

# biobanking reimaged – arctic XC modular storage network

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## introduction

- As biobanks strive to adopt best practice in sample curation, sample logistics remains a weak link in the chain.
- Process inconsistencies include: variable length of time between sample post processing to storage and variable freezing profiles of samples stored in racks depending on where each tube is in the rack.
- Addressing such inconsistencies, then maintaining process consistency as biobank collections grow is challenging, however, automation provides a solution.
- Implementing automated storage, however, can be a slow and costly process. For some solutions, significant changes to infrastructure are required to provide long term (up to 10 yr) capacity requirements upfront.
- The launch of SPT Labtech's arctic XC represents a significant step in tackling the inconsistencies of sample logistics whilst providing a cost and time effective solution to the challenges of scalability.

## 1. sample logistics and integrity

- Samples such as plasma and serum should be transferred to -80°C storage as quickly as possible.
- The batching and collating of samples post processing, results in variable times to reach storage, risking sample degradation and inconsistent data in future research.
- Almost 20 years ago, SPT Labtech introduced pneumatic sample transfer systems for small molecule sample management.
- This proven system has now been developed for use within biobanking. Pneumatic pipes connect laboratories to the biobank enabling samples to be stored at -80°C immediately after processing.



Fig 1. Remote delivery from sample processing laboratory on 1<sup>st</sup> floor to 3 arctic modular storage units.



Fig 2. 3 interconnected arctic systems in different locations connected to a common access point

## 2. storing in racks – the penguin effect

- As demonstrated by penguins in Antarctica, we hypothesised that samples stored at the edge of racks freeze much faster than those in the centre due to an insulation effect.
- We conducted experiments to measure the significance of the penguin effect using a standard SBS format rack containing 96 x 1.4mL vials, each filled with 0.97mL of bovine serum.
- Several vials were adapted to incorporate a thermocouple in the liquid. Temperatures were recorded as the samples cooled to -80°C (Fig 3.).

