Measuring Success

=

Volunteer Hours!

Recapping a Decade of IT Legacy Committee Accomplishments.

IT Legacy

1946 ====> Today!

Engineering **R**esearch **A**ssociates
Remington Rand
UNIVAC
Sperry
Burroughs
Unisys
Paramax
Loral
Lockheed Martin

VIP CLUB
Since 1980

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LABenson

December 2015

The VIP Club's Why, What, and Who.

From our constitution

MISSION: The VIP CLUB is a social and service organization dedicated to enriching the lives of the members through social interaction and dissemination of information.

GOALS: The CLUB shall provide an opportunity for social interaction of its members. The CLUB shall provide services and information appropriate to the interest of its members. The CLUB shall provide a mechanism for member services to the community. The CLUB shall provide a forum for information on the heritage and on-going action of the heritage companies (Twin Cities based Univac/Unisys organizations and the predecessor and successor firms).

MEMBERS are former employees and their spouses of Twin-Cities-based Univac / Unisys organizations and predecessor or successor business enterprises who are retired or eligible to retire, and are at least 55 years of age - Membership is voluntary. Payment of annual dues is a condition of membership. Each membership unit (retiree and spouse) is entitled to one vote. The CLUB maintains a master file of all members. This master file is the property of the CLUB and is used for communication with members and for facility access.

We dedicate this booklet/article to 'Ole' and our VIP Club founder, Millie Gignac.

Tributes:
- Millie Gignac was the first female DIRECTOR at Sperry.
- She founded the Sperry Retirees Club in 1980, now the VIP Club.
- Ms Gignac was the VIP Club President in 1988 and 1989.
- In 2009, the VIP Club designated Millie as a Member Emeritus.
- She was a DCHS Trustee in 2011 when the DCHS Board decided to be the artifact repository and exhibit site of the ERA to Lockheed Martin IT Legacy history.

This clock and onyx-with-diamond ring are symbolic of our heritage companies' employee service recognition programs:
- Sperry presented the clock to Mildred B. Gignac for 25 years of service.
- Inscribed inside the ring is 1956-1986, Millie's 30 years of service to Remington Rand, UNIVAC, Sperry, & UNISYS.

Both are donated to the Lawshe Memorial Museum for the VIP Club's Legacy exhibit.

Measuring Success = Volunteer Hours!

Introduction

The VIP Club's Information Technology (IT) Legacy Committee started in October 2005 when LMCO's Richard 'Ole' Olson brought a Legacy committee idea to the VIP Club's board. Then, after a January 2006 meeting at the Charles Babbage Institute, the committee set three objectives:

1. To **capture** whatever remaining material and information we can,
2. To **catalog and archive** all the material collected, and
3. To **publish/publicize** our history and heritage in a way that I will be interesting to others within our computer systems industry and to our fellow Minnesotans.

Although objectives 1 and 2 are yet ongoing after a decade, it is appropriate to summarize what we have accomplished. For objective three, we began a web site anthology and now have an exhibit at the Lawshe Memorial Museum in S St. Paul. This paper is a 'Readers Digest' version of many stories.

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Volunteers, et al'

Hundreds of people have donated thousands of hours over this decade. To date, 170 people have contributed career summaries and about 250 people have given us over 1,000 project, system, and product 'mini-stories'. Although I cannot name everyone, I would like to recognize some who have had a significant impact and a few stalwarts who have worked for most of these years. For example, if Ole had not approached the VIP Club Board in 2005, none of this would have occurred!

- Website anthologies telling the story. The five[1] most prolific item writers are Larry Bolton, Lyle Franklin, Jim Rapinac, John Westergren, and Dick Lundgren *(Dick and Larry pictured at the 2015 Club picnic.)* Tom Montgomery created/provided all the information for our most complete systems web page, Air Traffic Control, including about sixty pdf files of system and hardware descriptions,- http://vipclubmn.org/aircontrol.html.

- Lawshe Memorial Museum telling the story. In 2011, Bernie Jansen[2] convinced the Dakota County Historical Society (DCHS) board to accept our artifacts and to house a permanent exhibit. Chad Roberts, then DCHS Executive Director, created a vision for an "*ERA to Lockheed Martin: Minnesota's Computer Industry*" exhibit. John Westergren was a great organizer in getting three truckloads of artifacts, workstation equipment, photo media, and documents transferred to the museum. Club Treasurer, Harvey Taipale has been the primary liaison between the VIP Club Board and the museum staff. He helped the museum write the first Minnesota State Legacy grant to catalogue the artifacts. Harvey setup the 5-workstation network for photo identification. Keith Myhre helped the staff propose a second grant and then took the lead in identifying and creating topical exhibit posters. Tricia Myhre and Jon Simon have led the volunteer photo-ID teams alternating Tuesday mornings since January 2013.

- Not volunteers nor heritage company retirees nor company employees, but –
  o Thanks to **Lockheed Martin** and **UNISYS** for their continual support of our initiatives, work spaces, artifact storage, artwork creations, printing, and meeting rooms.
  o Special thanks to Lawshe Memorial Museum employees Rebecca Snyder, Nancy Hanson, and Andrew Fox for making our IT Legacy an integral part of their workdays.
  o Thanks to Dr. Tom Misa, Director of the Charles Babbage Institute, for counsel to our committee and for including some of our items in his Minnesota's Hidden History lectures and the 2013 *Digital State* book.

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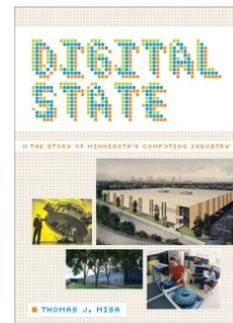
[1] The counts exclude Lowell Benson because as webmaster he has created or edited items for every web page.
[2] Bernie is a VIP Club Member Emeritus and a DCHS Board Trustee.

- Sesquicentennial Team – The 2008 team consisted of Dick Lundgren, Harvey Taipale, John Westergren, Lowell Benson, Quint Heckert, Ron Q. Smith, and Tom Turba - with behind the scenes support from many others. We had a display at the MN Capitol and the Minnesota State Fair. That 2008 story is http://vipclubmn.org/Articles/It%27sAWrap.pdf.

- Others un-named are countless wives and off spring of deceased people who have donated their parents' hardware artifacts and boxes of documents while cleaning garages/basements.

- Dozens of web browsing people who have chipped in their UNIVAC systems' experiences.

Accomplishments

Details about many of these items are in website 'Articles for the Month' or in our periodic newsletter articles; pdf-files archived on web site page http://vipclubmn.org/Newsletters.html.

- 2005: The whole Legacy effort was "kicked-off" by Lockheed Martin asking for sites to contribute their history to the Corporation as part of the planned Centennial anniversary book documenting the 100 years of the Loughhead brothers starting their airplane company. Peggy Mullikin, Ole, and John Westergren met with the members of the Corporation who visited Eagan to start the effort going. Richard, 'Ole' Olson asked the VIP Club Board to support Lockheed Martin in documenting their Twin Cities Heritage. Director Lowell Benson agreed to co-chair a committee with Ole. Board Associate and LMCO retiree Dick Lundgren volunteered to help, suggesting that we start with a visit to the Charles Babbage Institute (CBI).

- 2006: January: At a meeting with CBI Director Dr. Norberg; he counseled us; to do oral interviews and get written career summaries of 200 plus people to tell 'the story'.

- 2006 → today: Gathering career summaries, documents, and hardware items from retirees.

- 2006 → 2009: Ole and John W. conducted oral/video interviews with about three dozen retired persons (most are yet to be transcribed.)

- 2006 March: Lowell started a web page on his personal site to begin publishing and publicizing our heritage. LMCO provided office space, storage cabinets, and PCs for volunteers to store and catalogue collected items.

- 2007 March: Transferred all collected articles and career summaries from Lowell Benson's personal web site to the VIP Club's new web site. http://vipclubmn.org.

- 2007: Ed Nelson edited a booklet; "The Fred Hargesheimer Story" for local distribution and web viewing, LMCO printed copies. (Fred was a WWII P-38 pilot and a UNIVAC employee.)

- 2008 March: Ole retired, John Westergren became the LMCO focal point and replaced Lee Meyer as their local heritage 'Executive of Interest' on July 15, 2008.

- 2008 May: A team developed a technology history display for Minnesota's 2008 sesquicentennial Capitol Mall celebration. We subsequently showed this display at the Minnesota State Fair; UNISYS, Roseville; UNISYS, Eagan (the MACS building); LMCO in Eagan; and the Eagan Community Center.

- 2007 &2008: John W. reviewed inventory lists of over a 1,000 archived document boxes. Then he and a few volunteers cataloged 40 boxes of patent dockets before transferring them to the Charles Babbage Institute.

- • 2008: Harvey, Larry, and Quint created new genealogy charts from an old combined and a defense chart plus modern information - see our web site computers page, section 4.
- In September 2008, Dr. Misa started "Minnesota's Hidden History of Computing," a lecture series presented at the Charles Babbage Institute. The series placed the ERA story within the larger picture of Minnesota's computer technology history. Tom referred to our anthology web site in the lectures and cited a few specific web pages in his recent book *Digital State: the Story of Minnesota's Computer Industry* (University of Minnesota Press, 2013).
- 2009 January: Placed a report and token artifacts about our activities into the Minnesota Bi-centennial capsule to be opened in 2058. Coordinated by Dick Lundgren and Lowell Benson
- 2009 October: We setup then staffed a display of our History/Legacy booth items at the University of Minnesota's Computer Science open house. We did it again on October 10, 2009 and October 14, 2011. Lowell Benson & Tom Turba did the planning & setups.
- 2009: Earl Vraa led a group documenting the Computer Aided Design development at UNIVAC/Sperry.
- 2010 fall & winter: Displayed snippets of our IT Legacy for two 2010 semesters in the U of MN's Walter Library. Setups were by Lowell Benson and Tom Turba.
- 2011: Displayed the IT Legacy and NTDS participation during the 2011 50th Government Contractor Assn Forum - University of Minnesota, coordinated by Lowell.
- 2012 December: Led by John Westergren, we transferred all hardware artifacts and image media to the Dakota County Historical Society's Lawshe Museum in South St. Paul, MN. We also transferred a truckload of documents to the Charles Babbage Institute.
- 2013 August: Held an initial exhibit open house at the Lawshe Memorial Museum, led by Keith Myhre and Harvey Taipale. Volunteers assisted museum staff in obtaining a Minnesota State Legacy grant to support continuing exhibit development efforts.
- 2013: Bernie 'Mike' Svendsen lead an effort to document the history of semi-conductor developments in the Twin Cities area. History Paper and collected documents now at CBI.
- 2014: Bernie S. and Lowell B. documented the UNISYS, Roseville history wall shadow boxes.
- 2015 September: In cooperation with the Lawshe Memorial Museum staff, held a VIP Club private showing of exhibits and posters, led by Harvey Taipale.

Articles for the Month, #101 → #215

In January 2010, we started newsletter synopses of our web site's 'Articles for the Month' for our members who had no home internet access. We have replicated 115 article synopses on the next 52 pages – in effect a Readers Digest version of the articles[3] posted to date. Go to section 2 of http://vipclubmn.org/documents.html for links to all of the articles. We have another dozen articles in waiting for 2016 monthly postings.

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[3] These articles are numbered beginning with 101 to facilitate web site people name indexing.

In April of 2007, the first "*Article for the Month'*, was a scan of a 1965 Goddard News article submitted by Don Mager, #101. This article describes the Apollo computer network, identifying the 39 tracking sites around the world. It mentions engineers Don Mager, Glen Johnson, Les Brunker, Ed Willis, and Dale W. Call.

In May of 2007, we posted —Sperry Military Computers by George Grey, #102. This is an excellent five-page synopsis of our early computer history including Athena, Bogart, NTDS, Nike-Zeus, 1824, 1108, AN/UYK-7, and 1832.

In June of 2007, we posted #103, a copy of a Sperry newsletter with stories about the Canadian Patrol Frigate (CPF), AN/UYK-43, and AN/UYK-44 wins. Gene McCarthy was the CPF marketing director, the article author, and the article donor. Other CPF team members mentioned in these articles are Dennis Abbott, Steve Anderson, Ken Beuchler, David Bohne, Barry Cockerill, Bob Jablonski, Glen Johnson, Dick Kuhns, Keith Myhre, Dick 'Ole' Olson, Gary Peterson, Walt Ruziak, Marc Shoquist, Gerry Smith, Ross Starkson, Neil Williams, and Paul Williams.

Mike Bukovich wrote the AN/UYK-43 win article. Bob Elfering wrote the AN/UYK-44 win article. – Submitted by webmaster, LABenson

In July 2007, we posted #104, David Andersen's "The Invention of Voice Mail". This article focuses on both voice recognition and voice generation developed in a, sometimes secret, laboratory in the basement of Plant 8. A Voice Response Unit (VRU) was one of the products, which came out of that laboratory. In addition to David, some of the People who worked there over the 14 years of the lab were Dr. Mark Medress, Hank Ordson, Tim Diller, Toby Skinner, Karen Nieken, John Siebenand, Larry Lutton, Don Anderson (donator of drums to the Legacy project), Ray Hedin, Dean Kloker, Clint Crosby, Art Olive, Jens Peterson, Lowell Benson, and a marketer, Gene Chicoine. Go to your local library and ask for the book, "The Cello Maker and other stories of the working man" by David P. Andersen. This book includes the „Voice Mail" article as one of the 16 short stories therein.

In August 2007, we posted #105, "Networking" by John Nemanich. This is a brief history of networking at Unisys beginning with the end of the World War II. It covers some of the Burroughs history, the 3760 developed in the Plant 5 mezzanine, the Communications/Symbiotic Processor at Salt Lake City, Sperry U300 CRTs, and the AUTODIN network of the early 60s. "Unisys was an Internet pioneer from the beginning. The Internet has its foundations in the Department of Defense ARPAnet, which had its beginnings in 1970. Unisys had a presence on the ARPAnet in 1970, and by 1971 had two ARPAnet facilities." This article is 15 pages long – it is deserving of becoming one of the many chapters in our future legacy book.

In September 2007, we posted #106, "The Fred Hargesheimer Story" as written by Ed Nelson. Ed gathered previous publications both by and about Fred. He also talked to Fred a couple of times to create the „Reader's Digest" like story of a man who is/was from the Greatest Generation. There are a few prints of this booklet floating around, check with one of the First Friday luncheon group.

In October 2007, we posted #107, Larry Bolton's *Vendor Surveillance Notebook,* a record of an engineer helping our vendors solve their component manufacturing problems during the mid-60s.

This illustrated some of the technical details that we as a company went through in order to assure that our products delivered to customers would always be reliable. During this time, Larry worked with Robert Nelson, David A. Oines, Larry Pollock, Bob Rhode, and numerous Westinghouse persons. Larry is a U of MN 1965 graduate and 43-yr employee.

In November 2007, we posted #108, a *Harvey Taipale explains Legacy* flyer for distribution at various Club and associated meetings. The first paragraph is, "In late 2005, Lockheed Martin Corporate, motivated by the realization that their current company was created from over 20 predecessors, asked the various operating units to —capture their legacy without a real concept of what was to follow. In Eagan, Ole (Dick) Olson was tasked to respond; he formed an ad hoc group of volunteers and contacted the VIP Club Board. The group quickly realized that the history of Engineering Research Associates (ERA), continuing to the present, was a remarkable story of technological innovation and contribution to the computer industry in general and to Minnesota in particular*.* This story, particularly the early years, **has never really been completely told**; e.g. ATHENA launching missiles.

In December 2007, we posted #109, Dick Lundgren's *European Defense Business* articles, reprinted from the 2007 VIP Club newsletters. These covered the NATO Naval Tactical Data Systems and associated projects. Featured therein are Norway, Netherlands, France, and Germany. Keith Myhre, Art Francis, Denny Drake, and Gary Reetz were involved in the Norwegian P-3C system.

The German Navy Fast Patrol Boat Project's began in Hengelo Holland with a 1970 team of Ernie Lantto, Al Rudman, Bill Rogers, Tom Kratz, John Rachac, Jim Gannon, Dick Lundgren, Dick Denson, Ron Trowbridge, and Lowell Benson. Most of these engineers, instructors, and programmers later moved to Wilhelmshaven Germany to work on other FRG projects.

We did the ZKSD project, for the German Air Traffic Control Agency.

The Otto Versand project was previously detailed in David Andersen's —The Invention of Voice Mail paper. How many of you knew Bob Fischer who served in Paris for a few years when we sent CP-642B computers to the French? Ray Costello was our on-site representative there for many years.

2008, Articles #110 → #122

In January 2008, we posted #110, *A World Wide Career, behind my Sperry Badge* by Glen Hambleton. With a U of MN BS in Education, Glen started at 'the company' in June of 1959 working for Ken Fechter. He took advantage of an early out offer in December of 1986. Teaching computer classes and subsequent management positions took him and his family to Texas, South Africa, England, Russia, Germany, and Korea with stays in Minnesota between the tours. In this 16 page 'biography', Glen mentions many, many co-workers and project team members: Norm Alrich, Jack Anderson, Jim Arbona, Willy Bannow, Leo Bock, Ken Boehm, Bob Bro, Ron Brumm, Les Brunker, John Butler, Paul Burly, Herb Carrol, Pat Casey, Adam Charsean, Bruce Clark, Roger Dalziel, Larry Debelak, Walt Deitz, Thain Dikkers, Bill Doe, Doug Dorner, Tom Dunn, Gerald Engelke, Ron Favorite, Steve Fink, John Flood, Pete Freeman, John Fritz, Dick Gehring, Bill Geiger, Al Gresbrink, Janet Hagberg, Clint Haggerty, Ernie Hams, Richard J. Hansen, John Hartmann, Quint Heckert, Elli Hiller, Wally Heuer, Roy Hegler, Gary Holthusen, Ernie Horning, Bernie Jansen, LeRoy Jernigan, Emmett Johnson,

Dale Klette, Dave Klinzman, Bob Kochendorfer, Dave Kolling, Bud Krammer, Dick Kuhns, Gordy Lamb, Don Lampland, Dick Lundgren, Don Moran, Tom Morris, Fred Murray, Paul Murray, Dan Newton, Marv Nickle, John Nygaard, Leo O'Brian, Ed Olszewski, Bob Paterson, Dick Paulson, Dexter Pehle, Diane Plait, Knight Prior, Gerald Probst, Don Ream, Larry Reid, Dick Roessler, Dave Ruckman, Bob Ruud, Fred Schmugge, Dick Seaberg, Cliff Sheets, Romuald Slimack, George Soldata, Jerry Squires, Jim Stahley, Roger Stern, Bob Stevens, Eldon Stevens, Joe Stoutenburg, Les Swanson, Alex Trembly, Ted Torkelson, Ron Trowbridge, Dottie Tucker, Elmer Turcotte, Dick Wagner, Lon Weidenhaft, Bob Wells, Paul Welshinger, and Sharon Woods.

I, Lowell Benson, recall interfacing with about half of these people during my own 33.5-year career – what is your count?

In February 2008, we posted #111, *Carbon Heat Trapping: Merely a Bit Player in Global Warming, by* Richard J. Petschauer, Senior Member IEEE. Dick worked almost 30 years at UNIVAC and UNISYS with a 6-year break at another company in the 60s. In this paper he presents mathematical calculations, facts, and figures which refute much of the 'global warming' rhetoric bandied about without substance. This level of engineering analysis is typical of what led to so many highly reliable products at UNIVAC! {Although this is not a computer paper, it shows engineering skills!}

In March 2008, we posted A Gaggle of Geeks by James P. Lenfestey, prologue by Lowell Benson, #112. This was originally published in the Minnesota Monthly in 2005 as 'The Original Geek Squad", the story about a group of octogenarians who meet the first Friday of every month at the Casa Viejas on West 7th in St. Paul. Actually, it was Parish's Restaurant when the article was written. Several of the persons mentioned in the article have passed away: Sid Rubens, Earl Joseph, Harry Wise, George Hardenbergh, Jack Hill, Seymour Cray, and Bill Norris. This article was one of the stimuli to get the Legacy Committee started in the fall of 2005. Manny Block, Bernie Jansen, Marc Shoquist, and Warren Burrell mentioned in the article are still regular attendees at the First Friday lunches. {A First Friday group still meets, at the Lilydale Pool & Yacht Club, Jack Ross hosting.}

In April 2008, we posted #113, "Plated Wire Memory Usage" on the UNIVAC Minuteman Weapon System Computer (WSC) by Larry D. Bolton, Clinton D. Crosby, and James A. Howe. The technology developed was used because it was less susceptible to nuclear blast radiation than core and other memory types. The WSC nomenclature was AN/UYK-11. The AN/UYK-11 was used in the ground-based part of the Minuteman III system and was in the underground LCF (Launch Control Facility) as well as in each silo. The UYK-11 was well known within the Air Force for its reliability. The computers ran 24 hours a day, 7 days a week continually testing the Minuteman launch readiness. Most of them ran for over five years without any downtime! An actual Mean-Time-Between-Failure (MTBF) in excess of 45,000 hours for the 100 plus systems that were deployed was observed. A variation of plated wire memory was later used in the commercial 9000 computer series.

