

Problems posed by "difficult" environments to present linac-based systems

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Understanding what is “Difficult”

Technical challenges are not only factors

- Environment and technical (The machine)
 - Power, temperature, humidity etc.
 - There are technical solutions to these but these add cost and complexity of maintenance
 - Verifying correct local wiring and HVAC can be an issue.
- Decision making and commitments (The people)
 - Who decides what to buy, and who authorises payment
 - Is the capital purchase aligned with the ongoing costs (maintenance training, etc.)
 - Is there real commitment to keeping the facility working in the long term.

Present Linacs

Uptime >98%

- Present “mainstream” linacs have high clinical uptimes
- These figures do have key dependencies
 - Regular preventative maintenance
 - Rapid availability of genuine spare parts
 - Nearby availability of competent service personnel
 - Simple reverse logistics



Compare a PFN modulator with a more modern solid state design

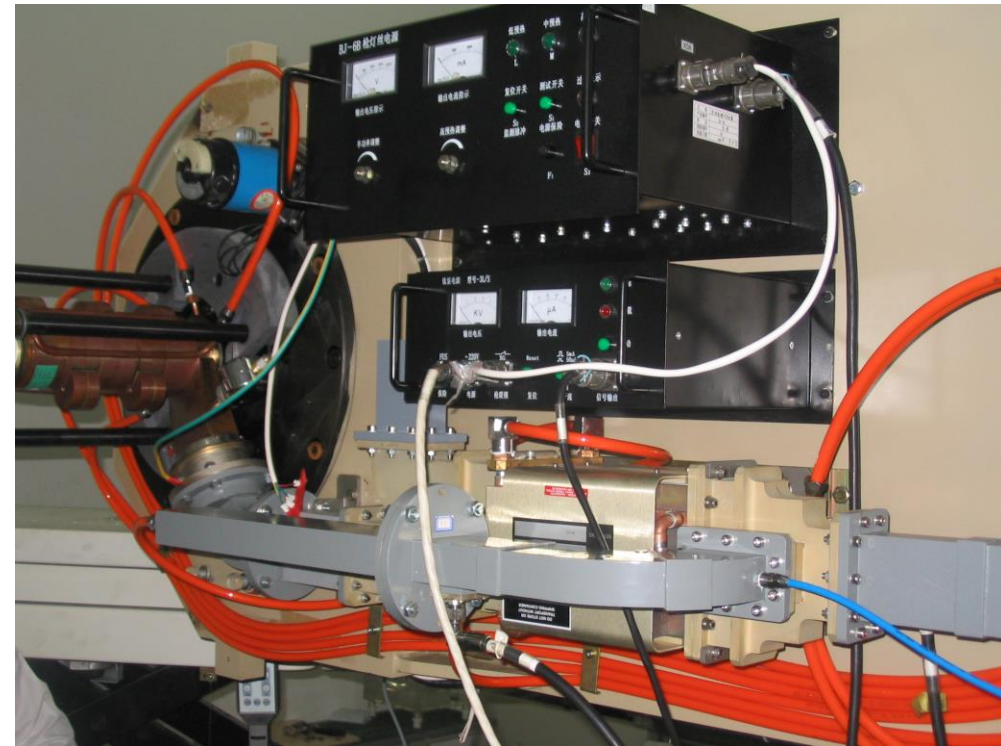
Old modulator use technology with simpler components that can be locally replaced, but is less reliable and requires more skill to service

The solid-state design able to adapt to local power condition and has no limited life components , but is not field serviceable.

