

INTRODUCTION

Oral Histories represent the recollections and opinions of the person interviewed, and not the official position of MORS. Omissions and errors in fact are corrected when possible, but every effort is made to present the interviewee's own words.

Dr. Steve Balut was the MORS Thomas Award laureate in 2006. He was President of the Military Applications Society (MAS) of INFORMS from 1995-1997. Steve was the first person to earn a PhD in Operations Research from the Naval Postgraduate School. He is now Assistant to the President for International Programs at the Institute for Defense Analyses (IDA). Prior to this assignment, he was the founding Director of the Cost Analysis and Research Division at IDA and served in that position for about twenty years.

MORS ORAL HISTORY

INTERVIEW WITH Dr. Stephen J. Balut
January 3, 2008
IDA

DR. BOB SHELDON, FS, INTERVIEWER

BOB SHELDON: This is January 3rd, 2008 and we're at the Institute for Defense Analyses (IDA) to interview Steve Balut. First of all, tell me your parents' names and how they influenced you.

STEVE BALUT: My father's name was Raymond Balut and my mother's was Lillian Pomichter. All four of my grandparents were immigrants from Poland; so we - my brother and two sisters - are second generation Americans.

BOB SHELDON: What year did they come over from Poland?

STEVE BALUT: All of my grandparents came from Poland roughly in the 1890s time frame. My father and mother were both born around 1910 and both died years ago. My father was a furrier his entire working life, which started earlier than most. He never finished grade school. Starting when he was going to second grade he walked to school along the river in Kingston, Pennsylvania, and set traps to catch fur bearing animals - muskrats and minks and things like that. On his way walking back from school he would take the animals he caught out of the traps to his basement where he'd clean them. With help from his

family, he sent the pelts to New York City and got between 25 cents and 75 cents for each depending on what kind it was. At the time my grandfather was a tailor in Wilkes-Barre, Pennsylvania. After a while, the sale of pelts brought more money than my grandfather made at his tailoring job. My father convinced him to start making fur coats rather than suits and from that time on my father, and his father, were furriers. I worked with my father for many years as a furrier and learned the trade quite well before I left when I was 22.

BOB SHELDON: What kind of animals did he catch?

STEVE BALUT: He caught mostly muskrats but sometimes minks, right there on the banks of the Susquehanna River. My mother was born near Wilkes-Barre from immigrant parents. She went to college for two years. At that time Misericordia was a women's college just north of Wilkes-Barre. Afterwards, she taught school but then met my father, got married and had four children. That ended the teaching career but started another. She worked with my father in the fur business, almost continuously. My father and mother would leave together in the morning and go to work in the fur business and then come back fairly late at night. The four of us, my brother and sisters, pretty much fended for ourselves when we were young. We lived in a little town of 2,000 people, seven miles north of Wilkes-Barre, in the coal mine region of Northeastern Pennsylvania. I was born in the house that my mother and father lived in and I lived with them for my first 22 years.

BOB SHELDON: Did you learn some business acumen or cost analysis from your Dad in the fur trade?

STEVE BALUT: My father was exceptionally creative. He could design and make furs but he wasn't an expert in business. I didn't learn much from my father about how to run a business but I did work alongside of him as a furrier while I was in high school and also through college. I attended King's College, a Catholic men's college in Wilkes-Barre at the time. I drove to Wilkes-Barre with my parents each morning where they dropped me off at King's. I attended classes until about noon and then walked to my father's store and worked with him until about 9:00PM. Then we'd drive home and we'd do it over again. So I

Military Operations Research Society (MORS) Oral History Project Interview of Dr. Stephen J. Balut

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spent an awful lot of time with my mother and father working in the fur business, particularly through my college years.

BOB SHELDON: What was your major in college?

STEVE BALUT: Mathematics. Math was a natural and it served me very well.

BOB SHELDON: Was it abstract math or applied math?

STEVE BALUT: Just general mathematics at the time. I wasn't really sure what I wanted to do but I was very good at mathematics so I took more math courses than anything else and enjoyed it and ended up with more than enough credits to get a degree. I was the first person in my extended family to graduate from college.

BOB SHELDON: Do you remember any notable math professors?

STEVE BALUT: Not from my undergraduate work but from my graduate work I remember people who were quite impressive.

BOB SHELDON: Coming towards graduation then from college, what were you looking for from the job market?

STEVE BALUT: After I graduated from college I started a small fur manufacturing business at the same location as my father's store. I rented a floor above his store and started to manufacture and sell fur collars, headbands, earmuffs and things like that. I made and sold them to department stores for about a year. But one day at about 5:30 my mother got a telephone call at her desk at the store and she called me down and said, "I just got a call from a friend of mine who's on the draft board, and this lady says she just mailed you a letter." I put on my coat and hat and went to a Naval Reserve Center and enlisted in the Navy.

BOB SHELDON: What year was this?

STEVE BALUT: That was 1961. So that was the beginning of my Navy career. I became an E-1, Seaman Apprentice, and attended reserve meetings for about six months. I applied to Officer Candidate School, got accepted and went to Newport, Rhode Island, where I received a commission in the Navy. Then I was off on my Navy way for the next 20 years.

BOB SHELDON: What was your first job in the Navy?

STEVE BALUT: My first job was in the engineering department onboard the USS Kitty

Hawk, CVA-63. I was onboard the Kitty Hawk for two years and spent almost the entire tour in the Western Pacific. It was during the period when the Vietnam conflict was building up and our carriers were spending much more time in that region. By the time I left Kitty Hawk I was a Lieutenant Junior Grade and was the Repair Officer. I went from there to a Combat Information Center - Air Intercept Controller (CIC-AIC) school in Glynco, Georgia where the most important event was meeting my wife-to-be. Glynco is just across the state line from Florida. On weekends I drove to the Naval Air Station in Jacksonville, Florida, to play golf. One afternoon I met Barbara in the Officer's Club, and a little less than a year later we got married.

BOB SHELDON: And still married?

STEVE BALUT: That's right; 42 years with four children and six grandchildren.

After CIC-AIC school my second assignment was to the USS Tattnell, DDG-19, as CIC officer. I was spot promoted to Lieutenant to take this job. The ship was home ported in Charleston, South Carolina. While deployed on the Tattnell to the Mediterranean with my wife pregnant in Charleston, I decided it was time I spent a little time ashore so that I could be with her when she had our first baby. I applied for both destroyer school and submarine school. The first response was from destroyer school. I went off to Newport, Rhode Island, to destroyer school, brought her there and we had our first child, Michelle, about a month later.

BOB SHELDON: How long were you at Newport for that school?

STEVE BALUT: That school lasted about six months. From there I went to the USS Stribling, DD-867, an east coast destroyer, as Engineer Officer for two years. Stribling was an old World War II destroyer.

BOB SHELDON: Where was the Stribling deploying to?

STEVE BALUT: To the Mediterranean and then back several times. During my first deployment Barbara was pregnant with our second child, Alison. The ship returned to Mayport between deployments but Alison was due to be delivered two days after my scheduled departure on the next deployment. Barbara arranged to have the baby induced a couple days early so

that I could see her before I left. I met and held our new baby, then went aboard the ship and didn't see her again for six months. That's the Navy way.

BOB SHELDON: Were you there by some of the hot spots in the Mediterranean during the Israeli wars or the Suez crisis?

STEVE BALUT: I was there during a very exciting time later when I was on the USS Pensacola on my fifth sea assignment. I'll tell you about that later. Stribling was just my third ship. The biggest thing that happened on the Stribling deployment I just referred to was a boiler casualty. We blew up a boiler while we were at sea and had to go to Malta Dry Dock to have the boiler rebuilt. The ship spent an awful lot of time there and afterwards in Spain recovering from this engineering disaster.

