

How Biobanks Are Assessing and Measuring Their Financial Sustainability

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As guest editors of this sustainability issue of Biopreservation and Biobanking focused on business planning, utilization, and marketing, we invited a number of experts from different sectors of the biobanking arena to provide their views on business planning issues. Each expert was asked to provide a brief background statement on their biobanks, to build a context to understand their answers to the sustainability questions. We hope that these insights and experiences can provide valuable considerations and ideas for other biobanks who wish to develop or refine their own business plans, measure their utilization rates, and work toward financial sustainability. In addition, after the expert input was gathered, the guest editors invited an additional expert to provide summary comments and observations on cost and operational optimization strategies. The broad experiences from all of the experts included and scope of the biobanks they represent should provide a level of relevant representation for all interested parties.

Asterand Bioscience, Detroit, Michigan

Please provide a short description of your biobank, type, and who your biobank serves. Please include how your biobank is funded in this description.

Asterand Bioscience (Asterand Bio) is a company dedicated to providing high-quality human tissue-based products and services to researchers in a wide range of not-for-profit and for-profit organizations, including universities, government agencies, and pharmaceutical, biotechnology, contract research, and diagnostics companies. Established in 2000, Asterand Bio's biobank now contains more than 300,000 human solid tissue and biofluid specimens sourced from a worldwide network of more than 100 strategic partners, such as hospitals and clinics. The biobank is self-supporting with costs associated with operations, business development, administration, etc., offset by fees paid by our clients.

Samples are collected over multiple therapeutic areas (oncology, inflammatory, autoimmune, etc.) and "normal"

donors and in several formats (frozen and fixed solid tissues, serum, plasma, whole blood, cerebrospinal fluid, synovial fluid, etc.). Most samples are collected prospectively as excess to surgical or diagnostic needs, but some are from postmortem donors or surgical archives. All prospectively collected samples are acquired with full IRB- or Ethics Committee-approved consent for research and supply to third parties. Surgical archives are obtained either with research consent or under an IRB-approved waiver of consent. Sample use is restricted to research for new therapeutic agents, diagnostics, etc., and use in humans is not permitted.

As well as providing "off-the-shelf" biospecimens, Asterand Bio also procures samples to meet customer-specific needs. These include fresh tissue and blood shipped directly from source to researcher, and samples collected under special conditions.

When did you develop a business plan for your biobank? Do you think the timing was appropriate and how often do you update it? Please note the key points you have included in your business plan. Do you have a specific person/group at your organization that is charged with the development/maintenance of your business plan? Please elaborate.

Although a business plan for our biobank was developed when the business was originally founded, we no longer use a formal written document during routine operations. The rapid and unpredictable changes in demand for human biospecimens in the fast-moving healthcare environment (e.g., because of changes in research direction, technologies, and therapeutic approaches) make it difficult to forecast even a few months ahead where demand may change. A written plan, therefore, becomes out-of-date quickly and needs frequent updating to remain current. This process is too onerous for a small organization like ours. Instead, over the past few years, our forward planning has been focused around the financial stability and development of the organization. It centers on preparation and maintenance of a budget looking 12–24 months ahead and based on inputs from our various teams, including

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tissue supply site management and development, laboratory, QC and QA operations, business development, and finance. The budget is largely based on historical data and trends, but we also try to plan for changes in demand for research samples and associated services and for introduction of new products, based on evidence from general market trends. This approach offers maximum flexibility and has been found to work well in our organization.

How do you define the utilization rate for your biobank? What is the target rate for your utilization of biospecimens and are you meeting your target(s)?

Our company's mission is to accelerate translational research from target to therapeutic use, and so we aim to maximize timely provision of human biospecimens to researchers. We try continually to increase the number of researchers we support and to maintain sufficient stocks of samples to do so. At the same time, we try to match our supply to demand over the medium to long term to ensure we hold the right samples to meet researchers' needs quickly while avoiding accumulation of unwanted samples. To achieve this, we review monthly the quantity of samples on hand, and the details of samples supplied to researchers and received from our suppliers. This enables us to make timely adjustments to the requests we place with our supply sites and sometimes prompts changes in development of new supply sites to meet changes in demand. We typically aim to maintain levels of banked items (and some combinations of items such as tissue with matching biofluids) at equivalent to 1 to 2 years of estimated demand, depending on sample type, frequency, and size of requests from researchers, and speed at which we can change the supply rate.

