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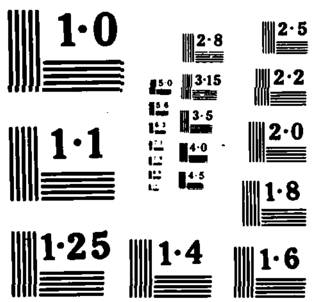
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PROCEEDINGS

FIFTH SHIP CONTROL SYSTEMS SYMPOSIUM

OCTOBER 30 – NOVEMBER 3, 1978

SUPPLEMENT

DAVID W
NAVAL SHIP RESEARCH
CENTER, ANNAPOL

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SUPPLEMENT

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KEYNOTE ADDRESS

SHIP SYSTEM INTEGRATION FOR FUTURE DESIGN

by The Honorable David E. Mann
Assistant Secretary of the Navy
(Research, Engineering and Systems)

It is not my purpose to come and talk to you today about ship control hardware, or hardware programs, or even about better or newer hardware that you will be dealing with in depth during this conference. Rather, I'd like to talk about one of the fundamental strengths of the United States and of our allies. That fundamental strength is the power of ideas and more particularly, I'd like to talk about how we translate ideas into hardware, and just as importantly how we group hardware or aggregate it together so that we, in fact, derive the delivered product -- combat ready ships. It's been very fashionable of late in our country to discuss, to dissect, to be concerned with the acquisition process. I would like to suggest to you this morning that there are in fact two aspects to that. The first represents the fundamental strengths of all of our democracies, that is, the ability to generate the technology. The second is the classical requirement that is involved in the give-and-take of the total acquisition process. As with any give-and-take, there are some fundamental difficulties which we should all recognize. First, it is a fact that technology and requirements are not necessarily synchronized in time. It is often the case that technology will be ahead of the relatively conservative nature of those who generate requirements. Let me give you an example of why this should be so. When the United States contracts for a ship with the shipbuilder, we let the contract for the entire ship; that is, we insist that the shipbuilder build the ship, install the equipment, cables, consoles, computer, radar, and all other equipments, and then demonstrate that they all operate together as designed. The shipbuilder is responsible for delivering a final product. It is the United States Government's responsibility to provide the shipbuilder with the equipment and with the tools to insure that the product is delivered as contracted for. It is however, the shipbuilder's responsibility to provide all of the myriad trade specialists which will insure proper installation and the performance of the equipments. Now the plain fact of the matter is that no shipbuilder in a free enterprise system can afford to maintain the myriad of special personnel required to install, to check out, and to insure the proper function of all the complex equipments that we utilize today. Hence, it should come as no surprise that shipbuilders and the naval personnel that work with them are, in fact, very conservative people and that the requirements for our ships, that is, equipments to go on the ship reflect the conservative approach inherent to the shipbuilders' business practices. Let me point out a second problem that is inherent in bringing technology into being in the face of conservative implementation efforts. In my position, I see a lot of good ideas and a lot of R&D initiatives, and many technology programs working to solve the world's problems. What one does not see is a coherent pattern behind the direction of the technology push. There is a lack of coherency in our technological approaches to the problem.

So far, I've only talked about new ships and new ship programs. That is not the only problem area. There is a need to infuse new technology into our naval ships throughout the life cycle of those ships. In most navies critical attention is paid to updating the combat system on a ship and to provide the latest combat system technology that is available during the ship's major overhaul. There is less tendency to update our basic hull and mechanical items; our engines: our electrical distribution system, our ship control system; our damage control items and our ship self-protection systems with regard to such things as armor and passive defenses against weaponry. Further, there is a tendency when updating our combatant ships to utilize what is available or what is already proven as state-of-the-art technology. A significant problem in the United States in attempting to update our ships and to use the latest technology throughout the life cycle is that ships of a given class tend to come into overhaul at different times. It takes five to six years to overhaul an entire class of United States combatant ships at this time. Consequently, there is a tendency to include the newer equipments toward the end of the overhaul cycle. We then have a problem in maintaining configuration control and with the cost inherent in supporting ships with different configurations.

