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Experience of Bi-Lateral Technology Transfer Projects

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Abstract

This paper considers bi-lateral technology transfer projects undertaken by IPSYS Software plc., a small UK software technology company specialising in the development of Computer Aided Software Engineering (CASE) toolsets. IPSYS had unique technology but limited expertise and market presence in the application of particular software development methods, and limited development capital. Partnerships with method specialists were identified as the way forward, and a series of bi-lateral technology transfer projects initiated. This paper examines the key factors in their successes and failures.

1. Introduction

We usually understand technology transfer as uni-directional, with expertise being transferred from one party to another. However, bi-lateral technology transfer can be the basis of projects where each individual participant has only part of the necessary expertise. This paper considers bi-lateral technology transfer projects undertaken by IPSYS Software plc., a small UK software technology company specialising in the development of Computer Aided Software Engineering (CASE) toolsets.

The technologists at IPSYS had developed over a period of years (at IPSYS and previously at Software Sciences) very specialised metaCASE technology to generate CASE toolsets for Unix and Digital VMS platforms. This technology, called ToolBuilder, is able to generate a fully functional CASE tool from a specification of the software engineering method to be supported (Alderson 1991). These technologists had successfully developed a HOOD toolset (Alderson and Elliott 1989) for the European Space Agency using the precursor of ToolBuilder. The impending success of that project prompted the management buy-out of the technology and its development team from Software Sciences Ltd. The HOOD toolset was subsequently mandated for the multi-national EuroFighter military aircraft project.

Although ToolBuilder's developers had a wide knowledge of CASE methods, they had no specialised expertise in using any method other than HOOD. This created the problem of how to exploit ToolBuilder to the full, since the direct market for ToolBuilder would clearly be limited. The way forward, building and selling toolsets for specific methods, required expertise that the Company could not afford to recruit. Further, IPSYS did not have sufficient capital to build other toolsets. The solution was to arrange partnerships with organisations that had the knowledge to develop specific toolsets, but lacked the technology.

All of our most successful endeavours involve mutual benefit. Where both parties to an enterprise gain from their collaboration, the likelihood of success is at its greatest. This was understood by the management of IPSYS. IPSYS attempted to create bi-lateral technology transfer projects, which would transfer ToolBuilder skills to a developer with specialist knowledge of a method and would transfer method knowledge to IPSYS, in a way that would bring mutual benefit. The transfer projects created by IPSYS are discussed below.

2. The Projects

2.1 The LBMS Project

The first project, with Learmonth and Burchett Management Systems (LBMS), was intended to develop an SSADM Version 4 (NCC 1990) toolset, which both parties could sell. LBMS and Software Sciences had been partners in the Alvey project Eclipse (Alderson and Bott 1989), which had seeded the development of ToolBuilder.

LBMS, having the successful PC-based Automate product, was looking to enter the Unix CASE market with an SSADM toolset, but had little Unix expertise. IPSYS had appropriate technology and Unix expertise. The companies agreed to a joint development of the toolset, with IPSYS providing LBMS with the ToolBuilder technology, training in its use and Unix expertise, and LBMS providing SSADM expertise and undertaking the development. Each company would have the right to sell the toolset, which IPSYS would maintain.

The mutual benefit was clear. LBMS as the leading player in the SSADM tools market could expand onto Unix platforms with increased sales potential. IPSYS was less likely to make direct sales but would have strong maintenance revenues. The project had every prospect of success. LBMS and IPSYS had access to all of the necessary technical and marketing expertise. Close technical co-operation flourished between the developers, with LBMS staff working for extended periods at IPSYS.

Unfortunately, the project foundered soon after completion of the initial toolset version, principally because of

competing products within the LBMS catalogue. LBMS salesmen could choose whether to promote Automate or the SSADM toolset. Automate was more familiar and attracted better sales bonuses from the higher volume, lower price sales to be made in the PC market segment. LBMS withdrew from the project and the Unix market, with an investment loss. IPSYS obtained full intellectual property rights in the toolset. However, it had gained only limited SSADM expertise, and with no presence in the SSADM marketplace and no sharing of financial burden, it was unable to market or sell the product effectively. Only one sale was made, making it extremely uneconomic to continue development, and the product was subsequently shelved.

2.2 The AEA Project

The Atomic Energy Authority (AEA) wished to develop a Unix-based toolset for James Martin's Information Engineering (IE) method (Martin 1989). IPSYS offered to supply ToolBuilder for this development, in return for rights to sell the product. AEA bought IE consultancy from the Savant Group. IPSYS provided ToolBuilder and Unix expertise, and further developed ToolBuilder in support of the project.

