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EXECUTIVE SUMMARY

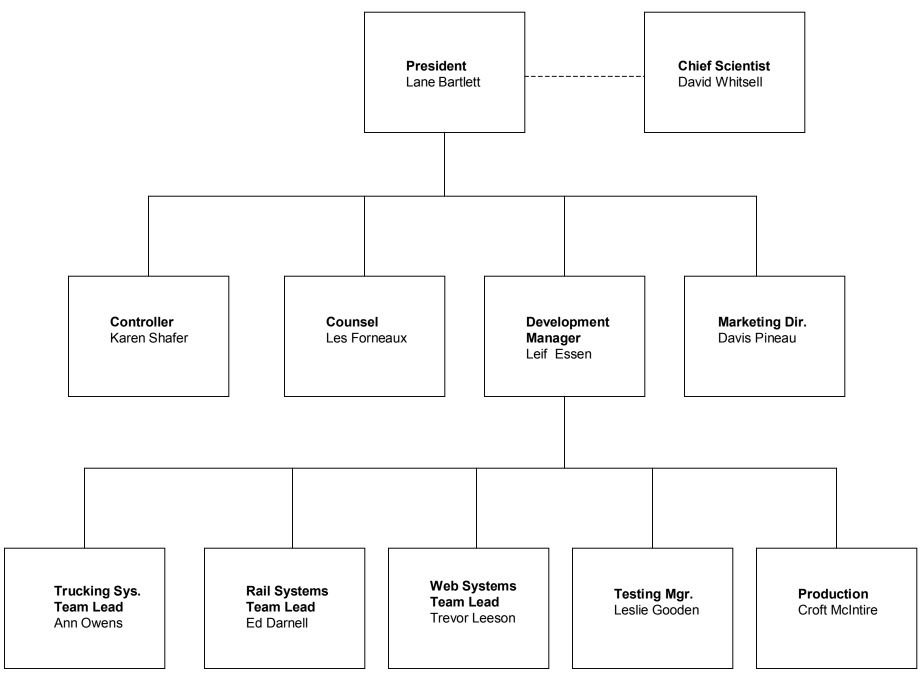
LXS Ltd., a Toronto software house, has identified high market demand for their proposed new product called Estitherm, a Web-based software tool that supports heat loss calculations for architectural engineers designing structures. Estitherm's development requires sophisticated Java programming skills, however, and the project stalls when LXS is unable to hire enough additional programmers to be able to meet the development deadlines dictated by competition. Through lucky coincidence, LXS' Chief Scientist stumbles onto a pool of Java talent while vacationing on the Caribbean island of St. Lucia. Negotiations follow, a contract is signed and the project is quickly brought to successful completion with the aid of Caribbean programmers, working via the Internet. Similar contract arrangements hold the promise for improved economic conditions in Caribbean nations and can reduce software backlogs for companies in developed nations, but better mechanisms are needed to bring together buyers and sellers of IT services.

BACKGROUND

Operating in Toronto since 1986, LXS Ltd. was founded by Lane Bartlett and David Whitsell, two programmers previously employed by CN Railway. At CN, they had been working on a C-language implementation of a freight tracking system that relied on bar code technology. That project bogged down in overruns and was eventually cancelled, but the system's concepts and algorithms had considerable promise, so LXS was founded to produce and market a version of the rail freight system, which was completed successfully in 1988. The package sold well internationally, and LXS grew rapidly.

By 1996 the firm employed about 75 programmers and another 12 people on the support staff, was generating about $26M (Canadian) annually and had successful product offerings in the railway, trucking and warehouse inventory control application areas. Five years later, sales had reached $47M, but the programming staff had only grown to 90 because of the difficulty of finding trained talent in the highly competitive job market. There were an estimated 950,000 unfilled IT jobs in the U.S., and Canada was experiencing similar skilled labor shortages. LXS had added a handful of Web-based applications to its product portfolio, and had organized as shown in Figure 1, below.

Figure 1: LXS Organization



As Figure 1 shows, product development was organized by application areas, with the bulk of the work residing in Ann Owens' Trucking Systems and Ed Darnell's Rail Systems groups. Each group consisted of about 40 programmers, most of whom worked on supporting the successful C-language software packages that accounted for the overwhelming bulk of LXS' revenue. A few of the luckier ones in each group were assigned to designing extensions and refinements for future releases of their packages.

In 1997, the "Web Systems" group was formed to explore Web technology and to develop some small scale product prototypes. LXS had been slow to recognize the potential of HTML technology because Chief Scientist (and LXS cofounder) David Whitsell was skeptical that the Internet would be able to provide the needed bandwidth cost effectively. By early 1997 it was apparent that Whitsell had been too pessimistic, and LXS found itself trying to catch up with the rest of the industry. As part of this catch-up strategy, Trevor Leeson was hired to head the Web group. Leeson had previously been Senior Programming Manager with the Canadian Broadcasting Corporation, which had gone live with one of the first (and best-rated) online Web-based programming guides in the industry. His Web experience included in-depth knowledge of CGI interfaces, PERL and Java, and he was an enthusiastic and visionary cheerleader for Web technology.

Since Leeson was brought into LXS as an outsider, he initially was received coldly, understandably, by the programmers who had been assigned to his new group. Quickly, though, his Scot accent, roaring laugh and sense of humor, and almost nutty enthusiasm for the future of the Web won him respect and cooperation within the group. In addition, he proved himself to be a technical wizard, able to write Java code apparently off the top of his head, with no design support, and make it work right the first time. Nobody else in the group was close to this level of Java ability, so Leeson quickly became a respected leader.

Initially, the new Web group spent all their time attending courses and seminars in order to "tool up" with HTML and Java. They also were sent to an in-depth Windows NT course to understand the architecture, configuration and support of the Microsoft Internet Information Server, as this was the target systems platform for the server-based Internet applications that they proposed to explore for product development.