In May 2008, we posted #114, Canadian Patrol Frigate by Dennis Abbott. Dennis Abbott worked at Sperry Univac/Unisys from February 1965 to September 2000. From early 1980 to August 1983, as Manger of the International Systems Development Group, he participated in the CPF Program acquisition process through contract award. From August 1983 to November 1987, he was the Project Manager responsible for Eagan CPF Engineering activities. From December 1987 to April 1989, he was the Defense Systems site manager at Paramax in Montreal, Canada and functioned as the Software Engineering Director within the Paramax organization. Dennis' personal experiences and recollections of the CPF activities complement the other CPF information on the web site which was provided by Dave Kolling and Gene McCarthy. The engineers who developed SHINPADS, the UYK-502, and UYK-505 equipment that were a vital part of this defense system built and integrated for the Canadian Government. Submitted by Lowell Benson.

In June 2008, we posted #115, Jack Sater's ATC overview slides from LMCO Brown Bag presentation on May 7, 2008. These slides start with "The FAA was put in contact with Univac by the Navy, who wanted to show Congress that their work on NTDS should continue to be funded because it also had application to civilian efforts, such as **Air Traffic Control**." This brought a 1963 contract for the Atlanta ARTS I followed by a 1966 award for the NY ARTS IA system. The engineering of these systems resulted in a 1969 contract for the terminal control systems [ARTS III] at the 64 major airports in the U.S. Ensuing systems were JARTS, Murphy Dome, ARTS IIIA, NY TRACON ARTS IIIA, Korean ARTS, ARTS IIIE, MATCALS, micro-EARTS, Taiwan ATCAS, German STCA, Denver FMA, China ASTEC, ..., Common Arts. {LMCO staff in Eagan, MN supports ensuing FAA systems yet in 2015.}

In July 2008, we posted #116, "Another Computer Was Born" by Curt Christensen. Selected paragraphs are "With the death of Howie Stensel in 2007 and the previous passing of George Workman, I think that that just leaves two, Jim Button and me, who met with Don Ream one Friday afternoon in the old gilder factory at 1902 Minnehaha Ave." "The sequence went like this - Red Phillips had signed a contract with the Marines to build a new 642B compatible computer using his department's shipboard packaging technology. I was assigned as program manager reporting to George Workman. Findley McLeod was tagged as the project manager reporting to Red. The contract stated the computer must be less than 20 cubic feet!"

"Findley had called a meeting to inform Red that there was no way that they could meet that 20 cu. ft. requirement! Red got upset and started throwing out options, like using flat head rivets! Findley's response was: "Hell Red, even if we use displacement volume instead of swept volume we still can't make it! " {Editor's note by John W.: This later became the CP-808, which was housed in a helicopter portable shelter designated the TYA-20.}

"A decision was made to explore using aerospace packaging developed by Tip Miller (being used for the 1830), a concern was that it had to be air cooled and Tip had used conduction cooling to a heat exchanger which was then cooled with forced air. This packaging technique used Muffin fans and multilayer boards for a proposed development of a 1236 computer" [would have been the 1219C.] The resulting packaging decisions became the 30-bit AN/UYK-8 for the Marines. A later "what if" study was presented to Mr. Ream on that Friday? The recommendation resulted in the definition of what was to become the 32-bit AN/UYK-7!

In August 2008 we posted #117, the "Evolution of an Environmental Test Laboratory" written by Paul Welshinger and Bob Keenan. Environmental testing began in 1954 during development of the Borehole cameras. The Plant 2 facility continued until the transition to the basement of Plant 8 in the 1990s. Laboratory personnel over the years were: Bob Brown, Paul Castrodale, Tom Cegla, LaVerle Cocchiarella, Pat Darmody, Bob Dieke, Lew Downing, Don Ellings, Tad Enyeart, Lauren Erickson, Norb Ewald, BobFaust, Don Gabrielson, Bill Hammond, George Hayden, Bob Kissling, Phyllis Kliniski, Al Koenig, Ted LaVake, Dennis LeCroix, Rudi Melzer, Arnie Ness, Al Nieters, Red Phillips, George Raymond, Dick Ruegemer, Burely Saunders, Ray Schieski, Harry Schramel, Bryce Shimmon, Barb Story, Art Timm, Frank Tomala, Carol Wilson, and George Ziemski. Paul Carlton added a Plant 8 capability paragraph to this history paper. Submitted by Lowell Benson.

In September 2008, we posted #118, the SNERT development paper by Ken Graber, Larry Bolton, and Jeff Parker. This was not about Hagar's dog, rather a **S**erial **N**ATO **E**ncoder **R**eceiver **T**ransmitter (SNERT) integrated circuit (IC) development for the Low Level Serial interface, MIL-STD-1397 - Type E. The 'Output function' of the SNERT was to Receive TTL NRZ data at the 10 Mega-Hz rate, and then to encode and transmit LLSI/O control frames, and data. The "Input Function" was to receive LLSI/O Manchester Code from the cable, decode, then determine whether the code was either a Control Frame or Data signal. The design challenge that was unique for the SNERT chip was that it was a custom IC with both analog and digital functions on a single wafer. I do not believe that Sperry had attempted that combination before. As previously mentioned, because of the required high speed and low voltage level, the analog portion of the circuit needed tight tolerances. Combining the digital front end on the same wafer was required for both proximity requirements of the analog and digital circuitry and the overall real estate available on a SEM Format B printed circuit card module. This combination of challenges drove the design requirements for the chip. The leadless chip carrier (LCC) package was required by the SEM module ceramic substrate. These devices were used in the AN/UYK-44 and AN/UYK-43 computers as well as several peripheral equipment types. These three authors amassed 116 years of career experiences at UNIVAC!

In October 2008, we posted #119, the magnetic tape development paper by Douglas C. Wendall Jr. "I was hired in November of 1947 at The Electronic Control Company {predecessor of EMCC} located in several floors at 1215 Walnut Street above a Lane Bryant store. John Mauchly, J. Presper Eckert, Isaac Auerbach, Frazer Welsh, Ted Bonn, and John Sims all interviewed me. They decided to take a chance on me, liking my combination of a degree in chemistry from Haverford College along with my electronics training and service as an electronic technician in the Navy during WWII." "The work in the basement of Ridge Avenue was the culmination of the first project I was assigned to. Ted (Theodore H.) Bonn was doing research aimed at developing a process for making magnetic recording tape by coating a non-magnetic metal supporting tape with a thin magnetic metal coating–the idea being that a thin coating would be capable of recording a higher data density than possible on the thicker iron oxide coating then used on {metal} recording tape. Another important consideration was that a metal-based tape would be mechanically stable, unlike the paper based recording tape then in use." "We had run over 500 tests before we found the properties we were looking for. We used the last few tests to optimize the plating process. Our development work was now finished and we were ready to try the plating process on a large scale. Our patent attorney,

George Eltgroth, filed the patent application while we were still at Walnut Street - it was issued in three or four years (about average). The Bonn-Wendell patent became widely investigated and was used by various companies in the computer industry in the production of tape, disks, and drums for many years.

In November 2008, we posted #120, the *7901000 Integrated Circuits* paper by Larry Bolton plus #121, Ralph Kerler's 1965 IC Development paper. The potential improvements in size, power, performance, reliability, and cost available with semiconductor integrated circuits have received a great deal attention throughout the electronic industry. From the start, digital switching applications have received the major benefit from this new technology, due to process requirements well within the state-of-the-art and due to the large number of repetitive functions inherent in most digital machines. Continuing its leadership in the application of new techniques, the UNIVAC Defense Operations **in** St. Paul was one of the first systems manufacturers in the United States to actively investigate and use integrated circuits. The purpose of this paper is to summarize the growth of this field within Defense and to discuss in detail progress during the last 12 months toward a "Standard" integrated circuit family fulfilling the earlier mentioned promises." The 1824 computer used on such programs as MMRBM, BGRV, MBRV, and SABRE required the design of the first integrated circuit family used in UNIVAC. The circuits were packaged in a 10 pin ¼ x ¼ inch flat package which was the industry standard at that time. The original 1824 circuits were designated part numbers in the series 7900300 and 7900600. There were 18 logic configurations of these developed using Westinghouse as the fabricator.

During late 1962, a contract was negotiated with the Department of Navy for the large-scale high-speed CP-667 system. Due to speed and availability considerations, the decision was then made to use a hybrid chip circuit rather than a monolithic fully integrated device. These new devices (7901000 series) were intended to be used in the CP-667 machine to replace the hybrid devices, and a redesign was actually released using these devices. However, only three CP-667 machines were built (before this integrated circuit development). The Navy cancelled the CP-667 program after two units had been delivered. UNIVAC thus put their third unit into their Military Computer Software Development Center, no CP-667 units were built using the 7901000 series devices. However, there were applications for these devices. Beginning in 1966, the CP-901, AN/UYK-7, AN/UYK-8[4], and CP-890 computer designs largely used only the 7901000, 7901001, 2801573, and 2801574 devices. Several peripheral device controllers also used these devices or PC cards from computers.

In December 2008, we posted #122, two Serial Input/Output papers from Marc Shoquist, a technology doublet. These papers provide the background of the Naval Tactical Data System's 1950s parallel interfaces followed by the evolution through the 10 MHz serial interface (Type D) and the Low Level Serial (Type E) to the fiber optic transmission systems at the beginning of 1980. Development of fiber optic interfaces at Sperry facilitated the Navy's use of fiber optic interfaces in

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[4] My recollection was there was only one (1) UYK-8 built - which was eventually accepted and deployed by the USMC. John Westergren

the AN/UYK-43 and AN/UYK-44 computers. The STANAG 4153 standards developed in parallel with U.S Navy standards also brought Low Level Serial and fiber optics to NATO ships.

2009, Articles #123 → #135

In January 2009, we posted #123, the [BEA reservation system](#) by Michael Knight. Michael Knight recalls Beacon - the pioneering reservation systems developed by British European Airways (BEA) and UNIVAC. Despite achieving so much with so little, Beacon did not survive the BOAC (British Overseas Airways Corporation) merger, but its ghostly legacy lingered on for a while in unexpected places. Beacon was British European Airways' computer online network, initially developed in 1963-7, to provide a full-scale passenger reservations service. Subsequently, the hardware was upgraded, and further applications added on an integrated basis. Later, following the merger with BOAC to form British Airways, these services were progressively taken over by Beacon's old rival system Boadicea. The memory of Beacon thus began a long evaporation.

In the mid-1960s, BEA carried over 7,000,000 passengers a year, and was fifth largest 'carrier' in the world. [BOAC carried over 1,000,000 a year and was ranked 35th largest]. By today's airline standards, these numbers are very modest, but they presented very demanding data processing challenges. The real-time solutions to these challenges were the ancestors of today's all pervading call-centres. {*Article Editor's note: This article is an abridged version of a talk given by the author to the Society at the Science Museum in February 2008.*}

In February 2009, we posted #124, [It's A Wrap](#) - A project report about our Sesquicentennial Team activities. The Sesquicentennial Team set up a UNISYS/LMCO display on the Capitol Mall in May 2008. At the request of the State Sesquicentennial Commission, most of this display was then set up in their tent during the 12-day state fair. Seven volunteer speakers also told our Legacy story at a morning State Fair forum in the Commission's presentation tent. Our speakers were Dr. Peter Patton (ERA history), Jack Sater (ATC), Marc Shoquist (Antenna Couplers), Bernie Jansen (Space Age systems), John Westergren (NTDS), Ron Q. Smith (Commercial Systems), and Brian Toren (future). Dick Lundgren and Lowell Benson with their grandsons witnessed the sealing of the Minnesota Bi-centennial time capsule, which contains a few hardware artifacts and documents relating our 60-year Legacy history.

In March 2009, we posted #125, the *40 Years of Excellence* booklet from the U of MN's Computer Science and Engineering Department. This book relates a beginning with the ERA Atlas/1103 computer. U of MN's CSE department head, Dr. Vadim Kumal, gave us posting permission.

In April 2009, we posted #26, 'About our 1950 period drums' by Larry Bolton. "The VIP Club has access to three drum memory units made by ERA/Univac, probably in the mid to late 1950s. This article makes comments based on observations and measurements made on those three drums. It compares that data with published specifications for the maximum capabilities

of the families for these drums." Don E. Anderson, the other by the estate of Harry Wise, donated two of these drums to the Club. Shown on the previous page is model 1119A1, S/N106 that is the oldest of the three.

Larry discusses drum operation in the paper. Not in the paper is the fact that the Sesquicentennial team included this drum among the artifacts displayed on the Capitol Mall and at the State Fair.

In May 2009, we posted #127, a letter image donated by Vern Sandusky. In this June 4th, 1986 letter, Mr. Blumenthal assures the then Secretary of Defense, Casper Weinberger, that "Burroughs will maintain and improve upon the quality and support which Sperry has provide its defense customers for over seventy years." Submitted by Lowell

In June 2009, we posted #128:" A Letter to the Editor" from Norm Palzer about the Drum prototype donation to the Minnesota Historical Society." Norm wrote "I worked in the Property Administration/Disposal Department spanning UNIVAC to UNISYS (1967 to 1993). The ERA Prototype Magnetic Drum was in our possession from about 1970 until 1991. It was always housed in our crib that was located at Plant-2, 1092 West Minnehaha Ave. As you know ERA's original plant was Plant-2. Every now and then, it would leave our possession to be displayed at trade shows. As the years went on, most of the people, who knew anything about the DRUM departed the scene. However, it was never unaccounted for. In 1986 when UNISYS celebrated the 40th anniversary of ERA's founding, the DRUM had some distinguished visitors. Among the 'ERA' veterans touring Plant-2 that day were Arnold Cohen and Jack Hill. Both Arnie and Jack along with Frank Mullaney developed the DRUM. In December 1990 after 44 years, UNISYS vacated Plant-2. In January of 1991, the DRUM and our crib moved. I was relocated to the U.E.C. Building and our crib was moved to the MMC Building. We shared space in the MMC Building with Jack Laver's and Maynard Paul's "Asset Reduction Group." Finally, in February 1991, the DRUM got its final marching orders. Realizing its historical significance in the development of the general-purpose computer, it was requested as a donation by the Minnesota Historical Society. Linda Miller (Public Affairs) approved the donation; signed off by Carole Bidon (Administration) on February 11, 1991. I generated Disposal File #208 declaring it for disposal. On February 13, 1991, I wrote up 'Order-to-Ship No. 90185.' Our truck delivered it to the Historical Society Storage Facility at 1500 Mississippi Street, Saint Paul on February 10, 1991.

I am glad to hear that after all these years the DRUM has been refurbished and beginning May 23, 2009 it will be featured as part of the MHS Greatest Generation Exhibit."

In July 2009, we posted #129, "The Minuteman Program History" by Larry D. Bolton. "The Minuteman program at UNIVAC began in 1969. The program was deemed of such significance and had such rigorous parts control requirements that component engineers from the central component-engineering group in plant 2 were assigned to the program full time for the development and early production phases of the program. TRW in California was the prime contractor for the system. Some new technologies were considered "risky" and required special attention. For most major/critical components, we base-lined (listed the process documents and their revision) the manufacturers processes and limited which lines on which the Minuteman

components could be made. Manufacturers were required to tell us of all changes they made to the process and/or materials. We audited the suppliers at least annually to make sure they had not made any changes without telling us. Another requirement was that all components had to be heavily electrically and thermally de-rated so as not to stress them too hard. There was a set of rules that had to be adhered to and we were required to justify and get permission from TRW for any application which violated the rules. As the design was being finalized, we had a couple of persons whose only job was to look at each and every component and determine what the design stress level was. The voltage, current, power, and temperature data was recorded for each and every application of every component. The customer reviewed this data. As you can imagine, this took a lot of paper. It was through these efforts that the AN/UYK-11 computer achieved the high reliability of the Minuteman Program. The fielded systems provided the U.S. Air Force with a Mean Time Between Failure (MTBF) of over 25,000 hours. The launch control facility system computers were running 24 hours per day, seven days a week for over a two decades – yes that is about 3 years of continuous operation per site without a single failure. The reliability was designed in and built in.

August 2009, we posted #143, a 1986 paper, "A System through Hardware Design Methodology" written by Larry D. Anderson and Earl M. Vraa. Selected excerpts are: "Sperry's entry into the Department of Defense's (DoD) Very High Speed Integrated Circuit (VHSIC) program enhanced our understanding of at least two issues important in Sperry's business planning. The issues include 1) the dangers of complacency with respect to technology advancements and 2) our strengths with respect to the development of cost and technically competitive electronic products." ". DoD requested a "hierarchical chip design methodology for use with computer aided design (CAD) facilities." The CAD tools were to "support the entire design process including functional definition, design, implementation, functional verification, and physical verification." The CAD tools were to be "integrated with a unitized data base into which data items need be entered only once and are then available to all tools and aids within the CAD system." "Discussions between the authors and several members of industry (e.g., RCA, Hughes, Westinghouse, TRW, TI, etc.) indicate *all* have some level of activity underway to better understand the concept of hierarchical design and its impact on new and existing CAD tools." ".a. presentation covered the utilization of ULYSSES in the design of a 24-bit adder for the Sperry Micro 1100 processor." "The concept of hierarchical design as supported by CAD tools is complex and will continue to evolve. In this paper, the authors have attempted to illustrate what we see occurring. Many of the ideas expressed have been borrowed from those people with whom we have been privileged to work including Mr. Mark D. Glewwe, Mr. Allan W. Kiecker, Mr. Dean R. Kioker, Mr. Steve J. Piatt, and Mr. John J. Travalent. Thank you for your contributions."

In September 2009, we provided a reprint of "Computer Aided Design - What is Worthwhile" by Earl M. Vraa et al. from 1972, #131. Earl started the paper with "CAD activity at Univac was initiated in 1954 with two people who started with automated documentation on a Flexowriter. This initial effort was very crude by today's standards, but it was a start toward CAD as it now is known. Now, nearly two decades later, this original activity has grown to include five identifiable CAD

organizations within three operations: Roseville Development Center (RDC), Philadelphia Development Center (PDC), and Defense Systems Division (DSD.) "

Mr. Vraa continues this paper with some comparisons of the three organizations, then writes some details about the Defense Systems Division Computer Aided Design. He concludes: "First, the experience in Univac indicates that very few processes lend themselves to total automation. They can be reduced in both time and cost through the use of CAD, but attempting total automation is prohibitive. Many processes can be nearly automated at cost effective dollar expenditures. The $ amount, although theoretical is based on Univac experience. In this case, a process is 95% automated for a 50% dollar ratio. To automate the other 5% of the process would require an equivalent expenditure. At this point, the cost effectiveness of CAD decreases. Again, CAD is only an aid to user."

In October 2009, we provided #132, a reprint of "A PROGRESS REPORT ON COMPUTER APPLICATIONS IN COMPUTER DESIGN" by S. R. Cray and R. N. Kisch - circa 1954, provided by E.M. Vraa. Yes, this was co-written by the Seymour Cray! The introduction reads "The subject of utilizing computers for designing other computers has been popular for several years. This subject generally brings to mind the reduction, or even the generation, of design logic with Boolean algebra or similar methods. These complex and difficult problems are ones that the authors of this paper have considered only superficially. Instead, consideration was given to the mechanization of several other phases of development work that represent probably the greatest portion of the effort that goes into the development of a new computing system. This paper summarizes the progress that has been made to date in the development and use of mechanized methods for checking design logic and for the performance of processes of detailed design. The planning of component arrangement and preparation of manufacturing wire tabulations for constructing the equipment exemplify the latter. These methods involve the use of a general-purpose computer: in this case, a Univac Scientific, Model 1103. The mechanization program described in this paper necessarily is based on a particular computer building block and particular type of cabinet design. It is independent, however, of any specific computer, and any logical design can be processed which uses the selected building blocks and cabinet structure."

Within the remaining dozen pages of the paper, the authors discuss the man-machine interface and how the system works when checking the logic design of multiple building blocks of magnetic logic. In their case, they used a Model 1103 computer, a magnetic tape file, a paper tape output and an electric typewriter.

