INCOSE Michigan Chapter

Monthly Newsletter

November 2026

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President's Message

We kicked off October with our Sidequest Social: *An Idiot's Guide to Wine*. It was an interesting event at the same venue that hosted our Dungeon Cocktail Experience in March. October 20th was a busy day; we hosted the multi-chapter Xavi Bou *Ornithographies* presentation and *Leveraging SysML v2 and Cameo to Realize True Model-Based Requirements.*

My wife and I traveled to Long Beach, CA for a *Star Trek*-themed behind-the-scenes tour of JetZero. This organization is developing a new airframe that promises to make air travel more enjoyable (assigned overhead bin space!!!); we also saw a Joby air taxi and had a surprise visit from Ethan Peck, who plays Spock on *Star Trek: Strange New Worlds*. Walter Koenig and Sir Patrick Stewart passed away shortly before I was finalizing this newsletter. I first encountered Koenig as Pavel Chekov and Stewart as Leondegrance in *Excalibur*; I will always remember them in their later roles as Alfred Bester (*Babylon 5*) and Jean-Luc Picard (*Star Trek: The Next Generation*).

November is our last Engineering Expedition of the year; we will visit the *Artemis Adventure with LEGO® Bricks* at The Henry Ford on Sunday, November 15th. We will meet for lunch at Plum Market Kitchen inside the museum at noon, then tour the exhibition together. November 17th is our final technical event of the chapter year, a presentation on *Systems Architecture for the Electrical, Electronics, and Software (E/E&S) Disciplines.* We have decided to defer our December social until next year and hope that you enjoy the holiday season.

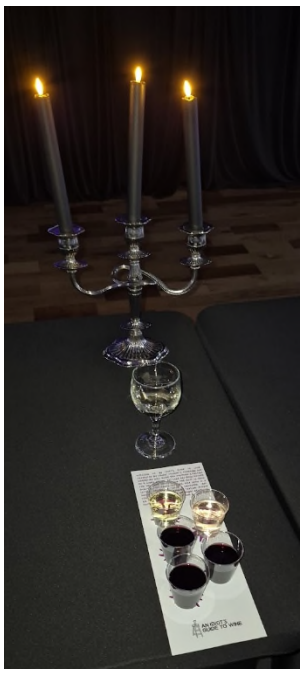
We are hosting an outreach workshop on November 21st: *Systems Engineering for Competition Robotics: Converting Time Into Points*. We are partnering with the Motor City Alliance, a Detroit-based robotics initiative supporting elementary, middle, and high school robotics teams. It will be a hybrid event and any interested robotics team is welcome to attend virtually.

INCOSE Michigan elections are just around the corner; we will host two virtual information sessions (dates and registration links under Upcoming Chapter Events) to give you a chance to learn about ways to join the Chapter board of directors (or volunteer in other capacities). Bylaws revisions will also be on the ballot. Members should watch for an e-mail including the new bylaws and a summary of changes.

We will provide a sneak preview of next year's events in our December newsletter.

Michael J. Vinarcik, ESEP-Acq, P.E., FESD

President



Wine selections at *An Idiot's Guide to Wine*



Engage!



JetZero aircraft concept



Joby Air Taxi

Upcoming Events Calendar

Date	Event	Organization
November 2	Election Information Session (virtual)	INCOSE Michigan Chapter
November 3	Election Information Session (virtual)	INCOSE Michigan Chapter
November 4	SE Lab Demo: Lean MBSE with iQUAVIS	INCOSE
November 4	Disambiguating Mission Engineering and Systems Engineering	INCOSE WMA Chapter
November 5	Guidelines for Implementing V&V Processes According to ISO 15288	INCOSE Latam Chapter
November 5	Fuel for Thought: The History of Electric Cars	Stahls Motors & Music Experience
November 7–8	LA–SD Joint Technical Conference (Hybrid)	INCOSE Los Angeles & San Diego Chapters
November 9	Lunch & Learn	PMI Great Lakes Chapter
November 9	National Officers and Fellows Night	ASM International Detroit Chapter
November 11	Scalable Qualification Architectures Commensurate with Verification Activity Complexity	INCOSE Enchantment Chapter
November 11	Challenges in Practicing Airborne Electronic Hardware Certification	INCOSE Seattle Metro Chapter
November 11	Parade Company Studio Tour	SAE International Detroit Section
November 15	Engineering Expedition: *Artemis Adventure with LEGO® Bricks*	INCOSE Michigan Chapter
November 17	Systems Architecture for the Electrical, Electronics, and Software (E/E&S) Disciplines	INCOSE Michigan Chapter
November 17	Strengthening the Digital Thread Through Executable Physics	INCOSE Los Angeles Chapter
November 17–19	SysML v2 3-Day Intensive Bootcamp	INCOSE North Texas Chapter
November 18	Member Appreciation 2026	PMI Great Lakes Chapter
November 21	Executable Physics Workshop (virtual)	INCOSE Los Angeles Chapter
November 21	Systems Engineering for Competition Robotics: Converting Time into Points	INCOSE Michigan Chapter / Motor City Alliance
December 2	Stahls Motors & Music Tour	SAE International Detroit Section
December 4	TechCentury Student Writing Contest deadline	Engineering Society of Detroit
January 30–February 2, 2027	INCOSE International Workshop 2027	INCOSE