During this time, Dave Ott, one of Trevor's senior programmers, played a round of golf with Jason Marks, a neighbor and friend. During the round, Marks talked of his problems at work, where he is an architectural engineer for a large engineering design firm. One of the many steps in designing and then obtaining construction permits for commercial buildings requires careful calculation of the thermal properties of the structure. The outside climate, seasonal variation, room dimensions, wall thicknesses and materials characteristics all have a bearing on the heat loss and gain calculations. Each interior space must be carefully studied and complex calculations performed to assure that adequate BTUs and airflow will be available in both heating and cooling seasons. This process is fairly straightforward—the thermodynamics involved are well-understood—but the calculations and analysis are very time consuming. Marks was doubly frustrated because there were at the time, surprisingly, no good PC-based software packages available that automated this design function.

Ott, of course, immediately saw this as an obvious software development opportunity. He arranged to meet Marks the next day for dinner, and they talked further. Marks explained that in the engineering design and construction industries, large design firms such as his compete for contracts to design (but not build) commercial structures. These firms provide a complete array of design services, including design aesthetics, functionality and fitness for purpose, structural loading, survivability, code compliance, electrical and plumbing design, permitting, inspection and HVAC (heating, ventilating and air conditioning) design. The customers of these design firms are contracting companies that actually perform the construction, working under the design guidance of the large engineering firms. The customer contractors range in size from the very small (approximately five employees) to very large firms that are not quite large enough, however, to possess their own in-house engineering design functions.

In the course of the conversation, both Marks and Ott realized that the real marketing advantage of a thermal design software package would derive not from its use in-house by the large design firm. Instead, Marks proposed to almost literally give away the package to the contractors who purchase design services from his firm. This would enable many of these contractors to do initial heat loss estimating on their own, providing their customers with better cost estimates, faster and more accurately. This gesture would serve as a goodwill mechanism that might bring large-scale design business to Marks's company in the same way that giving away pharmaceutical samples to medical offices bootstraps business relationships and contracts. The more they talked, the better the idea sounded, particularly given the void of PC-based thermal estimating software presently available to the engineering design industry.

Dave Ott then prepared a three-page synopsis of this product opportunity and presented it to his boss Leeson, who immediately passed it up the line. Bartlett and Whitsell quickly saw the potential. After only a two-week market-potential study performed for LXS by KPMG, it was clear that the proposed software product was a winner. The proposed package, which Leeson suggested should be called "Estitherm," was quickly approved and funded in November of 1997as a major product development project for LXS. Further, both Marks and the KPMG consultants suggested that the package should be made available as a Web-based application. Contractors would be able to log onto the site and follow a dialog, entering design specifications for their buildings using sophisticated drag-and-drop graphics, and be able to immediately receive a complete HVAC specification set. In return, the firms making Estitherm available would be building customer goodwill and obtaining contact information for all of the contracting firms that used the Estitherm site.

SETTING THE STAGE

In Toronto, frustrated managers at a software house bite their nails because they have a winning product, plenty of funding, but not enough Java programmers to finish the product and beat out their competitors. Two thousand-five hundred miles south, on the Caribbean island of St Lucia, frustrated managers at a small, new contract programming firm bite *their* nails because they will soon be laying off much of their young Java programming staff for lack of work. What to do? The solution is obvious, but achieving the needed connection between domestic buyers and overseas sellers of software services is anything but easy.

What can be done to eliminate the Information Technology (IT) skills shortage? The inability of companies in the developed nations to find enough programmers to complete their projects is rapidly becoming a strategic emergency (Blumenthal, 1998; PITAC, 1998). This skills shortfall is so severe that it is said (PITAC, 1998) to be constraining the overall growth of the U.S. macroeconomy. Other developed nations such as Canada are experiencing the same shortfalls. Expanded sources of IT expertise must be tapped. LXS Ltd. is no exception. One of their key projects, Estitherm, runs on the Web and enables quick and accurate estimated calculations of the size and type of heating and cooling equipment needed to satisfy a contractor's requirements. Demand for Estitherm is high, but the project is nearly a year behind its original development timeline. What to do?

Meanwhile, economic and development ministers in the small island nations of the Caribbean are struggling to develop stable and growing economies. They must find a way to break away from the rapidly declining plantation-based agriculture of the last century. They must decrease their reliance on unstable tourist income and reverse the brain drain as their best educated and most talented youth flee to Europe and North America for the lucrative jobs that their island homes cannot provide. What to do? Some Caribbean nations have taken tangible first steps to develop offshore IT business. The St. Lucia National Development Commission has built a 20,000-square-foot IT incubator facility to house programmers and provide advanced software development tools and high-speed Internet access, but most of the facility sits idle, wanting for contracts. How can more business be generated?

CASE DESCRIPTION

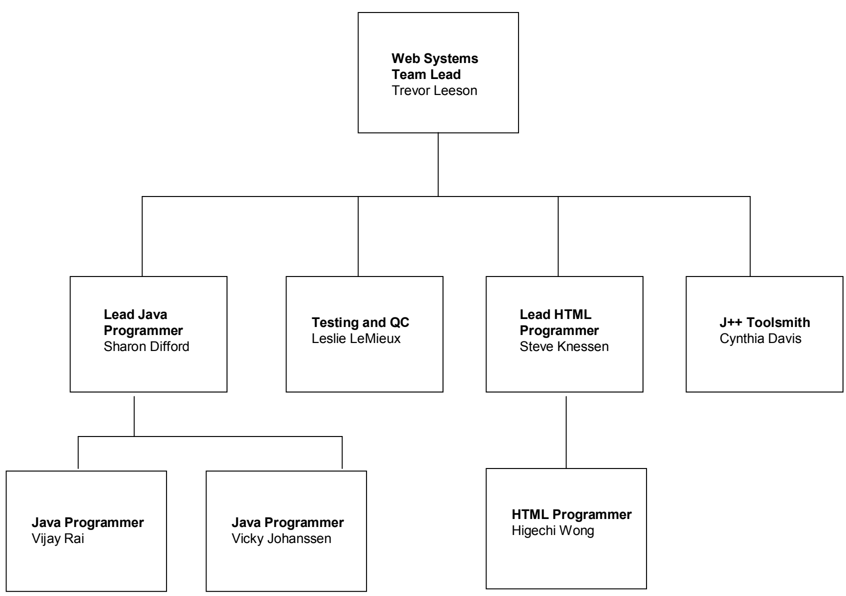
The Product Team

The Estitherm product development team was formed rapidly. Since it was to be a Web-based product, the team became part of Trevor Leeson's group. Six programmers were assigned into various roles, as shown in Figure 2.

