Running defence projects
in a tough economy

MODAF * DODAF * UPDM * Risk * Measurement * Decisions * Architecture * Impact Analysis

MDD at the MoD

Welcome

MINISTRY OF DEFENCE

Chris Raistrick
chris.raistrick@abstractsolutions.co.uk

Certified for IBM Rational software

Abstract Solutions
COMPLEXITY SIMPLIFIED

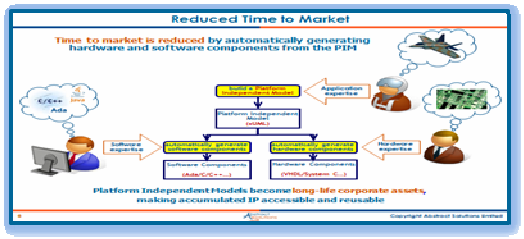
IBM Business Partner

www.abstractsolutions.co.uk

Abstract Solutions

Formerly Kennedy Carter

Since 1989, specialists in helping organisations adopt MDD for systems and software, primarily in defence



Partner with best-of-breed MDD tool suppliers to automate an agile process that reduces the cost and duration of systems development

IBM Business Partner

Copyright Abstract Solutions Limited

Essence of Model Driven Development (MDD)

our 2 main weapons are abstraction and agility

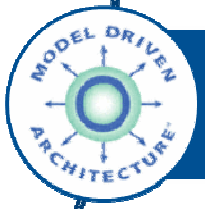
- Lightweight but rigorous process
  - Lightweight agile process reduces cost and risk
  - Rigour improves compliance and safety
- Abstract but precise notations to describe system structure and behaviour
  - Abstraction is how we attack complexity…
    …and defend against change…
    …to reduce time and cost of development and maintenance
  - Precision (or executable modelling) enables continuous integration and testing to manage risk

Copyright Abstract Solutions Limited

Agenda

NATO, DoD, MoD and the Big Squeeze

MoD Sponsored Model Driven Development



Why Use MDD in a Tough Economy?

Summary

Copyright Abstract Solutions Limited

Running defence projects
in a tough economy

MODAF * DODAF * UPDM * Risk * Measurement * Decisions * Architecture * Impact Analysis

MDD at the MoD

NATO, DoD, MoD and The Big Squeeze

Chris Raistrick
chris.raistrick@abstractsolutions.co.uk

Certified for IBM Rational software

Abstract Solutions
COMPLEXITY SIMPLIFIED

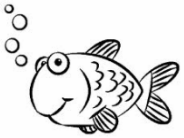
IBM Business Partner

www.abstractsolutions.co.uk

Software Everywhere

In the battlefield of the future…

…software will be everywhere



Copyright Abstract Solutions Limited

Challenge: The Big Squeeze

The MoD and its suppliers are faced with the challenge of delivering increasing capability with reducing funds…

…and are therefore seeking out ways to do more with less…

…by sponsoring Model Driven Development…

Copyright Abstract Solutions Limited

Solution: Lightweight Model-Centric Process

Agile Process

- Optimised and automated system and software development

Plug and Play Architecture

- Standardised frameworks for airborne and land vehicles

Reusable Model Assets

- Suppliers co-operate to build standardised models…
  …and compete for system implementations based on those models

Copyright Abstract Solutions Limited

NATO & MoD Sponsored Model Driven Development

iterative development gives early confidence and controls risk

Abstract Solutions were selected to lead the modelling process for a number of successful NATO and MoD sponsored initiatives…

NATO Models

Aircraft, Launcher and Weapon Interoperability

process & models have been used for development by

BAE Systems UK

Diehl BGT Defence Germany

General Dynamics AIS US

models adopted and extended by

OSD UAS Models

Weaponised Unmanned Aircraft Systems

models incorporated into

OSD* UAS Control Segment (UCS) Architecture
applies to all DoD Unmanned Aircraft Systems for vehicles over 20 pounds

http://www.ucsarchitecture.org

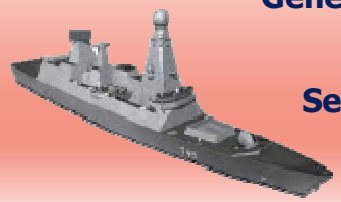
* Office of the Secretary of Defense

models adopted and extended by

MoD WIUK

Weapon Integration UK

process & models being used for other platform types by



Agusta Westland
BAE Systems
General Dynamics
MBDA
QinetiQ
Selex Galileo
Thales

MINISTRY OF DEFENCE

Copyright Abstract Solutions Limited

Running defence projects
in a tough economy

MODAF * DODAF * UPDM * Risk * Measurement * Decisions * Architecture * Impact Analysis

MDD at the MoD

MoD Sponsored
Model Driven Development

Chris Raistrick
chris.raistrick@abstractsolutions.co.uk

Certified for IBM Rational software

Abstract Solutions
COMPLEXITY SIMPLIFIED

IBM Business Partner

www.abstractsolutions.co.uk

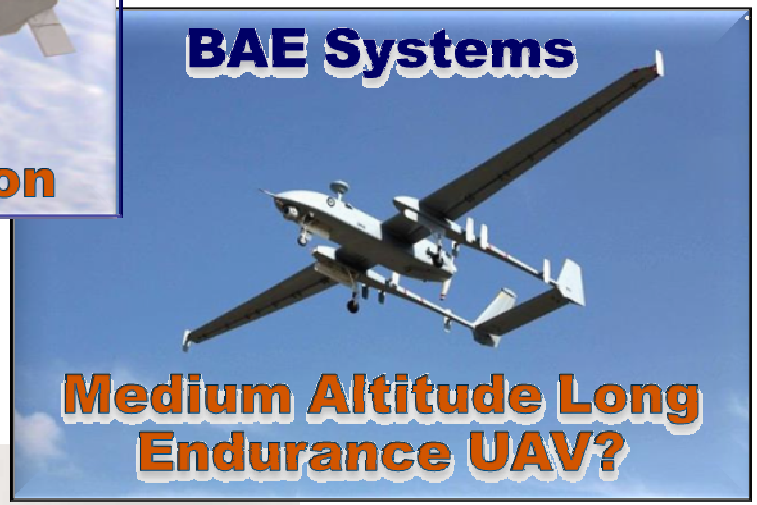
MDD at the MoD: Provenance

- Two prominent MoD sponsored Model Driven Development (MDD) initiatives in the UK are:
  - Generic Vehicle Architecture (GVA) for land-based platforms
  - Weapon Integration UK (WIUK) for airborne platforms
- The Model Driven Development Process and Models described in this presentation have been:
  - Sponsored and adopted by NATO, DoD and MoD
  - Incorporated into mandatory standards by the DoD and MoD
  - Deployed in a number of systems in the US and the UK, some of which are already in service

Copyright Abstract Solutions Limited

MoD Weapon Integration UK (WIUK)

The MoD WIUK strategies are being applied to:



