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Managing the NICS Project at the Royal Canadian University

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EXECUTIVE SUMMARY

This case describes the installation of an IBM mainframe computer at the Royal Canadian University. The goal of the described project was to establish a Numerically Intensive Computing Service (NICS) in order to provide "first-class" computing facilities to the researchers. Due to a number of factors, NICS failed to meet its objectives and the university abandoned the project within the first two years of its operations. The factors that contributed to its failure include: advancements in computing technology and changes in the computing style of end users; political and other non-technical considerations in selecting the system; and the weak and adversarial relationship between the computer center staff and the senior university administrators. These factors, with a special emphasis on organizational issues, are discussed throughout the case. At the end of the case, the reader is invited to provide solutions for managing the current failure situation and minimizing its negative consequences.

BACKGROUND

The University

The Royal Canadian University (RCU)[1] was established over 70 years ago. It is currently one of the largest universities in North America and employs about 2,000 faculty members in more than 100 academic departments, schools, and research centers. More than 30,000 students are currently enrolled at RCU. RCU's annual revenue exceeds $300 million. Provincial government subsidies and research grants account for about 85 percent of RCU's revenues and student tuition constitutes the remaining 15 percent. RCU considers itself one of the premier research institutions in North America. Currently, the university receives about $100 million annually in research grants and contracts. About 100 spin-off companies, with more than $700 million in annual revenues, have been established by RCU to market technology and know-how generated by its researchers.

RCU's administration structure includes the president, the chancellor, the board of governors and the university senate. The president of the university is RCU's chief executive officer and is responsible for overseeing its entire operations. The chancellor is elected by the university community and represents the university on official occasions. The 12 appointed and elected members of the board of governors are responsible for the administration of RCU's property and revenue. The senate, which has more than 60 appointed and elected members, is responsible for the academic governance of the university.

The daily operations of the university are managed by the president, five vice-presidents and

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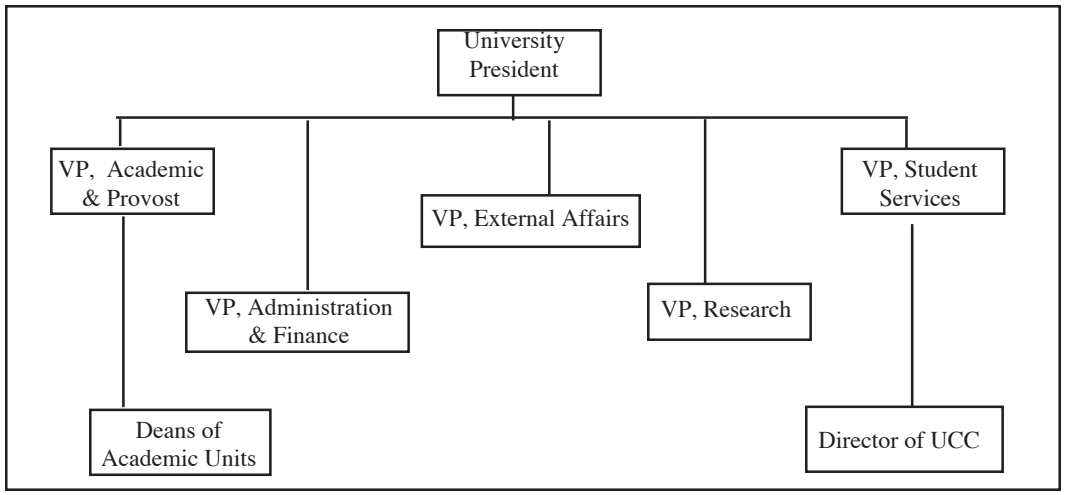
Figure 1: RCU's Organizational Chart



twelve deans (see Figure 1). The Vice-President (VP) of Academic and Provost oversees the operations of the academic units of the University. The VP of Administration and Finance oversees many of the administrative departments of the University, including Finance, Human Resources, Plant Operations, Security, the Bookstores, Planning and Development, and Purchasing. The VP of External Affairs is responsible for all external university relations, fundraising and development. The VP of Research oversees the research activities of the University and manages the relationships with grant agencies and private research organizations. The VP of Student Services oversees many of the support operations of the University, including the Registrar, Athletics, Computing, Telecommunications, Housing, Libraries, and Student Services.

