Case Study:

Expanding collaboration and seeking new horizons in research Keio University

Executive Summary

Keio University aimed to build on its core research strengths to meet the changing needs of society.

Together with Elsevier, the Faculty of Science and Technology launched a research expansion project to identify investigators who could serve as catalysts to increase multidisciplinary collaboration, and to seek new research areas. Using SciVal® Experts and SciVal® Spotlight, Keio University conducted an analysis in partnership with SciVal Consultants from Elsevier.

Professor Kouhei Ohnishi, Director of Research Coordination and Administration in the Office of Science and Technology, collaborated with SciVal's product and analytics specialists over a three-month period to:

- Develop an accurate profile of Keio University's existing research strengths
- Identify university researchers experienced in multidisciplinary collaborations to drive new, successful research partnerships in biomedical engineering
- Seek out researchers to form teams focused on research towards personalized technologies

"The best results are achieved in science when researchers are solely motivated by their own curiosity. Our aim is to create an optimal environment for researchers to pursue their research interests by providing support for collaboration with other top researchers. We want to help our researchers find new subject areas where they can expand their work. Our research expansion project is achieving these goals."

- Professor Ohnishi, Director of Research Coordination and Administration

"Having the right people in place resulted in success for the project. Professor Ohnishi's knowledge of the research and researchers allowed us to understand the implications in the data presented. Elsevier selected the closest matching products and implemented their advanced analysis techniques. Librarians played a critical role in managing the communication as intermediaries throughout the process."

Ms. Midori Ichiko, Chief Librarian of Keio University's Science and Technology Library

Background

Founded by visionary Yukichi Fukuzawa in 1858 as Japan's first modern institution of higher learning, Keio University has established itself as a leader of education and research in Japan, with a comprehensive range of academic disciplines in the natural and social sciences, humanities, engineering and medicine. Keio University has over 33,000 students in 10 undergraduate faculties and 14 graduate schools, with 30 research centers located across the greater Tokyo area.

Since the school's inception, students of Keio have risen to the forefront of innovation in every academic field offered.

Keio University's Faculty of Science and Technology, founded in 1939, will celebrate its 75th anniversary in 2014. The Faculty will commemorate this milestone by carrying out numerous initiatives to advance as a world leader in scientific research, including the research expansion project with Elsevier.

Challenge 1: Develop an accurate profile of Keio University's research strengths

To advance the research base of Keio University and to remain at the forefront in an era of rapid technological and societal changes, Keio University's Faculty of Science and Technology undertook an unprecedented reorganization in 1996 and 2000. The aim was to nurture organic growth within existing research domains.

Since then, the Faculty of Science and Technology evaluates its organizational research and educational effectiveness every five years. This exercise requires a data-driven blueprint of the university's current research strengths and characteristics. The challenge was to gain an objective and comprehensive examination within the context of global research outputs.

Solution:

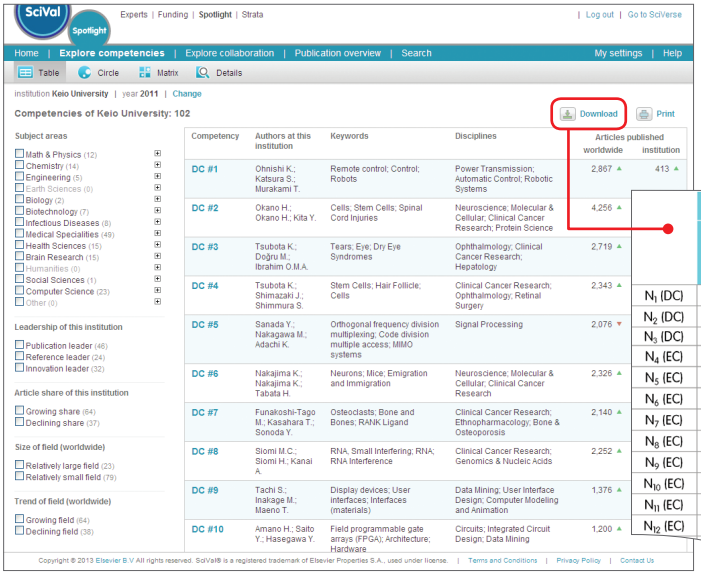
The Research Coordination and Administration Office of Science and Technology used SciVal Spotlight to examine 102 SciVal Spotlight competencies, of which Keio University identified 27 core research strengths. These strengths were classified into four groups of high-level conceptual themes (Human Support, System Design, Environmental Science and Discovery Science) for further analysis.

