

Bombardier Aerospace Belfast



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BOMBARDIER

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Agenda

- **Who are Bombardier Belfast**
- **Bombardier and Delmia**
- **Bombardier Belfast 2007 Project**
- **Progress so far**
- **Future work**
- **Findings, risks and issues**

Bombardier – who we are

Bombardier Aerospace

World leader in regional, business and amphibious aircraft



- F07 revenues: \$8.2 billion
- 56% of total revenues
- Backlog: \$13.2 billion*
- Employees: 27,130*

Bombardier Transportation

World leader in the manufacturing and servicing of rail equipment and rail-related products



- F07 revenues: \$6.6 billion
- 44% of total revenues
- Backlog: \$27.5 billion*
- Employees: 29,100*

*As at January 31, 2007

Bombardier regional aircraft



Q100/200



Q300



Q400



CRJ200



CRJ700



CRJ900/705



CRJ1000

Bombardier's Business Aircraft portfolio is centred on three families

LEARJET FAMILY



Learjet 40 XR



Learjet 45 XR



Learjet 60 XR

CHALLENGER FAMILY



Challenger 300



Challenger 605



Challenger 850

GLOBAL FAMILY



Bombardier Global 5000



Global Express XRS

The Short brothers – a heritage of innovation



Wright Flyer

Centenary in 2008

Bombardier Aerospace, Belfast - Manufacturing Sites

- | | | |
|---|----------------|--------------------------------------|
| 1 | Queen's Island | Main Assembly Facility |
| 2 | Dunmurry | Composites Fabrication and Assembly |
| 3 | Newtownabbey | Composites Fabrication and Assembly |
| 4 | Hawmark | Metal Component Fabrication Facility |



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Bombardier Aerospace, Belfast

Fuselages:

Belfast designs, manufactures and assembles fuselages for Bombardier business and regional aircraft programs

Nacelles –

Belfast designs and manufactures engine nacelles for major engine manufacturers

Advanced Composites (two plants)

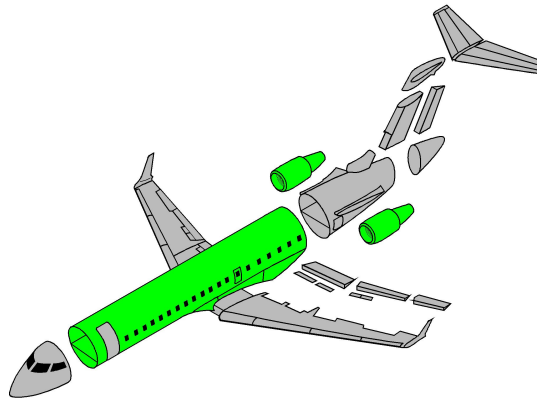
Centre of excellence for Composites within the Bombardier Aerospace Group.

