

Contract of shared maintenance with an industrial - supplier of a Particle Therapy Facility

Samuel Meyroneinc
Institut Curie – Centre de Protonthérapie d'Orsay
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Summary

- **Radiation Therapy – Institut Curie - CPO**
- **Particle Therapy – Expectations**
- **The contract of shared maintenance – history – some lessons learned**
- **Conclusion - perspectives**

The context



Radiation Therapy – Particle Therapy

« Conventional » Radiation Therapy Machines

photons or electrons

> 10 000 Worldwide

3 - 4 M€

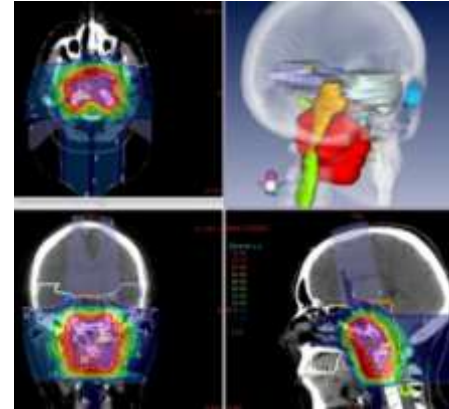


Particle Therapy Facilities

protons or carbons (more accurate)

50 Facilities worldwide, 50 scheduled in the next 5 years

25-120M€ (the coming new generation is more compact)



Institut Curie: HOSPITAL + RESEARCH + TRAINING



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We manage
50.000
patients
including
10.000
new ones

We have a staff
of
3,330
people

79
nationalities
represented

545
Medical
and scientific
publications

For a total budget of
€370 M,
21% of which
are generated
by public donations
(in 2015)

Radiation therapy facilities at the Institut Curie Hospital

Paris – Saint-Cloud – Orsay

Institut Curie boasts the most advanced radiation oncology department in France

- 9 Linear accelerators (4 RapidArcs, 1 Novalis)
- 2 Tomotherapy machines
- 4 high-dose-rate and pulsed-dose-rate brachytherapy systems
- Brachytherapy by 125 Iodine plaque and seeds
- 3 large bore CT scan with 4D acquisitions
- 1 Orthovoltage machine (Kv)
- 1 cyclotron with 3 proton treatment rooms (ICPO Orsay)



- 1957 Research physical center
-
- 1990: Creation of CPO (network)
- 1991: 1st Ocular treatment
1 Room – Fix. Line
- 1993: 1st intracranial treatment
2 Rooms – Fix. Lines
- 2004: Integration
into the Institut Curie
- 2006 1st General Anesthesia
- **2010 New cyclotron + 1 Gantry**
- 2011 1Gantry +2 rooms (Horiz line)
- 2017 10 000 fraction/year - PBS



**Cyclotron
230 Mev
(IBA)**

**Gantry Room:
All tumors
(IBA)**

**Y2 Room:
Ophthalmic Tumor
(Home made)**

**Y1 Room:
Intracranial tumors
(Home made)**

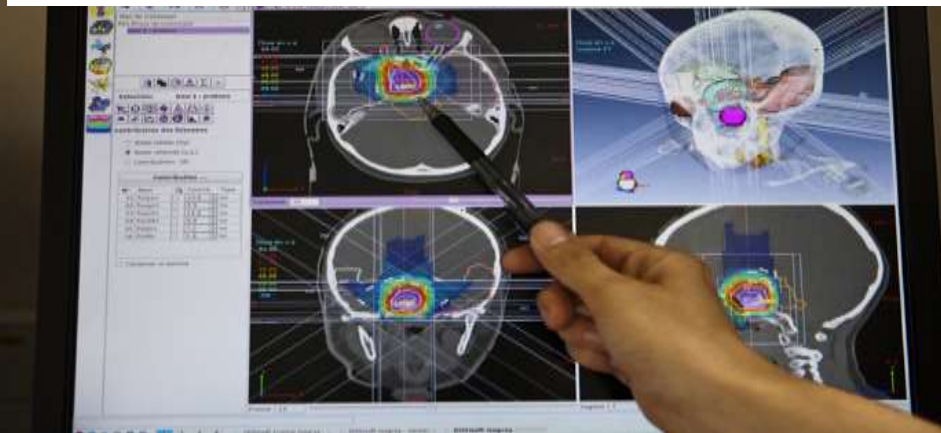
Centre de Protonthérapie d'Orsay



1991-2017: + 8000 patient treatments (# 4)
From 2010: treatments with an upgraded facility
2017: 45 patients treated per day – Staff: 50