SciVal Experts was then used to identify all researchers from the Faculty of Science and Technology who conduct research related to each of these groups of core research strengths. Of those researchers, hub researchers who act as catalysts to connect the teams were identified.

Step 1: SciVal Spotlight identified Keio University's 27 core research competencies by matching them against thresholds for six metrics (see Figure 1):

- Average annual growth (worldwide)
- Average annual growth (Keio University)
- Share (%) of articles published (worldwide)
- Keio University's Relative Articles Share against the top institution
- Keio University's State of the Art (index for innovation)
- Interdisciplinary index[i] calculated on the subject area spread of journals within each competency (Herfindahl–Hirschman index: HHI)

$$\text{Interdisciplinarity index} = 1 - \sum_i \left(\frac{\text{Total Number of Published Literatures in Journals of Field } i}{\text{Sum of All Fields for Number of Corresponding Papers in Each Field}} \right)^2$$



	Worldwide		Keio University							Competency
	Articles Published	Growth Rate	Articles Published	Articles Share Worldwide	Growth Rate	Relative Articles Share	Relative Reference Share	State-of the-Art	Citation Count	Interdisciplinary Score
N_1 (DC)	1092	8.61%	46	6.28%	18.80%	2.52	0.86	2.52	181	0.24
N_2 (DC)	1094	12.18%	35	4.81%	5.90%	1.15	0.57	1.35	37	0.45
N_3 (DC)	660	12.32%	12	2.39%	32.88%	1.08	0.12	2.16	23	0.00
N_4 (EC)	626	17.19%	10	2.44%	39.43%	0.71	0.1	0.71	22	0.00
N_5 (EC)	656	6.56%	39	10.23%	20.58%	1.02	0.71	3.12	140	0.71
N_6 (EC)	453	12.34%	12	3.35%	15.15%	1.02	0.09	-2.82	24	0.00
N_7 (EC)	696	7.13%	26	7.25%	26.82%	2	0.71	0.18	75	0.44
N_8 (EC)	1228	1.64%	41	6.81%	31.67%	1.68	1.43	0.36	736	0.44
N_9 (EC)	577	11.73%	65	22.48%	21.95%	1.93	1.32	-0.64	143	0.49
N_{10} (EC)	856	3.99%	20	4.79%	44.63%	1.52	0.58	2.66	55	0.35
N_{11} (EC)	377	38.15%	15	4.96%	-4.89%	0.8	0.5	-0.2	30	0.00
N_{12} (EC)	754	17.16%	12	2.89%	17.98%	0.55	0.17	0.93	140	0.27
	561	3.09%	27	7.42%	41.76%				370	0.73
			17							0.32

Figure 1: SciVal Spotlight competency data was downloaded and matched against predefined thresholds to identify Keio University's core research competencies

Step 2: The core competencies were categorized into the four groups of high-level conceptual themes, which the university aims to strengthen.

Step 3: For each group, the top ten keywords were extracted from each SciVal Spotlight competency.

Step 4: SciVal Experts was used to search those keywords to generate a list of related researchers from the Faculty of Science and Technology for each group (see Figure 2).

Step 5: Using an open source network analysis tool (NodeXL[ii]), two visualizations were developed, one showing the similarity of work between the researchers and the other showing the organic connection of research keywords (see Figures 3 and 4).

SciVal Experts Fingerprints	Researcher 1	Researcher 2	Researcher 3	Researcher 4	Researcher 5	Researcher 6	Researcher 7	Researcher 8	Researcher 9	Researcher 10	Researcher 11
Activities of Daily Living											
Animation		1		1		1		1			
Anthropomorphic robots											
Arteriosclerosis											
Intracranial Arteriosclerosis											
Augmented reality		1		1		1			1		
Bone and Bones											
Cameras		1	1	1		1		1	1		
CCD cameras						1					
High speed cameras						1					
Video cameras			1	1	1	1		1		1	
3T3 Cells											
Bone Marrow Cells											
Cell culture	1										
Cells	1		1	1	1		1			1	1

Figure 2: For each group, researchers were mapped to their research keywords.