AgustaWestland BAE SYSTEMS QinetiQ MBDA Raytheon UK THALES

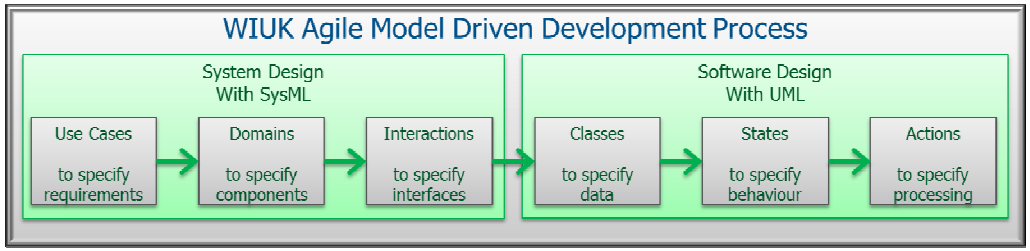
Abstract Solutions

Copyright Abstract Solutions Limited

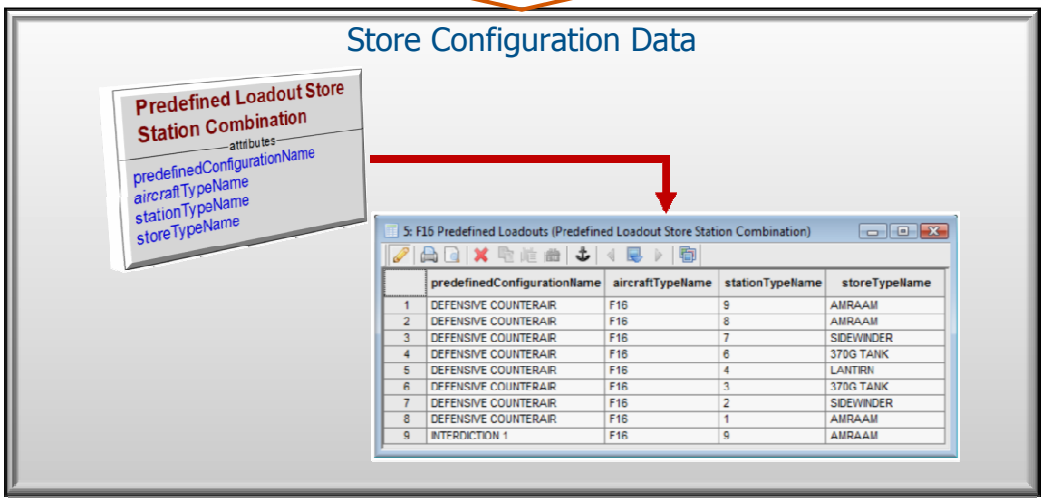
WIUK Components

The MoD WIUK framework embodies proven process, architecture and modelling strategies specifically developed for military embedded systems

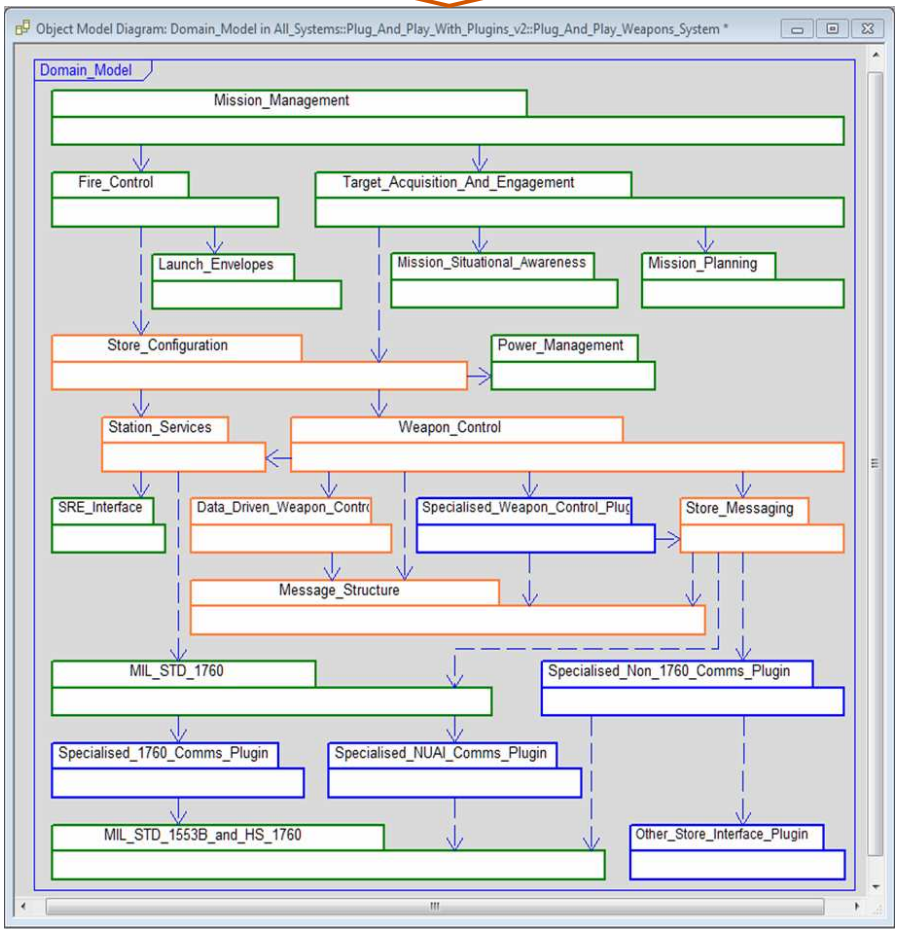
Optimised Automated Process



Easy-to-Upgrade Data Driven Components



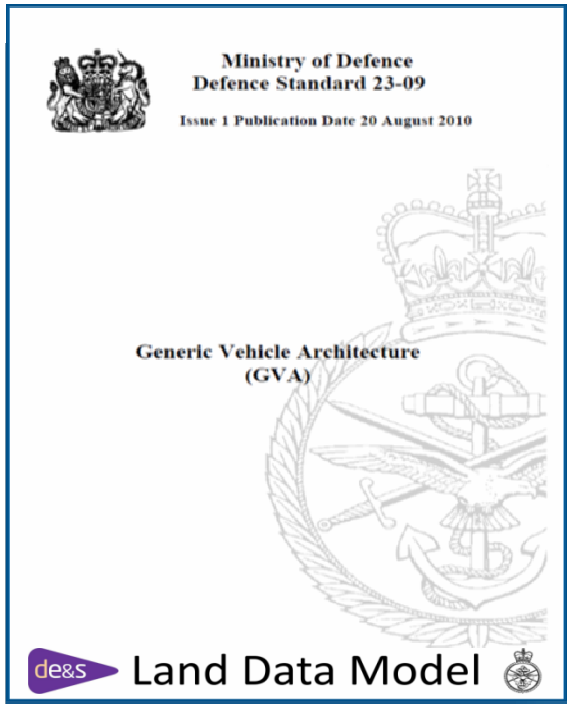
Reusable Component Architecture



Copyright Abstract Solutions Limited

MoD Generic Vehicle Architecture (GVA)

The GVA is being applied to:



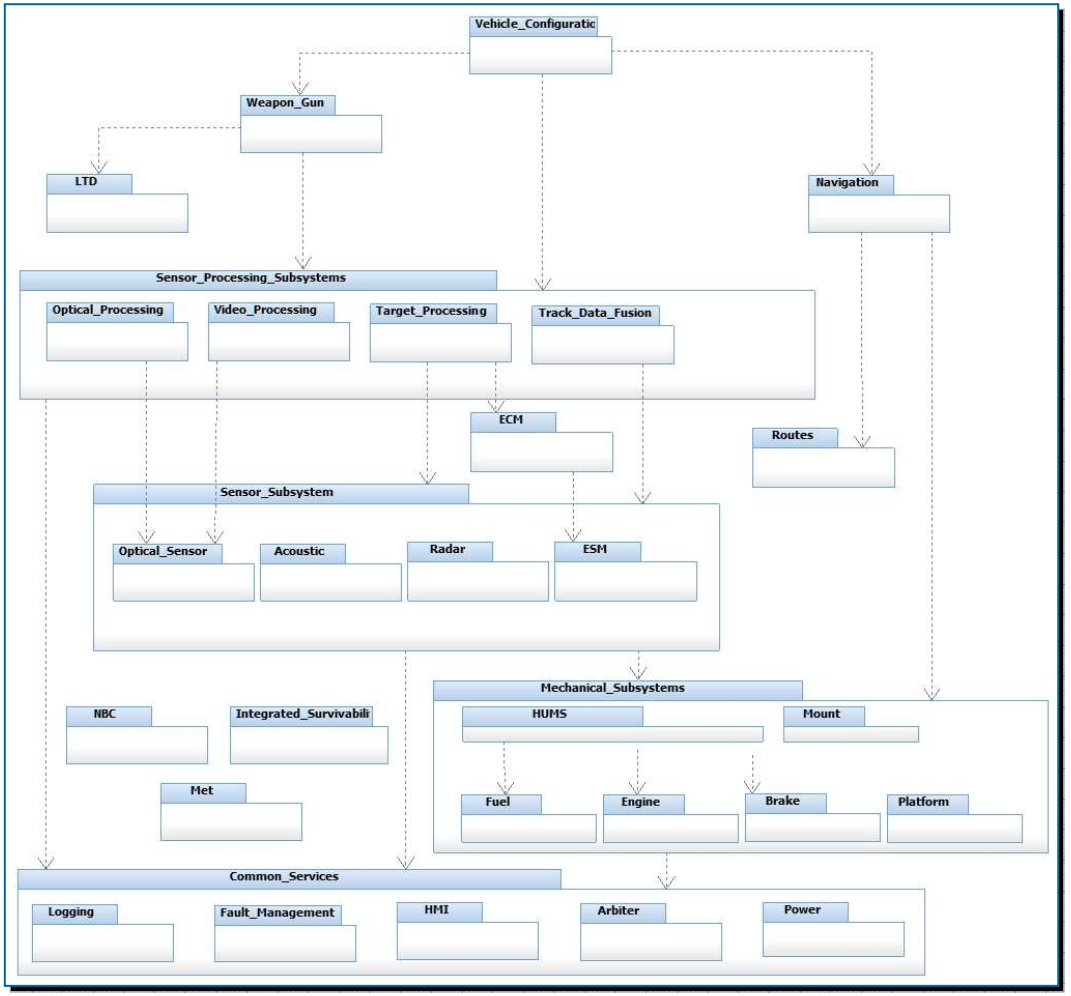
QinetiQ
GENERAL DYNAMICS United Kingdom Limited
Ultra ELECTRONICS
SELEX GALILEO
[dstl]
THALES
VRC Vetronics Research Centre
LOCKHEED MARTIN
Raytheon
BAE SYSTEMS
MINISTRY OF DEFENCE

