



ISRAEL AEROSPACE INDUSTRIES



SYSTEMS MISSILES & SPACE GROUP

System Engineering Process Improvement using the CMMI in Large Space Programs

Revital Goldberg, Sarit Assaraf

Israel Aerospace Industries



13th Annual System Engineering Conference 25-28 Oct. 2010 San Diego CA.

Israel Aerospace Industries (IAI)



- Largest aerospace & defense company and the largest industrial exporter in Israel (> 15,000)
- Missiles, Satellites, UAVs, Avionics, Upgrades, RADARS, etc.
- Activities encompassing: Development, Production, Maintenance and Service of Aerospace Systems
- IAI divisions are certified for *ISO9000* and *AS9100*

IAI Organizational Chart



**Military
A/C
Group
(3 Div.)**

**Commercial
A/C Group
(4 Div.)**

**BEDEK
Aviation
Group
(3 Div.)**

**Headquarters
Organizations**

**Engineering
Group
(2 Div.)**

**Systems
Missiles
Space
Group
(5 Div.)**

**ELTA
Systems
Group
Ltd.
(4 Div.)**

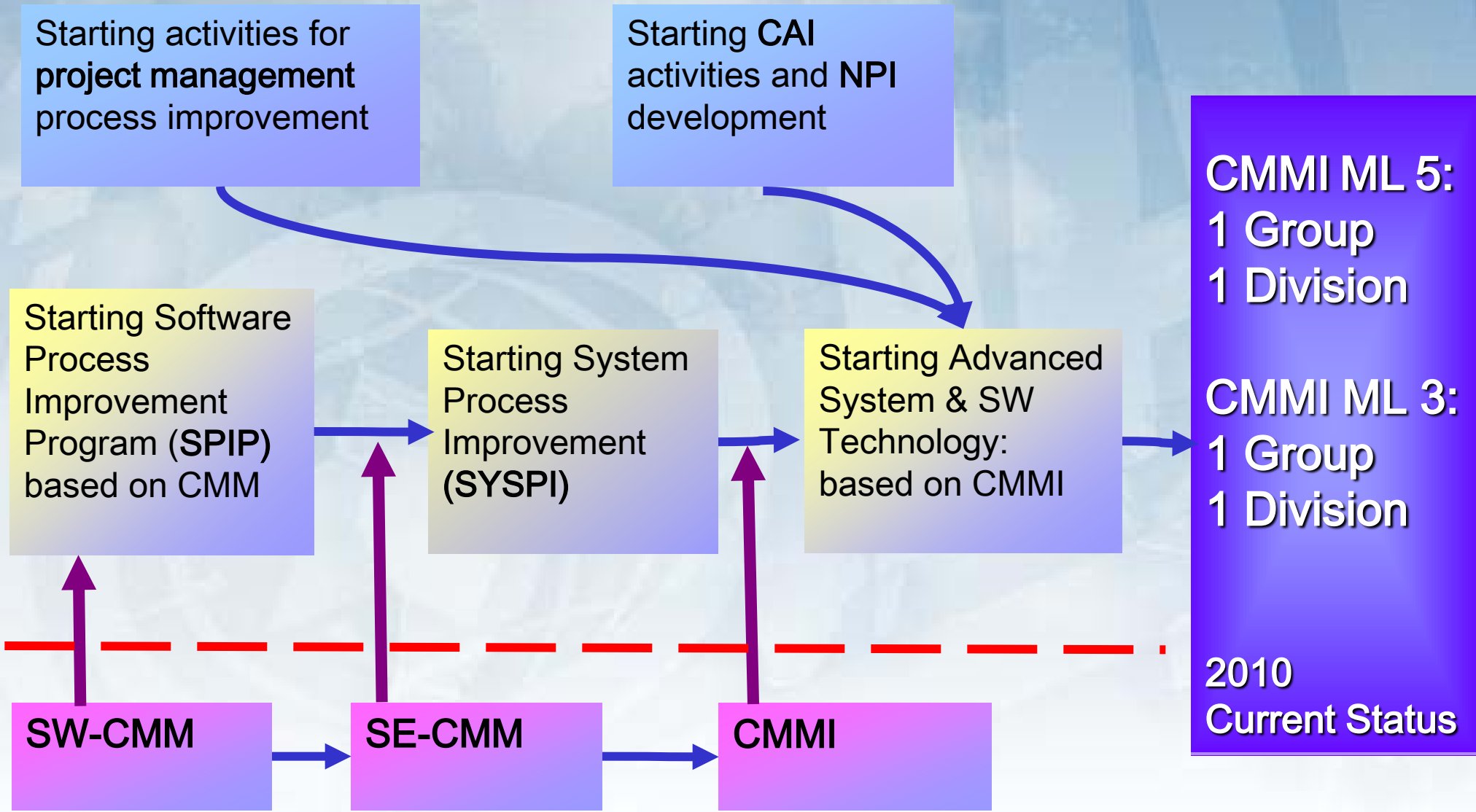
Process Improvement – WHY?