Estitherm Architecture

Leeson initiated the Estitherm project with a series of informal team brainstorming sessions soon after the last programmers had returned from their training courses. Initial discussions centered on overall architecture, and the team decided quickly that most of Estitherm would be written as a Java applet. This meant that most of the Estitherm program code would be

Figure 2: Organization of the Web Systems Team



transferred from the server to the client's machine when the application was initially invoked on the Web. After the transfer, the program would run on the client's machine, freeing busy central servers to attend to other tasks. Java was especially appropriate to this task because it is "platform-neutral," meaning that Java applets would run on almost any computer running almost any browser software. During execution of Estitherm on the distant client machine, the program will make data requests via the Internet back to the server to obtain materials properties and climatological data from the Estitherm support database. This rough overall system architecture appears below.

Timetable and Project Management Scheme

As 1998 began and the rugged Canadian winter hit its worst, Team Leader Leeson found himself in a software development manager's "dream" situation. He had a clear project objective, a product that they were confident would be successful in the marketplace, strong executive support from Bartlett and Whitsell and a well-trained team of technically current programmers. Even better, he had the full attention of the team because the rugged January weather eliminated most recreational distractions. They could focus intensively. He drafted an overall project plan, and then modified it in consultation with his staff. The plan called for a working prototype of Estitherm to be ready by September 1998, with all testing and QC complete

Figure 3: Overall Estitherm Architecture

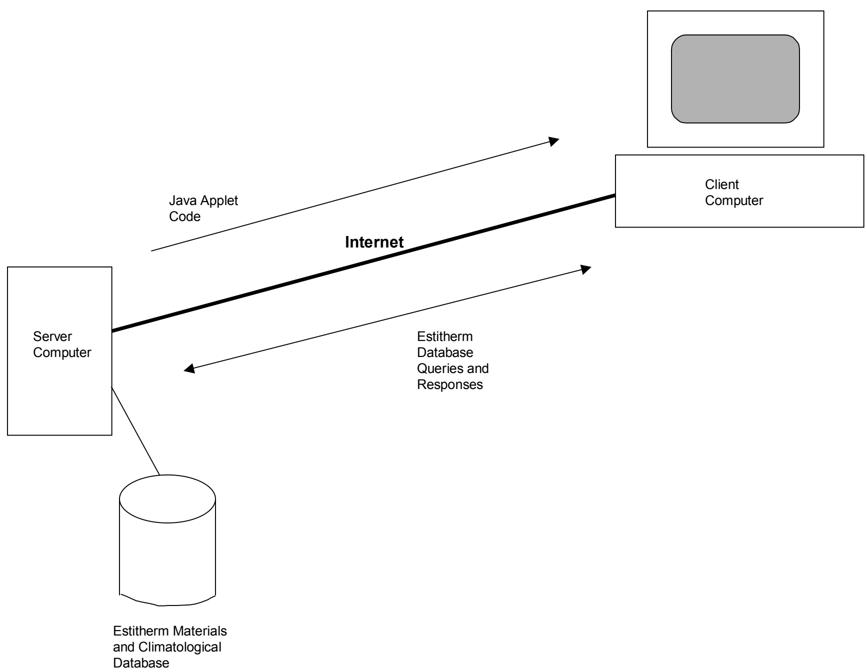


Figure 4: Estitherm Project Plan

Milestone	Description	Person-Hours	Target Date	Budgeted (CDN) (Labor only)
Detailed Architecture Complete	Design the Estitherm database record layout, the Java applet object structure, and the intercommunication routines.	360	22 January 1998	$16,200
Interface Design Complete	Layout and prototype client screens in the thermal design dialog, then prototype and tune the dialog with user involvement	600	5 March 1998	$28,800
Engineering Algorithms Complete	Engage licensed professional engineer to assist in algorithm design and validation for all thermodynamics module calculations	180	18 February 1998	$15,300
Program Design Complete	Design the internal structure for the Java applet routines	340	20 March 1998	$17,000
Build Server to be Test Bed	Install and test and configure Microsoft IIS on server machine to host testing	160	17 March 1998	$7,200
Applet First Release Coding Complete	Write all first release Java code for the applet and run it in test mode in local browser	1280	17 July 1998	$70,400
Server Database Support Coding Complete	Code all routines necessary to support database lookups on server	410	24 April 1998	$26,650

Figure 4: Estitherm Project Plan (continued)

Support Complete	Design and test backups, recoveries, database maintenance routines, logging and audit routines.	260	8 September 1998	$10,400
Testing Complete	Build 500 test cases for various building designs; validate all cases	600	16 October 1998	$24,000
Beta Test	Release to selected beta testers for comments and corrections (8 weeks in duration)	40	17 December 1998	$1,800
Certification	KPMG Certification Testing and liability validation certification	40	22 December 1998	$16,500
Production Release	Place in production	25	29 December 1998	$1,250
TOTAL				**$235,500**

by late November, and production release at the end of December 1998. The overall plan was submitted to Essen and then to Whitsell, who approved it with minor modifications and authorized the budget as requested. This project management outline appears as Figure 4.

The project plan above reflects labor costs only, and allows for 36% fringe benefits costs above the equivalent hourly rate of the technical personnel involved. KPMG's certification fee was an estimate, and included projected variable expenses above their flat fee for small system certification. In addition to these costs above, another $28,700 was estimated for hardware needed to support the system, and $18,200 for the first-year software licenses.

Team Leader Leeson produced a set of basic project management tracking tools, including a Gantt Chart and CPM diagram. The Critical Path Method graphic was not really necessary because it was obvious to everyone at the start that the first-release coding of the Java applet would be the constraining milestone upon which the entire project depended. Leeson and his boss Leif Essen agreed to hold 30-minute progress briefings each Thursday afternoon for Bartlett and Whitsell. Key technical staff were also to be included in these meetings when their expertise was needed. This simple project management methodology was expected to enable immediate detection of slips in the planned development schedule.

Funding

The funding levels shown in the project plan were presented to Development Manager Leif Essen in mid-December of 1997 and quickly approved by him and President Lane Bartlett. Salary costs would be allocated to the project based on actual hours reported each week. Disbursements for hardware and software would be timed as requested by Team Leader Leeson, with the only requirement being a three-day lead time notification to Controller Karen Shafer.

