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Software Development in Rural Georgia: A New Model for University Partnerships with Industry

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Abstract

In November 2001, NCR's Retail Solutions Division approached Georgia Southern University with a unique opportunity. One of NCR's retail point-of-sale (POS) systems, NeighborhoodPOS, was in need of significant enhancements to remain competitive. Although this application was a valuable piece of intellectual property, NCR's strategic plan called for focusing its own internal R&D efforts on the development of new systems in the self-checkout market. Not wanting to let the NeighborhoodPOS system simply fade away, NCR considered outsourcing the development effort to offshore centers as well as selling the application to a smaller software development company. Both of these options, however, proved less than desirable, leading NCR to consider a third, innovative approach – donating the software (valued at $2.7 million) to a university, which in return, would involve students in course projects and internships geared toward creating the next generation of the NeighborhoodPOS system. Over the last year, NCR, Georgia Southern University, and the State of Georgia have worked together to create a framework within which such a project could take place. This paper describes that framework and the forces that brought it together. Future papers will detail the successes and challenges of this initiative.

Keywords: University/industry partnerships, software development, economic development, outsourcing

Introduction and Rationale

University degree programs that prepare students for careers in Information Systems, Information Technology and Computer Science provide foundations in the theoretical aspects of software development. It is difficult if not impossible in the academic setting, however, to instill a practical understanding of developing large, commercial systems that must not only be quick-to-market, but also professionally tested and easy to use. One of the larger problems facing IT companies that develop software for vertical markets (such as retail, health care, and insurance) is the time to "ramp-up" a new programmer to a state of self-sufficient productivity. Graduates typically emerge from university degree programs with the technical tools and methodologies necessary for success. Understandably, however, most university programs do not directly address the domain knowledge associated with a vertical business. Similarly, the applications used in industry tend to be much more complex than the typical exercises that can be used in instructional settings.

Relationships with industry are often used to offset these problems and extend the educational process. Many universities encourage or require internships to help students bridge the gap between academics and business, and gain exposure to real-world problems. Meaningful internship experiences, however, can be difficult to find -- especially for students attending universities in small towns where information technology positions are limited.

The shortage of internships in our area prompted Georgia Southern University to respond to an opportunity to develop a new model for university partnerships with industry. As will be detailed in the remainder of this paper, the university recently established an innovative relationship with National Cash Register (NCR) Corporation for the purpose of undertaking a significant, real-world software development project. The project involves major enhancements to a retail point-of-sale system consisting of more than one million lines of code, and will be primarily staffed by students.

The benefits to Georgia Southern University for participating in such an initiative are many. By incubating an industry-specific software development enterprise, the university gains in-depth knowledge of the business rules, inner workings and problems of that industry. Faculty gain immediate access to rich resources for both teaching and research. Students gain both an understanding of software development fundamentals and an understanding of a specific application area. Graduates will be more marketable by virtue of having been exposed to problems in a large and complex business information system.

Georgia Southern University also stands to reap financial benefits from this endeavor. The initiative detailed in this paper calls for a portion of the revenues from the sale of the improved software to flow back to the university. In addition to offsetting development costs, this revenue stream could be used to fund scholarships, endow a faculty chair, and establish a Center for Retail Information Technology. Additionally, the success of this project will showcase the credentials of Georgia Southern University and identify southeast Georgia as an attractive software development center.

In this paper, we describe the relationship that has been formed between NCR, Georgia Southern University (GSU) and the state of Georgia. To our knowledge, the undertaking described herein has not been attempted elsewhere, experimentally or otherwise. We begin with an overview of the retail sector, the point-of-sale (POS) market, and the forces that brought this initiative together. We then discuss the business climate in the information technology industry, emphasizing the factors that make this partnership attractive to IT companies such as NCR. This is followed by a description of the roles of various entities involved in this project. We conclude with a summary of the tasks that comprised the initial phase of this project and an overview of the work that lies ahead.