Page 8 of the 9-page paper reads "Phase Three - When the design checking process has been completed, another formidable operation must be undertaken. Decisions must be made regarding the placement of the magnetic switch packages in the standard chassis assemblies, and manufacturing tabulations must be prepared which completely describe the wiring required to interconnect all of the packages. A standard chassis accommodates up to 180 of the building block packages so that in an equipment using, for example, 2000 packages - 12 assemblies would be required. Indiscriminate or improper assignments of the various magnetic switch packages to the chassis would result in an excessive number of interconnections between chassis, in tolerable

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lengths of wire on some of the switch outputs, and possible excessive unbalance of the loads on the clock-pulse driver lines. In view of the number of factors to be considered and the tremendous number of options available for placement, the Model 1103 computer, in a manner far more rapid than the designer could do it, handles the assignment job. The same is true of the process of preparing wiring tabulations. Several hundred pages of material are prepared in a few hours by the computer, and freedom from the various types of human errors is assured. The connection points are listed in an order such that subsequent wiring in that order will require a minimum length of wire. The length of wire required is also listed in each case and a color code is assigned."

As a former logic designer in '66-'69, we took automated wire tab generation as just a part of the job, when this paper was written in '54 it must have been cutting edge technology. [Labenson]

In November 2009, we posted #133: "EVOLUTION OF MECHANIZED DESIGN, AUTOMATED DESIGN, COMPUTER-AIDED DESIGN AT ERA, REMINGTON RAND, UNIVAC, AND SPERRY**" *from the early-1950s to late 1980s – as compiled by Earl M. Vraa*. Contributors: John Alton, James R. Andrews, Keith Behnke, Curt Bute, John Esch; W. Burt Horsted; John J. Travalent, and Earl M. Vraa. A meaningful 'recap' of this 18-page paper covering 30 years would be useless. In addition to the contributors, the people mentioned therein are almost like a Who-is-Who book: Seymour Cray, Wally Eidahl, Howard T. Engstrom, Robert 'Bob' A. Erickson, Leland A 'Lee' Granberg, Stan Halper, Joe Kimlinger, R. Kisch, Bruce Klugherz, Bob Lawler, Wayne Leverkuhn, Ralph. I. Meader, Milton (Milt) Montgomery, Jerry Neese, William C. Norris, Wayne Olson, John Parker, Red Phillips, Kenneth J Thurber, Al Wald, and Paul Welshinger. Systems noted were: AUTOGRAM, AUTOVG, BISON, CAMIDS, DODO, FLOWCHARTS, INDICATES, LAMPS, LOCATES, MIDAS, MIXSIM, NETTERHELPER, OPTIMA, PERT, SIM-LOGIC, SLATE, SNOOP, and TEKGERBER.

In December 2009, Vern Sandusky provided us with #134 & 135, two 1972 Field Service reports describing the repair actions taken on Johnston Atoll after hurricane Celeste caused some devastation on August 19, 1972. The first is an initial analysis of the damage; the second is about the repairs to bring the systems back on line. Paul Castrodale and Vern were on site within 3 days of the Air Force request for an assessment. There were two 642B computers, a 1218 computer, and numerous peripherals on site - none were damaged beyond repair. While bringing the systems back on line, several PC cards were replaced with design updates to give the systems broader operating margins.

2010, Articles #136 → #148

In January 2010, we posted #136 *Our Winnipeg Story* by Glen Johnson with an addendum from Dave Saxerud, #136. Winnipeg manufactured computers and computer modules from 1977 to 1997. This included the AN/UYK-502, AN/UYK-507, and many of the modules for the CP-140 (the 1832 used aboard the Canadian P-3C ASW aircraft.) They also built most of the SHINPADS system hardware.

"As with any facility, it's the employees who make it successful, and Winnipeg had a wonderful group of people. At one time, we counted 27 first-generation nationalities among the 600 employees we had. In 2005, the former employees held a Sperry reunion for all the folks who had worked for Sperry over the years, and 350 people showed up. Not bad considering that every one of them had been laid off at some point. It was a great evening. It was a hell of ride while it lasted. Glen"
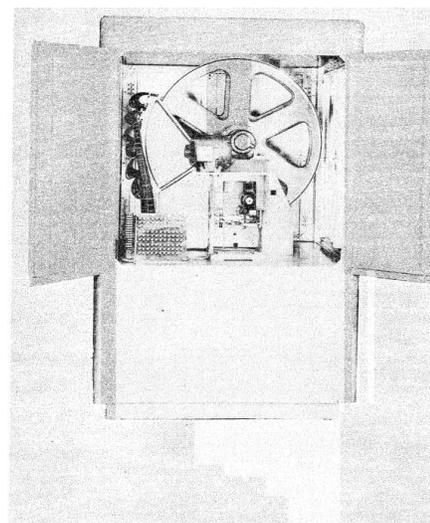
In February 2010, we posted #137, "The almost Silicon Valley" by Tom Webb - Used with permission, originally published in the 1-3-2010 St. Paul Pioneer Press.

This was a great article for us as the Press front page led readers to the business section with: "Remembering when St. Paul was the cradle of the computer industry." Our VIP Club Legacy Committee co-chair, John Westergren had read an Armour Company 'history article' in the Pioneer Press the summer of 2009. John called the author, Tom Webb, to suggest that Engineering Research Associates (ERA) could be a good topic for an article. Mr. Webb researched ERA at the Charles Babbage Institute then interviewed the following people from a list provided by Lowell: Dr. Tom Misa, Don Weidenbach, Paul Nikolai, Jack Ross, Jerry Williams, Harvey Taipale, and John Westergren.

In March 2010, we posted #138, *Legacy' at the University of Minnesota* by Lowell Benson. This paper is a description of the Legacy Committee's artifact and document exhibit that was on display in the University's Walter Library from mid January to mid-May. The primary section of the display used some of our sesquicentennial posters supplemented with the ERA to UNIVAC relationships with the University including the 1958 delivery of an 1103 computer to begin the foundation of their Computer Science department. The secondary section of the display focused on the evolution of memory technology that began with the ERA drum memory. The U's Computer and Electrical Engineering facilitated the paper work required to bring the display to the University.

In April 2010, we posted #139, 'Drum Prototype Design', a 1947 paper written by ERA's J.M. Coombs. This paper came from Don Weidenbach, labeled as "Reprinted from the *Proceedings of the National Electronics Conference* Vol. 3, 1947." The pages were numbered 201 through 209. A surprise is that there was a sheet with page '#30' on it stapled to the back of the paper. (shown at the right)

Goldberg Computer *MEMORY*
MAGNETIC DRUM

30

"*Abstract -* This paper describes a memory system for storing digital information on magnetic tapes. The tapes are bonded to the surface of an aluminum drum. Associated with each tape are three heads for reading, writing, and erasing magnetized spots on the tapes. This equipment allows numbers to be stored indefinitely, to be inspected as often as required, and to be removed when no longer needed.

The system will store 200,000 magnetized spots on a drum 34 inches in diameter and 10 inches wide." "To test the feasibility of a system capable of storing a larger amount of information, a cast aluminum drum 34 inches in diameter and 10 ¼ inches wide was made. This drum was carefully heat-treated to minimize any tendency toward dimensional changes, and final machining was done with the drum on its own bearings and supported by the frame in which it was to be used. The initial eccentricity of the drum was 0.0007 inch. For four months, this dimension did not change. After six months, it has grown to 0.0009 inch. A sketch of the drum is shown in Fig. 3."

An essential part of many automatic digital computers is a memory device, in which numbers may be stored for any desired length of time, and withdrawn from storage as required. The specifications for a memory device are dependent upon the techniques used in the remainder of the computer, and upon the type of problems that the computer is designed to solve. In general, the memory will store one or more of the following types of information:

FIG. 3—Sketch of drum.

(1) the original data of the problem, which may consist of measured values of physical quantities, known physical constants, or previously calculated tables; (2) the instructions for the operation of the computer, which may be changed automatically during the process of computation; or (3) the intermediate or final answers of the computation. Among the devices that have been used for number storage are mechanical counters, relays, conventional electronic tubes, punched tapes, punched cards, and acoustic delay lines. Currently under development are several types of electrostatic storage tubes and a number of methods for using magnetic wires and magnetic tubes. Thousand numbers, and into which numbers can be readily inserted, deleted, or changed in value. The features of magnetic recording offer attractive possibilities for problems of this type." "The writer wishes to acknowledge the contributions made by J. L. Hill, S. M. Rubens, and R. L. Perkins to the technical part of this work. He is indebted to W. F. Winget for assisting with the manuscript. "
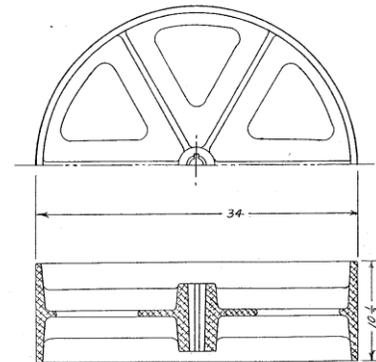
In this web site posting postscript, Lowell makes several observations: "1) somewhere out there is a document that has 29 pages in front of a page 30 figure labeled Goldberg Computer[5]. 3) Figure 4 and 5 of the paper appear to be photos of the Drum presently at the Minnesota Historical Society, although the MHS does not have the shrouds over the 'spinning' wheel. 5) The original paper appeared in a 1947 Vol. 3 issue – Assuming that volume 3 was the third quarter and that the drum had been running for four months when the article was drafted means that the initial operation had to have been either early 1947 or late 1946. 6) Page 95 of Capt. David Boslaugh's book *When Computer's went to Sea* states that John Coombs presented a paper on magnetic drum storage techniques at the November 1947 National Electronics Conference. Obviously, it was this paper. The same page states that the Goldberg drum was a 24" size."

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[5] Editor's note – I later found this page in a [1959 UNIVAC](#) product book, donated by Don Weidenbach to CBI.

In May 2010, we posted #140, ERA 1102 Computer. This article relates experiences written by Warren Burrell, 1102 Project Engineer, with editing by Lowell Benson and some technical text extracted from an unpublished Blue Bell book. "Three Engineering Research Associates (ERA) 1102s were contracted by the U.S. Air Force for the Arnold Engineering Development Center (AEDC) in October 1952. For almost twelve years (1954-1966,) they made significant contributions to the military and space programs of the free world. This is believed to be the first ever application of on-line data acquisition and reduction using a production model, large scale, general-purpose digital computer. The three major test facilities, each equipped with one of the data reduction computer systems were:

- Engine Test Facility (capable of testing any existing or projected jet engine under simulated Operating speed and altitude conditions).
- Propulsion Wind Tunnel (capable of testing a jet engine. pod and wing section in its sixteen feet by sixteen feet throat at transonic and supersonic speeds, and at simulated operational altitude conditions).
- Gas Dynamics Facility (capable of testing aircraft models at supersonic and hypersonic speeds).

Arnold Engineering Development Center is named for the man responsible for its conception – General of the Air Force Henry H. (Hap) Arnold. Then President Harry S. Truman dedicated the Center in 1951. The first test complex went into operation in 1953. As of 1993, development testing had encompassed the Atlas, Titan, Minuteman, and Peacekeeper ICBMs; the space shuttle, F-15, F-16, F/A-18, F-22, F-111, F-117, C-17, X-29, B-1, and B-2 aircraft; Navastar Global Positioning System satellites, the Inertial Upper Stage, the anti-satellite program, Trident submarine launched ballistic missile, Tomahawk, Air Launched Cruise Missile, and the Advanced Medium Range Air-to Air Missiles."

In June 2010, we posted #141, 200 Nanosecond Memory . Quint Heckert, one of our Legacy Committee core workers, found a scan of a photo of a plaque which states: "Minnesota Society of Professional Engineers Honors UNIVAC – Seven Wonders of Engineering – in Minnesota for Distinguished Engineering Achievement – 1966 – 200 Nanosecond Memory." After a flurry of e-mails to half-a-dozen former memory engineers, we received: "Ken Pearson – reply 1: Hi Lowell, Yes! I remember the 200 nsec memory very well as Sam Meddaugh and I co-authored a paper about it entitled "A 200 Nanosecond Main Frame Memory" and presented it at the 1965 IEEE Fall Joint Computer Conference in San Francisco. It was the Mainframe Memory for the Nike-X Anti-Missile Project Computer and was deployed on the Kwajalein Islands in the Pacific Ocean ".

In addition, from Curt Hogenson's files we got a 1965 newsletter article: "The memory was developed in less than six months – a real tribute to the team that designed and built it. An achievement of this scope obviously reflects the contributions of many persons, but special acknowledgment is due the engineering – manufacturing team headed by Project Engineer Curt Hogenson." "Others who participated in the development group were Ken Mulholland, Bob Bergman, Bob Boylan, John Lundquist, Ted Maki, Chuck McKee, Dean Morgan, Ralph Oliver, Tom Peckham and Howard Silver." Lowell Benson edited this article with text inputs from Curt Hogenson, Dick Erdrich, Don Mager, Ken Pearson, et al.

In July 2010, we posted #142, Legacy Display at the University of Minnesota - 2010-summer session by Lowell A. Benson. This summer session display focused on the ERA spinoff history and the rich legacy of our involvement with computers and systems of the space age. One of the poster illustrations showed the T-III computer. Another showed the 200-nanosecond memory plaque of which I wrote last month. This article shows snapshots and descriptions of posters.

In August 2010, we posted #143, History of NSA General Purpose Electronic Digital Computers by Samuel S. Snyder, 1964. This document chronicles all of the National Security Agency's computers through 1963 including the ERA ATLAS I, ATLAS II, BOGART, the UNIVAC 1224A (CRSPI), and UNIVAC 490. This governmentattic.org paper was declassified in 2004 by NSA, forty years after internal „military" need to know availability. On page 39 is written "Two UNIVAC 1224~ computers have been put into use, the first in June "1963 "and the second in July 1963. Performance has been excellent. Four more are under construction for delivery early in 1964. Procurement of 10 more for other purposes is being initiated." The document Chapter 3 also lists some Commercial computers including several early IBM and CDC units. One of the more interesting chapters talks about remote operations in 1958 using the BOGART S/N 5 as its central computer. This system was upgraded to a UNIVAC 490 based operation in 1963. Page 93 of this document lists the ATLAS I (1) as being installed in December 1950 and retired in 1959.

In September 2010, we posted #144, "*CP-823/U communications reveals discovery of an intact 1963 computer*." The Naval Air Development Center (NADC) contracted a CP-823 in 1964 for 30-bit Anti-Submarine Warfare software development. This Univac 1830, CP-823/U was donated to Drexel University in Pennsylvania around 1970. Drexel put it into storage about 1973. A graduate student there rescued the computer and development documentation from a dumpster as Drexel was

cleaning house in the winter of 2010. Mr. Todd J. Thomas bought the 'scrap' system in the spring of 2010. He contacted us 7/2010 after finding a tidbit about the CP-823/U computer on the VIP Club web site. The article chronicles the emails as we dug deep into the memories of Curt Nelson, Jim Rapinac, George Kydd, and M. R. Clement – Larry Bolton deftly provided archived data about the part numbers provided. Two follow on ASW system articles will be reviewed in the next

CP-823/U SERIAL A1 COMPUTING SYSTEM, A-NEW MOD 3 (UNIVAC 1830). FROM LEFT TO RIGHT: 4 AIRBORNE I/O UNITS (SERIAL A1-A4), GROUND I/O, MEMORY, PROCESSOR, AIRBORNE POWER SUPPLY, CONTROL CONSOLE.

newsletter issue. {Editor's note: Mr. Thomas subsequently created a CP-823 web site.}

In October 2010, we posted #145, "How was the CP-754/A associated with the Navy's Anti-Submarine Warfare Project ANEW in 1963? Read an Aviation Week article to find out." Curt Nelson contributed this July 8, 1963 item. "PROJECT A-NEW, RECENTLY LAUNCHED Navy land-based ASW aircraft into more effective system for coping with high-speed nuclear submarines. Previously, Navy

first bought able aircraft such as the P-3A and S-2d, and then stuffed them full of avionic black boxes." "Because of the key role planned for the airborne digital computer, Sperry rand's Univac Div. is playing a major role in the A-New program. It is responsible for modifying an existing computer, originally developed by Univac under Air Force sponsorship for missile guidance, to suit the ASW mission. Univac also is developing the complex programs, 'software,' needed for this new ASW mission." This AF computer was type 1020, the type 1824 predecessor. "The machine is a stored-program type rather than a wired-program computer which Navy currently is using on its Grumman E-2A and A-6A. The choice of a stored program machine will not only provide greater flexibility for evaluating different tactics and procedures during the early flight test phase, but also will make it easier to adapt an operational system to new ASW sensors or tactics, according to M.R. Clement, Jr., Univac's A-New program manager."

The rest of the story not in that article is that Mr. Clement convinced the Navy to use a UNIVAC 1206 computer as a simulator and software development and then the 1830 – CP-823 computer so that there would be software compatible with the fleets NTDS computers. Then it was the 1830A – CP-901 of which we built 499, there are still a few of these flying in P-3C airplanes operated by other countries! Next month I will review the systems specification authored by Bob Blixt, by LABenson

In November 2010, we posted #146, a high-level technical description of the CP-754/A hardware and system design, authored by R. P. Blixt in 1963. The CP-754 was UNIVAC Type 1020, a modified AF type 1000 computer. "The first experimental version of the A-NEW data processing system, designated XN-1, was initiated by the Naval Air Development Center at Johnsville, Pennsylvania in December, 1962. Following the completion of a study program to determine the feasibility of the concept, UNIVAC was selected as a team member for the XN-1 program. UNIVAC's role on the XN-1 system was threefold: 1) to assist NADC in defining XN-1 functions, 2) to design and develop the required digital computing equipment, and 3) to develop the computer programs necessary to carry out the system functions. The target date for equipment delivery was 1 July 1963 and 31 October 1963 was established as the date for commencing the first flight tests with the equipment installed in a NP-3A aircraft (a modified Lockheed Electra). The delivery date was met by UNIVAC, the equipment being in operation at NADC on 2 July 1963."
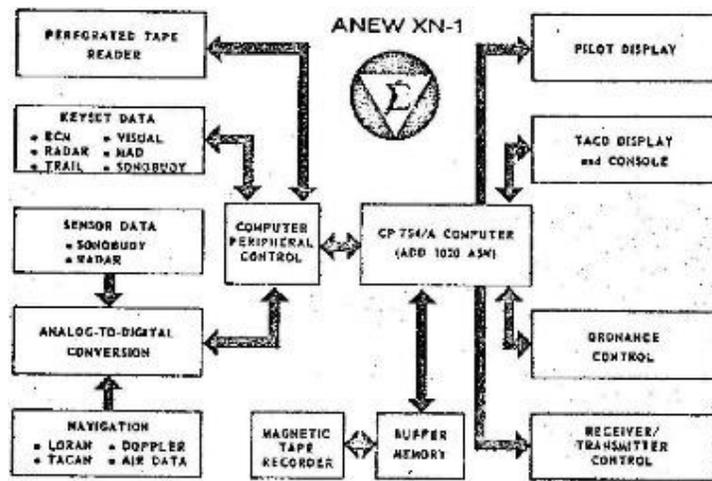

Fig. 1 Block Diagram of A-New XN-1 Equipment

"The digital computing equipment supplied by UNIVAC consists of the following: 1) CP-754/A Computer, 2) Computer Peripheral Control Unit (CPC), 3) Buffer Core Memory, 4) Perforated Tape

Reader, 5) Magnetic Tape Recorder, and 6) Computer Maintenance Test Bench. The CPC logic chassis is physically the same as that of a UNIVAC 1218 Computer, employing the same type of logic cards except for a few special input-output matchers. The other major components of the XN-1 data-processing system include: 1) Tactical Situation Display with operator controls, 2) Sensor Operators' Keysets, 3) Ordnance Display and Control, 4) Receiver/Transmitter Control, and 5) Pilot's Display."