Again the mutual benefit was clear. AEA would fund development of the product then recoup the investment through royalties. AEA would obtain the toolset it wanted free of licence fees, then have it maintained free of charge. IPSYS would obtain a product to sell and gain IE expertise. Technically the project team worked well together and a viable but restricted first version, satisfying AEA's needs was developed. Savant got consultancy fees for their method expertise. IPSYS got a toolset for sale with the minimum of investment and was able to further develop the core ToolBuilder product.

Again, this was potentially a very successful project. The Unix IE toolset market segment was empty, although it was known that major players in the PC segment were working to port their products to Unix. AEA and IPSYS reached that market first. The project failed because neither partner could contribute market knowledge. IPSYS failed to generate sufficient sales. Its low capital base precluded extensive marketing, particularly in the USA that offered the major sales opportunities, but required high marketing investment.

These difficulties were compounded by the contract between AEA and IPSYS. AEA retained the intellectual property rights of the toolset, and required royalties of £80,000 from the first five sales and high subsequent royalties. IPSYS was required to maintain and develop the toolset. Reduced ongoing royalties to AEA could only be achieved by IPSYS undertaking significant further development. The very high early royalties removed investment needed for further development and marketing of the IE toolset. Desire for an early return by AEA significantly hampered IPSYS's ability to generate a significant long term return from the product, to the detriment of both parties.

2.3 The CPBS Project

CPBS Ltd. has expertise in software applications supporting food distribution. It had developed its product in RPG on IBM's AS/400 range and was concerned that the platform was restricting its market. Doubts were being expressed about IBM's ability to retain their market share. CPBS wished to port its product to Unix platforms. Prolonged technical assessment with IPSYS led to a project to reverse engineer the RPG source code into a design representation in IPSYS's IE toolset. Code generators would be written to generate both AS/400 and Unix applications from the same representation.

CPBS placed a fixed price contract for IPSYS to extend the IE toolset product with a design representation compatible with the reversed engineered RPG code, and to provide reverse engineering technology. CPBS would undertake the reverse engineering and develop the RPG code generator. IPSYS would develop Unix code generators.

The project was attractive to both parties. CPBS would expand its market, while IPSYS would obtain funds to develop code generators for the IE toolset it had built with AEA. IPSYS had identified code generation as the way to attract market attention. CPBS was keen to ensure that its needs would be met by an IPSYS product, rather than a bespoke development, so minimising future maintenance and development costs.

Technical collaboration was close. IPSYS progressed development of the Unix code generator on the basis of the mutually agreed design representation. To accelerate the technology transfer, an IPSYS employee was transferred to CPBS. Unfortunately, this inhibited the initial close interaction by reducing the need for meetings between the companies.

CPBS's reverse engineering proceeded to the point that successful representations of many modules and gen-

eration of RPG code were achieved using a code generator developed by CPBS. However, the reduced interaction together with the retirement of the technical director from CPBS, had led to different uses of the design representation by the two parties. Although the reverse engineering system could have been adjusted to realign use of the representation, CPBS would not follow this course because of time pressures. IPSYS had sold a copy of IE and a Unix code generator based on its interpretation of the design representation in the USA. Therefore, IPSYS was forced to maintain two copies of the IE toolset, which were later merged only at great expense. The incompatibilities and a change in the economics of the AS/400 market led to the eventual demise of the project.

For IPSYS, the project was seriously diversionary, directing focus to the very specialised RPG requirement. It was ill-judged for CPBS to aim to have its future specialised needs met by a product, while at the same time requiring the product development to be subservient to the needs of the RPG reverse engineering. To achieve that goal would have meant far more constraints on the solution than its technical team was prepared to accept and/or more constraints on the general product than could be realistically supported. Both companies lost heavily and although CPBS had insisted upon a contract heavily biased in its favour - one condition was that CPBS could stop the project and reclaim all payments at any time - the bias appeared to inhibit it from pursuing that reimbursement through the courts.

2.4 The Union Bank of Switzerland Project

Union Bank of Switzerland (UBS) wished to standardise its internal application development activities through use of a method and a supporting toolset. UBS was interested in an adapted form of SSADM, and had retained the expertise of Model Systems Ltd., to assist with this. IPSYS had the SSADM toolset from the failed LBMS project. The intellectual property rights in this were sold to UBS. IPSYS agreed to provide technical knowledge of ToolBuilder and the SSADM toolset, and to provide development facilities. IPSYS and UBS anticipated selling the toolset and jointly profiting.

UBS retained the services of an ex-IPSYS consultant to redevelop the toolset under the direction of Model Systems Ltd. Access to internals of the IPSYS technology and to its developers was freely provided and collaboration was close. Technically sound, the project also had the advantage of anticipating the development of the new SSADM 4+ standard being progressed by the UK Government through CCTA (Blackwells 1995). The developed UBS toolset was used at the launch of SSADM 4+ to demonstrate its features.