These problems certainly are sufficient food for thought. They give us a great deal of difficulty in digesting them. The question then remains, "What should we do about all these problems?" We need to do total ship engineering, top-down design, etc. We need to engineer our ships as a whole. We need to engineer the combat system together with its supporting machinery. We need to engineer hull and machinery together. We need to do the whole package together. Let me add two items to those needs. We need to do this top-down engineering -- this total ship engineering -- in such a manner that the total ship is more tolerant of future change. Secondly, we need to consider ships as life cycle entities in the very earliest stages of conception and design.

Let me say, at this point however, that we in the United States do a great deal of top-down engineering today. Much time, effort and money is put into generating top-level requirements, in generating mission profiles, or what we want a ship to do, and how we want it to go about carrying out its mission. There is a great deal of effort expended in assessing combatant capabilities. There is also a great deal of thought that goes into how we want to use the ship and what possible improvement can be contemplated in the future. Let me suggest that there is a bottom line driver in any given series of trades, and today that driving element is the acquisition cost of any given ship and its equipment suit. Increased consideration of life-cycle cost could, in fact, reshape the way ships are basically designed, the way new technology is infused throughout the life cycle of the ship, and probably would result in improved total coherency of our research and development program.

One might ask then, "How would life-cycle cost change our approaches in basic ship design?" Consider the need for tolerance of change. Ships today basically have all their equipment wired together by dedicated cables. There are hundreds and thousands of cables connecting every electrical function in the ship in one way or another. Each time we change one of these pieces of equipment, we must change the dedicated wiring which supports those equipments. Next, consider the fact that we in the United States are moving into a digital world. Today when we change equipments which are dependent upon digital computers, we must also change the digital computer programs. Since most United States ships use only a few digital computers and are, in fact, highly centralized, the programs which are done in these computers are sophisticated and complicated, and each change to a piece of equipment with its attendant change to the computer program tends to create difficulties throughout the whole computer program. The cost of change on today's ship is very high. If life cycle cost or the cost of future change were embedded into the original concept of the ship, I suggest that more careful attention would be paid to the design margins or the standard to which a ship and its inherent systems are built. If, in fact, we include margin for growth or for future change into the basic design of the ship and its basic supporting elements, then the cost of change will indeed be less when the change is effected. There is little sense in designing a ship with an electrical system or an air conditioning system which is limited to support only the equipment with which the ship is originally equipped.

Next, consider the area of maintainability as a life-cycle cost driver which should be considered in basic design. How much more does it really cost us to acquire an automatic performance monitoring system for main ship propulsion? How much will that save in the long run in terms of early detection of equipment failure?

Lastly, we need to consider people as a life-cycle cost driver, and people implication on basic ship design. In the United States Navy today, the use of people is expensive. We all recognize that it has been very fashionable to replace people with machines and to count all kinds of attendant cost savings for that replacement. One of the problems with this has been however, that there is a tendency to take the people that are replaced right off the ship. We forget that in many instances people are multi-function machines. They do not only do the function of the machines which replaced them. People are watch standers in addition to equipment monitors. People provide security to a ship in port. People cook and serve the meals. People have to clean the compartments. People help move the paperwork and even polish the ship's brass bell. All of these functions, while not very glamorous, I contend, are still necessary even in a modern technology navy. I suggest that there is a minimum number of people that are necessary to perform the basic functions on a ship. I suggest that in the long term, improved technology can aid greatly in increasing the productivity of people. I suggest this productivity could be oriented towards improving and increasing the maintenance of the machines which are aboard a modern combatant. I suggest that machines and improved technology can do away with much of the non-productive efforts of our people onboard ship today and allow us to focus their efforts to increase productivity. There is a basic trade involving people productivity and maintenance which must be considered in the automation of today's ship and in the improved technology which we included in today's ship.