The Project Begins

Internal Architecture

Work on Estitherm proceeded rapidly and on schedule. Leeson assigned Java programmers Difford and LeMieux to work with HTML guru Steve Knessen to work out the details of the Estitherm architecture. The resulting scheme was as described earlier. All of the climatological data needed to support heat loss and gain calculations would be obtained from U.S. NOAA international databases and formatted and loaded into a Microsoft SQL Server database that would reside on an Estitherm server. This climatological data included worldwide temperatures, humidity, wind and insolation, in all of their seasonal variations. The Server was planned to run Windows NT release 4.0, with Microsoft IIS actually providing Web and database hosting services. SQL Server would use industry standard ODBC (Open Database Connectivity) protocols to support intercommunication with the HTML applications on the clients. The database would also host extensive tables of the engineering properties of materials used in construction. The thermal transmissivity of, for example, an 8 cm thick layer of brick is considerably higher than that of a comparable thickness of pine. Heat loss through concrete floors is much more rapid than if that floor is underlain with a thickness of sand. All database access events would be logged using the audit and journal capabilities built into Windows NT 4.0, thus allowing troubleshooting and bug fixing to proceed rapidly.

On the client side, Estitherm would initially execute by loading HTML code from the server that would present a series of forms to the user. These would be implemented with support from FrontPage, with extensions on the IIS server, and would walk users through a series of input panels requesting initial descriptive data about the proposed building design. After that data had been obtained and validated by editing routines on the server, the Estitherm Java applet would invoke. This highly sophisticated routine would present the user at the client computer with a blank drawing pad and a set of symbols indicating different types of floor, wall and ceiling compositions. The user would then use the mouse to draw out the floor plan of each room in the proposed structure, dragging and dropping materials symbols to each surface after its dimensions had been specified. Microsoft OpenGL standards and tools would be used to build and support these sophisticated graphics routines. As the user specified individual rooms and spaces, those rooms would be shown in a thumbnail graphic at the bottom left of the screen, showing the room-by-room synthesis of the entire structure, level by level. Once the graphic depiction of the structure was complete, the thermal calculations would be executed. The engineering algorithms would be implemented as Java code within the applet on the client's machine, but several queries to the server database would be needed during this process. These queries would provide the needed climatological and materials properties data for the specified structure and its location. This process was anticipated to require about 30 seconds under normal Internet loading conditions, so the design specified provision of a sliding progress bar to keep the user informed.

This architecture design was projected for completion on January 22, but was actually finished on Tuesday the 20th. Leeson reported that happy event in Thursday's update meeting to management, with smiles all around.

On Time, On Budget!

Similar successes were experienced with the Interface Design, Engineering Algorithm Design and Server Build phases of the project. All three of these project subcomponents met their time and cost targets within 5%. Vijay Rai led the interface design. He started with a series of two-hour meetings with contractor and architectural design personnel in Marks's architectural design firm. They had agreed to participate in the design of the product in exchange for a free perpetual license to the finished product. After determining together what the initial design screen should look like, Rai used Visual Basic to quickly build semi-working prototypes of the screens for user reaction, comment and redesign. This process quickly netted a usable, slick interface dialog with which all the users were well-pleased.

Leeson himself took the lead in getting the algorithm design complete because his undergraduate background was in mechanical engineering. He worked for two days with an HVAC (Heating Ventilation and Air Conditioning) consultant from Black and Veatch Ltd. to be sure that he understand the basic heat transfer equations, and finished the project working with Vicky Johanssen over a period of about three weeks. The result was a complete set of validated thermal properties relationships that could then be included into the Java applet. Meanwhile, Cynthia Davis, who was not yet needed on the

Java portion of the project, ordered two high-end PCs, loaded and configured Windows NT 4.0 Server on both machines, and then configured IIS to support the client development and testing. Two parallel systems were created for reliability.

By mid-March of '98, work on Estitherm was proceeding on track, and it appeared that LXS had a winner. Cynthia Davis, the J++ toolsmith, had installed the Java development tool on all four of the Java programmers' PCs, and they had successfully completed several small Java test projects from the technical training course they had recently taken. Coding work on the Estitherm applet began in earnest in late March.

Java R (Not) Us

Java programming started out beautifully. Initially, the team focused on writing and testing code to extract user input from the forms. Next, the database queries to the server were coded and tested, and all went smoothly thanks to the easy interfaceability of the ODBC routines. Trouble came suddenly, however, with the graphics routines. The goal was to initially present the users with a room design panel that started as an empty rectangle. The user could then drag the rectangle's lines in any way necessary to specify the desired shape of a room, and the dimensions would move alongside each line dynamically. After the layout for a room was complete, the user would use simple mouse manipulations to specify the construction characteristics of all surfaces.

Programming these graphics routines in Java proved much more difficult than had been expected. The programmers' learning curve for the difficult vector graphics programming techniques was quite steep. Once the programmers had developed good proficiency, though, the programming process was still very slow because of the inherent complexity of what they were trying to do in the application, and the large quantity of program code necessary to do so. In the April 9 progress meeting, Leeson mentioned that the graphics work was difficult, but expressed confidence that learning effects would enable them to catch up. The following week, in the April 16 meeting, he decided to come clean and confess to Essen and the President that they were two weeks behind at only the third week of graphics programming. No dramatic improvement was anticipated. All concerned had seriously underestimated the difficulty of the graphics programming.

As a possible fix, the entire project team dropped what they were doing and met for two hours on the morning of April 17 to explore whether some different, less graphics-intensive user interface might be employed. This possibility was dispatched quickly, though, because it would require users to enter room dimensions numerically, manually, and made it nearly impossible to account for irregularly shaped rooms. Since Estitherm's goal was to attract customers and win goodwill for the firms who provided it for use on the Web, it was decided that a clunky user interface that angered users would not be acceptable.

