

Managing Major Defense Projects: The Case of Israel's "Arrow" Program

Presentation to the PGCS Symposium, Canberra Australia

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- Background: Missile threats and missile defense.
- How the decisions on the "Arrow" project were made.
- Managing the project: Strategies, organization, methods, tools.
- Major challenges: Technology, schedule, budget, political support.
- Concluding remarks



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Geography



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The Missile Threat on Israel – 1970's



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The Missile Threat – 1980's

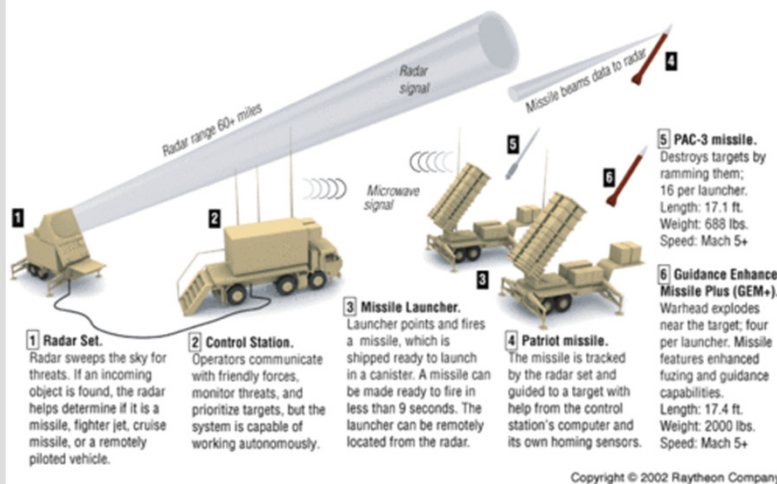


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Patriot Air & Missile Defense System: How Patriot Works





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The Decision Making Process

- **Initially** Israel's defense analysts and senior officers tended to trivialize missiles as weapons of consequence.
- In 1987, upon US invitation, Israel joined President Reagan's Strategic Defense Initiative ("Star Wars") and received financial support to study the implications of the missile threats.
- In 1988, the IMoD launched a joint program with the US for the development of an interceptor missile ("Arrow") much against Israel Defense Force (IDF) objections.
- Following the Iraqi missile attack on Israel during the 1991 Gulf War, the IMoD established a missile defense program office (IMDO) and authorized the development of an early warning/fire control radar – again without the IDF consent
- In 1992, Prime Minister Rabin overruled the IDF and authorized a full scale program to develop, manufacture and deploy the Arrow missile defense Weapon system
- Once the US Government agreed to join the full program (1994), IDF endorsed the program and initiated the process of organizational and technical preparation for deployment.
- Initial Operational Capability status was declared in late 1999.



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Developing the Program Management Strategy

- Once established, the IMDO team embarked on a learning process.
- All previous major programs were studied, and their management teams interviewed.
- The lessons were discussed with the industry and served to develop the basic Management Strategy:
 - Consolidating responsibility and authority in the program office with comprehensive authority over technology, budgets and contracts
 - Director IMDO designated as chief acquisition officer and chief technology officer.
 - A "System of systems" approach
 - Distributed contracting structure (No industrial Prime Contractor).
 - Exclusive cost contracting of all R&D programs.
 - Fixed price contracts limited to series production items.

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The Industrial Team and the Work Breakdown Structure

- **Israel Aerospace Industries:**
 - Prime System Integrator.
 - Major Contractor for interceptor missile, launcher and flight testing.
- **Israel Military Industries: Major Contractor, first stage rocket motor.**
- **Rafael: Major Contractor, second stage rocket motor and target missile.**
- **Elta: Major Contractor, early warning and fire control radar.**
- **Tadiran (later Elbit): Major Contractor, battle management system.**



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Program Management Structure