Abstract Solutions
Copyright Abstract Solutions Limited

The MoD Generic Vehicle Architecture

The Def Stan 23-09 Generic Vehicle Architecture enables the MoD to improve operational effectiveness and reduce the cost of ownership across the fleet

- **The OMG Data Distribution Service (DDS) is used to establish an information backbone…**
  …and provide an implementation for "plug and play" system architectures
- **A comprehensive data model is defined for all subsystems**
- **A vehicle profile is applied to the data model to extract only interfaces required for that vehicle**
- **The interface code for each subsystem is generated from the profiled model**



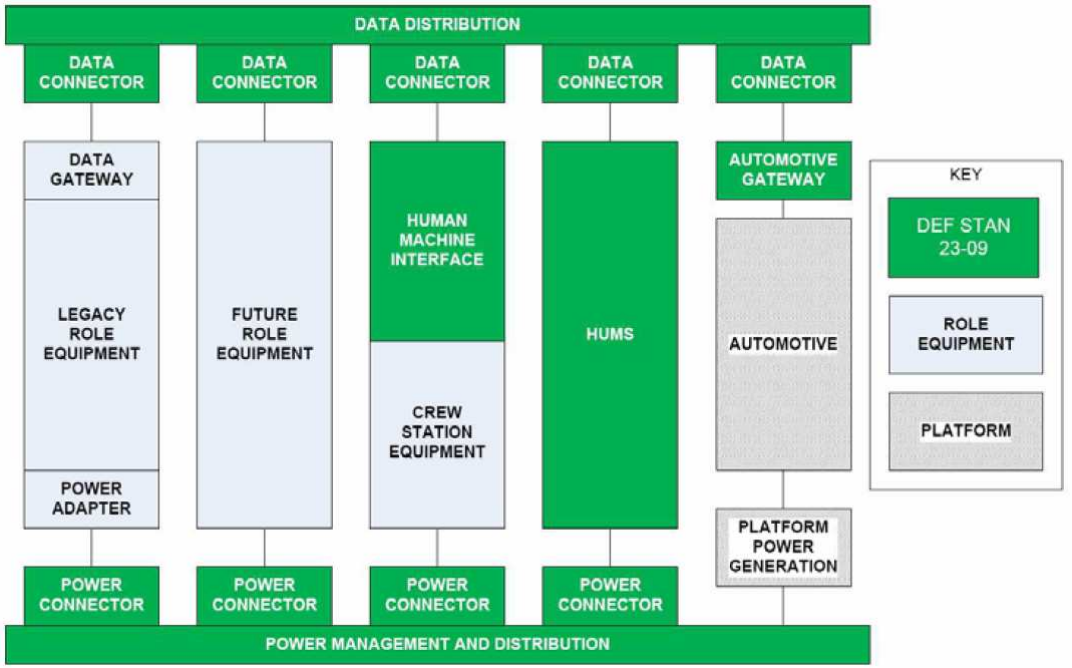
Copyright Abstract Solutions Limited

GVA and WIUK Benefits

With the GVA and WIUK, the MoD has leveraged the power of MDD to:

- **shift the emphasis of procurement to achieve collaboration between the Defence Procurement Agency and the System Integrators**
- **provide for the development of all future vehicles using a single cohesive architecture**
- **initiate a more competitive procurement process to improve the economics of future vehicle development**
- **reduce costs of MoD procurement**
- **reduce risk to prime SIs, allowing them to reduce the amount of contingency and Tier-2/3 margins**

GVA: Model-Centric System-of-Systems Integration



Copyright Abstract Solutions Limited

Running defence projects
in a tough economy

MODAF * DODAF * UPDM * Risk * Measurement * Decisions * Architecture * Impact Analysis

MDD at the MoD

Why Use MDD in a Tough Economy?

Chris Raistrick
chris.raistrick@abstractsolutions.co.uk

Certified for IBM Rational software

Abstract Solutions
COMPLEXITY SIMPLIFIED

IBM Business Partner

www.abstractsolutions.co.uk

Why Model Driven Development?

The promotion of a model-centric process, and development of reusable models by NATO, the DoD and the MoD is driven by common goals:

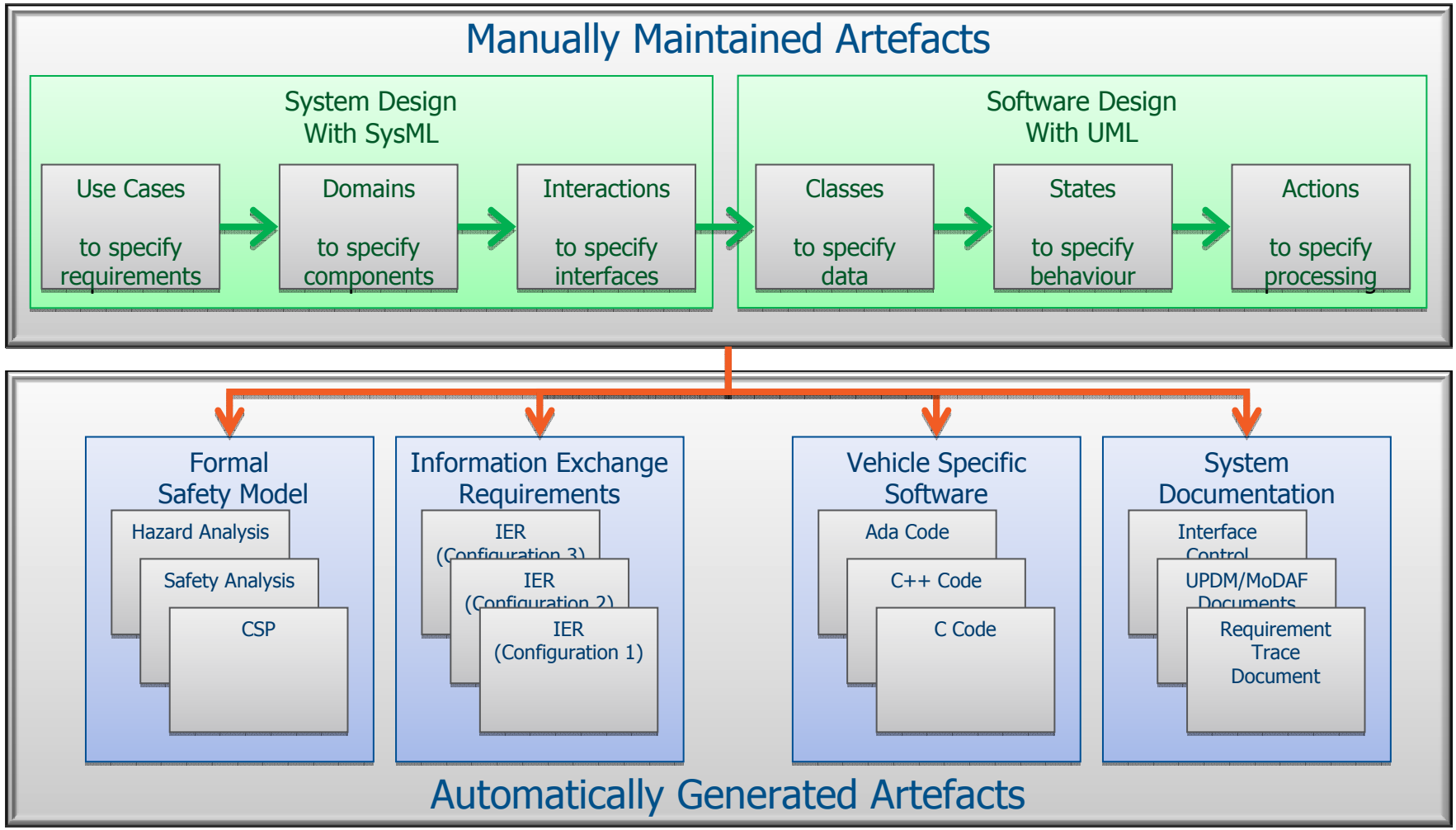
manage risk	through	agility
improve quality	through	testable models
portability	through	layered architecture
maintainability	through	data driven models
reuse	through	pollution control
reduce cost and time	through	automation
preserve IP	through	platform independence
collaboration	through	model centric process
extensibility	through	open-closed principle
simplify complexity	through	precise, small notations