Lastly, let me suggest some implications which many of our navies are having to face up to. In today's all-voluntary force environment, the United States has to work harder to keep its people. It would seem to be appropriate to focus technology and include it in ships such that we can get some of the burden off our people, improve their work week, improve their working hours, improve the usefulness of tasks at which they are engaged, and improve the rewards that come from a job well done. In short, we can and should improve the conditions in which our people in an all-volunteer force work under.

So far, I have suggested a philosophy. I've suggested an approach, and I've suggested increased examination of life-cycle cost drivers and their effect on design. What does all this philosophy mean in terms of how we do business? How would we actually make something like this happen? I suggest to you that there are two basic changes which would be required in the way we do business. First, there is a need for insistence that ship life support be one of the basic considerations that are factored into the total trades included in the basic design of the ship, before that design is frozen. Secondly, there is a need to provide organizationally for sustained, forward-looking, top-down engineering on a life-cycle basis by ship class.

I recognize that there are a great number of problems inherent to move into the direction that I have outlined, and inject the considerations that I have suggested into our thinking process. The problems are several-fold. Institutionally, it is the "now" cost, the "today" cost, the "today" problems which are more heavily weighed in our decision-makers' thinking. This is perfectly natural. I further recognize the pressure today in the political environment on any given set of budgets. There is a great need to get more for today's investments and there is a reluctance to consider the cost savings five, ten, and fifteen years down the road if those costs necessitate increased current investments. There is a need to get the budget down.

While recognizing these problems, I also suggest that there is a need for management to ensure that today's investments in ship control, and in general, result in both a better Navy today and a continued vitality of our Navy in the future, and I assure you that that concern is both recognized and is being acted on by today's Navy management. Thank you very much.

AN ANALYSIS OF THE TECHNOLOGY CONTRIBUTIONS
FROM THE FIRST FIVE SHIP CONTROL
SYSTEMS SYMPOSIA

by W. Ward Rosenberry, Consultant

In a series of discussions among representatives from the United Kingdom, Canada and the United States, the need for an organized exchange of technical ideas, plans and recent developments in ship control was recognized. Consequently, in 1966 the first Ship Control Systems Symposium (SCSS) was organized in the United States with all three countries participating. As the first host country, the United States representatives presented 87% of the technical papers; although the exchange of information turned out to be much more evenly balanced. That we all benefited was demonstrated by the extent of the participation three years later in a second SCSS. Although the United States, through the David W. Taylor Naval Ship Research and Development Center, again acted as host, the extent of the non-United States participation was doubled; i.e., United Kingdom and Canada presented 27% of the papers. All parties agreed on the mutual benefits of the exchange and that it would further serve the Naval and Maritime communities if participation could be extended to additional countries sharing common interests. The third SCSS, held in Bath, England, in 1972, had 40% of the papers from the United States, 40% from the United Kingdom and Canada and the remaining 20% from five of the other nine participating countries with half of these from the Netherlands.

Figure 1 shows the growth in the number of papers contributed by participating countries. It is clear from this figure that this has become an international forum for ship control systems. In 1975, in the fourth Symposium, United States and United Kingdom contributions were nearly equal at about 33% each, with the remaining 34% coming from nine additional countries, again with almost half of these from the Netherlands. The work reported on represented a continuation of many developments first reported on at the earlier symposia. Since it was held in Europe, it gave ample opportunity for European participation. The fifth Symposium had 40% United States papers, 29% United Kingdom and 21% from nine additional countries. The decision to return the fifth Symposium to the United States reflected a confidence that the symposium was fulfilling a technical need in the international "free world" ship systems community and could be shifted in locale without jeopardizing the extent or quality of the contributions. This was amply demonstrated by the attendance and participation.