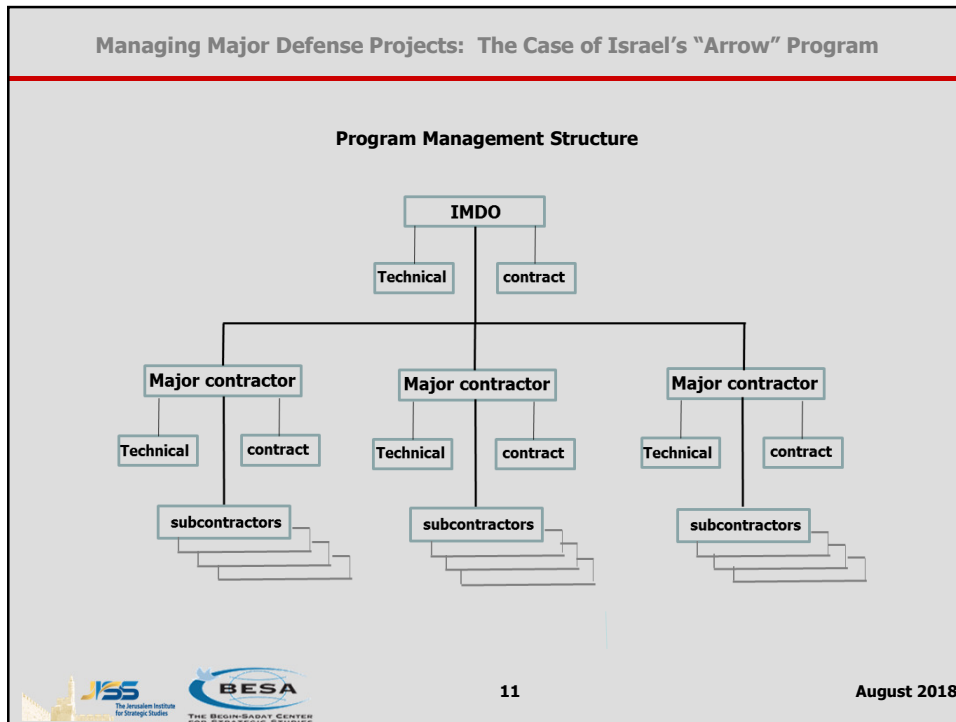
- Major contractors selected by IMOD on the basis of specialization and capabilities, rarely though competition.
- Each major contractor was required to appoint an IMDO approved PM and establish an integrated program office to manage his part work share.
- Each major contractor was awarded his contracts directly from the IMDO. However, he was free to select his own subcontractors, subject to IMDO approval.
- The Prime System Integrator was responsible for overall system performance, and was given the authority over the major contractors for defining and managing interfaces.



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Some Methods and tools

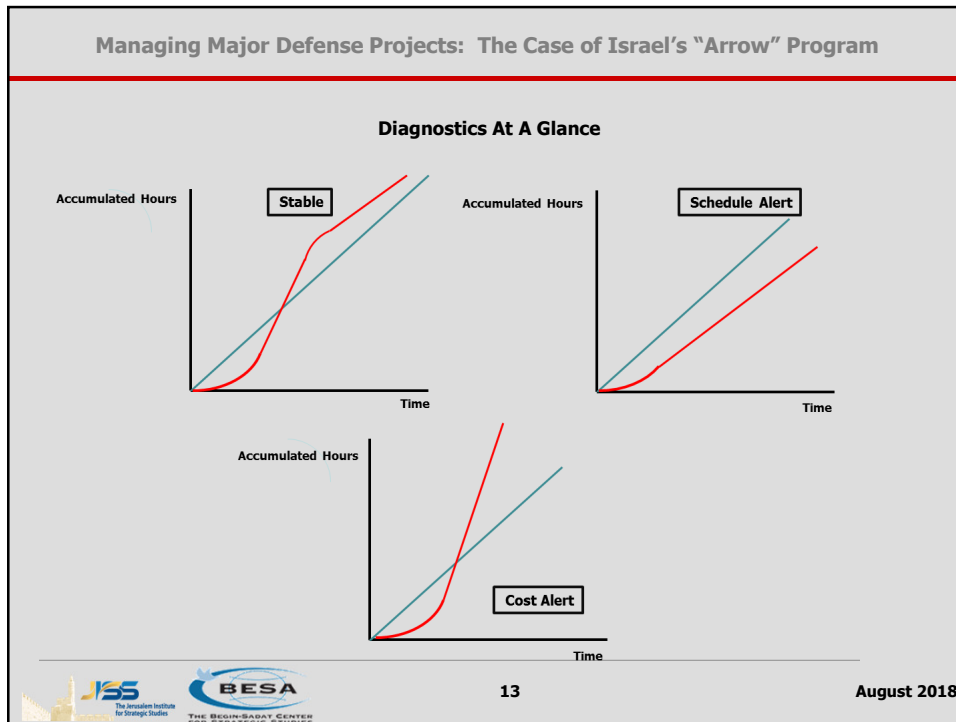
- Progress was monitored in monthly status reviews for each major program (missile and launcher, radar, battle management, rocket motors, system performance, target missile, flight testing, series production etc.), chaired by Director IMDO.
- Reviews invariably started with presentation of accumulated cost charts followed by technical progress review. Issues of concern were defined and corrective actions discussed and decided.
- IMDO decisions on open issues were made in real time (as a rule).
- The visibility of costs in cost contracting provided the most useful management tool: The accumulated cost charts in labor hours.