The equipment installation in the YP-3 aircraft is illustrated in this drawing from the description document. "As in most data-processing systems, operation is centered on the digital computer. The computer software is responsible for integrating the inputs received from the various ASW sensors, determining the optimum tactics to employ, executing the tactic, computing the probability of success or failure, and navigating the aircraft. UNIVAC developed seven program modules: 1) navigation, 2) search and correlation, 3) contact conversion, 4) automatic tracking, 5) extend track, 6) attack, and 7) post flight analysis." "At the completion of each flight, the magnetic tapes will be read on a ground-based UNIVAC 1206 Computer." By L.A. Benson

In December 2010, we posted #147 & 148, the 30-year Anniversary booklet (1.2Mb) as written by Quint Heckert w/some edits by Lowell and the Hidden History of Computing (9.6Mb) viewgraphs by Dr. Misa which was presented at our October 13th, 2010 VIP Club anniversary celebration program. The booklet is a walk through memory lane: 17 pages of text and photos including a snapshot of each former president: Al Mueller, 1980-81; Vida Hildyard, '82; Ray Nimmerfroh, '83; Ray Miller, '84; Ed Kulczycki, 1985-86; John Bleckner, '87; Millie Gignac, 1988-89; Warren Becker, 1990-92; Owen Scharf, 1993-94; Chuck Homan, 1995-96; Barney Buss, '97; Bernie Jansen, 1998-99 & 2006; John DuFour, 2000/01; Hank Dotzler, 2002-03; Dale Phelps, 2004-05; Brian Berggren, 2007-08; and Tom Turba, 2009-10."

"The first general meeting was held on September 3rd, 1980 with about 75 people in attendance. Officers were elected; plans were made for future monthly meetings and a set of rules was drawn up. Club members were advised they would have to abide by Company regulations, but other than that they were on their own – it was their club – even as far as clean-up was concerned. A well-written constitution and by-laws were drawn up which protected the Club and the Company."

Measuring Success = Volunteer Hours!   December 6, 2015

Al Mueller (first Club President,) Bob McDonald (UNIVAC President), and Millie Gignac (Club Founder) – Cutting the ribbon to open the VIP Club room.

How many of you remember that the VIP Club had a clubroom in plant 1 until the 1995 defense systems sale to Loral Corporation. Loral decided to not be a sponsor of the VP Club. In 2000, LMCO joined with UNISYS as a co-sponsor of the club. For this 30th anniversary booklet, they wrote: "Congratulations on 30 years of service to the community! The VIP Club has been a significant presence in the community through its volunteerism and participation in community events. In the last two years, UNISYS and Lockheed Martin have been privileged to support the VIP Club at the: Minnesota Sesquicentennial exhibition; Eagan July 4 Funfest Celebration; 2008 Minnesota State Fair; Charles Babbage Institute at the University of Minnesota; Minnesota History Center; University of Minnesota Department of Electrical and Computer Engineering Displays; and the Pioneer Press through Tom Webb's Jan. 3, 2010 Article – *The Almost Silicon Valley*. All of these activities brought home the contributions of our companies and employees to the history and economy of the region and made them visible to the community. Many thousands of people have viewed these events and talked to VIP Club members about the contribution of our companies." Signed by UNISYS Liaisons Sue Carrigan & Ron Smith and Lockheed Martin Liaisons Peggy Mullikin & John Westergren. LMCO had graciously printed 100 copies of this booklet, most now on the bookshelves of Club members.

The Hidden History of Computing viewgraphs by Dr. Tom Misa were selected from his 2009/10 lecture series on the same topic. These showed how the ERA 1101 (originally the then classified ATLAS computer delivered in 1950 to the NSA predecessor) was not a part of early computer history because of the secrecy of code breaking activities at that time. He also talked a bit about the Honeywell vs. Sperry lawsuit that made the ENIAC „computer invention" patents invalid. Interesting facts that he presented were that in 1989 there were 68,000 computer industry jobs in Minnesota, 3.3% of workers at that time. This was second to Massachusetts' 4.1% and ahead of CA 2.8%, VA 2.2%, and TX 2.1%.

Did you know that before the UNIVAC West 7th plant was built, ERA had their own plants 1, 2, and 3? The ERA plant 1 became the UNIVAC plant 2. Dr. Misa also touched on the Legacies of ERA:

- ERA ❱ patents ❱ IBM 650 *"secured IBM's leadership of industry"*
- 20+ start-ups from ERA veterans
- Control Data [1957]
- 45 start-ups, spin-offs, ventures
   o Dataproducts [1962] Erwin Tomash CBI [1978/80]
   o [Seymour] Cray Research [1972] Cray Computer [1989] SRC Computers [1996]"

As an advisor to our Legacy Committee, Dr. Misa is an excellent proponent of our history – thanks to him for helping to „Tell the Story" of computer developments in Minnesota. It is so appropriate that

he holds the Engineering Research Associates Land Grant Chair for the History of Technology at the University. By Lowell A. Benson

2011, Articles #149 → #161

For January 2011, #149 posted on 12 December 2010 - A reprint of ERA document XA19742 dated 12 December 1950. {50 years apart!} The XA19742 paper and associated Technical Memorandum Cover Sheet came from Ed Nelson's archives. The Title is "*Communication between Electronic Circuitry and Mechanical or Electro Mechanical Devices*." F.C. Mullaney prepared the Memorandum; Task 13 Personnel developed the document under -3020-Task 13. The memorandum was delivered to BuShips (855) USNCML.

The content of the document included detail description of several vacuum tube based circuits, one of which is this Pulse Amplifier.

The report also shows a flip-flop circuit, a multi-vibrator circuit, and a Print-Punch Register Element. All diagrams and functional descriptions would be somewhat interesting to Electrical Engineers of the '40s and 50s.

Figure 3 – Pulse Amplifier

Historians however would relish the names on the distribution list much more! J.E. Parker, W.C. Norris, and Knight Pryor head the list. Three VIP Club octogenarians are there; Ed Nelson, Don Weidenbach, and Warren Burrell. I also recognized the name R.H. Sorensen, Bob was an Antenna Coupler mechanical engineering supervisor when I was hired in 1960. The memorandum went to four people in Arlington; H.T. Engstrom, R.C. Bryant, L.R. Steinhardt, and R.E. Kilham. The other St. Paul people on the distribution list were: J.M. Coombs, J.H. Boekhoff, R.K. Patterson, W.F. Winget, W. Asmoth, V.A. Gill, D.I. Hinz, K.E. Johnson, D.C. Johnston, R.A. Madvig, W. Ogden, L.C. Pollock, D.H. Raudenbush, T.D. Rowan, G. Rowland, R.F. Thews, T. D. Thornton, F.E. Tidball, E. Tomash, and E.B. Zimmer.

From another source, I know that Frank Mullaney went with Bill Norris to found CDC. E. Tomash is credited with being a Charles Babbage Institute Founder – if any VIP Club readers recognize other names and could write a bit about them, please do so.

For February 2011, we posted #150, "An addendum to the April '08 Plated Wire Manufacturing document by Larry Bolton and Clint Crosby." This addendum has five equipment photos – showing what was used in several stages of the plated wire manufacturing processes. The plated wire memory stack tester is shown here.

Larry and Clint wrote about a couple of the process steps as these machines began with 5-mils beryllium-copper wire material which was plated to result in 18" lengths of wire which could be used in memory module assemblies.
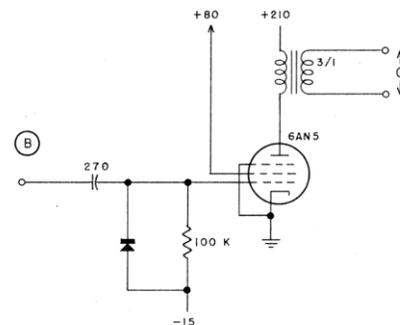
In today's vernacular, we have flash drives, USB sticks, RAM, hard drives, etc. None of these technologies has the radiation resistance levels that were required for the Minuteman computers – met by the use of plated wire memory instead of the more susceptible core memory of that generation. Submitted by LABenson

In March 2011, we posted #151, Pre-ATHENA musings by Warren Burrell. Warren started working at ERA in 1948 after a stint in the Air Force. One of his jobs was to evaluate transistor versus magnetic circuitry as vacuum tube logic replacements. These studies were for the Tactical Air Command computer system proposals. He wrote, "At the subsequent briefing at the Western AF Development Procurement Office, I met with Erv Tomash, UNIVAC marketing, and Major Gerry Probst. In response to their queries about circuit choices, I promptly read from my data in the proposal."

"Several engineers [including myself] did try to graphically create values for the comparisons between magnetic logic and transistor logic after the tests and decisions had been made. It showed a later ascendency of transistors though time. The two curves were very close for a period before the transistor forged ahead gradually. Note: As depicted in the chart, the graph ordinates are quite arbitrary as the ultimate value was a combination of many factors."

{Editor's note: *The vertical axis has somewhat arbitrary numbers. The horizontal axis is time in years – the illustration is not factual, rather to illustrate the recollections of the author.*}
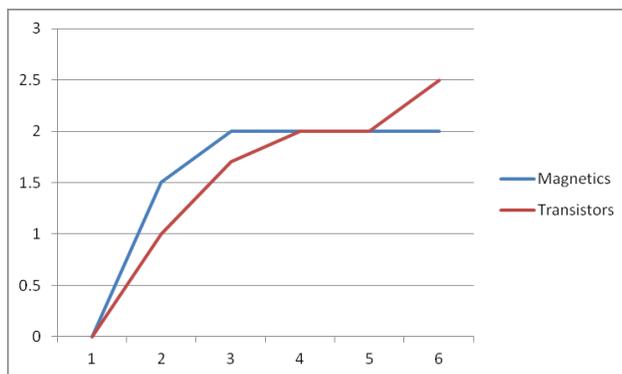
In April 2011, we posted #152, "MATCALS - Controlling the Skies" written in 1993, author unknown and #153, "Deployment to Somalia" by CWO4 John P. Rego, March 1996. Both articles submitted by Ron Irwin.

View of radar system taken from the control tower.

1993 - "In the wake of Operation Desert Storm two years ago, commercial air traffic over Kuwait was at a standstill until the U.S. Marines --and a unique mobile air traffic control (ATC) system --came to the rescue. The Marine Air Traffic Control and Landing Systems (MATCALS) returned normal air service to Kuwaiti skies after electrical power problems and war

damaged control equipment shut down commercial air traffic. More recently, MATCALS was deployed to Africa as part of the Joint Task Force's humanitarian relief effort Operation Restore Hope in Somalia. More specifically, MATCALS was utilized at the International Airport at Mogadishu as its sole air traffic control system from mid- December 1992 through April 1993 when ATC responsibility transitioned to the United Nations."
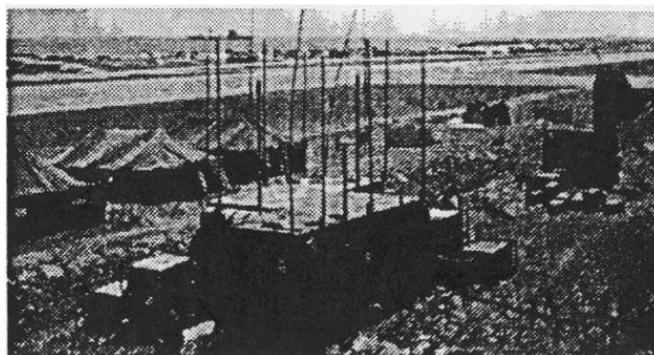
The development of MATCALS, from initial studies in 1973 to the field-proven system of today, has been driven by the growing demands of ATC and military technology. Its application for military and commercial air traffic control --in both Kuwait and Somalia --is proof that the system goes beyond military use with a flexibility that can be applied in nearly any civil or military emergency situation. MATCALS is proven as a mobile air traffic control center in both civilian and military environments."

"During our final approach into Mogadishu, our C5 was jinking about as though we were in severe turbulence. About halfway through the approach, an aircraft crewmember came back and suggested that we lock and load (we had been issued ammunition at El Toro prior to departure). He also mentioned that the evasive flying was due to the small arms fire that was apparently directed at our aircraft."

Our shower facilities were right in the middle of the action (C-5 in the background).
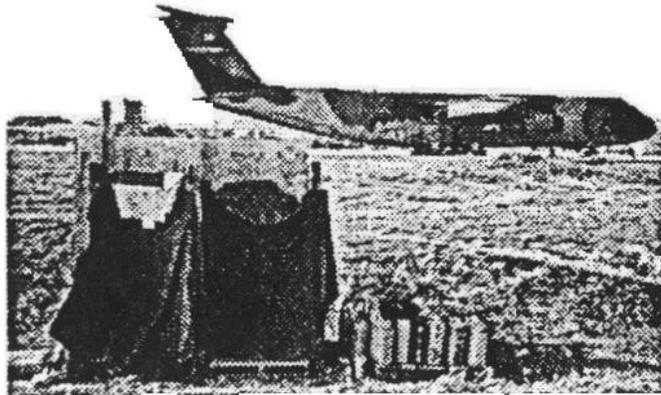
"During April of 1993, serious planning was underway for the withdrawal of remaining US Forces, which would complete the "thirty day" operation known as RESTORE HOPE. Responsibility for Somalia was to pass from US to UN Control upon our withdrawal. What we considered a key part of this plan was the fact that the ATC Detachment could not withdraw until replaced by another ATC organization. The search for a replacement was more difficult than anticipated, but this would not hinder the retrograde of other US forces. There was some talk of assigning us to the UN force, but we were saved when the UN hired some Kenyan controllers to work out of a tower, eagerly constructed by our detachment with the assistance of Army Engineers and Canadian Forces personnel. The thought of living on the airfield with a perimeter guarded by forces (who shall remain nameless) was not a pleasant one and we were quite happy indeed when our personnel started departing on the fifth of May and were completely out by the eighth."

In May 2011, we posted #154, a Marine Air Traffic Control and Landing System (MATCALS) descriptive document scanned by Ron Irwin with web formatting by Lowell. "*MATCALS - TACTICAL AIR TRAFFIC CONTROL USING A DISTRIBUTED SYSTEM ARCHITECTURE* by Bill Ganz - Sperry Corporation, St. Paul, MN."

Practically everyone is familiar with the mechanics of a basic air traffic control (ATC) system, i.e., NAVAIDS, displays, surveillance sensor, and landing systems. These capabilities are normally housed in fixed ATC installations of varying sizes. This paper describes an ATC system that has the additional requirement of tactical mobility. It must be capable of deployment anywhere in the world and must incorporate the further capability of rapid emplacement and displacement. MATCALS is comprised of three basic subsystems:

- Air Traffic Control Subsystem (ATCS), which performs the surveillance radar, function including identification of friend or foe.
- All Weather Landing Subsystem (ALS) that provides precision guidance for final approach.
- Control and Communications Subsystem (CCS) that integrates all sensor data. It is the operational center for MATCALS.

An effective, tactical ATC system must be designed to overcome the major requirements associated with its application in a deployed system. These requirements are:

- TRANSPORTABILITY: It must be transportable by aircraft, helicopter, ship, or truck.
- SURVIVABILITY: Because of the requirement to operate in a hostile environment and the importance of continued real- time operations, survivability is a critical factor.
- FLEXIBILITY: Since MATCALS must deploy to any geographical area and considering transportability constraints, it is normal to plan judicious deployment configurations. However, since any tactical situation may change, the system must be readily capable of expansion of operator positions, communications equipment, etc.
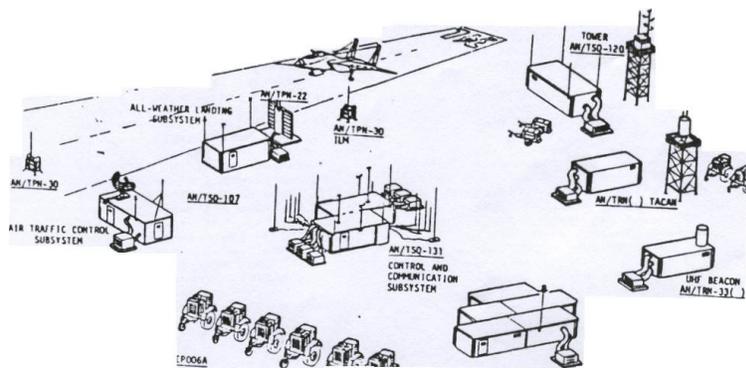
- MAINTAINABILITY: Space in a deployed shelter is always at a premium and any interruption of operations could be critical. Therefore, MATCALS is designed for high reliability and maintainability to reduce frequency of repairs and to expedite restoration of any lost capability."

The system met the requirements and served the US Marines well in several hostile deployments.

In June 2011, we posted#155, *ENIAC - Beginning Summarized* by Curt Christensen: "Dr Mauchly received his PhD from John Hopkins University in 1932; his PhD was in physics with a strong interest in mathematics and meteorology. He got a job on the teaching staff of Ursinus College in Philadelphia. He advertised himself as chairman of the physics department, it should also be noted however, that he was the only member of the physics department. In an effort to determine how to improve weather forecasting, he concluded, that mechanical calculators were not fast enough. And, that he needed to develop a better understanding of electronics and electricity. The Moore School of Engineering was running a course, ESMOT, for the Army Engineering, science, management/ defense training during War World II. There he met his lab instructor, Pres Eckert, a graduate student. Upon completion of the course, Dr. Mauchly became a member of the school's staff.

In August of 1942, Dr Mauchly wrote a memo advocating the development of a large electronic calculator. The memo was ignored by the MOORE engineering management, however, the Army liaison officer, LT Herman Goldstine, read it and discussed it with his superiors in the Army. As a

result of this, the Army requested a proposal from the MOORE engineering school to develop the device described in the memo. Eckert and Mauchly wrote the technical section of the proposal that was submitted in May of 1943. The contract went into effect July 1, 1943.

In early 1944 the group tested a two accumulator model as a test vehicle verifying the ability to conduct the required computations. This first, general purpose, electronic calculator was formally dedicated at the MOORE School of Engineering at the U of Pennsylvania in February 1946.

Built to do ballistic calculations for the US Army, it was named the **ENIAC (Electronic Numerical Integrator and Computer.)**. Further details are available in the books, *From Dits to Bits* by Herman Lukoff, with Robotics Press; *ENIAC: the Triumphs and Tragedies of the World's First Computer* by Scott McCartney with Walker and Company, New York; and *A Computer Perspective*, by the office of Charles & Ray Eames with Harvard University Press, Cambridge, Massachusetts, 1973." Submitted by LABenson

In July 2011, we posted #156, "**When Computers came to Minnesota"** - Jim Ketchum raised questions in a paper left with Warren Burrell. This was to have been chapter 1 of Jim's book which he began writing after retirement while volunteering at SCORE. Unfortunately, he passed away before writing subsequent chapters to answer the questions. I think that Gerald Pickering's paper *CREATIVITY-SUCCESS-OBSCURITY, 'UNIVAC - What Happened?* posted in April 2012 answered some of Jim's questions.

In August 2011, we posted #157, a "Video Library List:" Beginning when Dick 'Ole' Olson was the Legacy Committee co-chair, continued by John Westergren – the Legacy Committee has recorded 30+ history interview tapes to capture recollections of our 'pioneers'. The interviewees are: Clyde Allen, Manny Block, Bill Butler, Tom Delaney, Abe Franck, Bill Geiger, Jay Gildemeister, Jack Hill, Chuck Homan, Gale Jallen, Bernie Jansen, Jim Kzaley, Frank Kline, Dave Kolling, Steve Koltes, Myron Lecy, Don Mager, John Markfelder, Ed Nelson, Howard Nissen, Phil Phipps, Chuck Proshek, Jack Ross, Sid Rubens, Marc Shoquist, Roy Valentini and Don Vizanko.

These tapes do need transcribing for publication as we have done with the Fred Hargesheimer and James Rapinac interviews [posted on the People, Oral Interviews web site page.] We ask that you contact John Westergren or Harvey Taipale if you are willing to try transcribing any of these interview sessions.

In September 2011, we posted #158, the Hardware Artifacts List: Larry Bolton compiled this list of 468 items. The actual count is about 400 as we have several duplicate items. The oldest DATED artifact that we have is a 1954 ERA magnetic drum memory, which Don Andersen donated. See http://vipclubmn.org/Artifacts.html for an on-line version of the list with linked pictures.

World's first computer **Hard Drives** invented in St. Paul

We do have photos of many of them, the links in the document were not put onto the website – we could send the *.jpg file to anyone who wants it. The Legacy Committee needs to find a home for them by 2013 – some will become part of our Dakota Co. Historical Society Lawshe Museum history

display this fall. Contact either Bernie Jansen or John Westergren if you are willing to help set up the displays at the museum.

In October 2011, we posted #159, The Digital Age, a scan of an *Inventing Tomorrow* article on pages 14 and 15 of the *Inventing Tomorrow* issue that was a special edition celebrating the 75th anniversary of the Institute of Technology; now the College of Science and Engineering. I obtained U of MN permission to post the article on our web site. Two of the sections are:

The history of computing in Minnesota can be traced back to the post-war era when Engineering Research Associates (ERA) in St. Paul was developing some of the most advanced computers.

