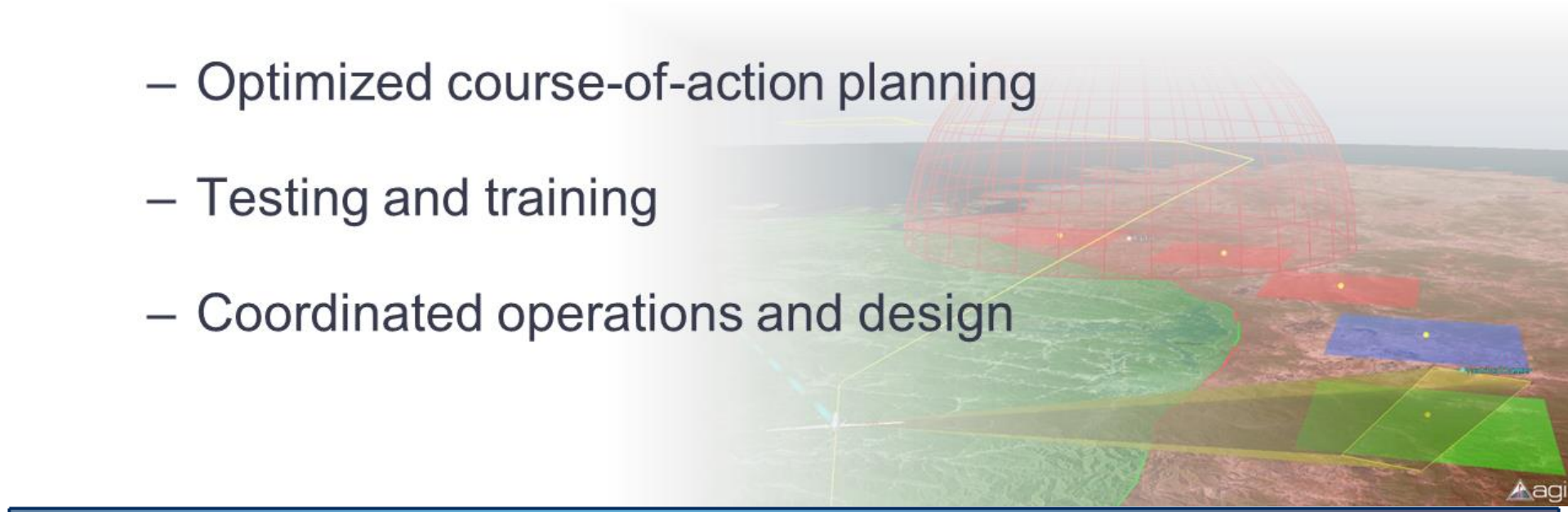
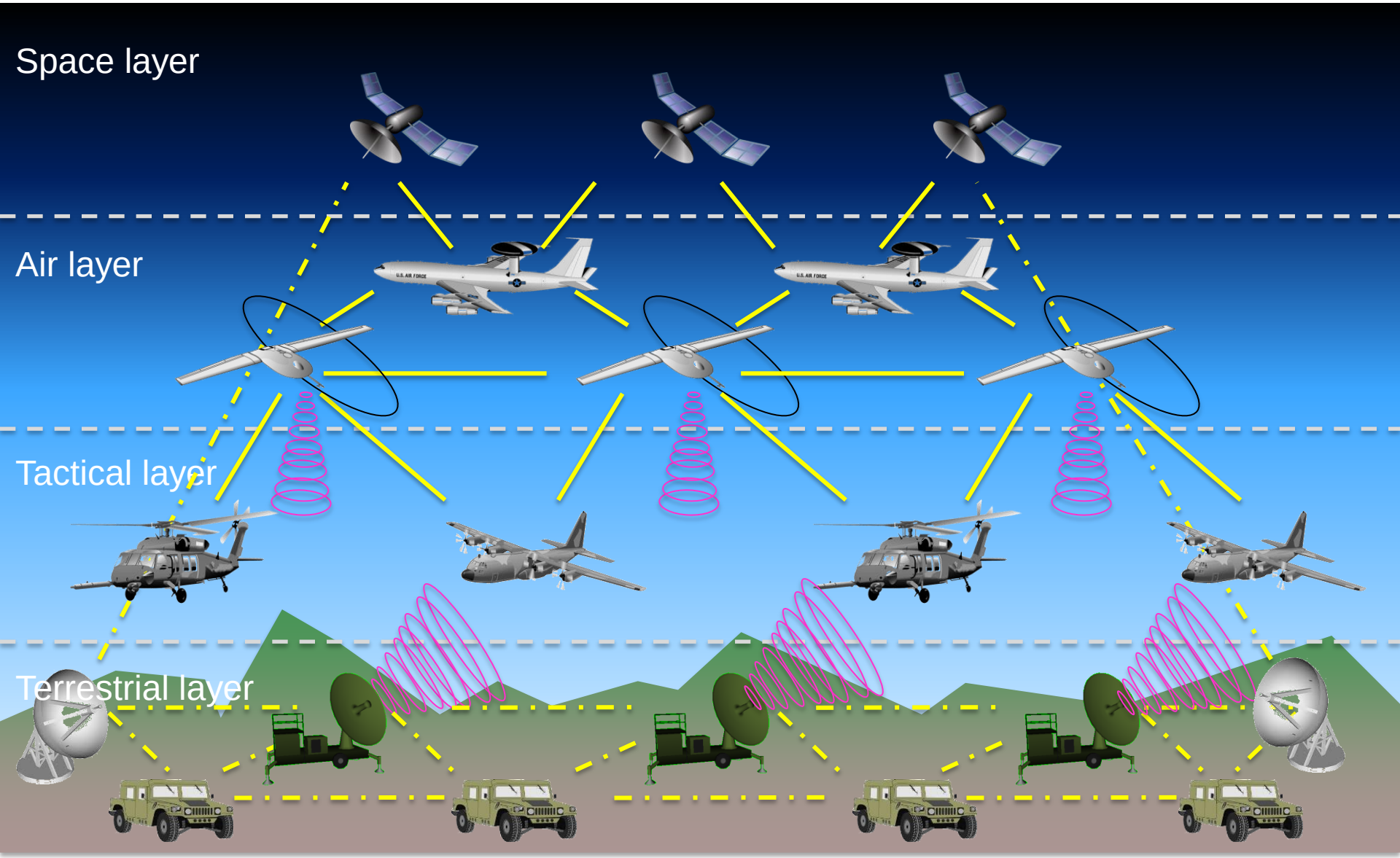
Process Automation and Optimization for Aerospace and Defense Operations