Upcoming Chapter Events

INCOSE Michigan Election Information Sessions

Date: Monday, November 2, 2026, 7:00–8:00 PM Eastern;
Tuesday, November 3, 2026, 12:00–1:00 PM Eastern

Location: Virtual (Microsoft Teams)

Cost: Free

Chapter elections are coming up. These two virtual sessions explain how to get involved: the open positions on the chapter board of directors, other volunteer roles, and the proposed bylaws revisions that will be on the ballot. Watch for an e-mail with the revised bylaws and a summary of the changes.

Register:

Monday, November 2: https://events.teams.microsoft.com/event/13681ff4-f747-4263-bf95-da4438557b84@3523a793-0e50-4646-b80b-25d83bd7f296

Tuesday, November 3: https://events.teams.microsoft.com/event/73b4ad3e-2ac2-4569-a3f9-8be0134c1a95@3523a793-0e50-4646-b80b-25d83bd7f296

Engineering Expedition: Artemis Adventure with LEGO® Bricks

Date: Sunday, November 15, 2026, 12:00 PM Eastern (lunch), exhibition to follow

Location: Meet at Plum Market Kitchen, inside Henry Ford Museum of American Innovation, 20900 Oakwood Blvd., Dearborn, MI 48124

Cost: Attend on your own ticket; lunch on your own

Join fellow members for lunch at Plum Market Kitchen, then head together to *Artemis Adventure with LEGO® Bricks* in The Gallery by General Motors. The traveling exhibition pairs large LEGO sculptures with hands-on engineering stations based on NASA's Artemis missions. The sculptures include the Space Launch System, the Orion crew module, the Human Landing System, a Lunar Gateway habitat cutaway, Canadarm3, and the Apollo Lunar Module *Eagle*. At the stations, visitors design lunar landers, power a Moon base, and race LEGO rovers across lunar terrain.

Why This Event?

Artemis is a system of systems. Its launch vehicle, crew vehicle, lander, and supporting elements are developed separately and must work together. The sculptures set those elements side by side, and each build station is a small requirements-and-test loop: build against a stated challenge, test it, revise it. It is an easy afternoon to share with family members and anyone curious about what systems engineers do. This month's Historical Corner sidebar on Lunar Orbiter 2 covers how Apollo chose where to land.

Details:

- Plum Market Kitchen is inside the museum; no museum admission is needed to dine there.
- The exhibition is free for members of The Henry Ford or included with museum admission. Online tickets are $34–$39 depending on date; a $10 parking fee is added to each online order (members park free).
- The exhibition runs through January 3, 2027, daily 9:30 AM–5:00 PM Eastern.
- Tickets: https://www.thehenryford.org/visit/plan-your-visit/admission
- Exhibition page: https://www.thehenryford.org/visit/things-to-do/calendar/artemis-adventure-with-lego-bricks

RSVP: Contact michael.vinarcik@incose.net if you plan to attend, so we can hold enough tables.

Systems Architecture for the Electrical, Electronics, and Software (E/E&S) Disciplines

Date: Tuesday, November 17, 2026, 12:00–1:00 PM Eastern

Location: Virtual

Cost: Free

About the Talk

The integration of Electrical, Electronics, and Software (E/E&S) architectures has become a critical component in managing product complexity, while enabling seamless collaboration across engineering teams. CATIA Magic continues to provide value for Enterprise Architects, Systems Architects, and now E/E Architects with the CATIA Magic Systems Electrical/Electronics & Software (EE&S) Architect Plug-in, a solution created to synthesize the Hardware, Software, and Network Communication point of views, conveying design intent to discipline specific implementation engineers. This presentation will focus on how a Model-Based Systems Engineering (MBSE) approach to E/E activities helps deliver optimized architectural proposals to multidisciplinary development teams, guiding further activities in their respective domains, and ensuring implementations meet customer requirements.