Watts Humphrey

“Software Process Program” founder at the
Carnegie Mellon’s Software Engineering Institute:

**“The *Quality of a System*
is Governed by
the *Quality of the Process*
Used to Develop it”**

IAI Process Improvement Path



IAI Organizational Chart



**Military
A/C
Group
(3 Div.)**

**Commercial
A/C Group
(4 Div.)**

**BEDEK
Aviation
Group
(3 Div.)**

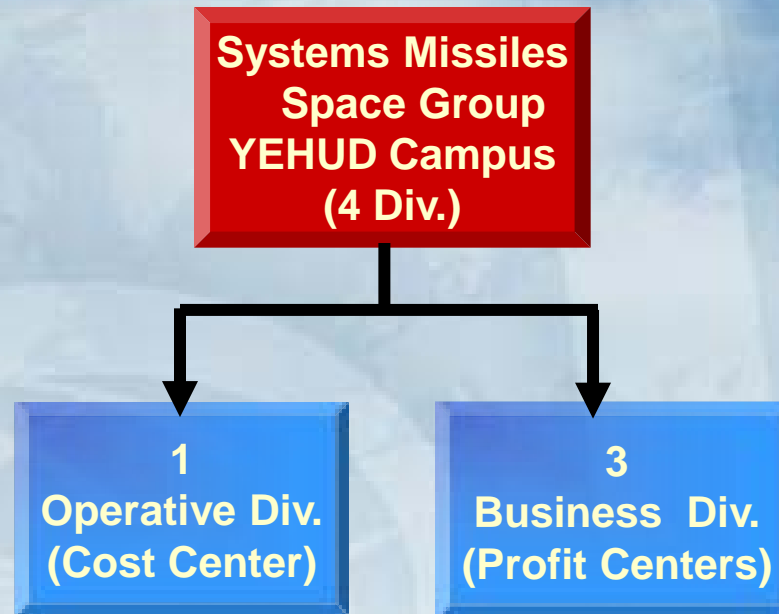
**Headquarters
Organizations**

**Engineering
Group
(2 Div.)**

**Systems
Missiles
Space
Group
(5 Div.)**

**ELTA
Systems
Group
Ltd.
(4 Div.)**

CMMI & SEPG Program - Group Level (1)



- The CMMI implementation is ***managed as a program*** for process improvement at the group level

SAPIR – **S**tandard **A**nnual **P**rocess **I**mprovement **R**oadmap

- The ***management concept*** is based on the CMMI ORG and Support PAs

CMMI & SEPG Program - Group Level (2)

- Discipline based PITs - **P**rocess **I**mprovement **T**eams
(Process Leader + Project Representatives)
PM, SE, VVT, SW, HW, QA, CM, SAM, ORG ★
- Each PIT conducts meetings and activities,
managed by PIT Leader ★
- **ORG PIT** comprises of all PITs Leaders ★
- **CMMI *Integrated plan*** consisting of all PITs' plans

IAI Process Improvement Strategy



IAI Corporate Level



- Sponsorship
- Coordination
- Budget Allocation
- Process Assets Development
- Support and Implementation

IAI Groups and Divisions



- Local Sponsorship
- Local Budget & Resources
- Process Assets Adaptation and Development
- Process Implementation
- Process Feedback

