

From Sea 1114 to Sea 1000: the Collins submarine project and the next RAN submarine

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The Beginning Tells the Tale

The history of the Collins class submarine project is the study of a very complex and detailed undertaking spanning some 30 years which saw fundamental change in Australia. As I traverse the major events of the story, I will try to identify issues that were significant from the perspective of project management. Unavoidably, in covering the events of 30 years in a short time, there will be many things glossed over and, of necessity, judgments made that you may think wrong or disputed by other evidence. Hopefully these differences will highlight the fact that there are lots of trails in the history of the Collins class that lead in different directions.

Although much discussion of the Collins class acquisition program begins in early 1983, with the beginning of approaches to industry by the project office established under Captain Graham White a year earlier, the Navy's* work to provide a new submarine had begun some five years earlier.

In 1978, Barry Nobes, then director of submarine policy, had produced a paper justifying the continuing relevance of submarines in the RAN once the then serving Oberon class boats had retired. These arguments were adopted by the Defence Operational Requirements Committee as the basis of further work in August of that year. By 1980 the project had developed to the point where Frank Owen was posted as 'follow-on submarine project officer' and began developing a paper that, by early 1982, had gained Navy acceptance as detailing the key characteristics of a new generation of RAN submarines. The early work saw the Fraser Government funding of the project in the Budget of August 1981 and the requirements defined at that time were to remain the basis for the development of what was now designated Project Sea 1114.

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* 'Navy' and 'RAN' are used interchangeably throughout this paper. They refer to the Royal Australian Navy.

The required ships characteristics were derived from the Navy's experience operating the Oberon submarines and, particularly, their development of long-range intelligence gathering missions. These had proved to be highly effective and gained praise from the United States for the quality of the information the RAN boats were able to garner. Based on Oberon operational experience, the requirements for the new submarine emphasised the need for long-range and high endurance.

Often depicted as a range of 10,000 nautical miles and a mission endurance of 70 days, these simplistic metrics represented a synopsis of a number of far more sophisticated performance parameters.

Experience was also central to the development of the systems for the Collins class.

At the time, the RAN was implementing the Submarine Weapons Update Program (SWUP) to modernise the combat systems of the Oberons. These had been acquired with an almost Second World War command arrangement of glass plotting table and grease crayons. The SWUP introduced a computerised system that provided the commander with firing solutions derived from the data of the latest generation of submarine sonar—types of sonar that were then so novel in conventional submarines that they were themselves the subject of considerable research by the Defence Science and Technology Organisation. The crucial operational benefit of this work was that, when the SWUP was perfected, the Oberons were the first conventional submarine in the world capable of operating the US Navy's nuclear attack submarine weaponry of Mark 48 torpedoes and sub-launched *Harpoon* anti-shiping missiles.

The Navy's conviction that it already possessed the most advanced combat system in a conventional submarine led it to conclude that this superiority could not be sustained by accepting anything that came with an existing design. Consequently, the opinion grew that the combat system for the new submarine would have to be developed as a distinctly separate component within the acquisition program. In an era where systems came with the platform in a package dictated by the shipbuilder, this was a radical approach to capability development and was to become one of the most important decisions influencing the future of the Collins class.

In yet another area, Oberon experience was critical to the way the project developed.

The RAN had experienced increasing difficulty in maintaining its O-boat fleet. Through-life-support requirements were never a strong point of the Oberon design and, with the RN focused on nuclear boat operations, it became increasingly difficult to get them to respond to the support issues that arose. With the Falklands War, British support for the Oberons all but ceased.

Now, the RAN reasoned that if the new submarines were built in Australia they could be maintained throughout their service lives by the local industry that the build program would create. They argued that the increased operational availability of the new submarines would represent a benefit that outweighed the additional cost entailed.

This objective shaped the way the submarine project developed. If it was going to be about building submarines in Australia, it was no longer a traditional capability acquisition program but now had to balance the objectives of naval capability, industrial development, complex project management, parent navy responsibility and through-life logistics support planning in equal part.

So the observation that the future of any complex engineering project is determined during the first 5 per cent of its life was certainly true with the Collins. Before any formal approach to

industry had been made, the RAN was shaping a project that attempted something that Australia had never before done, that was to requiring a submarine of a type existing nowhere in the world, and envisioned systems that had not yet been built (in fact, there was no accepted working definition of distributed processing, the architecture that was to be specified for the new submarine's combat system).