History of Computing at RCU

In the mid-1950s, the university president established a committee to assess the university's interest in "computing machines and the study of automation in general." After a review of RCU's needs, the committee recommended the purchase of a computer for academic use. Contributions from local organizations in exchange for future computer usage were sought to help pay for its cost. A number of local firms declined the university's request because they did not see a reason for using such a machine! One of them even replied that "with reference to your letter of August 20th, I confess that I am unfamiliar with the electronic computer and its possible uses." Despite this lack of awareness in the business community, RCU managed to raise $20,000 in contributions from local organizations and acquired its first computer for $60,000 in 1957. This computer was an Alwac III E, a first generation, single-user computer capable of performing 250 instructions per second. This was among the first installations of computers in Canada. As expected, the Alwac III E became very successful soon after its installation. In its first two years of operation, it was used by more than 25 university departments and 16 outside organizations.

Due to the increased demand for computing services and the introduction of newer, more powerful machines, the Alwac III E was replaced in 1961 by an IBM 1620 computer. These two trends, the introduction of more powerful machines in the marketplace and the increasing demand for computing services, continued to play a key role in the university's computer purchasing decisions for a number of years. By the early 1990s, RCU had acquired ten new machines, each providing two to 15 times the computing power of its predecessor. These frequent computer purchases were made necessary by RCU's annual increase in mainframe usage, which is estimated to be about 20 percent.

The arrival of the first computer in 1957 was accompanied by the creation of RCU's first computing center (CC). The center was developed to support the computing needs of the academic community. A director (who later became the president of the university) and two computer

programmers were hired to staff the center. The responsibility for overseeing the center's operations was assigned to the Provost. This center continued to operate as the sole computing facility at RCU until the mid-1960s when the university acquired its first computer to support its administrative services. At the time of the purchase, RCU established a separate data processing center (DPC) to support its non-academic staff. DPC was placed under the responsibilities of VP of Finance.

Since the establishment of DPC in the 1960s, the organization of computing services at RCU went through a number of structural changes. In 1980, the two centers were merged. In the Fall of 1984, the university decided to put renewed emphasis on administrative computing and the academic and administrative computing operations were again reorganized. The administrative systems staff were moved to a new department, Information Systems Management (ISM), under the supervision of VP of Finance; the academic computing services were moved under the supervision of a newly appointed VP of Student Services (who received a mandate for improving the university's computing and networking facilities). In 1990, after an internal review, RCU's administration again restructured its computing services. The CC and ISM were integrated into one department, University Computing Center (UCC). At the same time, all network related services (data networking, cable plant and telephone services) were moved to a newly established Data Network and Telecommunications (DNET) department.

By the early 1990s, UCC grew to include over 100 staff (three management staff, 52 programmers and analysts, 42 operations staff and seven administrative clerks). The staff was organized in several groups: Office of the Director, Academic Operating Systems, Administrative Operating Systems, Educational Services, Computer Operations, Statistics and Numerical Analysis, and Applications Support. The annual budget for UCC was about $6 million; $3.2 million were spent on salaries. Until recently, these funds were directly allocated to UCC as a line item in the university's overall budget.

UCC received input and direction from both the users and senior administrators. User input was received through a committee, the Campus Advisory Board on Computing (CABC). CABC was established in 1968 to "discuss and comment upon future plans and communicate feedback concerning the operations of the center." The interface between UCC and senior management was implemented through a direct reporting relationship between UCC's Director, Bob Lewis, and the VP of Student Services, Dr. John Parker. The relationship between Lewis and Parker was not a close one. This was reflective of the adversarial working relationship and politics between UCC and the university administration in general. The senior administrators viewed UCC as an auxiliary service and treated it as a cost center. Their main concern was to reduce its costs. The management of UCC was assigned to technical people who lacked the political power and leadership abilities to alter these negative perceptions and attitudes towards UCC and its services. A staff member commented on this issue:

> The VPs that we reported to did not have a good understanding of what was involved. They had a very high level overview of what was happening. I don't think they had a good understanding of really what was involved in providing a computing environment for either academic or administrative computing. They were not familiar at all with the center's operations. I think this low level of involvement was typical in industries that the computing side was still seen as black magic. Computing services were really only understood by people doing it and by key user groups because they were very aware of what was involved. I don't think senior management ever understood our operations. Indeed, the planning, the execution, the operation of computing services was all done by the technical people alone.