New RTM facility -

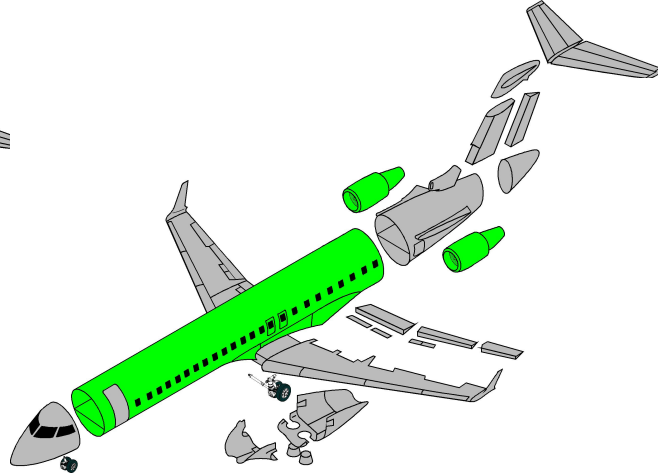


Belfast participates in all Bombardier aircraft families

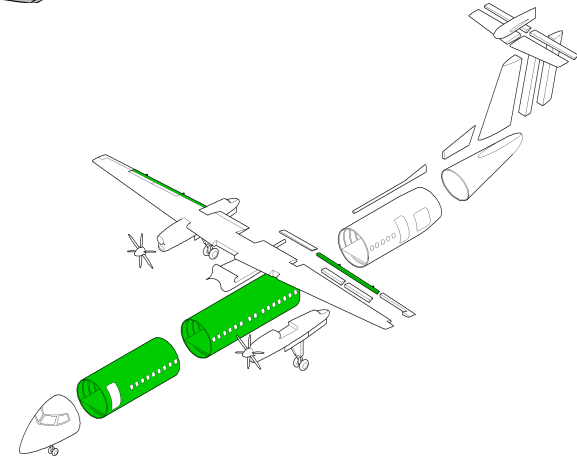
BOMBARDIER CRJ700



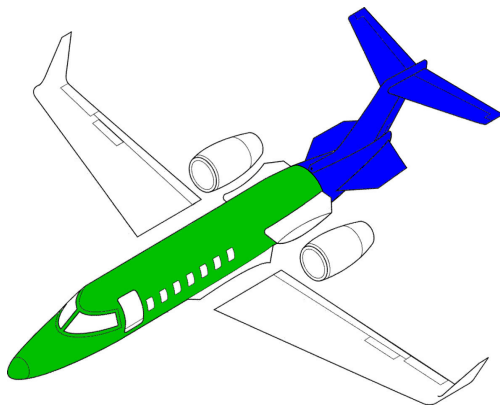
BOMBARDIER CRJ900



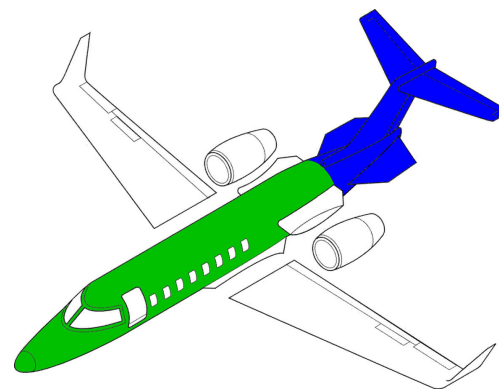
BOMBARDIER Q400



BOMBARDIER LEARJET 40XR

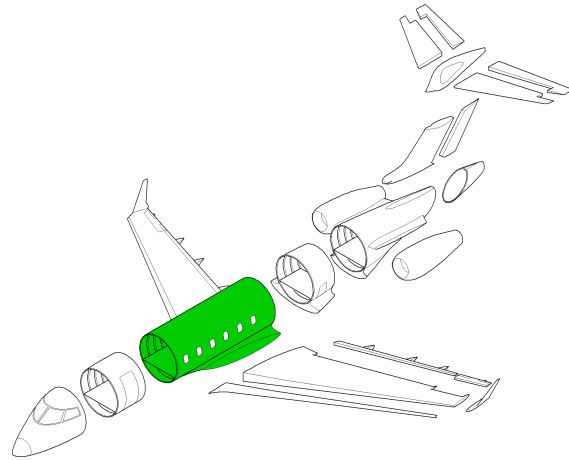


BOMBARDIER LEARJET 45XR

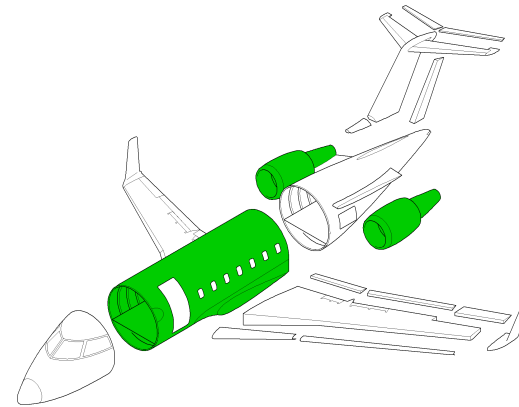


Belfast participates in all Bombardier aircraft families

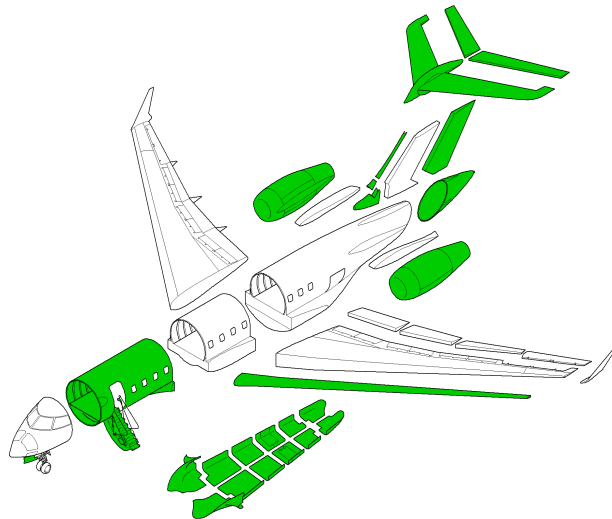
BOMBARDIER CHALLENGER 300



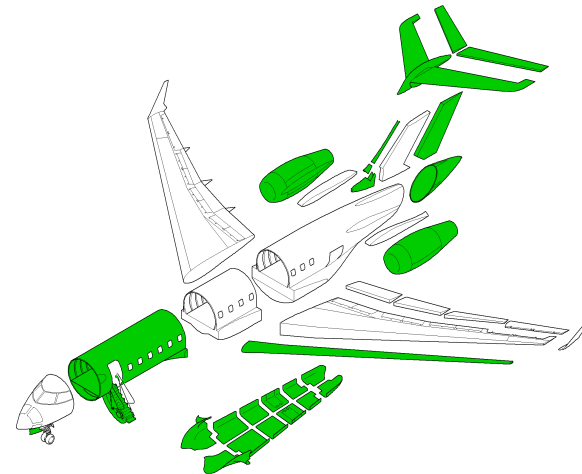
BOMBARDIER CHALLENGER 605



BOMBARDIER GLOBAL 5000



BOMBARDIER GLOBAL EXPRESS XRS



Bombardier and Delmia



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History of Delmia and Bombardier Aerospace

- **Belfast Manufacturing Engineering initial investigation/pilot of Delmia 2004**
- **Virtual factory analysis Belfast/Montreal 2005**
- **Belfast M.E. DTI funded *PreMade* 2006**
 - Consortium of 12 partners
- **Belfast Production Pilot 2007**
 - Today



Drivers for Digital manufacturing

- **Engineering change at NPI**