Gantry room





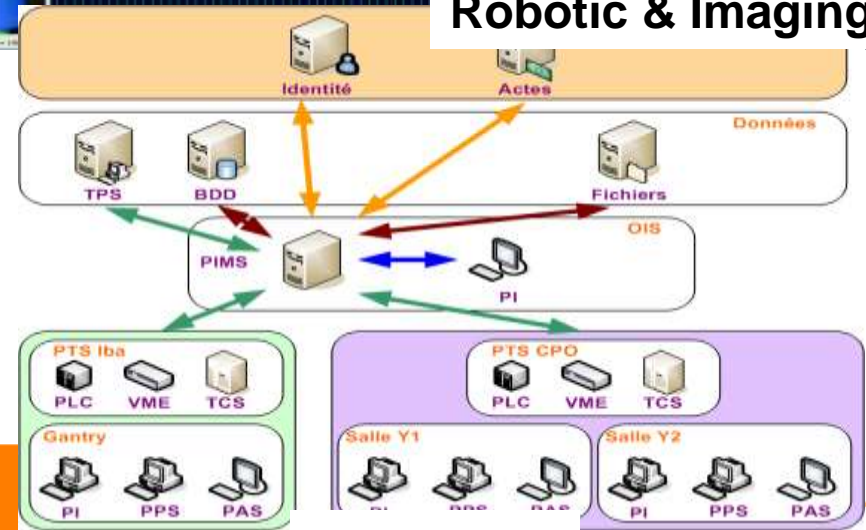
Cyclotron&Beamlines



Robotic & Imaging



R&D physics



IT&Control

The IBA cyclotron –C230

Energy: 230 MeV

Current max: 500 nA

Minimum: 0,1 nA

Emittance: 12 pi.mm.mrad

External magnetic diameter: 434 cm

Total magnetic height: 210 cm

Total weight of magnet: 220 tons

Electrical consumption: 446 KW

Harmonic mode: 4

Frequency: 106,1 Mhz

Voltage on Dee (extraction) 130 kV peak



Expectations for Particle Therapy



Performances expected in radiation therapy

1. Good patient

2. Good position

3. Good beam

Good data

- checked before
- some checked during (on-line, polling)
- checked after **R&V** (Record & Verify)

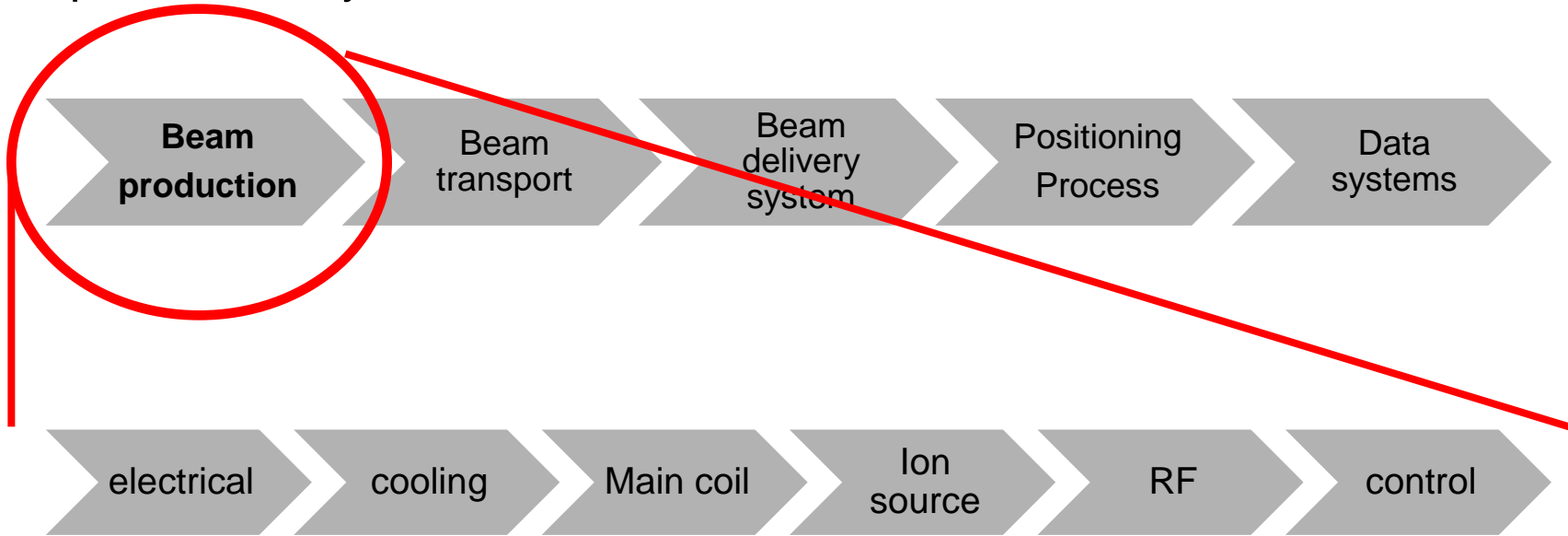
- If not good: stop, understand, fix, check, treat