"Within the human support group, two key hub researchers were identified. One connected researchers across three schools, and the other was the central connector of his own school. These two researchers played an essential role in creating collaborative research strength at Keio. Without them, robust collaborative research would not have materialized."

- Professor Ohnishi, Director of Research Coordination and Administration

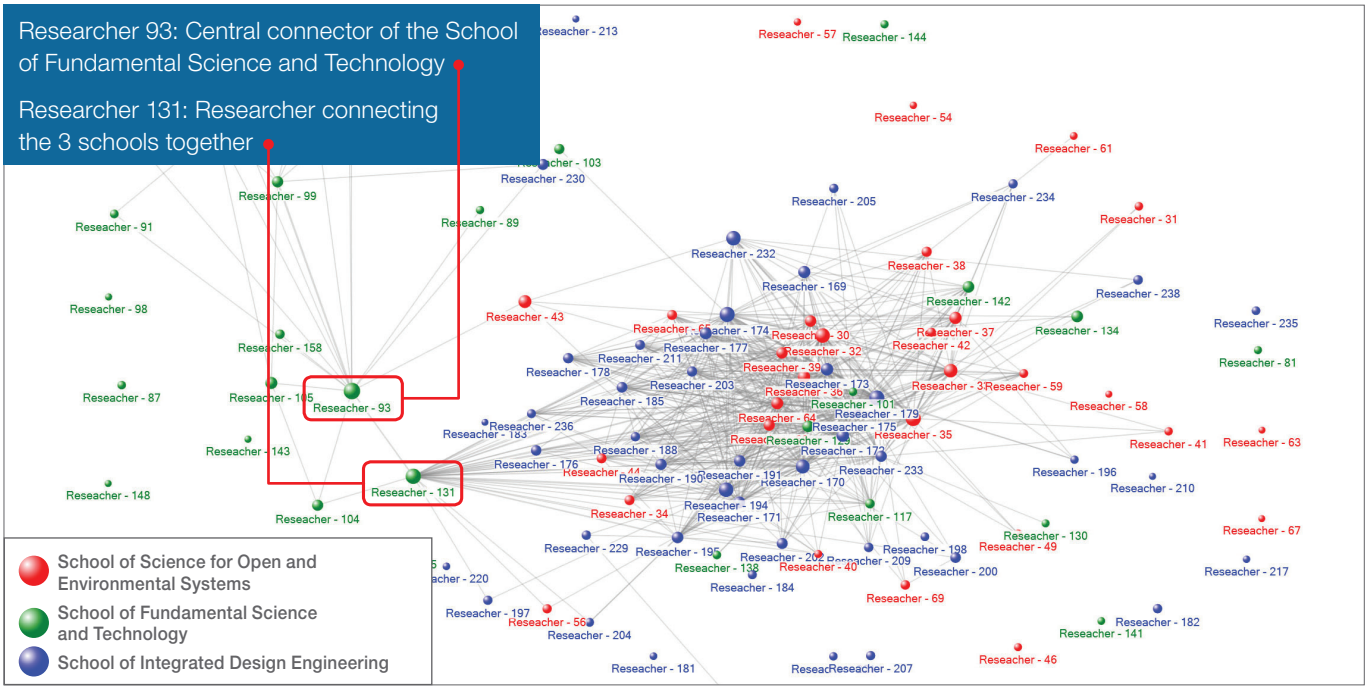


Figure 3: Each node represents a researcher and the lines show their connections based on keywords. The node size is based on the number of keywords matched to each researcher. Researchers with larger node and more connections have strong potential to act as catalysts for new collaborations.

"The keyword network indicates areas where collaborations are happening between technical and medical fields. It also shows potential research topics to further explore. Looking at each keyword and its connections can inspire new ideas. This would be difficult to achieve from a simple list of keywords. The visualization provides a tool to help researchers 'see' opportunities to develop research on new frontiers."