SETTING THE STAGE

Until the late 1980's, UCC enjoyed a somewhat monopolist power as it was the sole provider of computing services at RCU. All computer-related funds were centrally allocated to UCC which decided which systems to implement and which services to offer to the users. This monopolist advantage of UCC, however, was eliminated by two recent changes.

The first threat to the power of UCC was caused by changes in the hardware industry.

Specifically, the introduction of RISC-based[2] computers into the marketplace made it possible for smaller organizational units to acquire their own relatively inexpensive and powerful computers. The introduction of these new computers created quite a concern in the computing industry, which up to that point was mostly dominated by large mainframes centrally located and administered in corporate IT units. For the first time, serious departmental users of intensive computing were able to gain access to powerful computing facilities without having to purchase a mainframe or subscribe to a centralized organizational computing service. However, as this new technology represented a dramatic shift from the traditional, well-accepted "big iron" approach and the RISC technology was not yet proven as a robust alternative to mainframe-based computing services, there was some uncertainty about its eventual success in the marketplace. Some computer experts felt that mainframes and supercomputers would continue to dominate the intensive-computing niche of the market; others felt that the newer RISC-based machines would be able to erode the virtual monopoly of the mainframe and push the industry towards an alternative, decentralized-model of computing.

In addition to the challenges created by the introduction of the RISC machines, UCC faced additional pressures from RCU's administrators who unilaterally decided to decentralize the allocation of computer funds. The administrators felt that this decentralization of resources and decision-making authority would improve the quality and reduce the cost of the computing services at RCU. The president's office strongly supported these changes because "a decentralized budgetary model encourages users to make informed choices as to which type of equipment or service is most effective, desirable and affordable for their particular needs." Under this new plan, the various academic units (instead of UCC) would receive annual allocations of computing funds. In turn, these units would have to pay UCC, based on a charge-back policy, for all the computing services they receive from it. To further increase the efficiency of its operations, UCC would be required to recover all computing-related investments through charge-back fees. This decentralization of the computer funds was gradually implemented. During the first year of this model, only ten percent of the funds were allocated to the academic units. Eventually, 100 percent of all computer funds were allocated to them. One of RCU's vice presidents explained the rationale behind the move to this decentralized model of computing:

> It was a time of change and it was not easy for anybody but with the president being as sort of strong-willed as he is, he felt, and I agreed with him, that decentralization in the longer term was the best bet. It gave individual units choice of what they wanted to do. And the argument that I used to hear was that there would be a lot of unused MIPS sitting on people's desks if you decentralized it. So, if you take the global view of the university there is a lot of redundant capacity and therefore you can have economies of scale by having a central machine and that's a traditional argument. But then my response to it was that if I drive on a highway I see a lot of redundancy with cars having only one passenger. And the reason why we tolerate that one passenger in a car is the individual freedom, flexibility of the people. We felt that we needed to give a similar type of flexibility to our computer users.

UCC personnel expressed strong opposition to this decentralization policy partly because of its potential limiting effects on their discretion and partly because of its lack of involvement in the policy's planning and implementation. One UCC manager commented:

> The decentralization process has been proceeding on an ad hoc basis. Our organization was so uncertain and the critical thing was that the fee for service transition was never outlined in a planned manner. It wasn't clear whether the university wanted us to become fee for service, whether they were going to force us to or not. What was definitely clear was that none of our customers like the idea and the idea was never ever promoted within the university. There was no process by which the university community was involved and could buy into the idea.

Overall, the transition to a decentralized, charge-back system, coupled with the availability of more powerful, smaller computers, which were being acquired by the users independently, had a

negative impact on the perceived power of UCC. This is reflected in the following comment by one of RCU's deans:

> The computing center was technically a very good organization that kind of lost its way in the early 1990s. At that time they were providing less and less of a service. They were becoming less and less relevant to what was going on in our department because the administrative systems were in place and people were using workstations. Computing services has not been a powerful department within the university since they started to decentralize its funding.