Process Definition and Tailoring Method



IAI Corporate level
Company HDQ

A set of SE standard processes, methodologies, tools, tailoring guidelines & training material

At the Group level
within the SE PIT

Tailoring

Deployment

Tailored HDQ SE set

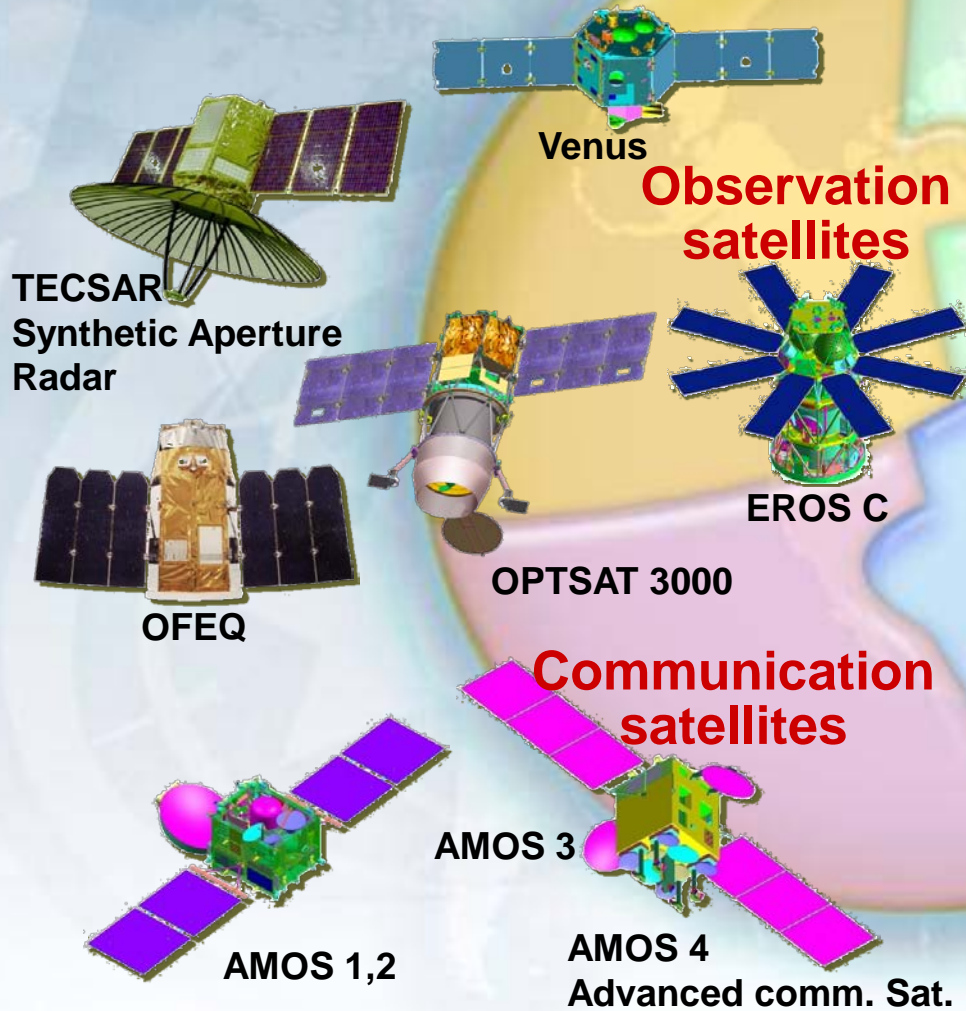
Project SE

Feedback