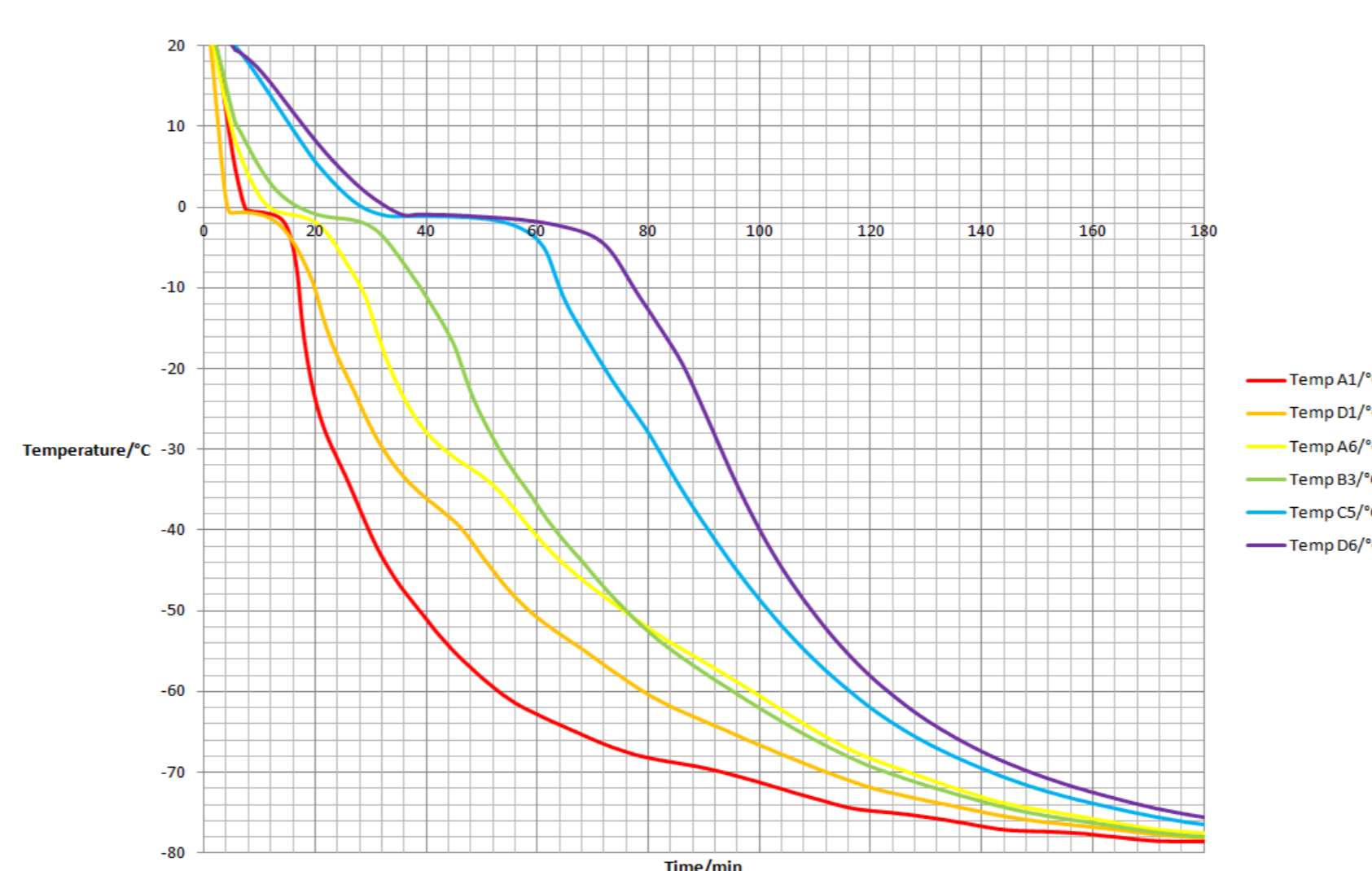


Fig 3. Freezing profiles for different positions in an SBS rack

- Our results confirmed that edge vials freeze faster than centre vials. Greater than 60 mins difference was observed between samples reaching sub-zero temperatures and 70 mins difference reaching -40°C.
- To avoid rack-based penguin effects the arctic system does not store vials in racks. Instead vials are stacked on each other in aluminium pipes, ensuring consistent freezing profiles.

## 3. comparing the economics of automated storage solutions

Consider a biobank storing 100,000 samples per year for 10 years

**Option 1** install a large automated storage system with a 1M sample capacity.

- Cost per samples includes purchase cost, ongoing service costs and electricity costs, but not infrastructure changes which could be considerable.