Copyright Abstract Solutions Limited

Manage Risk Through Agility

an agile process can be rigorous and formal

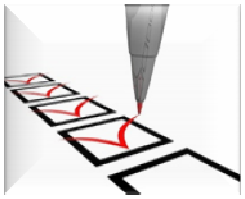
- Iterative development
- Continuous integration and testing
- Agile but formal and rigorous



Copyright Abstract Solutions Limited

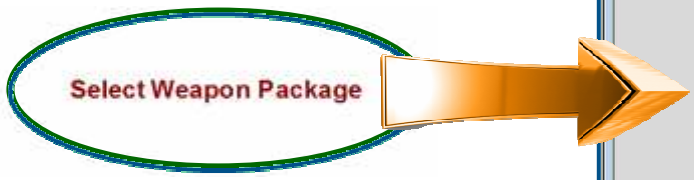
Quality Through Testable Models

test the models as they are built

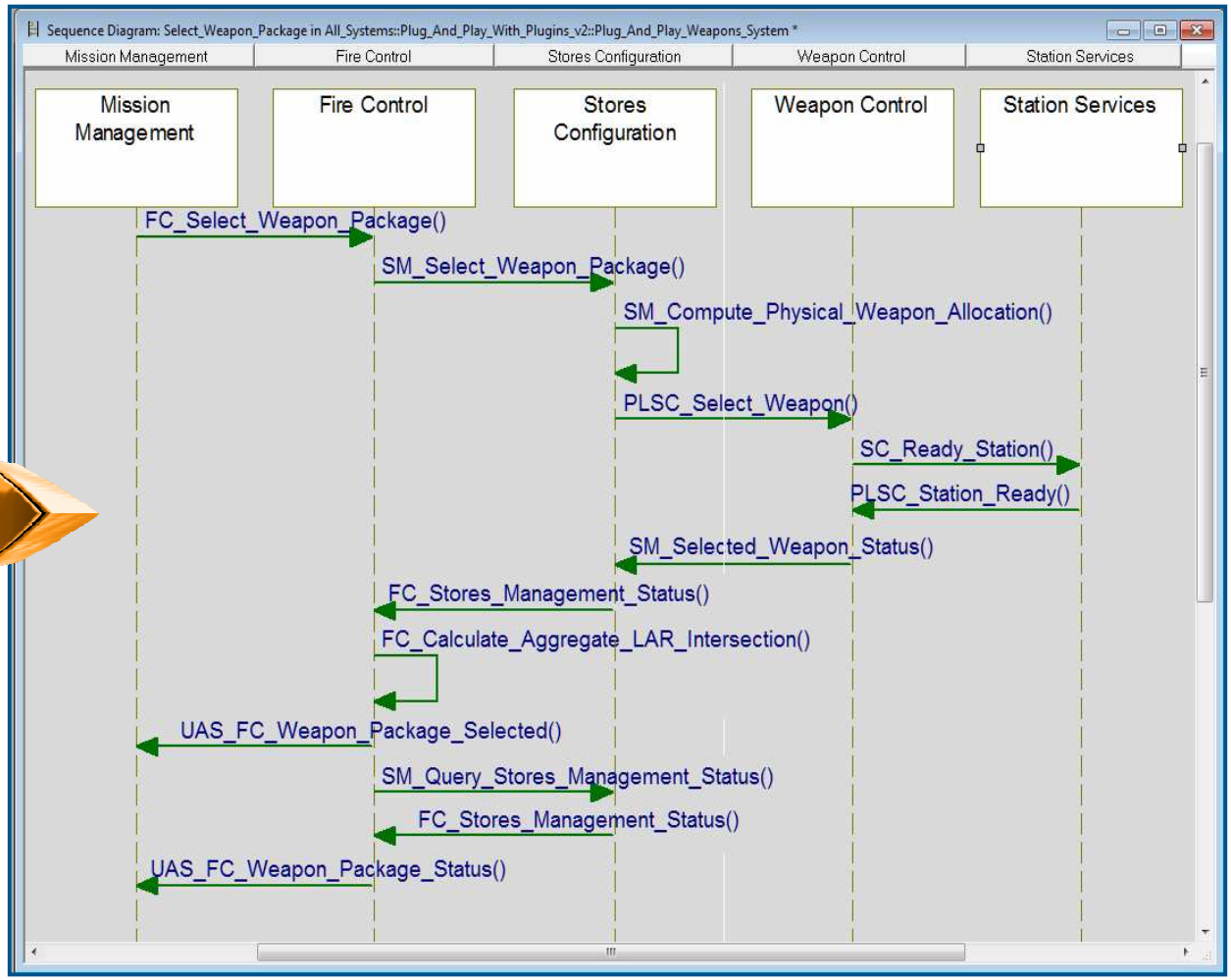


- Use case driven executable models
- Test-as-you-go

Sequence Diagrams identify the domain interfaces needed to support early and continuous integration