Re-treating too fast can be unsafe

Treating too late can be ... unsafe

Systems: two levels of serial links

1 per PT facility



3 Key Performances Indicators (CPO)

1

% patient treated the day scheduled



Branding
external

2

Detailed Uptime:
sum of downtimes/
Normal time of operations



Analysis
internal

3

Feedback from medical users:
are you OK ? List of top-problems



Happy Users
internal

The contract of shared maintenance





Negotiate

Project

Operations

2006

Signatures for
1. Facility
2. Service

2010

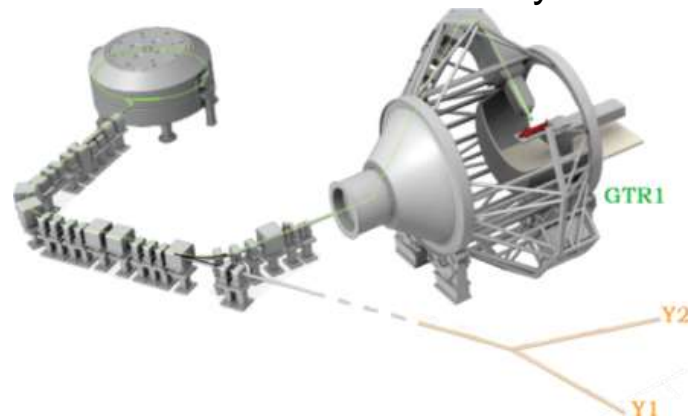
Start of the new
facility

2017

7 years



15 years of PT



< 5 facilities

> 40 facilities



Contract of service with shared maintenance



item	IBA	CPO
Training	Do training first year	Trained first year
Operations	Year 1	From year 2
Maintenance lev 1		X
Maintenance lev 2	X	Support
Spare parts		First set bought year 1
Pack for corrective missions	6 * 2 days	Corrective AMAP + support
On-call helpdesk	Service	
Update of software	Yes	
Teams	3 engineers on site	7 technicians + 4 engineers

Not contract of uptime but a contract of means

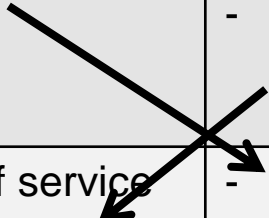
A common story (2006 ... 2010 ... 2017 ...)

ID	Y - M	W	Date	Time					Description			Y1-Y2		Who	Resp.	
				Sta	Cal	Fixed	Total	Gantry	System	SubSystem	Summary	Impact	Y1-Y2	Who	Resp.	
	2017-10	41	1un 02 oct		06:35	06:40	00:05	0,08				relance beam common process suite a défaut sur degardeur		0,00	LF EH	
	2017-10	41	1un 02 oct		06:45	14:55	08:10	8,17				Defaut FPA water flow sur Filament FPA - L'eileta 7305180052 renvoie et indique un défaut de débit	YES	8,17	LF EH	
	2017-10	41	1un 02 oct		08:00	08:00	00:00	0,00				Après diagnostici, il semble que le régulateur de pression d'eau soit la cause du défaut FPA,Nous le remplaçons par une vanne qui devrait permet un réglage de pression à 4 Bar pour un debit nominal de 60 l/mn environs, Bingo		0,00	Tout le monde	
	2017-10	41	mar 03 oct		12:05	12:15	00:10	0,17				defaut TCU UNHEALTHY		0,00	LF ST AP	
	2017-10	41	mar 03 oct		13:42	14:10	00:28	0,47				Contact sur snout100 défailant, Impossibilité de tourner la gantry en position Xray,Reparation immédiate par deux		0,00	ND JBR	




mixing experiences ?