Searching for a solution, Essen and Leeson met with all four Java programmers the following Monday. They quickly decided that the only way to finish anywhere close to schedule was to hire more help. The programming task and technology were well understood — they simply needed more hands to get it done fast enough. Since coding productivity was running about one-third of that planned, the three Java programmers needed to become nine programmers. Rather than the projected 1,280 hours needed for this phase of the project, roughly 3,840 hours were needed, an increase of some 2,560 hours. At a labor rate of $40/hour, this would add $101,600 to the projected cost of Estitherm, a 42% cost overrun. These numbers were presented to Bartlett and Whitsell who, to everyone's incredible surprise, agreed immediately. They later confided that they secretly double-budget almost all projects, based on long and rugged experience with software project estimating failures, and were very confident that Estitherm would be a success in the marketplace. To them, a 42% overrun was a small one.

Into the Marketplace

Essen, then, had received authorization to "add capacity" immediately. He contacted several Toronto consulting firms looking for Java programmers who were also familiar with graphics and OpenGL programming. The skills existed, but the lowest consulting billing rate began at $140/hour CDN, clearly an unacceptable number, and even at that rate, it would be at least a three-month wait until six people could be available. Calls to placement firms followed, with the grim news that Java programmers were simply nonexistent in the marketplace. While the staff of three slogged forward on the graphics programming, making steady but slow progress, Essen continued trying to hire more talent. In desperation, he expanded his search to include newspaper ads in major U.S. and Canadian cities, visits to recruiting fairs at McGill University in Montreal (a strong source of computer scientists) and even discussions with colleges about hiring Java programming interns. Obviously, LXS had run squarely against the IT skills shortage—this problem they had been hearing about in the media was real, quite tangible and was directly frustrating their company's strategic product development plan.

Vacation Time

In mid-April, Chief Scientist David Whitsell left with his wife for their annual escape to warm weather. By this time of year in Toronto, the snow has been on the ground for six continuous months and patience is at an end. Whitsell was worried about leaving in the midst of the Estitherm project crisis, but knew that all that could be done was being done. This year, instead of their usual destination of Key Largo, Florida, Whitsell's wife had booked a week in the Caribbean on the British Commonwealth Island nation of St. Lucia. They had booked to stay at Le Sport resort on the north end of the island, so their arrival at the Hewanorra Airport on the south end afforded them an interesting taxi tour from one end of St. Lucia to the other. The early part of the cab ride met their expectations of a slow, sleepy, palm-covered island paradise — hilly roads that later gave way to lush and incredibly green banana plantations in the central part of the island. Driving through the main city of Castries was also stereotypical, and the slow traffic and street vendors were no surprise. Emerging from the north side of town, though, David was amazed to see what appeared to be the early stages of a developing technological industry. There were commercial computer contractors, networking vendors, and they even passed one secure bunker-like building ringed with barbed wire and peppered with satellite antennas.

St. Lucia Development Initiatives

What Whitsell and his wife viewed on their ride to Le Sport was far from their expected stereotype of a stagnant, backward tropical nation. Table 1 lists some of the computer-related organizations actually operating in St. Lucia in 1998.

The "bunker" Whitsell passed is part of a technology incubator project jointly sponsored by the The World Bank and the St. Lucia National Development Commission aimed at attracting information technology services business to the country (SLNDC, 2000). The following specific initiatives have been taken on St. Lucia to attract IT:

- Construction of a 20,000 sq. ft. facility specially designated as an information processing center. The facility is air-conditioned and can be modified to specification. The structure is divided into four sections, with telecommunication lines all the way up to the doorsteps.
- Negotiations with Cable & Wireless, the St. Lucia telecommunications carrier, to reduce telecommunications rates specific to this industry, resulting in an agreement that rates will be consistent with the more competitive rates in the region.

Table 1: Real-World IT-Related Business Operating in St. Lucia, 1998

ISIS World Wm Peter Boulevard Box 1000 Castries, St Lucia 451-6608 Institute of Self Improvement Systems Ltd John Compton Highway Castries 452-1300 Micoud Computer Learning Center 32 Lady Micoud St Micoud 454-0556 University of the West Indies Mome Fortune 452-6290 452-3866 MainLANLtd (Network administration, consultation /documentation) PO Box 346 Castries, St Lucia Mainlan@candw.lc Business & Technical Services Ltd GBTS Ltd 49 Mary Ann St Box 1829 Castries 452-4564 FAX 453-1727	Nicholas Institute of Computer Literacy Cadet St Castries 453-7754 Also at Louisville and Vieux Fort 454-7757 Caribbean Computer Literacy Institute Gablewoods Mall Sunny Acres Box 3097 La Clery Castries 451-3030 CES San Souci Box 1865 Castries 453-1444 • Fax 452-1558 Computer Centre Ltd Hill Twenty Babonneau Box 1092, Castries 453-555 FAX 450-6199 University of the West Indies School of Continuing Studies (UWIDITE) Box 306 Castries 452-4080

- Identification of schools interested in training personnel in the applications needed for the IT industry. In addition, St. Lucia has established a government-subsidized training center and maintains a database of potential employees so that they can be easily identified.
- New legislation has been passed to facilitate easy set up of Information Services-related businesses.
- SLNDC has performed identification of local individuals and companies interested in joint venture partnerships with potential investors.

This project was partly funded by $6 million of financing targeted at telecommunications infrastructure improvement in the Eastern Caribbean (Schware & Hume, 1998; The World Bank Group, 1998). The grant project (Schware & Hume, 1998) included funding for vouchers to partially fund training of selected qualified students. It is clear from this project that St. Lucia understands fully the potential of Offshore Programming(O.P.), has elected to invest significantly in creating attractors to industry and has chosen to attempt to capitalize on the seed investment from this grant.

St. Lucia's project is part of a larger multi-nation effort to attract investment to the Eastern Caribbean that has been spearheaded by the Eastern Caribbean Investment Development Service (2000). Headquartered in Washington DC, this agency of the Organization of Eastern Caribbean States promotes offshore business, and information processing specifically, for Anguilla, Antigua and Barbuda, British Virgin Islands, Commonwealth of Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines. ECIPS emphasizes political stability, quality labor force, English-speaking tradition, proximity to the U.S. and alignment with U.S. time zones, offering a range of incentives including tax holidays and duty-free entry of equipment and raw materials.

