how the ***different levels*** will ***communicate*** with each other during simulation process; (parameters from higher levels modifying lower levels parameters and vice-versa).
    - That this “better organized” approach (high cohesion and low coupling) will lead to ***model reuse***



Legged and Air-bag concepts – Two of the options considered for the Lunar Lander

Further Development / Conclusions

- How to figure out to which extent we should model? We could spend effort ***modeling a solution that will never be developed*** !
- How can the models evolve?
- Conclusion of current study case (Lunar Lander)
- Implementation of an *user-friendly* tool able to mechanize the proposed approach (Association OPM + Hierarchical OPN)