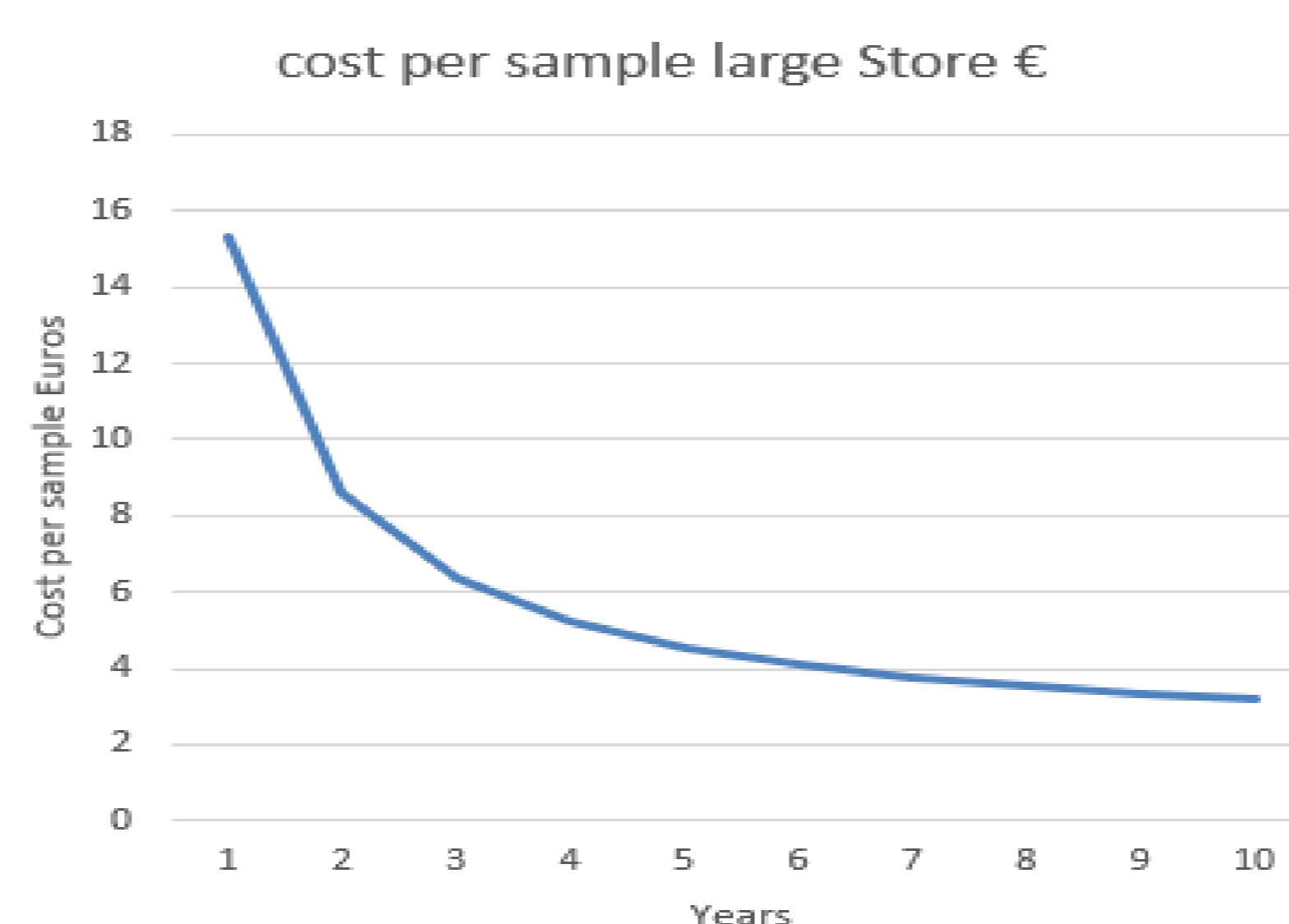


Fig 5. Cost per sample illustration for a large automated store

- Fig 5. indicates that cost/sample ranges from ~ €15 initially to €3.2 once the store is full.
- After 10 years the store may reach the end of its working life, requiring new funding to replace and/or expand.
- As a large upfront investment, this solution is inflexible to unforeseen changes.

**Option 2** start with a single arctic automated storage system. Expand into an integrated arctic XC system over time.

- Cost/sample includes: purchase, service and electricity. Its compact module size means infrastructure changes are not generally required.