- **Reduce operations learning time at NPI.**
- **Influencing early Design**

- **Manufacturing Engineering Vision is process design, not I.T.**
- **Move M.E. to higher value added activity.**

- **Investment in Catia V5 not exploited**
- **Investment in systems lagging competitors**
- **Design are moving to solely 3D definition**
- **Burning platform systems**
 - Current CAPP system 23 years deployed

The Current ME Environment

SINGLE LEVEL BILL OF MATERIAL

LINE	COMPONENT/REFNA	DESCRIPTION/MODELS/UNITS	UM	T	C	RV	DM	D	CSM	PKCT	QTY	PER
001	063025	M525083 78B8	EA	1	P	01	2	N	Y		1	
001	070912	M536388 138 LOCKING WASHE	EA	1	P	01	2	N	Y		4	
001	072099	M525083 28510	EA	1	P	01	2	N	Y		5	
001	073696	M536387 267	EA	1	P	01	2	N	Y		1	
001	083657	M520470AD4 4A	RIVET	EA	1	P	01	2	N	Y	2	
001	084413	M521299C4	EA	1	P	01	2	N	Y		5	
001	089243	M520392 3C11 PIN	EA	1	P	01	2	N	Y		1	
001	090333	NAG6204 B	EA	1	P	01	2	N	Y		4	
001	096318	M53047AD4 6A	RIVET	EA	1	P	01	2	N	Y	1	
001	800-31175-27	DIAPHRAGM ASSY	EA	1	E	01	1	Y	Y		7	
001	SHB70-41523-5	BRACKET, TANK, SUPPLY	EA	1	E	01	1	Y	Y		1	
001	SHB70-41549-1	CHANNEL, SUPP. ST319-349, PO	EA	1	E	01	1	Y	Y		1	