BOB SHELDON: Where in Spain?

STEVE BALUT: In Rota. The end of that tour brought a major decision point in my life. It was during that period that my father wanted me to get out of the Navy and come back to Wilkes-Barre and join him in the fur business. By then I had a wife and two young children and Navy detailers trying to get me to go to graduate school in Monterey at the Naval Postgraduate School (NPS). My Navy preference at the time was to go on a fourth sea tour as XO [Executive Officer]. The detailers said, "It's time for you to stop going to sea for awhile. It's time for you to get a Master's Degree at NPS, and then you can go back to sea again." The Navy and my wife won the dispute and graduate school was the course that I chose. My father was very disappointed. Nonetheless, that turned out to be the best thing to do at the time. That decision started me towards Operations Research (OR).

When I got to NPS I spent six months in a program they call the Engineering Science Program. This program is designed to prepare officers who have been away from college for a long time for the rigors of a very difficult mathematics and physics based program. When I was on my way to NPS I thought that I'd probably only stay six months, finish the Engineering Science Program, and then go off to an XO job on another ship. But it turned out differently. Once I was there, I got very interested in OR. The way that happened is interesting. Jack

Borsting was the Chairman of the NPS OR Department at the time. That was in 1968 during a period when OR was expanding in many places and Jack had developed a very large program and faculty at NPS. I think, at that time, NPS had to have one of the largest OR faculties. Jack had almost 80 faculty members on his Staff. NPS had quite a program going. Large numbers of naval officers were being pushed through that program because OR and naval operations seemed to go hand in hand. It seemed a natural thing to study if you wanted to develop educationally, academically and better prepare yourself for operations at sea. Jack was very convincing and I remember very well sitting in his office while he told me that this is something that I just ought to do - to go into his OR program - and I did. It was a hard choice between computer science and OR. Those were the two high interest areas that were happening back in the late 1960s. Computer science was extremely hot at the universities and I was very interested in that as well.

So I rolled into the OR curriculum and stayed in that program for about a year when Jack decided to initiate a PhD program in OR at the NPS. He asked the current 100 or so Navy officers who were in the program at the time if anyone was interested in being guinea pigs for a PhD program. 19 students raised their hands. We all took tests; three were selected to enter the program and I was the first one to successfully complete the program. So I got the first PhD in OR at NPS. Jack Borsting was the one who put the hood around my neck at graduation.

BOB SHELDON: Who were the other two?

STEVE BALUT: Neil Shackleton got his PhD about a year after I did and continued to work as an engineering duty officer. The third, Dave Anderson, left without getting his PhD.

BOB SHELDON: You mentioned there were some more memorable professors there. Other than Jack Borsting, who do you remember?

STEVE BALUT: I was impressed with a professor named Gil Howard who taught mathematical programming. He is probably the reason why I got into mathematical programming. He and several others, - well there were so many I'd shortchange most of them if I started listing just a few. Carl Jones was an extremely impressive person; Dave Schrady was another.

Some of the people who became President of ORSA are on that list of extremely impressive individuals. But what a wonderful opportunity I had as a naval officer - to enter into a master's degree program and then be allowed to continue on for a PhD.

BOB SHELDON: How did you choose your thesis topic?

STEVE BALUT: The NPS master's program in OR includes an experience tour. NPS sends all OR students somewhere for a three-month period to get involved with and some experience doing OR, and hopefully come back with a thesis topic. I chose to go to the Center for Naval Analyses (CNA). While at CNA, several analysts suggested that I work on a current problem that CNA was sent by the Navy. The problem was related to activity off the coast of Vietnam. At the time, North Vietnamese were bringing guns and ammunition down the coast in small boats and dropping the stuff off into South Vietnam. The North Vietnamese boats were using the heavy traffic of small boats off the coast as cover. The problem was to try to help the U.S. patrol boat commanders search through this mass of small boats and find the ones that were bringing contraband, weapons and ammunition into the South. The patrol boat commanders were searching in ad hoc ways, just randomly selecting boats to investigate and were reportedly not doing very well at stopping the flow of ammunition. The analytical problem was to make this patrol boat commander more efficient in the way he searched for and identified contraband traffic down the coastline.

I worked for three months on that problem while I was at CNA, and then took the problem back to NPS. In my research, I developed analytical methods for obtaining an optimal solution to the problem - optimal in a sense of minimizing the use of time or fuel by the patrol boat commander. Optimal solutions to scenarios were then used to create good (but not necessarily optimal) rules of thumb that a patrol boat commander could use off the top of his head while he was actually performing the search.

There was a reason for developing rules of thumb. At that time, the late 1960s, computers were not installed on Navy ships or patrol boats so the patrol boat commanders couldn't rely on a computer-based solution. They had to use

rules of thumb. So, I developed a number of practical, easy to apply rules of thumb for this particular situation. In addition, the solution to this problem was applicable to other similar problems that were pressing at that particular time. One of them happened to be the targeting of MIRVs [Multiple Independent Reentry Vehicles]. The approach used for the patrol boat problem applied to the problem of minimizing the fuel needed to target MIRVs in flight.

BOB SHELDON: Who was your primary thesis advisor?

STEVE BALUT: Professor Harold Greenberg was the Chairman of my PhD Committee until he left NPS and went to Israel. Professor Gil Howard took his place and assisted me through to the end when I completed my dissertation.

BOB SHELDON: Did you get to see the results of your thesis put into practice in Vietnam?

STEVE BALUT: My thesis was published after the announcement that "Peace is at hand," so I didn't see this work put into practice in Naval activities in Vietnam. However I was told that the Coast Guard applied the technique to similar searches in similar environments. So it did get applied.

BOB SHELDON: How many years were you at NPS?

STEVE BALUT: Over four years, start to finish, but I was there for the last six months in early 1973 because the Navy ran out of PCS funds and couldn't move me out of Monterey. I was assigned to NPS on the faculty of the OR Department where I taught OR courses to engineering students.

BOB SHELDON: Which courses did you teach?

STEVE BALUT: Introduction to OR.

BOB SHELDON: Finishing up there, what job did the Navy have in mind for you?

STEVE BALUT: As I neared completion of the PhD requirements in late 1972, I volunteered for a one-year tour of duty in Vietnam. I was scheduled to go to a Navy Staff in Saigon as a Systems Analyst. You may remember in late 1972 Henry Kissinger made the announcement "Peace is at hand." Shortly after that happened, the Navy stopped sending analysts to Saigon, my orders were cancelled and I was reassigned to an XO job onboard the USS Pyro, AE-24, an ammunition ship that was still operating off the coast of

Vietnam. I spent nearly all of the next two years off the coast of Vietnam instead of inside Vietnam.

An interesting aspect of my tour on the Pyro was bringing the Program for Afloat College Education (PACE) program onboard. In this program crew members who were deployed could earn college credit while at sea. I worked with Chapman College, gained certification to teach, and made arrangements to teach courses to crewmembers of the Pyro while deployed off the Vietnam coast. We transformed one of our spaces on the ship to a classroom where I taught the classes.

BOB SHELDON: Math courses, I assume?

STEVE BALUT: Almost all math courses, yes that's right.

BOB SHELDON: Anything else exciting happen during your tour off the coast?

STEVE BALUT: We loaded a lot of bombs and bullets onto the destroyers, carriers and the other ships that were launching them in-country. We spent a long, long time at sea and long hours with two ships alongside at once. The captain managed the big ships on the starboard side and I managed transfers to the smaller ships on the port side - just loading bombs and bullets.

BOB SHELDON: Did you use any of Professor Schrady's logistics analysis to study your problems?