Co-founded by computer pioneer and visionary William Norris, and employing numerous engineering graduates of the University of Minnesota, including Seymour Cray, ERA was a dominant player in the budding computing industry. Several computer industry powerhouses can be traced to ERA, including Sperry-Univac, Control Data Corporation (CDC), and Cray Research.

On the University campus, there was growing interest in computing and its application to mathematics, physics, chemistry, and economics. Several departments were using the University's Reeves Electronic Analog Computer (REAC)—state-of-the-art in 1949. The REAC was in constant demand and it soon became clear that the University needed to expand its resources. In 1955, Sperry-Univac, a company formed by the merger of ERA and Eckert-Mauchly Computer

Corporation, gave the University a gift of 400 usage hours on the ERA 1103, which sparked the beginning of the Department of Computer Science and Engineering.

"I was fortunate in having an instructor at the University of Minnesota who was looking after me. When I said, 'What's next?' he said, 'If I were you, I'd just go down the street here to Engineering Research Associates, and I'd think you'd like what they're doing there'."

—Seymour Cray, EE '49
FATHER OF THE SUPERCOMPUTER

In this posting prologue, I wrote "More of **our legacy story -** not in the brief article! As Dr. Stein took on more computer science department responsibilities in late '70s, Dr. Peter Paton became director of the Experimental Engineering housed Numerical Analysis Center. Pete was a former UNIVAC employee – In the early '80s; he and Dr. Bill Franta collaborated on a cache memory simulation-consulting contract with Sperry-UNIVAC. Lowell Benson was the cache memory study manager, Dave Kaminski the lead engineer. Those simulation results subsequently formed the architecture basis for the cache memory designs of the AN/UYK-43 - Dave was actually the Lead Engineer for the UYK-43 CPU development.

In November 2011, we posted #160, "Focus on the Future" - a set of viewgraphs used by John Westergren on 11/18/2011 to brief the Unihogs/ Uniturkeys attendees about the Legacy Committee status and processes. OK readers, use your magnifying glasses to zoom in on each of the corporate logos which we've had.

A Little Background

- ERA started in 1946
  - First American computer company
  - 40 code (crypto) crackers in an old glider factory
  - Eckert-Mauchley started six months later
  - Both acquired by Remington Rand by 1952
- Univac major contributor to Naval Tactical Data Systems (NTDS)
  - Lead Contractor
  - System Engineering, computers, and software
  - First combat tactical data link
  - In place for Cuban Missile crisis
- Missile Ground Guidance
  - 300+ NASA launches: never a launch failure due to Univac
  - Launched first U.S. communications, weather satellites
  - Critical support for U.S. men into space: Mercury, Gemini, Apollo
  - Tomahawk missile guidance software used in combat: on target.
- Original U.S. air traffic management architecture
  - Some "Firsts"—1) automated terminal system, 2) automated minimum safe altitude warning system, 3) automated conflict alert warning system, 4) all-digital terminal system
- USN Standard Computers for 50+ Years
  - USQ-17 through UYQ-70
  - UYK-43's controlled Feb08 satellite shootdown
- Multiple platform applications
  - Domestic and International
  - Submarine, Maritime Surface, Air, Space, Ground
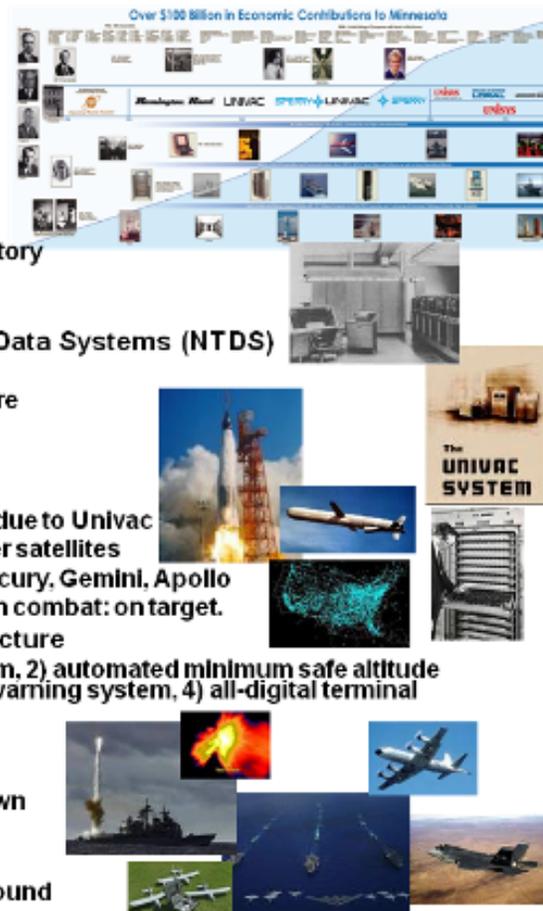
In December 2011, we posted #161 A review of the four *IT Legacy Display* venue setups used this fall to get the word out. "An Objective of the VIP Club Information Technology (IT) Legacy Committee is to tell the untold story, i.e. let the public know that an important part of computer history began with **E**ngineering **R**esearch **A**ssociates (ERA) in 1946 and continues yet today in Minnesota. During the fall of 2011, a Legacy Committee informational display was setup at four venues:

- 50th Annual Seminar of the Twin Cities Chapter of the National Contract Management Association - Sept. 14th & 15th, 2011
- University of Minnesota Computer Science and Electrical Engineering Forum - October 14th, 2011
- Unihogs/Uniturkeys Annual Gathering -November 18, 2011
- Old Timer's Annual Gathering - December 1, 2011

The theme at all four venues was the 65-year history, which continues today with minor focus on
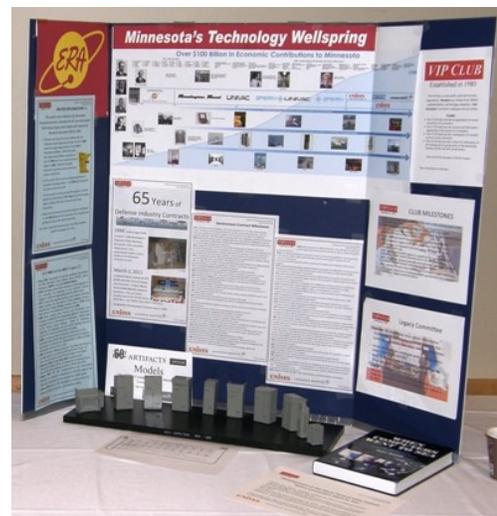
relationships with the University of Minnesota. Some of the charts and display data had been used during the 2008 Minnesota Sesquicentennial and the 2010 U of MN Walter Library displays. The primary display board is shown on the previous page.

Thanks to the entire Legacy Committee who gathered the materials as I developed the display poster text. In addition, thanks to Lockheed Martin for printing the large poster items, Quint Heckert was the principal creator of the main history poster. Immediately in front of the display board is a set of Naval Tactical Data Systems computer models. Just in front of the display is the book: *When Computers Went to Sea* by David L. Boslaugh and a sheet relating the book to the Navy, UNIVAC, and U of MN.

The beginning of the '65 Years' poster are: Government Contract Milestones (two 8 ½ x 14 posters) **1947:** ERA delivered the Goldberg I with a drum memory for a U.S. Navy crypto-analytic system. Goldberg I and II were developed for the Navy, for classified purposes. They are historically significant as the first magnetic drum was built for use with the Goldberg I analytical processor. This rotating magnetic drum memory was the world's first delivered, operational hard drive.
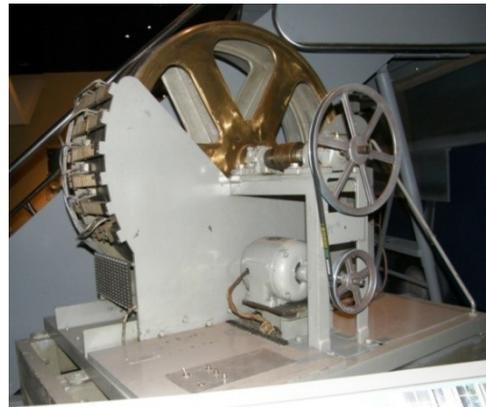
The end of the '65 Years' poster is: March 2, 2011 Delivered S/N 8000 AN/USQ-70 Dual Display and Processor - Today's Naval Tactical Data System standard hardware.

This unit was installed aboard the USS Minnesota (SSN-783) - a new Virginia Class attack submarine launched in September 2013.

2012, Articles #162 → #175

In January 2012, we posted #162, "Lowell Benson developed a Computer History Review of the first 25 years of computing. A 2006 Lockheed Martin (LMCO) corporate flyer stated: "A pioneer in the computing industry, Maritime Systems & Sensors (MS2) delivered the world's first stored-program computer in 1950. Today they are a premier systems integrator for customers worldwide." The veracity of that corporate flyer statement was challenged thus, the purpose of this computer history review is to clarify, verify, and/or rectify the publically known history of electronic computers. This paper shows the corporate progression from **E**ngineering **R**esearch **A**ssociates (ERA) to Lockheed Martin MS2, recaps the first 25 years of computer history, and then concludes with this author's observations and opinions."

VIP CLUB Measuring Success = Volunteer Hours!   December 6, 2015

Established in 1980   References used to develop the paper were:

1. Engineering Research Associates – the wellspring of Minnesota's computer industry‖ published by Sperry in commemoration of ERA's 40th anniversary in 1986. History researched, written and produced by Hakala Associates Inc., St. Paul, MN.
2. Computer History Museum - http://www.computerhistory.org/timeline/.
3. History of Computing by Lexikon Services - http://Computermuseum.li.
4. The Hagley Library & Museum - http://www.hagley.lib.de.us/2015.htm
5. High Speed Computing Devices, May, 1950, Engineering Research Associates *Reprint Series for the History of Computing' published in 1983 by the Charles Babbage Institute*
6. Many retirees have contributed to http://vipclubmn.org/milestones.aspx
7. Department of Defense history: History of NSA [National Security Agency] General-Purpose Electronic Digital Computers, Samuel S. Snyder, 1964 [declassified 2009]
8. Knight, Changes, *Datamation*, pp. 40–54, and —Evolving Computer Performance, pp. 31–35)
9. http://picasaweb.google.com/wendy.mauchly/ComputerHistory #
10. *WHEN COMPUTERS WENT TO SEA, Digitization of the United States Navy* by David L. Boslaugh => IEEE, 1999 "

The most compelling point is Dr. Arne Cohen statement in reference 1: "The Navy confidence was rewarded. The ATLAS I computer (the '**I**' was added after design work had started on a more powerful successor, ATLAS II) was delivered to Washington, D.C. in October 1950. — "It is my belief that ATLAS I was the first American stored-program electronic computer to be delivered – delivered in finished, working condition" observes Cohen."

Some of Lowell's observations in the paper are: "I do not believe that is very important to be the first – it is important to note which 'first' claimants became a viable part of the computer industry. Today, many would say Microsoft – IBM – Control Data – Apple – Intel – Bill Gates – Steve Jobs – Seymour Cray, etc. were first in computers. Of these, only IBM has had the staying power of engineering successes like those that began with Engineering Research Associates in 1946.

Yes, there were a couple of laboratory stored-program computer concept demonstrations before the ATLAS delivery, however their memory sections used various storage tube hardware that lost both data and programs when power was interrupted – volatile memory necessitated a 're-boot'.

The ATLAS, a magnetic drum based system, kept the data and programs when power was off thus could easily and quickly resume operations. ERA's then president, John Parker, got government permission to build and market a commercial version of this ATLAS computer. Since the ATLAS was designed and built under Task 13, Jack Hill, a versatile ERA engineer suggested that the commercial version be numbered the 1101, 13 in binary. Subsequent models transitioned from ERA 1101, ERA 1102, ERA 1103, UNIVAC 1103, UNIVAC 1103A (UNIVAC Scientific). The series then had the UNIVAC 1105, 1107, 1108, Sperry 1106, 1110, UNISYS 1110, Unisys 2200, Clear Path, etc. continuing in production today using embedded Intel chips as their processing core.

- Most early machines had one or two inventor-names associated with them, in reality all were built by teams of people – not just the named individuals.

- The ATLAS claim-to-fame is that it was delivered and operational in the customer facility compared to the others which were only functional in the design/ development laboratories.

- The machines through 1949 were large-scale electro-mechanical calculators because they were not of a stored-program design. Although plug boards held programs, mechanical work was needed to change the sequence of instruction executions.

- The Zuse machines were in Germany, most data were lost during the WWII.

- The ABC was at the University of Iowa, a single purpose machine.

- The Colossus was an analytic machine in England used for code analysis – note that the ATLAS was initially termed an analytic machine, not a computer.

During the first 25 years of computer infancy, Minnesota was one of four Centers of Knowledge: the others being central New York (IBM), Philadelphia (EMCC-UNIVAC) and Boston (PDP, MIT). ERA along with its spin-off companies and eventually the University of Minnesota were the Midwest core. It was only decades later that Silicon Valley (CA), Research Triangle (NC) and others came about – not part of this early computer history review. "

The paper's conclusions are: The LMCO flyer statement: " A pioneer in the computing industry, Maritime Systems & Sensors delivered the world's first stored-program computer in 1950. Today they are a premier systems integrator for customers worldwide" is not false!

1. The corporate lineage from ERA to LMCO MS2 is clear and well documented. In March of 2011 LMCO delivered S/N 8,000 AN/UYQ-70 to the US Navy – the design of this unit came out of ERA's home town, St. Paul, Minnesota.

2. The shipping of the ATLAS in October 1950 via rail car and subsequent CSAW acceptance in December 1950 was a delivery, not just a benchmark in a laboratory. The baseline magnetic drum memory for data and instructions was non-volatile therefore indeed a stored-program computer ".

In February 2012, we posted #163, "Arlyn Solberg programmed TRANSIT, the Navy's first GPS test."

The Applied Physics Laboratory (APL) of Johns Hopkins University [Baltimore, MD] developed the TRANSIT satellite system for the U.S. Navy. Just days after the launching of Sputnik I on October 4, 1957, APL scientists George Weiffenbach and William Guier were able to determine Sputnik's orbit by analyzing the Doppler shift of its radio signals during a single pass. Frank McClure, APL's Research Center chairperson, suggested that if the satellite's position were known and predictable, the Doppler shift could be used to locate a receiver on Earth.

> Commemorative stamp image from Dr. Tom Misa.
>
> Translation of the 40-kopek postage of the USSR: "First in the world, Soviet artificial satellite of the earth". By *LABenson*

{Editor's note: In my personal archives, I have a 35 mm slide of the 1st Sputnik in orbit - taken with my Leica on a tripod from the Defense Language Institute in Monterrey California – Nov. 1958.}

This is the system, which I programmed and tested in late 1963 based on a model from APL. I was working in San Diego for UNIVAC on the Naval Tactical Data Systems (NTDS). I was assigned the task of analyzing and converting the APL Fortran model into assembler language to run on the on-board AN/USQ-20 NTDS computers. The Navy had installed a 'transceiver' on a Cruiser [or destroyer – it was a long time ago] which was in dry dock at the Mare Island Naval shipyard north of San Francisco in early 1964. I had use of the on board computer system and transceiver equipment during third shifts. I finally got correct results based on APL's data profiles and the Navy decided to run a sea trial.

I was requested to join the fleet after the upcoming sea trials. Navy HQ in Washington DC gave me a field rank of Lt. Commander, USN as I had to fly over Cuba on my way to sea trials in the Virgin Islands. They wanted me to be treated as an officer in case the plane went down and I was captured. I still have the ID card. The fleet sailed into the Caribbean and I was sent to meet them in late March, 1964 to make sure that the systems were running ok. I arrived in St. Thomas, Virgin Islands via San Juan, Puerto Rico and checked into the Holiday Inn to await the fleet arrival. The fleet was still a couple days out of port and I and our engineer from San Diego enjoyed the mini-vacation.

We were finally contacted and picked up in a launch to go out to the CGN-9 to check out the results of the sea trial that the Navy had run on the way down. I verified that the data fit within tolerances as I had expected. We compared the satellite navigation positioning data to the Loran C data and found our accuracy was about 1/10th of a mile in Longitude/Latitude. The Loran system was about ½ mile in accuracy. The Navy command on board was satisfied with the results and I was returned to the island after about two hours on board. I didn't realize at the time the magnitude of the importance of the system in years to come. I had successfully programmed and tested the Navy's version of the forerunner to the first GPS!

In March 2012, we posted #164 & 165, the 14 slides and associated 'talk' script used by Lowell at a Round Table presentation, the first slide is shown here.

Collin Burke, co-author of "The Secret in Building 26" was the featured speaker; I provided the ERA to LMCO perspective. WHY? Col. Don Patton, coordinator of the Round Table series, invited the VIP Club's participation as a complement to the speaker. Building 26, located in Dayton, OH was the location that the Navy used during WWII to build electronics used for code busting.

Our second slide has the words: "As WW II ended, the Navy, concerned that the makeup of the CSAW team be preserved in peacetime, offered civil service appointments to several members including Engstrom and Norris – Engstrom suggested that they form a private company. They were joined by a new partner, Capt. Ralph I. Meader, who had headed the **N**aval **C**omputing **M**achine **L**aboratory (NCML) that manufactured devices for CSAW at NCR in Dayton, Ohio. The result was Engineering Research Associates (ERA) located in an old glider factory in St. Paul, MN."
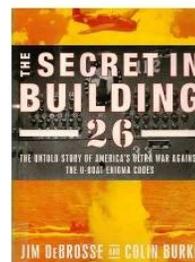
Yes, our founders were involved with 'code breaking' and classified work before ERA so it is no wonder that ERA's first few analytic machines have little or no published data. Chapter 3 of "When Computers went to Sea" by Capt. David Boslaugh talks about the founder's history thus is recommended reading.

Only half a dozen of the 250 attendees were VIP Club members so these two bullets were quite apropos:

- A 66-year LEGACY of Defense Industry **I**nformation **T**echnology (IT) developments and applications started in 1946 with **E**ngineering **R**esearch **A**ssociates (ERA) at 1902 Minnehaha Avenue in St. Paul, Minnesota. This Information Age Legacy merged and diverged through the corporate ownerships of Remington Rand, UNIVAC, Sperry, UNISYS, PARAMAX, Loral, and Lockheed Martin.

- In 2005, the VIP Club & LMCO began a Legacy Committee – collecting artifacts and documenting the ERA IT Legacy as a web site anthology; over 250 ex-employees have contributed their career summaries and/or project/product stories.
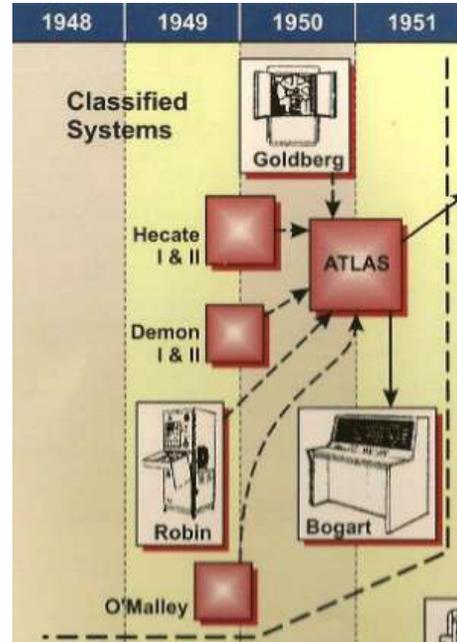
In April 2012, we posted #166, *CREATIVITY-SUCCESS-OBSCURITY*, 'UNIVAC - What Happened?' by Gerald E. Pickering. "A fellow retiree posed the question of what happened. **How did the company that invented the computer snatch defeat from the jaws of victory?** The question piqued my interest, thus I tried to draw on my 32 years of experiences in the company and the myriad of information available on the Internet to answer the question for others, and hopefully myself, that may still be interested 60+ years after the invention and delivery of the first computers. Computers plural, as there were more than one computer and more than one organization from which UNIVAC descended."

"Though *IBM and the Seven Dwarfs* may have been a whimsical play on words in the early 1960's, UNIVAC was head and shoulders above the other six dwarfs. Though IBM may have enjoyed greater revenue and greater profit, in no way did UNIVAC yield superiority to IBM in military business, large scale mainframe and real-time and communications computers, or the share of commercial computers sold to the federal government."

"This story concludes with a detailed account of my work assignments within UNIVAC. The reader can determine for himself what creditability I personally bring to the accounting of this story of UNIVAC and the industry. The reader should know that I am an octogenarian, retired from the company for 22 years. Recollections of events no doubt have faded over time and my relationships with people, inside and outside the company, friendly or adversarial have influenced my perspective and impressions."