Feedback

Space systems

The Satellite Program = A System of Systems Program



**Shavit
launch
vehicles**

**Observation
satellites**

**Ground
control
stations**

**Communication
satellites**

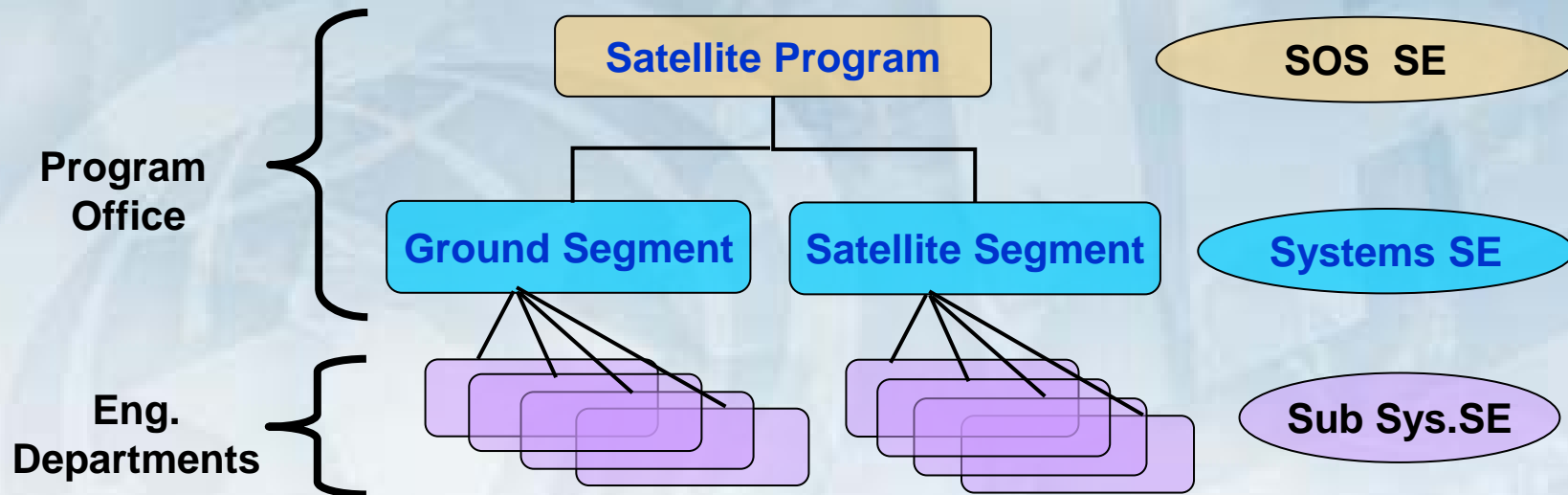


IAI SPACE Programs Main Characteristics

Program Internal Structure (1)