STEVE BALUT: Actually OR was always on my mind while I was XO. As XO you're the Chief Operating Officer of the ship - you're trying to make the ship operate as efficient as possible. I was constantly looking for ways to make our ship's operation more efficient in every way that I could think of from keeping the ship clean to how to get the food to the people out on station and just the general operations onboard. I had to keep the crew awake, healthy and able to do their jobs. The stress of Vietnam was very high at that time, so while I can't point at a linear programming solution to those problems, I'm sure OR served me very well. It served me even better when I was Commanding Officer of a ship going through an overhaul. I was able to apply PERT-CPM [Program Evaluation and Review Technique / Critical Path Method] methods to a one-year overhaul at the Norfolk Naval Shipyard, but that was later.

BOB SHELDON: Where did you go after your two-year tour off Vietnam?

STEVE BALUT: Several analysts from CNA came out to the ship while we were in the Pacific to see whether I would like to come to CNA on my next tour of duty. I thought the offer was quite interesting. I had been at CNA for three months on my NPS experience tour and they invited me to join the Staff of OP-96, the group that works with CNA. I accepted, went to CNA and worked mainly in the area of manpower and personal planning. While there I worked mostly on a linear programming model intended to help the Navy improve its management of enlisted personnel by matching requirements with inputs in an efficient way - skill planning and skill training to meet the demands of the force.

BOB SHELDON: This was during the force drawdown after Vietnam?

STEVE BALUT: Yes.

BOB SHELDON: How did the force drawdown impact your study?

STEVE BALUT: The way the drawdown affected my work showed up in the continuation rates that were included in the models that I was developing. The drawdown caused a change in the environment - a change in the way people attrited out of the Navy or decided to continue in the Navy. We had quite a time modeling the flows of enlisted people near the end of their service obligation. We tried to capture what was happening during this critical period for reenlistments. So the drawdown did impact the work and was taken into account.

BOB SHELDON: Did your analysis go to the Navy personnel office in the Pentagon?

STEVE BALUT: We worked with the people up on the hill right next to the Pentagon, the Navy Annex. BUPERS was located in the Annex - they managed the Navy enlisted force from there. BUPERS had their large scale models for this purpose, and Bob Lehto was the civilian in BUPERS who managed the system of models and analytical techniques the Navy used at the time. We had frequent exchanges and interactions with Bob and he did on occasion use some of the recommendations that CNA made.

BOB SHELDON: Were you affiliated with the OEG [Operations Evaluation Group] at CNA?

STEVE BALUT: No, I was with INS [Institute for Naval Studies]. Hershel Kantor was the Director of INS at the time, and

Ken Goudreau was my direct boss. I had an extremely interesting moment with Hershel Kantor. The day I arrived, I sat down to interview with him and his first question to me was, "What do you know about POM?" Of course he was talking about the Program Objective Memorandum used to submit Service budget positions. I said, "Well, that stands for Pre-Overseas Movement." Hershel sat back in his chair and put his head back, looked at the ceiling, and I can still see him saying to himself, 'Oh my God, this guy doesn't know anything at all about Washington.' So that was quite a beginning. Nevertheless, I worked for Hershel for about a year and a half before I left and went to the Pentagon.

BOB SHELDON: How were you involved with the POM?

STEVE BALUT: I was very involved with the POM in my next job after I left CNA and went to the Pentagon. I relieved Don Pilling there. He later became Vice Chief of Naval Operations and is now President of LMI. At the time, he was the Navy representative in the Cost Analysis Improvement Group (CAIG) in OSD (PA&E). His tour was about up and he called to ask if I would be interested in taking his job working for Milt Margolis in the CAIG. I said I would come over and talk to Milt, which I did. We quickly agreed that Milt would make arrangements with the Navy to shift me from CNA to his office.

That was in 1977. I took Don's office, a very small room with no windows that was just big enough for a small desk and three safes. You had to squeeze by the desk to sit down in the chair. But the nice part about it was this office was right alongside Howard Manetti's office. Howard Manetti was the individual who had the responsibility for estimating the costs of aircraft systems. I became his partner, he became my tutor and he taught me cost analysis. I learned it at his knee.

I am indebted to Howard Manetti. He played an extremely important role in my professional career. He is an exceptional cost analyst. He and Milt Margolis were at the RAND Corporation when cost analysis was being invented, along with David Novick, Gene Fisher and the other pioneers who actually developed the techniques that we're still using today. Howard followed Milt to OSD (PA&E) and

became the principle cost analyst for aircraft systems. He sometimes worked other programs, but mainly aircraft systems. So that became my job in the Pentagon as well. The job involved reviewing cost estimates for aircraft systems developed by the military departments and the associated budget submissions. We also did independent estimates of aircraft systems to compare with the service estimates. Sometimes I would develop an estimate and sometimes Howard would, but mostly we did them jointly. When completed, the estimates would be reviewed by Milt Margolis who would present them to the Defense Acquisition Board (DAB) on occasions when major decisions were pending to enter a program into R&D or full scale production. I did that job for about two years. It was extremely interesting. The work was almost entirely OR. The applications of cost analysis are, in my view, a subset of the broader category of OR and certainly a key part of it.

BOB SHELDON: Were any of your cost estimates contentious between the services and OSD PA&E?

STEVE BALUT: All of them. *(Laughter)*

BOB SHELDON: How did you resolve those differences?

STEVE BALUT: We would meet with the contractors and service cost analysts, resolve most of our differences, then agree to disagree on the rest. Milt Margolis knew the estimates caused trouble with the services and he didn't want the professional careers of the military working for him jeopardized. To get around this problem, we were careful about who presented the results. When I would do an estimate on a Navy aircraft system, Howard would be the front for the results. When I did an estimate on an Air Force or Army system I would present the results myself. The same practices applied to the Army and Air Force people on CAIG Staff. Milt took care of us that way.

BOB SHELDON: When the differences came up, what would you attribute the differences to? Was it the services trying to make their programs look cheaper or was it omitting cost functions?

STEVE BALUT: Over the ensuing 30 years or so that I've worked in this area, I've studied cost growth and the reasons for trends in cost growth. The primary reason why costs end up

being greater than initially projected is technology, difficulty of installing new technologies in developmental systems, systems that haven't been built before or tried before. It always looks easier at the outset than it actually turns out to be and it always costs more. It takes longer than you plan on it. Now there is the aspect that you referred to and it's definitely a player. The military departments, all of them, learn very quickly that low cost systems sell better than high cost systems and are easier to get approved in the budget process. So the services tend to be complicit with the contractors in being optimistic at the front end of a program when they need to get something going – that is, initial funding. Later, after the program is rolling, the optimism is revealed when problems occur, schedules are stretched and more dollars are added to the program's budget. Sometimes the effects include unwanted reductions in planned capabilities of the system.

BOB SHELDON: You spent four years at desk jobs; did that hurt your career as far as the Navy was concerned?

STEVE BALUT: I went from the OSD CAIG job to command. While I would have preferred a front line cruiser or destroyer, I was assigned to an amphibious ship. The ship I got was a wonderful ship, - a workhorse - the USS Pensacola, LSD [Landing Ship Dock] 38. I had a great tour. The first year I was on board we deployed to the Mediterranean and Indian Ocean. This was the exciting time I mentioned earlier.

BOB SHELDON: What happened?

STEVE BALUT: It was during the Iran hostage crisis when 52 U.S. diplomats were being held after militants took over the U.S. embassy. Just after the Pensacola deployed to the Med, the U.S. decided to attempt a rescue and launched Operation Eagle Claw. That was in April, 1980. Pensacola was part of the Marine Amphibious Ready Group (MARG) that was sent through the Suez Canal to the Indian Ocean as a backup force to support the attempted extraction. Of course you know it failed, terribly. The 400 Marines that were on my ship at the time never did go ashore or see action, but it certainly was an exciting moment. We were there, off the coast, ready.