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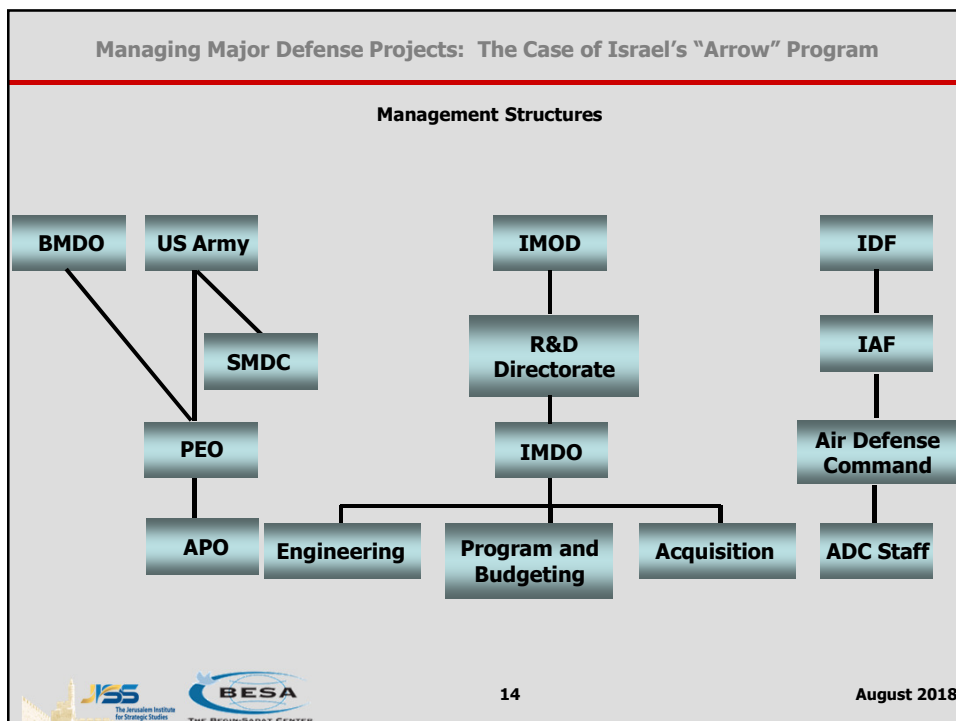
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Interfacing and handovers

- **IMDO – Israel Air Force (IAF)**
 - The IMDO Organizational Establishment Order decreed that the Arrow Weapon System will be designed to meet the user's (IAF) Operational Requirement Document (ORD) but that IMDO will be responsible to the technical specification document.
 - Prior to the IDF's endorsement of the program, no ORD was issued. Instead, the IMDO generated its own provisional ORD in consultation with retired IAF ranking officers.
 - During that period, the IAF held no authority, but was given full visibility into the program.
 - Once the IDF endorsed the program, the IAF published a formal ORD, closely based on the provisional document. The technical specifications were updated accordingly.
 - The handover proceeded smoothly with no delays or cost overruns and the IAF became an enthusiastic team member.