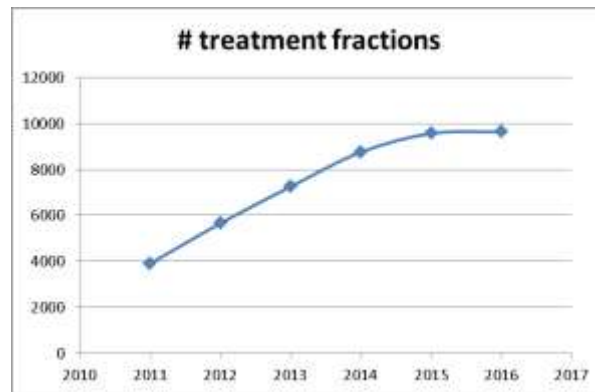
	IBA (industrial)	CPO (local team)
strenghts	<ul style="list-style-type: none">- The 10th version of the machine- Devoted team for each subject- « Pack safeties » upgrading the machine- ...	<ul style="list-style-type: none">- Long experience of the requirements for operations for PT- Know-how linked with local academics (CNRS)- Reactivity with other issues and people of the site
weakness	<ul style="list-style-type: none">- 2010: low experience of service for PT- Over documentation- Turnover of staff- ...	<ul style="list-style-type: none">- 2010: no knowledge on the IBA technology- Under documentation- No experience to work with a big third party- ...



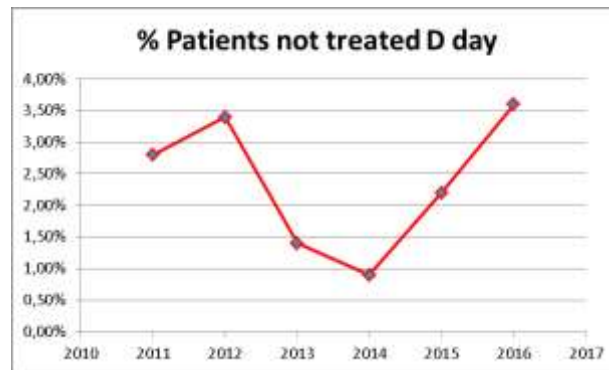
Data

- Technical hours 6:30 - 19h30
- Patients: 8h00- 18h30
- Tech-ing team: 14 people + 3 IBA
- Maintenances: Monday-Thursday early morning, some Saturdays, 4 Fridays OFF /year (no shutdown)