Overview

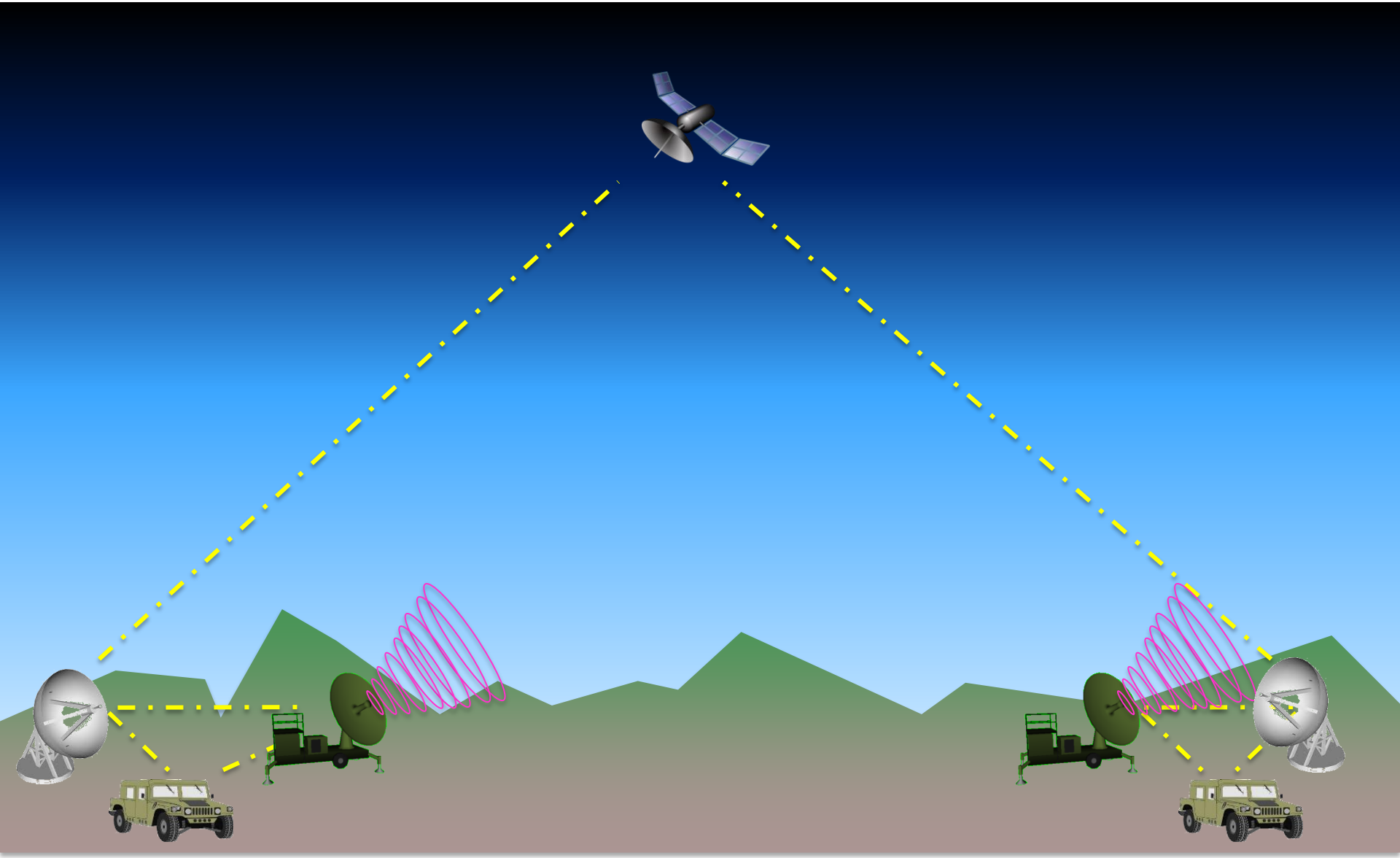
- **Automate operational processes**
  - Evolve over time
  - Desire to ultimately “routinize”
- **Integrate engineering models and simulation**
  - Optimized course-of-action planning
  - Testing and training
  - Coordinated operations and design