1 - MAXIM

SELECTION: INEMB ITEM: SHB90-30000P10X12 OPTION: 4 DATE: 050607 TIME: 15:06

SINGLE LEVEL BILL OF MATERIAL

PARENT PART SHB90-30000P10X12 FUSELAGE EQUIPPING OPER ALL

MOD UNIT BLK U/M EA TP T1 EFF CTL 1 E REV 01 M REV 01

LINE COMPONENT/REFNA DESCRIPTION/MODELS/UNITS UM T C RV DM D CSM PKCT QTY PER

001 063025 M525083 78B8 EA 1 P 01 2 N Y 1

001 070912 M536388 138 LOCKING WASHE EA 1 P 01 2 N Y 4

001 072099 M525083 28510 EA 1 P 01 2 N Y 5

001 073696 M536387 267 EA 1 P 01 2 N Y 1

001 083657 M520470AD4 4A RIVET EA 1 P 01 2 N Y 2

001 084413 M521299C4 EA 1 P 01 2 N Y 5

001 089243 M520392 3C11 PIN EA 1 P 01 2 N Y 1

001 090333 NAG6204 B EA 1 P 01 2 N Y 4

001 096318 M53047AD4 6A RIVET EA 1 P 01 2 N Y 1

001 800-31175-27 DIAPHRAGM ASSY EA 1 E 01 1 Y Y 7

001 SHB70-41523-5 BRACKET, TANK, SUPPLY EA 1 E 01 1 Y Y 1

001 SHB70-41549-1 CHANNEL, SUPP. ST319-349, PO EA 1 E 01 1 Y Y 1

2 - CAPP

EPR - CRJ-700 Title: FUSELAGE EQUIPPING

ct|ct name|ct|ct name2|upart number -w1|fa| part | no/s | str | cos

71 CRJ-900 | C|SHB90-30000P10X12-A | Y | L7110B | 0001 | * |

Query/PM24 | orig date|u|opposite hand | | part | no/s | str | Sk

X0000000X | 07/05/31 | | | | | | | N

planner name| capp date|Phone | c | et | fin | st | fin | st | fin | st | fin

WMAN I | 07/05/31 | 2810 | |A155 | | | | | | |

Reference: EPR w1-A CREATED TO EMBODY MODISM SH670T300001 REV-NC [Estimated by]

Info. : AND SHB90-70000 N1E0-9 (IDENTS IWO IRU CONNECTORS ON |

: LH & RH SIDE CHANGED).

| | madeby | ub | superseded part | opp.hand sup part | cy.tis | account

A | 58 | 58 | SHB90-30000P10X11 | | | | | EPR

STATUS |Action Sheet No. | Amend# | ad| specinfo | send err|send to

|21SH670T300001 | REV NC | -01 | | | *

COMMAND(H,M,+, -, B,(E)nd display) ACCOUNT:CRJX Screen 1

1 Sess-1 | 172.25.36.12 | 1 | 1/13

2 Sess-1 | 172.25.68.26 | 1 | 2/35

PVA No: SHB90-30000P10-0005-03-NC Prepared By: D.NEWELL Date: 02/04/07 (See EPR for Drawings, Parts & Specs.)