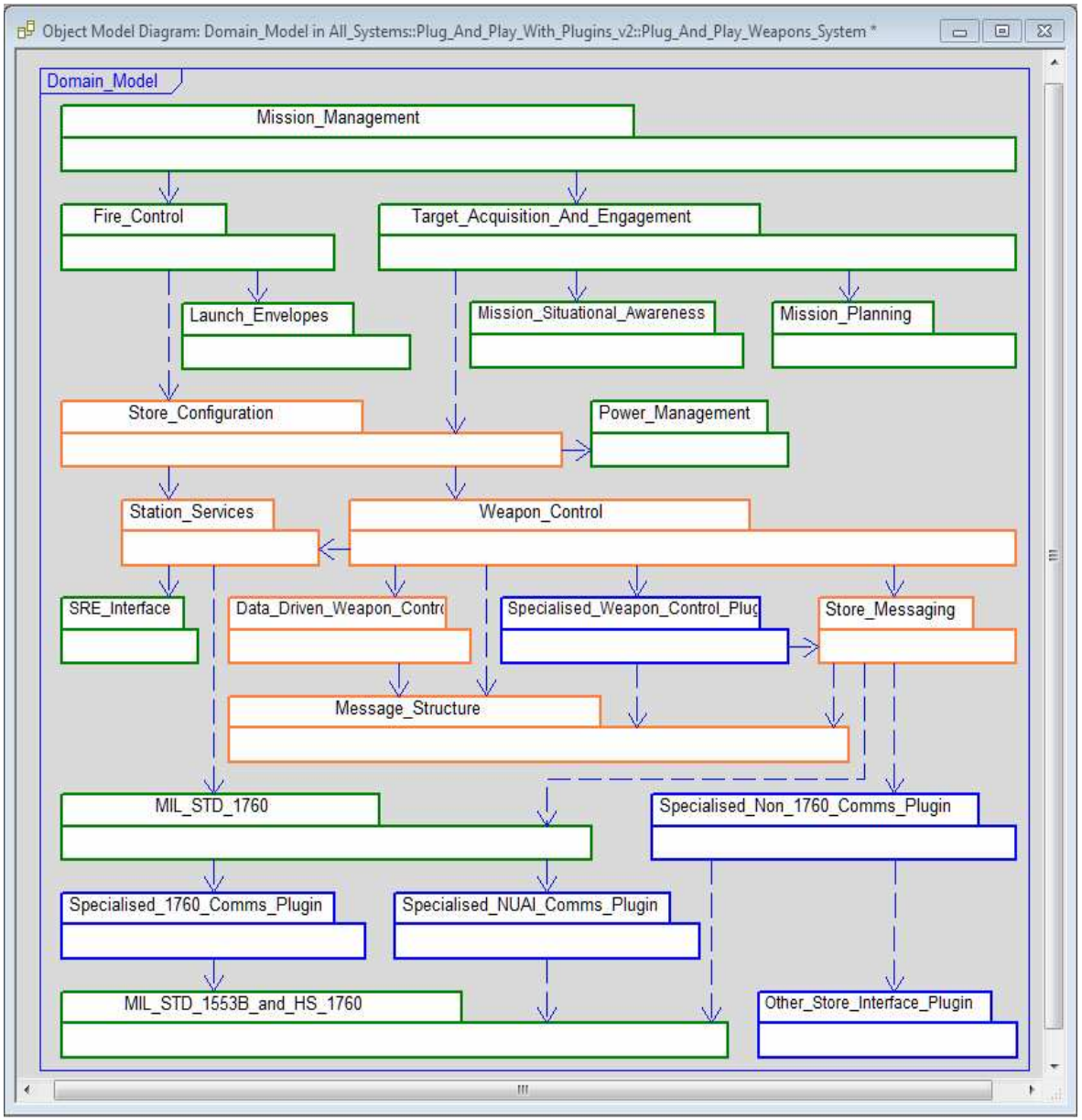
...and specify the expected results of model based testing



Copyright Abstract Solutions Limited

Portability Through Layered Architecture

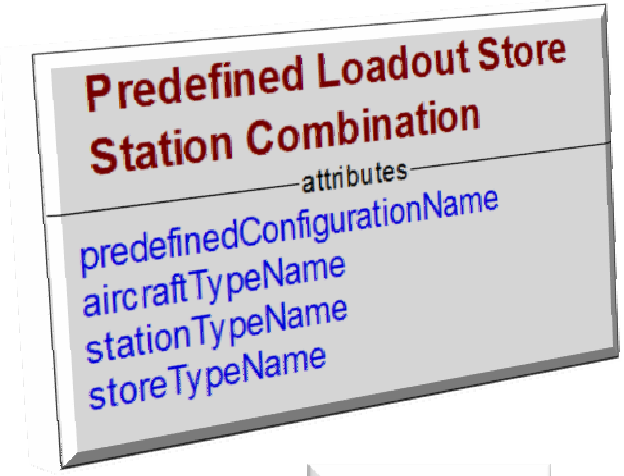
- Domains embody the subject matters, or areas of expertise, in our system
- Layered domain architectures are easy to extend and port
- For each domain we build a Platform Independent Model



Copyright Abstract Solutions Limited

Maintainability Through Data Driven Models

where possible change data, not code



A common reusable model is configured with data for each different aircraft type…

…allowing new weapon types and configurations to be added without changing any code

5: F16 Predefined Loadouts (Predefined Loadout Store Station Combination)

	predefinedConfigurationName	aircraftTypeName	stationTypeName	storeTypeName
1	DEFENSIVE COUNTERAIR	F16	9	AMRAAM
2	DEFENSIVE COUNTERAIR	F16	8	AMRAAM
3	DEFENSIVE COUNTERAIR	F16	7	SIDEWINDER
4	DEFENSIVE COUNTERAIR	F16	6	370G TANK
5	DEFENSIVE COUNTERAIR	F16	4	LANTIRN
6	DEFENSIVE COUNTERAIR	F16	3	370G TANK
7	DEFENSIVE COUNTERAIR	F16	2	SIDEWINDER
8	DEFENSIVE COUNTERAIR	F16	1	AMRAAM
9	INTERDICTION 1	F16	9	AMRAAM

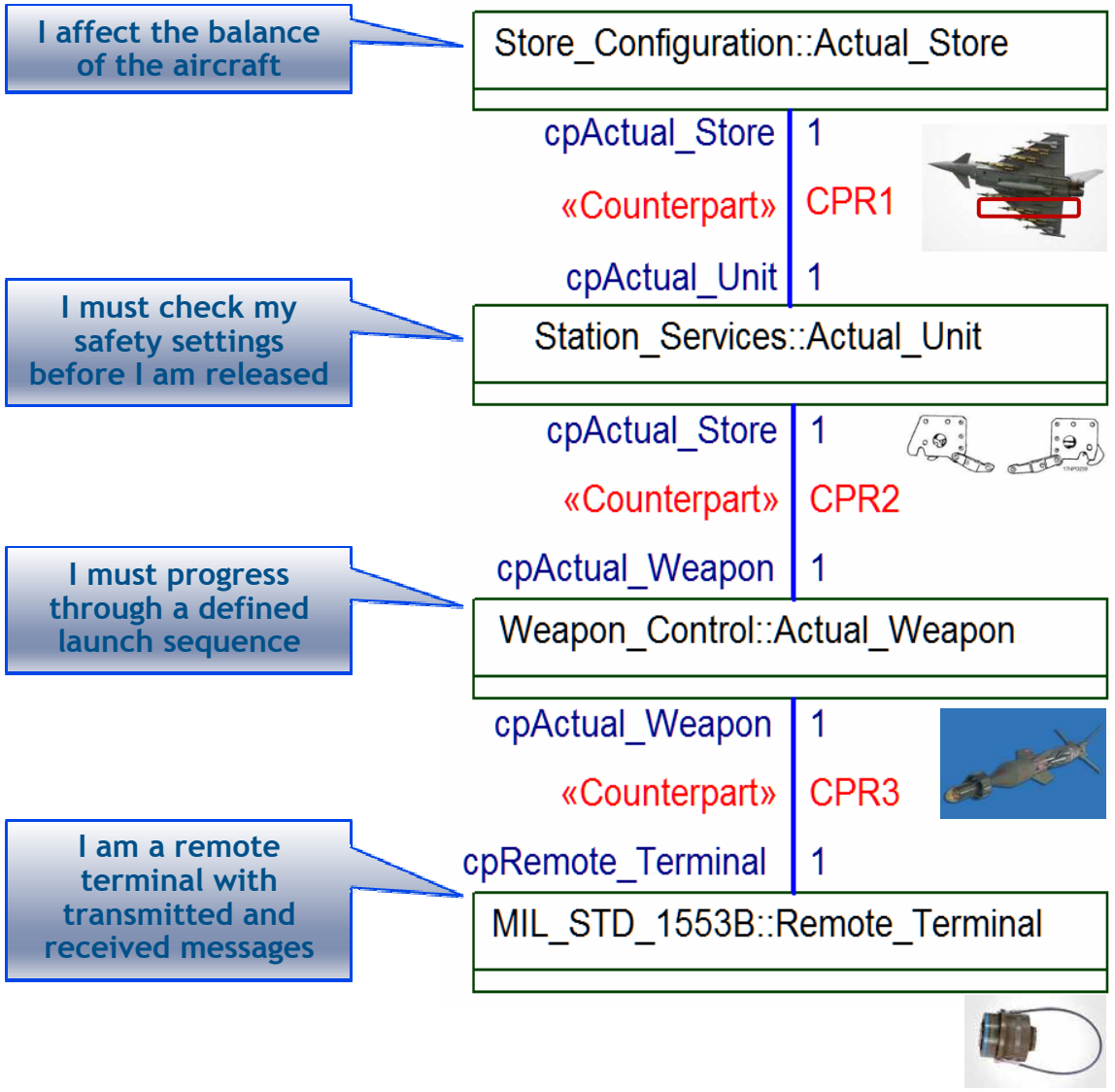
F-16 Rail Stores Loadings	Right Wing			7a		5R	Center	5L		3a			Left Wing
Rail ID	9	8	7		6		5		4		3	2	1
Defensive Counterair	AMRAAM	AMRAAM	Sidewinder		370g Tank				370g Tank		Sidewinder	AMRAAM	AMRAAM
Interdiction 1	AMRAAM		GBU24		370g Tank		LANTIRN		370g Tank		GBU24		AMRAAM
Interdiction 2	Sidewinder		AGM65		370g Tank		ECM Pod		370g Tank		AGM65		Sidewinder
Suppress Enemy Air Defense	Sidewinder		Harm		370g Tank		LANTIRN		370g Tank		Harm		Sidewinder