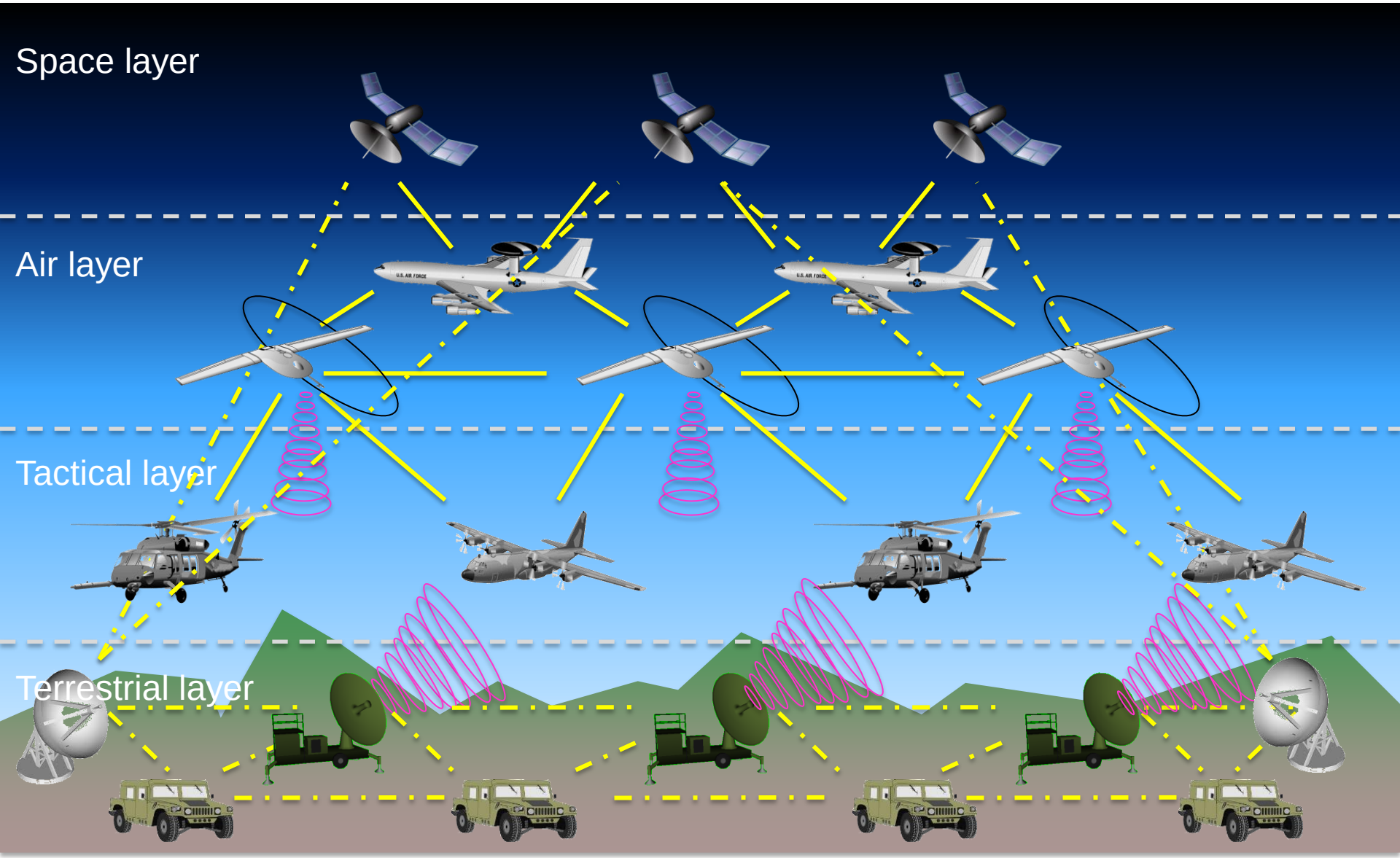
Motivation for Process Automation



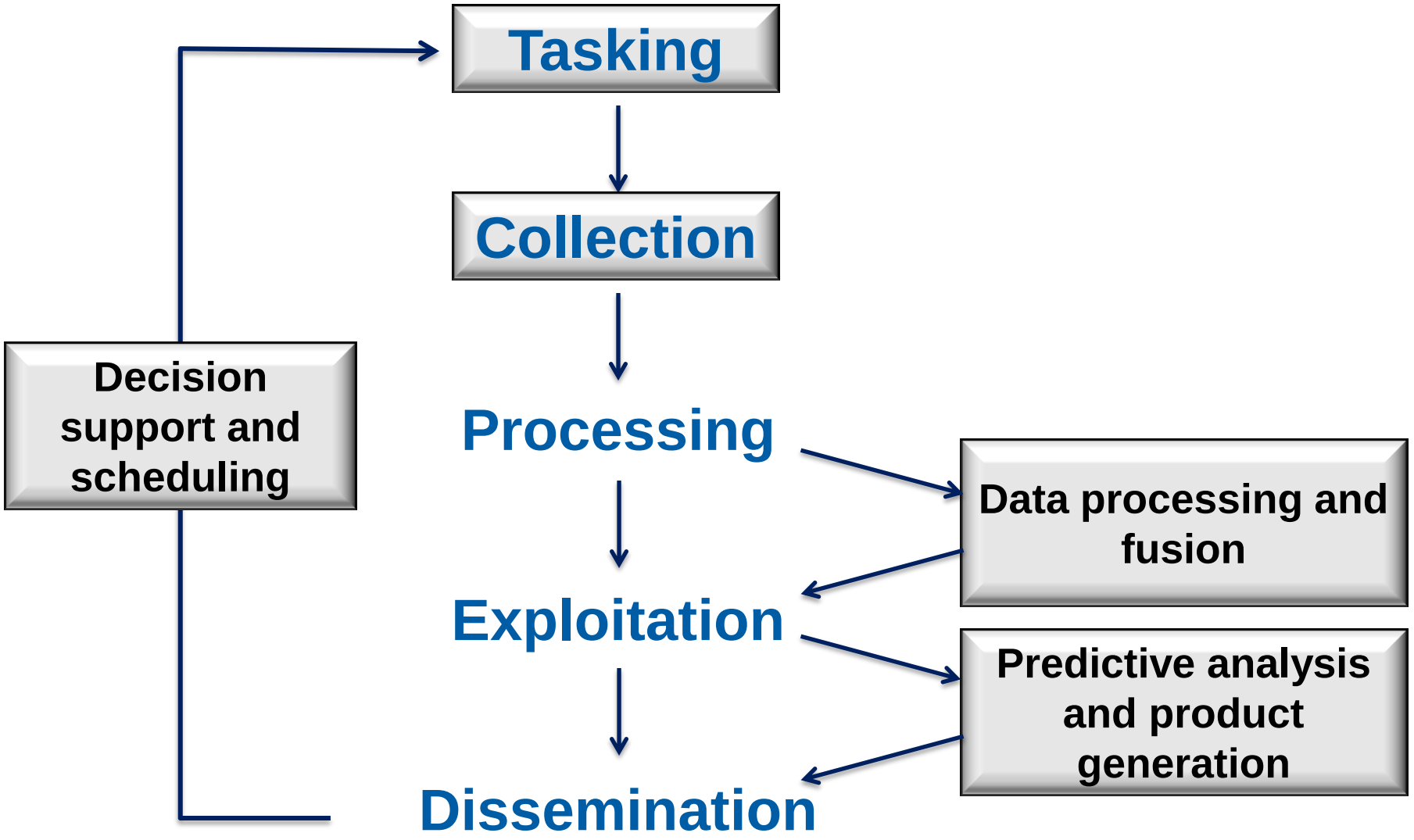
Motivation for Process Automation



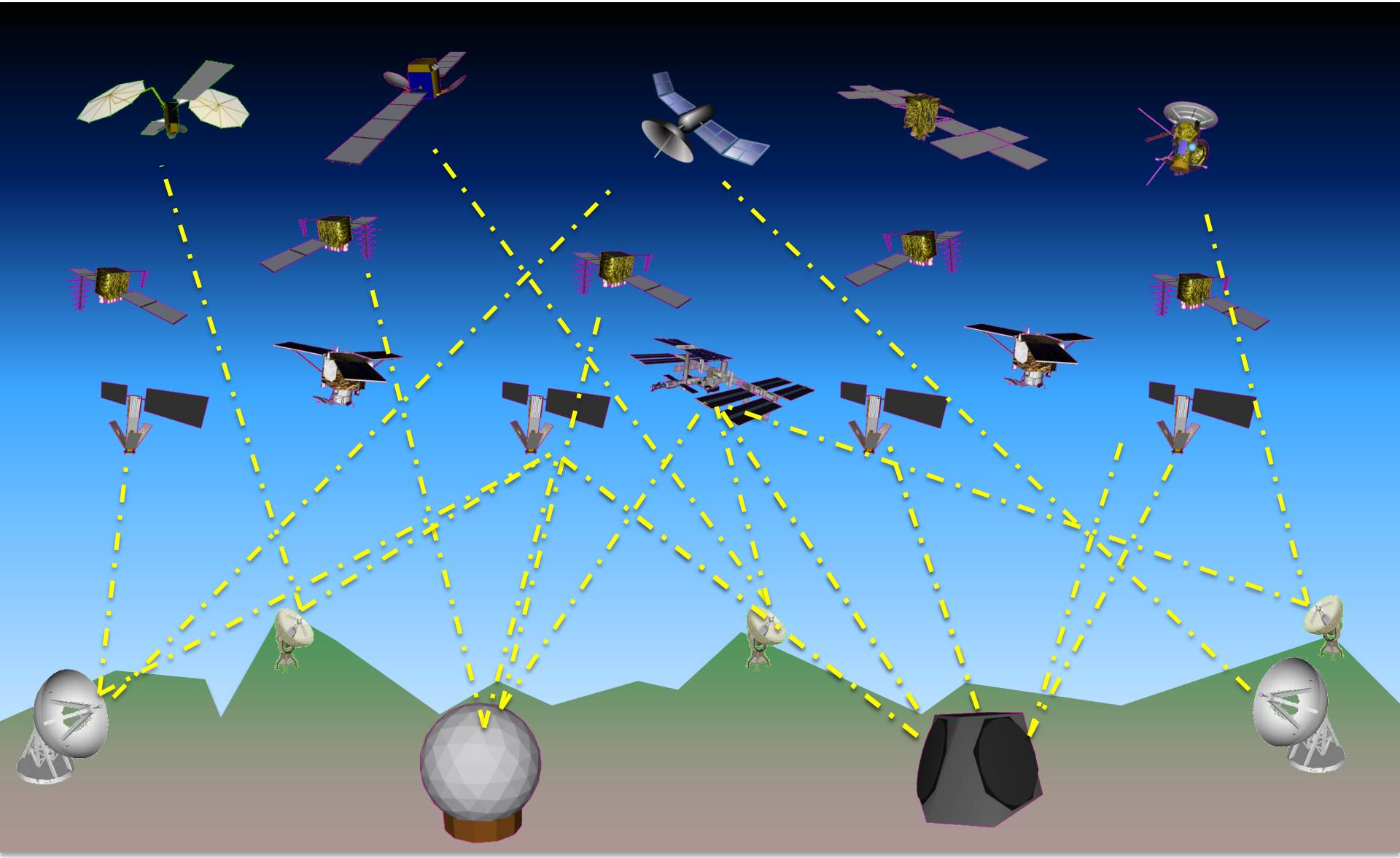
Motivation for Process Automation



Representative Process



Satellite Observation and Processing



Representative Process

Decision support and scheduling

Tasking

Collection

Processing

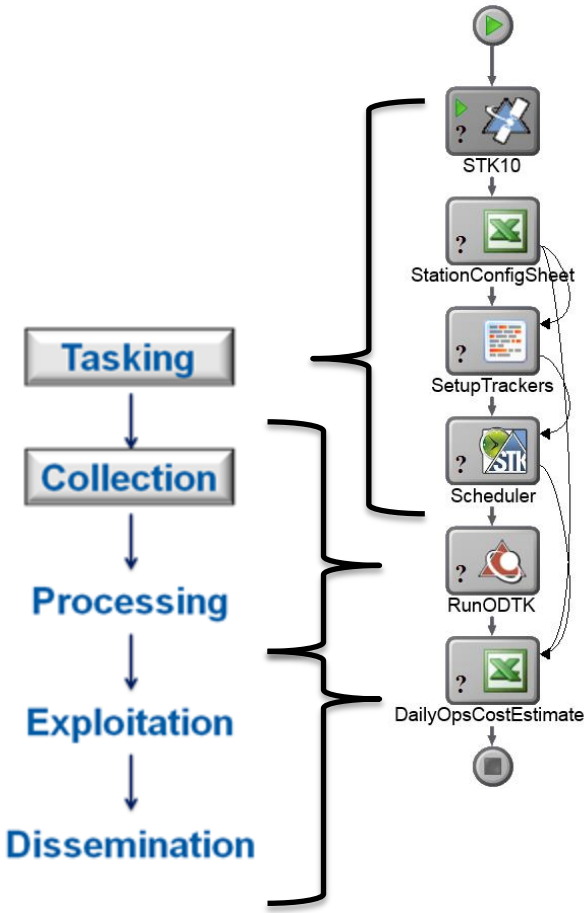
Exploitation

Dissemination

Data processing and fusion

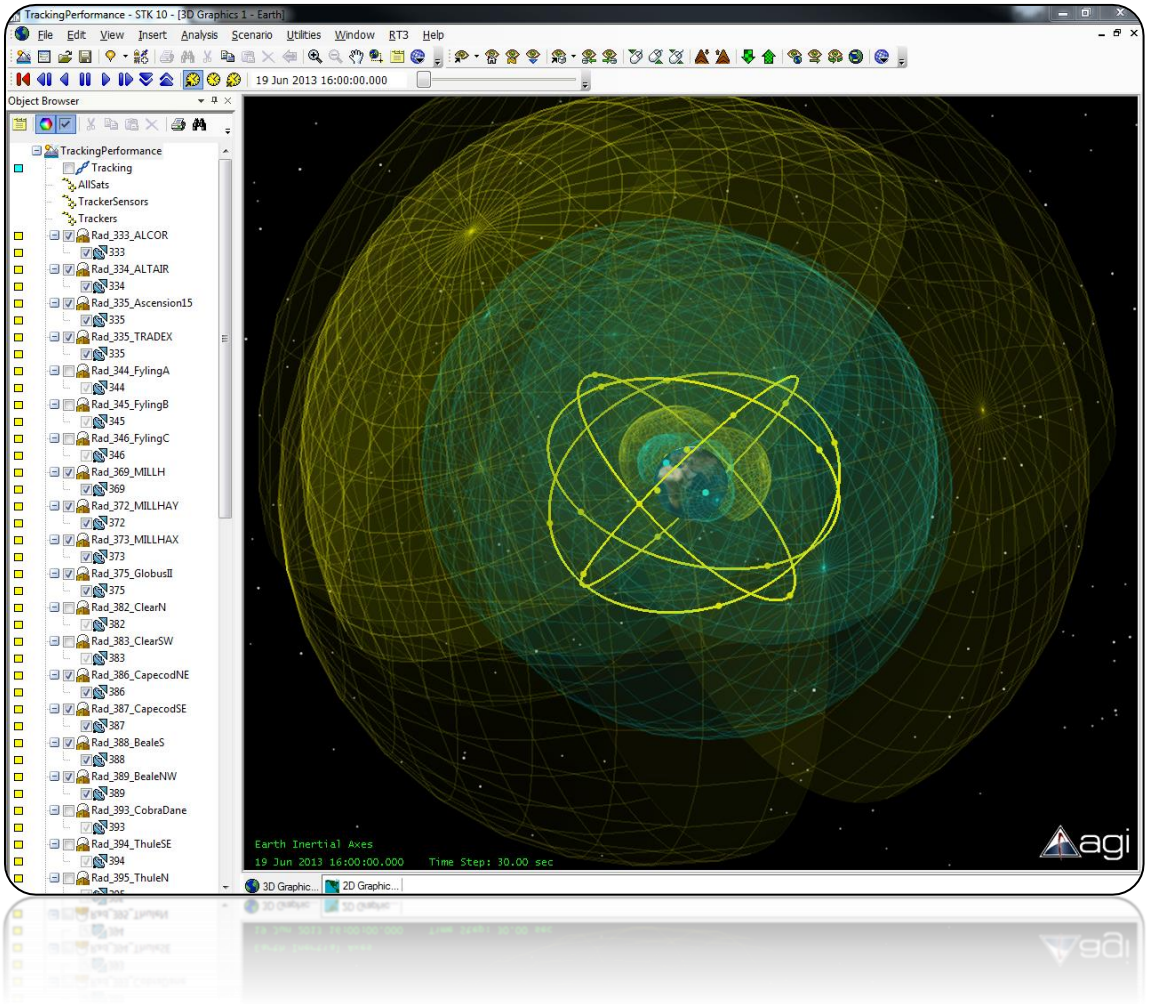