CASE DESCRIPTION

Project Initiation

After the introduction of the charge-back rates, a number of science researchers in Chemistry, Physics, Engineering and other disciplines began lobbying the administration of the university to increase the level of computing support that was provided to them. This group of researchers, led by a Chemistry professor, demanded that the established mainframe CPU usage rates be reduced for off-peak use so that researchers with intensive computing needs could perform their computing tasks in the evening hours without draining their research budgets. In addition, they requested that the university seriously consider the purchase of a numerically intensive supercomputer for its researchers. At the time, only a couple of supercomputing facilities existed in Canada. Researchers with a need for such facilities had to independently arrange and pay for access to them.

The president of RCU responded favorably to these initiatives. Off-peaks rates were drastically reduced. Most importantly, the president, who felt that "a first-class university should have first class computing facilities available to its researchers," established a committee to evaluate the intensive computational needs of the researchers. Several researchers and CABC members were appointed to the committee, which was chaired by the VP of Student Services. After considering the needs of the researchers, the committee concluded that the university should indeed develop a large, numerically intensive computer service (NICS). The committee felt that such a facility would be pivotal in ensuring the future success of the university's research endeavors. In response to this committee's finding, the president created a university-wide vendor selection committee, composed by researchers and UCC staff members and chaired by two senior science professors, to identify and review candidate systems for this service and recommend a specific solution to the VP of Student Services for purchase.

Vendor Selection

Due to the uncertainty caused by the introduction of the RISC-based machines and powerful personal computers in the marketplace, the members of the vendor selection committee had difficulties agreeing on a specific system configuration for NICS while preparing the request for proposal (RFP). Some members of the committee believed that the proposed facility should consist of a single supercomputer. Others felt that the university should acquire a number of powerful workstations and connect them using a network. As a committee member pointed out, the selection of an optimal configuration was a difficult task due to the diversity of alternatives and preferences:

> The workstation technology was changing very rapidly and throughout the discussions there were proponents of the workstation solution, the clustered workstation solution, the multi-processor approach as well as proponents of the very expensive supercomputer, CRAY approach. Some felt that the only solution was the purchase of a "big iron." Others were making the decision between doing their intensive computing on a central machine and their own personal computers. They would have runs that would take perhaps days to do on a personal computer but there was no problem in terms of cost once you bought the machine—the cost is fixed. There are no problems in terms of scheduling— you didn't have to worry about anyone else's workload. And because the style of computing was changing, you could, for example, break a problem up into small pieces that they could run a piece overnight and come back the

next morning and look at the results and continue from that point. The change in computing at the time created a big question for us.

Because the committee was unable to specify the exact architectural configuration of the potential service, it decided to let interested vendor recommend specific configurations and products. However, all members of the committee agreed (and so indicated in the RFP) that the proposed service should be a UNIX-based[3] one and should be scalable so it could act as "the beginning of a more comprehensive network-based large scale computing." The RFP was sent to 35 vendors. Thirteen of them responded to it.

The vendor proposals varied greatly, both in terms of computer architectures and processing power. The proposed solutions included super-workstations, mainframes, mini-supercomputers, near-supercomputers, supercomputers and various combinations of these. For about three months, the selection committee met to discuss the submitted proposals and review their technical and financial feasibility. However, the committee was unable to reach a consensus in selecting the "best" proposal due to two controversial issues. These issues related to the scale of the facility (whether the service should be based on a large supercomputer or a smaller machine) and its management (whether it should be managed by UCC or the science department). Due to these disagreements, the chairpersons approached the VP of Student Services and described the difficulties faced by the committee. During their consultations with him, they indicated that two proposals received considerable support but neither of them received the unanimous approval of the committee members. The first proposal was by Cray and it was recommending the acquisition of a Cray XMP-14 supercomputer. This solution represented the most powerful computer among the proposed systems and received the support of a few researchers who believed that a supercomputer was the only way to implement a numerically intensive service. The second proposal was by Convex and it was recommending the purchase of a Convex C220 vector computer. This solution was endorsed by UCC staff members and many researchers who felt that even though C220 was not a supercomputer, it would offer adequate computing power to the users at a significantly lower cost than that of Cray.