How has technology advanced

What is important to the effectiveness of RT and what is not

- What is **less important**
 - Multiple X-ray energies
 - A single X-ray energy combined with IMRT can deliver high quality plans
 - Electrons
 - Electrons do have a role in certain treatments, but their use has not advanced much over the decades

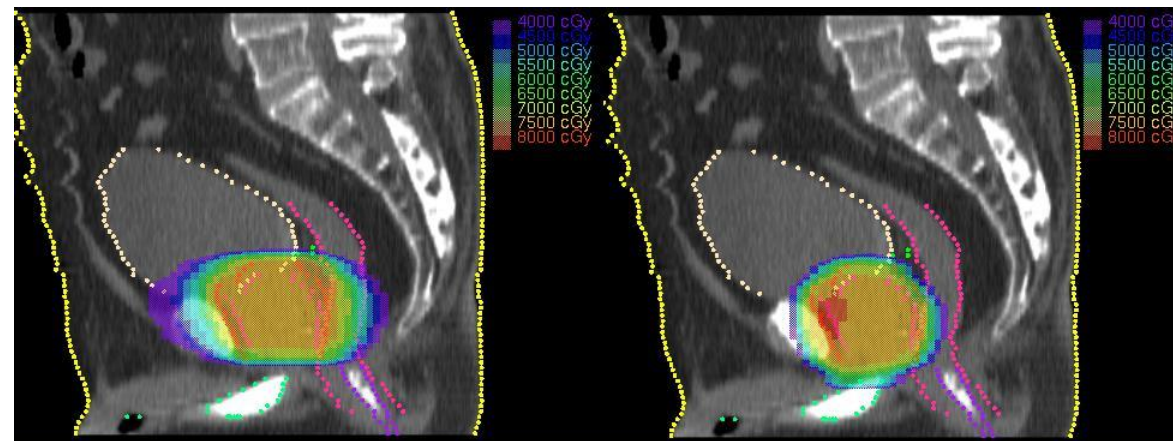
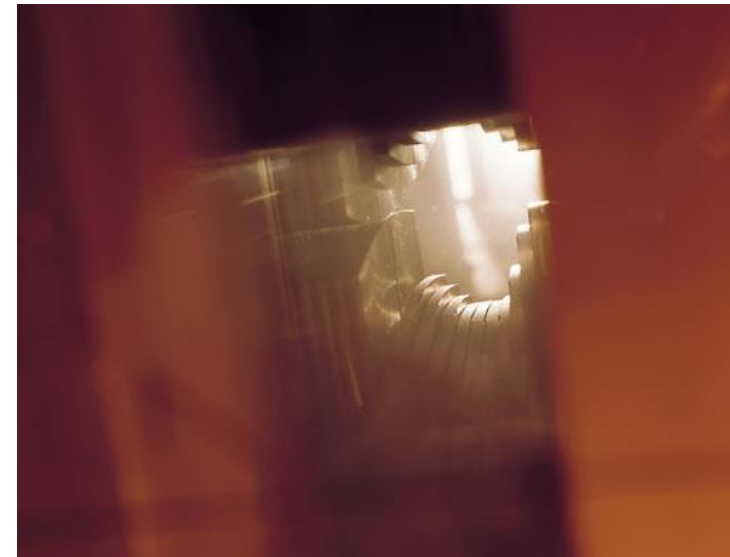