Predictive analysis and product generation

Example Process – Satellite Tracking



1. STK – Model sensor network and associated satellites
2. Excel – Configuration of "active" sensors
3. Vbscript – Apply "active" sensors to STK
4. STK / Scheduler – Task sensors to track satellites
5. ODTK – Simulate collection and product generation
6. Excel – Estimate cost based on sensor tasking

Example Process – Satellite Tracking



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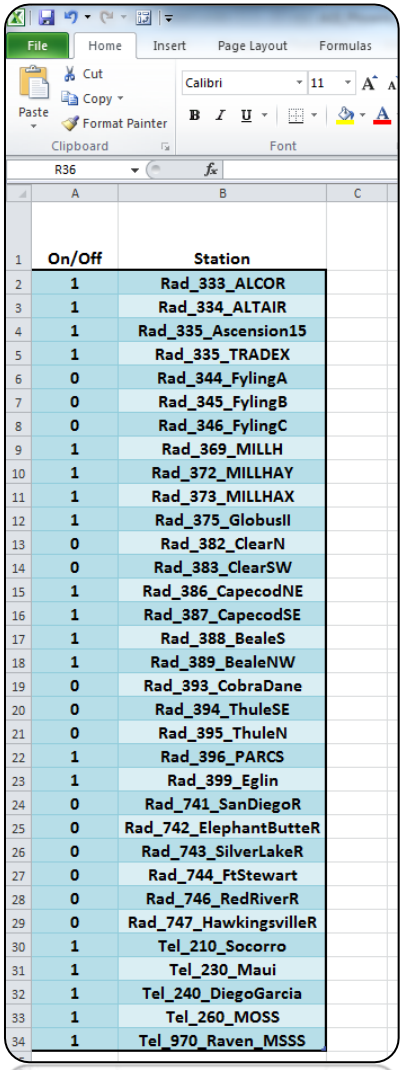
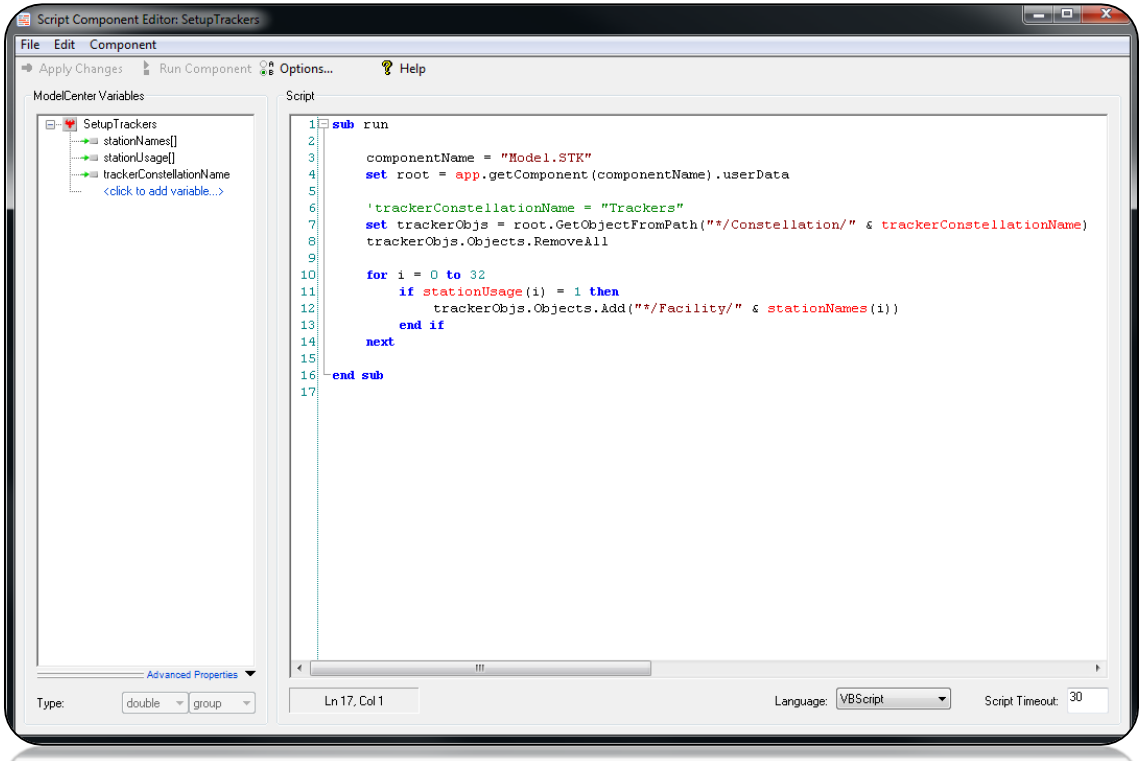