How do you market your biobank and what are the most important marketing activities? If appropriate, include any successes you may have experienced reaching a new customer base through your marketing.

Asterand Bio has designated business development and marketing teams. Our business development team members are in regular contact with existing and prospective clients in their territories within the United States, Europe, and Asia-Pacific to identify and support their needs for human biospecimens and/or services. Our major clients are in the pharmaceutical, biotech, and diagnostics sectors.

Our marketing team has two main responsibilities. The first is to increase awareness and understanding of Asterand Bio's products through placement of advertising and attendance at conferences. The second is performing market research to understand trends in demands for human biospecimens and related services. This research aims to give our tissue supply and operations team early indication of changes in demand for Asterand Bio's products and services, and is particularly important because of the relative difficulty in rapidly increasing supply of some human tissue types. Input from business development and marketing teams may also identify new product opportunities whose development and marketing are then led by the marketing team.

Successes resulting from our marketing activities have included timely introduction of genetic mutation screening of our

samples and maintenance of cohorts of prescreened tissue samples, identification of the potential to use surgical archive samples to support R&D for diagnostics, and a forecasted increase in demand for tissue samples with matching blood for use in development of "liquid biopsy" diagnostics for oncology.

How sustainable is your biobank today?

Asterand Bio's human tissue biobank started in 2000 and since 2009 the number of samples supplied to researchers has remained reasonably steady between 18,000 and 22,000 per year, with the current trend being upward. Sample acquisition has generally kept pace with demand and the number of specimen supply sites has increased significantly. So, although the mixes of samples acquired from our supply sites and provided to researchers have changed over the years (in terms of both disease and tissue type and format mix), the overall trend of our operations indicates a biobank showing consistent sustainability over many years with no indication of imminent decline.

What key success factors and/or challenges in your operational, financial, and social sustainability have you experienced?

Our greatest challenge continues to be matching biospecimen supply to demand, particularly in response to sudden increases in demand for specific specimen types. Solid tissue samples from donors with late-stage cancers or rarer diagnoses (e.g., pancreatic tumors and bone marrow from hematological malignancies) have consistently proved difficult to acquire, as have samples from organs affected by diseases/conditions not routinely treated by surgery (e.g., asthma, chronic obstructive pulmonary disease, and diabetes). Meeting the need for samples in these therapeutic areas is increasingly important as researchers work to apply human tissue studies in their searches for new drugs and diagnostics. In general, it is difficult to change supply rapidly, particularly if it requires new sources. This is true regardless of whether the aim is simply to broaden the supply base or to make up for an unpredicted shortfall like we encountered several years ago when a country providing part of our supply suddenly imposed restrictions on export of human research samples.

However, although we have inevitably encountered challenges in our business, perhaps the most important influences on our business have been our successes, particularly the early adoption of the highest ethical and technical standards in our collection processes and the maintenance of these standards throughout the organization's life. This has led recently to ISO and CAP accreditation for our biobank. These high standards, together with the commitment of our staff and strategic partners worldwide, mean that researchers can trust the quality of our biospecimens, which has ensured continued demand for these biospecimens over many years and the continuing success of our biobank.

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The Oregon Health & Science University, Knight BioLibrary

Please provide a short description of your biobank, type, and who your biobank serves. Please include how your biobank is funded in this description.

The Oregon Health & Science University (OHSU) Knight BioLibrary was established in 2008, and is a matrix organization of human specimen collections supported by dedicated staff, with the goals of standardizing specimen management and coordinating disbursement to researchers. Starting as a collection of tissues left over from clinical procedures, the BioLibrary is now among OHSU's largest collections of clinical data, tissue, blood, and other biospecimens reserved solely for research use. The BioLibrary serves local and global researchers alike, whether under collaborative research agreements with nonprofit entities or under license agreements with commercial entities. To date, the BioLibrary contains more than 3 million specimens across 260 anatomic sites.

