Cross-cutting Investments

Core Facilities

Core facilities play a critical role in innovation and interdisciplinary science that justifies increased coordination and strategic investment.

Yale makes a substantial investment in core facilities that support the research and education missions of the University. The quality of these facilities is highly variable, and they span all scales of the University. There are University-wide cores, cores that support individual schools, cores that support individual departments, and some that support clusters of faculty laboratories. The funding mechanisms of these are equally variable, with support coming from internal and extramural sources, but all involve some level of cost recovery from users.

The USSC repeatedly heard about the importance of modern and highly functioning core facilities, and the important role they play for innovation and interdisciplinary science across the University. Particularly in the life sciences, we learned that the sophistication of many fundamental technologies has grown to the degree that leading-edge work is now well beyond the reach of individual laboratories or departments. The availability and quality of core facilities are also increasingly prominent factors in recruitment and retention of faculty, and in the review of research proposals. Based upon the input received, we made an effort to identify areas where incremental core investment is needed to advance science on our three campuses. Through that analysis, we discovered several things about organization of the cores at Yale that may be leading to underperformance on a University-wide level relative to the scale of our investment and relative to the efforts of our peers.

- There is no overall campus-wide strategy or source of funding for core investment.
- There is relatively little coordination between the different schools in the development of emerging core technologies.
- Many existing cores have emerged through expansion of local, home-grown, efforts – resulting in a patchwork of services that suffers both from scientific gaps and overlapping/competing service areas.
- Growing out of the lack of coordination, each core has had to develop its own solutions to address basic processes such as scheduling, sample tracking, order processing, staff training, billing, negotiating service contracts, etc.
- The communication of core services to the user community through web sites or other internal communication is disorganized, reflecting both the patchwork organization of our cores and the absence of overall University strategy.
- There is no central inventory of what core services are available at the University, how they can be accessed, what they cost, what are their capabilities, or who to contact.
- In almost every case, cores run a deficit. The magnitude of the required subsidy is a source of concern both for the users and those responsible for running the cores.
- In several key areas, cores lag behind the current state-of-the-art, limiting Yale science and forcing Yale scientists to seek facilities at other universities or forgo good ideas.
- In many cases the cores lack a strategic plan and funding to upgrade their equipment and services.
• In some other important areas, core facilities do not have the capacity to meet the needs of Yale laboratories and/or are not cost effective.

Through our analysis of the Cores at Yale, the USSC also identified features that have led to particularly successful core facilities across our campus and at other institutions. Not every successful Core has all these features, but we observed that these represent best practices.

• Significant faculty involvement in the form of advisory committees and/or faculty director leadership to provide vision, expertise and the innovation necessary to support and advance current and future leading-edge technologies.

• Dedicated, highly qualified staff whose salaries are underwritten at least partially by central support to provide continuity of their employment.

• Substantive consultation is provided at no cost to users, with comprehensive guidance to both internal and external facilities.

• Cores keep abreast of the most current developments in their respective technology, and tailor these developments according to the needs of the community. Development is considered a cost of operation.

• Resources are available for upgrading and replacing equipment from internal or external funding sources.

• Groups of faculty and staff are willing to write successful project and equipment grants to help support the core infrastructure.

All of the priority scientific ideas in the biological and physical sciences (see below) depend upon effective core support. Modern ‘precision’ biology is technology driven, requiring collection and analysis of ‘omics’ data on a large scale. ‘Next-generation’ technologies will define all current and future advances in Precision Medicine, Cancer, Regenerative Medicine, Neuroscience, and Immunology and Inflammatory Disease. Yale’s leadership in these areas will depend critically upon improved and expanded leading-edge Core facilities with continued investment and development. The USSC recommends against making incremental technology investments specific to individual institutes or departments. Rather, as outlined below, Cores at Yale should be considered as part of a larger infrastructure of ‘next-generation’ support for all of biological science that will also serve to bridge departments, institutes and schools.