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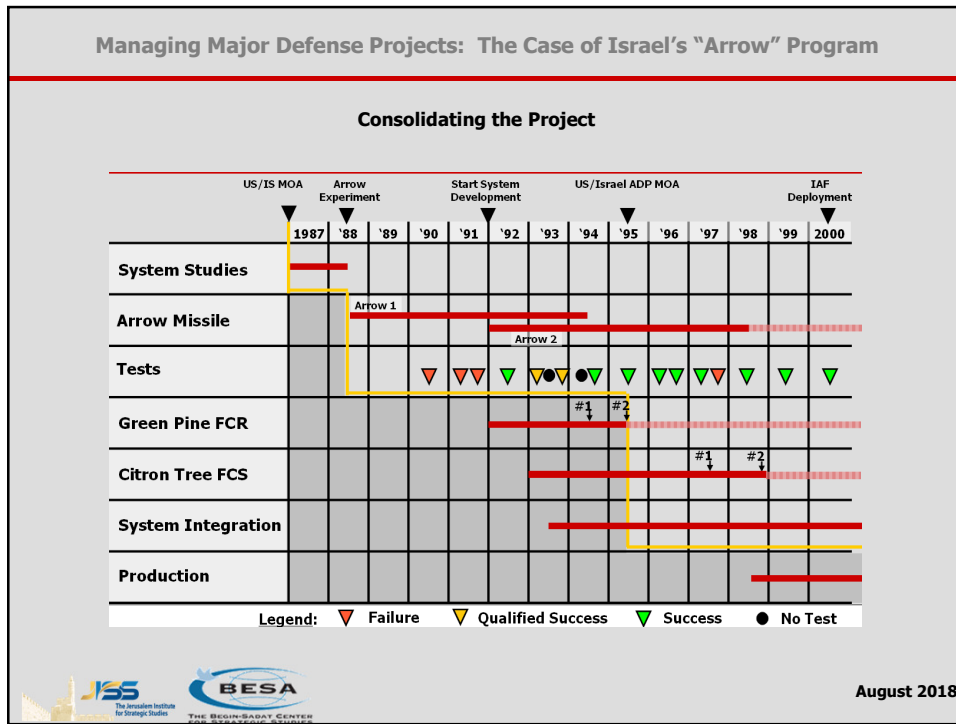
Interfacing and handovers

- **IMDO – US Army**
 - By agreement, the IMDO had full managerial authority over the program while providing full visibility to the US Army Arrow Program Office (APO) in Huntsville and in Tel Aviv.
 - Quarterly Program Management Reviews were held alternatively in the US and Israel.
 - A procedure was developed to bridge over US Army acquisition practices (Fixed price contracts) and the IMDO acquisition policy (cost contracts).
 - The ownership of the program generated Intellectual Property was defined in an MOA and jointly managed by the IMDO and the APO.
 - A procedure was developed to bridge Israeli and US disclosure policies (Israel has an Official Secret Act, the US has none).
 - Once all the procedures were worked out, the IMDO – APO relations became exemplary.

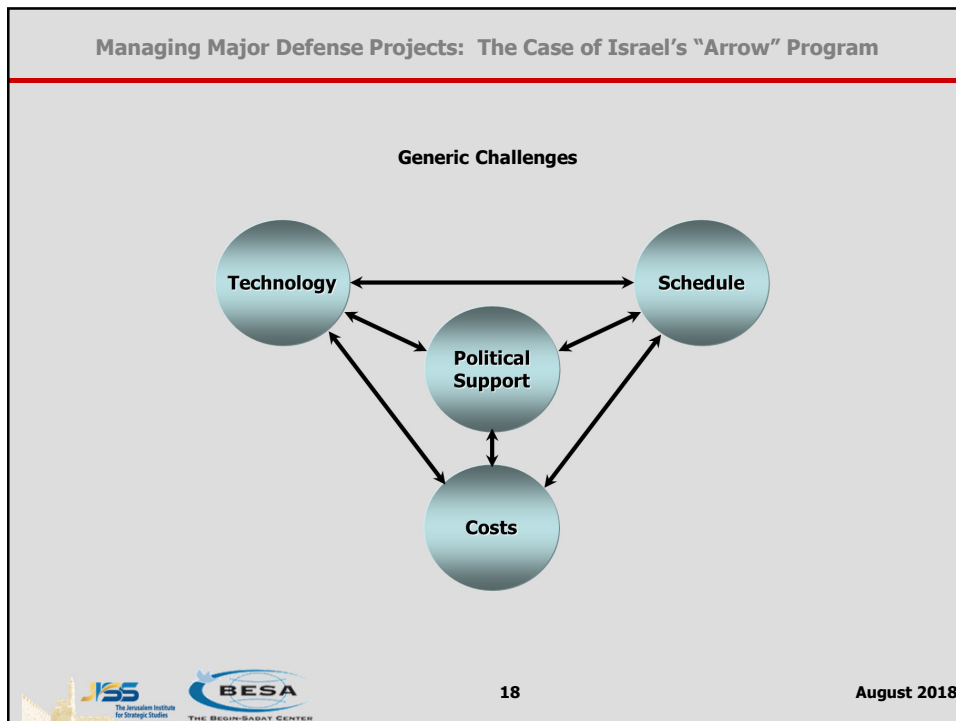
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Some Risk Management Approaches: Technology