When did you develop a business plan for your biobank? Do you think the timing was appropriate and how often do you update it? Please note the key points you have included in your business plan. Do you have a specific person/group at your organization that is charged with the development/maintenance of your business plan? Please elaborate.

The business plan for the biobank was created 3 years after the biobank was formed. The drivers to create the business plan were initially in receiving a significant donation of philanthropic funds, and second, the development of an overarching strategic plan for the Cancer Institute to best utilize the gift. One of the components of the strategic plan included the development of a robust biorepository wheelhouse, which necessitated the investment in a director of operations, informatics platform, and personnel to handle the increased number of accrued specimens.

The business plan is reviewed each year, coinciding with the institutional budget planning cycle. The plan includes a listing of roles within the BioLibrary, standard operating procedures manual, IRB-related documentation, core services and related fee structure, key performance indicators, details of the quality management plan, itemization of disease areas supported and primary contact details for each, and allocation of resources (staffing and budget) to strategic projects. The director, with input from leadership and key stakeholders, is charged with development and maintenance of the business plan.

How do you define the utilization rate for your biobank? What is the target rate for your utilization of biospecimens and are you meeting your target(s)?

The utilization rate of the biobank is determined by a variety of factors. The primary measures that are used by the BioLibrary are quantitative—for example, the number of cases accrued versus the number of cases distributed, the number of researchers accessing services, and number of

publications generated from the use of received samples. Although no targets have been set, monitoring of these metrics over the past 4 years has demonstrated a significant and steady increase in utilization of the resource.

Lagging measures, such as the primary measures already described, are metrics that in and of themselves do not fully describe utilization. There are other leading measures that may be used to demonstrate utilization, such as the number of support letters provided to principal investigators (PIs), or the number of grant applications that intend to use the resource. These are just as important to monitor as the primary measures for demonstrating utilization, and subsequently a return on investment in the resource.

How do you market your biobank and what are the most important marketing activities? If appropriate, include any successes you may have experienced reaching a new customer base through your marketing.

Marketing of the BioLibrary occurs through two primary avenues: web presence and through networking opportunities at conferences. In developing a marketing plan, it is important to decide what your core business services are and to target the most appropriate customer base. For example, if your aim is to help develop diagnostic assays, networking at a biomarker conference that is heavily attended by industry members could generate some solid collaborations.

How sustainable is your biobank today?

It is hard to set a value on sustainability. As with any business, a biobank interacts with and is part of a complex ecosystem, comprising many factors, some of which are within control of or within the influence of the biobank and some of which are not. To maintain sustainability, operations of the biobank need to be flexible and change its operations to account for pressures and opportunities as they arise. The BioLibrary has a strategy that we feel positions us to maintain a longitudinally sustainable enterprise.

What key success factors and/or challenges in your operational, financial, and social sustainability have you experienced?

We have had good success in our sustainability efforts by utilizing a two-pronged approach to business planning. The first prong is in considering the intersection (think Venn diagram) between three critical elements: (1) the demographics of our patient population, (2) the needs of our researcher community (in terms of research foci and required sample types), and (3) our financial constraints (i.e., “right-sizing” of our operations, in which the proper amount of resources is available to meet the aims of the group, while demonstrating a return on investment).

The second prong to our approach is in conducting regular SWOT (strengths, weaknesses, opportunities, and threats) analyses. By focusing our efforts within the intersection of the three critical components as already described and coupling this with the findings from the SWOT analyses, we have been able to stay focused on what is of most importance to the broadest number of stakeholder groups.

Although we have had good success in this area, it has not been without challenges, one of which has been that of benchmarking. Benchmarking may be defined as a measurement of an organization as compared with similar measurements of its peers, with the objective of using this information to improve performance. Benchmarking as a way to measure return on investment is easier with publicly held companies, but is more challenging when looking at privately held entities—where many biobanks exist. We have found that it has been hard to identify similar biobanks that are able to (because they have been collecting metrics data) and are comfortable with providing sufficient information for us to quantitatively and qualitatively benchmark our operations. This is an area of interest for us such that we facilitated a workshop titled, “Qualitative and Quantitative Measures for Benchmarking Biobank Operations” at the Biorepositories & Sample Management Conference held in Boston in 2016.