Description: FIRE DETECTION BONDING JUMPERS View From: DR9, SHB90-30000

INSTALL PER BAPS 145-003 HUMISEAL PER BAPS 140-013

DECOMPRESSION PANEL BETWEEN FJMS L/H

384 - 379	✓
453 - 469	✓
517 - 533	✓
549 - 565	✓
581 - 597	✓
953 - 969	✓

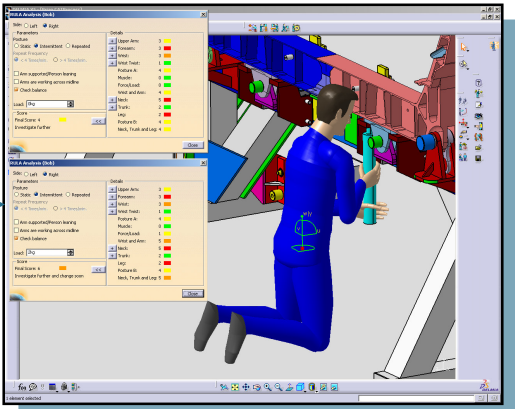
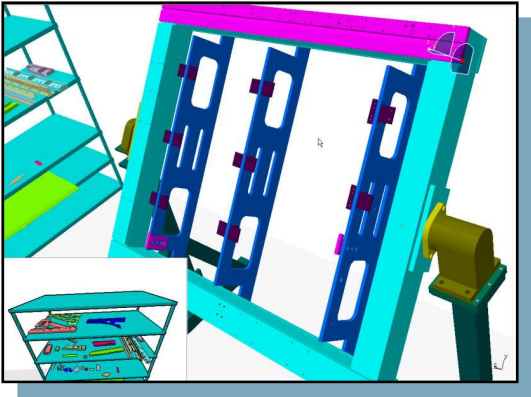
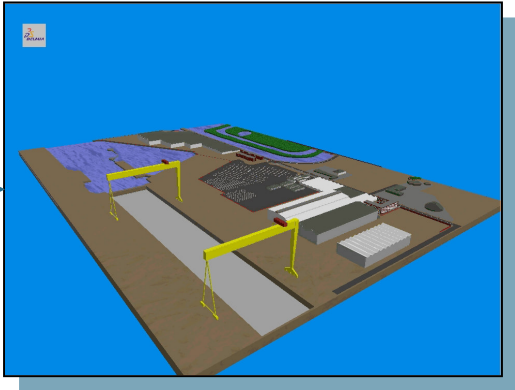
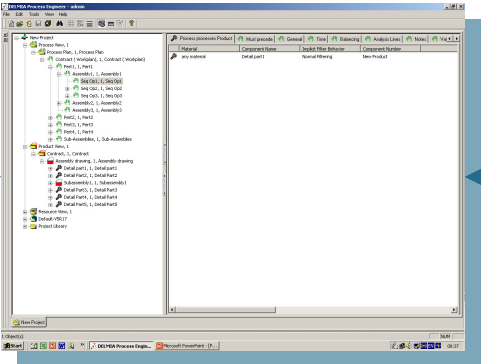
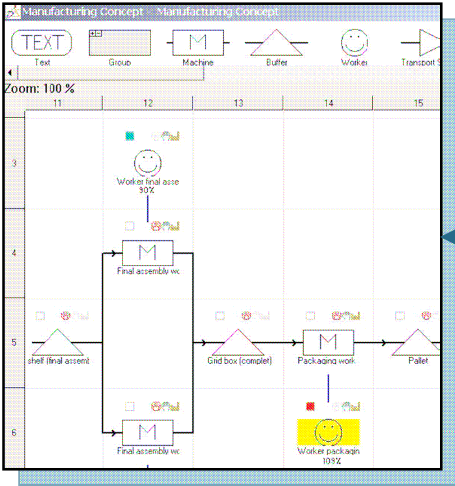
DETAIL D