During its discussions with the senior administration, the committee was informed that the university was not in a position to purchase the Cray supercomputer due its high capital cost and operating expenses. The committee was also asked to reconsider a proposal by IBM that had rejected during its early deliberations. The proposal recommended the purchase of an IBM 3090 mainframe computer using the AIX [4] operating system. The cost of IBM's proposed solution was about $4 million.

After discussing the feedback of the senior administration, the selection committee reconsidered and rejected IBM's proposal again. The director of UCC and the chair of the selection committee wrote memos to the VP of Student Services indicating that the Convex solution was preferable to IBM's proposal, because the cost of the Convex C220 system was significantly lower than the cost of an IBM3090 even though both systems had comparable levels of performance. The following extract from the UCC's director memo illustrates the reasoning behind his decision:

> The Computing Center recommends that the University purchase the proposed Convex C220 system. The Convex is the superior choice because of its price, software maturity, performance, and ease of installation and operation. The Cray proposal is operationally very expensive and carries too much risk in terms of future cost and installation difficulty. The IBM proposal is too expensive relative to the performance of the computer. In addition, industry observers currently caution against purchase of low-end IBM 3090 computer for economic reasons.

Despite the negative feedback received from both selection committee members and UCC staff, the senior administration of the university continued to express a strong interest in IBM's proposal and engaged in discussions with the vendor to refine it. According to a senior administrator, because of RCU's relationship with IBM, the administration felt that it could significantly influence IBM in improving the terms of the proposal. Indeed, the relationship with IBM was a multifaceted one. RCU was among the recipients of the largest IBM donations in Canada. Also, at the time, IBM was

contemplating the implementation of an air traffic control project (as part of a governmental contract) and RCU was being considered as a candidate partner for this project. A UCC staff commented on the attitudes of the senior administration:

> In the minds of many people, the NICS project was part of a bigger plan. It was part of RCU and IBM's existing and future relationship. At the time, I think the university was relatively predisposed to work with IBM. I recall that at the time we were talking about having a major computer lab out here and RCU was one of the candidate partners for it. The sad part is that lab was tied to some air traffic control bids and it never happened.

The apparent support for IBM's solution was met with strong resistance by both researchers and UCC staff members. They were concerned with the high cost and poor performance of the IBM 3090 computer and the immaturity and instability of the AIX software. As the following comment indicates, they attributed the administration's support towards the IBM proposal to non-technical, political reasons:

> IBM's proposal was not included in the short list of the selection committee, let alone be the top choice. Certainly the opinion of most of us was that [the selection of IBM's proposal] was a decision made at very high levels of the university for political reasons that had to do nothing whatever with the technical suitability of the solution —but had do to with a relationship with IBM. That remains my opinion to this day.

To address the financial and technological concerns raised by faculty members and UCC staff, IBM modified its initial proposal to make it more economically attractive for RCU. According to involved IBM managers, IBM was willing to reduce the cost and risk to the university because it was under a lot of pressure to maintain its market share (which was being attacked by manufacturers of smaller machines) and it wanted to establish itself in the growing UNIX market. IBM's modified proposal recommended a three year large scale computing software joint study with the university. As part of this study, IBM was willing to give RCU free use of an IBM vector facility for the duration of the study, and transfer title of the machine to the university upon its conclusion. It would also waive any license fees for the use of AIX for three years, and offer at least a 50% discount for such fees after the completion of the project. IBM was also willing to provide RCU with an early support plan (ESP) for its pre-release version of AIX for a few months until the product became more robust and commercially available. In addition, IBM indicated that it was willing to assist RCU in securing external funding for the lease payments.

Despite the significant improvements in IBM's proposal, the resistance among the UCC staff remained strong. In an eight-page report to the VP-Student Services, one of the senior programmers strongly opposed the acceptance of the IBM proposal because of its risk. The report listed a number of unsuccessful installations (and some "disastrous" ones) of the IBM 3090 vector facility and stated that the proposed solution offered low performance and high level of software unreliability at a too high price. Other UCC employees voiced their strong opposition to the revised proposal as well. Unfortunately, as the following comment indicates, their opinions did not carry significant weight:

> It didn't do any good saying that we had problems with this system because the decisions were made outside UCC. I don't think any of us had the ear of the president' office. Those of us who said things developed the reputation for being troublemakers. A couple of technical people who had said things at the VP's level were at the point where they were being shut out. They had the reputation as being negative towards IBM and therefore anything said was not being taken seriously. People were basically jeopardizing their own careers by arguing levels about the UCC director. In fact, both of these individuals left UCC because of they way they were treated by the administration.