Main Results

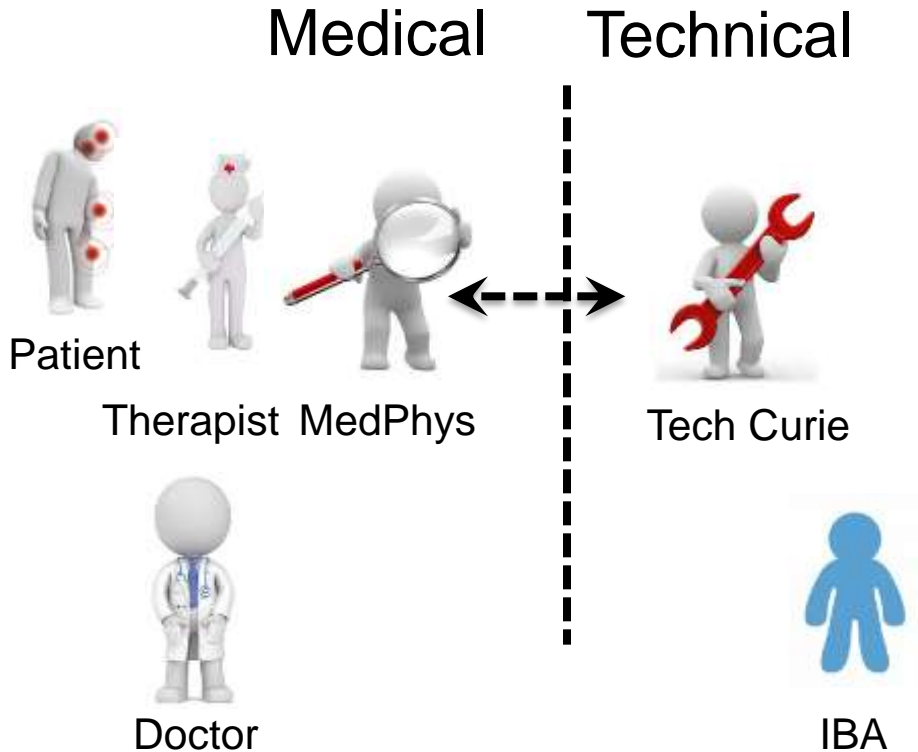


>10 000
/year



97,5%
Treated
D day

Example of short-term issues: interaction & escalation

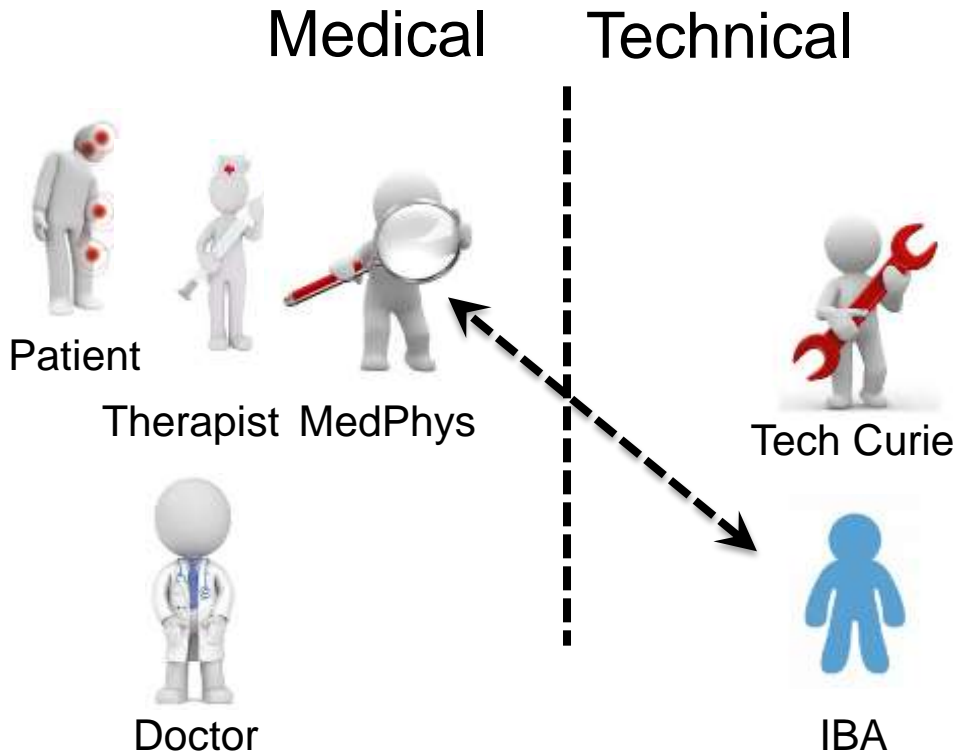


- Timing and protocols for escalation (2 min - 10 min – 30 min- 1h- 2hour-1day)

- Protocol of interface **1-1** (simple, no affect)
Level of trust in the diagnosis and duration

-
- Define who is the **owner** of the affair
- **Critical Components Identified**
- Documentation- Safeties

Example of short-term issues: escalation process



- Timing and protocols for escalation (2 min - 10 min – 30 min- 1h- 2hour-1day)

- Protocol of interface **1-1** (simple, no affect)
Level of trust in the diagnosis and duration

-
- Define who is the **owner** of the affair
- **Critical Components Identified**
- Documentation- Safeties

Example of Middle term issues: ions source lifetime

A annoying problem

1. From the statistics

- Low impact on uptime
- 3 spare parts

2. Feedback from users

- Can occur in the middle of the day
- uncertainties

Technical management

Local CPO know-how

- Based on experience
- Try to understand and improve

IBA approach

- Local staff not experimented
- Multi parameters from multi-sites

Example of some Long-term issues

CPO inputs

- Main coil monitoring
- Stop some « Run until it breaks »
- More detailed and dedicated approach for Radiation protection



Main coil
(SC200-Orsay-1985)

Example of some Long-term issues

IBA inputs

- Debug and upgrades on weak points
- Mutualization of know-how
- Professional Obsolescence analysis

Users meetings
User letters

Perspectives - Conclusion



For Particle Therapy

- **More patients treated, more publications**
- **More efficient – less expensive**
- **Share our know-how, use your know-how (large scale facilities)**

For Institut Curie - CPO

- **More patients, + Pencil Beam Scanning + localizations**
- **News technics**
- **R&D program, Radiobiology- Experimental beamline – New Linac**