- Hiroshi Fukunari, SciVal Consultant

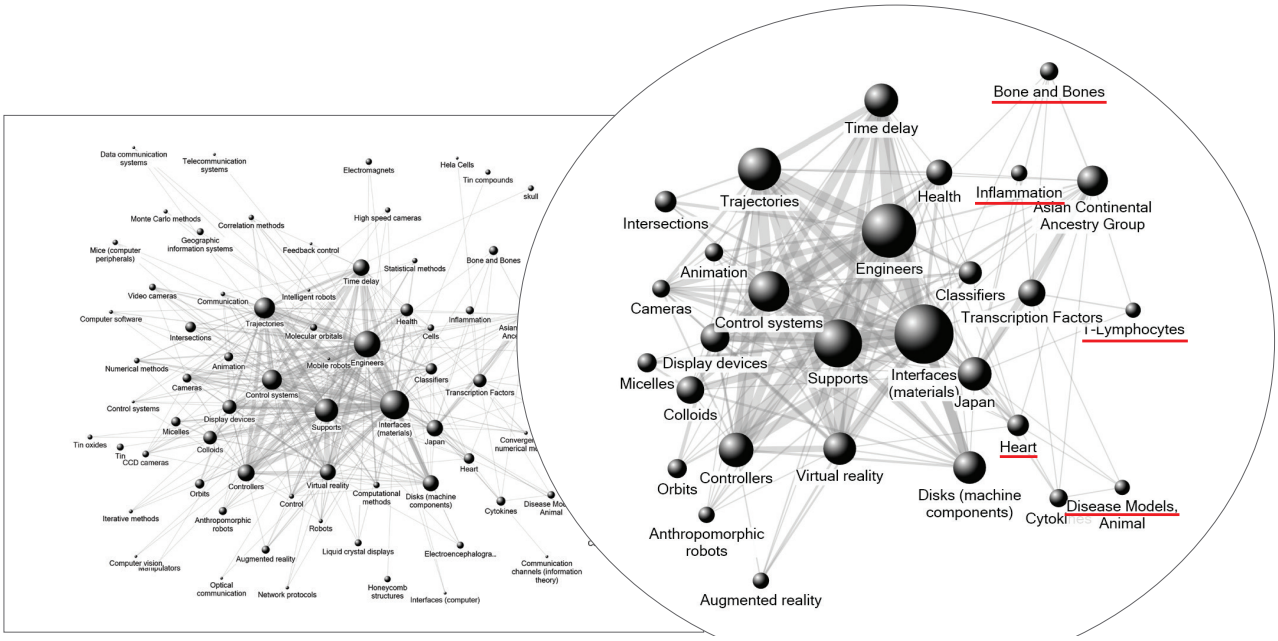


Figure 4: Keyword network visualization of the Human Support group shows collaborations between technical and medical fields. Each node represents keywords and the size shows the number of researchers related to that keyword. The lines show keyword connections based on researchers.

Challenge 2: Identify university researchers experienced in productive multidisciplinary collaborations to drive new, successful research partnerships

In 2007, the Faculty of Science and Technology, Medicine and Pharmacy adopted a strategic plan to accelerate biomedical engineering research, a field that applies engineering and information technologies to develop solutions to medical problems. The objective of this new research effort was to provide cutting-edge solutions to drive the advancement in medical approaches and the changing needs of society.

To achieve these strategic objectives, Keio University needed to identify researchers from the Faculty of Science and Technology who have engaged in biomedical engineering research. The experience of these researchers would help create a bridge between the three departments.

Solution:

Using SciVal Experts, Keio University identified 82 researchers from the Faculty of Science and Technology who have participated in biomedical research collaborations. SciVal Spotlight then identified 100 university researchers with research competencies that include both medicine and science/technology disciplines. Researchers from these two groups have matched or complementary expertise, which can catalyze successful collaborations.

Step 1: To identify Faculty of Science and Technology researchers with biomedical research experience, the SciVal Experts Web Service was used to export co-author information for each researcher, identifying those with keywords "medicine" or "hospital" included within their co-authors' affiliations (see Figure 5).

Step 2: SciVal Spotlight was used to identify researchers outside the Faculty of Science and Technology. Keio University identified nearly 100 researchers from 33 relevant cross-disciplinary competencies that comprise primarily of science/technology and medicine related disciplines (see Figure 6).

Step 3: Then, SciVal Spotlight was used to select the top three authors from Keio University within each of the competencies (see Figure 6).