BOB SHELDON: Was this your first experience working with the Marines on a ship?

STEVE BALUT: I found the Marines to be absolutely terrific. I have the greatest respect for Marines.

BOB SHELDON: Did you go through training exercises with them?

STEVE BALUT: Many.

BOB SHELDON: Describe those training exercises.

STEVE BALUT: We would sail from Virginia down to North Carolina, pick them up at Moorhead City, practice loading the men and their gear onboard the ship and then take them to a practice landing. We would anchor offshore, then flood our tanks, sink down in the sea and fill the well to float the boats. When the Marines were loaded and ready, we would open the gate at the stern and launch the boats. The image is a World War II movie with John Wayne in the lead landing craft with the front of the craft popping down on the beach and Marines charging ashore. They would dig in and stay on the beach for an exercise period and then they'd reload back on board the ship and we'd take them back to Moorhead City and off load them.

BOB SHELDON: Any logistics hazards during those exercises?

STEVE BALUT: Many. We had a crew of about 370 and we would load a like number of Marines, ending up with about 700 plus people on board the ship including two captains. I mean I was captain of the ship, but the Marines had a commanding officer as well. It was extremely important that the two of us got along and coordinated our activities well, which we always did. The Marines are exceptionally good at operating in this kind of an environment.

BOB SHELDON: Who was your Marine counterpart?

STEVE BALUT: There were several. I don't remember their names at the moment.

BOB SHELDON: What was your next job in the Navy?

STEVE BALUT: The second year of my command was spent in Norfolk Naval Shipyard in a major overhaul. That's where OR definitely came in. Starting with the early planning about six months before the overhaul and through the entire overhaul itself, I used the hidden ingredient as Saul Gass calls it, OR, to plan and then execute the overhaul. I taught my officers, the managers on board the ship, enough about

PERT-CPM so they could manage their work packages themselves using these techniques. Of course I kept a broad view of all the activities that were going on in the shipyard and monitored the activities of each of the departments and their PERT-CPM approaches. It was helpful. It was a way of organizing the thinking of managers who had never been in or done anything quite like this before. The Navy is full of surprises - always something new - and our overhaul was a first for nearly all of the people on the ship.

BOB SHELDON: What were some activities that were on the critical path?

STEVE BALUT: The propulsion system was always on the critical path, right from the beginning to the end. We had an oil-fired boiler system, one of the old ones. Through the period I served in the Navy, the Navy was having a good deal of trouble with oil fired boilers. In fact, I've already mentioned a good example of that - the boiler that blew up on the destroyer *Stribling* while we were chasing a carrier in the Mediterranean. That wasn't uncommon. So the propulsion system overhaul was key. We had a lot of other important changes that were being made to our ballast system and other systems, but the propulsion system was the one to watch.

BOB SHELDON: Were you able to do the overhaul on schedule?

STEVE BALUT: We just barely got out on time. My tour onboard ended almost exactly on the day we were to complete overhaul. I went from there to Washington to work for the OSD Comptroller, who, by the way, was Jack Borsting. So I left and the ship deployed to the Mediterranean two months later. As all ships do, she had a few things that had to be done while in Little Creek preparing for the deployment, but the overhaul was essentially completed on time. I think that outcome had to do with the way we prepared for and executed the overhaul.

BOB SHELDON: Was Jack Borsting responsible for recruiting you to the Pentagon?

STEVE BALUT: I had to go to Washington about three months before the end of my tour. While there I went to the Pentagon, walked into Jack's office, shook his hand and said, "Do you remember me?" He said, he certainly did remember me and then said, "How about coming to work for me?" Just like that. I said, "Sure, I'd

be glad to." He described the job he had in mind for me. After I left, Jack notified the Navy.

BOB SHELDON: He had some influence.

STEVE BALUT: He did have a lot of influence. I went back to Little Creek. A day or two later, my wife and I went to a party at the Commodore's house. When we knocked and the door opened, the Commodore looked at me and said, "Who the hell do you know in Washington?" *(Laughter)*

BOB SHELDON: What was your rank at the time?

STEVE BALUT: Commander. We moved to Washington and I became Deputy Director of Program and Financial Control in his office. P&FC is the office that gathers the service inputs and integrates them into a single DoD budget submission and sends it off to be used as the President's budget submission. I was Deputy Director there for a little over a year. Mike Sovereign was a Director of Special Projects at the time. He led a small OR group working directly for Jack. Mike went back to NPS about a year after I arrived and Jack asked me to take Mike's job. I did and stayed there until both Jack and I left.

BOB SHELDON: Talk about some of the special projects you worked on.

STEVE BALUT: They were all short-term, quick response PPBS [Planning, Programming, and Budgeting System] related activities. I spent most of my time coordinating programming activities between the Comptroller and PA&E. Since I had experience in both offices and knew the right people in both places, it was very easy for me to walk into offices, talk to people and resolve problems and differences between a Comptroller perspective and a PA&E perspective.

BOB SHELDON: What is the difference in their perspectives?

STEVE BALUT: The Comptroller is mostly interested in budget submissions - it's a near-term view. His office is also concerned about fiduciary responsibilities, the legal responsibilities associated with putting the budget together. In contrast, PA&E analysts take a distant view, looking out 10-15 years and further in their cost effectiveness analyses. The Comptroller analysts, while aware of these views, must spend almost all of their time concentrating on the near term, the next two or three years. The difference is a matter of focus. You will

remember Jack Borsting talked about his job at the MORS Symposium in Monterey in the Heritage Session. Jack was extremely busy. It was a very interesting time and I think he was happy to have Mike there as well.

BOB SHELDON: What was your next assignment in the Navy?

STEVE BALUT: That's when I got out.

BOB SHELDON: Was that at the 20 year point?

STEVE BALUT: Exactly the 20 year point. The reason for that was purely economic. I loved every day I spent in the Navy, and so did my family, but I have four children. The oldest was a senior in high school and about to go to William & Mary; the next was a junior in high school and going to college the year after, and two more closely following them. My four children were going to step one after the other into college, and I wasn't sure how in the world I was going to pay for that. So I decided to get out and get a real job. I did what a lot of people do – I took the job from the highest bidder. After working for MCR for a little over a year, I learned I preferred the non-profit environment and shifted to IDA.

BOB SHELDON: Who were your customers for MCR?

STEVE BALUT: Our customers were in the DoD cost community. MCR did cost studies. They collected cost data and organized it for use by the cost people in the services and OSD. On occasion they did cost related studies. I did a number of those while I was at MCR. One was a cost comparison of the F-4 and the F-15 that was noteworthy. The study demonstrated that the direct costs of both aircraft were essentially the same even though the difference in heritage was more than 20 years. The differences in their total costs derived from differences in indirect costs, the overhead costs. Overhead costs were a particular interest of mine ever since I started doing cost analysis. Cost analysts are good at estimating direct costs, particularly labor costs, but they represent only a very small portion of total cost. However, indirect costs, the portion of costs that cost people don't understand very well, represent over half of the costs of weapons systems.

BOB SHELDON: Talk about some of those indirect costs for the F-15. What were the big drivers?

STEVE BALUT: Let's talk in general about indirect costs first. Indirect costs are costs not associated with a single contract - rather the general costs that apply across all contracts in the plant. Examples include security at a plant, the salary of the President of the company, and things that apply to all work at the plant rather than an individual contract. These costs are proprietary and can be a company's competitive edge. The information is closely held and not visible or understood outside of the firm. The only people who really understand a firm's indirect costs are the accountants within the firm itself. So here's the scene. We, defense cost analysts sitting in the Pentagon, try to guess what indirect costs will be at a Boeing plant in St. Louis or a Lockheed-Martin plant in Dallas-Ft. Worth without any idea of what is really happening in the indirect world in those plants.