Yet remember that all of these objectives, as daunting as they appeared, were logical deductions from the experience that the RAN had already accrued in submarine operations. The deductions were so powerful that risk controls in the procurement strategy, such as a requirement for a proven or parent navy-supported design, fell away as evaluation of industry offers showed the RAN needed to develop a new design to meet its requirements.

Bold Initiatives, Problems and Controversy

Given all of the above, it's hardly surprising that the Collins project was to provide so many surprises and challenges, so much political drama and such public controversy.

Surprises were many. Most of the publicly fancied designs were passed over in the first stage of the evaluation. The eventual winner of the selection process, the Kockums Type 471, had hardly been considered a serious contender when the first requests for tenders were made. The Australian Submarine Corporation, the consortium that was to build the Collins class, was created barely in time to submit a 'best and final' offer to the Commonwealth.

Furthermore, the site Australian Submarine Corporation (ASC) chose as its construction facility was not a proven shipyard but a swamp near the mouth of the Adelaide River.

Everyone involved was determined to avoid the dysfunctional characteristics afflicting Australian industry at that time (and 'everyone' included the union leadership) and start the project with a clean slate on a so-called 'greenfields' site.

Such a move might have met passionate resistance a few years earlier but the timing of the Collins project was to prove fortuitous. Australia was in the grip of a severe recession, one that had damaged heavy industry particularly and seen over 100,000 jobs lost to the metal trades alone. Hence everyone was keen to get a slice of the multi-billion dollar contract that the Collins represented—not only shipbuilders, industrialists and unionists but State governments anxious to underwrite a future employment base for their populace.

It was to be the almost ferocious zeal with which State governments pursued workload that gave the RAN and Federal government the support to ensure that such a daunting, if not outright risky, project went ahead. Furthermore, because the project team had recognised that modular construction was the way to make feasible submarine building in Australia (with ASC's site more of grand assembly park than traditional shipyard); there were slices of the action to spread around most of Australia.

The contract to build six Collins class submarines (with an option for a further two) at an estimated cost of A\$3.9 billion was signed by then Defence Minister Kim Beazley on 3 June 1987. The contract document departed from the previous 'cost plus' model of contract management and applied a 'fixed cost' basis for the discharge of the contractors' obligations, with a separate contract for ASC and for the Rockwell consortium developing the combat system. Yet not all details of the contract had been fully negotiated, particularly those that went to guaranteeing the contractors' performance and strangely, although Rockwell had a separate agreement with the Commonwealth, the documents designated it as a subcontractor to ASC.

Although no one saw it in these terms at the time, the Navy was embarking on one of the earliest examples of 'just-in-time' project management. Detailed design of the submarine was still evolving as ASC was constructing its yard and companies around Australia were gearing up to produce structures, systems or components. The design was to grow through this period from a boat a little over 2000 tonnes to one that hit the water at 3051 tonnes, making it the largest modern conventional submarine. Simultaneously, ASC was training from scratch a workforce to use the latest heavy engineering technologies and materials, whilst its own company structure was being subjected to internal friction and fundamental change with some major participants in the consortium dropping out and being replaced.

It is probably not surprising, therefore that when the first boat, HMAS *Collins*, was launched in August 1993—to meet the contractual schedule agreed some six years before—it was not ready. In fact, it was almost another year before the boat was fit to start trials. Gradually, and again unsurprisingly, these began to unearth problems. Actually it is more accurate to say that already problems had threatened the trials, which were only possible after some quick computing fixes—the combat system did not work as required and was so unstable that a meaningful schedule of work could not be compiled.

By 1997, the problems being faced by the project were beginning to become public. They had spread beyond the recalcitrant combat system to include unacceptable noise levels, unreliable diesels, dodgy and sometimes even dangerous periscopes, leaky valves and seals and completely inadequate communications.

Although *Collins* had been commissioned in July 1996, the Navy continued to refuse to accept the submarines as fit for initial operational capability and it suddenly faced an extended compromise of its submarine warfare capability, with the last of the O-boats about to retire. The situation led relations between the Navy and its contractors to become extremely tense. Then, the Liberal/National Party coalition government, still in its first term, decided to use the project as a weapon to attack the Leader of the Opposition, then none other than Kim Beazley, the *Collins*' earlier champion.