Whitsell and his wife enjoyed a couple of days of doing nothing on the beach. But as a high-energy CEO-type, he quickly grew bored and rented a car from the resort so he could try to satisfy his curiosity about the IT activities he saw in town. One thing led to another, and he found himself the next day meeting with a government vice-minister of technology, who explained the incubator project, with a focus on St. Lucia's desire to cultivate an offshore programming industry. The minister explained that the overall economic picture in the Caribbean is one of stagnation or of very slow growth. Most of the countries exhibit "economic dualism," where a modern economy is superimposed upon a less advanced system held over from plantation days. Oil and sugar prices are low, the cost of maintaining those oil and sugar infrastructures is high, tourism is capricious and not fundamental to economic growth, urbanization is imposing ever-increasing social costs and major investments in manufacturing are not occurring. As a result, nearly all of the educated, ambitious youth of the region are leaving to pursue the superior professional employment opportunities in other parts of the world, most especially in England, Canada and the U.S. For example, in relation to the resident population, the overseas population at the end of the 1980s stood at 40% for both Jamaica and Guyana, 23% for Puerto Rico, 21% for Trinidad and Tobago, 15% for Haiti and 10% for Cuba (Girvan, 1997). There is an almost desperate need to find a way to stimulate economic growth in the Caribbean if the brain drain and downward spiral of these economies is to be arrested. Good IT technology training is available in St. Lucia and other Caribbean nations, but the students can't find work and, understandably, depart to developed nations.

Whitsell was then given a tour of the incubator facility. He was surprised to find very high-speed Internet access, hardware equivalent to that at LXS, student programmers with excellent advanced technology skills (including Java (!)), immediately available programmers and a wage structure less than one-third of that in Toronto. He ended his vacation visit to St. Lucia with a promise to return soon to try to construct a Java programming contract arrangement.

Striking a Contract

Immediately upon returning to Toronto, Whitsell called a meeting of the President, the LXS Development Manager Essen and several members of the Estitherm technical project team. They responded enthusiastically to the prospect of getting assistance from St. Lucian programmers, and literally drew a straw to determine who would be lucky enough to accompany Whitsell and Essen on a trip to St. Lucia. The following week, Whitsell, Essen and straw-winner Sharon Difford, Estitherm specifications in hand, met with several managers and programmers of a small software contracting firm in the incubator on St. Lucia. Contract terms were agreed to and papers signed for a "time-and-materials" arrangement at a rate of $16/hour (CDN). Most coordination would be accomplished via the Internet, and the Java code itself could be sent to LXS electronically. Difford stayed behind one more week to coordinate, as seven St. Lucian programmers began coding work on the graphics portion of Estitherm. One of the programmers, Ernest Millston, was a 15 year-old high school student, and Difford was particularly amazed at his skills and energy.

A Clash of Cultures?

LXS programmers were initially concerned about possible cultural differences between their approach to work and that of the St. Lucians. Their stereotype was that people in "that" part of the world are lazy and move slowly, consistent with the universal "No problem" epithet. Most of the stereotype proved, fortunately, to be incorrect. The St. Lucians were agreeable and responsive to inputs from the Toronto-based programmers. After the first week there was, however, a clear indication that the pace of *everything* on the island is much slower than in the North, and the Canadians had trouble communicating and sustaining a sense of project urgency to the St. Lucians. After a bit of trial and error, Essen found that frequent reminders seemed to work. After each prod, the St. Lucians would accelerate, then on about the third day, again begin to lag. Another prod would yield another surge followed by deceleration. While somewhat frustrating, this arrangement worked and "kept the Caribbean programmers going." In the project postmortem meetings, a key item in Leeson's "lessons learned" list was to put one Canadian in place on the island for the project duration in order to keep the work pace high on a daily basis.

Project Completion

The arrangement worked. Toronto programmers and the St. Lucians divided up the work on the Java graphics modules, working out rough spots via e-mail, Internet chat and an occasional phone call. To the regret of all the Canadian programmers, there was no need to make another coordination trip to the Caribbean—the Internet-based communication was adequate. Java programming was complete on August 7, only about three weeks behind the original schedule, and at a very attractive total cost. Rather than the expected $101,600 overrun associated with using Canadian Java programmers (who were nonexistent in the marketplace), the Java portion was completed with only a $40,960 direct labor cost overrun, thanks to the St. Lucia connection.

The balance of the Estitherm project milestones were achieved close to targets, and the system was converted to production only about a month late.

CURRENT CHALLENGES/PROBLEMS

Offshore programming is not a new practice. Indeed, arrangements wherein U.S. firms contract with software developers and technicians in India, Ireland and Pakistan have been in place since about 1985 (Heeks, 1995). This arrangement is mutually beneficial because it provides much-needed employment in the "offshore" nations, improves their balance of foreign credits and aids customer firms in completing stalled or behind-schedule software projects at attractive labor rates (King, 1999). This "offshore programming" ("O.P.") activity is now greatly facilitated by the Internet because the product itself is information, which can move about the world with no delay and at no cost. Software specifications can be sent to contractors, and the resulting software products sent back to purchasers with complete ease. For example, Levi-Strauss, based in San Francisco, contracts for programming services with Cadland Infotech Pvt Ltd., Bangalore, India (Cadland Ltd., 2000). Offshore programming is place-displacement work at its best. Table 2 summarizes offshore programming activity worldwide.

In the Caribbean, however, the offshore programming industry is small, and is struggling for recognition and a way to build business volume. The most visible offshore programming effort in the Caribbean is centered in Montego Bay, Jamaica. Furman University, Greenville, SC, U.S., is involved with the Caribbean Institute of Technology (CIT), training teachers and leading curriculum design with the objective of building a training infrastructure to produce information technologists in Jamaica (Tracy, 1999). This effort, coordinated via HEART, a Jamaican government agency for technology training, recognizes the potential of offshore programming to stimulate the Jamaican economy, and is pursing that opportunity aggressively. Per capita

Table 2: Dollar Value of Offshore Programming Exports by Nations (Heeks, 1995)