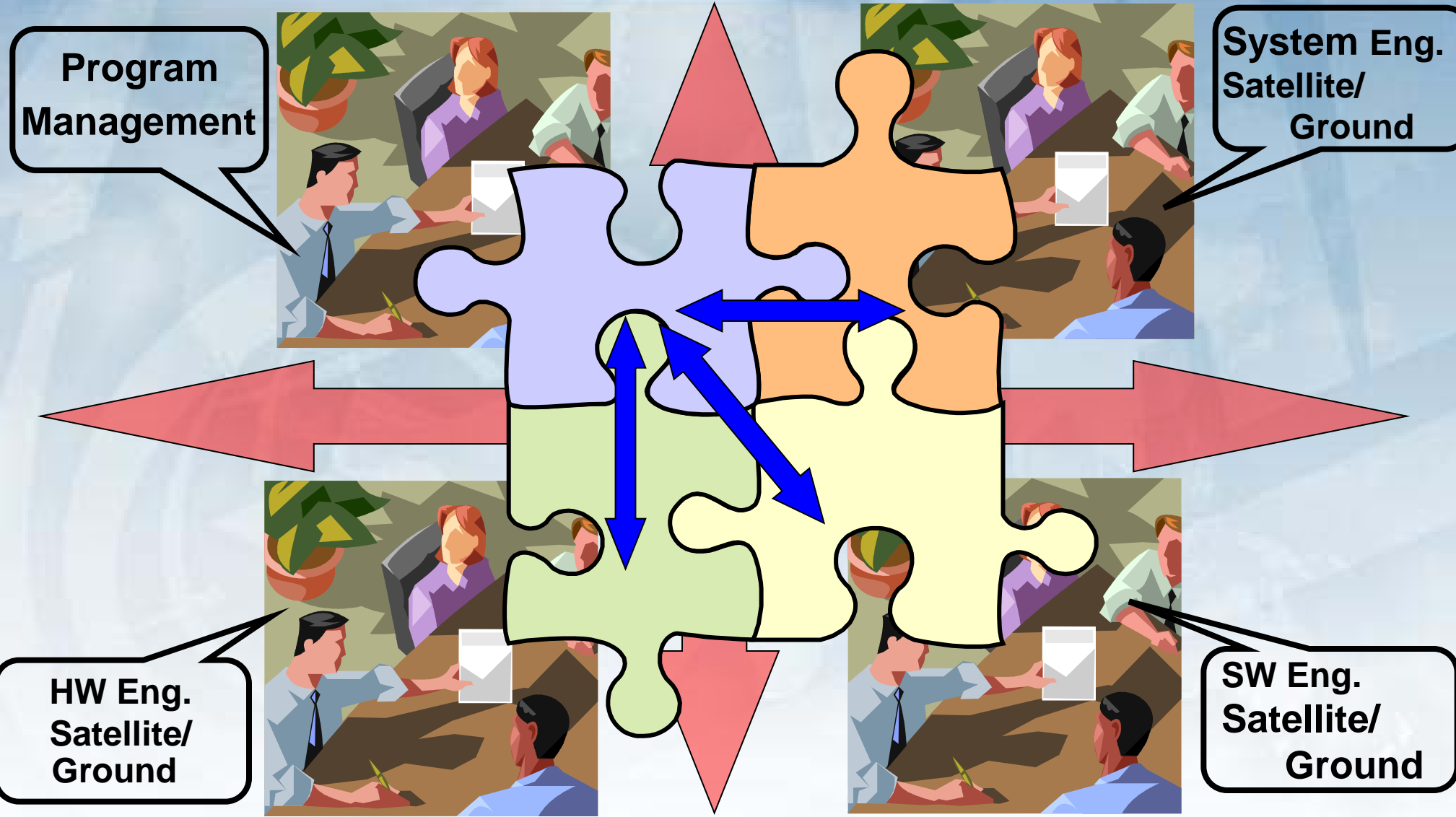
- ◆ Decentralized SE at the group level –
The **SOS and the Systems SE** are part of the program office, also managing the Sub-Contractors.
The **Sub Systems SE** are part of the Engineering Departments



- ◆ **Different views and meanings** of SE activities adequate to each level of the system: SOS, System, Subsystem.
- ◆ **Large project teams** (often, geographically dispersed)

IAI SPACE Programs Main Characteristics

Program Internal Structure (2)



IAI SPACE Programs Main Characteristics

Program Internal Structure (3)



- **FORMAL *mutual commitment*** between the Program office and the Engineering Groups *supports implementation of*
PP SP3.3, PMC SP1.2, REQM SP1.2 & IPM SP2.2:
 - ◆ The Program Office issues Internal Customer–Supplier Agreements
 - ◆ The Program Office allocates budget for the engineering groups against their commitment to supply adequate products on time
- The program establishes Integrated teams consisting of different disciplines (IPT = Integrated Product Teams)