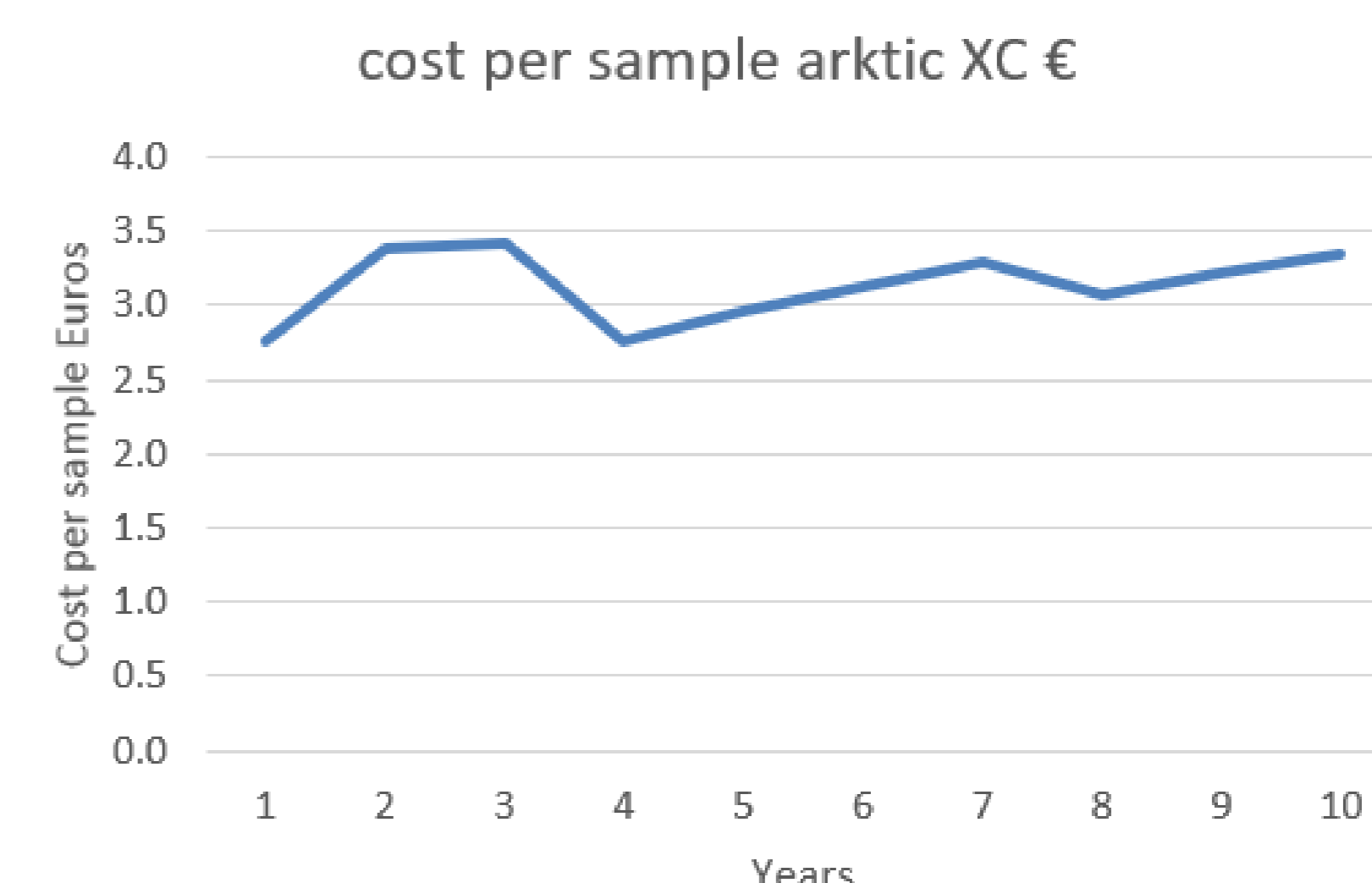


Fig 6. Cost per sample illustration for arctic XC store

- Fig 6. indicates cost/sample ranges between €3.4 to €2.8, fluctuating a little with the addition of integrated modules as required.
- This solution is highly adaptable to future changes, offering limitless expansion possibilities.

### Depreciation of assets

- Considering the residual asset values over the 10 year period is also quite revealing.