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The BC Children’s Hospital BioBank (BCCHB), Vancouver, Canada

Please provide a short description of your biobank, type, and who your biobank serves. Please include how your biobank is funded in this description. (See attached example from December 2015 sustainability issue in BIO)

The BC Children’s Hospital BioBank (BCCHB) is a campus-wide biobank that collects specimens and annotated data from neonates, children, and women at BC Children’s Hospital and BC Women’s Hospital in Vancouver, Canada. The Biobank is unique in that it is focused on a wide range of health issues related to pediatric and fetal–maternal medicine. Investigators locally on campus, nationally, and internationally can gain access to specimens and clinical data in the BCCHB, although there is priority for supporting local research. The BCCHB is funded by a significant start-up donation from the BC Children’s Hospital Foundation, but aims to become sustainable through cost recovery, services rendered, additional grants, and institutional support.

When did you develop a business plan for your biobank? Do you think the timing was appropriate and how often do you update it. Please note the key points you have included in your business plan. Do you have a specific person/group at your organization that is charged with the development/maintenance of your business plan? Please elaborate.

We developed a business plan for our biobank in 2013 with the help of a business plan consultant. Our business

plan was approved by an advisory committee composed of key stakeholders at each of the institutions that are affiliated with our campus.

It was an appropriate time as our campus was exponentially growing with many small disease-specific biobanks, many of which did not address current issues of biobanking, including ownership and guardianship of specimens and data, budget planning, and consent burden. The need to address these issues in a systematic and ethical manner was recognized and we were awarded start-up funding for the campus-wide biobank. The business plan was created before implementation of the BCCHB to clearly lay out our mission, vision, and key elements. It projected the allocated budget over a 10-year period and allowed us to earmark sufficient amounts for renovations and equipment purchases.

Our business plan is used on an ongoing basis as a guiding document and the budget is reviewed yearly by the BioBank Oversight Committee, a committee in charge of the direction of the BCCHB. Some adjustments have been made over the past 3 years especially in the area of personnel, in which more resources have been allocated to the development of the BCCHB database with less resources being used for upper management and the cost of the physical database itself. The finance team at the BC Children’s Research Institute (formerly the Child and Family Research Institute) also monitors how we are managing our finances on a quarterly basis.

Our BioBank has two main components (1) general biobanking and (2) principal investigator (PI)-driven biobanking services, including collection, processing, storing, and consenting. The latter has proven to be a significant source of income and recognition and our challenge will be increasing our income and recognition for the general biobanking arm.

How do you define the utilization rate for your biobank? What is the target rate for your utilization of biospecimens and are you meeting your target(s)?

Our biobank has two arms of operations;

- (1) General biobank: It takes time to build a bank that has the number and scope of specimens useful for researchers. In the first and second years combined, we had only four requests from researchers for which we could provide specimens and data from the general biobank. Although this utilization rate is lower than we would like, we are currently seeing an increase in requests for specimens. Our goal for this year is to bring more attention to the general biobank and promote this resource by engaging investigators further through presentations, town hall meetings, and one-on-one conversations with individual researchers to determine future research needs. We will then aim to accommodate investigators’ specific requests.
- (2) PI-driven research: In the first and second years combined, we supported 17 different investigators by providing them with services for their research. The services for these projects have provided us with 30% greater income than we anticipated for the second year, so it has been a good source of income. We encourage PIs to obtain a general biobank-specific consent in addition to their study-specific consent so that specimens

that are left over after their research studies can be transferred to the general biobank instead of being discarded. We believe that this arm will definitely help to develop more useful cohorts of specimens for future research.

Overall we are on target in terms of utilization.

How do you market your biobank and what are the most important marketing activities? If appropriate, include any successes you may have experienced reaching a new customer base through your marketing.