About Erick Richardson

Erick Richardson is a Systems Engineering Consultant at Dassault Systèmes with over 20 years of experience across Aerospace, Industrial, and Consumer industries. Erick holds a Degree in Electrical Engineering from Missouri University of Science & Technology, and Certificates in Systems Engineering, Model-Based Systems Engineering (MBSE), Cyber Security, and Systems Thinking from California Institute of Technology, Saint Louis University, and Cornell University. Erick is also an International Council on Systems Engineering (INCOSE) Certified Systems Engineering Professional (CSEP). At Dassault Systèmes, Erick guides customers in building Virtual Twins of Systems, specializing in applying MBSE, creating Electrical / Electronics (E/E) Architecture, and developing Software Defined Products.

Register: https://lp.constantcontactpages.com/ev/reg/4bgdmp6/lp/3187ac14-2bb4-4a96-bae3-a93ea9d059a4

Systems Engineering for Competition Robotics: Converting Time into Points

Date: Saturday, November 21, 2026, 12:30–3:00 PM Eastern

Location: Hybrid (in-person location TBD, see registration site)

Cost: Free

About the Workshop

Every competition robot has one job: to convert time into points. Before it can score a single point, though, it has to be eligible to compete. That means passing inspection, meeting every deadline, and staying within the limits on cost, mass, and design.

Hosted by the INCOSE Michigan Chapter for the Motor City Alliance and the Mars Society's University Rover Challenge teams, this session shows high school and college teams how systems engineering helps them do both. Other interested competition robotics teams are welcome to join.

Topics include:

- Finding and tracking every requirement, including rule updates and Q&A rulings
- Building a simple compliance matrix
- Computing points per second for every scoring action
- Deciding what to build and what to ignore
- Making trade decisions deliberately

The session draws on two sources:

- A 2016 FIRST Robotics Competition (FRC) case study: Team 1701 RoboCubs' USS Valiant
- The "Top 20 Rules for University Rover Challenge Success," developed from judging the 2026 INCOSE Foundation Systems Engineering Excellence Award

It also looks ahead to the 2027 seasons: the FRC BIOCORE kickoff on January 9 and the URC Preliminary Design Review deadline later this year. It makes the case that every team needs a lead architect or systems engineer. It also points teams to free resources: the SEBoK, the NASA Systems Engineering Handbook, INCOSE student membership, and local chapter mentoring.

Students, mentors, coaches, and parents are welcome.

Register: https://events.teams.microsoft.com/event/f884566d-d494-4381-9401-ce9caac2e50e@3523a793-0e50-4646-b80b-25d83bd7f296?source=copyLinkLegacyShareEventDialog

Partner Organization Events

ASM International Detroit Chapter

National Officers and Fellows Night: Materials Science Research at Savannah River National Laboratory

Date: Monday, November 9, 2026, 5:30–8:00 PM Eastern (social hour 5:30, dinner 6:15, announcements 6:45, speaker 7:00–7:45)

Location: Detroit Marriott Livonia, 17100 Laurel Park Dr N, Livonia, MI 48152

Cost: $30 with reservation; $25 retirees and unemployed; $5 students

Dr. Elizabeth (Liz) Hoffman, FASM, Director of Institutional Mission Capture at Savannah River National Laboratory (SRNL) and ASM International's Immediate Past President, reviews the national laboratory system and SRNL's mission. She then turns to SRNL's materials research, including advanced manufacturing of refractory alloys, radiation-resistant polymers, and additive manufacturing of deuterated polymers. Her own research background is materials performance in extreme environments, the question behind every qualification requirement for a system that must survive heat, radiation, or corrosion. Dinner is included.

Register: RSVP by Wednesday, November 4, at https://asm-detroit-chapter.square.site/product/nov-9th-dinner-meeting/ZAGJCWCHT5NDWXSUI7U2OO4B or by email to asmdetroitchapter@gmail.com

Engineering Society of Detroit (ESD)

Call for Mentors: Michigan Regional Future City Competition

Date: Mentoring now through January; competition Tuesday, January 19, 2027

Location: Participating schools (in-person or virtual); competition at Vibe Credit Union Showplace, Novi

Future City asks teams of 6th–8th graders to do what our members do every day: take an open-ended problem, set requirements, make trade-offs, and defend a design before judges. This year's theme, "Fire Resilient Future," has students designing cities that prevent, withstand, and recover from fires. Teams produce a 1,500-word essay, a scale model built from recycled materials, a project plan, and a live presentation. Several Detroit-area schools are still seeking mentors, and employers can sponsor hands-on activity stations on competition day.