Copyright Abstract Solutions Limited

Strategic Reuse Through Pollution Control

simplify and reuse by separating concerns

- **Highly cohesive, loosely coupled domains**
- **Separation of concerns makes each domain much simpler…**
  …and is the key to reuse



Copyright Abstract Solutions Limited

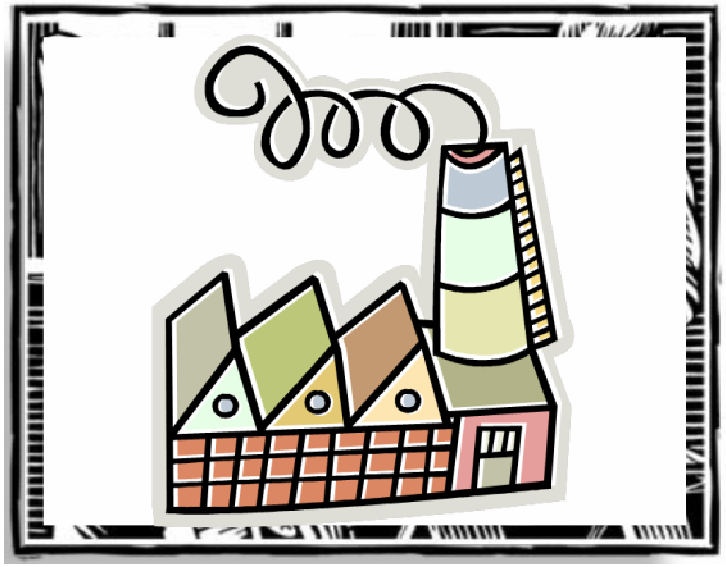
Reduce Time and Cost Through Automation

optimise and automate

Before 1800

- Hand crafting by skilled practitioners
- Idiosyncratic design strategies
- Every item different
- Premium is on the practitioner

After 1800



- Automated production lines with no waste
- Consistent design strategies
- Every item identical
- Premium is on the process

Copyright Abstract Solutions Limited

Reduce Time and Cost Through Automation

resistance is futile

Elaborate

manually build a System Design

System Design Document

manually build a Software Design

Software Design Document

manually code the System

System

Translate

manually build a Platform Independent Model

PIM (UML)

automatically generate the System

System

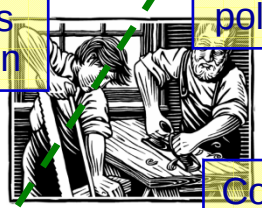
Buy and customise a System Generator

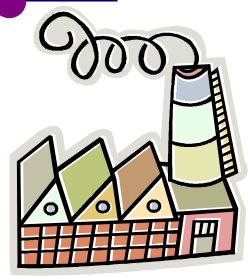
System Generator

Process definition

Design policies

Coding rules





ent Change impact

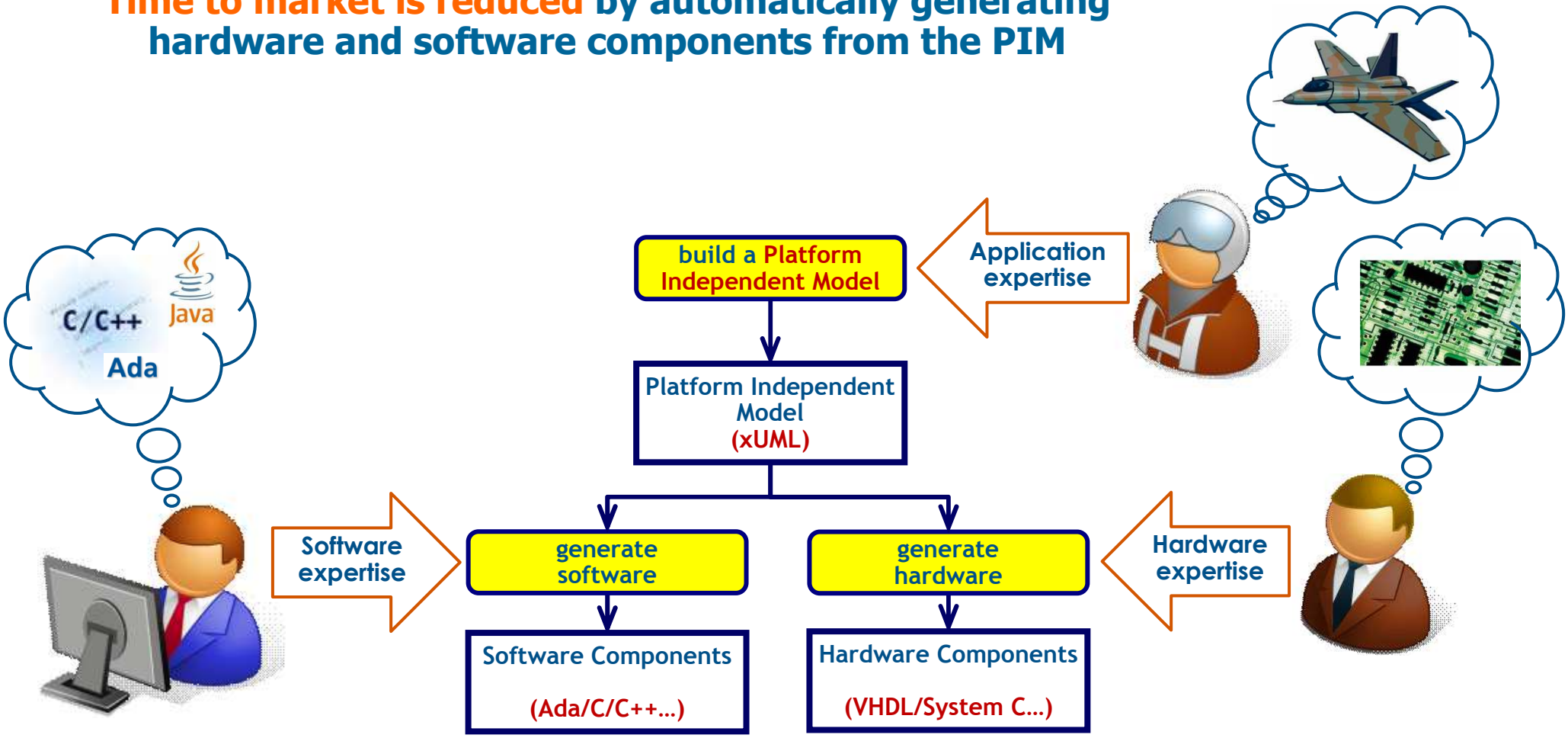
Technology Change impact

Copyright Abstract Solutions Limited

Reduce Time and Cost Through Automation

platform-independent components survive longer

Time to market is reduced by automatically generating hardware and software components from the PIM