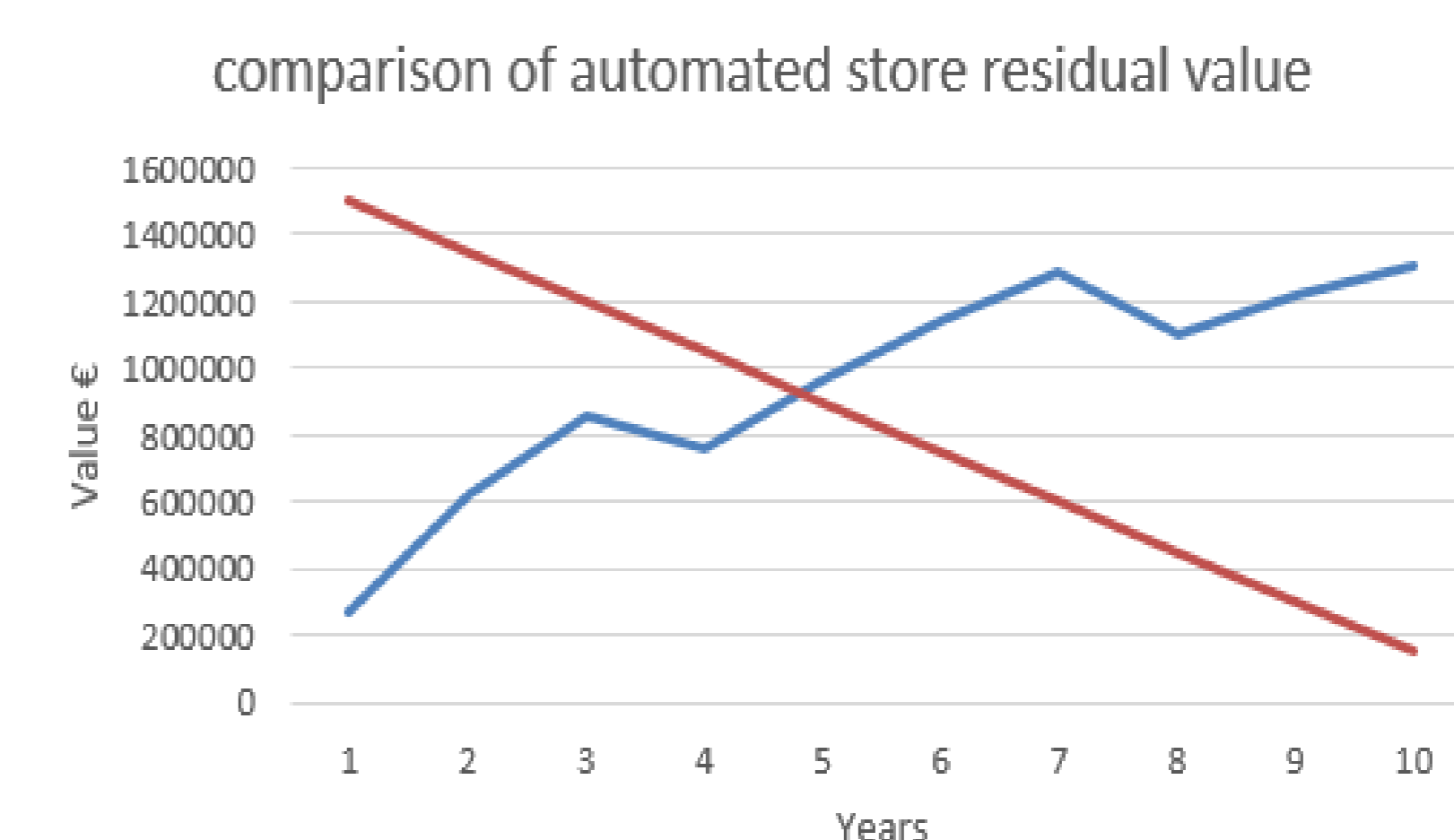


Fig 7. Comparison of residual € values of large store (red) vs arctic XC (blue) when storing 100,000 samples per year over 10 years

- The arctic XC approach enables a rolling, programme of module replacement versus replacement of the entire system (see Fig 7.).

## conclusions

- Planning the long term curation of samples is challenging and requires consistent, reliable and scalable processes.
- Introducing automated storage has generally required significant up-front investment, major infrastructure changes, lengthy implementation and slow return on investment.
- SPT Labtech's arctic XC system approach addresses these key factors providing:-
  - Standard "off the shelf" storage systems
  - Rapid install in standard laboratory spaces
  - Options to connect laboratories directly with storage
  - Improved sample handling and reduced time to store enhancing sample integrity
  - Flexibility to manage budgets effectively by scaling capacity only when needed
  - Adaptable systems that fit into existing and future infrastructure.