The emphasis changed when a new head of department was appointed within UBS. Less certain about its future use of the toolset and its desire to maintain and extend it, UBS transferred intellectual property rights to IPSYS in return for free use of the toolset, free ongoing maintenance and a voice in future development direction.

Initially a bespoke development project, it became a transfer of SSADM 4+ knowledge to IPSYS. UBS got the toolset it wanted, for the method it wanted, maintained and free of licence fees. Model Systems was funded to develop and validate its method ideas and to participate in the launch of the SSADM 4+ method, enhancing its status in the SSADM community. IPSYS got a product at minimal cost. Again however, IPSYS failed to generate sales of the product having no knowledge of the SSADM market, and again the product was shelved.

2.5 The Kennedy-Carter Project

Kennedy-Carter is a UK partnership specialising in the Shlaer-Mellor object-oriented analysis (OOA) method (Shlaer and Mellor 1992). Having developed a strong consultancy business, it was interested in having an OOA toolset to sell to its clients. ToolBuilder was known to the partnership through an employee who had used it at CERN.

A deal was struck whereby Kennedy-Carter would obtain ToolBuilder at no initial cost. Rather, ToolBuilder was to be paid for by royalties upon sales. IPSYS required 50% of sales value on all sales until the ToolBuilder licence fee had been paid. Royalties would then be significantly reduced. IPSYS also had the right to sell the product.

The collaboration between the technical staff of the two companies' was excellent. Kennedy-Carter staff were able to use facilities at IPSYS. They had direct access to the developers of ToolBuilder. Kennedy-Carter was given access to the source code of ToolBuilder to build additions in support of some very specialised needs. It also retained the consultancy services an of ex-IPSYS employee, who was also given free access.

The project was very successful in sales terms. Kennedy-Carter is well established in its market. It designed a

good product and it sold well, and continues to do so. The knowledge acquired by IPSYS technical staff contributed to the evolution of the IE toolset.

Financially, the only negative aspect was the price set by IPSYS for ToolBuilder, which in retrospect Kennedy-Carter considered too high. The effect was to maintain the high level of royalties to IPSYS for a longer period, reducing Kennedy-Carter's return and reducing funds for further marketing and development. Otherwise, both Kennedy-Carter and IPSYS were pleased with the return from sales.

3. Conclusion

The success of its technology transfer projects was vital to IPSYS. Without them it could not derive benefit from its significant technology development. The projects all appeared to have high potential for success, but only one achieved this. IPSYS finally went into receivership.

The first point to note is that technical co-operation is not the key determinant of success in technology transfer projects. While necessary, it is not sufficient. In general, the technical collaborations were sound, with a strong willingness to give access to privileged information, to knowledgeable staff and to other technical resources. The exception was the CPBS project, where reduced contact led to technical divergence. Financial and business issues were generally at the root of any difficulties of IPSYS's bi-lateral technology transfer projects.

The second point is that the application specialist, not the technology specialist, was key to the success of these bi-lateral technology transfer projects. IPSYS successfully sold HOOD toolsets. Kennedy-Carter successfully sold OOA toolsets. IPSYS successfully sold ToolBuilder to the limited market of European research organisations through its application expertise of building CASE tools using metaCASE, but IPSYS was unsuccessful in selling either IE or SSADM toolsets. The most successful of the CASE products developed were those sold by the party expert in the method, not the one expert in the technology.

An interesting confirmation comes from the comparison of the OOA experience with the SSADM and IE experience. IPSYS sales and marketing personnel were of the view that the technology underlying the CASE tools was a major hindrance to obtaining sales. Kennedy-Carter's OOA toolset using exactly the same technology easily outsold IPSYS's SSADM and IE toolsets during the same period.

The third key lesson is that successful technology transfer requires not just mutual benefit but equity also. Success depends upon the special capabilities of both partners, so the incentive for each must be the same. It is typical for the partner making the highest financial investment to demand advantageous treatment. This will always be to the detriment of both. The desire for inequitable short term return of investment is seen in AEA's treatment of IPSYS and, to some extent, in IPSYS's treatment of Kennedy-Carter. Draining investment in early stages can hamper long term prospects for both parties. Equally, CPBS's insistence on the IE product bending to their needs, led to loss for both partners.

Finally, long-term commitment is required on both sides. Transfer of expertise is a slow process, and , except for the Kennedy-Carter project, the IPSYS projects failed before either partner had learned enough to carry on alone. The LBMS and CPBS projects further illustrate the dangers to projects from changing market economics. Where commitment falters, failure is guaranteed.

The IPSYS experience shows the necessity for more than just technical co-operation. Bi-lateral transfer projects demand a spirit of partnership bringing mutual benefit with fairness. Given these conditions, bi-lateral technology transfer projects clearly have the potential to be successful.

Disclaimer

The opinions and interpretations are those of the author alone and are not necessarily supported by any of the organisations mentioned.

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