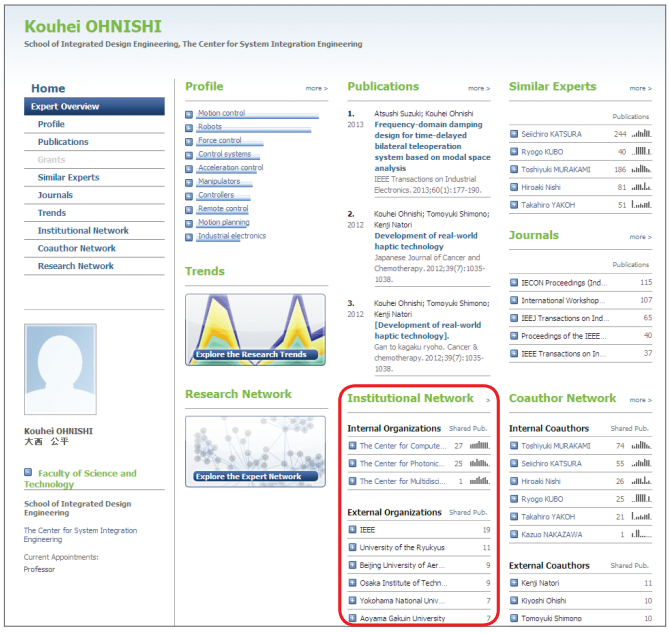


Figure 5: Researchers' institutional networks were analyzed to identify researchers working with medical affiliations.

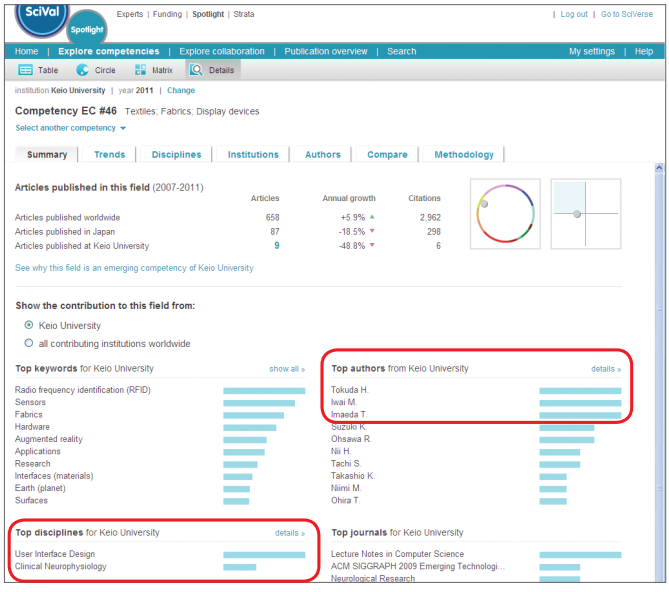


Figure 6: Cross-disciplinary competencies were identified using SciVal Spotlight along with top authors from Keio University.

> "Prior to using SciVal Spotlight and SciVal Experts, the Faculty of Science and Technology identified 23 notable researchers engaged in medicine-related topics. SciVal Spotlight and SciVal Experts increased the base of researchers to provide the university with a wider variety of collaborative research opportunities."
>
> - Ms. Ichiko, Chief Librarian of the Science and Technology Library

Challenge 3: Seek out researchers to form teams focused on personalized technologies

Keio University's Faculty of Science and Technology sought researchers who could advance the institution's focus on research for personalized technologies. Societal need is shifting from standardized, mass produced products to solutions that can be personalized to improve the quality of life of individuals.

Solution:

Using SciVal Experts, Keio University examined the expertise of researchers from the Faculty of Science and Technology who received KAKEN[iii] funding in 2012. The university identified a wide range of researchers for their potential to contribute to research that will help develop personalized technologies.

Step 1: The university used SciVal Experts to examine the top 10 Fingerprints™ [iv] of each researcher and identified concepts that relate to personalized technologies.

Step 2: Those concepts were searched in SciVal Experts to find related researchers from the entire Faculty of Science and Technology.

Step 3: A list of researchers was developed.

Step 4: Following the same approach as Challenge 1, two visualizations were developed to explore the connections among the keywords and to understand the similarity of work among the researchers.