Howard Manetti and I both have a great and ongoing interest in trying to improve the visibility of these costs to defense analysts and also trying to develop methods for estimating these costs in a reasonable and sensible way. I've spent about 30 years thinking about that problem - a long time - and have made some headway, mainly here at IDA. Indirect costs are a mixture of fixed and variable costs. Some overhead costs vary with output and the rest don't. The portion of indirect costs that vary with output is fairly easy to estimate, given the right data, using regression with independent variables that depict output, such as units produced per time period. The residual then represents the fixed portion of overhead.

Overhead is the difficult piece that cost analysts generally don't understand very well and don't estimate well. Over the years, the Cost Division here at IDA developed techniques for use by analysts in the Pentagon for dealing with this problem in a reasonable, sensible way. When developing these methods, we worked with the contractors themselves - having them review the methods we derived using their data. Some contractors adopted our methods for use in their own planning - when preparing proposals and forward pricing rate agreements. We've done a lot of work in this area and the work was possible only with access to contractor proprietary data. We as a non-profit, Federally Funded Research and Development

Center (FFRDC), were able to gain access to proprietary information from contractors under strict legal arrangements. We entered into agreements with corporations under which we would receive the proprietary data, protect it from release to their competitors by handling it as if it were classified secret, and return it to them when we were finished. We would tell them in advance, exactly what we intended to do with the data, and afterwards, we showed them the results of what we did.

So under these special handling arrangements, we have access to indirect costs of virtually all major U.S. aerospace companies and continue to develop a massive database of indirect costs of the defense industry. Our sponsors in the Pentagon benefit greatly from this information. In each of these cases though, it's important to point out that participating contractors worry that some of their proprietary information will be revealed to another contractor. Well, we have safeguards to prevent that. That can't happen because of the way we handle and deal with the data itself. We get it for a specific purpose; we use it; we show the results and give the data submissions back to the contractors if they require that. So it works very well. The contractor's trust us, which is good. We couldn't do this research without the trust of the contractors. The individual contractors benefit because we share our models of their firms with them. The DoD cost community benefits by gaining a better understanding of contractor indirect costs in general and sensible approaches for estimating them.

BOB SHELDON: Going to IDA, did somebody from IDA recruit you or had you looked at IDA previously?

STEVE BALUT: When I was getting out of the Navy, I interviewed here at IDA. The President of IDA at the time was Al Flax. I was told that Al Flax had a policy at the time of not hiring former military officers. So even though they asked me in for an interview, afterwards I was told - sorry, this policy is still in effect. So I took a different job. But about a year later I got a call from Joe Arena who was a former colleague of mine while working together in OSD PA&E. General Andrew Goodpaster had by then taken the position of President of IDA and Joe was his assistant. By then the old policy had changed

and I was asked if I would come back over and talk to them again. This was an opportunity for me and IDA because IDA needed help in the cost area.

BOB SHELDON: What kind of projects did you work on initially in IDA?

STEVE BALUT: At that time, IDA had six large operating Divisions and a small cost group that was a body shop for the Divisions. This group consisted of seven or eight cost analysts who were loaned out to work on Division projects that had cost components. Around that time, IDA's sponsors asked IDA to expand and improve its cost analysis capabilities in support of the Department of Defense. Prior to this time, the Department relied heavily on the RAND Corporation for its cost support. However, RAND had just gone through a troubled period because of the release of the secret Pentagon Papers to the press by a RAND analyst. Leaders in the Department were furious and called for RAND's closure. In the end, RAND was reduced in size by about half. During that drawdown, many expert, renowned cost analysts left RAND. A tremendously valuable capability had been seriously diminished. In the ensuing years, the Department didn't get the cost support it needed. That's why they turned to IDA and asked General Goodpaster if he would strengthen IDA's capability in order to deal with the problem they were having with RAND. After I was at IDA for a short while, General Goodpaster asked if I would expand IDA's cost analysis capabilities and establish a cost division. I said I would be absolutely delighted to do that. I started building in 1984 and the Division was formally established in 1986. Since that time we've built an exceptional capability in the cost analysis area and we're now one of the largest divisions at IDA.

BOB SHELDON: How large was it when you started, and how large is it now?

STEVE BALUT: There were about seven or eight people in the cost group when I joined and now there are somewhere around 100 analysts working in the division on a daily basis, plus about 40 or 50 consultants come in from time to time as needed. That 100 includes two different categories of employee but this point is not really of interest here. About 100 very capable cost analysts are working here at IDA now.

The quality of our work is well known and our reputation is high.

BOB SHELDON: What kind of cost analysis issues did you tackle?

STEVE BALUT: My interests veered towards indirect costs. One thing we did early on was tackle the cost data problem. As I mentioned earlier, DoD cost analysts were pretty good at estimating direct costs but terrible at estimating indirect costs. So a lot of our early research, sponsored mainly by OSD PA&E, focused on the indirect piece of defense systems costs. We continued this thrust over the years, spending decades developing both data and methods for improving that aspect of cost analysis. Through the years our Division completed many studies that had impact and that you likely have read about in the newspaper. An example is the 767 tanker aircraft problem that the Air Force recently had with Boeing in which a Boeing Vice President ended up getting fired and another official went to jail.

In that case the Air Force and Boeing entered into a contract whereby the Air Force would lease 100 Boeing 767 tanker-passenger variants. The lease arrangement didn't look right to many people, including leaders in PA&E and here at IDA. An argument ensued between the Undersecretary, AT&L, and the Director of PA&E. IDA was called in to resolve the argument between those two offices. We were asked to develop an estimate of the purchase price upon which the lease arrangement could have been based. So we took on the job of trying to estimate the price of a 767 tanker-passenger variant. We used a variety of different techniques for doing that. The job called for a creative and innovative approach because it required an understanding of not just manufacturing but also the marketplace. Standard cost estimating techniques had to be applied in many portions of the estimate, yet market-driven forces had to be taken into account. It turned out that as a result of our expert analysis, we determined that the lease arrangement between the Air Force and Boeing afforded Boeing a high internal rate of return - higher than one would expect. That result was presented to our sponsors and subsequently, at our sponsor's request, to the Congress. Dr. Dick Nelson, the lead IDA analyst, testified to our findings before two Congressional committees. The fallout was

the firing of a Boeing Vice President, the jailing of another Boeing manager who had been recently hired out of the OSD, and cancellation of the contract. Of course the 767 issue is coming around again and the program will eventually likely go forward.

BOB SHELDON: During your 20 plus years with IDA, any concepts of cost analysis that you've worked on other than indirect costs?

STEVE BALUT: Yes - many. For example, we work on the relationship between technology and cost progress. That is, how does insertion of new technology affect cost progress? In particular, how does technology effect cost progress curves, the so-called learning curves that are the standard tool used by most cost analysts to forecast the cost of developmental systems. We do research into the effects of the timing of insertion of new technologies. We also study simple cost trends and the reasons for cost growth. Dr. David McNicol, former chairman of OSD Cost Analysis Improvement Group and now the Director of the Cost Division at IDA, completed a book on cost growth three or four years ago that analyzes the reasons for and the extent of cost growth in defense weapon system acquisition programs.