The future of the project had come under real threat. A proposal from Treasury that the *Collins* project be capped at four boats, made during the lead up to the 2000 Defence White Paper, reflected the extreme doubt over the worth of continuing the project that existed at some levels of government.

However, behind the atmospherics, much was being done to improve the situation. The Navy had achieved the near impossible task of being granted access to the submarine technologies of the US Navy and the Defence Science and Technology Organisation had begun a series of tests and analysis on diesels, periscopes, underwater noise and the architecture of the combat system. Thus when the Minister for Defence, John Moore, in July 1999 instituted the Submarine Capability Team (SCT), an extra-ordinary project under Admiral Peter Briggs to fast track *Dechaineux* and *Sheean* to minimum operational capability by the end of 2000, the tools were available to allow him to get the submarines into operational service. More importantly, because of their support of the SCT initiative, the Government was now committed to the *Collins*.

Yet, in reality, Peter Briggs did not fully achieve his objectives. Even though *Dechaineux* and *Sheean* entered service in February 2001, they never met the desired level of capability simply because, no matter what the hard work of the contractor (now Boeing, having acquired the defence work of Rockwell), the combat system—though somewhat reformed—continued to be cranky.

It seemed undeniable that the only way to address the problem was to adopt a recommendation of the Macintosh/Prescott Report (released by Defence Minister John

Moore in June 1999) that a proven, off-the-shelf combat system should be selected as a replacement, and this was duly approved by government. The replacement was quickly identified as the German Krupp Atlas ISUS after an expedited selection process.

However, in another of those dramas that marked the Collins project, the recommendation was overthrown on advice of the then Chief of Navy, David Shackleton, and an evaluation that may have led to the selection of a German heavy weight torpedo was also suspended. Instead, the government decided in mid-2001 that the RAN would enter a development program with the US Navy for a replacement combat system based on the core of the US Navy's AN/BYG-1(V)8 nuclear attack submarine system, but which retained many of the features developed by the project office and DSTO to achieve an acceptable degree of functionality with Rockwell's original system. The new torpedo would be a further Mod number of the Mark 48, again to be developed with Australian participation.

The government's reverse of policy did nothing achieve the upgrade of the Collins class' operational capability by the mid-2000s, which had been expected to flow from the work of the SCT. It was to be another eight years before the replacement combat system was to be demonstrated; when HMAS *Waller* deployed it during the 2008 RIMPAC exercises.

However, the change of direction did give Australian industry and defence science a significant role in the development of submarine technologies, with the Commonwealth undertaking the responsibility of design approval authority for the combat system. Further, it cemented the RAN's unique cooperation with the US Navy in submarine matters—an arrangement formalised by the joint agreement for cooperation on submarine matters signed by both navies on 10 September 2001.

An Overall Success

By 2004, Project Sea 1114 was complete. It had delivered a comprehensively updated submarine warfare capability to the RAN, despite problems and some continuing shortcomings. The Collins project provided the RAN with much more than the six largest conventional submarines of the modern era. It was also the basis for consolidating and extending the Navy's expertise into the next century.

If deployability is the foundation of capability it is doubly so for submarine warfare, where the operating environment is brutal. In this regard the project and, indeed many of the outcomes of tackling its problems, has left the Navy well endowed. The RAN's submarine operations are now supported by a development and build capacity at Adelaide, a deep maintenance, overhaul and design authority (also in Adelaide) and the Collins SPO plus commercial maintenance facilities in Perth.