It is impossible to re-cap 25 pages of insightful writing in a few paragraphs – Please, at your library's desktop computer, read http://vipclubmn.org/Articles/CreativityToObscurity.pdf.

In May 2012, we posted #167, David Shelander's synopsis of the AN/UYK-43 US Navy computer. "Starting in 1984, the AN/UYK-43 became the new standard 32-bit computer of the US Navy for surface ship and submarine platforms. The size of a refrigerator, it replaced the older AN/UYK-7 Naval Tactical Data Systems (NTDS) computers. The UYK-43 shares the same instruction set architecture as the UYK-7 and AYK-10 computers. Some 1,250 units had been delivered through year 2000. In 2008, NTDS software hosted on the UYK-43 was successful in launching and guiding a missile to shoot an errant satellite out of the sky. {Editor's note: The AN/UYK-43 was designed and prototyped in the Sperry Defense Systems Eagan, MN facility. Production units were built in the Clearwater, FL facility - continuing through the Sperry to UNISYS merger and the UNISYS to Lockheed Martin divestiture.}"

"Although AN/UYK-43 computers and functions are gradually being replaced by the NTDS AN/UYQ-70 dual display unit with embedded COTS modules, UYK-43s will still be in use on a large number of USN and international Navies' ships well into the 2020s. Retired AN/UYK-43 units are being cannibalized for repair parts to support these systems still in use."

Mr. Shelander's paper includes a photo copy of a 1984 letter from the Navy's Project Manager, Joe Mallone. In it Joe congratulates the Sperry program manager, Don Dunn, and the development team for the delivery of AN/UYK-43 S/N 1.

In June 2012, we posted #168 & 169, two web pages created by Al Reiter. The first is about maintenance people who worked on and with the UNIVAC I computer. The second is about the UNIVAC I hardware.

" My name is Allan Reiter and in 1954 began my career with a company in St Paul, Minnesota called Engineering Research Associates (ERA) that was part of the Remington Rand Corporation. I was hired with three friends, Paul S. Lawson, Vernon Sandoz, and Robert Kress. We were buddies who met in the USAF where we were trained and worked on airborne radar on B-50 airplanes. In a way, this was the start of our computer career because the radar was controlled by an analog computer known as the Q-24. After discharge from the USAF, Paul from Indiana and Vernon from Texas drove up to Minnesota to visit me. They said they were looking for jobs. We picked up a newspaper and noticed an ad that sounded interesting and decided to check it out. The ad said they wanted people with military experience in electronics.

We were hired by the Field Service Division to maintain installations of the UNIVAC I System. We obviously needed to know how these complex things worked and along with other new hires were sent to New York City where we attended UNIVAC I classes. This was during 1954 when NYC was considered a nuclear target area of the cold war and there we were on an upper floor of the Remington Rand Building, a 20-story structure at 315 Park Avenue South. One tidbit of information I

still remember from these classes was that the total capacitance of the power supply of the Central Computer was 0.7 of a Farad. After a brief period at General Electric in Louisville where UNIVAC I (serial #8) was located I was assigned to Wright-Patterson AFB (WPAFB) near Dayton, Ohio. Air Material Command (AMC) was being used for inventory and related activities by UNIVAC I (serial #10). It was there I met Robert Stark.

Bob and his wife Lois live in the Twin Cities area so I see them now and then. Bob supplied several of these photos, shown in the Photo section of the hardware page. He also gave me valuable technical data in areas not familiar with me, such as the memory changes for UNIVAC II. The major change for UNIVAC II was removing the 7 large mercury tanks used for the 1,000 word main long term memory of UNIVAC I and replacing them with the new magnetic core memory. This increased the number of words that could be stored in UNIVAC II from 2,000 up to an optional 10,000.

Univac II was built in St Paul, MN from a Univac I (serial #16) that was shipped from the factory in Philadelphia to St Paul in 1955. That prototype Univac II went into operation at Sperry Univac's Plant 5 located on Prior Ave in St Paul. I knew three of the people that programmed on that computer, Willis Unke, Bibsy Kinghorn and my late wife Mildred. There is a picture of that Univac II in the Photo section of the hardware page; it shows Rollie Arndt inside it.

1970 was the end of the UNIVAC I and the UNIVAC II era that lasted almost 20 years. The last UNIVAC I's in operation were at L-C Ins. in Nashville, TN. The oldest one was serial #24 and the newer one serial #37. My late friend Paul Lawson nursed these two UNIVAC I's along through the years."

I am quite glad that Al took the time to create these two web pages! Also sorry that Al's health now inhibits participation in VIP Club activities. *LABenson*

In July 2012, we posted #170, "A Legacy Epoch", http://vipclubmn.org/Articles/LegacyEpoch.pdf. Webster defines an EPOCH: "A period marked by certain events." The genealogy chart {in the paper} clearly illustrates a '40 years' operational use' epoch within the 50+ year Air Traffic Control (ATC) Systems evolution which is a significant part of our IT Legacy. The first IOPs began operational use September 29, 1971 in Chicago, IL. The last IOPs in operational use were retired June 4, 2011 in Dayton, OH. Hundreds, if not thousands, of people have designed or worked on aspects of these systems. Congratulations to those engineers who designed the IOP (**I**nput **O**utput **P**rocessor) hardware and the programmers who did the systems, tracking, and display software. I'm quite sure that the 1970 engineering team, who were designing the IOP, could not have imagined that their designs would still be operational 40 years later! *The 'energizer bunny' fades quickly when compared to these 'UNIVAC' systems!* Before the IOP, the UNIVAC Type 1218 radar processing computer was the baseline for the ARTS I system in Atlanta, GA. The NTDS military designation for the 1218 was CP-789; UNIVAC commercial applications of this 18-bit Instruction Set Architecture (ISA) were identified as the 418 computer series. Along with the 1218 and IOP computers and operational software, UNIVAC/ UNISYS supplied much of the ancillary equipment such as printers, buffers, etc. Although the first ARTS operational system was at the Atlanta airport, a complete test bed for systems development was at the Minneapolis St. Paul airport – many of our systems programmers spent time at that facility [originally called Wold-Chamberlin field.] *Yes, for 50 years, whenever &*

wherever we have flown, UNIVAC – UNISYS – Lockheed Martin ATC systems have kept US commercial flights arriving and departing safely! Thanks to Tom Montgomery who provided the charts and basic data for this paper.

In August 2012, we posted #171, "The ATLAS Evolution". This paper's purpose is to document a set of shadow box displays, which have graced the 'history' hallway of UNISYS in Roseville, MN for a couple of decades. (The 2012 reconstruction has taken away that hallway – in January 2013, these were remounted in a shared hallway space, secure for another 5 years.) The first of these shadow boxes shows (at left) the 1955 technology that was used in the 1103 computer. The 1103 logic modules used vacuum tubes; the memory was a combination of core modules and a rotating drum. There are 16 shadow boxes on the wall showing 40 years of computer technologies up to 1996, the IX4800 and IX5800 systems. *LABenson*

In September 2012, we posted #172, *50 Years of Airborne* Anti-Submarine Warfare (ASW) *Experiences* - A slide set from Les Nelson with comments by Lowell.

- UNIVAC, St. Paul (predecessor of LMCO Eagan) experiences **began in 1963** when we were contracted to deliver a modified airborne ADD 1000 computer to NADC as the first digital mission computer project. We were also contracted to do the mission software.
- In June 1965 we delivered the CP-823U, an NTDS software compatible airborne computer and an AN/USQ-20A for compiler support.
- In September 1967 we shipped the 1st CP-901 computer to NADC. - S/N 499 shipped in 1992, a 25-year AN/ASQ-114 systems production run! We developed P-3C ASW software at St. Paul, MN; Johnsville, PA; Patuxent River, MD and Burbank, CA.
- *Bob Pagac*, retired LMCO program manager: **"**In 2012 there are still 40 CP-901s flying on Japanese P-3C search & rescue missions."

The original 'application' software was written in 30-bit NTDS compatible code. The current application software is written in ADA 95 C/C++.

The ADD 1020, the CP-823, and CP-901 hardware used hardwired logic. The current hardware has embedded microprocessors (Sparc and PowerPC) executing Solaris VxWorks DII COE runtime software. The first CP-823 and CP-901 code was generated with the CS-1 compiler. Current software is generated with the AdaMulti compiler.

Our Airborne ASW history is more than the P-3C systems reviewed in the five slides provided by Les Nelson:

- We developed the hardware (AN/AYK-10(type 1832)) and systems software for the carrier based, Lockheed S-3A and S-3B aircraft.
- We developed the software for the Canadian Aurora program which used the P-3 aircraft with an 1832 computer.
- We've tailored P-3C systems for the Japanese, Australians, Norwegians, Dutch, etc.

In October 2012, we posted #173, <u>UNIVAC Computers I Have Known</u> by Dr. George Champine. Paragraphs are copied here: "I joined Univac directly out of college in the spring of 1956. I stayed for 22 years, leaving in December 1979. The following is a summary of my early work at Univac in the Defense Systems Division. I transferred to the Commercial Division in 1970.

My first job was to do numerical analysis and programming for Project 2052—the world's first airborne computer. The project was called 'Project 2052' for reasons that I do not remember. It could be because the project was started in 1952. The project was to build an airborne digital computer that would accept signals from the aircraft radar to get the location, speed, and direction of the target, and then point the tail gun on the airplane, which was a B-24. Because of weight and power restrictions, the computer used a special architecture that was a Digital Differential Analyzer, which computed the change in values rather than the entire value itself. The computer had a small drum storage device and a 64-word core memory of one bit per word. It had a serial arithmetic unit. As I recall the computer was about one cubic foot and was operational in the summer of 1956.

Seymour Cray, who was a quiet, soft-spoken engineer/mathematician who stayed mostly in his office and developed the specifications, did most of the computer's design. Cray had left the project before I joined the project, but I met him several times.

Most of our design and software development work was done on the Univac 1103 computer Serial 7 [the second generation after the 1101] housed in the old glider factory on Minnehaha Avenue. This machine was unique in that it was the first 1103 with a core memory in place of an electrostatic memory. Later it was called the Univac Scientific when it got hardware floating-point. An immense vacuum tube super computer occupied a room of 1,000 square feet. It was one of the largest computers in the world of its time. It had a main memory of 1024 36-bit words, and a drum memory of 16,000 36-bit words with paper tape input and output. The architecture was two address and ones' complement. To print the output, we had to run the paper tape through a Flexowriter, which had a paper tape reader and typewriter output. The memory drum was about 24 inches in diameter and about four feet long. The computer weighed 17 tons and required 45,000 watts of power. It could carry out 50,000 operations per second (such as an addition).

Subsequent to my leaving the project, the computer and my software were installed in a B-24 and flown successfully that fall somewhere in Texas. I learned many years later that it was the world's first airborne digital computer. I wish that I had known it at the time.

I returned to college in the fall to continue working on a Master's degree in physics during 1956-1958. As part of getting the degree, I took the qualifying exam for a Ph.D. in physics. I passed the exam and was invited to continue on for a Ph.D. Through my work at Univac I knew that I wanted to go into computers and not physics, so I declined."

In 1958, George returned to UNIVAC to work on the Nike-Zeus system and other systems. He also has written about those experiences – too long to include.

In November 2012, we posted #174, 'Sperry History Boxes'. "This series of seven photos was recorded in the UNISYS, Roseville facility on April 4, 2012. These shadow box photos illustrate the Twin Cities Sperry-UNIVAC company Engineering Developments in the years FY '79 through FY '85, the seven years before the Burroughs buyout of Sperry in 1986." These boxes are now mounted in a different hallway at UNISYS, Roseville.

Mike Svendsen is in the process transcribing all the words of these seven technology history boxes. He will also transcribe the other 16 shadow boxes which exhibit the systems technologies of computers from 1955 thru 1996 [These photos are at http://vipclubmn.org/Articles/ATLASevolution.pdf .

In December 2012, we posted #175, IT Legacy - Preservation Sites, a presentation by Bernie Jansen at the 2012 Unihogs/Uniturkeys luncheon.

Artifact Preservation Site Summary

Exhibit Location: *Lawshe Memorial Museum*

Dakota County Historical Society

Planned Exhibit Size: ~1,000 square feet

Material contributions from Lockheed Martin, the Club's Legacy Committee, and many former employees: including -A variety of computers, including the AN/UYK 43 shown at the right.

Other items available for Lawshe exhibit variations are Training films, Photographs, Marketing materials, Project files, Internal phone books and sample forms, and selected Laboratory equipment.

We have been working in conjunction with the Charles Babbage Institute for preserving our collection of documents. The CBI Director at the University of Minnesota is Dr. Tom Misa, an advisor to our IT Legacy Committee. CBI is housed on the west bank of the Minneapolis campus; located and shown below.

Charles Babbage Institute, University of Minnesota
211 Andersen Libraries - 222 - 21st Avenue South
Minneapolis, MN 55455
http://www.cbi.umn.edu/

In January 2013, we posted #176 "*A Brief History of Sperry Corporation*", copy of an undated paper.

"The Sperry story begins in 1873 with the introduction of the first commercial typewriter by E. Remington & Sons of Ilion N.Y. After a half century of business operation, E. Remington & Sons was merged with several other business machine makers to form a new company in 1927 - Remington Rand, Inc. During the next two decades, Remington Rand earned an enviable reputation as a developer of financial record and filing systems and a manufacturer of typewriters, mechanical calculators and punched card systems. But, the acquisition of two small companies in 1950 and 1952 would form the nucleus of an entirely new kind of business which continues to be reflected in the organization today.

In 1950, Remington Rand purchased the Eckert-Mauchly Computer Corporation of Philadelphia, PA. A few years earlier, while affiliated with the University of Pennsylvania, J. Presper Eckert and John Mauchly had designed and assembled ENIAC (Electronic Numerical Integrator and Calculator.) This huge electronic computer, the first of its kind in the world, was built to solve ballistics problems for the U.S. Army and was hundreds of times faster than any of its mechanical counterparts. The success of ENIAC prompted Eckert and Mauchly to form their own computer company in 1947. In 1949, they completed BINAC (Binary Automatic Computer) for the Northrop Corporation in California. Another computer, which they called UNIVAC (Universal Automatic Computer), was only partially completed when Remington Rand acquired the Eckert-Mauchly Computer Corporation in 1950. the first model of the UNIVAC I Series was delivered to the United States Bureau of the Census in 1951.

In 1952, Remington Rand purchased Engineering Research Associates (ERA) of St. Paul, Minn. ERA had been organized in 1946 by a group of World War II mathematicians and engineers who had developed considerable expertise in electronic cryptography and special purpose military electronic systems. In 1950, ERA delivered two electronic computers to the United States Navy and Tahoma Institute of Technology. After Remington Rand acquired ERA, each of the computer models in this initial series was identified as a UNIVAC 1101.

In 1955, Remington Rand merged with the Sperry Corporation, forming Sperry Rand. The Sperry Corporation had been founded in 1910 by Elmer A. Sperry, a prolific inventor and applied scientist. The 1969s and 70s were decades of organizational stability and business growth in Sperry's key markets. The company expanded its international operations through formation of joint ventures in Scandinavia and Japan and established engineering and manufacturing sites in Canada, Belgium Germany, France, Scotland and England. In 1979, with the planned divestment of Sperry's electric shaver and office products operations, Sperry Rand Corporation changed its name to Sperry Corporation to streamline the corporate identity. The 1984 divestment of Sperry Vickers further focused the corporate mission on designing and producing high technology, electronic-based systems, and products for commercial business, government, defense, aerospace and maritime markets.

Since the 1952 acquisition of ERA, the company's operations in the Twin Cities area of Minnesota have been steadily expanded. Today, Sperry's employment in Minnesota numbers 14,000, ranking the company as the State's fourth largest industrial employer.

The Defense Products Group is headquartered in Eagan, Minn., and operates 12 divisional facilities in the St. Paul area. Information Systems Group's System Products Division designs and manufactures large-scale computers and components at facilities in suburban Roseville, Brooklyn Park, and Eagan, and in outstate Jackson, Minn. A regional Information Systems Group asset reclamation center is located in Mendota Heights, as is the Systems Management Group's air traffic control operations group. Eagan is also the site of regional operations for Sperry New Holland."

In February 2013, we posted #177, *My ERA and pre-ERA 'mini-history' by Don Weidenbach.* This paper begins: **"Prologue:** Don Weidenbach is from America's 'Greatest Generation' – those who served our country during WWII followed by a memorable career. Don's career was part of the Information Technology industry, which had some of its roots in St. Paul, MN. (Photo circa 1939) Don has been supporting the VIP Club's IT Legacy project with recollections of computer technologies of the 50s and 60s." "In July of 1946 I was on board an Army troop ship, along with several thousand other GI's, coming home from the Philippines. We were in a happy mood. The war with Japan had been over for a year and we were finally on our way home."

Don's mini-history story ends with: "In 1976, I retired from Univac after 30 years in a company that I doubted I would stay with for more than a year or two when I joined it in 1946!! My parting gift was a desk set with a Speed Tally vacuum tube, an Athena module, and a Nike-X project sticker – it is now at the Lawshe Museum in S. St. Paul [photo below.] *It was a great time for 30 years!"* Edited by Lowell A. Benson.

In March 2013, we posted "24-bit Computer Repertoire Cards" as scanned and described by Lowell Benson. Programmers, field service engineers, test technicians, and design engineers all used pocket sized repertoire cards as a quick reference when trouble shooting hardware or when debugging software. As the VIP Club IT Legacy committee has been collecting documents, hardware artifacts, and career summaries, many repertoire cards have also been donated. This paper shows and discusses several repertoire card types for 24-bit computers and the sequence of these machines. Cards in the collection, destined for the Charles Babbage Institute, are the Transtec, the 1824, The Titan

Missile Guidance Computer, and the 1224 computer. The Transtec card shown on the previous page is illustrated as a predecessor to the 24 bit Athena Computer. {Editor's note: about 200 rep cards have been scanned by Keith Myhre as pdf files, originals now at the Charles Babbage Institute.}

In April 2013, we posted #179, "The Plant 8 Closure edited by Lowell Benson using inputs from Dan Carlson, Dick Lundgren, Kristen Maloney, Tom Montgomery, and John Westergren; plus photos by Mike Eischen's team."

"This paper documents the end of an Information Technology (IT) Legacy epoch, i.e. the closing of an engineering facility in Eagan, Minnesota. The epoch began the fall of 1967 as the UNIVAC Division of Sperry Rand opened their Twin Cities' eighth local facility. The epoch ended in March 2013 as the last resident, Lockheed Martin MS2, handed over the 'keys' to the building's owners."

Located at the northwest corner of Pilot Knob Road and Yankee Doodle Road this facility once was the 'work' home of a few thousand-defense industry employees. The building will be razed to make way for a shopping mall and small business offices."

"The epoch began just over 45 years ago. Company publications then referred to it as Plant 8, the only plant name known to many UNIVAC veterans who left or retired when Burroughs bought Sperry to form UNISYS in '87. When UNISYS sold the defense division to Loral, then when Loral sold to Lockheed Martin – the building was known internally as their Eagan facility."

From a vibrant beginning to vacant space!

This paper also contains a recap of the 45-year Plant 2 history and several additional 'empty space' photos.

In May 2013, we posted #180, a letter to the Smithsonian asking to correct an exhibit's erroneous information noticed by Keith and Tricia Myhre.

"Dear Sir or Madam: One of our *VIP CLUB* UNIVAC/UNISYS retiree members recently visited your Udvar-Hazy Center at the Dulles International Airport. There he took these two photos of your "UNIVAC 1232 Computer" poster and hardware display. The poster has two factual errors that we urge you to correct.

1. The UNIVAC 1232 **was not** a computer per se', but a man/machine operator station connected to the AF's 1230 MTC computer in the Sunnyvale facility. The **M**obile **T**actical **C**omputer developed for the U.S. Air Force, was called the 1230 MTC because it performed many of the same system functions as the Type 1230 computers developed earlier for NASA (http://vipclubmn.org/Articles/Apollo.pdf.) The UNIVAC Type 1232 operator station was originally developed by UNIVAC for the **N**aval **T**actical **D**ata **S**ystems (NTDS) project. This NTDS 1232 console design was also used in AF, NASA, and FAA systems.

2. The 1232 **was not** "a military version of the UNIVAC 490 general purpose commercial computer." Rather, the UNIVAC Type 1230 (military) and Type 490 (commercial) were both 'progeny' of the NTDS AN/USQ-20A (Type 1206) computer. The following two pages provide supporting references and a UNIVAC COMPUTER GENEALOGY chart."