	On/Off	Station
2	1	Rad_333_ALCOR
3	1	Rad_334_ALTAIR
4	1	Rad_335_Ascension15
5	1	Rad_335_TRADEX
6	0	Rad_344_FylingA
7	0	Rad_345_FylingB
8	0	Rad_346_FylingC
9	1	Rad_369_MILLH
10	1	Rad_372_MILLHAY
11	1	Rad_373_MILLHAX
12	1	Rad_375_GlobusII
13	0	Rad_382_ClearN
14	0	Rad_383_ClearSW
15	1	Rad_386_CapecodNE
16	1	Rad_387_CapecodSE
17	1	Rad_388_BealeS
18	1	Rad_389_BealeNW
19	0	Rad_393_CobraDane
20	0	Rad_394_ThuleSE
21	0	Rad_395_ThuleN
22	1	Rad_396_PARCS
23	1	Rad_399_Eglin
24	0	Rad_741_SanDiegoR
25	0	Rad_742_ElephantButteR
26	0	Rad_743_SilverLakeR
27	0	Rad_744_FtStewart
28	0	Rad_746_RedRiverR
29	0	Rad_747_HawkingsvilleR
30	1	Tel_210_Socorro
31	1	Tel_230_Maui
32	1	Tel_240_DiegoGarcia
33	1	Tel_260_MOSS
34	1	Tel_970_Raven_MSSS

Example Process – Satellite Tracking



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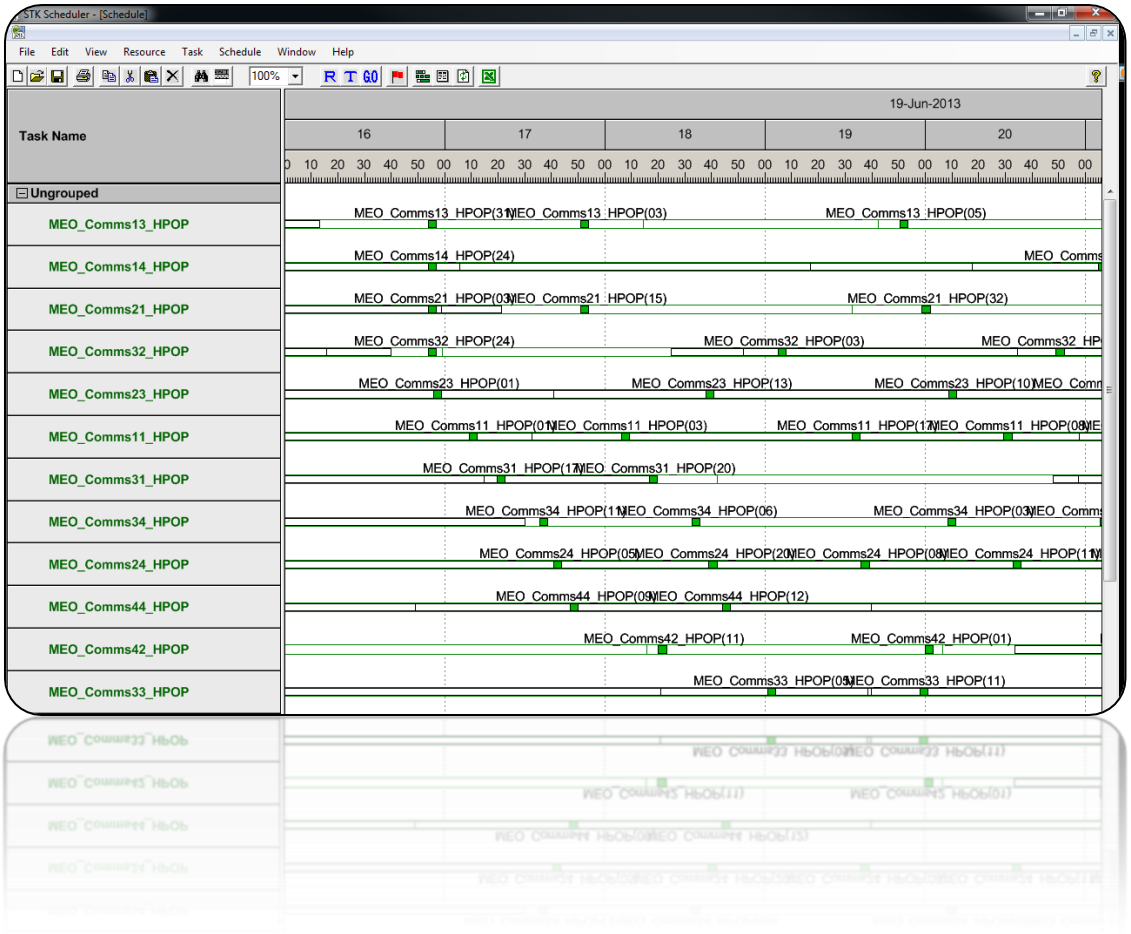

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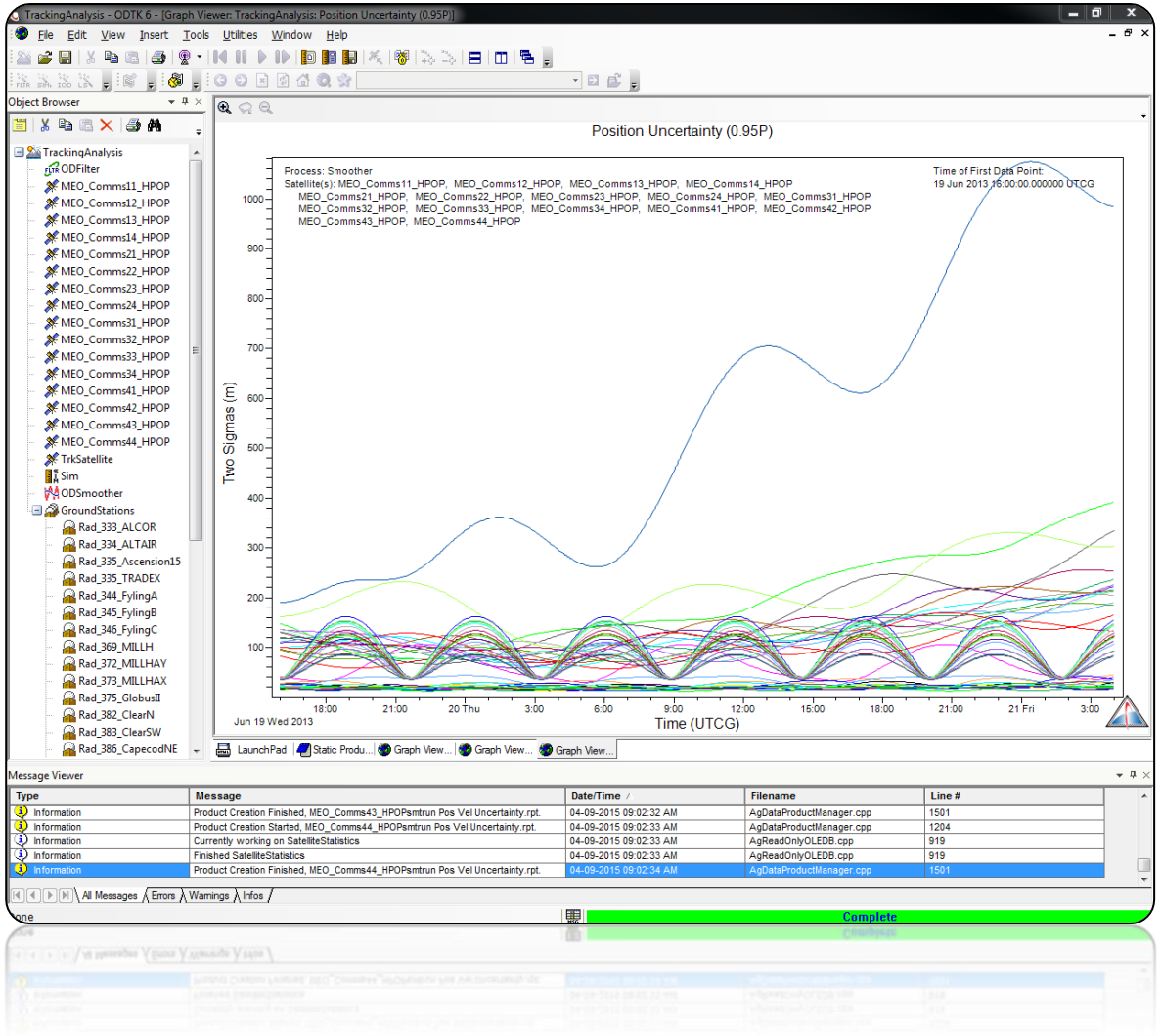