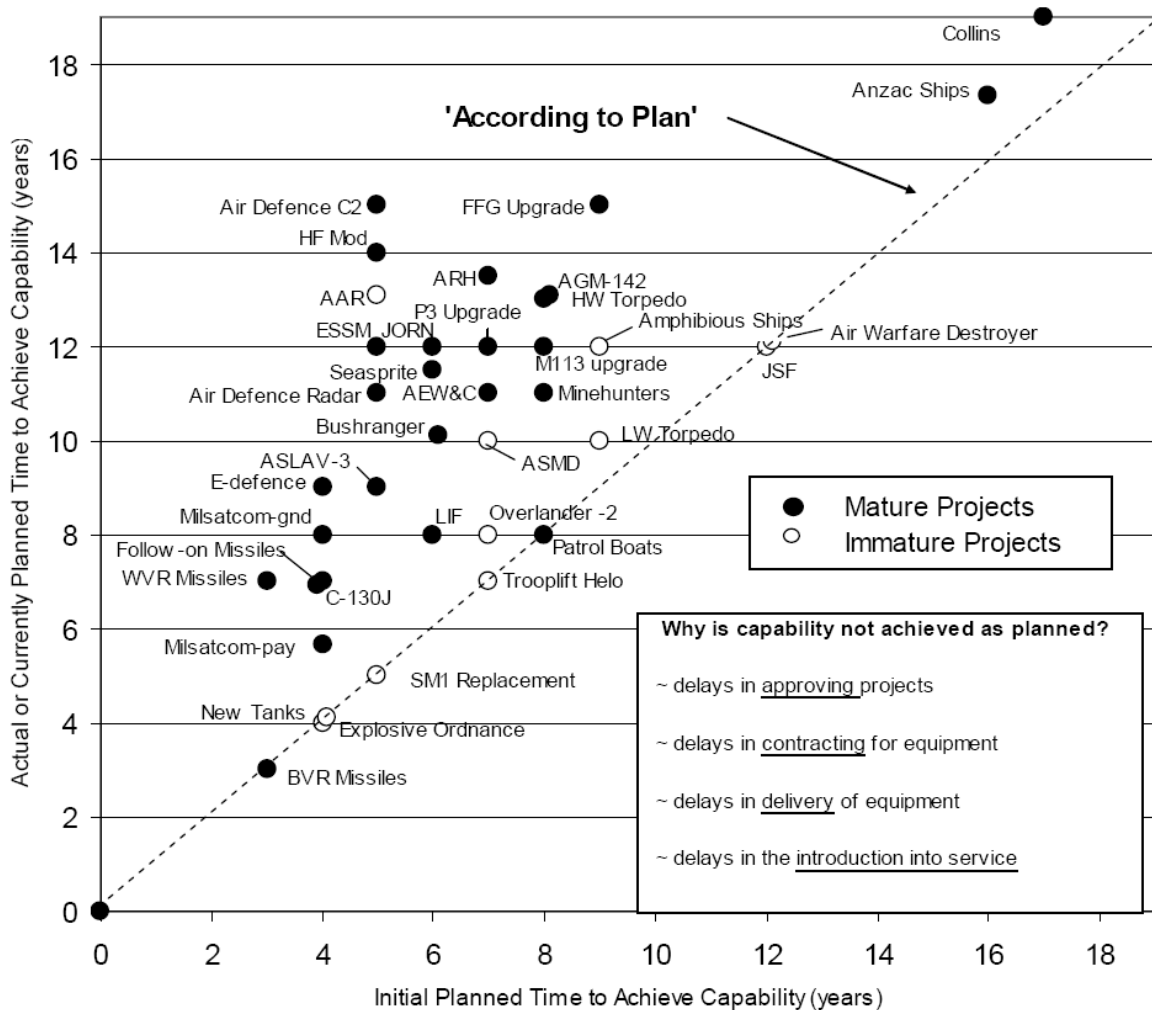
The demanding submarine operational environment requires rigorous attention to safety. With the Collins project, Australia developed its own procedures to warrantee and manage the operational safety of its submarines. The development of an indigenous Subsafe licensing regime was one of the significant achievements to emerge from the project. Extensive scientific RD&E capabilities (metallurgy, diesel technology and undersea acoustic research in Melbourne; systems research, design, integration and proof testing at Edinburgh), created or enhanced to support the development of the Collins, remain as significant supports of the operational effectiveness of the class. As well, the unique channels for access to US Navy subsurface warfare technology won during the project's most challenging days remain as an ongoing support to RAN submarine operations.

The Collins project delivered world-class performance in many, often surprising, areas. There were significant technological advances—the introduction of a new alloy of high stress steel,

pioneering technologies in welding that sometimes disproved previous industrial practice, anechoic titles of indigenous design (as other nations would not release details of theirs) that perform effectively and, unlike the others, do not fall off.