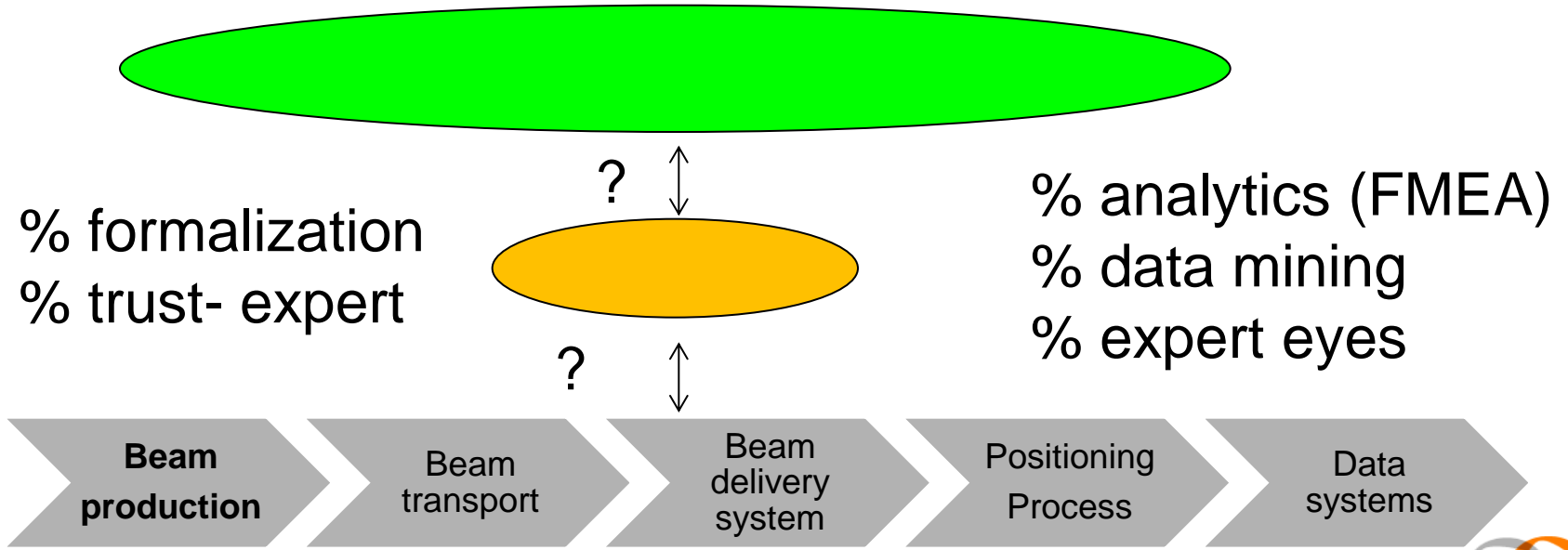
Lessons learned

Contract of service of shared maintenance:

- **explicit contract to define as much as possible**
- **implicit interactions to tune: (ex: owner – decision – priorities)
for common targets**
- **mix of challenges: high expectations - achievable**

One of the main up-coming challenge

monitoring and associated adaptative maintenance



Head of Radiation Oncology Department : Pr P.oortmans Philip

Head of Physic Service: Mazal Alejandro

Delegate director of ICPO: Dr R. Dendale



The Institut Curie –PT team

Medical Team

Dr Dendale R Colella H
Dr Calugaru V Beauzac P
Dr Mammar H Bihouee P
Dr Alapetite C Bourdeaux C
Dr Bolle S Le guillou S
Dr Feuvret L Lucas S
Pr Habrand JL Menard V
Dr Helfre S Oliveres S
Dr Jouglar E Pechmagre C
Pozzobon N
Cordillot C
Lanchas C
Rebechaud L
Alem S

Physics Team

Goudjil F
Delacroix S
De Marzi L
Mabit C
Nauraye C
Pasquiet I
Ribes S
Vaillant M
Leroy A
Besse M

Administrative T

Rochas C
Judzinski A

Tech& Engineering Team

Meyroneinc S.
Devalckenaere C.
Patriarca A.
Assuli J.
Bocquet JD
Brot E
De Abreu
Delivet V
Fugeray L
Hierso E
Le Tuault S.
Martin F
Maroni A
Thepault S

IBA teams

Ruaud JB
Nacivet S;
Danguillaumen N.
@LLN:
Pereira C.
Comblez C.
Pélerin P
B. Mickael.
Caillau Ph.
Deplasse P.
Verbruggen P
DeVoghel
...

Thank you

Questions ?

More: visit of Saturday morning