The technical coverage through the years has developed into a definable pattern. Figure 2 categorizes all the papers given at the fifth Symposium into technical sub-areas and identifies the contributing countries. There were 24 papers that were categorized in the bridge control areas and 22 that dealt with various aspects of propulsion control. Bridge control technology includes: piloting and navigation, bridge, collision avoidance, steering control, maneuvering, and maneuvering simulation. The propulsion control technology includes: automation, propulsion plants and control, and propulsion simulation.

Figure 3 lists the technology area contribution for each symposium by year. Over the years, 55% of all papers presented have been in either the bridge control or the propulsion control technology area. Two major supporting technologies that have contributed from the beginning are human factors, accounting for 6% of the total papers, and automatic monitoring, accounting for 7% of the total papers. Other technology areas that have been included from time to time are: stabilizers, propellers, electrical systems, microprocessors, and relevant systems analysis. The control problems of special craft have been included in each symposium, accounting for 10% of the total contributions. The technology distribution in any individual year reflects the special theme emphasis in soliciting papers for that symposium.

Figure 4 contains similar data to that shown in Figure 3 except that instead of separating contributions by years, it shows total contribution by country in the various technology areas. Examination of the figures here can be used to show where the various technology papers originated. For example, the number of United Kingdom contributions in the technology of stabilizers far outweighs all others. Their propulsion control papers also represent the single largest contribution in this otherwise well distributed area. The special craft contributions have come mainly from the United States and Canada, while maneuvering and maneuvering simulation seems to be a concern of all countries.

The data included in this summary were based on this writer's opinions and in some cases, almost arbitrary choices of assigning technology categories to "hard to define" papers. The wealth of papers presented in the proceedings of the fifth SCSS contain much information of value that has supported or stimulated work in other centers around the world. It is realized that the analysis herein cannot represent the worth of the individual contributions, but it does serve to demonstrate that the symposium has become a major technology transfer medium.

NOTE: Material from the above analysis was presented during the Closing Remarks session of the symposium by Dr. Robert C. Allen, Head, Propulsion and Auxiliary Systems Department, David W. Taylor Naval Ship Research and Development Center.