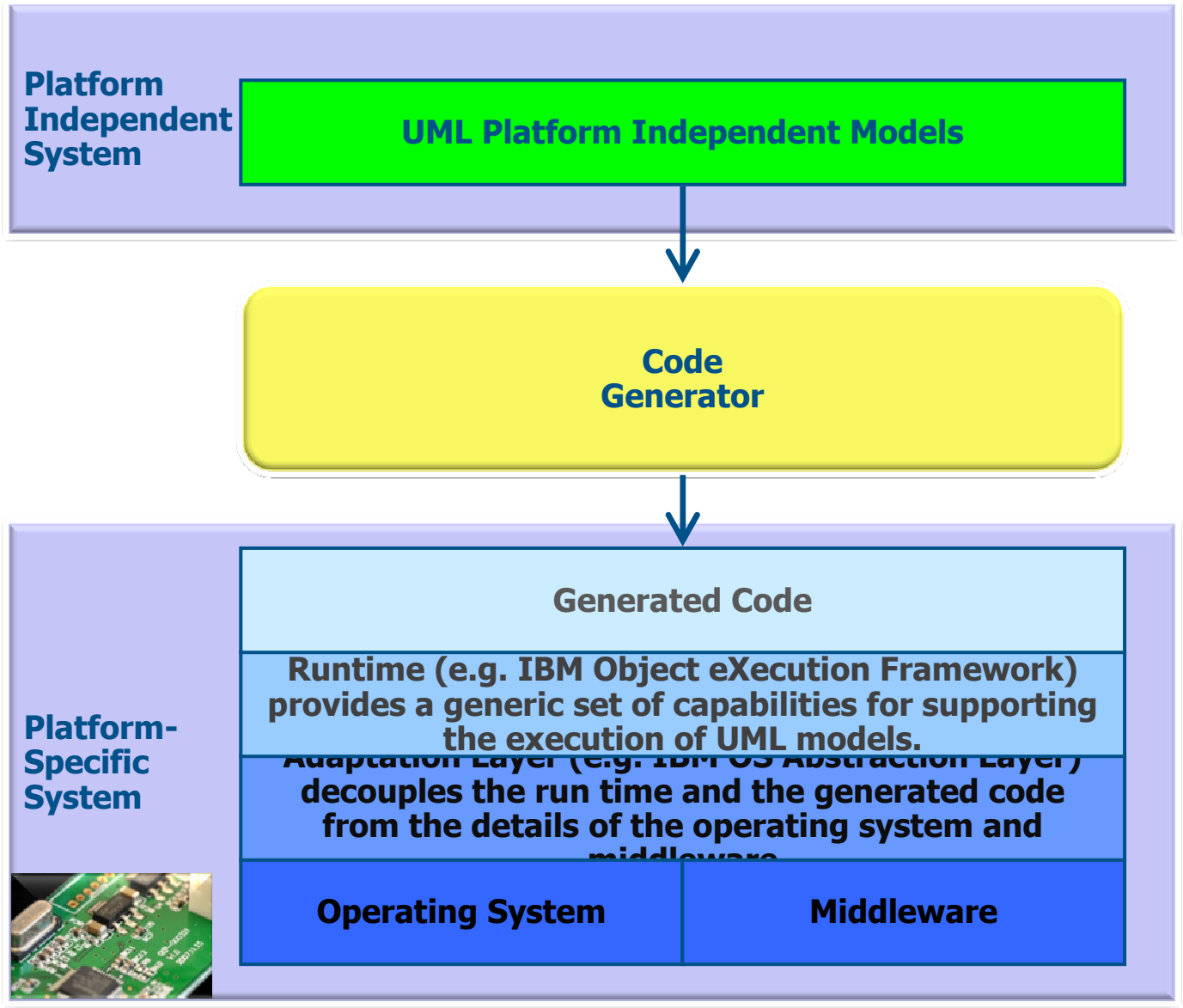
Platform Independent Models become long-life corporate assets, making accumulated IP accessible and reusable

Abstract Solutions

Copyright Abstract Solutions Limited

Preserve IP Through Platform Independence

abstraction provides longevity



Platform Independent Models (PIMs) make no assumptions about the execution platform...

- Middleware
- Operating System
- Hardware Architecture

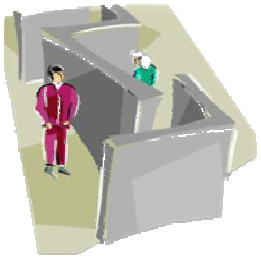
PIMs are therefore much simpler than a Platform-Specific Model (PSM)...
...and can be deployed onto many different platforms...

...enabling easy adoption of new technologies

Copyright Abstract Solutions Limited

Enable Collaboration Through Model Centric Process

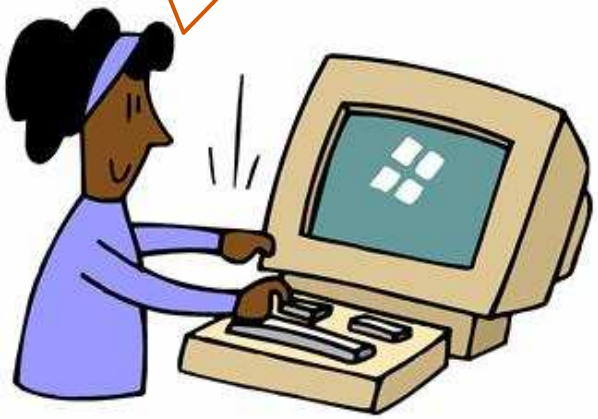
executable models are more comprehensible than code



- Agility encourages collaboration between customers and developers
- Non technical stakeholders contribute more if the process is model-centric rather than code-centric

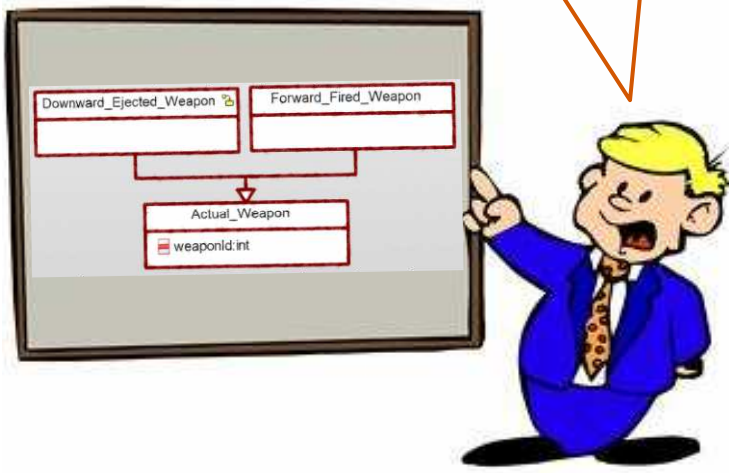
Code-Centric Agile Development

So as you can see, we can use multiple inheritance and a polymorphic operation to achieve runtime binding when invoking weapon-specific virtual methods…