Contact: Allison Marrs, Future City Program Manager, amarrs@esd.org, 248-353-0735 ext. 121 | www.esd.org/futurecity

9th Annual TechCentury Student Writing Contest

Deadline: Friday, December 4, 2026

Eligibility: Students at Michigan universities studying engineering or a related field

Prize: The top three entries will be published in the Spring 2027 TechCentury. First place receives a $1,000 scholarship sponsored by Fishman Stewart, LLC.

Requirements, trade studies, and design rationale all depend on clear writing, and this contest rewards students who can explain engineering to a broad audience. Please share it with students you mentor, teach, or supervise as interns.

Contact: Susan Thwing, sthwing@esd.org

SAE International Detroit Section

The Parade Company Detroit Studio Tour

Date: Wednesday, November 11, 2026, 4:30–6:00 PM Eastern (networking 4:30, tour 5:00)

Location: The Parade Company, 9500 Mt. Elliott, Studio A, Detroit, MI 48211

Cost: $25 (enter INCOSE as your member number)

A behind-the-scenes look at how America's Thanksgiving Parade is designed and built: roughly 200,000 square feet of floats, the world's largest collection of papier-mâché heads, and a costume shop producing more than 3,000 costumes on site. Every float is a one-off build against a fixed, very public deadline. Open to SAE members and guests ages 8 and up; registration closes November 10 and refunds November 5. Family-friendly. Spaces are limited.

Register: https://www.sae-detroit.org/event-details/?id=498

Stahls Motors & Music Experience Tour

Date: Wednesday, December 2, 2026, 5:30–7:30 PM Eastern

Location: Stahls Motors & Music Experience, 56516 N Bay Dr, New Baltimore, MI 48051

Cost: $25

Vehicles from the Brass, Depression, and Art Deco eras alongside automated musical instruments, including the Mighty Wurlitzer theatre organ.

Register: https://www.sae-detroit.org/event-details/?id=502

PMI Great Lakes Chapter

Lunch & Learn: AI in Enterprise Portfolio & Project Management Intelligence

Date: Monday, November 9, 2026, 12:00–1:00 PM Eastern

Format: Virtual

Cost: $15 members / $20 non-members

PMI Great Lakes' November lunch session gives project, program, PMO, and portfolio professionals a practical, non-technical framework for applying AI. Dr. Anthony Amalraj, co-founder of Jupiter.AI and a PMO and portfolio executive (PMP, PgMP), explains generative AI, retrieval-augmented generation, and AI agents against common portfolio problems such as priority overload, fragmented data, and reactive risk. He also covers the governance responsible adoption needs: human oversight, traceability, and auditability. The session earns 1.0 PDU. Online registration closes at noon on Tuesday, November 3. Under the INCOSE–PMI MOU, these hour-long sessions are the lowest-cost way for members to build cross-discipline depth.

Register: https://pmiglc.org/calendar?eventId=44986

Member Appreciation 2026

Date: Wednesday, November 18, 2026, 5:30–8:30 PM Eastern

Location: MSU Management Education Center, 811 W. Square Lake Rd., Troy, MI 48098

Cost: $15 for members and non-members; paid PMIGL members are reimbursed after the event

PMIGL's appreciation evening offers networking with project managers and the PMIGL board, a career fair with résumé assistance, and activities with prizes. Food is provided (not dinner) and there is a cash bar. Non-members are welcome, which makes it an easy first in-person contact with the PMI side of the INCOSE–PMI MOU. No PDUs are awarded.

Register: https://pmiglc.org/calendar?eventId=45333

Other INCOSE Chapter Events

SE Lab Demo: Lean MBSE with iQUAVIS

Date: Wednesday, November 4, 2026, 10:00 AM Eastern

Format: Virtual

Cost: Free

Matthias Greinert gives an accessible introduction to MBSE and a live demonstration of how iQUAVIS supports systems engineering throughout development. A good entry point for members new to modeling, or anyone weighing lighter-weight tooling.