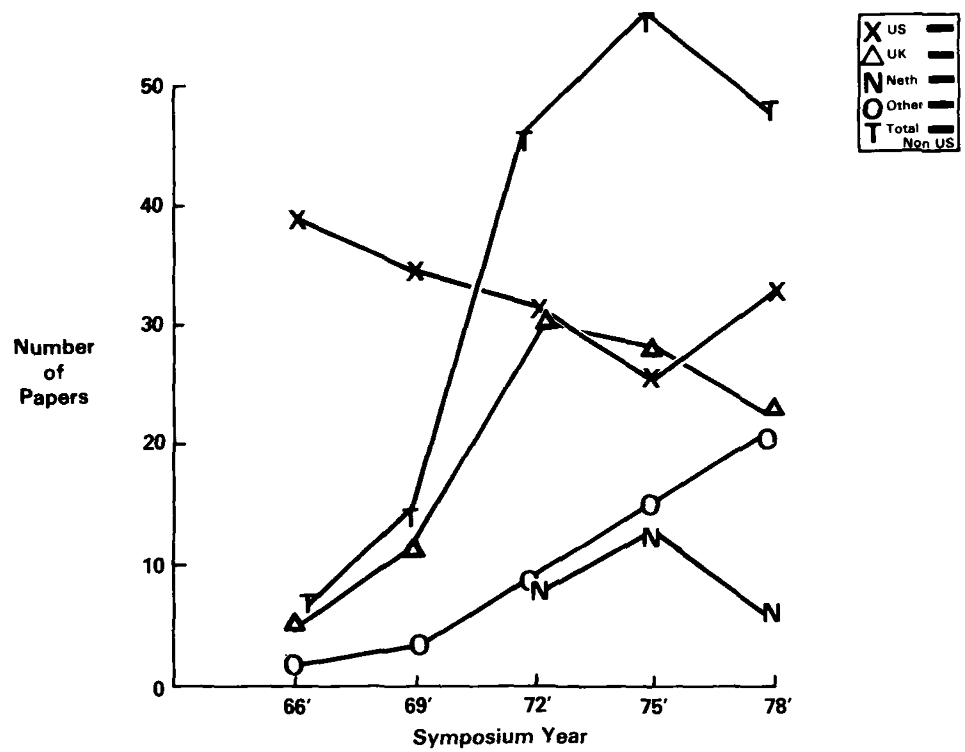

Figure 1. Major Contributors to the Ship Control Systems Symposia

	Overview	Piloting & Navig.	Bridge	Steering Contr.	Collision Avoid	Maneuvering	Maneuv.–Simulation	Stabilizers	Automat &Control	Propul. Plants	Propul. Control	Propul. Simulation	Propellers	Auto. Monitoring	Electrical Power	Microprocessors	Human Factors	Special Craft	Systems Analy	Total
USA	2		2	5		1					7	2		3	1	2	2	6		33
UK	1	1		1			1				5	3		2	1	5	3			23
Neth.		1	1	2		1								1						6
Canada	1										1						1	1		4
Norway		1										2		2						5
Sweden				1		1														2
Japan				2			1													3
W. Ger.										1							1			2
Italy				1																1
Canal Zone						1														1
Israel										1										1
France							1													1
Total	4	3	3	12	0	4	3	0	0	2	13	7	0	8	2	7	7	7	0	82

Figure 2. Technology Contributions by Country - 1978
(Fifth Ship Control Systems Symposium)

Technology Area	'66	'69	'72	'75	'78	Total
Overview	3	2	0	1	4	10
Piloting & Navigat.	3	4	6	0	3	16
Bridge	5	0	2	5	3	15
Steering Contr.	-	-	-	6	11	17
Collision Avoid.	-	-	-	4	0	4
Maneuvering	2	4	4	9	3	22
Maneuv.-Simulation	5	6	2	8	3	24
Stabilizers	3	5	6	3	0	17
Automation & Contr.	6	2	8	0	0	16
Propul. Plants	0	2	4	0	2	8
Propul. Control	3	4	11	12	13	43
Propul. Sumulation	3	4	3	5	7	22
Propellers	1	3	5	3	0	12
Auto. Monitoring	0	3	8	4	8	23
Electrical Power	0	0	6	1	2	9
Microprocessors	-	-	-	0	7	7
Human Factors	2	1	3	7	7	20
Special Craft.	8	9	3	6	7	33
Systems Analy.	1	0	6	6	0	13
Total	45	49	77	80	80	331

Figure 3. Technology Area Contributions by Symposium Year

	Overview	Piloting & Navig.	Bridge	Steering Contr.	Collision Avoid	Maneuvering	Maneuv.–Simulation	Stabilizers	Automat & Control	Propul. Plants	Propul. Control	Propul. Simulation	Propellers	Auto. Monitoring	Electrical Power	Microprocessors	Human Factors	Special Craft	Systems Analy	Total
USA	7	9	10	7	3	9	14	6	12	4	15	9	7	8	1	2	9	28	4	164
UK	2	2		1		7	5	11	2	1	21	9	3	9	5	5	5	1	6	95
Neth.		4	1	5		2	3				3		1	2	2		3			26
Canada	1		3						1		2						1	4		12
Norway		1				1						2		4	1					9
Sweden				1		2						1	1				1			6
Japan				2		1	1					1							1	6
W. Ger.					1					1	1						1		2	6
Italy				1						1	1									3
Spain			1																	1
Israel										1										1
France							1		1											2
Total	10	16	15	17	4	22	24	17	16	8	43	22	12	23	9	7	20	33	13	331

Figure 4. Total Symposia Papers (1966-1978)

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Goff, C. N. Naval Training Equip. Center	4	N	4-1
Goransson, S. Statens Skeppsprovningsanstalt (Sweden)	3	K1	3-1
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Ronning, O., CAPT Royal Norwegian Navy (Norway)	2	F1	1-1
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