Background: The Retail Industry and the POS Market

The partnership forged between NCR and Georgia Southern University is intimately tied to the retail industry – a key sector of the regional, national, and global economies. The retail industry is strong and growing. Worldwide retail sales are around $7 trillion, with the retail industry employing over 18% of the labor force in the United States (Walter, 2002). In 2000, the retail industry was up 3%, outperforming the S&P Index in most sub-sectors. Retail sales for the state of Georgia totaled over $110 billion that same year, with the retail and wholesale trades making up 24.59% of all trades combined (Walter, 2002). The Georgia Department of Labor projects industry growth of Georgia's retail trade from 1998 to 2008 to be 22.7%.

Store automation, including point of sale systems, represents a major category of information technology based solutions for the retail industry. POS solutions account for almost 30% of retail store automations. Based on industry sources and forecasts, NCR estimates that the store automation market is growing at a moderate pace (5%), with the 2001 revenues for store automation totaling $26 billion. NeighborhoodPOS (NHPOS), the smallest of NCR's point-of-sale solutions, is the focus of this project. NHPOS is a full-featured point-of-sale application targeted for companies whose annual revenue is less than $100 million. It is a parameterized solution, which means that the system can be customized to meet the unique business requirements of individual retailers. The parameterized solution offers virtually all of the functionality found in high-end POS solutions, but in a less complex and less costly implementation.

Key features of the NHPOS application include a redundant totals architecture that stores all key financial totals in both master and backup terminals. NHPOS offers a full range of management reports including both end-of-day and period-to-date reports. In the table service market segment, NHPOS supports up to 800 guest checks, server banking or cashier tendering of checks, optional beverage dispenser interface, optional server key-lock and sign-in, and team servers. NHPOS also supports up to eight logical prep devices, including remote printers and a kitchen display system. In the quick service market segment, NeighborhoodPOS supports a store recall file that allows up to 99 open orders, both counter and drive-through support, scale support for weighed items, and optional kitchen display system with scoreboard interface. NHPOS also includes business logic specific to the check out industry, including price lookup capability for up to 100,000 items, scanning support for multiple bar coding schemes, support for UPC coupons, sales restrictions (e.g., no beer on Sunday), and age audit features.

POS systems represent a large revenue component of NCR's portfolio and constitute an area where NCR has a well-established history of leadership. The market for POS solutions is changing, however, bringing both opportunities and threats to NCR's established position. The POS market is being impacted from several directions. Self-service check out appears likely to displace traditional POS in as many as 7% of the lanes of Tier I and II checkout retailers (Walter, 2002). In addition, competition from ECR vendors entering the POS market is continuously increasing.

NCR must continually respond to market demands and competitive pressures by investing resources in the development of new technologies such as self-checkout. From NCR's perspective, the business case regarding NeighborhoodPOS in November 2001 was clear. Historical and projected sales data indicated that the level of spending required to enhance the NHPOS application as a traditional, NCR in-house program was too large to achieve an acceptable level of profitability over the next planning horizon. However, the NHPOS application as an intellectual asset still possessed significant value for NCR, making it important to find the best possible mechanism for realizing that value.

For reasons that will be detailed in the next section of this paper, outsourcing the development to a third party was eliminated as a viable option. Selling the asset to a competitor was considered unlikely, as NHPOS did not present a business advantage to a vendor who already had a competitive offering. Entrepreneurial companies who did not yet have a competitive offering but wanted to enter the market generally did not have sufficient capital to purchase the intellectual property, develop the enhanced application, and establish a distribution channel. Partnering with a large, established company to license the product and perform the necessary software development work also posed difficulties, as such business partners have similar cost structures to NCR, and thus saw no advantage to such an undertaking.

Donating the intellectual property to a university provided a completely different approach for NCR to extract value from the application. Under such an arrangement, the university would implement the enhancements and agree to license the derivative product to NCR at a preferable rate. NCR would retain the exclusive right to market the derivative product, enabling the university to capitalize on NCR's distribution channel and established leadership position in the industry. In addition to having an enhanced product to sell, NCR would realize an immediate tax benefit for the donation and develop a source of highly qualified graduates to help meet its future employment requirements. The key ingredients for success are a supply of software developers and a source of knowledge of the retail industry. Together, Georgia Southern University and NCR provide these elements.