The maintenance panel setting on the 1232 desk adjacent to the keyboard/printer is for the UNIVAC Type 1230 MTC computer, which was at Sunnyvale CA for almost three decades.

Thanks to Dr. Tom Misa who provided the Smithsonian contact person's name and sent him a note to lend credibility to our change request.

In June 2013, we posted #181, 45[+] years **Ma**intaining, **P**reparing, and **P**roducing **E**xecutive **R**eports; a MAPPER History Presentation: by Lou Schlueter.

"In 1968, once an adequate hardware input device was available in form of the UNISCOPE 300 CRT display, it became possible to do transactional real time information processing. The software design was first implemented on the Univac 418 CRT-Report Processing system, which was the beginning of Virtual Report Processing as provided by MAPPER Business Information Systems (BIS) systems.

Early in the development of the 418 CRT-RPS System, 3 individuals entered the picture that were of major importance to the evolution and promotion of Report Processing Services (RPS). The first of these was William 'Bill' Gray. He became manager of the Diagnostic Software Development Group, which was also responsible for the 418 CRT-RPS projects. Jack Olgren, the top, senior programmer of the Diagnostic Program Development group initially declared that such a generalized, programmer-less method of using computers was not feasible. Based on prior experience, he believed that all applications had to be specifically coded. To his credit, upon further consideration, he conceded it might work. After reconsideration, he actually became the lead programmer for the Report

Processing System project. His contributions to initial phases of system development were invaluable. Unfortunately, he died of a tragic motorcycle accident a year or so into the project. Chuck Hanson also became a key programmer and system designer especially with later MAPPER 1100 and MAPPER C systems.

At this time, I was working in the Univac Commercial Division. In this division, Univac had established two main lines of computers; the 1100 line of mainframe computers and a 418 mid-frame line of computers that were especially effective as communications processors.

Univac had recently obtained major contracts to provide United and Eastern Airlines with computer systems to manage their reservation processing. Besides providing the control processors and networks, these contracts also required the first large-scale use of display terminals. These were Uniscope 300 CRT terminals. The Univac 418 Computer was chosen to run this RPS application because of its communication system orientation.

   The 418 CRT-RPS grew providing services to departments other than the original Test Department. Also the system was adapted to use the newer Uniscope 100 terminals. It should be noted that the Uniscope 300 and 100 were dumb terminals providing only a display and keyboard.

   It quickly became apparent that the concepts of report processing were popular with the users and demand for the services quickly accelerated. The need for a service Coordinator-Administrator-Teacher became apparent. I wrote the on-line Use Procedures and Guidelines contained in Report 1A and assumed the role of System Coordinator. It was not long before a second Coordinator in the person of Lou Cramer was required. He became well known in the MAPPER world. He traveled much teaching the role of Coordination and promoting principles of User Driven report processing.

The first commercial use of Sperry Univac's MAPPER was on the Santa Fe Railway in 1976. By 1982, over 2,500 terminals were on-line tracking over 68,000 cars in over 175 rail yards. The system used two Sperry 1100/84 central multi-processors and had a total value of over $25 Million." Summary by *LABenson*

In July 2013, we posted #182, [Semiconductors at UNIVAC](#). Bernard 'Mike' Svendsen created this history paper at the request of Dr. Tom Misa, Director of the Charles Babbage Institute (CBI) at the University of Minnesota with great inputs from Larry Bolton, Ralph Kerler, David Kirkwood, and Richard 'Dick' Petschauer – formatting for the web by Lowell.

This paper describes the highlights, interactions, and changes that occurred between the Semiconductor Industry and Univac during the 50 years after the invention of the transistor. In its 30 pages it shows how and what semiconductors were used in the Military and Commercial Divisions of Univac. The availability issues generated from the rapidly changing technology combined with Univac's diverse customer base required unique procurement and engineering solutions. An in-house facility was created in the 80's but was short lived.

Supporting documents (memos, charts, data, brochures, publications, articles, and presentations) are contained in six loose-leaf binders. Two additional binders contain photographs of devices that

give visual evidence of the transition of semiconductors from their invention to become one of the greatest technologies of the century.

During 60 years, semiconductor technology has gone from a single gate to over a half million equivalent gates in a device, with no end in sight. Gordon Moore's prediction was right on! Univac has been involved in all aspects of the technologies growth and contributed significantly to its becoming a mature industry. It was very exciting and rewarding to be involved and I hope this paper has given the readers an overview of the Univac participation.

I want to pay tribute to all those people at UNIVAC and our vendors who helped make semiconductors one of the major technologies of the century. It is amazing that semiconductors are this successful considering their shaky beginning.

I have compiled over 600 documents, memos, presentations, and actions from this time-period which are listed in Appendix A. They will be archived along with this document at CBI at the University of Minnesota. *Bernard N. "Mike" Svendsen*

In August 2013, we posted #183, Ocean Surveillance - 2013 is the **GOLDEN ANNIVERSARY** of our IT Legacy involvement with the Navy and Lockheed Martin in the airborne **A**nti-**S**ubmarine **W**arfare systems engineering, software, and hardware production. These airborne systems capabilities have transitioned to Ocean Surveillance systems as the cold war Soviet threat lessened in the late 80s and early 90s. The cooperation between UNIVAC/Sperry/UNISYS and Lockheed Martin in the development of an airborne Anti-Submarine Warfare (ASW) capability for the U.S. Navy was a 'quiet' part of our Twin Cities' IT Legacy.

Our IT legacy began with Engineering Research Associates (ERA) in 1946 in St. Paul Minnesota – continues today at Unisys, Roseville and the Lockheed Martin Air Traffic Management site in Eagan.

UNIVAC, St. Paul [predecessor of LMCO, Eagan] experiences began in **1963** when we were contracted to deliver a modified airborne ADD 1000 computer (CP-754) to Naval Air Development Center (NADC) as the first digital mission computer project. We were also contracted to do the first mission software.

In June **1965,** we delivered the CP-823U, an NTDS software compatible airborne computer, and an AN/USQ-20A for compiler and software support.

In September **1967,** we shipped the first CP-901 computer to NADC - S/N 499 shipped in **1992**, a 25-year AN/ASQ-114 systems production run! In the early 90's we began a program for the Navy to replace the CP-901s (DTL integrated circuit technology) with CP-2044s (embedded microprocessor technology.)

We developed P-3C ASW software in St. Paul, MN; Johnsville, PA; Patuxant River, MD; and Burbank, CA. Art Francis spent virtually all of his career programming and/or managing projects of this business arena, his career summary is in the paper. Five slides by Les Nelson depict 40 years of LMCO/Eagan P-3C **A**nti-**S**ubmarine **W**arfare experience, 1962 => 2001 - slides provided. We included a summary of the LMCO aircraft used by the Navy, including the carrier based S3A and Canadian forces CP-140, written by Sherm Mullen, Lockheed Vice President and Director of the Skunk Works.

VIP CLUB

Established in 1980

In **2012** there were still 40 CP-901s flying on Japanese P-3C search & rescue missions according to Bob Pagac, retired LMCO program manager. A 45⁺-year hardware design life! All of the development engineers should have a feeling of pride! Summary by *LABenson*

In September 2013, we posted #184, A First Flying Programmer as follow-on to the August Ocean Surveillance history article. Oscar Lundbeck was our first flying programmer on the Lockheed P-3C out of NAS Patuxent River. Pax River conducted the early operational tests of digital computer based flying Anti-Submarine Warfare systems.

Ned Hunter wrote, "We convinced the Navy we needed an "on-site programmer" to provide liaison with the software group in St. Paul, but that was only half the issue. We had to provide someone who could quietly gain his or her respect and be an integral, contributing part of the team. Remember, this was early in the game, and most people did not know who programmers were or what they did. Some were convinced that programmers had to have come from another planet! They were more skeptical of programmers than they were of the unproven system they were asked to test.

Oscar walked into this environment. He arrived with no job description in hand and had to hammer out his role on his own. This could have gone either way, but Oscar had the moxie and personality to make it work. His rapport with Cmd. Waller [later Admiral] was excellent! Oscar earned this rapport through showing a dedication to supporting the test team. Oscar not only spent many extra hours on the ground but also in the air because the system could only be integrated and tested in the air; mostly over the Atlantic Ocean at altitudes of two to three hundred feet. Some of these P-3C flights lasted 12-16 hours. This was very stressful, as anyone belonging to the "Flying Programmer Club" can attest." This article also recaps the CP-754/A and CP-823 computers' places in history.

In October 2013, we posted #185, Realization of a Dream - The 1st report about our IT Legacy exhibit at the DCHS Lawshe Museum. The Lawshe Museum entryway poster reads as follows: "Most of the history of computers is focused on the contributions from Silicon Valley in California, but Minnesota also played an integral role in the computer industry; so much so that it could be considered the 'Silicon Valley' of the 50s and 60s.

Minnesota's legacy in the computer industry began with **E**ngineering **R**esearch '**A**ssociates, Inc. (ERA) which was founded in 1946. The legacy continued with ERA's successor companies, which include Remington Rand, Univac, Sperry, Unisys, and Lockheed Martin. Over the years, the corporate name of the company changed many times but its ingenuity endured. These companies have had a vital presence in the computer and defense industries.

In 2010, Lockheed Martin announced that it would close almost all Minnesota operations by the end of 2012, including its facility in Eagan in Dakota County. This marked the end of an epoch of Minnesota's innovation in the computer industry.

With the of the Eagan facility closure, a large collection of artifacts - representing the companies' legacy – was donated to the Dakota County Historical Society. The collection includes objects from the 1940's up to the present day covering all time periods in the Lockheed Martin's history. There are archival records for once top-secret projects, naval computer workstations, pictures of early computer production, a Japanese airplane computer, and many other artifacts.

We are honored to be able to help preserve this legacy of innovation through the preservation of these artifacts and the presentation of this exhibit." Signed by *DCHS Board of Directors.* Web site *'Article'* summaries by *LABenson*

November 2013, we posted #186, UNIVAC's London Development Center by Arlyn Solberg. 494s, 1108s, Exec 8, Airline Reservation Systems, and Minnesotans overseas are all part of this brief history.

December: #187, We [UNIVAC/Sperry/UNISYS] supported the KH-9 Imaging program and others with the 1230 MTC computers at Sunnyvale, CA. The KH-9 program lasted for 20 years with a variety of spacecraft; information at http://www.thespacereview.com/article/2383/1 and http://blogs.fas.org/secrecy/2013/04/kh9-imagery-declass/. Sunnyvale facility data is available too; http://vipclubmn.org/Articles/AFD-060912-026.pdf. By Don Neuman

2014, Articles #188 → #201

January #188 & 189: In 1949, Eckert-Mauchly Computer Corporation hired Herbert Mitchell out of the Army. He left UNIVAC in 1960 for Honeywell. His perspectives on engineering and marketing in Philadelphia, New York, and Los Angles during this formative decade are detailed in his autobiography. Computer Historian, George Grey, excerpted the UNIVAC relevant sections from Herb's autobiography; we have posted the resultant two volumes as http://vipclubmn.org/Articles/MitchelVolOne.pdf and http://vipclubmn.org/Articles/MitchelVolTwo.pdf. Mr. Mitchell has some interesting comments about the Bill Norris and John Parker relationships. For the 20% of our members without home internet, I suggest that you take a look at these files at your local library, by *LABenson*.

For February 2014, we posted #190, an article about how a local Army Security Agency reserve unit moved into the Plant 2 Navy buildings, as NSTR phased out their use of that 'classified' facilities. Thanks to Ben Monson (USAASA CWO-4 Ret.) read the article at: http://vipclubmn.org/Articles/ASAinPlant2.pdf.

For March 2014, we have posted #191, a slide set showing how museums have captured the history of WWII gliders built by Minnehaha Ave in St. Paul, our Plant 2, before ERA existed. Thanks to Gish Devlaminck for the photos, read the article at http://vipclubmn.org/Articles/Plant2History.pdf - Enjoy these tidbits of our history, *LABenson*.

**April 2014, #192**: Our Legacy Committee has focused quite a bit on the ERA to LMCO lineage, recognizing that LMCO Corporation roots went back to 1912. The UNISYS lineage goes back even further to 1873, the origin of Remington!

http://vipclubmn.org/Documents/HistorySequence.pdf shows the sequence of this UNISYS corporation lineage. It also provides readers with the technology evolution of the ERA 1101 through the UNISYS 2200 systems of the 90's. Ron Q. Smith had created these 63 history pages as part of our 2008 State Fair Technology Symposium. *LABenson*
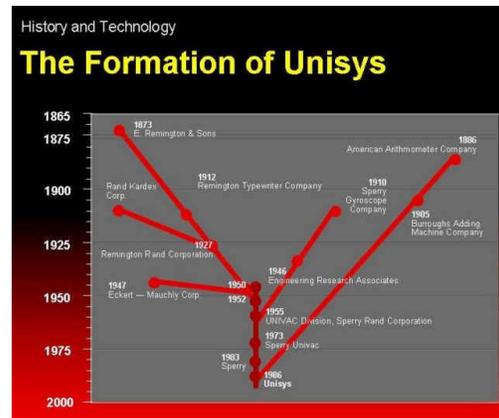
May 2014, #193 and June #194: UNISYS Roseville had a sense of history thus began creation of technology artifact shadow boxes a decade before our IT Legacy Committee formation. Harry Smuda [management] and Richard Petschauer [engineering] are credited with the development. When

UNISYS, Roseville downsized a couple of years ago, Chuck Lefebrve coordinated shadowbox mounting in a new hallway. Now Mike Svendsen has transcribed all of the plaque text from within these shadow boxes. The sixteen computer series shadowboxes are listed in http://vipclubmn.org/Documents/ERA2unisys Web.pdf, the May article. The June seven 'Engineering Highlight' shadow boxes paper is still being edited as this newsletter issue goes to press, by *LABenson*

For July 2014, we have posted #195, a UNIVAC 1100 Series technical paper generated by Richard Petschauer. This covers the hardware design details from 1101 vacuum tubes to the microcircuits of the 2200 computer series.

For August 2014, I wrote and posted #196, a synopsis of Dr. Misa's recently published "*Digital State*" book. Citing the book's back cover paragraph written by Margaret Anderson Kelleher, President and CEO of Minnesota High Tech Association: "Thoroughly researched and engagingly written, Thomas J. Misa's impressive book tells the story of a revolutionary group of companies and individuals who, during the middle of the twentieth century, transformed the computing industry right here in Minnesota. Digital State provides a much-needed look at the roots of Minnesota's high-tech economy." *LABenson*

For September 2014, we have posted #197, a 'bottoms up' chronology of semi-conductors used by the defense groups of ERA/UNIVAC/Sperry/UNISYS/LMCO, much of it experienced by Larry Bolton. This tubes-to-custom-chips progress report provides a nice complement to the exhaustive Semi-Conductor Facility (SCF) and Procurement history written by Mike Svendson. Larry's 41 years with

the company were mostly in the Component Engineering departments. His paper has some excellent artifact photos too.

October 2014, we have posted #198, a report from 2006, *Charles Babbage Institute, Our First Visit* written by Richard Lundgren. Bernie Jansen, John Skonnord, and Lowell Benson were with Dick at the early Legacy Committee meeting with CBI Director Dr. Arthur Norberg and Archivist Carrie Seib. The attendees became enthralled by the very idea of putting our papers at an excellent facility for use by future computer history researchers. {Sorry, this should have been posted in 2007!}

November 2014, we have a doublet submitted by Bernie Jansen, a Dakota County Historical Society (DCHS) trustee and a VIP Club member emeritus: #199) *From ERA to Lockheed Martin: Minnesota's computer Industry* by Andrew Fox and #200) *Dakota County Accessions Lockheed Martin Collection* by Sally Anderson. Mr. Fox is a part time DCHS employee, active in cataloging and documenting our artifact collection since 2012. Ms. Anderson is a DCHS trustee. Both articles used with permission of the Lawshe Museum publications coordinator. Andrew summarizes our corporate history and recaps the events that led up to the emerging exhibits at the Lawshe Museum.

Sally wrote, "The Dakota County Historical Society has been busy processing a large donation of documents and artifacts from the Lockheed Martin Company's Eagan facility, which closed in 2012. The project started more than a year ago, while the records were still onsite at the Eagan facility. Employees at the location had been collecting historical items for several years, and volunteers began sorting and cataloguing the records and artifacts." "The collection includes artifacts,

documents, memorabilia, company newsletters, and more than 50,000 photographs and slides. Some date back to the mid-1940s, and the early days of the Lockheed Martin Computer Division, when it was called Engineering Research Associates (ERA). The crew indexes each of these items using a custom database, which will make them more accessible to future researchers." Volunteers shown in this snapshot are Jim Donaldson (erroneously identified as Les Nelson in the Museum's article), Clint Crosby, Tricia Myhre, and Jon Simon.

"The next phase of the project has now started. Volunteers and staff will be culling through thousands of images, selecting and digitizing several hundred, which will be juried down to several dozen representing the history of ERA and its successor firms. The images and descriptive captions will form the basis of a new permanent exhibit, "The Birth of Minnesota's Computer Industry."

As the Legacy Committee begins its 10th year, we still need your personal story for the web site anthology, volunteers to help at the Museum, and more monthly articles. All 100 Articles to date are linked from section 2 of http://vipclubmn.org/documents.html. By *LABenson*

For December 2014, we have posted #201, *'More than a Customer'*. Captain Don Leichtweis, USN retired, along with a few other retired Navy officers and a couple of retired Sperry executives have created a letter to the Secretary of the Navy nominating 'Donald L. Ream' as a future Navy Ship name, recognizing Mr. Ream's leadership role in the NTDS development. A few excerpts from the Nomination paper:

"In 1954 the highest levels of leadership in the U.S. Navy were concerned about the future viability of the Navy's surface fleet. Fleet exercises with massed Soviet style practice air attacks against U.S. task forces had revealed that World War II style manual plotting teams could not support fighter, gun and missile direction at a pace fast enough to adequately defend forces afloat. The high speeds of new jet propelled attack aircraft allowed too many attackers to break through to fleet center; thus, in war game exercises task forces were theoretically annihilated."

"In April 1956 the Chief of Naval Operations tasked the Bureau of Ships (BUSHIPS) to develop an automated system to correct this problem with fleet anti-air battle management. It would be called the Naval Tactical Data System (NTDS) and the new BUSHIPS NTDS project office was expected to do in five years, what normally took 15 years of development time. The heart of this radical new command and control system was what would become the Navy's first shipboard digital computers, and a young Bureau of Ships engineer, Donald L. Ream, was assigned the job of developing the new computers."

"Don Ream was more instrumental than any other person in bringing the U.S. Navy into the information age decades ahead of the other industries! Don's guidance led the Navy to making maximum use of the new digital technology that gave the USN a great advantage during the "Cold War" years. What Rear Admiral Grace Hopper was to Navy business, administrative, and financial computing systems, Don Ream was to tactical and strategic digital weapon systems. However, because his work had to be done in far greater secrecy, his contributions were well known only to those who had a need to know. We, who served with him in the Naval Tactical Data System, Operational Control Centers, and subsequent projects, recommend strongly that a U.S. Navy ship be named "Donald L. Ream" in his honor."

This photo from the 100th AN/UYK-7 delivery shows VP & GM Richard 'Dick' Seaberg, Rear Admiral Wayne Meyer, Sperry Mfg. Dir. Robert 'Bob' Faust, Mr. Donald Ream, and a USN Captain (unknown).

{Editor's note: As of December 2015, the nomination request is awaiting s ship assignment by the Secretary of the Navy.}

For January, we have posted #202, "B-2 Stealth Bomber Story" by Jim Inda.

From the internet: "The Northrop (later Northrop Grumman) B-2 Spirit, also known as the Stealth Bomber, is an American strategic bomber featuring low observable stealth technology designed for penetrating dense anti-aircraft defenses; it is able to deploy both conventional and nuclear weapons. The bomber has a crew of two and can drop up to eighty 500 lb. (230 kg)-class JDAM GPS guided bombs, or sixteen 2,400 lb. (1,100 kg) B83 nuclear bombs. The B-2 is the only aircraft that can carry large air-to-surface standoff weapons in a stealth configuration."

Coordinating this paper, one of several Program Managers, Mike Wold wrote: "What is not known by many people is that Sperry Univac (later Unisys, Loral, and Lockheed Martin) in Eagan, Minnesota made major contributions to the success of this program while at the same time accomplishing some rather amazing computer engineering feats."

