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THE IMPORTANCE OF SPACE PROJECTS TO THE DEVELOPMENT OF THE AUSTRALIAN SOFTWARE INDUSTRY

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Summary: It is argued that Australia's involvement in the planning and execution of space projects will provide a considerable impetus to the development of the national software industry. Logica's experience in space projects in Europe is used to provide examples.

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THE AUSTRALIAN SOFTWARE INDUSTRY

It is the consideration of many that software provides one of the keys to the future industrial development of Australia. While it is becoming increasingly difficult for Australia to compete in conventional manufacturing industries with the cheaper labour of developing countries, there is an enormous potential for export earnings in the highly skilled indigeneous software community. It is not the purpose of this paper to present an argument for this case but rather to argue that a strong Australian space industry will provide a great boost to the development and the competitiveness of the Australian software industry. That this is the case in the United States where the space and software industries have been developing hand-in-hand for about 25 years is undeniable. A closer parallel to what is possible in Australia can be drawn from Europe where the space industry has only come into its own in the past ten years or so and is a considerable stimulus to the European software industry. Logica in Europe has been involved in space software from an early date and much can be learnt from its experience.

SOFTWARE IN SPACE

The benefits to the software industry of space projects must be seen in the context of the rapidly growing importance of software to those projects. Software has come to play a crucial role in space mainly due to three trends:

- The proliferation of microprocessors onboard satellites means that the software resident within those micros is called upon to provide functionality which previously would have been supplied by hard-wired electronics.

- The ground segment is more and more recognised as the part of the space programme which ensures that the user community obtains the benefits available from the space segment. Extension of the user community to include 'non-space' members calls for ground facilities which are responsive to their needs, and this is increasingly achieved by having software provide a 'user friendly' interface.

- Computer simulation plays an increasing role in the development phase of space projects. The cost effectiveness of computer simulation continues to increase relative to alternative design verification techniques such as breadboarding, prototyping, etc. Software is the key element in ensuring the integrity of the simulation.

These trends point to the infiltration of software skills into the system level of space projects. The three mission areas listed above - onboard functionality, end-user service and design simulation - can only be undertaken by personnel who understand the mission goals and constraints. The management of space projects must adapt to these trend in two ways:

- The project system engineering team must be skilled in software techniques.

- The contractors chosen to carry out the software tasks identified above must be conversant with mission objectives. Only in this way can they realistically undertake to deliver software meeting the functional requirements of the mission.

The key role played by software in current and planned space projects calls for the use of project and quality control techniques as for space hardware. The software contractors must in turn be qualified to implement those techniques.

BENEFITS TO THE SOFTWARE INDUSTRY

Space sector projects are of particular importance to the software industry because of the need to use advanced techniques and tools. In general terms that need stems from:

- high reliability and fault tolerance of onboard software due to the inaccessibility of satellites after launch

- constraints on mass and power in orbit which lead to the need for very efficient usage of the onboard computer hardware by its software, both in terms of memory capacity and processing power

- a corollary of the previous item whereby the tendency to use non-standard onboard computer hardware requires software devlopment without a full range of support software

- the use of computer simulation in the design phase calling for confidence in the integrity of the simulation software

- the complex project team structure which is typical of many space projects, resulting in the software contractor having interfaces with many organisations and subsystems

- the need for the satellite to work first time, unlike (say) missile or aircraft missions where several prototypes are first constructed and flown.

The software, the associated skills and the supporting software engineering techniques and tools which have been developed for space projects have found application in many other sectors because of this reliance on high reliability and leading-edge technology. Unlike hardware, software is unaffected by weightlessness, thermal extremes, vacuum and radiation. Spin-offs to other sectors from space projects has therefore proved much more feasible for space software than for the much larger space hardware developments.