Plan: 19230 Issues: 1 - Plastic

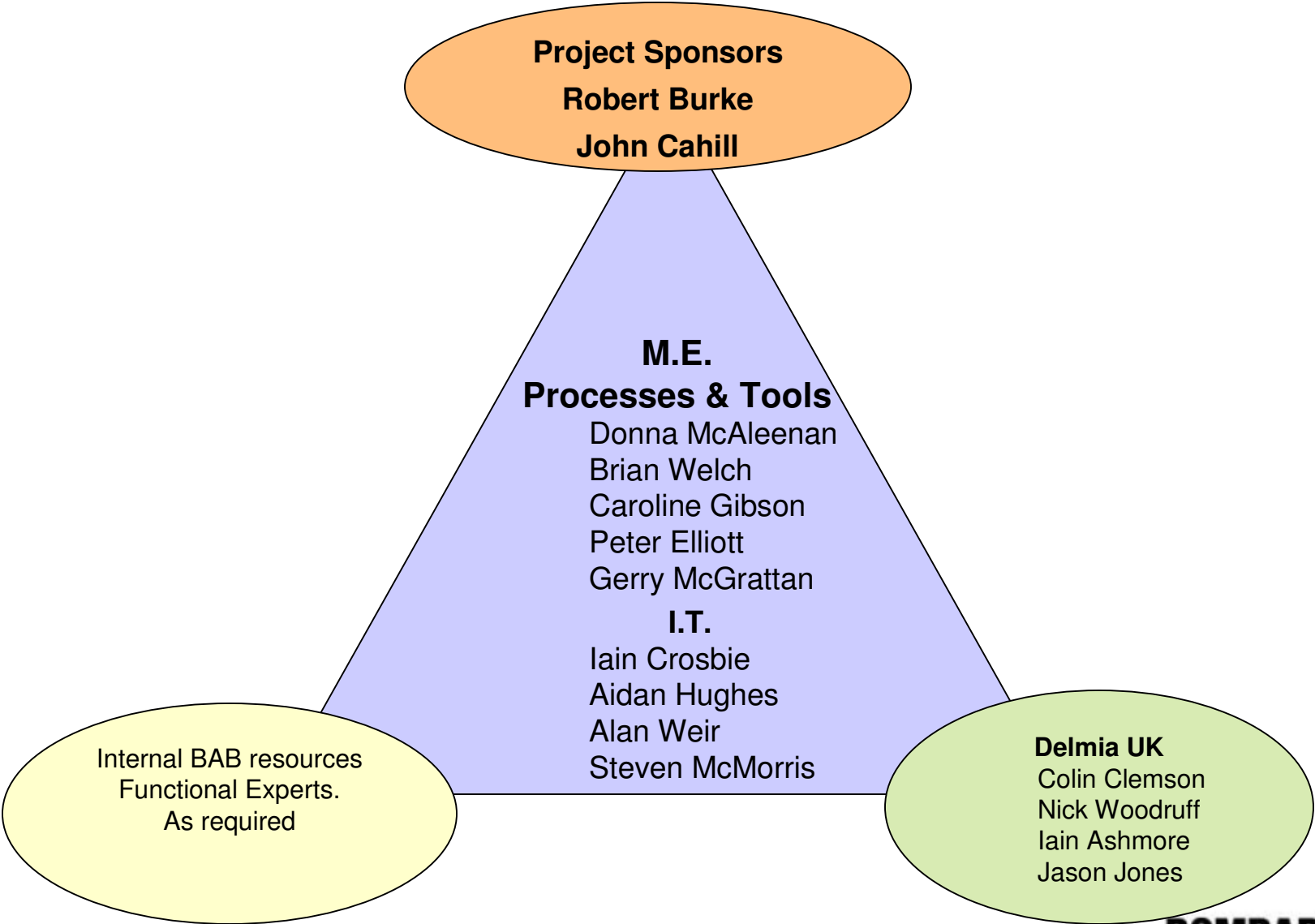
Step	Operation ID	Description	User Number	Work Center	Department	Part/Setup	Rate	Unit	Total Time	Time/Floor	Operator
1	15090	SEALING COATING 0610	47	NA	BE78	1.000	0.378	0.378	0.378		
2	15091	SEALING COATING 0610	47	NA	BE78	1.000	0.445	0.445	0.445		
3	15092	INSTALL FASTENER 0611	47	NA	BE78	1.000	0.040	0.040	0.040		
4	15093	INSTALL FASTENER 0611	47	NA	BE78	1.000	0.060	0.060	0.060		
5	15094	REASSEMBLE 0630	47	NA	BE78	1.000	0.369	0.369	0.369		
6	15095	REASSEMBLE 0630	47	NA	BE78	1.000	0.063	0.063	0.063		
7	15096	INSTALL FASTENER 0621	47	NA	BE78	1.000	0.306	0.306	0.306		
8	15097	INSTALL FASTENER 0621	47	NA	BE78	1.000	0.076	0.076	0.076		