Another thing we do here at IDA that's different from other places is develop and evolve tailored cost models for major acquisitions such as the F-22 or the Joint Strike Fighter. When faced with this kind of challenge, we develop a cost model based on the place where the system is going to be built, including the indirect costs of these facilities - drawing on the research we've done over the past several decades. So, we don't use a canned cost model that we cram data into and out pops an answer. Every time we face a major estimate, we build and tailor the cost model for that particular purpose. A real advantage to this approach is that not only are we able to develop early estimates, early on in the process when a concept is little more than an idea and there's sparse data or description of the program, but as the program enters the development stage and then moves closer to production, as we observe the cost experience of the system, we use the cost experience to date to modify, update and improve the same model. We follow the program with this model, tracking cost experience and estimating future costs.

BOB SHELDON: It sounds almost analogous to the statistical concept of a Bayesian prior distribution, updating new information as you learn.

STEVE BALUT: Yes, it's a learning thing. As time goes on and cost experiences are reported, we update and refine the model.

BOB SHELDON: What's your impression of the Cost as an Independent Variable (CAIV) concept?

STEVE BALUT: This is a concept that has popped its head up a number of times through my career in cost analysis under different names and at different times. It's a concept that can't be disagreed with. If you can use cost as a way of constraining the design in a practical way, that's a good idea. Formalizing it under this so-called CAIV program was, in my view, nothing new. What it did was strengthen a practice that had been in place and managers had been using all along. I can say, in its favor, CAIV served as a useful increase in emphasis on the fact that you have a budget and you should plan your acquisitions to your budget.

BOB SHELDON: Let's backtrack. When did you first become involved in professional societies?

STEVE BALUT: I first became involved when I was in the OR program at NPS. I've been a member of ORSA and INFORMS since the 1960s. My first jump into the parade was in the early 1970s. I entered a student paper competition run by ORSA and placed third. I went to New Orleans to receive a prize, since renamed the Nicholson Prize. Later, when Dave Schrady became President of ORSA, he appointed me Membership Chair of ORSA and I served in that position for about eight years. During that period, ORSA's membership was declining and the ORSA Council was concerned. So one thing I did while Membership Chair was increase the number of student members by establishing student chapters at universities that offered OR. This brought a significant increase in members. Concern by Dave and the Council about the decline in membership led them to ask me to conduct a large-scale survey of ORSA members - asking current members what they thought of the society, what they liked about the society, and what they didn't like about the society. Bob Armacost and I did

that survey and published the results in the ORSA journal. The title of the article is *ORSA as Viewed by Its Members*. It was published in 1986 and gave insight to the Council on actions to take to improve the membership problem. Later, Steve Pollack asked me to be on his long range Strategic Planning Committee. That was when he was President-Elect and made plans for his tenure as President. So I served on his committee the year before he was President and also during the year he was President. After that I was editor of the Topics in OR series of books.

This series of books was initiated by John Kettelle. John's still up and around and having fun and he is still active at Roundtable meetings. But when he got tired of being editor of the Topic series of books, he called me and asked if I would take it over. Of course I agreed. I did that for about ten years. Some of the things that were published while I was editor were really quite interesting. I published one of Hugh Miser's books, *Operations Analysis in the Eighth Air Force, 1942 to 1945: Four Contemporary Accounts*. That was really a nice piece, and it was nice working with Hugh. What a gentleman. *Fields of Operations Research* by Howard Kreiner was another one that is noteworthy, along with Al Washburn's *Two-Person Zero-Sum Games* and also his *Search and Detection*. Another interesting book was by Russell Rhyne's *Evaluating Alternative Indonesian Sea-Sovereignty Systems, an Exercise in Soft Technology Transfer*. I found that interesting because the U.S. is moving closer to Indonesia again.

BOB SHELDON: In picking books to publish, was there demand from the membership for certain kinds of books, or did the authors come to you with books to publish?

STEVE BALUT: John Kettelle's idea was that there are books that will have such limited distribution that a publisher wouldn't find it profitable to publish. He petitioned ORSA to front the money to publish a limited number of books for the purpose of sharing them with the OR community. So, ORSA became the publisher, and still is the publisher of these books. None of the books are intended to make a profit. All of them are targeted to break even, just pay for themselves while benefiting the professional.

I ran for ORSA Council once and lost, but it was flattering to have been asked to run. Keith

Womer, Tom Gullede and I wrote a paper that was published in *Operations Research* in 1989 titled "A Method for Repricing Aircraft Procurement Programs." That paper resulted in all three of us receiving the Koopman Prize.

BOB SHELDON: Had you ever met Bernie Koopman at CNA?

STEVE BALUT: No, I didn't. I wish I had. I was the Business Chair for the Washington ORSA meeting. At the time it was the largest meeting we'd ever had. I was very active in the Military Applications Section (MAS) of ORSA and later INFORMS. I was on the MAS Council for many years – an active participant in those meetings – and finally I was elected President of MAS. During my tenure, MAS successfully petitioned ORSA to become a Society of INFORMS.

BOB SHELDON: What years were you President of MAS?

STEVE BALUT: 1995 to 1997. During that period MAS changed from being a section of INFORMS to being a society of INFORMS, the Military Applications Society.

BOB SHELDON: How did becoming a society change MAS?

STEVE BALUT: The organization and responsibilities changed. Rather than having just a Chairman and ad hoc committees, which is the way MAS was structured since the 1960s when it began, it became much like a regular society with a full staff, a President, Vice President, all of those trappings including a role in money management. As a section all the money was managed by the ORSA office. As a society, MAS had some control over at least portions of the funds that they earned through meetings and publications and was able to award prizes.

BOB SHELDON: Any other exciting things happen during your tenure as President of MAS?

STEVE BALUT: One really good thing that happened while I was President was my involvement with MORS. I thought it was extremely important that MORS and MAS either collaborate or coordinate their activities because many of the same people were active in both. The portion of INFORMS that is MAS was very active in MORS and vice versa, yet there weren't any strong links between the managements of those two organizations. So Dick Wiles [then Executive Vice President of MORS] and I both took initiative to strengthen that relationship. We

went to each other's meetings and participated in the professional activities of both groups. He invited me to come to the MORS Board meetings, and I invited him to all of our important meetings as well. We coordinated our efforts and our investments in a way that benefited this group that was an intersection of both MORS and MAS. That was a very good time I thought. On a different subject, I'm now a participant on the INFORMS Roundtable and have been for about seven or eight years. Roundtable members are corporations and I represent IDA. The size of the Roundtable is limited to about 50 companies that are leaders in the application of OR. The intent is to impart the practitioners view to INFORMS, to advise the Council, and to assist the Council in keeping practice a strong part of the society.

BOB SHELDON: MAS used to hold its meeting in conjunction with an INFORMS meeting. Do they still do that?

STEVE BALUT: Yes. They always have their major meeting in conjunction with an INFORMS meeting. During my tenure, we had a separate meeting at Quantico as well.

I've been active with MORS throughout my career – mostly in the Cost Analysis Working Group (WG). I've participated in about 20 or 30 of their meetings. I'm like a permanent fixture there. I'm also an Associate Editor of MOR.

BOB SHELDON: How do you look at MORS as compared to INFORMS?

STEVE BALUT: I'm going to share an opinion with you. It's been my experience that I get more out of a MORS meeting than I do out of an INFORMS meeting. The main thing I get out of an INFORMS meeting is association with colleagues – meeting with them, renewing friendships, finding out what they're doing, and new things that are happening. But at a MORS meeting, it's different. At MORS, you benefit technically, not just socially. I encourage my staff here at IDA to participate in MORS.

BOB SHELDON: Is there something like a Code of Best Practices in the cost analysis community?