Marketing biobanks is challenging and time consuming. In terms of marketing to investigators, we have mainly pursued as many local opportunities as possible, whether this be clinical rounds or scientific venues. We always encourage potential users to discuss their needs and the collections they would like to be available. We try to accommodate these requests whenever possible.

We have developed a website (bcchbiobank.ca) containing information about the services we provide and the application procedure for researchers as well as information about “what a biobank is,” consent forms, biobank publications, and a list of research projects that we are supporting for participants and other interested people. We send quarterly newsletters to our participants that feature stories about biobanking, including the research the BCCHB is supporting as well as patient stories. Links to these newsletters are posted on various institutional newsletters/communications.

We are in the process of developing a data dashboard that will run periodic reports of the specimens we have in our biobank, and these will be posted on the website. We hope in the future that investigators can have access to this dashboard and search the resource themselves.

I think the best marketing for our biobank has been word of mouth with content users spreading the word. We have not done any formal marketing as such.

How sustainable is your biobank today?

Today our biobank is on track for sustainability, given the business plan projections and current financial status. However, in this year of operations (year 3), our business plan predicts \$250,000 as income from other grants. Given the current lack of grant funding opportunities for biobanks, this is unrealistic and we are currently working on identifying other sources of income, including institutional support to mitigate the risk of not being able to acquire grant funding. We are in deliberations with our campus institutions to determine the feasibility of establishing ourselves as a core facility within the research institute. This would mean revising our sources of income as established in the business plan.

What key success factors and/or challenges in your operational, financial, and social sustainability have you experienced?

The key successes have been a strong, transparent, and inclusive governance structure involving many key stakeholders who have become advocates for our biobank. I think that these advocates are the key to success as the promotion by these individuals is exponential. Our biobank also has a

team of people who are very passionate about what they do and are extremely diligent in ensuring that specimens are processed carefully and quickly. This means that we have great customer satisfaction. The provision of services has also really helped establish our biobank.

Lastly, our donors have shown great interest in participating in research and the biobank allowing many valuable specimens and data to be stored and, therefore, making the BCCHB a unique and valuable resource.

I believe that setting up a biobank requires patience and perseverance. Gaining acceptance from the research community and clinical staff will take time and hard work. Many investigators still have a preference to have full control over their specimens. There is also some concern about the cost associated with obtaining specimens from a biobank. Our cost recovery fees are based on the fee calculator tool developed by the Office for Biobanking and Education and Research. I believe educating researchers on the actual costs of obtaining consent and processing specimens will result in a better understanding that using biobank specimens is a cost-effective way to obtain specimens and clinical data for research purposes.

Although our consent rates are very good and we receive a lot of positive feedback from participants, some clinical staff are still reluctant to approach potential participants for consent. I believe with better education and information of the public on the benefits of biobanking, the voice of participants will get stronger, allowing this barrier to be removed.

We continue to promote biobanking as an ethical, cost-effective, and most importantly participant-centered way of obtaining specimens and clinical data for research.

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The SAHFOS Plankton Biobank, Plymouth, United Kingdom

Please provide a short description of your biobank, type, and who your biobank serves. Please include how your biobank is funded in this description.

The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) is an internationally funded independent research organization responsible for the maintenance of the SAHFOS Plankton Biobank and operation of the Continuous Plankton Recorder (CPR) survey. The SAHFOS Plankton Biobank is a collection of more than 250,000 formalin-fixed silk filters, each representing $\sim 3 \text{ m}^3$ (3000 L) of seawater filtered during a 10 nautical mile tow by a CPR. As a large-scale global survey, it provides the scientific and policy communities with a basin-wide and long-term measure of the ecological health of marine plankton.

Established in 1931, the CPR survey is the longest running and most geographically extensive marine ecological survey in the world. It has an archive of preserved samples dating back to 1964 largely from the North Sea and North Atlantic, although increasingly from the global ocean, including the North Pacific, Southern Ocean, South Atlantic, Mediterranean, and Indian Ocean. In addition, there is a considerable database of marine plankton and associated metadata dating back to 1931 that is used by researchers and policy makers to examine strategically important science pillars such as climate change, human health, fisheries, biodiversity, pathogens, invasive species, ocean acidification, and natural capital.