ID	Task Name	EPR Title	Work	Duration	Predecessors	Resource Names
1	AB300		62.32 hrs	32.22 hrs		
2	100345TG10P2811-A	LOCATE STA FRAMES FWD FLOOR B &	4.29 hrs	4.29 hrs		Fiber
3	100345TG10P1813-A	STAGE 1 ASSY LOCATE PRESSURE FLOOR	7.5 hrs	2.5 hrs	2	Fiber(200%)
4	100345TG10P2827-A	STG 1 LOCATE FROM SPAR STD FRMS A	5.19 hrs	5.19 hrs	3	Fiber
5	100345TG10P2827-A	LOCATE HOOKEY STICKS B HEADS & S MA	6.06 hrs	3.09 hrs	4	Fiber(200%)
6	100345TG10P2829-A	STG 1 UNINSTALL FASTENERS W/O PRESS FL	9.79 hrs	4.89 hrs	5	Fiber(200%)
7	100345TG10P3103-A	STG 1 RIVET TWO PRESS FLOOR	3.4 hrs	1.7 hrs	6	Riveter(200%)
8	100345TG10P2830-A	STAGE 1 LOCATE REAR SPAR & INSTALL	9.81 hrs	9.81 hrs	6	Fiber
9	100345TG10P4314-A	INTLN OF AFT AC BLKHEAD	7.28 hrs	7.28 hrs	5	Fiber
10	100345TG10P4103-A	INTLN OF CLEATS W/O REAR SPAR & FW	1.53 hrs	1.53 hrs	11	Fiber
11	100345TG10P2814-A	STG 1 LOCATE FWD BTM PANEL FWD BHE	7.52 hrs	7.52 hrs	5	Fiber(200%)
12	100345TG10P2835-A	STG 1 UNSTL FASTENERS POSTS BTM PNL	6.81 hrs	3.4 hrs	11.9	Fiber(200%)
13	100345TG10P4102-A	STG 1 RIVET REAR SPAR POSTS BTM PNL	5.02 hrs	2.51 hrs	6,12	Riveter(200%)
14	100345TG10P2827-A	RIVET TWO AFT BELLSH-SH PRESSURE BEE	2.87 hrs	1.43 hrs	12	Fiber(200%)
15	100345TG10P1828-A	STG 1 LOCATE BLUNT STOP SEALING BEAC	6.4 hrs	6.4 hrs	5	Fiber
16	100345TG10P2836-E	STG 1 INTEL B/STOP BEAM'S SHEAR DECK	4.74 hrs	2.37 hrs	15	Fiber(200%)
17	100345TG10P2814-A	STAGE 1 INSTALL AFT LOWER BLKHEAD	4.01 hrs	4.01 hrs	14	Fiber
18	FINISH		0 hrs	0 hrs	7,10,13,16,17	