STEVE BALUT: Let me back up. The Institute of Cost Analysis (ICA) was a professional organization that served cost analysts in OSD and the military departments. It was created specifically for that purpose. John Morgan was

one of the early leaders in forming ICA. I was very active in ICA for many years and I became President of ICA in 1989. One of the things that happened during my tenure was a merger between ICA and the National Estimating Society (NES) to form the Society of Cost Estimating and Analysis (SCEA). So we had government cost estimators merging with industry cost estimators into a single organization. This new, merged organization has a professional certification program for cost analysts. I became a certified cost estimator through this program and SCEA still offers certification by taking and passing a series of tests. They have a recommended training program that one can go through to prepare for the exam. So, yes, there is a certification program offered by SCEA. That's the only one I know of. Otherwise, there is no, as you say, Code of Best Practice for cost analysts, to the best of my knowledge.

BOB SHELDON: Since you became a cost analyst by on-the-job-training, and now they have cost analysis academic programs at NPS and other schools, what's your opinion of the current academic programs in cost analysis?

STEVE BALUT: Let me give you a little background on that. When I became the Director of this new division at IDA, I had to hire people to work in the Cost Analysis Division. I found it very difficult to find people who even referred to themselves as cost analysts or had cost analysis capability. There were a few organizations in the Washington area where you could find them, such as OSD PA&E. There were some at RAND and a few in the military departments. But for the most part, there were no educational channels that cranked out cost analysts like you have for engineers, doctors and lawyers. I searched for university programs across the United States and found one at the New Jersey Institute of Technology. It was the only one at the time, except for a course at the Air Force Institute of Technology (AFIT). AFIT didn't have a full program but they did have an emphasis area in cost analysis. NPS didn't have anything going in cost analysis at the time, George Washington University (GWU) didn't, George Mason University (GMU) didn't. None of the local universities did. So I talked with Carl Harris who was the Chairman of the OR Department at GMU and said, "I'll make you

a deal. There's no place around the Washington area that teaches cost analysis. I'll teach the course if you'll administer the course." So I agreed to provide a 17-week full semester course with lectures given by IDA staff members in my Division, each one a practicing expert in the subject matter taught. GMU's part was to register the students, test them, grade them, and grant credit. We struck that deal 17 or 18 years ago and we've been doing it ever since. Our next course starts this month. That course is now not just a course at GMU. It's one of two core courses in a Military OR Master's degree program. Students have to take this Cost Analysis course to get the degree.

BOB SHELDON: How has the course changed over the 17 years or so that it's been out?

STEVE BALUT: It's evolved. We started out teaching the key things that cost analysts need to know, such as economics of cost analysis, statistical techniques, learning curves, how to deal with data, life-cycle costs, all the basic techniques. Each of the lectures is given by someone who's an expert in the subject matter. For example, the two lectures that involve heavy statistical methods are given by Phil Lurie who has a PhD in statistics from Harvard and who has worked over thirty years practicing what he teaches. That's the level of quality and experience of the people who teach our course. I teach two of the lectures. We're fortunate to have an expert in software costing on our staff. Dr. Tom Frazer has spent a good deal of his life doing research and practicing in this area. He teaches the software costing part of our course. Our lecturers update their course material annually, keeping up to date on advances in the field. It's an excellent course. Professor Loerch, who was the GMU coordinator, reported last year or the year before that this course received the highest rating of any course at GMU in the student evaluations.

BOB SHELDON: How many students do you typically get?

STEVE BALUT: We typically have around 20 students in a class. It's taught right here at IDA on Thursday evenings. So it's very convenient for the staff and also for the students. The lecturers walk from their offices down to the classroom and teach. It's a two and a half hour lecture and that's that.

BOB SHELDON: Do you recruit any employees out of the class?

STEVE BALUT: I have definitely interviewed a number of former students from the course in cost analysis. And yes, we have hired graduates of the course.

BOB SHELDON: What other OR classes have you taught?

STEVE BALUT: My experience with teaching OR started at NPS when the Navy didn't have PCS funds to move me. My second teaching experience was in the PACE program, the classroom I brought onboard the USS Pyro in the Pacific. The third was right after I came to Washington to work at CNA. Don Gross gave me an appointment as a professorial lecturer in engineering, and I taught in GWU's OR department for about 10 years. I taught their graduate linear programming course, both on and off campus. That was about a 10-year stretch. Another thing that I did is teach at ICAF [Industrial College of the Armed Forces]. One of the functions that OSD PA&E performed, one of the favorites, was send a lecturer to ICAF to teach their classes the roles and responsibilities of the CAIG. So I was sent there to give these lectures. That was another way I got involved in teaching. And then Carl Harris at GMU asked me to teach some OR courses at GMU as an adjunct professor. I did that for a number of years as well. The most important way I've taken part in education in OR is developing courses. The course we developed for GMU is important for the Washington area. The course provides, for the first time, a way for local people to gain the skills they need to work in the cost offices, both in the Systems Commands, the services and the OSD. They can receive the training right here, at night, while working at their regular jobs. I think that was an important contribution.

Another thing we did about eight or nine years ago was develop a course in weapons system operating and support cost for DAU, which they still offer. Moving to an area we haven't talked about yet, we here at IDA, in the Cost Division, have developed an educational program for our international collaborators and friends. This started about 10 or 12 years ago when I got a call from an analyst at the Korean Institute for Defense Analysis (KIDA) in Seoul. About

forty years ago, the Republic of Korea (ROK) Ministry of Defense decided they needed an FFRDC, like RAND or IDA or CNA. They chose the IDA model and established KIDA, with IDA's help. At the time IDA didn't have a Cost Analysis Division. So their model didn't include a cost analysis capability. After I established this division and our reputation got around, I got a call from KIDA saying, "Can you help us do the same for KIDA?" So, with the President of IDA's full support, we put together an education and training program in cost analysis for KIDA. The effort included condensing our GMU course down to one week, bringing a group of their analysts here and force-feeding this course to them. Then we went to KIDA and lectured there. I've been exchanging engagements ever since. I have exchanges with KIDA six or eight times a year along these same lines – collaborations in cost analysis and resource management. They've become quite good at it. KIDA's organization was expanded to include a cost division, similar to IDA's but smaller. KIDA went on to support the establishment of a cost office in the ROK Ministry of Defense, similar to the OSD CAIG. Before that happened, the Ministry did not have a cost office. So now I have frequent interactions on cost analysis topics with both KIDA and the cost people in the ROK Ministry. That's one. A second initiative is with Taiwan. Three years ago, Admiral Dennis Blair, who was the President of IDA at the time, was in Taiwan observing one of their military exercises. Their Deputy Minister of Defense, Mr. Tsai, complained to Admiral Blair that he was having great difficulty justifying Taiwanese budget submissions to their legislative Yuan, that is, their Congress. He said their costs just weren't credible and he couldn't justify them. Admiral Blair said, "I think we can help you." So, when Admiral Blair came back to IDA, he told me to go over and talk with Mr. Tsai to see what we could do to help them. The result is a training and education program in cost analysis for the Republic of China Ministry of Defense. In 2005, David McNicol, Bruce Harmon and I spent two weeks in Taipei in a large room with 40 members of the Ministry, teaching them the fundamentals of cost analysis. We've been meeting with them regularly ever since.

The Taiwanese effort is ongoing and expanding. It started out in the areas of cost analysis and resource management, but it now includes additional subject areas. We have another initiative with Singapore. In 2001, Larry Welch, IDA's President, visited Singapore briefly and talked with permanent Minister of Defence, Mr. Peter Ho, and agreed to have discussions on topics of common interest. IDA's had annual engagements with Singapore since then. Initially, what the Singaporeans wanted more than anything else was to develop a technical capability to estimate the costs of developmental systems. The Singapore Ministry was in an era when they wanted to stop buying weapon systems off-the-shelf and start developing their own systems in Singapore. They didn't know how to estimate the costs of developmental systems. They knew that IDA did and they wanted IDA to help them to learn. We've been having annual exchanges with the Singapore Defence Science and Technology Agency (DSTA), ever since. Last year we stepped beyond just having workshops and completed a joint research project with DSTA. As time went on, we moved beyond cost analysis. This joint research project was on the topic of persistent surveillance in the maritime environment. Their concern is pirates and terrorists in the straits of Malacca. Our parallel concern is drug runners off the coast of Florida. It's a common problem. We did research together to find ways of improving surveillance in these environments. We completed that task in 2006 and 2007 and we intend to continue to do collaborative research efforts with Singapore.