Country	Year of Data	Exports (USD, $M)	Growth Rate
Ireland	1990	185	38%
India	1990	120	34%
Singapore	1990	89	43%
Israel	1990	79	39%
Philippines	1990	51	32%
Mexico	1990	38	30%
Hungary	1990	37	53%
Russia	1993	30	N/A
China	1990	18	43%
South Korea	1990	15	40%
Taiwan	1987	11	48%
Egypt	1994	5	N/A
Argentina	1990	4	N/A
Chile	1990	2	98%
Cuba	1993	1	40%

income for the 2.6 million residents of Jamaica is only $6,000, and the 45% unemployment rate (Davidson, 1999) characterizes the desperateness with which the economy needs opportunities such as O.P. INDUSA Offshore, an Indian software company with offices in Atlanta, is seeking programming customers in the U.S., and an initial contract has been arranged with Realm Information Technologies (Atlanta). Realm is currently contracted for thousands of hours of programming work with Indian software firms, and will shift much of that business to Jamaica as soon as the training is complete and the first crop of Jamaican programmers comes online. Edward's Fine Foods, the Southern Company (an electric utility) and Centris Insurance are also carefully studying signing on as customers (Davidson, 1999). There are other early efforts at building offshore programming activity in Barbados, Trinidad and Tobago, Cuba, Antigua and St. Lucia.

The St. Lucian effort, described earlier, has resulted in construction of a sophisticated telecommunications facility to serve as a nucleus for offshore programming on that island. It is in this facility that work on the fictional LXS programming contract began.

The contact between LXS and St. Lucia occurred through serendipity. Had not Whitsell's wife booked a vacation to St. Lucia, this arrangement would not have come about, to LXS', Estitherm's and St. Lucia's mutual loss. Much is to be gained by finding ways to bring together companies like LXS, who desperately need additional IT skills, with nations of the Caribbean, who possess the skills and badly need the revenues.

What is needed to promote these mutually beneficial offshore programming arrangements? Both LXS and St. Lucia were faced with significant challenges. LXS' strategic product development plans were being frustrated by a scarcity of Java programmers. St. Lucia, and the Caribbean generally, is frustrated by the loss of college-trained technicians to other nations because there is not work for them at home. Clearly, the main driver of O.P. is a supply-demand imbalance on the world IT skills market. One nation, usually a more developed one, has a shortfall of available IT skills, and another nation, usually a Third World one, has a skills surplus. Thus, from a macro perspective, O.P. activity can be viewed as a classic economic market-clearing operation, matching demand and supply at some agreed price. If this supply-demand imbalance ever disappears, the entire economic rationale for O.P. is also likely to disappear.

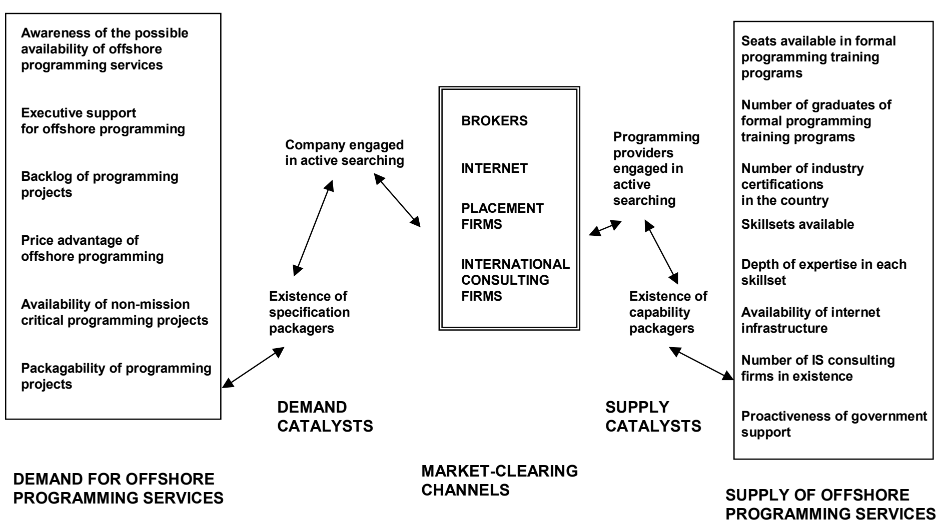
What factors influence the demand for offshore programming services such as those needed by LXS? What prompts a nation such as St. Lucia to try to establish a supply of offshore programming services? How do these buyers and sellers find each other? How will companies all over the globe benefit from an understanding of the kinds of offshore programming services available in the Caribbean and elsewhere? What systematic methods should be put in place to help customers and providers strike arrangements such as that at LXS?

Figure 5 shows a proposed model of factors and effects that may influence the origination of offshore programming arrangements such as the one that benefited LXS. This is a hypothetical model, deduced from real-world experiences, and is offered to spark discussion about all aspects of O.P. activity.

Demand for programming services must exist in excess of the domestic supply. As mentioned earlier, it is this imbalance that drives O.P. activity. Demand requires a backlog of IT work in the services-purchasing nation, a price differential between domestic and offshore programming services, and strong executive support for the concept in corporations in the purchasing nation. Because many executives are uncomfortable entrusting mission-critical projects to the as yet only a partially developed O.P., industry, a supply of projects that are important but not survival-critical can be expected to heighten the demand for O.P. Finally, projects that are well-specified, tightly bounded in scope and cleanly packaged are much more likely candidates for being contracted overseas.

In situations where either there are few well-packaged projects, or where managers simply do not have time to "shop" the world for O.P. contractors, specification packager intermediary firms can catalyze O.P. activity. These firms, which can be domestic or overseas, intervene in the early stages of an

Figure 5: Proposed Supply/Demand Model for Offshore Programming



O.P. activity, working with the buyer to clearly package and bound a project and then to find an appropriate overseas contractor. Only a few “specification packaging” organizations exist at present, and as more evolve, O.P. activity can be expected to grow.

At the center of the model are the market-clearing mechanisms that might unite buyers and sellers. At present, much of this is done by large consulting firms, such as KPMG, Accenture and others that are building practice areas in O.P. In addition, a small but growing number of brokerage houses are coming into existence for the sole purpose of pairing buyers of O.P. service together with suppliers. These firms also often assist in the construction of contract terms, the monitoring of project activity and provide troubleshooting support as needed.