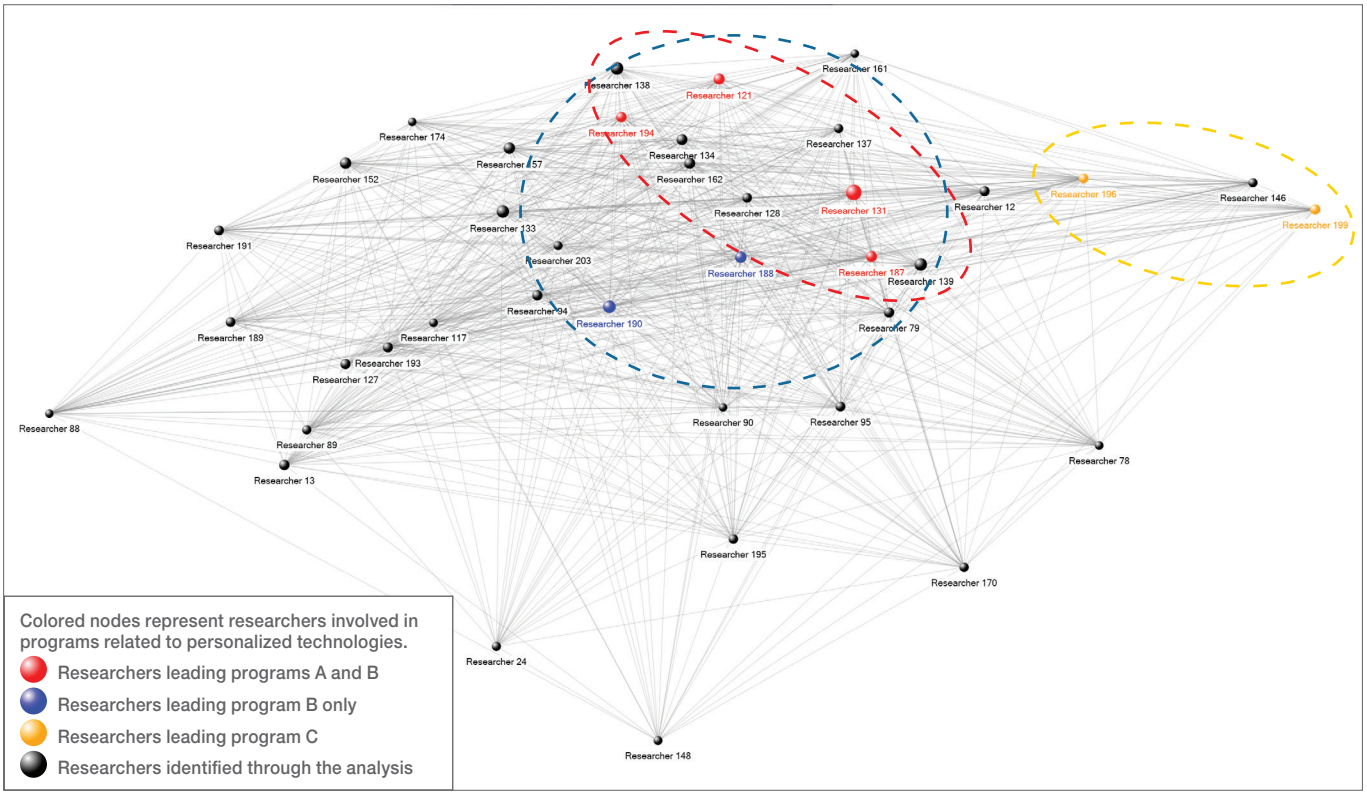


Figure 7: Researcher network visualization shows well-connected researchers and potential collaborators. Each node represents a researcher and the lines show connections between researchers based on keywords. The node size represents the number of keywords matched to each researcher.

"Researchers from the Faculty of Science and Technology who are leading programs related to personalized technologies appear as the key connectors of the network. These researchers will continue to act as catalysts for expanded research opportunities. The visualization also revealed new researchers with potential to join existing programs and expand new and diversified solutions."

- Professor Ohnishi, Director of Research Coordination and Administration

"The keyword network shows the expertise of the identified researchers. There is a cluster being formulated on one side which is the collaborative research output of the existing team members. The other unconnected concepts could be new areas where the Faculty of Science and Technology can look to expand by inviting the candidate researchers to the team."