CMMI V1.3 - New Version IPM & OPD

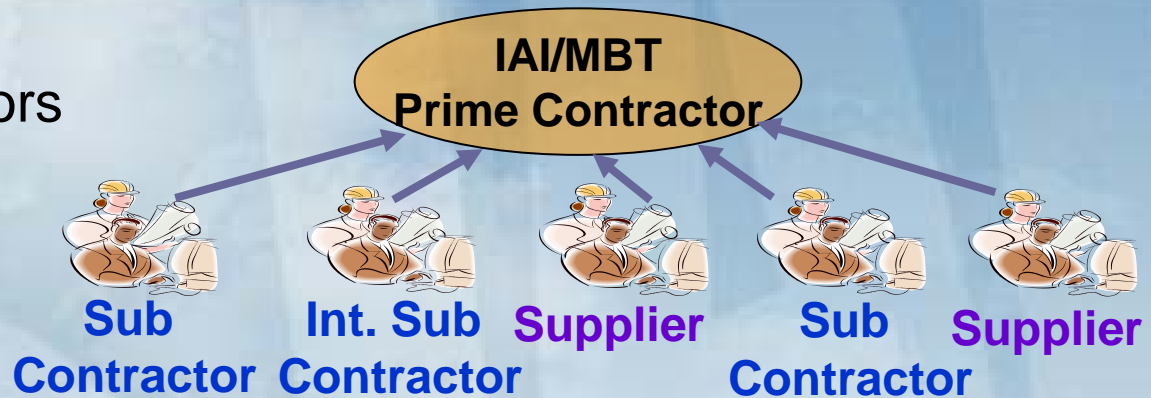
IAI SPACE Programs Main Characteristics

Many Sub Contractors & Suppliers



- ◆ **Complex coordination**
 - Internal (IAI) sub contractors
 - External sub contractors
 - Suppliers

Supports implementation of



IPM SP2.1, SP1.5; SAM SPs; TS SP2.4; DAR

- ◆ **Complex System Integration aspects** – Integration Strategy planning requires special attention (**PI SP1.1**):
 - Scheduling
 - Sub Contractors Monitoring
 - Interfaces definition correctness and completeness (**TS SP2.3, PI SP2.1**)
 - Integration Readiness Review (**PI SP3.1**)

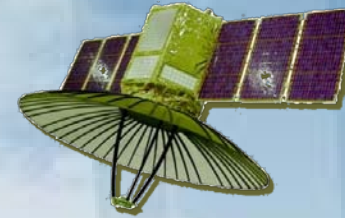
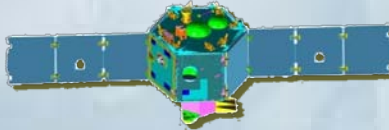
IAI SPACE Programs Main Characteristics

The Satellite “Nature”



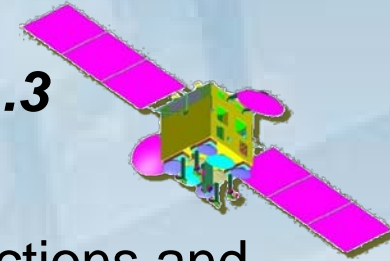
- ◆ Each Satellite is “One of a Kind”

however ...



Verification & Validation are limited, especially by the ability to simulate the environmental conditions.

Support implementation of **VER & VAL SP1.1, SP1.2, SP1.3**



- ◆ **Once Launched** – Repair activities are limited to SW corrections and updates. Requires special attention to:
 - **Requirements validation** at early development stages (**RD SP3.5**)
 - **Analysis of Failures** found on PI, VER & VAL stages (**PI, VER SP3.2, VAL SP2.2**)
 - Special efforts in Engineering and Management activities to **minimize typical Space Programs risks** (**RSKM**)

Conclusions & Lessons Learned

- The IAI process deployment method relies on a Corporate Level processes definition, followed by Group/Division Level tailoring and implementation.
- The products and projects characteristics require special attention to the **RD**, **TS**, **PI**, **VER** & **VAL** process areas
- Using the internal Customer–Supplier Agreements and IPT’s ensure
 - ◆ Better definition and management of the commitment
 - ◆ Integrated team work along the projects’ life cycle

CMMI V1.2 Process Area Abbreviations

- **CAR** Causal Analysis and Resolution
- **CM** Configuration Management
- **DAR** Decision Analysis and Resolution
- **IPM** Integrated Project Management
- **IPPD** integrated product and process development
- **MA** Measurement and Analysis
- **OID** Organizational Innovation and Deployment
- **OPD** Organizational Process Definition
- **OPF** Organizational Process Focus
- **OPP** Organizational Process Performance
- **OT** Organizational Training
- **PI** Product Integration

CMMI V1.2 Process Area Abbreviations

- **PMC** Project Monitoring and Control
- **PP** Project Planning
- **PPQA** Process and Product Quality Assurance
- **QPM** Quantitative Project Management
- **RD** Requirements Development
- **REQM** Requirements Management
- **RSKM** Risk Management
- **SAM** Supplier Agreement Management
- **TS** Technical Solution
- **VAL** Validation
- **VER** Verification

Thank you

Revital Goldberg - rgoldberg@iai.co.il

Sarit Assaraf - sassaraf@iai.co.il