Register: https://www.incose.org/event/se-lab-demo-lean-mbse-with-iquavis/

INCOSE WMA Chapter: Disambiguating Mission Engineering and Systems Engineering

Date: Wednesday, November 4, 2026, 6:00–8:00 PM Eastern

Format: Virtual (Zoom)

Cost: Free

Mission engineering and systems engineering share vocabulary, artifacts, and often the same people, and programs regularly blur where one ends and the other begins. Dr. Rafi Soule draws the line between them at the WMA chapter's November meeting. Her research is on early-phase mission engineering: how stakeholders frame a mission before any system is defined, and how model-based methods keep that framing traceable into the system work that follows.

Dr. Soule is a Project Scientist at Old Dominion University's Virginia Modeling, Analysis and Simulation Center (VMASC). She also serves as a model-based systems engineer for ODU's Spectrum Advanced Technology and Training Lab. Her doctoral research in ODU's Engineering Management and Systems Engineering department combined MBSE, digital thread, human-centered design, and participatory design in early-phase mission engineering.

Zoom Link: https://incose-org.zoom.us/j/84086951628?pwd=GDJ7R7Frk5tRiV4OeLjZ6lDeR1HkCe.1

INCOSE Latam Chapter: Guidelines for Implementing Verification and Validation Processes According to ISO 15288

Date: Thursday, November 5, 2026, 1:00–2:00 PM Eastern

Format: Virtual (Zoom), in English

Cost: Not published

Juan Llorens (CSEP, ESEP), CTO of The REUSE Company and a past president of INCOSE Spain, walks through V&V under ISO/IEC/IEEE 15288, using the V-model to trace how baselines evolve from stakeholder requirements to a finished product. He introduces the verification action as a digital record of objective evidence and covers quality measures that keep requirements and models consistent across the lifecycle. A practical companion for anyone writing or auditing a verification plan.

Register: https://incose-org.zoom.us/meeting/register/YSoWY5KQQp2LlYKK6vVJ8A

INCOSE Los Angeles & San Diego Chapters: 2026 Joint Technical Conference

Date: Saturday–Sunday, November 7–8, 2026, from 12:00 PM Eastern (9:00 AM Pacific)

Location: Caltech, Pasadena, CA

Format: Hybrid

Cost: $99

A two-day technical conference hosted jointly by two of the largest West Coast chapters, with remote attendance available — the largest sister-chapter program this fall that Michigan members can join without travel.

Register: https://los-angeles.incose.org/event/2026-incose-la-sd-chapters-hybrid-2-day-joint-technical-conference/

INCOSE Enchantment Chapter: Scalable Qualification Architectures Commensurate with Verification Activity Complexity

Date: Wednesday, November 11, 2026, 4:45–6:00 PM Mountain / 6:45–8:00 PM Eastern

Format: Virtual (invitation by request)

Cost: Free

How much SE rigor does a given verification effort actually warrant? The talk takes the position that the scope of SE implementation must itself be managed and scaled, just as system scope is — useful for anyone who has watched a qualification program either under-reach or drown in its own process. Request the meeting invitation through the event page.

Register: https://enchantment.incose.org/event/scalable-qualification-architectures-commensurate-with-verification-activity-complexity/

INCOSE Seattle Metro Chapter: Challenges in Practicing Airborne Electronic Hardware Certification

Date: Wednesday, November 11, 2026, 5:45–7:30 PM Pacific / 8:45–10:30 PM Eastern (presentation from 6:25 PM Pacific / 9:25 PM Eastern)

Format: Hybrid (Bellevue, WA, and Zoom)

Cost: Free

Brian Petre, a consultant DER with more than 26 years practicing airborne electronic hardware certification under RTCA DO-254, discusses overseeing certification across distributed OEM and supplier networks: requirements traceability, verification and validation, configuration control, and supplier oversight. He compares DO-254 with its software counterpart, DO-178, and argues for treating lifecycle data as a strategic asset rather than something assembled for formal reviews.

Event page (Zoom link and RSVP): https://seattle.incose.org/event/november-11th-general-membership-meeting-challenges-in-practicing-airborne-electronic-hardware-certification/

INCOSE North Texas Chapter and Dassault Systèmes: SysML v2 3-Day Intensive Bootcamp

Date: Tuesday–Thursday, November 17–19, 2026, 9:00 AM–5:00 PM Central

Format: In-person, North Texas

Cost: Free; seats limited

Covers the three pillars of MBSE — language, tool, and methodology — through lectures, demonstrations, and hands-on work. Listed for members who travel to the Dallas area; for everyone else, a useful benchmark for what a structured SysML v2 curriculum looks like.