- Hiroshi Fukunari, SciVal Consultant

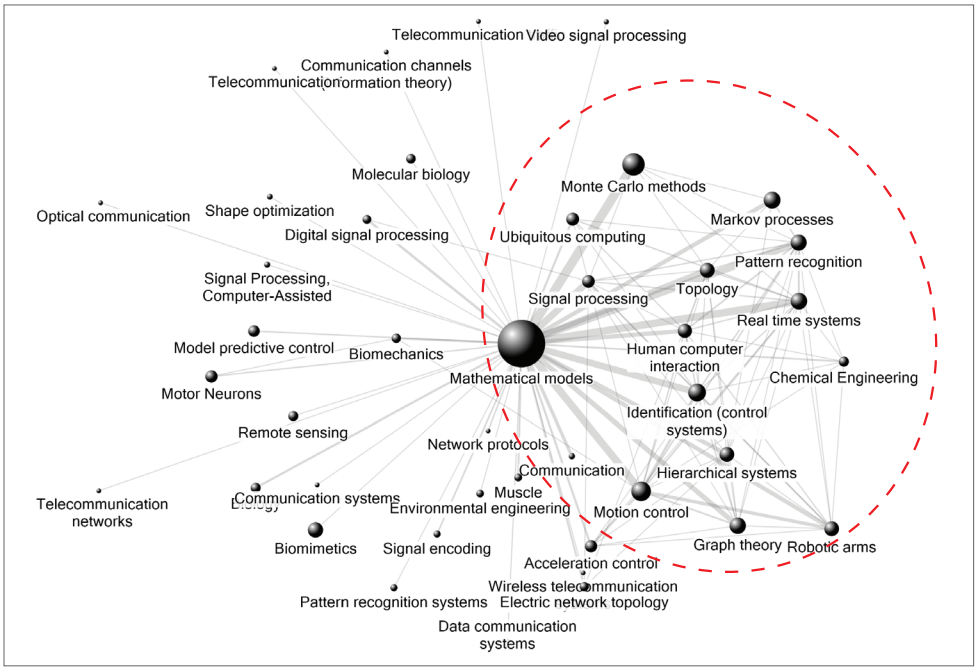


Figure 8: Keyword network visualization reveals expertise within the Faculty of Science and Technology which can be explored to expand research focused on personalized technologies. This can inspire new research collaborations.

Conclusion:

Through the research expansion project, Keio University gained an accurate, objective understanding of its research strengths, which helped the Faculty of Science and Technology make organizational decisions to further strengthen targeted fields. They also identified researchers who can spearhead collaborations in biomedical engineering and can accelerate advancement of research for personalized technologies. Information obtained through this exercise reinforced the importance of effective knowledge management. The project helped the Faculty of Science and Technology understand the significance of the roles each researcher plays within the organization, and enabled the Faculty to identify ways to catalyze further collaboration. Furthermore, through a clear view of the existing organic connection of keywords, the Faculty of Science and Technology provided a tool for researchers to inspire new ideas and to expand their research capabilities.

Keio University's Research Coordination and Administration Headquarter will also reference these data in building strategic action plans that include department reorganization and development of researcher advancement programs.

"It surprised me to learn how much can be defined from the data produced with the help of SciVal Spotlight and SciVal Experts. The analysis is based on publication data only, but it tells more than I expected, particularly the data that helps to identify individual researchers who can best help us achieve our research improvement objectives. These data will deliver results and help us gauge progress in our research expansion project."

- Professor Ohnishi, Director of Research Coordination and Administration

i. Referenced articles: Stirling, A. A general framework for analyzing diversity in science, technology and society (2007) Journal of the Royal Society Interface, 4 (15), pp. 707-719.

Anzai, T., Kusama, R., Kodama, H., Sengoku, S. Holistic observation and monitoring of the impact of interdisciplinary academic research projects: An empirical assessment in Japan (2012) Technovation, 32 (6), pp. 345-357.

ii. NodeXL, an open source software was used to visualize author and keyword networks. nodexl.codeplex.com

iii. KAKEN: A Grant-in-Aid for Scientific Research by JSPS (Japan Society for the Promotion of Science).

iv. SciVal Experts uses the Elsevier Fingerprint Engine™ to mine the text of publication abstracts, and creates a semantic index of weighted terms which defines the text, known as a Fingerprint™. By identifying key concepts from a wide range of subject-specific thesauri, the Elsevier Fingerprint Engine generates terms that represent each researcher's distinctive expertise and enables institutions to look beyond metadata. www.info.scival.com/fingerprint

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