After considering the new proposal and the recommendations of the committee and UCC, the

VP of Student Services selected IBM as the winning vendor. Many UCC staff members felt ignored and were angered by this decision:

> The original decision to purchase an AIX system was viewed with total astonishment by most of the people on the technical side. They couldn't understand why the decision was made. [That this was a mistake] was extremely clear to the technical people. The trend of moving to smaller machines was not a new trend. It was clear that advances in RISC based systems would have dominated the mainframe market.

Many of the opponents of the IBM solution attributed the selection of the administration to political, non-technical reasons:

> IBM interacts with the University at many levels. It interacts with the university on different kinds of computers and different faculties and different kinds of uses so presumably all these different interactions were taken into account when the final decision was made. The result in the end was that the university decided that when factors other than the price performance ratio that we were looking at narrowly on this project were taken into account, IBM could make a proposal that would benefit the university better overall. That may well be the case. I mean there are other things that come into play when you look at this from the president's office. But I think it is true that the technical assessment was not that we buy an IBM computer.

According to the joint study agreement that was signed between IBM and RCU, the university was to receive an IBM 3090/150S mainframe with a vector facility operating the AIX operating system under ESP.[5] The primary of objective of this study was "to convert the major scientific applications from MTS (a non-IBM environment) to an IBM environment using AIX/370 and the Vector Facility." In a related agreement, RCU was to acquire the hardware through a four-year lease. According to the lease, RCU was to make the following payments to IBM: $400,000 during the first year of the project; $650,000 during the second year; $1,275,000 during the third year; and $680,000 during the last year. According to an IBM executive, this transaction was structured as a lease (instead of an outright sale) because of RCU's concerns about the eventual viability of the system:

> From our point of view as well as RCU's point of view there was a bit of anxiety about whether this solution was really going to make sense given the changes in the industry. Certainly some RCU people questioned whether this was going to be the right technology in the long term, but many others thought it would be a good solution. IBM did everything it could to adjust to the new environment. But, as you may know, when IBM was getting into the Unix area, it kind of stumbled a couple times in terms of the basic boxes it was making.

Finally, IBM agreed to purchase RCU's Amdahl 5860 computer for $165,000. These agreements were supplemented by a standard Government Term Lease Agreement as RCU was a provincial university. This agreement included a "non-appropriation system return clause" that would allow RCU to return the machine if it was not able to receive appropriations of sufficient funds to make the lease payments after making bona fide requests for such funds.

NICS Installation

When the IBM mainframe was delivered to RCU, an early release version of the AIX operating system was installed. UCC staff members tested the system and quickly identified a number of issues related to the performance and reliability of the system. UCC asked IBM to guarantee that it would address 18 specific issues that were identified by its staff during its early testing of the mainframe and software. Included in these issues was the need for a usage tracking software module that would enable RCU to track usage and bill its users.

Six UCC staff were assigned to maintain and support NICS during its pre-release stage. Also, 25 faculty members and their graduate students participated in the AIX pre-release testing. These researchers used the computer for free and reported problems to the UCC staff. A number of bugs

in the system were identified by the users:

> There were a number of problems with the pre-release version of the software, including wrong answers. The Pentium problem all over again. So there would be a situation where they would simply get the wrong answer in very simple situations so it wasn't a complex one in a billion chance that the Pentium was. It was common and it was to the point that one plus one didn't equal two. It was that simple.

Despite these problems, UCC spent a significant amount of energy and resources on getting the NICS service operational. The attitude of UCC's management towards the implementation of NICS is reflected in the following comment:

> Once the decision was made it was our baby. And it doesn't matter if you don't like the baby to begin with, you still have to work with what you have, you still have to offer the services based on resources we have. So I think we took the point of view of doing everything we possibly could to make that system work. We worked with IBM in solving a whole number of technical issues.