The Future ME Environment for Assembly



The Belfast Team

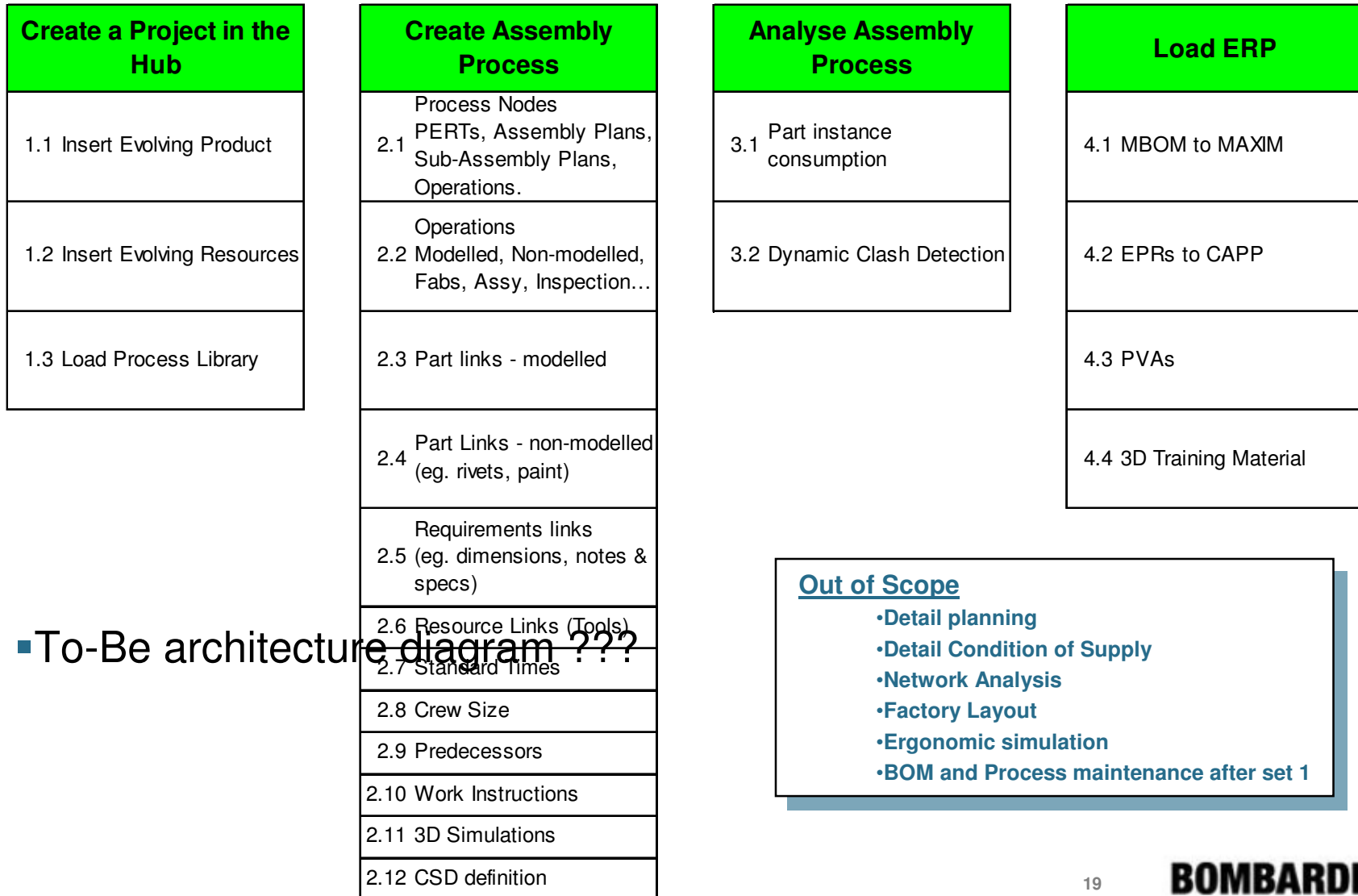


Delmia Project Objectives & Scope for CRJ1000 Flights

- **To partially integrate & configure Delmia (DPE & DPM)**
 - To provide a system that enables assembly processes to be designed and validated prior to a first physical build (up to and including data take-on for the first build)

- **To develop Delmia competence within ME & IT**
 - ME competence in the use of various Delmia workbenches
 - IT competence in configuring & supporting Delmia

Project Scope - High Level Process Map



Progress so far(1)

- **Consulting with Delmia UK**
 - Training
 - User training
 - Business Consulting
 - Basics of PTS and database objects

 - Scripting
 - Getting data into PPR hub
 - Moving data around
 - Extracting data (eg BOMs)

 - Script Actions
 - Listening for events and taking actions
 - Preventing functionality
 - Helping users make the right choice

Progress so far(2)

- **Load Product and Tooling from Legacy PDM (not Enovia)**
- **Mechanism to highlight change in evolving product**
- **View design changes in DPE :-**
 - Use light Browser technology
 - Geometric and non geometric changes.
 - Control over if/when M.E. accept/hold the design changes into the process
- **Aerospace PTS as a starting point for BAB configuration**
- **Utilising Delmia deployment methodologies as a framework**
 - Developed in conjunction with aerospace PTS in the U.S
- **Apron & uplock avi with red parts ?!?**

Intent

- **From**

- Disparate applications and data duplication
- Unstructured process planning data

- **To**

- Network, BOM, work instructions, Std Times on one platform ie Delmia
- Structured Data sets enabling analysis and Automation

Next steps

- **COS management**
- **Configuration control (DMU)**
- **Network analysis**
- **Full integration to ERP**
- **3D work instructions**
- **Detail part planning**
- **Factory Layout**
- **Ergonomic simulation**

Findings, Risks, Issues, Lessons and Constraints.

- **“Unique in the world” methodology of in-house software development**
- **Standard of license sets DPE/DPM/Human/Quest etc.**
- **Bombardier Aerospace Group PLM strategy**
- **Utilising Consultants effectively**
- **The Aerospace PTS and modifying it**
- **Implementation methodology**
- **Business Change Management**
 - Eg Tooling models from Sub Contractors
 - Roles & responsibilities
- **Moving forward in one step change**