Register: https://north-texas.incose.org/event/north-texas-chapter-and-dassault-systemes-sysml-v2-3-day-intensive-bootcamp-2026/

INCOSE Los Angeles Chapter: Strengthening the Digital Thread Through Executable Physics

Date: Tuesday, November 17, 2026, 5:30–7:30 PM Pacific / 8:30–10:30 PM Eastern; hands-on virtual workshop Saturday, November 21, 2026, 9:00 AM–1:00 PM Pacific / 12:00–4:00 PM Eastern

Format: Talk format not stated; workshop virtual

Cost: Not published

Mark TenEyck of Dassault Systèmes introduces 1D-coupled-3D lifecycle simulation as a way to keep the links between engineering disciplines intact over a product's life. Topics include causal and acausal modeling, physics at different time scales, and using the results to assess design changes, degradation, maintenance, and modular component options, including as a possible basis for Modular Open Systems Approach (MOSA) evaluation.

Register:
Tuesday: https://lp.constantcontactpages.com/ev/reg/xnv7bty/lp/cc1a8e0a-8f39-4f9e-823b-a9bec075e77d

Saturday: https://lp.constantcontactpages.com/ev/reg/7fyykax/lp/19f80c07-a027-4a95-8897-765ff5333992

INCOSE International Workshop 2027

Date: Saturday, January 30 – Tuesday, February 2, 2027

Location: Torrance Marriott Redondo Beach, 3635 Fashion Way, Torrance, CA 90503

Cost: Registration details not yet posted

INCOSE's annual working meeting: four days of working-group sessions aimed at defined outcomes, with no paper, panel, or tutorial presentations. It is where INCOSE's technical products move forward, and the most direct way for members to join a working group. Watch the event page for registration.

Event page: https://www.incose.org/event/incose-international-workshop/

Other Events

Fuel for Thought: The History of Electric Cars

Date: Thursday, November 5, 2026, 5:00–8:00 PM Eastern (presentation and Q&A 6:00–7:00)

Location: Stahls Motors & Music Experience, 56516 N Bay Dr, New Baltimore, MI 48051

Cost: Free (donations encouraged)

Car restorer Ken Litchfield, who has more than 45 years in automotive restoration, traces the electric car from the 1890s to today and covers what it takes to convert a gasoline car to electric power. A conversion is an integration exercise in miniature: a new energy source, drive, and controls fitted into a structure designed around something else. Seating is limited to 200 RSVPs; the form closes at noon on Wednesday, November 4, and guests without an RSVP may take any empty seat at 6:00.

RSVP: https://www.stahlsauto.com/event/fuel-for-thought-the-history-of-electric-cars/

Historical Corner

Two November anniversaries, twenty-five years apart, and one question underneath both: how do you let a traveler reach any destination on a network that many separate owners built, without a guide at every junction? On November 11, 1926, the state highway agencies adopted a single numbering plan for the country's main roads. On November 10, 1951, a New Jersey mayor dialed ten digits and reached California without an operator. Both answers were numbering plans, and both are still in daily use. The columns below take the highways first, then the telephone network. A short sidebar on Lunar Orbiter 2, launched sixty years ago this month, closes the section as a companion to the chapter's November 15 Engineering Expedition.

This Month in SE History: The U.S. Numbered Highways — An Architecture Written in Numbers

November 11, 1926 — One Hundred Years

On Sunday, August 30, 1925, the president and general manager of the American Automobile Association left Washington, D.C., in a Cadillac bound for San Francisco. They drove around the clock and arrived 96 hours later. Finding the way was easy until western Utah, where the Lincoln Highway and the Victory Highway parted. They took the Victory Highway and soon met a hill with six roads leading over it. General manager Ernest N. Smith walked half a mile ahead to make sure the road they chose would carry them through.

The roads they were following had no common addressing scheme. By the mid-1920s, private trail associations had named more than 250 routes and marked them with paint on telephone poles, barns, and rocks. Many associations routed their trails through towns that paid dues rather than along the best line. Rival trails overlapped; one stretch of highway in southwestern New Mexico carried markers for five of them.