Due to bugs in the system, the announcement of NICS was delayed several times. As a result, IBM extended the ESP indefinitely until the system was put into production. To compensate RCU for some of the additional costs associated with these delays, IBM paid $300 thousand to the university. Two hundred thousand dollars were allocated to the science department and $100 thousand to UCC. This allocation upset many UCC staff who felt that the UCC should be the only recipient of these funds (as it was now operating on a cost-recovery basis).

After a number of delays, the usage tracking software was installed and the system was finally put in production about a year after its delivery. According to the usage policy, interested researchers had to apply to the VP of Student Services to receive approval for an account. The usage rates that were established for the service were: $4.50 per minute for CPU usage; $0.50 per MB-minute for memory usage; and $0.08 per MB-day for disk usage. As part of the newly implemented charge-back policy, these charges had to be paid using distributed computing funds or research grants. A project participant described the effects of this policy on usage:

> There were a number of technical problems that meant we couldn't charge for the service initially but those eventually got resolved and at the point they turned charging on, usage dropped dramatically. Basically the system was being used by a whole number of people who simply didn't have the money to pay for computing. Graduate students were using it; some researchers were using it. The assumption that they made going into the project was that there would be funds available for this style of computing. However, as it turned out, the university budgets were being cut, researchers were not getting access to large amounts of grant money, and nobody had the money to pay for the service. At the same time, personal computing was becoming more powerful and affordable. And so from their point of view, the decision people were making was: do I run my programs on my PC or do I do it on NICS? If I can do it on the mainframe for free, then I'll do that. Then I use my PC for word processing too. If I have to pay for it however, I'm going to bring it back and put it on my PC. So, when we actually got the charging operational on NICS, on that particular date, the usage dropped from 100% to less than 7%. In the first day of the service we generated something like $3.87!

NICS continued to be operational with disappointing results. The average monthly CPU utilization for the first six months of its operation was about 480 hours (which is equivalent to about two thirds of the system's theoretical capacity). While the users continued to express their increased need for UNIX-based computing services, very few of them were willing to use NICS. Due to the wide availability of inexpensive RISC-based UNIX workstations and powerful personal computers in the marketplace, most users felt that the NICS rates were too high and a few of them began

purchasing their own workstations and other computers using their research funds.

While NICS was being put in operation, the administration of the university established a new senior administrative position to improve the relationship between UCC and the university (which was further deteriorated by the selection of IBM as the NICS' vendor) and better coordinate the various technology units on-campus. To fill this position, Dr. David Williamson was hired as an Associate Vice-President (AVP) of Information and Computer Systems. As a result of this administrative change, the reporting relationship between UCC and the senior administration was altered. The director of UCC began reporting to Dr. Williamson instead of the VP of Student Services. Dr. Williamson commented on the responsibilities of this newly created position:

> I think the university computing services has always had at RCU, and in fact across the country, a very good reputation as a first class service. The other departments in my portfolio were relatively small and less significant at the beginning, when I started. We sort of expanded their role in a way that made it more integrated over computing and communications. Even though the computing center was quite well respected for what it did, due to changes within the university and in the computing environment in general, the administration saw a need for reorganization and direction and probably for getting on with a different role for the 90s than its role in the past.

Soon after his arrival to RCU, Dr. Williamson became aware of the issues related to NICS. Overall, he was concerned that UCC was losing both political capital and revenue by not taking advantage of the inexpensive RISC technology to offer UNIX computing services to the users (other than the expensive NICS service). More importantly, he was concerned with the ability of UCC to raise sufficient funds from usage charges to meet the next lease payment to IBM. As Dr. Williamson commented, this was a significant concern for him as the UCC budget was severely limited (due to the decentralization of the computer funds):

> My initial awareness [with NICS] had to do what I think was about 300 thousand dollars, or something of that neighborhood, of IBM donations. From what I was told, essentially IBM gave the university that amount because it really hadn't delivered what we had anticipated. I had a discussion with the VP about this. As I dug deeper to better understand the situation, I was getting the feeling that this project was not going to take off. In fact, because we were moving towards a cost-recovery model I was worried that when we eventually put the service in production it would not generate enough money for the next lease payment that was coming up. UCC, which was part of my portfolio, was expected to cost-recover all of its investments and I didn't think that was possible with this system. So, I began examining the issue in more detail and kept the administrators closely informed and involved with all the decision-making.