The constraints imposed on software by the space industry are obviously directly comparable with the requirements of certain other sectors such as defence. However, the success of numerous other industries demands software attributes similar to those required by space projects. For example, the reliability of software in the financial sector can mean the difference between efficient operations and huge financial losses. The efficient production of compact, high functionality microprocessor software for consumer items can be crucial to the final cost and hence competitive position of the items. Just as computer simulation saves time and money in space programmes it can prevent enormous waste in projects as diverse as designing new cars and planning new telecommunications systems.

Some examples from Logica's experience are given in the following section.

SPACE SPIN-OFFS AT LOGICA

Logica has had some involvement in the European space industry since the mid-70's. Since 1979 a systematic concentrated effort has taken place to build up Logica's space business in line with the development of the European space industry. The resulting staff and revenue growth in Logica's division specialising in space projects is as follows:

YEAR	79	80	81	82	83	84
STAFF	5	10	25	40	75	125
$M	0.3	0.8	1.9	3.2	5.3	6.4

All the staff are university graduates, a large proportion of whom are recruited directly from university and are trained by Logica. Their skills cover a wide range of areas many of which find direct or indirect application outside of the space industry as can be illustrated by some examples.

Looking first at space science projects, almost every involvement by Logica in such activities has led to commercial benefits in other areas. Four examples follow.

- **GIOTTO (Halley's Comet)**

Logica evaluated and simulated the Reed-Solomon error correction coding units being developed by Laben (Italy) under contract to British Aerospace and later to the European Space Agency's (ESA's) ESTEC establishment. Since that quite small activity, development work has continued and several consultancy and in-house design contract for data coding systems based on the Reed-Solomon approach have been undertaken.

- **HIPPARCOS (Astrometry)**

Under contract to Matra (France) Logica designed, developed and operated a software simulation of the mission performance of the Hipparcos space and ground system. This experience led to Logica's selection by another client, not related to Matra or the Hipparcos project, to develop simulation software for advanced missions.

- **IUE (Ultra-violet spectrometry)**

The ESOC establishment of ESA contracted Logica to develop and enhance the image processing software at the IUE Villafranca ground station. Upon completion of that project Logica initiated an in-house R & D programme which led to several image processing products and projects. The IUE experience was crucial in confirming Logica's recognition that existing image processing systems had serious flaws and limitations. In addition, it helped to clarify a number of technical decisions during the design of Logica's proprietary INSIGHT image processing package. INSIGHT is now being used by clients in the communications, medical and defence sectors as well as for space applications.

- **SARSAT/COPAS (Earth segment)**

Logica is developing the software at the ESOC control centre for several scientific missions. This experience has been fundamental in allowing the development by Logica of a number of ground processing systems such as the UK Local User Terminal for the SARSAT/COSPAS search and rescue mission.

The spin-off from non-scientific space missions are just as impressive as for the scientific ones. The following are just a few examples:

- One of our current applications of the concept of Expert Systems is to an earth observation space mission. The software developed by Logica for that application is now being used for non-space applications of this artificial intelligence concept.

- Logica developed a data encryption system for the wideband satellite network established during the Project Universe exercise in the UK. The system is based upon the UK DES standard and uses the RDA public key cryptography approach for key management. This experience has led to contracts for data encryption consultancy and implementation, particularly in the banking sector.

- The management of space software projects has been a powerful training ground for Logica's managers. The Managing Director of our UK company and several of his Business Managers have gained experience on multi- national space software projects.

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- ESTEC chose Logica to develop a software engineering tool to assist with the acceptance phase of software procurement. The QUAY package, as it is called, analyses FORTRAN programs for conformance to standards and test coverage requirements. QUAY is now being marketed generally, and is being considered by non-space clients in the defence, energy, research and civil engineering sectors.

CONCLUSION

The benefits to the European software industry of the European space programme are indicative of what could be achieved in Australia if a healthy space industry were established. Principal amongst these perceived benefits is the prospect of employing and developing the large pool of technical talent both already existing in the Australian workforce and being trained within the education system and turning this talent to establishing a strong competitive edge for Australia in the world software market.

Logica in Australia is well prepared to contribute to this beneficial process by providing technology transfer from its European involvement in space projects.

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