The IT Business Climate and the NHPOS Initiative

Underlying NCR's willingness to donate the software is the decision not to outsource the development to a third party. To appreciate the potential of the partnership model we have created and the extent to which it may be generalizable to other universities and IT companies, it is important to understand the rationale behind this decision.

U.S. based companies face an increasingly difficult economic problem. The cost of technical resources, specifically programmers and software engineers, skyrocketed during the high tech business boom of the 1990's. Starting salaries doubled (or tripled) for software professionals who were skilled in the right tools and techniques. This was a predictable outgrowth of an economic environment based on unbridled optimism in high technology, and fueled by inflated share prices for unproven businesses. With the business slowdown of the last 18 to 24 months and the events of September 11, 2001, this bubble has burst. As a result, many high tech businesses started in the 1990's have ceased to exist. The ones that remain, along with many in the established high tech business community, have been forced to significantly reduce costs to achieve stability and profitability.

While inflated salaries for programmers and software developers have declined in recent months, a shortage of software professionals continues to exist within the United States. This has kept salaries elevated, particularly in geographic areas such as Silicon Valley, Phoenix, and Boston, where many software development companies are located and the cost of living is high.

Given this situation, many companies struggling to cut costs are outsourcing software development to low-cost centers offshore. A study conducted by InformationWeek shows that 37% of the IT executives are outsourcing application development and/or maintenance activities to offshore service providers. Data from the Technology Alliance for Southern California indicates that over 10% of Southern California's 8,000 software firms are now relying on skilled workers in foreign countries (Ballon, 2001). Nearly one-third of Microsoft's 34,000 employees are now based abroad, with Microsoft owning software development facilities in India and Israel, and a research center in China.

High tech outsourcing centers have existed in India, Ireland, and Israel for some number of years, but the recent upswing in outsourcing activity by U.S. companies has fueled the growth of similar types of operations in Russia, Malaysia, Pakistan, Brazil and the Philippines. The shortage of software engineers in the U.S. notwithstanding, the primary reason for offshore outsourcing of software development is a significant reduction in the cost of labor. In a survey conducted by the Outsourcing Institute, 48% of respondents indicated that reducing and controlling development costs was the primary reason for outsourcing. This was more important than all other potential reasons, including improving company focus, resource availability, freeing resources for other purposes, and access to world class capabilities (Casale, 2001). The salary differential can be quite significant. One company

in the video game industry reported that qualified candidates in the U.S. expect $90,000 per year in annual salary, plus a signing bonus and stock options (Ballon, 2001). This same company was able to hire qualified workers in Russia for about $18,000 per year.

On the surface, it would seem that software companies in the U.S. that do not outsource offshore would be at a competitive disadvantage with those that do. However, the collective experience of U.S. companies that have assigned large projects to these offshore centers indicates that there are hidden costs associated with the outsourcing model. Although direct labor costs are significantly reduced, communication must take place daily on many different levels, particularly during the critical phases of a project (Greenemeier, 2001). Physical distance, vastly different time zones, and language difficulties produce increased levels of frustration. Solutions to problems like these become expensive, often requiring frequent face-to-face meetings, teleconferencing, or relocation of an entire project team. If it can be managed effectively, offshore outsourcing can lead to as much as 25% savings on the total project cost over in-house development or outsourcing to local contract programmers (Greenemeier, 2001). Even when such cost savings are achieved, however, they are often accompanied by a reduction in service that, in turn, leads to frustration and disappointment on the eyes of the stakeholders (Hirschheim and Lacity, 2000).

The fundamental premise of the initiative detailed in this paper is that it is feasible to establish a software development center in rural Georgia at about the same net cost as offshore outsourcing, but with little reduction in service, through an alternate mechanism – the donation of commercial software to a university that then undertakes the development effort. This requires a high tech infrastructure, including but not limited to a source of qualified labor, and an economic stimulus mechanism. The University System of Georgia can provide the former; the Board of Regent's Intellectual Capital Partnership Program (ICAPP) can provide the latter. The lower cost of living and attraction of the small town lifestyle make it possible over the long term to attract and retain skilled software development professionals with salaries in the $50,000 - $55,000 range, essentially matching the overall costs of offshore outsourcing with minimal communication difficulties. Thus, rather than outsourcing information technology tasks to offshore sources, we propose that U.S. companies can affect total project savings of 25% over in-house development or outsourcing to local contractors by building a software development industry in regions such as rural Georgia.