Model-Centric Agile Development

So as you can see, each weapon is either forward fired or downward ejected…

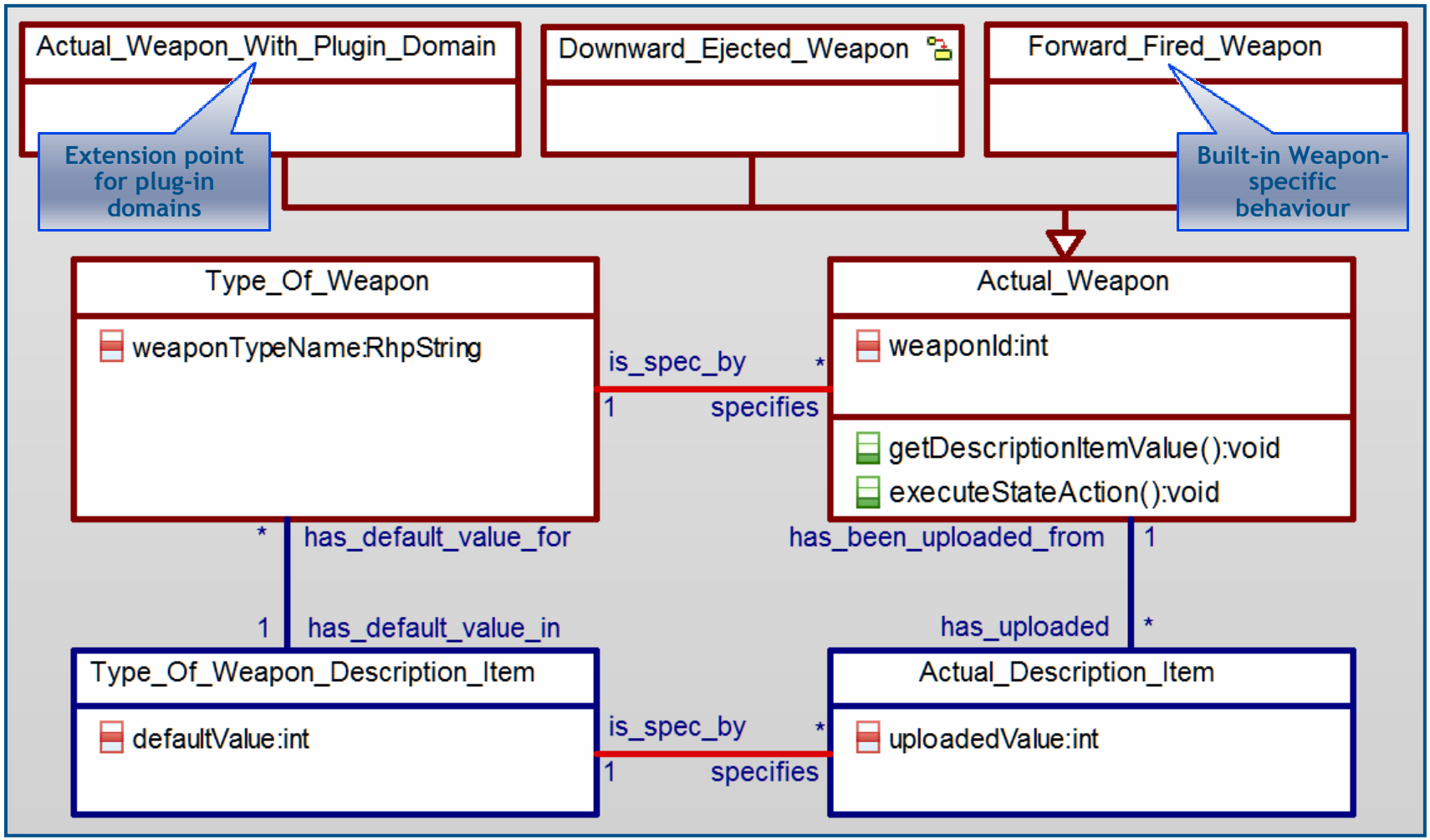


Copyright Abstract Solutions Limited

Extensibility Through the "Open-Closed" Principle

- **The WIUK PIMs are open to extension…**
  …and closed to modification
  …allowing them to be tested and certified for widespread reuse

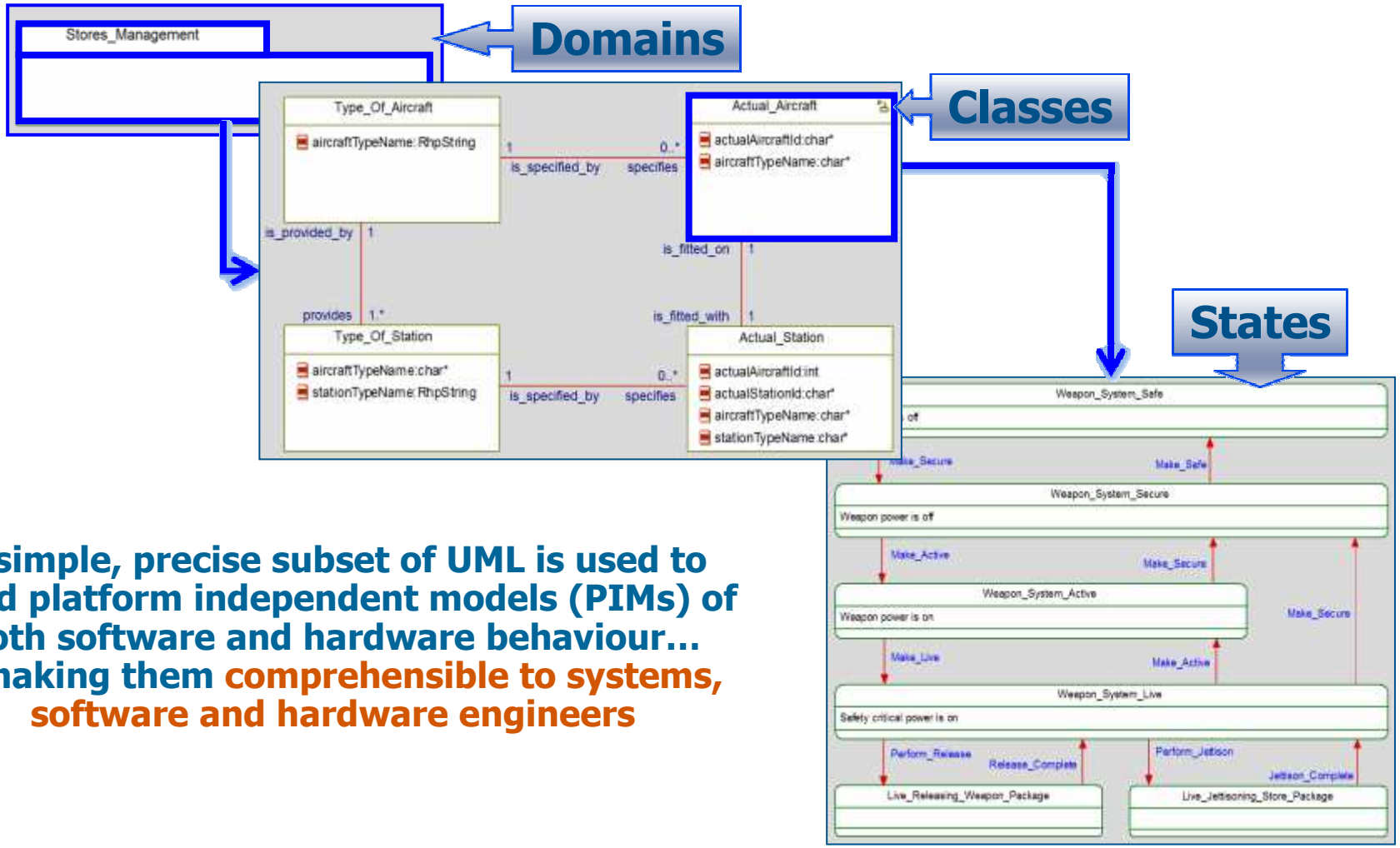
Each domain has built-in extension points for additional plug-in domains



Copyright Abstract Solutions Limited

Simplify Complexity Through Precise, Small Notations

you don't need a complex formalism to formalise complexity



A simple, precise subset of UML is used to build platform independent models (PIMs) of both software and hardware behaviour…
…making them comprehensible to systems, software and hardware engineers

Copyright Abstract Solutions Limited

Running defence projects
in a tough economy

MODAF * DODAF * UPDM * Risk * Measurement * Decisions * Architecture * Impact Analysis

MDD at the MoD

Summary

Chris Raistrick
chris.raistrick@abstractsolutions.co.uk

Certified for IBM Rational software

Abstract Solutions COMPLEXITY SIMPLIFIED

IBM Business Partner

www.abstractsolutions.co.uk

Executive Summary

- MDD offers a strategy for system development that promotes:
  - Effective management of complexity
  - Formalisation of expert domain knowledge as executable specifications
  - Compatibility with any present or future platform
  - Large scale collaborative development
  - Application of best engineering practice

- And consequently is allowing the MoD and its suppliers to:
  - Control and protect critical intellectual property
  - Be flexible when choosing development contractors and implementation strategy
  - Reduce risk for each programme
  - Make significant through-life cost savings

Copyright Abstract Solutions Limited

Running defence projects
in a tough economy

MODAF * DODAF * UPDM * Risk * Measurement * Decisions * Architecture * Impact Analysis

MDD at the MoD

Questions?

MINISTRY OF DEFENCE

Chris Raistrick
chris.raistrick@abstractsolutions.co.uk

Certified for IBM Rational software

Abstract Solutions
COMPLEXITY SIMPLIFIED

IBM Business Partner

www.abstractsolutions.co.uk

Running defence projects
in a tough economy

MODAF * DODAF * UPDM * Risk * Measurement * Decisions * Architecture * Impact Analysis

MDD at the MoD

Thank You

MINISTRY OF DEFENCE

Chris Raistrick
chris.raistrick@abstractsolutions.co.uk

Certified for IBM Rational software

Abstract Solutions
COMPLEXITY SIMPLIFIED

IBM Business Partner

www.abstractsolutions.co.uk