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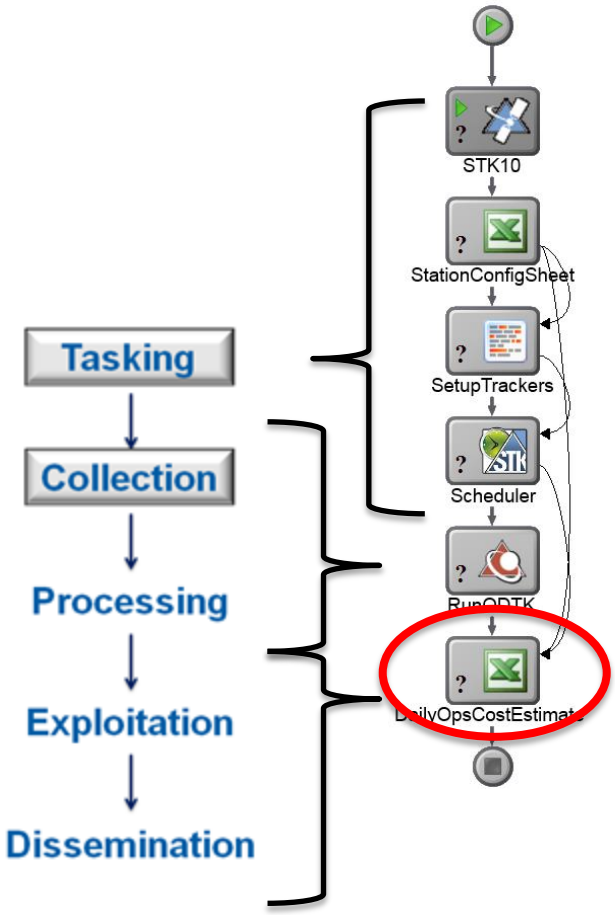
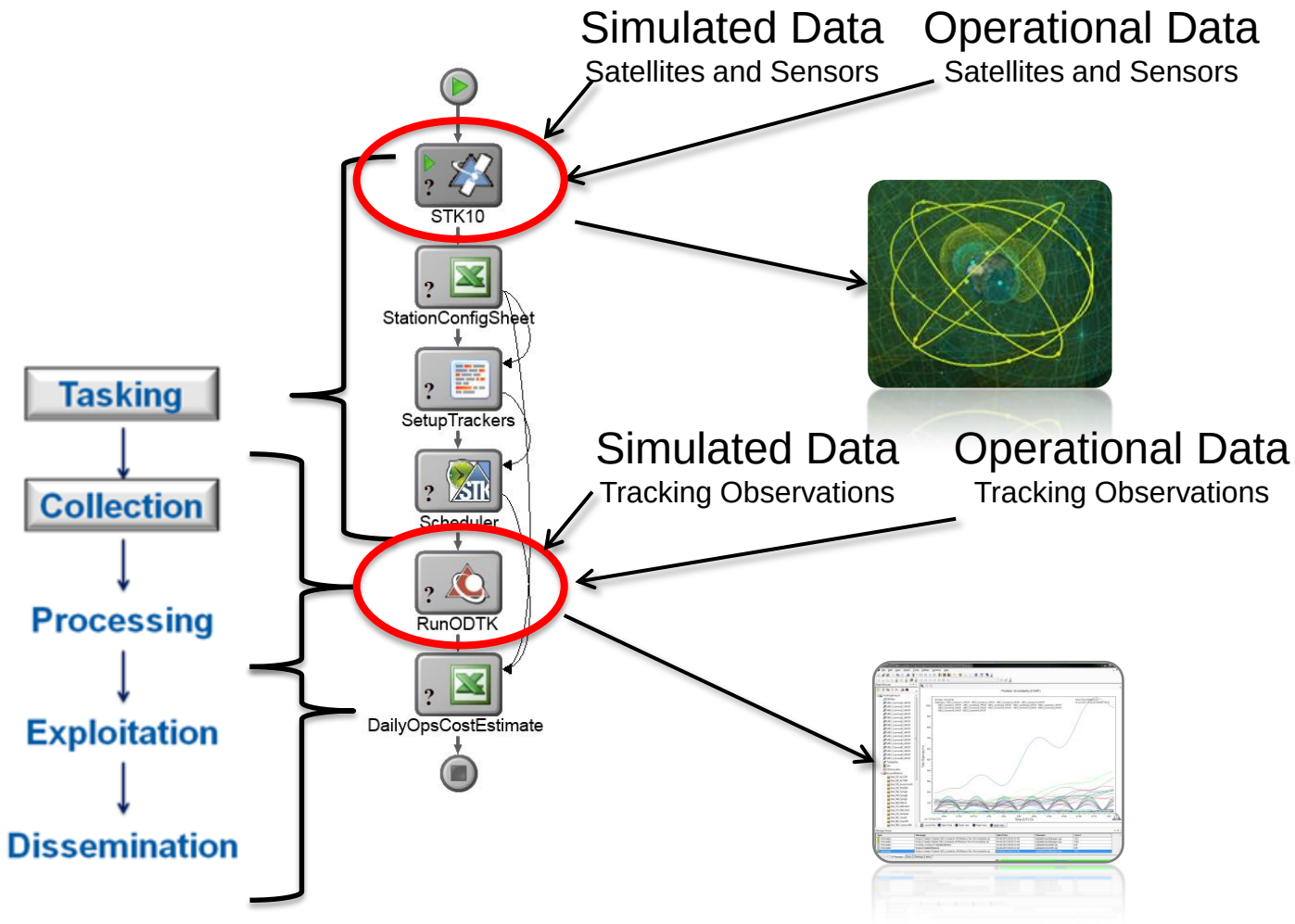


SSN_sensor_cost.xlsx - Microsoft Excel

On/Off	Station	Type	Cost	Usage	SensorUpgrade	Accomodation
1	Rad_333_ALCOR	Radar	$16,245.00	3420	0.5	1
1	Rad_334_ALTAIR	Radar	$12,825.00	2700	0.5	1
1	Rad_335_Ascension15	Radar	$15,390.00	3240	0.5	1
1	Rad_335_TRADEX	Radar	$12,825.00	2700	0.5	1
0	Rad_344_FylingA	Radar	$0.00	0	0.5	1
0	Rad_345_FylingB	Radar	$0.00	0	0.5	1
0	Rad_346_FylingC	Radar	$0.00	0	0.5	1
1	Rad_369_MILLH	Radar	$17,100.00	3600	0.5	1
1	Rad_372_MILLHAY	Radar	$16,245.00	3420	0.5	1
1	Rad_373_MILLHAX	Radar	$13,680.00	2880	0.5	1
1	Rad_375_GlobusII	Radar	$18,810.00	3960	0.5	1
0	Rad_382_ClearN	Radar	$0.00	0	0.5	1
0	Rad_383_ClearSW	Radar	$0.00	0	0.5	1
1	Rad_386_CapecodNE	Radar	$5,130.00	1080	0.5	1
1	Rad_387_CapecodSE	Radar	$5,130.00	1080	0.5	1
1	Rad_388_BealeS	Radar	$7,695.00	1620	0.5	1
1	Rad_389_BealeNW	Radar	$10,260.00	2160	0.5	1
0	Rad_393_CobraDane	Radar	$0.00	0	0.5	1
0	Rad_394_ThuleSE	Radar	$0.00	0	0.5	1
0	Rad_395_ThuleN	Radar	$0.00	0	0.5	1
1	Rad_396_PARCS	Radar	$4,275.00	900	0.5	1
1	Rad_399_Eglin	Radar	$5,985.00	1260	0.5	1
0	Rad_741_SanDiegoR	Radar	$0.00	0	0.5	1
0	Rad_742_ElephantButteR	Radar	$0.00	0	0.5	1
0	Rad_743_SilverLakeR	Radar	$0.00	0	0.5	1
0	Rad_744_FtStewart	Radar	$0.00	0	0.5	1
0	Rad_746_RedRiverR	Radar	$0.00	0	0.5	1
0	Rad_747_HawkingsvilleR	Radar	$0.00	0	0.5	1
1	Tel_210_Socorro	Telescope	$0.70	900	0.5	1
1	Tel_230_Maui	Telescope	$0.70	2520	0.5	1
1	Tel_240_DiegoGarcia	Telescope	$0.70	2520	0.5	1
1	Tel_260_MOSS	Telescope	$0.70	1980	0.5	1
1	Tel_970_Raven_MSSS	Telescope	$0.70	1980	0.5	1