The Role of the University System of Georgia

The common denominator in all of the offshore outsourcing centers is the proximity to technical universities and centers of higher learning. The universities provide a source of trained software professionals and the foundation for building a local technical community. It is much the same with established high tech centers in the U.S. The proximity of the Silicon Valley to Stanford and the University of California, Los Angeles to Cal Tech, and Boston to MIT represents a critical factor in each of these locations becoming an established high tech center.

In Georgia, Georgia Tech is best recognized for playing a similar catalytic role for the development of Atlanta's high tech community. On a smaller scale, other institutions can play a similar role. A number of institutions in the University System offer information systems and computer science degree programs. These programs are oriented toward not only the theoretical grounding of the science but also the practical application of software development skills to business problems. Academic programs provide credible sources of the software development skills required for building an applied software industry. In essence, these institutions are preparing students for careers in programming and software development, as opposed to advancing the state of the art.

Many of these institutions are located in rural areas where the quality of life is high and cost of living is relatively low. Software development in rural areas of the U.S. offers distinct advantages in competing with offshore outsourcing, including virtual elimination of problems caused by language, distance and time zone difficulties. Additionally, many of the technical resources in offshore centers are researchers and scientists who have been forced into the commercial world by the lack of research funding in their native countries. Typically, these developers will return to their passion for teaching and research at the first opportunity. This creates a great deal of turn over and discontinuity in the offshore outsourcing companies.

The Fit Between NCR and Georgia Southern University

The opportunity at hand involves retail information technology, with an emphasis on point-of-sale systems. Successful development of such systems will require software professionals that not only possess knowledge of software development

methodologies but also an understanding of the retail industry. Georgia Southern University is uniquely positioned to produce graduates that meet these requirements.

The Governor and Board of Regents recently funded a new $33 million facility to house a state-of-the-art College of Information Technology. A new Bachelor of Science in Information Technology (BSIT) degree program provides strong, classical grounding in the reference disciplines of information systems and computer science, supplemented by new courses that address evolving information technology topics. A distinguishing and key component of the BSIT is the requirement that students complete essentially a second major (21 semester hours) in an applied discipline, such as retail, supply chain management, or health care. One of the second disciplines approved by the College of IT is in Retail Information Technology. Much of the necessary synergy for this second discipline existed through the long-standing Center for Retail Studies in the College of Business Administration. Having both such a center and a flexible, forward-looking Information Technology program suggests a high degree of fit between the opportunity afforded by NCR and the resources within Georgia Southern University.

The following table outlines some of the courses offered by Georgia Southern that directly address the technical and business skills required for this project. This is not an exhaustive list, but it does serve to further illustrate the fit between the opportunity and Georgia Southern.

Course Number	Course Description	NeighborhoodPOS Skill Need
CISM 2230	Applications Development Using Java	Programming
CISM 3135	Systems Analysis and Design	Re-Architecting
CISM 4134	Data Management	Re-Architecting
CISM 4135	Project Management and Development	Project Planning
CISM 4234	Application Development with Objects	Programming
CISM 4830	Special Problems - Retail POS Technology	Domain Knowledge
CISM 7332	Client Server Computing	System Testing
CSCI 1236	Introduction to Java Programming	Programming
CSCI 1301	C++ Programming	Programming
CSCI 3230	Data Structures	Re-Architecting
CSCI 5140	Software Engineering	Re-Architecting
CSCI 5240	Cmputer Organization / Architecture	Re-Architecting
MKTG 3135	Principles of Retailing	New Requirements
MKTG 4131	Marketing Research	New Requirements
MKTG 4132	Retail Store Management	New Requirements
MKTG 4135	Buyer Behavior	New Requirements

Leverage for this opportunity can be obtained by using the NeighborhoodPOS application for projects, exercises, and case studies in several of the above courses. We are currently piloting this approach in two courses: Software Engineering and Principles of Retail. In the Software Engineering course, students are developing prototypes of utility programs that will be required to enhance NHPOS. Students in the Principles of Retail course are conducing surveys to determine changing POS requirements. We believe that other courses (highlighted in white above) could also potentially employ NHPOS as an instructional tool.