ASC's Adelaide yard grew into a site using the most advanced computer assisted production techniques available and capable of producing a submarine a year, a remarkable achievement by any world standard—but outstanding compared to the first-build projects of other nations. The management of assembly was so accurate that when submarine sections were joined together (each section being a completely fitted-out module, with anechoic titles attached) there were no visible gaps between the tiled sections along the length of the hull.

Most of this was delivered under Sea 1114 for around A\$5 billion, which, allowing for inflation, was actually slightly less than the contracted price of A\$3.9 billion. However, the project had encountered many difficulties that were to be rectified under new project numbers, and an additional A\$1.2 billion was spent overcoming these. Yet of this additional expenditure most was for capability upgrades; only around A\$143 million was spent to rectify the specific faults (excepting the replacement of the now terminal combat system). On that ground the Collins is a singular success because, despite its portrayal in the media as a financial disaster, it arose out of a period of enormous acquisition cost overruns to finish two decades later with the original price still relevant to project management objectives.



(Source: Mark Thompson, *The Cost of Defence: ASPI Defence Budget Brief 2006–07*, Australian Strategic Policy Institute, Canberra, May 2006, p. 112, Figure 4.11 'The long Wait' at <http://www.aspi.org.au/publications/publication_details.aspx?ContentID=93&pubtype=-1>, accessed 1 February 2009)

Such a performance is not that unusual today, where contractors are generally compelled to meet the cost of rectifying unsatisfactory performance. Consequently, escalation of the price to the Commonwealth is no longer a useful guide for comparing the management of acquisition project. Nowadays, performance to schedule is a more useful independent variable. On this basis, the performance of the Collins project is amongst the best. The project experienced delays for a variety of reasons but, after contract signature, the Collins boats were delivered on average within 26 months of agreed dates.

The chart on page 6 shows the actual time to deliver recent complex acquisition projects compared to contractual objectives. It was prepared in 2006 and in some cases, such as with Project *Wedgetail*, the outcome predicted has since worsened. Of complex projects, only the ANZAC class frigate, which followed the Collins and benefited from the experience, displays a better performance. Even projects that have been considered models of successful project management, such as the off-shore mine hunters, experienced longer delays. It is difficult to not think the Collins project a success when it built from scratch something never achieved before in Australia, which required complex processes and advanced technology and was brought on stream in the same or better time than other benchmark projects.

Some Preliminary Thoughts on Lessons

Now, I'll try to develop some thoughts about lessons for Sea 1000 that we can draw from Collins.

If, as I have argued, the project was a significant success, the most important lessons must be about how this was achieved. The fundamental insight into the management of the project relates to how its most important objectives were conceived in its early days. I would identify two key concepts that were crystallised in the very early days of the project and that influenced its entire structure. To summarise, I'll call these 'sustainability is capability' and 'the task is assembly, not shipbuilding'.

Sustainability is capability

The Navy's desire to build the submarines in Australia so that they might be supported in service by the builder was, as I have said above, influenced by the difficulties that the RAN experience in keeping their Oberon boats operational. The project team did not, at the time, formulate the issue as bluntly as I have, but they fully realised that the efficiency of their submarine force was impaired by its unsatisfactory support arrangements. The capability of the RAN's submarine force was directly linked to its availability and the availability of the new submarine would be best enhanced with through-life-support provided by an Australian-based builder.

This was probably the dominant concept influencing the Collins project. Once it was agreed to build in Australia, the nature of the project was defined and all management concepts had to be changed to fit. The early work of the project team and supporting elements within the Navy, particularly under Bill Rourke as Chief of Navy Materiel, exerted considerable effort within Australia and overseas to understand what would be involved in local construction. This enabled the project to clearly define the challenge and allowed them to focus the responses required when industry was approached. As a consequence, responders to the first tenders were asked not just for offers of equipment but for concepts and details for its construction in Australia. This was an important building block for the project and fundamentally changed the nature of its management.

This concept was successfully implemented. The project acquired naval vessels with a 70 per cent Australian industry content at a time when Defence struggled to get a 10 per cent

offset in major acquisition contracts with overseas prime suppliers. It also succeeded in providing the basis for long-term support for Australia's submarine force, once some political diversions had been bypassed, for the life of the class. Somewhat circuitously, for they came by way of solving the problems delaying development of the class, Australia's venture into submarine building provided an entrée to collaboration with the United States in submarine technology and the establishment of an Australian design authority for supporting capability enhancement and future class development.