Funding to maintain the SAHFOS Plankton Biobank and run the CPR survey comes from a portfolio of research council national capability and UK government department sources; international governments, research grants (the UK and international), foundations, company consultancy, and training and education. The majority of this funding supports CPR survey logistics and research activity. Maintenance of the SAHFOS Plankton Biobank is currently a minor part of the overall business and our strategy for its commercial exploitation is still in its infancy.

When did you develop a business plan for your biobank? Do you think the timing was appropriate and how often do you update it? Please note the key points you have included in your business plan. Do you have a specific person/group at your organization that is charged with the development/maintenance of your business plan? Please elaborate.

The plankton biobank business plan is currently in development. Before now, the physical archive of filters (the biobank) was not recognized as an exploitable resource because the strategy was to exploit data obtained from microscopic analysis of the plankton collected on the filters. Company Intellectual Property was seen (and is still seen) as the database of temporal and spatial plankton taxonomy that is used by researchers globally. With a new director only recently appointed, the onward strategy is to continue utilizing and expanding this database, but also investigate ways of exploiting the physical archive.

One challenge is that archive contains formalin-fixed samples, each containing varying degrees of fragmented DNA (particularly in old samples). However, with advances in DNA extraction and sequencing technology, we are now able to reliably extract DNA, which can be archived in parallel with filters and made available for downstream analysis. The plan for this new part of our business is to make this new biobank available to researchers. With increased interest on the impacts of climate change, we believe the SAHFOS Plankton Biobank will have a wide utility. The business will require initial infrastructure investment to create appropriate molecular biology laboratory space and storage facilities in addition to IT infrastructure to create e-commerce functionality, which will provide a better business footing for tracking sales, customers (through a customer relationship management [CRM] system), and report generation. Through integration with our updated website, it will also vastly improve the customer experience through easier search functions, ordering, data availability, marketing, educational material,

blogs, and social networking. This initial period of investment is predicted to take 2 to 3 years to realize from planning (where we are now) to eventual fruition, where we will be in a position to open the biobank for business.

At SAHFOS, we have a Director of Business Administration who will coordinate the business plan, a process that is directed through a management team by which each member is responsible for aspects associated with governance, finance, and administration; data management and instrumentation; laboratory management; logistics and operations; human resources; and outreach and marketing.

How do you define the utilization rate for your biobank? What is the target rate for your utilization of biospecimens and are you meeting your target(s)?

Although we have not determined the utilization rate yet, it will be calculated based on a combination of the outcome of initial market research and known business intelligence from previous trading data at SAHFOS (primarily volume of requests of our plankton data).

How do you market your biobank and what are the most important marketing activities? If appropriate, include any successes you may have experienced reaching a new customer base through your marketing.

A comprehensive marketing strategy is being developed. It will focus on marketing four key areas of revenue for the biobank: (1) website sales of archived material and nucleic acids, (2) research services and collaborations, (3) consultancy, and (4) specific training courses. Key aspects of the marketing strategy include hiring of a business and marketing manager, development of individualized marketing materials that focus on what products are on offer and what science questions it can help you answer, attendance at a range of science conferences as a trade exhibitor, website/social media marketing, and e-commerce (CRM)-targeted marketing.

How sustainable is your biobank today?

This is not applicable to our biobank because that part of the business is still at the inception stage. The CPR survey has been running since 1931, and SAHFOS as a business (which runs the CPR survey and maintains the plankton biobank) was established in 1990 and has wide international support, both scientifically and financially. Development of the biobank is part of a wider SAHFOS strategy to diversify its revenue streams and help ensure long-term sustainability.

What key success factors and/or challenges in your operational, financial, and social sustainability have you experienced?

A key success factor is the diversity of funding we currently receive from an international customer base. However, research funding is becoming increasingly competitive and our scientists spend considerably more time bidding for contracts. One specific challenge we currently face is the uncertainty in the role of EU funding availability after the UK voted to leave the EU in the 2016 referendum. A key

first hurdle will be to attract initial investment for infrastructure to get the biobank started. A solid business plan will be critical to persuade any grant-awarding bodies that this Plankton Biobank is a worthwhile venture and represents a sensible investment in national capability.