The Role of State Government

One cornerstone of this project is enhanced educational opportunities for students. The other is economic development. To that end, the participation of state government is critical. While NCR and GSU possess many of the elements required for success, "seed money" was required to get the project going. The Intellectual Capital Partnership Program (ICAPP) of the Office of Economic Development of the Board of Regents in the University System of Georgia was chartered to undertake projects like the one detailed herein. It is the mission of ICAPP to promote economic development in Georgia by leveraging the strengths of the University System. For programs such as this one, ICAPP must effectively sell the strengths the degree programs offered by its member institutions in applied software development.

ICAPP has been the catalyst for linking industry partners with members of the University System of Georgia. If a member institution is willing to bid on a project from an industry participant, ICAPP funds can support the initial phase of the project. Our "seed money" from ICAPP for the initial phase of this project was $100,000. It is possible for ICAPP to recover its investment

by receiving a share of the profits that later accrue. However, in this case ICAPP seeks to recover its investment through the IT jobs that will be generated within the state of Georgia by the end of the program.

The importance of the economic development piece to the birth of this project cannot be overemphasized.

Roadmap for the Initial Phase of the Project

As might be expected, a number of discussions have taken place over the last 12 to 18 months to make this project happen. In November 2001, representatives from GSU, NCR and ICAPP began assessing the feasibility of this project. Those meetings involved key executives at NCR, faculty and administrators at GSU, and high-ranking officials in the state government. It is important to note that from its inception, this project had the support of the Provost and President of Georgia Southern University, the Board of Regents, and the Governor of the State of Georgia, as well as the support of NCR executives. Because this undertaking represents an approach that had not been tried before by either entity, this top-level support was critical for success.

All concerned recognized that there were risks. Specifically, carrying out a project of this size with student interns is challenging. The overall project risk, however, was considered minimal. Had GSU had not responded favorably to this opportunity, NCR would have discontinued the NHPOS application. Thus, in the event that the project is not successful, NCR will be no worse off than if the project had not been attempted, and will have the benefit of a sizeable tax write-off. Georgia Southern will have the benefit of using the NHPOS application for instructional purposes regardless of the outcome. The start-up funds provided by ICAPP, however, are at risk. To minimize the financial risks, a gated process is being employed to pursue this opportunity. As with all software development projects, the commitment of funds and resources occurs at predefined points in the process where the scope of the next phase of development can be determined with reasonable accuracy.

The initial phase of this project was primarily concerned with successfully transferring the NeighborhoodPOS application software to Georgia Southern. This included educating the designated team at Georgia Southern to acquire a sufficient understanding of the software to configure and use it in its current state as well as to scope the development effort required to update NHPOS. The following outlines the first steps associated with this project.

Appoint Project Managers: Managers from both NCR and Georgia Southern were appointed to oversee the project. This was a full time commitment (100% buyout) for the faculty member designated as the Georgia Southern project manager for at least the first two semesters of development.

Staff the Project: Students in the Information Systems, Computer Science, and Information Technology degree programs were invited to apply for competitively awarded internship positions on this project. Many of the best students in each of the degree programs responded. We have since hired 11 interns, a full-time co-op student, and a graduate assistant. To provide leadership and establish continuity throughout the project, Georgia Southern also hired a full-time software engineer to work with the students. This position will be funded only as long as the project remains active.

Acquire the Technology: This task involved working directly with the developers of the NeighborhoodPOS application located at NCR's facility in Oiso, Japan. These developers worked with the project managers to gather all of the intellectual property and relevant documentation, including all source code, all object code, any specialized utility routines used in the development or testing of the software, functional specifications, implementation specifications, project plans, team meeting notes, etc. In parallel with these activities, arrangements were made to receive the technology at Georgia Southern. A laboratory facility to house the necessary equipment was established. NCR provided hardware to Georgia Southern for testing and supporting the inherited version of NeighborhoodPOS and for developing the next generation. This included a cluster of terminals for the inherited generation of the software and a cluster of terminals that will be the target hardware environment for the enhanced version of NHPOS. In addition to this specialized hardware, Georgia Southern provided several standard PCs, printers, supplies, and miscellaneous tools to be used for the actual software development.