However, the history of the project was to show that the growth of a new industry brings with it its own collection of interests, and that these could be a persisting source of difficulty. More will be said later about this.

The task is assembly, not shipbuilding

Abandoning the natural assumption that the project would be an exercise in shipbuilding and conceiving of it as project management applied to a complex assembly operation, made feasible what was previously considered impossible.

The adoption of this concept initiated another imperative that forced selection criteria to be radically altered. When the project office began its work, the general attitude outside the Navy was that submarines could not be built in Australia. This was in part because of the perceived complexity of submarine construction, but it was also a result of the appalling recent record of traditional ship yards in Australia. However, viewing the task as assembly allowed the project team to verify that Australian industry could build, or develop the capacity to build, the components needed to complete a submarine. What you then needed from tender respondents was a management system that allowed you to reliably and efficiently assemble the components into a submarine. Although it was hardly noticed at the time, Newport News, then building the latter series of Nimitz class aircraft carriers, had adopted Kockums' computer-based management system and reported reductions in production costs of up to 25 per cent.

However, developments such as this did indicate that the innovative approaches to production management, site arrangements and industrial relations that would be needed to make the concept work were becoming available. By the early 1980s information technology was spreading into industry, with the realisation that the consequences would be considerable. As the Collins project developed, these influences spread from design to production management and on to the development of logistics, training and through-life-support planning.

Hence, the concept underlay much of the success of the project, underpinning production rates of one submarine per year, the widespread use of sub- and sub-sub contractors and the achievement of 70 per cent by value of all expenditure being paid in Australia.

And Getting it Wrong

As a contrast, it can be shown that poor conceptualisation of objectives early in the development of the project led to failure. The prime example is, of course, the Collins combat system.

At the time of developing the characteristics for the new submarine, the idea of developing a combat system separately from the platform was revolutionary. The project team conceived this approach because the RAN's submarine operators saw their objective as maintaining the pace of advances they had made in getting the SWUP Program into operational service.

There was no submarine design house that offered a combat system with better performance than that already at sea in the Oberons.

Furthermore, the next level of technological advance, software-based systems, seemed to reduce developmental risk compared to the previous reliance on proprietary processing hardware, although the project was acutely aware that some aspects of the systems concept pressed against the boundaries of technology and that it would be making some decisions with very limited information. An alternative concept might have been to migrate a variant of the Oberon system, evolved to process data from the new sensors, to the Collins.

The evaluation of the commercial combat systems offered to the project suffered a weakness that limited scrutiny of the basic concept in contrast to the issues arising from local construction, which had been subjected to vigorous opposition. In execution, the evaluation of combat system tender responses became a classic case of familiarity reducing the threshold of risk perception. The success of the SWUP led to over-confidence through the conviction of the Navy's Submarine Warfare Systems Centre that it could develop a forward-looking and realistic set of operational requirements for the new system and that it could assess the compliance of responding tenders.

The Tender Evaluation Board's assessment of the competing systems was logically structured and objective, evaluating comparatively the features of even those proposals thought to have little chance. However, familiarity with the consortium led by Rockwell (which contained Singer Librascope, a central participant in the SWUP) caused the Board to abandon its dry and technical impartiality and adopt an enthusiasm seldom seen in formal government reports.

The faith that the project placed in the automatic processing capacity of the Rockwell system proved unjustified. So to did trust in the capacity of international technology leaders to deliver the product for which they had freely contracted—a phenomenon repeatedly demonstrated right up to the recent conclusion of the Kaman helicopter saga. The Collins combat system was to fail in architectural concept, technical capability and industry-partner relationships. Acceptable performance was not achieved until its architecture was altered and data processing broken out from its original pathways and assisted by new American and Australian applications introduced with DSTO assistance after the RAN sought help from the US Navy.

In general, the Collins combat system showed many similarities with acquisition programs for software intensive systems that were to follow. The most important of those features that came to be replicated were a desire to centrally process input data from too large a range of sensors, to simultaneously distribute and concurrently display so much data that it exceeded the system's capacity to exchange information and to remove human expertise from the loop at too early a stage. This is a list that was echoed in the desired objectives of the Kaman Super Seasprites' Integrated Tactical Avionics System and the Recognised Air Picture supposed to be produced by Project *Vigilare*.