SAHFOS scientists regularly publish articles in high-impact journals, hence even as a small research organization (36 staff), our resources are widely recognized and highly respected. From a business perspective, we have a unique selling point in the operation of the CPR survey and this is something we currently market in our promotional material. It will be the foundation for a business plan and onward marketing campaign to promote the SAHFOS Plankton Biobank in the future.

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Recommendations and Discussion

The contributions to this Experts Speak section show that a growing number of biobank operators need to take economic considerations into account. In addition to the scientific aspect of a biobank, the business aspect is increasingly significant and sustainability becomes an essential characteristic of a collection. Economic evaluations and controlling costs are as much a part of operating a biobank as aliquoting and freezing of samples. Funding opportunities in a country are highly competitive and financial resources must be used efficiently and sustainably.

Business plan for biobanking

As with every enterprise, it is advisable to develop a business plan for a biobank before starting, but at least during operation as a tool for strategic and operational planning. So what are the required steps leading to a business plan for biobanking? The first step is a breakdown of the planned workflow and finding the right workflow to meet the requirements of the facility, respectively. What do you intend to store, what is the most efficient container format to increase the utilization, how long will a sample stay in the bank, and what is the expected sample traffic? Outlining the workflow gives you an idea about the hardware for equipping your biobank.

Sample capacity and sample traffic: key issues in cost optimization of a biobank

If you plan to put samples away in a tank with the demand to retrieve it in 25 years and your traffic is just a couple of tubes per day, you would not go for a fully automated storage solution to reduce personnel costs. With a sample traffic of a couple of 100 tubes per day for the next few years, you could consider the higher initial costs for automation because the personnel costs would be the highest running costs and adding automation can reduce the overall expenses by 30%. A second, very important, feature of a biobank is the total sample capacity while keeping the filling level of all tanks as high as possible. With a storage

site occupancy rate of around 75% per tank, a 10 times increased tank capacity decreases the costs per sample and year by also 75%. Considering a different labware manufacturer is an opportunity to lower costs also. For example, there are low and high profile tubes in the market with the same volume capacity, but because of the height difference between the tubes caused by lower caps, you can increase the sample capacity in huge storage devices holding 400,000 tubes by more than 30%, up to 535,000 tubes. This lowers the storage costs per tube annually by around 25%. The tubes should be high-quality products to enable them for reliable operation in automated systems and to maintain the samples securely for decades.

Flexible growing biobank and automation

As you usually do not need the full capacity from the very beginning, you can start with a modular system growing in accordance with your capacity needs. If the sample traffic starts to expand and you need to reduce the handling time, a modular system allows you to add automation components to keep the most efficient procedure. From outlining your workflow, you can define your key requirements for your biobank project such as capacities, level of automation, and necessary additional requirements for freezing and handling samples. This gives you the initial costs of the system as well as a good base for estimating the running costs for the next years.

Sample quality—your best marketing instrument

The second step is the comparison between your costs and the available funding. If the funding is not sufficient, you can either adapt the workflow to reduce hardware requirements or you can try to acquire new financial resources or an improved concept for cost recovery if you are going to provide samples from your collection to other facilities and researchers. This will lead you to the demands of marketing. There is a growing market for providing adequate storage of scientific samples to allow generation of income to support keeping the biobank operational and contributing to the funding of annual costs. High-quality storage solutions with a high degree of automation at the lowest temperatures within an uninterrupted cooling chain support successful marketing to offer valuable samples to the market and charge for the outstanding quality. Higher initial costs for state-of-the-art devices can help to generate higher revenues during running time and to reach sustainability. Therefore, marketing becomes an essential pillar for the business plan of biobanks and biobanks operated not only by profit-orientated companies but also by public facilities, thus they need concepts and structures to offer their services.

Within the coming years, we will see more and more tools for systematic economic analyses and control in biobanks, leading to new products and services promoted by new marketing strategies adapted to the special features in biobanking.

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