On November 11, 1926, the state highway agencies, acting through the American Association of State Highway Officials (AASHO), replaced that arrangement with a single plan: the U.S. numbered highway system, about 96,600 miles of the nation's main roads. The engineering problem behind it will be familiar to anyone who has worked on a system of systems. Forty-eight separate owners built, maintained, and signed the roads, and no one could compel them to adopt a common design. The plan had to impose an architecture and an interface standard on a federation, and it had to survive every town that wanted a better number.

Michigan was close to the work. Frank F. Rogers, Michigan's member of the board that drew up the plan, sketched the shield that still marks every U.S. route. The board's plan was presented to AASHO at its 1925 annual meeting in Detroit.

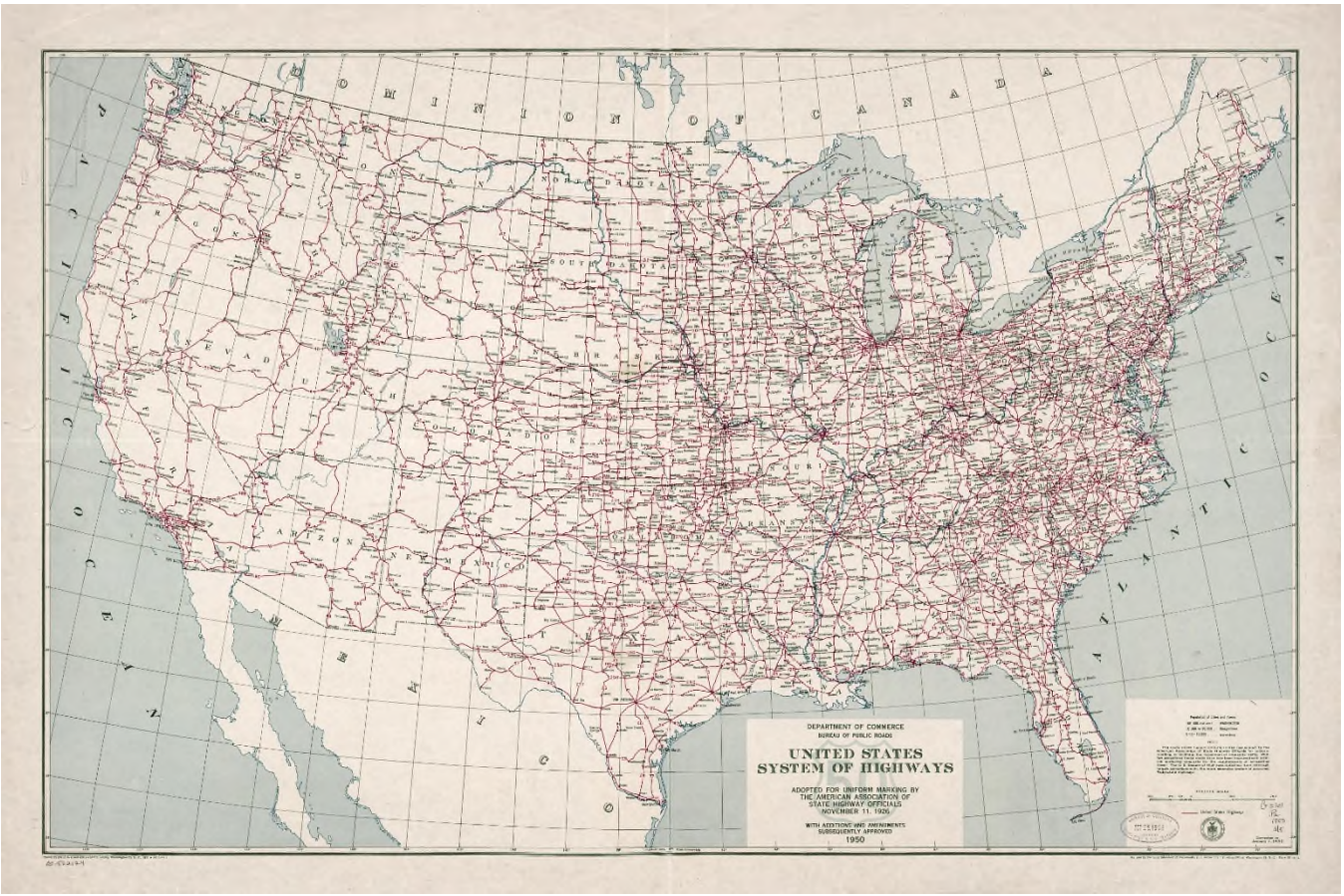


Figure 1. The system as of 1950, with additions approved after its 1926 adoption. Even numbers run east–west and odd numbers north–south, and the transcontinental routes carry multiples of ten, so a driver can read direction and rank from the number alone. (U.S. Bureau of Public Roads, 1950; Library of Congress)

Wisconsin's Prototype

Wisconsin replaced trail signs with numbers first. A 1917 state law created a trunk highway system and required uniform signs for it. The state numbered its trunk lines, designed a triangular marker, and had its counties install the signs at an agreed hour on May 24, 1918. A later state highway engineer recalled the effect: directions that once depended on forks in the road, schoolhouses, and red barns became a single sentence of route numbers.