On the supply side, one can also envision a small catalyst company that functions as a “capability-packager,” fronting for one or more offshore programming firms, or for entire nations. These packagers would have current information on the technical specializations, supply depth and performance records of O.P. firms in supplier nations and thus lubricate the process of locating buyers for services. No such companies have yet been identified, but as O.P. practice grows, the birth of “specification packagers” is hypothesized by the model.

Finally, at the right hand side of the model, supply of O.P. services is obviously a function of the number, quality and productivity of educational programs in IT, the alignment between skillsets needed and skillsets available, connectivity to a particular nation and the attitudes of the host nation governments. Governmental imposition of tariffs on transnational data flows, for example, could greatly inhibit O.P. activity in a particular nation.

Critique this model. What factors in the model seem to be credible? Which do not make sense? What would you add to this model?

The LXS experience was a successful one. What can go wrong in offshore programming activities? List and discuss the pitfalls for both buyers and sellers of O.P. Are these risks strategic, in that they are potential showstoppers for O.P. as a global activity? Are there legal and public policy steps that can be taken to minimize these risks? What agencies, national and global, should take an interest in assuring the success of O.P.?

Research can answer many of the open questions about offshore programming. Work is needed to characterize the kinds of conditions within a software development company that are most likely to prompt a search for an offshore programming solution. More knowledge is needed about the various contracting structures that are employed between O.P. buyers and sellers, and which are most successful. Research on the market-clearing mechanisms are needed—are brokers required, and do brokerage arrangements lead to successful contracts? Are there privacy, tariff, tax or public-policy issues for nations wishing to build O.P. activity? There is no shortage of unanswered questions.

CONCLUSION

LXS' story is typical. Organizations all over North America are experiencing acute shortages of trained information technologists. More than just an inconvenience, these shortages are preventing the timely completion of projects that are often central to strategic organizational goals. In some of these situations, affordable overseas pools of IT talent can be a viable solution, but only if the companies know to look overseas for help. LXS got lucky—they found a source of help in St. Lucia by accident, and were then clever enough to take advantage of that happy accident to complete their project. This is a key message—there is help for beleaguered managers of software projects, but the provider nations must make their availability much more widely known.

IT activity is rapidly "going-global." Today, offshore programming and contract activities such as this LXS project are isolated exceptions. Unless unexpected showstoppers appear, there is every likelihood that systems project teams will routinely and predominantly span national boundaries in the near future. IT managers need to prepare now for the cultural, language, security, economic and quality issues that will accompany the global development teams of the future.

FURTHER READING

CGCED. (1998). Caribbean Group for Cooperation in Economic Development. Workers and labor markets in the Caribbean. *The World Bank Group*. Retrieved on the World Wide Web: http://wbln0018.worldbank.org/external/lac/lac.nsf/c3473659f307761e852567ec0054ee1b/a7df291a495614df852567f20063b23f?OpenDocument.

Davidson, P. (1999). *USA Today*. Jamaica's silicon beach? Retrieved September 13 on the World Wide Web: http://usatoday.com/life/cyber/tech/ctg112.htm.

Girvan, N. (1997). Societies at risk? The Caribbean and global change. Retrieved on the World Wide Web: http://mirror-japan.unesco.org/most/girvan.htm. Paper presented at *Caribbean Regional Consultation on the Management of Social Transformations (MOST) Program of*

UNESCO, Kingston, Jamaica. February.

Heeks, R. (1996). *India's Software Industry: State Policy, Liberalization and Industrial Development*. India: Sage Publications.

Heeks, R. (Ed.). (1995). *Technology and Developing Countries: Practical Applications, Theoretical Issues*. London: Frank Cass & Co. Ltd.

McKee, D. and Tisdell, C. (1990). *Developmental Issues in Small Island Economies*. New York: Praeger Publishers.

Schware, R. and Hume, S. (1998). Organization of Eastern Caribbean States Telecommunications Reform Project. The World Bank Group. Project ID 60PA35730. Retrieved February on the World Wde Web: http://www.worldbank.org/pics/pid/oecs35730.txt.

REFERENCES

Blumenthal, H. (1998). Ready to get your degree in IS? *Netscape Enterprise Developer*. Retrieved January on the World Wide Web: http://www.ne-dev.com/ned-01-1998/ned-01-enterprise.t.html.

Davidson, P. (1999). *USA Today*. Jamaica's silicon beach? Retrieved September 13 on the World Wide Web: http://usatoday.com/life/cyber/tech/ctg112.htm.

Eastern Caribbean Investment Development Service. (2000). Retrieved on the World Wide Web: http://www.ecips.com/descript.htm.

Girvan, N. (1997). Societies at risk? The Caribbean and global change. Retrieved on the World Wide Web: http://mirror-japan.unesco.org/most/girvan.htm. Paper presented at *Caribbean Regional Consultation on the Management of Social Transformations (MOST) Program of UNESCO*, Kingston, Jamaica. February.

Heeks, R. (Ed.) (1995). *Technology and Developing Countries: Practical Applications, Theoretical Issues*. London: Frank Cass & Co. Ltd.

King, J. (1999). Exporting jobs saves IT money. *Computerworld*. Retrieved March 15 on the World Wide Web: http://www.computerworld.com/home/print.nsf/all/990315968E.

PITAC. (1998). President's Information Technology Advisory Committee. Interim report to the *President, National Coordination Office for Computing, Information and Communications*. Retrieved August on the World Wide Web: http://www.ccic.gov/ac/interim.

Schware, R. and Hume, S. (1998). Organization of Eastern Caribbean States Telecommunications Reform Project. The World Bank Group. Project ID 60PA35730. Retrieved February on the World Wide Web: http://www.worldbank.org/pics/pid/oecs35730.txt.

SLNDC. (2000). *St. Lucia National Development Commission*. Information services industry. Retrieved on the World Wide Web: http://www.stluciandc.com/info.htm.

The World Bank Group. (1998). World bank finances telecommunications reform in the Eastern Caribbean. News Release No. 98/1798/LAC. Retrieved June 4 on the World Wide Web: http://www.worldbank.org/html/extdr/extme/1799.htm.

Tracy, A. (1999). Pushing to put Jamaica on the high-tech map. *Business Week Online*. Retrieved July 19 on the World Wide Web: http://www.businessweek.com/bwdaily/dnflash/july1999/nf90719a.htm.

BIOGRAPHICAL SKETCH

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