To address the first concern, the lack of inexpensive UNIX service, UCC decided to offer a second UNIX service using inexpensive RISC workstations to users who could not afford to purchase their own workstations or use the NICS service. To implement this service, UCC acquired a Sun SPARCstation 2 and two Silicon Graphics computers. After considering the acquisition and maintenance costs of these computers, UCC set the general UNIX usage rates. These rates were significantly lower than those of NICS. Specifically, the rates for the general UNIX service were $0.50 per minute for CPU usage; $0.063 per MB-minute for memory usage; and $0.04 per MB-day for disk usage. Shortly after its introduction, the UNIX service became very popular: there were more than 900 accounts on this service, with an average CPU utilization of 670 hours per month. Due to the high performance and low cost of the new UNIX systems, many NICS users moved their accounts to the new service. However, about 75 of them, who needed to use the vector facility and certain AIX-based software on the IBM system, continued to use NICS.

To address the issue related to the financial viability of NICS, Dr. Williamson spent many hours consulting with UCC staff and senior administrators. This was a critical issue for RCU which was

facing the deadline of the third lease payment. At the time, the outstanding lease payments totaled almost $2 million while the market value of the IBM computer was estimated to be about $50,000 (according to the Computer Merchant's Price Guide). The low demand for NICS and the depreciated value of the hardware itself made the continuation of NICS an extremely difficult choice for Dr. Williamson.

CHALLENGES FACING RCU

Issues

Two years after the inception of the agreement and about a year after the introduction of NICS, RCU was faced with the decision of whether or not to continue the service. The timing of the decision was also affected by the preparation of the university's annual budgets, which needed to take into consideration the lease payments to IBM.

If RCU decided to continue to operate NICS, Dr. Williamson knew that UCC's budget would be severely impacted by the lease payments and the lack of revenue. Although abandoning the project could reduce the financial loss to the university, he knew that it would be difficult to convince IBM to accept the system's return. Also, the abandonment of NICS could create a potential public predicament for RCU. Abandoning the service after having paid about $2 million for it and having spent over a year to eliminate software bugs could be a major embarrassment for the university. On the other hand, if the university continued to operate NICS, there would be no available funds for the acquisition of additional RISC computers, further limiting the ability of UCC to respond to the needs of its users and increasing its credibility liability. Furthermore, Dr. Williamson needed to decide whether it was indeed wise for UCC to continue offering centralized UNIX services as RISC machines were becoming less and less expensive enabling academic departments and even individual researchers to acquire them on their own (and therefore reducing the demand for a centralized service).

In summary, Dr. Williamson needs to develop a plan to manage the issues related to the future of NICS while (1) ensuring that the university avoids additional financial losses and a public embarrassment and (2) ensuring that the needs of users for UNIX services are appropriately satisfied. What should he do?

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ENDNOTES

[1] Certain names and other information have been altered to protect the identity of the organization and individuals involved in this case. In all other respects, the case provides an accurate account of the facts. The data presented in the case are based on structured interviews and an analysis of numerous documents (meeting minutes, agreements, memorandums, electronic messages, etc).

[2] RISC stands for Reduced Instruction Set Computer. RISC is a computer processor containing a small set of simple instructions. Such processors are capable of performing faster processing through the use of the limited instruction set, uniform encoding, homogeneous register sets, and simple addressing modes.

[3] UNIX is an interactive, time-sharing open operating system.

[4] AIX stands for Advance Interactive eXecutive, which is IBM's version of UNIX. Even though IBM had just announced the development of AIX at the time, the software was not ready for commercial release and use yet.

[5] This was a single processor IBM 370 Enterprise System Architecture (ESA) machine and was rated at 12MIPS. The vector facility was rated at 10 MFLOPS. It had 64 megabytes of central storage

(the maximum available on this model). Two IBM PS/2-70s were used as front-end processors. AIX's Transparent Computing Facility (TCF) was used to connect these machines so that they appear as a single computer to the end users. Initially, the following software was installed on the NICS: AIX/370 operating system, FORTRAN VS compiler, IBM's Engineering and Scientific Subroutine Library (ESSL), International Mathematical and Statistical Libraries (IMSL), Numerical Algorithms Group (NAG) Library, U.S. Department of Energy Laboratories' SLATEC library, and standard UNIX utilities.

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