Jim Inda, a retired senior system engineer, reports that sometime in the early 1980s a group of Air Force and Northrop Aircraft people came to Univac Plant 8 to set up a meeting. Jim, one of the top system engineers at Sperry Univac with a unique knowledge of nuclear attack resistant hardware, said that in addition to himself, the meeting included Paul Kruelle, his engineering boss at the time, Daryl Kulenkamp from contracts, a Univac Vice-President, and a marketer were the only Univac people invited to be present at the meeting. The attendees at this meeting were told to sign some papers that indicated they could not disclose anything said at this meeting. The Northrop representatives then proceeded to explain that they were designing and proposing to build 132 new technology bombers. Each of the 132 bombers would require 13 General Purpose computers. With spares this would mean our company would sell the Air Force more than 2,000 computers. At $50 K per computer, that would be a sale of at least $100 Million. Were they interested? You betcha, they were interested!

One of the funnier stories Jim remembers was how they would walk through the Northrop facility to get to a meeting room. Security has two parameters. The first is having a valid level of clearance appropriate to the material being discussed, and the second is to have a need to know. As they walked through the facility, they were normally in a single file with a Northrop person in the lead and another Northrop person at the end of our group. They had the proper security level clearances, but they did not necessarily have the need to know as they passed through different aircraft design areas. As they walked the lead person would announce in a loud voice: "Un-cleared personnel". This was done to warn the people in that area that un-cleared personnel were coming through their work area. After a while they would say "unclean personnel' and laugh about it. The visitors did feel like they were being treated as lepers in their area. Again after a while as they walked in single file, one or more of them would start to say under their breath, Baaaa, just like a bunch of sheep. Meanwhile people they passed would shut any papers on their desk into folders, put them in a drawer, or cover their computer screen. After a while you did feel as if you were unclean.

Because of defense cutbacks, only 21 B-2 planes were built." The US AF is still flying B-2s with updated systems. Edited by *LABenson*

For February 2015, we have posted #203, "*The UNIVAC 8008 Micro*". Craig Solomonson wrote about his found treasure, perhaps the world's first 8-bit microcomputer built by UNIVAC in 1972! Please refer to your March and April 2014 newsletters for additional snapshots.

Thanks to Steve Newcomer and others for the development history. By *LABenson*

For March 2015, we have posted #204, "NSA Used UNIVAC Computers." George Gray has extracted several pages from previously classified NSA documents, focusing on the use of UNIVAC equipment during the 60s and 70s. He found these at the George Washington University National Security Archive. The extractions include applications of the 490, 494, 1108, and CP-818 FLEXCOP computers in various NSA programs.

In 2007, Mr. Gray had provided our web site with article #102, see section 2 of http://vipclubmn.org/documents.html. George also co-authored "*Unisys Computers: An Introductory History*" (UNISYS, 2008) with Ron Q. Smith. Ron had sent George's paper to me for our IT Legacy web use.

For April 2015, we posted #203 & 204. Blue Bell to LMCO employee, Harry Goldbacher [1965-2007] has bits of his career summary in a hardware paper, wired up, and in a personal paper, Mentor Frank. The hardware paper includes some interesting snapshots of manufacturing equipment used to build and test plated wire memory which was used in the 9200, 9300, and Minuteman computers.

His papers complement previous articles #113 and #150 written by Larry Bolton, et al'. Harry's mini-bio from an email: "Lowell, being a Brilliant Univac Blue Bell Alumnus (BUBBA), I thought I knew nearly everything – but, thanks for the Blue Bell retirees' URL. I will be attending their next meeting. There were some rough spots in my career but for the most part the company was good to me. I went from the wire program to software development in CAD, manufacturing technology, hardware test, OS1100 development – then worked on NEXRAD in Ivyland, PA. When we delivered NEXRAD, I had the option to go to [what was then] LMATM in Atlantic City (AC). I commuted from Montgomery County, PA to AC for 14 years; 2 hours down and 2½ back [if I was lucky]. After a while it wore me out but I loved it. I still keep in touch with my old buddies in sunny New Jersey. Looking forward to keeping in touch, and by all means, please use the article. I assure you that it was more fun to write than it will be to read. Best," *Harry*

For May 2015, we posted #206, "*Legacy Preservation Partnerships*". Lowell Benson's paper describes Club partnerships with our hosts, the Charles Babbage Institute, and the Dakota County Historical Society. The paper's subtitle is "*Millie, the Club, the University, the Museum and more!* This paper also provides some prognostications for the future of the IT Legacy Committee. Thanks to Sue Goolsby for editing the article. A previous, shorter version of this article appears as

PARTNERSHIPS FOR COMPUTER HISTORY in the Charles Babbage Institute 2015 spring newsletter, Vol. 37 No. 1.

For June 2015, we posted #207, "MATCALS – A 30-Year Life". Ron Irwin sent a 2014 item written by Emily Strotman, NAWCAD Public Affairs Communication Support. "NAVAIR's Marine Corps Expeditionary Air Traffic Control (ATC) Systems Integrated Product Team completed the demilitarization of its Marine Air Traffic Control and Landing Systems (MATCALS) this fall."

"Thus, it looks like MATCALS has finally reached the end of its life cycle. It had a 30-year life cycle that seems remarkable since it still had 1980 hardware technology. It just goes to show that LM/UNISYS/SPERRY built a great system (hardware and software) and made it to last. The last update to the chronological support of MATCALS was to say the software support ended in 2010. The hardware support must have continued by SPAWAR until last year."

"P.S. We have had periodic luncheons over the years with the people still living and in the area who worked on the software at Mare Island. Our last luncheon was on 4/18/2015 with seven of us meeting to enjoy a get-together: Gordy Erickson, Vern Sandusky, Dennis Larson, Scott Hovey, David Kreiss, Foster Poole, and I were in attendance." from *Ron Irwin,* edited by *LABenson.*

For July 2015, we posted #208, '*1988 Club member recruiting'*. We recently received and scanned the information letter and flyers given to UNISYS retirees – this was before Lockheed Martin or Loral were in the picture. A couple text excerpts: "Unisys provides a pleasant room for meeting with other retirees which is equipped with lounge furniture, a television, cards, games, a complete kitchen, and telephone. This room is exclusively for retirees and is open night and day, seven days a week." "Your VIP pass will also entitle you to lunch at 1/2 price at Unisys cafeterias. Guards will let you in the building during the lunch hours when you show them your VIP pass. Retirees are not permitted to go to their old work areas, visit old friends, etc. The VIP pass is intended to allow retirees to go directly to and from the cafeteria without an escort." LABenson.

For August 2015, we posted #209, the February 1977 Engineering Organization list of Vice President, R.A. Erickson 'Bob'. At that time, there were 512 people reporting to Bob via two directors, Hy Osofsky and Ralph Kerler.

The original list only had the staff first & middle initials, Larry Bolton diligently entered the first names that he knew into an Excel spreadsheet. Then we distributed it to a few people in the list for whom we have email address to fill in many more. The unusual thing about this bit of history is that some engineering staff at Clearwater FL and Salt Lake UT reported to St Paul – and not to the top or second level of management. Both the indented organization chart and an alphabetized list are included in the paper.

By my count, ninety-two current VIP Club members are in this document including three 2015 board members. I would guess that about a dozen are now employed at Product Development Associates! *LABenson*.

For September 2015, we posted #210 *'Eighteen Bit Computers'* an article inspired by emails from three 'outside of Minnesota' people:

- "We have the last remaining mainframe computer used by NASA for the Apollo Moon Missions, a UNIVAC 418-II used at Mission Control in Houston." George Keremedjiev; Director of the American Computer Museum in Bozeman, MT
- "Mid Atlantic Retro Computer Hobbyists (MARCH) are looking for info on 1219's, 1532's, and 1540's that we've rescued from Johns Hopkins APL." From Duane Craps.
- "I am an old service engineer from Univac to Unisys. I am trying to find out if there are any more physical units (418-II) in the world. Our website has some pictures, https://datamuseet.wordpress.com."

   From Anders Carlsson, Sweden

Keith Myhre provided this NASA snapshot showing two 1218s and a 418 computer with peripherals.

Thanks to Keith who scanned the picture at the Lawshe Memorial Museum and to several others who provided 18-bit computer experience and information tidbits. Article is on-line at http://vipclubmn.org/Articles/EighteenBitRevB.pdf.

For October 2015, we posted, #211 the 1980 Clyde Allen engineering organization (when the VIP Club started) and #212, the 1961 Noel Stone engineering organization (when Lowell was hired). Clyde wrote an introduction: "In 1980, I joined the staff of Dick Seaberg, General Manager, Sperry Defense Systems Division, as Vice President of Product Engineering. I recall that Jim Rapinac, John Vold, Ken Meinelt, Emmett Johnson, Ken Oswald, Jerry Squires, among others, were members of Dick's staff at that time.

I was challenged; coming out of the software world to lead an engineering organization, but also honored to be chosen. The organization was staffed with very capable engineers who gave their all to the company. Our Sperry Organization was a great asset to the U.S. Navy. The UYK 7 and UYK 20 were among the many projects we were developing at the time. Some of our customers were Don Ream, Paul Hoskins, Jim O'Donovan, and Joe Mallone of the U.S. Navy. To relieve our stressful times, we managed to have fun and develop friendships through golf events, dinners, and many other after work activities." *Clyde Allen*

Eight of the people listed in the 1961 Noel Stone organization are current VIP Club members; for example, Ernie Lantto is listed therein as supervisor of Ascension Island Equipment.

For November 2015, we posted #213, *Employed 60 Years,* a tribute to James Bacon. LMCO's Eagan based Steve Koltes presented Mr. Bacon with a recognition plaque at the FAA's William J. Hughes Technical Center near Atlantic City, NJ. This paper includes a scan of the 8/28/91 ATC/Air Defense organization under VP Bill Marberg. Mr. J. Bacon was then in that organization as was Lowell Benson.

For December, we posted #214, a decade recap paper - this booklet! Also, #215, a letter to Ole mailed with a printed copy of this booklet.

Your public library PCs are available to re-read all of the 'Articles for the Month',
which are linked from section 2 of http://vipclubmn.org/documents.html.

Logo Evolution

Our heritage company logos are time-lined by LMCO's John Skonnord, now retired.

Our IT Legacy logo has evolved over the decade. The first Legacy logo just showed the 60 years since the ERA beginning. Then we changed to a block listing the company names. Quint Heckert had found some State of Minnesota incorporation papers dated in December 1945. Since this was obscure, we decided to use 1946 as the beginning as that is when the doors opened.

In 2010, we updated with the company names on a Minnesota outline background. After a few months, a committee member commented that the logo looked like Minnesota's yellow snow! Thus, we changed to a blue and green coloring to reflect the sky blue waters and our lush fields and forests.

Future Committee Work

As long as volunteers are interested in documenting and writing about history of the companies illustrated in our Legacy icon and/or the people involved with the products and systems, a committee will exist. We have some things yet to do, as noted in the four subsections below.

Photo Identification:

Our most important current IT Legacy project is the Tuesday morning photo ID work at the Lawshe Memorial Museum, not obvious on paper is the camaraderie among those volunteers. Earlier this

year, I joined some of them and two LMCO visitors during their lunch break at the nearby Coop sandwich shop, Bob Pagac, Scott Schmidt, Tricia & Keith Myhre, Les Nelson, Steve Koltes, Greg Oxley, and me. One of these days I hope to catch up with Jon Simon, Clint Crosby, et al' on their Tuesdays at the museum.

Flash back to December 2012 when LMCO donated three truckloads of three-dimensional items such as computers, hardware items, corporate mementoes, photo prints, 35mm slides, photo transparencies, etc., to the DCHS Lawshe Memorial Museum. DCHS Executive Director Mr. Chad Roberts had proposed and received a state Legacy grant for the accessioning of the artifacts into the DCHS database. Keith Myhre converted the previous Legacy Committee cataloguing format from Excel spreadsheets to a Microsoft Access database. At the museum, VIP Club volunteers use a five-station computer network to log and identify approximately 20,000 photos.

This photo ID identification will continue through 2016 with a goal of finishing by summer of 2017.

Exhibit Expansion:

Thanks to a second State of Minnesota Legacy grant to the Dakota County Historical Society (DCHS) in 2014, museum staff and our volunteers prepared materials for a photo exhibit depicting the history of Engineering Research Associates and successor companies' Minnesota operations. A significant part of the research into the best topics to 'snapshot' this history was predicated on securing ideas from the employees and retirees.

Various company publications, newspaper articles, and videos contain the usual business history. We all understand that these "official" sources tell only part of the story – the rest of what really happened is still kept in the minds of the people who lived and worked through the past 67 years. Keith Myhre prepared an extensive list of topics in spite of very little retiree feedback. Then a steering committee narrowed these down to eighteen topics. Museum staff and Club volunteers then drafted topical educational posters. Museum employee Andrew Fox concluded this second DCHS Legacy grant with a 'Juried Review' of sample posters. The reviewers were Dr. Tom Misa, Charles Babbage Institute; Adam Scher, Senior Curator at Minnesota Historical Society; Ben Leonard, Manager of community outreach and partnerships at Minnesota Historical Society and former Director of Nicollet County Historical Society; and our lead exhibit volunteer Keith Myhre.

As we look ahead, our volunteers expect to support museum staff as they seek the means to implement the reviewers' recommendations.

- Connect the exhibit to everyday technology (i.e. iPhones, etc.) making it more people relevant
- Explain why MN was such a "fertile ground" for ERA/UNIVAC to become a pioneering company
- Less text per panel and more colors! (Tinting B&W photos to add variety)
- Making the exhibit more accessible/understandable - with fewer technical terms and names
- Maps showing plant locations in the TC, and other associated companies in MN
- More context within the MN computer industry (brief information about CDC, Cray, etc.)
- Personalizing the story with oral histories and stories of individuals
- QR codes with links to additional videos, pictures, and/or oral histories
- Smaller exhibit with 6-7 "core" panels and an additional 6-7 complementary panels
- Working in reverse chronology to show where/how/why certain technologies were developed

Oral Interviews:

If you are interested in the interview of a specific person, John Westergren has provided a list of those recorded to date and the media type. We are seeking persons who are willing to transcribe these 30[+] interviews. Two have been transcribed, see web page http://vipclubmn.org/People8.html.

The Charles Babbage Institute also has many other, already transcribed, oral interviews available.

Patent Wall:

Plaques recognizing patents grace a hallway at UNISYS, Roseville. The Legacy Committee needs a volunteer to generate a spreadsheet cataloguing these patents; i.e. who, when, Patent #, title then a bit of research for a patents' summary. The ensuing spreadsheet will to become a web site 'Article for the Month'.

Please contact Lowell Benson or Tom Turba to arrange for your access via our UNISYS liaison person.

If this recap booklet has missed your personal tidbit, check the web site. If you do not find it there, send it to webmaster@vipclubmn.org. We will fit it into the appropriate page(s).

Current IT Legacy Committee list

Lowell Benson***** - Engineering Manager, Keith Behnke – Manager & 2016 VIP Club President, Bill Bergen - Systems Engineer, Larry Bolton - Component Engineer, Clint Crosby – Systems Engineer, Anil Deodhar - Systems Engineer, Andrew Fox – museum staff, Millie Gignac – Club founder, Quintin Heckert -Systems Engineering Fellow, Bernie Jansen - Engineering Manager, Brent Jordahl – Contracts Manager, Steve Koltes – LMCO contact, Dick Lundgren - Instructor/Writer, Dr. Thomas Misa – CBI Director, Keith Myhre - Systems Engineer & Marketing Manager, Tricia Myhre - Systems Programmer, Ed Nelson - Engineering Manager, Les Nelson - Systems Engineer, Greg Oxley – DCHS Trustee, Bob Pagac - Program Manager, Jim Rapinac - Marketing VP, Dan Rogers - Systems Trainer, Jon Simon - Systems Engineer, Mike Svendsen - Procurement & Semiconductor Development Director, Harvey Taipale - Engineering Manager, Tom Turba - Engineering Manager, Earl Vraa - Engineering Manager, Don Weidenbach – ERA historian, and John Westergren***** – Program Manager. *****Committee Co-chairs.

Thanks to John Westergren, Keith Myhre, and Larry Bolton for their editorial changes.

Respectfully: *LABenson*, VIP Club President, 2011/14/15; BEE U of MN '66

VIP CLUB

Established in 1980

We have displayed this poster at many outreach venues since its 2008 creation for the Minnesota Sesquicentennial.

The chart's middle timeline shows corporate name logos beginning with ERA. The timeline starts with a picture of the first office on Minnehaha Ave in St. Paul MN, opened in January 1946 – 70 years ago! Of note is **1986** when Burroughs bought Sperry to form **UN**ited **I**nformation **SYS**tems. UNISYS then sold their Eagan based defense operations to Loral in **1995** who in turn sold to Lockheed Martin in **1996**.
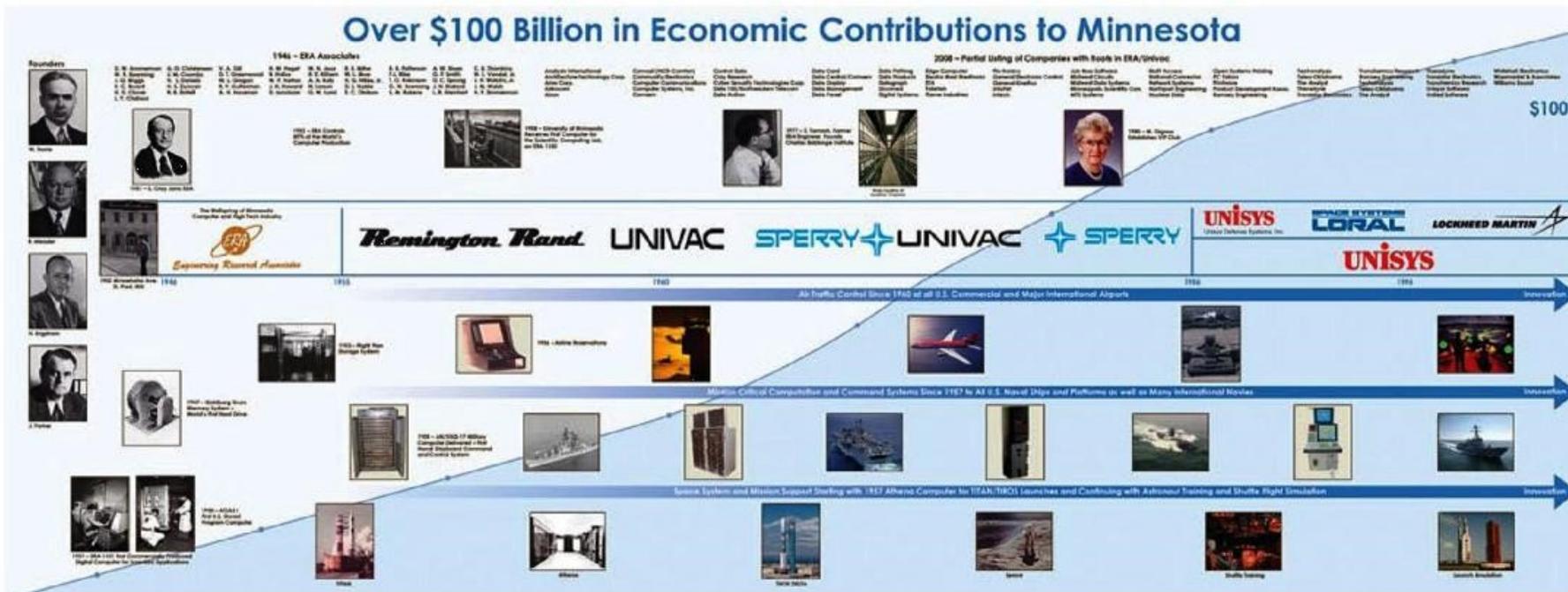
- On the poster's left are the four Engineering Research Associates (ERA) 'founding officers'; Norris, Meader, Engstrom, and Parker. Just below the poster's **Over** word is a list of the 1946 ERA Associates with a photo of Seymour Cray who joined the company in 1951.

- At the top right is a partial listing of spinoff companies, the most significant of which was in **1957** when one of the founding officers, William 'Bill' Norris, et al' formed Control Data Corporation (CDC) – many Minnesotans don't know that CDC was his second MN company.

- Above the time line are significant milestones: **1950,** stored-program computer delivered; **1958,** University of Minnesota's first digital computer; **1978**, former ERA engineer Erwin Tomash founded the Charles Babbage Institute; and **1980,** Millie Gignac founded the VIP Club.

- The poster's lower third has some IT systems first developed in MN: Naval Tactical Data Systems, NASA launch & communications, etc.

Send comments or questions about this article/booklet's contents to labenson@q.com, please specify the page number.