- **Capability driven program: Preference to available/low risk technologies for "good enough" results**
- **Extensive use of simulations at all levels: System performance, subsystem performance and component performance.**
- **System integration laboratory set up and running well before the first real hardware became available.**
- **Calculated risk approach in major ground and flight testing: "One leg on the ground, the other leg swinging forward"**
- **Flight tests treated as technical events, not as political demos. Success was prioritized over costs and timetables.**
- **VIP presence in test ranges strongly discouraged.**






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Some Risk Management Approaches: Schedule

- **Development by Capability Level (Blocks) from the start ("spiral development"). Full specifications capabilities reached in steps of interim Blocks.**
- **System integration starts simultaneously with the full scale development of the system's major constituents.**
- **Production of operation units contracted for "off the drawing board".**
- **Operational deployment as soon as the weapon systems achieved a basic acceptable level of performance**

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Some Risk Management Approaches: Costs

- "Cost" was given equal footing with "Performance" and "Schedules", with a continuous tradeoff between the three.
- Direct contracting by IMDO saved fees. In some instances, the IMDO awarded direct contracts to selected subcontractors, saving time and major contractors fees. .
- Cost not held hostage to timetables: Programs with anticipated major cost overruns were immediately stopped for re structuring and corrective action.
- Cost predictions of series produced items began from day one by a team of experienced cost analyzers, refining their predictions with the progress of the design and were used as a basis of fixed price negotiations. This mitigated the "single source" dilemma.



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Securing Political Leadership Support

- The IDF's refusal to endorse the project was partly based on a claim of "non affordability".
- To secure the Prime Minister, Minister of Defense and Knesset (parliament) confidence, it was required:
 - To make the project visibly "lean".
 - To win the battle over public opinion.



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The Lean Program Approach

- **Lean management team.** At the time of establishment, IMDO counted 21 civilians and officers, including secretarial staff.
- **Extensive use of Commercial Off the Shelf (COTS) subsystems, components and material.**
- **Outstanding example: Use of commercial IBM hardware and operating software in the battle management system.**
- **Demonstrative application of low cost solutions to program needs, e.g.:**
 - **Use of a domestic iron for a tool as a calibrated heat source for hardware in the loop simulations.**
 - **Use of swimming pool inflatable domes to house the fire control radars, instead of expensive military grade Radome.**







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The Battle Over Public Opinion

- **The project faced hostile media commentary and analysis, based largely on the criticism of "Star Wars" in the US at its time.**
- **To win the media support, the MOD reversed its then held disclosure policy.**
- **The media was given a then unprecedented access to the program. In each case of security dictated refusal to disclose information, the media was given full explanation why such disclosures might be a security risk.**
- **Hostile media articles and TV coverage was rebutted by "friends of the program".**

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The Human Factor

- The IMDO was given priority to select and employ the best officers and civilians from the pool of available skilled personnel in the IDF (not limited to the IAF), defense industries and the MOD R&D Directorate.
- Team spirit and sense of mission were actively encouraged.
- To create personal commitment, annual budget plans were presented to top level of the MOD by the team members, each in his own area of responsibility (rather than by the Head of the IMOD).
- Completion of each first off system component (missile, launcher, radar etc.) was marked by formal rollout events, attended by MOD and IDF top echelons, with the lead persons in the IMDO and the relevant industry being openly recognized.



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Recap: Major Features of the Management Process

- **Comprehensive management:** Concentrating all authority for technical, programmatic, financial, inter organizational and public diplomacy in a single powerful management team.
- Strategy of "capability driven program" and "Spiral Development" to manage technical, cost and schedule risks.
- Program management acting as its own Prime Contractor.
- Direct contracting with major contractor to ensure control and reduce fees.
- Cost contracting of R&D for flexibility and visibility.
- Lean program approach
- Emphasis on highly qualified and highly motivated management team.



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Arrow 2 Interceptor



Super Green Pine Radar



The Arrow Project is perceived today as an example of successful program management
The Project leaders in the government and the main industries were awarded the prestigious Israel Defense Prize of 2003