BOB SHELDON: You brought up earlier that cost analysis is a subset of OR. What makes for a good cost analysis background, apart from just general-purpose OR?

STEVE BALUT: Cost analysis is done by a team. It requires several disciplines. OR is not enough. The three components that are needed most are OR, Economics, and Engineering. You also need business and finance, and the physical sciences for the technical aspects of the weapons systems. The team has to have a good, solid statistician. So you need a whole variety of skills and experience. It's a combination of things. So when I'm looking to hire someone - not an experienced cost analyst who's already

developed capabilities - but rather an inexperienced person to grow into a cost analyst, the key features that I want include a keen, sharp mind, energy, a mathematical bent, and education and preferably some experience in one of the three areas - engineering, economics, or OR. From then on, it's on-the-job-training with experienced cost analysts. But smart, energetic, analytical people are what you need.

BOB SHELDON: Do you assign mentors to these younger folks you bring in?

STEVE BALUT: We don't have a formal mentoring program, at least I don't. IDA has, on occasion, toyed with the idea. Over the 24 years I've been here, the idea had its ups and downs. A mentoring program was pushed down from the top once or twice and eventually it disappeared under its own weight. A formal mentoring program is cumbersome, difficult and expensive. Fortunately, we have a way of operating at IDA that achieves exactly the same result without the formalisms of a mentoring program. That is, we have a very flat organizational structure here. We have a President, Division Directors, and staff. Division Directors assign projects to Project Leaders and assist in forming project teams containing the right mix of skills to answer the research question. The Project Leader is an expert on the subject matter, a proven leader, and acts as the mentor for the team. It's just as natural as it can be. It just falls right out of our organization.

BOB SHELDON: Did you ever have an analyst job in a non-cost related field? How different is the general methodology between cost and non-cost?

STEVE BALUT: Yes, my first job after the PhD (other than driving ships) was as an analyst at CNA doing manpower and personnel planning studies. Immediately after that, I was a cost analyst in the OSD CAIG. So I did move from a non-cost job directly to a cost job. There are two aspects to my answer to your question. First, it is my opinion that an effectiveness analyst does not need a deep understanding of cost to be a good effectiveness analyst; however, a cost analyst needs to understand the effectiveness aspects of an issue to do a good job at estimating associated costs.

At IDA we're blessed with having specialists in effectiveness, such as Bill Greer, and other

specialists in cost, such as Dick Nelson. Bill Greer has a good appreciation for the importance of cost in a cost-effectiveness study, but he is not a cost analyst, nor does he want to be. Bill relies on Dick to advise him on the correct application of cost analysis principles. There is a good deal of risk and trust involved with this relationship between analysts. Dick, on the other hand, needs a complete understanding of the structure of the effectiveness analysis in order to produce the relevant costs. Dick sometimes has to argue for Bill to change the structure of the cost-effectiveness analysis when the costs Bill wants and needs cannot be produced (due to lack of data or some other reason). Under these circumstances, Dick would describe the costs that can be produced with confidence and work with Bill to restructure the analysis appropriately.

The second aspect has to do with the "art" of cost analysis. There is a considerable difference in difficulty associated with estimating the cost of something that is being produced now or has been produced before, and something that has never been produced. The former is straight forward and involves the application of standard, generally accepted and practiced methodologies. However, estimating the cost of a developmental item, something that has not been designed or produced before, involves a good deal of "art." Military developmental systems commonly involve the introduction of a new, emerging technology (e.g. pulse Doppler radar) that promises to give our side a fighting advantage over the enemy if implemented. In such a case, there is no historical cost experience to turn to for indications of the likely costs. In these cases the cost analyst must be creative and turn to artfully-applied analogies to identify a reasonable range of likely costs. In contrast, the effectiveness analyst does not face this type of challenge. New military systems are designed to achieve specific effectiveness levels that are readily available and known by the analyst.

BOB SHELDON: Is it easier to go from doing effectiveness analysis to cost analysis or vice-versa?

STEVE BALUT: You must understand that my answer to this question is biased by my experience (I moved from being an effectiveness

analyst to being a cost analyst) and the next person asked might answer quite differently. That said, it is my opinion that it is more difficult for an effectiveness analyst to shift to cost. Here is my thinking on the reasons why. Let's assume that "ease" is measured by the additional knowledge and experience required to complete the transition and the difficulty in obtaining the additional knowledge and experience. Universities do a great job of preparing their students to conduct studies. Curricula abound with the necessary ingredients (e.g., engineering, economics, operations research, statistics, etc.). Graduates who selected and absorbed the ingredients necessary to do effectiveness analysis leave the university prepared to work as an effectiveness analyst upon graduation. Experience is gained on the job. In contrast, universities (except for two or three military-related programs) do not offer courses in cost analysis. A cost analyst learns his trade and gains experience by doing - on-the-job - and the quality of his on-the-job education is dependent upon the capabilities of his mentor or mentors. A good technical education makes learning cost analysis easier, but does not equip the person with the approaches, techniques and methodologies that are generally accepted and practiced. Obtaining the capabilities expected of a cost analyst requires a considerable investment of time and effort, over and above what is available from the university.

BOB SHELDON: Any other significant accomplishments you want to mention?

STEVE BALUT: Back when I started this Division 22, 23 years ago, I was given a relatively small amount of independent research funds to conduct research of my choosing that is not paid for by sponsors. The funds are to be used to improve the capabilities of the staff and thereby IDA's ability to support our sponsors. It's sort of like independent research and development (IRAD) in a for-profit corporation. As I sat at my desk, the first time I was faced with deciding how to spend this money, I thought, - well, I have no idea what my colleagues around Washington or elsewhere are doing with their money. What are they spending their money on? Suppose I spend my money on something they've already done. It would be wasteful. I picked up the phone and called my colleagues around

the Washington area and other areas of the country and asked them to come to IDA and let's talk. Let's exchange ideas on what we're going to invest in, what the products are going to be, and let's make arrangements to share our products, making our combined research efforts more efficient. Well, the first time I did that was 19 years ago. That initial get-together evolved into what we now call the annual IDA Cost Research Workshop. Originally IDA funded the symposium, and invited all the Directors of all offices that sponsor or conduct cost research activities in the United States. About 40 representatives from DoD cost offices and FFRDCs came annually and exchanged ideas, told what they were doing and offered to share their findings with everybody. I have produced a report every year for the past 19 years that contains the summaries of all cost research projects in progress or planned that year. The report is distributed to all participants and is used by the cost community. This beneficial

activity is now jointly sponsored by the OSD PA&E. The symposium has become a way for the OSD PA&E to satisfy one of their missions - to keep abreast of cost research activities Department wide and to foster and lead cost research activities in the Department. This symposium and the associated report are vehicles that the CAIG Chairman now uses for these purposes. Participation extended beyond the U.S. on occasion. Representatives from the UK Defence Procurement Agency took part for a number of years. Representatives from the Korean Ministry of Defense have participated as well, and the Taiwan Ministry has expressed interest in taking part. I think this has been a significant accomplishment.

I thank you, Bob, and MORS for this opportunity. As for the future, I will continue to work to expand IDA's international program in support of our allies, particularly in the Asia-Pacific region. We have much to offer and they are reaching out for help.