Single energy “straight through” linac system

How has technology advanced

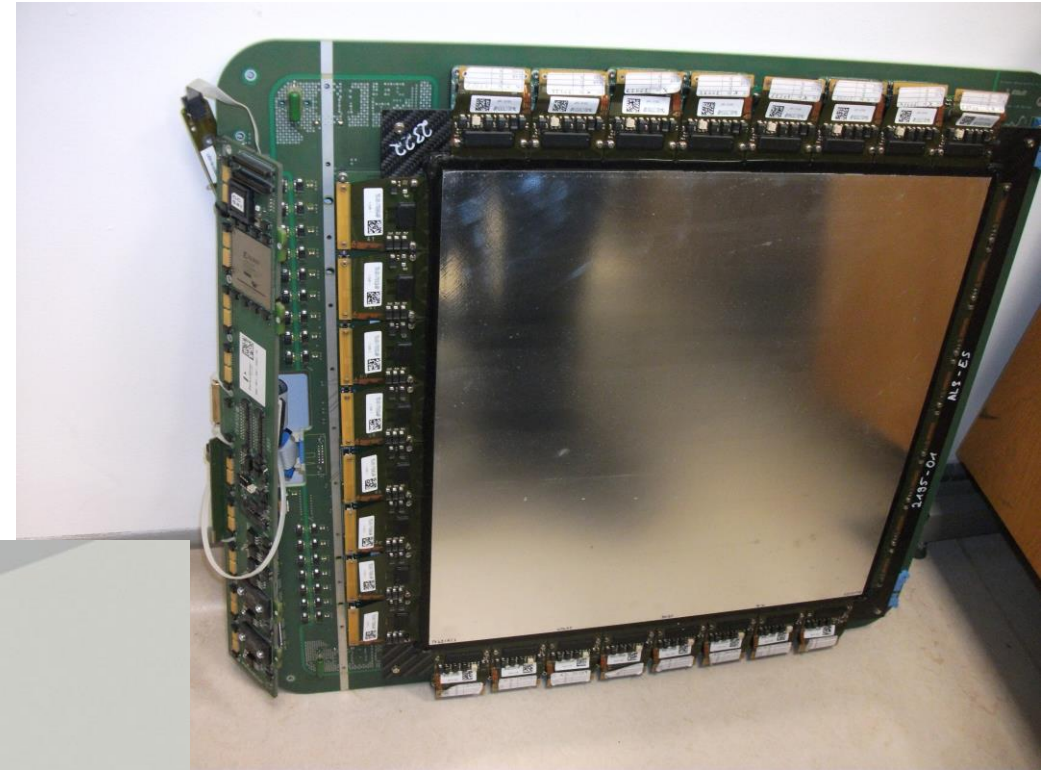
What is important to the effectiveness of RT and what is not

- What is **important**
 - High quality MLC
 - Low leakage and IMRT capable
 - IMRT reduces output factors, hence a high dose-rate becomes more important
 - Image guidance
 - To ensure that the anatomy is in the right place



More on image guidance

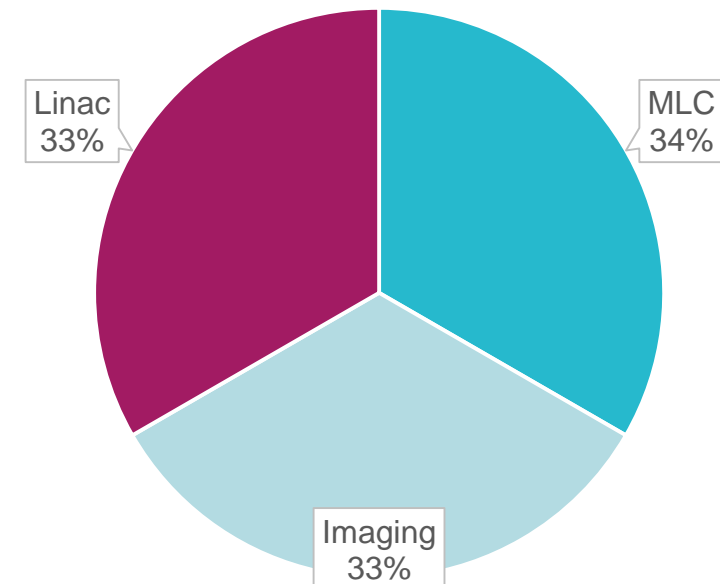
- Image components are expensive
 - AmSi imaging panels
 - Lower cost alternatives exist but at the expense of image quality per unit dose.
 - E.g. camera based EPID



Costs

For an image guided IMRT system

- The linac is only a part of the cost
- Don't confuse cost of goods (COGs) with the price to the customer
 - A company's profit is their net margin not their gross margin
 - Fixed costs are very sensitive to volume
- To supply at a low price, high volumes are very important
 - This means there should be a real incentive to align specifications with those of high population countries.



Selling and maintenance through local agents

Challenges

- For smaller markets multi-national companies use local agents
 - Skill levels can be variable
 - There may be trust and compliance issues and there maybe local conflict of interests.
 - Multinational companies will want to apply their own corporate governance and social responsibility models, but must also comply with local legislation and local business culture.



Key takeaways

The benefits of industrialization

- High quality and low cost products are best produced by industry
- Volume and standardization are key drivers of lower cost.
- Producing a “linac for everybody” will be more sustainable than any “special” device.