Yale’s current biological cores represent most – if not all – required technologies at some scale or generation, yet we also recommend greater investment is these resources. Leadership in the big ideas recommended by the USSC, and across the life sciences, will require substantial expansion of this infrastructure and timely adoption of next-generation technologies. One exemplar of the impact this can have is provided by the Yale Center for Genome Analysis (YCGA), which allowed Yale to be at the forefront of whole exome sequencing and to perform the world’s first genetic whole exome diagnosis of a chronically ill infant. YCGA brought leading-edge high throughput genomic analysis technologies under one roof to provide a centralized Yale resource for large scale genomic studies, with substantial faculty involvement, space, resource and personnel commitment – and a significant technology development component. It also included a significant central financial investment. Development of YCGA was a necessary step in the evolution of next-generation DNA sequencing technologies at Yale, superseding several cores across the University that employed outmoded methods. YCGA is a model for how the University should adopt other burgeoning technologies and analytical methods that lie at the heart of modern life science and medicine, including transcriptomics (RNA analysis), mass spectrometry
(proteomics and metabolomics), genomic perturbation (CRISPR), biostatistics/bioinformatics, imaging/image analysis, and single cell biology.

Excellent core facilities are equally essential for Yale to be at the forefront of research in the physical sciences. The Yale Clean Room and Yale Institute for Nanoscience and Quantum Engineering (YINQE) nano-fabrication facilities are essential for the fabrication of samples used in sophisticated devices ranging from chips for optical signal processing to superconducting qubits for Yale's quantum computing effort. Sample characterization via scanning electron microscopy, transmission electron microscopy, atomic force microscopy and other techniques is an equally vital service. YINQE users come from many different departments and areas of research. Another example is the Chemical and Biophysical Instrumentation Center (CBIC), which is a vital resource for chemists and biologists interested in high-quality NMR, X-ray, optical, mass spectrometry and various other biophysical measurements. All of these cores have achieved their success through the efforts of expert and dedicated staff working in cooperation with faculty committees. But even in these best-case examples, there continues to be a need for instrumentation upgrades, adoption of new technologies, and better communication and coordination across the University of its core services.

We offer the following recommendations to improve and expand the support services provided through the University's cores. These recommendations apply to all the science Cores on campus.

- Create a position in the Provost's office that has responsibility for overall coordination and integration of the Cores at Yale.

- Establish strategic oversight committees (SOCs) for Yale Cores in the life sciences and physical sciences, each comprising 5-8 faculty who represent the highest level of science. Charge the committees with formally evaluating core technologies and aligning Core development with current strengths, respective needs, and strategic interests of the University – noting that Cores should not strive to be comprehensive, but should be excellent and well-staffed.

- Conduct an inventory of all Cores available across the University on all three campuses – including the types of services offered, equipment available, staffing, pricing, reporting lines, extent of cost supplementation, and other practices. This information should be analyzed for redundancies, gaps, and inefficiencies in the Core services, and for quality.

- Make information about Cores accessible through a prominent, well-designed, and continuously updated website that is visible externally.

- Establish simple, standardized and publicized procedures for appropriate core use by external entities.

- Survey the faculty for their use of Core services, what work they do in-house and what they choose to send to facilities at other universities. Seek faculty input to identify gaps in Core services or emerging services that should be considered for future Core support.

- Guided by the strategic oversight committees and the Provost's office:
  - Establish centralized Yale Cores in areas of greatest impact, associated with recruitment of a faculty-level scientific director with expertise in advancing the relevant technologies, as well as investment in appropriate instrumentation and professional staff.
  - Invest in staffing and instrumentation in strategically important developing cores at the School and/or Department level, ideally in association with faculty recruitment.
• Recognize technology development as an important aspect of all Core facilities, and include this requirement in the funding model.

• New services or equipment should be added to the Cores as identified based upon the Core review described above. For example, several faculty across many fields expressed a need for greater Data Science consultative support (for example see Precision Medicine and Cancer below). Pending the results of the Core assessment, a Data Science core is likely to be an area that warrants investment.

• Scale back or eliminate redundant services, where possible, based upon the Core review.