Watch for the Inherent Contradictions

It has to be recognised, however, that such pathways to success as outlined above also contain traps that project management should locate and remove. The Collins project demonstrates the probability that the implementation of any procurement strategy will inevitably require trade-offs.

The implementation of the major project concepts was notable for the use of a fixed price contract. Underlying this was a belief that a contractor's signature would see it taking

responsibility for the risks and the obligations required to discharge the contract. The assumption proved to be by no means guaranteed, as developments during the life of the project proved capable of defeating the intent of any legal obligation, regardless of earlier agreement between the participants.

One of the factors in operation was industry politics. By this I mean not merely attempts by commercial bodies to influence the political facets of the project, but interference arising from the internal agendas of the participating companies. The decision to build in Australia was a project cornerstone, but it exposed Collins to this hazard—difficult to avoid since the commercial entities involved would always have their own interests to safeguard, regardless of their conjoint participation with others to meet the Commonwealth's objectives.

A casualty was to be the Collins combat system, where the politics of protecting commercial interests were to prove disastrous. Rockwell and Singer Librascope may have been members of the successful consortium, but their separate commercial goals placed them as competitors in the world outside the Australian project. Seeking not to advantage its competitor, Singer delivered on its obligations early and effectively left the consortium—its expertise (an important factor leading to the consortium being evaluated as preferred supplier) thus being unavailable when, later, the combat system failed to meet requirements.

Then again, despite its commitment, a company might find its technological capacity rendered insufficient by the changes that inevitably occur over the lifespan of most major acquisition projects. There was an element of this in the dispute that occurred between Kockums and the Commonwealth over the need to improve the cavitation performance of the boats' propellers. With the best will in the world, Kockums could neither hope to compete with the output from the project's access to the US Navy's underwater technology nor even to be in a position to assist the absorption of that classified information into the Collins design. Nonetheless, Kockums retained a responsibility to safeguard its shareholders' interests and its continuing roles in the project and the protracted legal action that ensued was a classic example of the consequences of growing misalignment between project requirements and industry politics.

In an even worse manifestation of industry politics, market imperatives may remove a contractor altogether, causing turbulence and delays and (often of significant consequence) the loss of the expertise and dedication of the original commercial participants. Of the original ASC consortium, Wormald (then one of Australia's leading technology developers) ceased to exist early in the life of the project. Rockwell's US parent left the military systems market in the 1990s, flick passing the Collins combat system to Boeing. Kockums itself was acquired by its old competitor, HDW, triggering a government take-over of ASC which, whilst allowed under the contract, was nonetheless completely against the direction of general economic policy.

The lesson is that, ultimately the Commonwealth cannot leave it to contractors to solve problems in major defence acquisition projects. Only the Commonwealth has an abiding interest in the objectives of a project. One feature that stands throughout the Collins project (especially as the project team searched for responses to problems, as DSTO conducted research on their origins and the Navy sought assistance from the United States to overcome them) is that the Commonwealth must command access to the means to rectify problems if it intends to have projects achieve their objectives.

A Reflection of Society and the Times

In the end, the ability to implement such bold concepts as I have outlined and the form that they adopt, is inevitably influenced by the availability of technological solutions but also, at a

fundamental level, by the environment of the times. As the Collins project came on stream it was drawing on significant advances in technology, much of them locally developed. At the same time, it also drew on some fundamental changes in Australian society as the nation became less inward looking and industry more export oriented. It was this social environment of the times that provided the important subtext to the success of the Collins class project.

In a way that most people do not notice, the social context influences the way that most complex projects are developed. Indeed, major defence projects tell a lot about the societies in which they occur. You can think, for instance, of the great dreadnought race in Europe around the turn of the twentieth century, what Adolf Hitler's rearmament said about both Germany and the state of European security at the time or what the American-Soviet missile race said about the state of society during the Cold War. It is the economic base and technological capacity of a country, the determination of political, Service and project leadership and their approach to retaining project objectives as problems emerge that ultimately decides the fate of complex projects such as the Collins class and, one would presume, whatever we decide to call Sea 1000 when it eventually enters the water.

My judgement is that having been through that process with Collins, despite changes in the structure of Service and industry support in the meantime; those conditions persist in Australian society and will sustain the successful development of a new class of submarine.