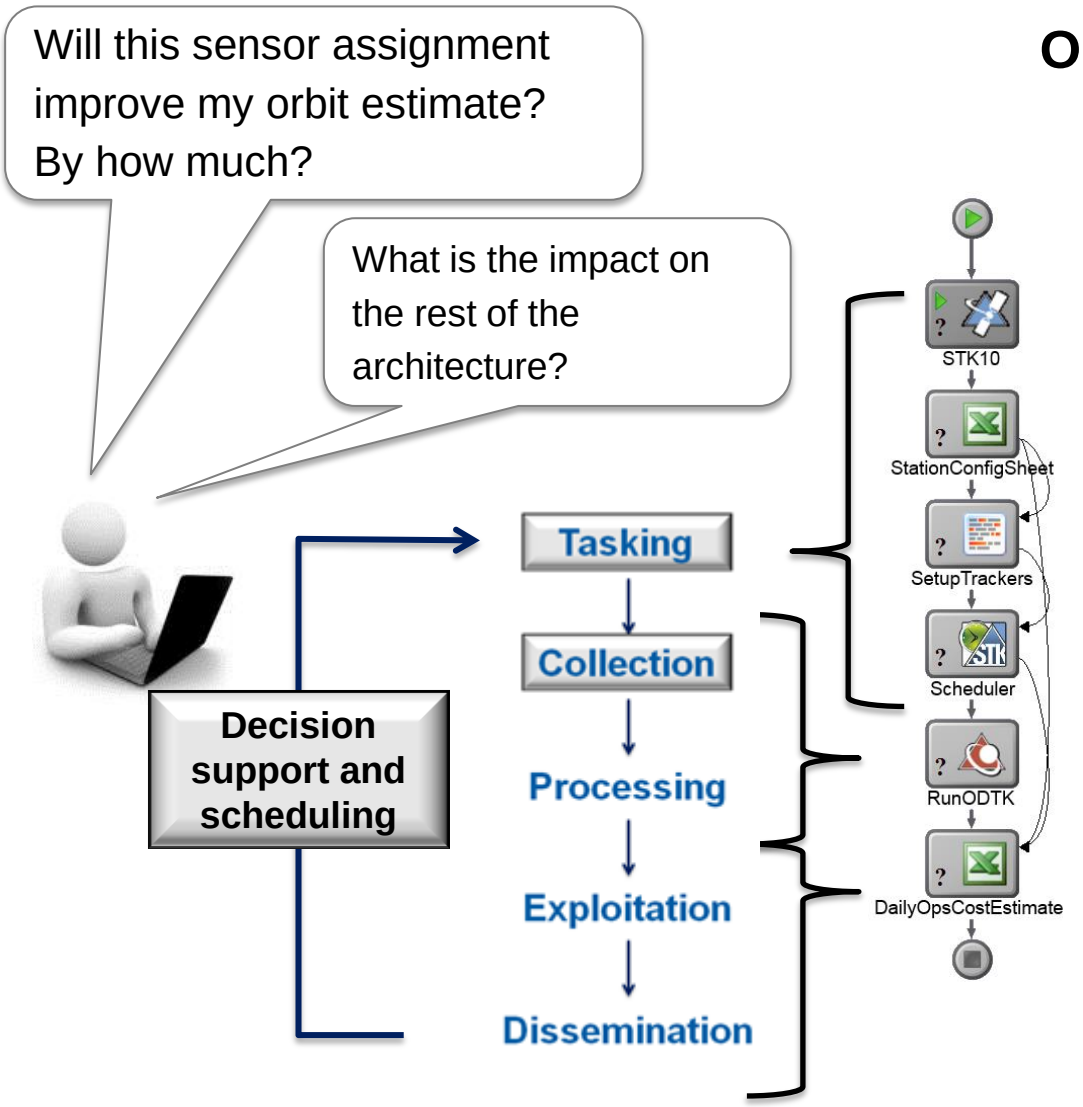
Radar Cost:	$1.90
Telescope Cost:	$0.70
SystemCost:	$161,598.50

Example Process – Satellite Tracking



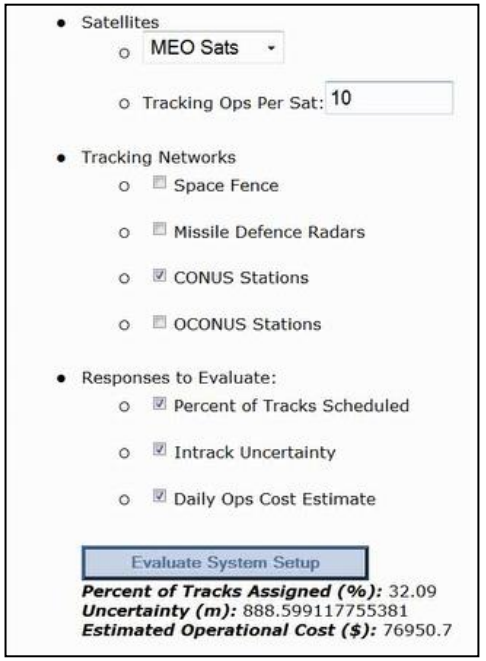
This same process applies using simulated and operational data

Example Process – Satellite Tracking

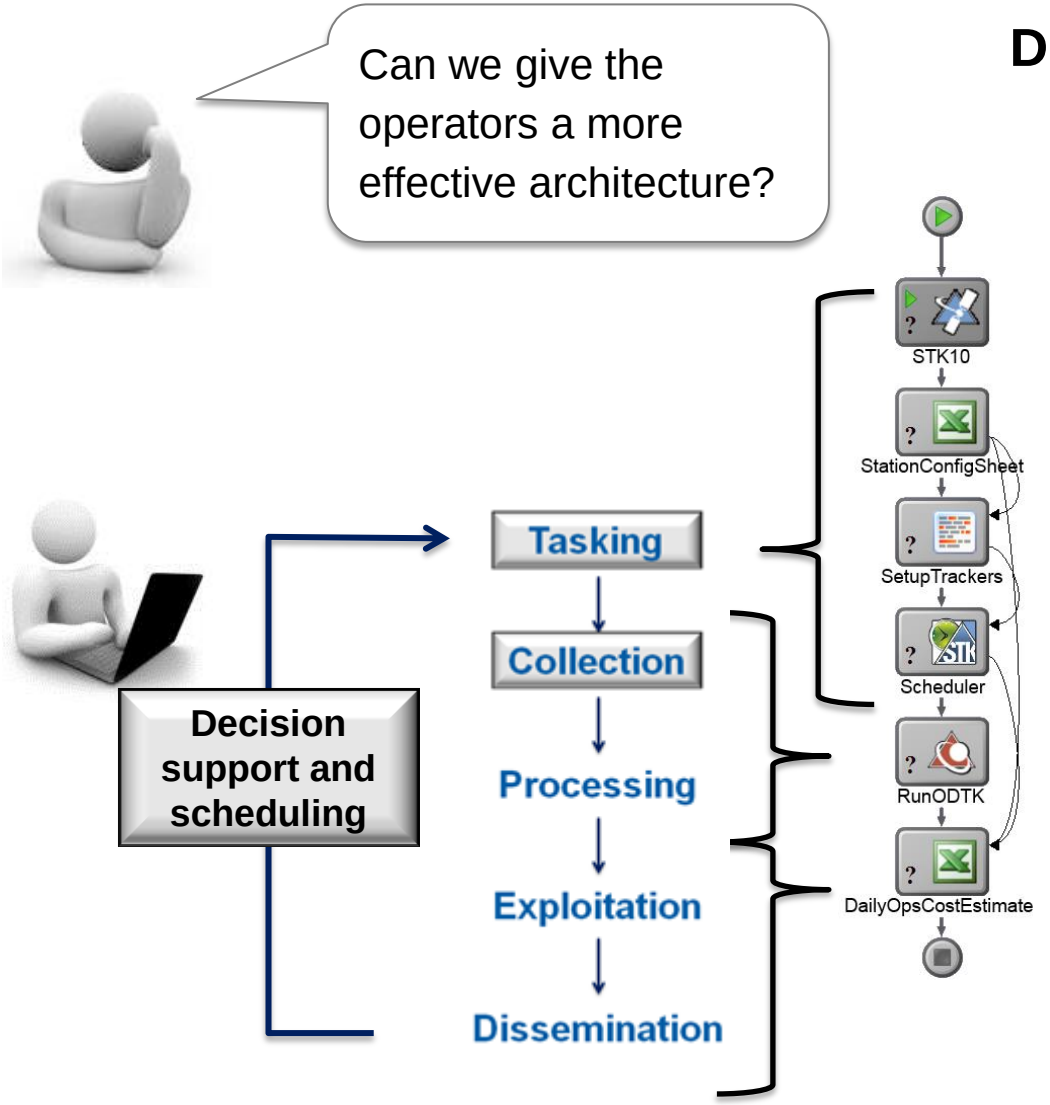


Operational Process Automation

- Eliminates requirement for SME operator
- Jointly optimize sensor tasking for:
  - Orbit accuracy
  - Cost
  - Overall system impact