Educate the GSU Team: One of the most significant tasks in the technology transfer phase of this project has been educating the GSU team in sufficient depth so that they are able to continue NeighborhoodPOS development and successfully complete the next phase. A significant portion of this education was achieved by bringing the Japanese developers to Georgia Southern to provide formal classroom training for faculty, professional staff, and student interns. The remainder of this education process is being completed at Georgia Southern in the laboratory and at the NCR training center in Atlanta, Georgia. This second phase of

the education process consists mainly of actual hands-on use of the current software to include set-up parameterization and operation of the system.

Negotiate Legal Contracts: Attorneys for NCR and GSU have worked diligently to negotiate the necessary contracts and legal documents. The first and most important of these was the Donative Agreement, whereby Georgia Southern took ownership of NHPOS. To minimize project delays, this agreement was developed in concert with rather than prior to the above activities. An important preliminary activity for the Donative Agreement was determining the value of the intellectual property donation. NCR engaged Ernst & Young to conduct this valuation. The Donative Agreement became official in October, 2002. The attorneys are now negotiating a second agreement that spells out the terms and responsibilities for licensing improved products back to NCR.

The Next Step

Upon the successful conclusion of the tasks described above, the development team at Georgia Southern began the actual software development for the enhanced system. The enhancements necessary to make NHPOS competitive include: (1) migration to a touch screen user interface; (2) conversion to retail industry standard I/O interfaces; and (3) migration to the Microsoft Embedded XP operating system. Recent opportunities in Asia have created an additional requirement to internationalize the software for distribution in those markets. NCR's internal estimate for these enhancements (not including internationalization) called for 98 person-months of effort at an average cost of $85 per hour for project management and $60 per hour for software developers. Because student interns cannot be expected to be as productive as experienced NCR developers (and because we will be adding international features), our development effort is expected to exceed 98 person-months, but at a lower average cost per hour.

As noted above, an infusion of capital from ICAPP funded the initial phase of the project (transferring the asset and establishing a project infrastructure). Based on success in the first phase, ICAPP allocated an additional $300,000 to begin the second phase (actual software development). Assuming success continues, funding to subsidize the project through June 2005 is expected. This is necessary to get the project to a self-sustaining revenue generation point.

As the project unfolds, four other sources of revenue will begin to offset these startup and ongoing development costs. Georgia Southern has the option of making modifications to the current software for specific customers on a fee basis while development of the new system is ongoing. Currently, we are making such modifications for the U.S. Customs Service. A second source of revenue will be royalties that accrue from the sales of new versions of NHPOS. Our first minor release is scheduled for release to NCR customers this month. In addition to royalties, Georgia Southern will realize a third stream of revenue in the form of support fees. A fourth potential source of revenue stems from opportunities to provide training to NCR customers. Once the Georgia Southern team has gained sufficient expertise with set-up parameterization and operation of the system, training programs for NCR dealers and customers could shift to the university. Once again, Georgia Southern is uniquely positioned to provide this service -- an executive training center designed to support such programs is a planned feature of the new College of Information Technology facility. These revenues will collectively flow back into the project, funding ongoing investment in research and development. By June 2005 these revenues are expected to be sufficient to support a self-sustaining software development and research center.

[Note: At the AMCIS meeting in August, we will summarize our successes and our failures to date. We will also provide an update on the pitfalls involved in undertaking a project like this, and the potential conflicts associated with incubating a business in a university setting.]

Summary

The partnership formed between NCR, Georgia Southern University, and the State of Georgia is innovative and promising. Georgia Southern graduates will enter the marketplace with strong technical skills, knowledge of the retail industry, and meaningful software development experience; NCR will have a new and improved product to sell; the university will have an established reputation as a software development center; and the region we serve will benefit from an infusion of revenue from the sales of new systems and the creation of high-tech jobs. Perhaps more importantly, this partnership may serve as a model to other schools in the University System of Georgia and beyond who wish to provide their students with the tools and techniques necessary to deal with large and complex systems.

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