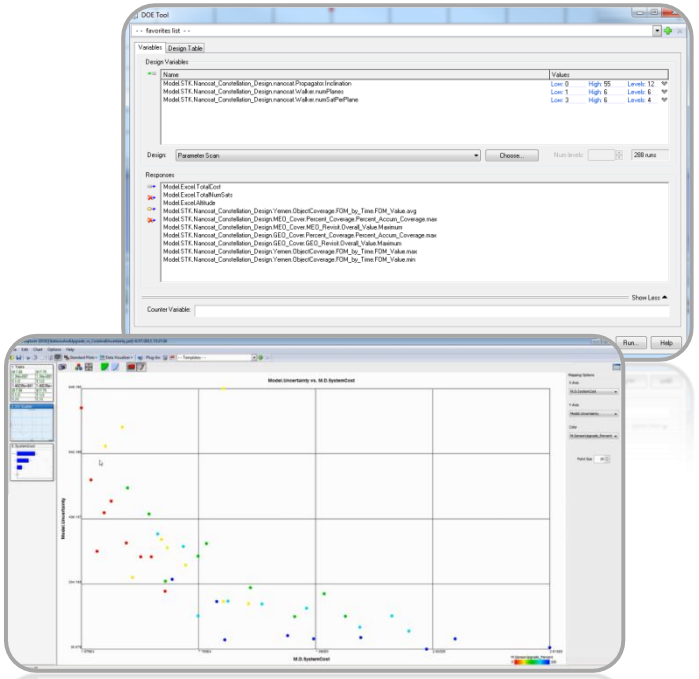


Bridging Operations and Design

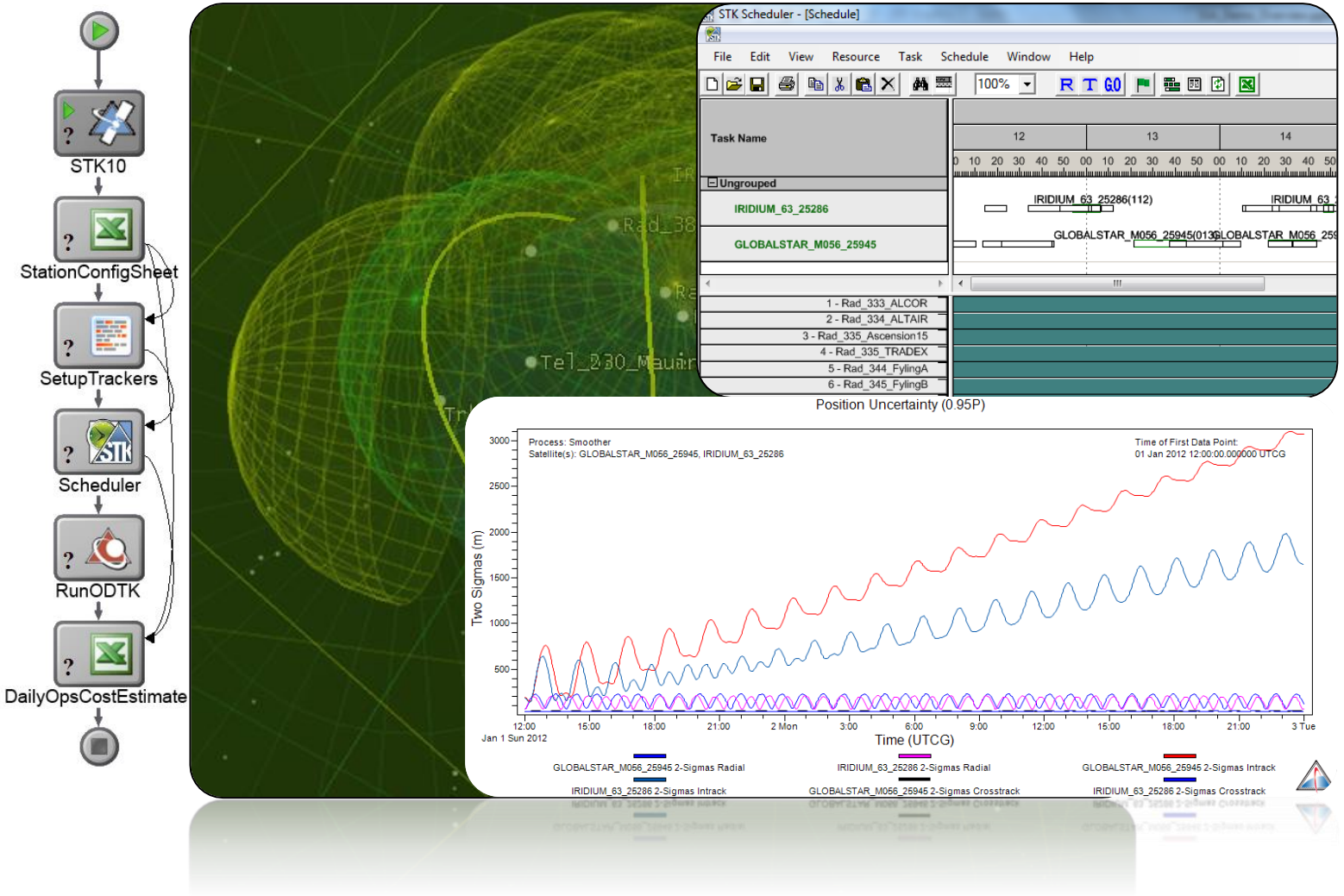


Design Process Automation

- Incorporates operational processes
- Facilitates trade studies
- Jointly optimize architecture for:
  - Orbit accuracy
  - Cost
  - Overall system impact



Demo Video


STK10
StationConfigSheet
SetupTrackers
Scheduler
RunODTK
DailyOpsCostEstimate
STK Scheduler - [Schedule]
File Edit View Resource Task Schedule Window Help
Task Name
Ungrouped
IRIDIUM_63_25286
GLOBALSTAR_M056_25945
IRIDIUM_63_25286(112)
GLOBALSTAR_M056_25945(013)
1 - Rad_333_ALCOR
2 - Rad_334_ALTAIR
3 - Rad_335_Ascension15
4 - Rad_335_TRADEX
5 - Rad_344_FylingA
6 - Rad_345_FylingB
Position Uncertainty (0.95P)
Process: Smoother
Satellite(s): GLOBALSTAR_M056_25945, IRIDIUM_63_25286
Time of First Data Point:
01 Jan 2012 12:00:00.000000 UTCG
Two Sigmas (m)
Time (UTCG)
Jan 1 Sun 2012
GLOBALSTAR_M056_25945 2-Sigmas Radial
IRIDIUM_63_25286 2-Sigmas Radial
GLOBALSTAR_M056_25945 2-Sigmas Intrack
IRIDIUM_63_25286 2-Sigmas Intrack
GLOBALSTAR_M056_25945 2-Sigmas Crosstrack
IRIDIUM_63_25286 2-Sigmas Crosstrack

Summary

- **ModelCenter supports automation of A&D operational processes**
  - Supports use of legacy tools
  - Takes advantage of natural process evolution
  - Enables task-oriented workflows
- **Integrates engineering models and simulation**
  - Testing
  - Training
  - Integrated operations and design
- **Going forward**
  - Take advantage of ModelCenter cloud deployment