In 1922, maintenance officials from Wisconsin, Minnesota, and Indiana pushed the idea further. They proposed that a sign's shape, not its words, carry its meaning, so a driver could recognize it at night before the lettering was legible: round for railroad crossings, octagonal for stop, diamond for slow. AASHO took up those recommendations in 1924 and asked the Secretary of Agriculture to form a joint federal–state board to number and mark the interstate routes.

A Board Without a Public Hearing

The Joint Board on Interstate Highways was approved on February 20, 1925, and its members were appointed on March 2. Thomas H. MacDonald, chief of the federal Bureau of Public Roads, was chairman; E. W. James of the Bureau was secretary; twenty-one state highway officials made up the rest. At the first meeting, on April 20–21, 1925, the members unanimously favored numbers over names. They also made two procedural decisions that shaped everything after.

First, on a motion by Ohio's Lou A. Boulay, they agreed not to discuss numbers at all until the routes had been selected. Second, they declined to hold public hearings, which would have obliged them to hear every trail promoter and turned the board into an arbiter among local interests. Wisconsin's member proposed a selection rule instead: roughly one percent of a state's road mileage as primary routes, with similar shares for secondary and tertiary routes. Near the end of that first meeting, Rogers passed James a doodled shield. James redrew it, Rogers presented it, and the board approved it as a tentative design.

Selection, and the Growth Problem

Regional meetings in May and June 1925 produced a tentative system of 81,000 miles, and the states kept proposing routes beyond the main ones. At its August meeting the board cut the system to 50,100 miles. By the time its report went to the Secretary of Agriculture on October 26, 1925, requests from the states had pushed it to 75,800 miles. The system AASHO adopted a year later was nearly double the August figure.

The shield shows the same pressure. In August the board voted 10 to 9 to leave the state's name off it, then reversed itself the next day without recorded debate. AASHO's executive secretary later explained why: some southern members expected trouble persuading their states to accept, and pay to sign, a "United States" road, and some legislatures had already fixed state route numbers in law. Putting each state's name on its shields kept those states in the system.

An Expansible Grid

The numbering scheme came from James. In a letter of August 27, 1925, he proposed odd numbers for north–south routes, rising from east to west, and even numbers for east–west routes, rising from north to south. He later described the pattern as "simple, systematic, complete, expansible." The numbering committee adopted it in St. Louis on September 25. Transcontinental and principal east–west routes received multiples of ten, starting with U.S. 2 near the Canadian border. Principal north–south routes ended in 1, with U.S. 1 on the East Coast; secondary ones ended in 5. Branches received three-digit numbers formed by adding a prefix to the parent route.

Several one- and two-digit numbers were deliberately left unassigned, so the grid had room to grow. The board's report also conceded that strict numerical order could not be kept everywhere: where heavily traveled routes crossed, order gave way to the actual flow of traffic.

When the Numbers Carried Meaning

The public read the grid at once as a ranking. Routes ending in 0 or 1 were taken as first class, those ending in 5 as secondary, and a three-digit number as a demotion. That reading turned numbers into something to fight over.

The sharpest fight was over 60. The numbering committee had assigned it to a route from Chicago to Los Angeles rather than to a transcontinental east–west line, and three of the committee's five members came from states on that route. Kentucky's governor protested that his state was the only one in the Mississippi Valley without a route ending in zero; MacDonald later called it the one argument that could not be fairly met. Missouri, meanwhile, had already printed 600,000 maps showing U.S. 60, and Oklahoma had prepared the signs.

The deadlock broke on April 30, 1926, in Springfield, Missouri, when Oklahoma's chief highway engineer, John M. Page, noticed that 66 had never been assigned. Oklahoma and Missouri wired Washington that they preferred it, and Kentucky agreed that July. A number left open in James's grid became Route 66, whose centennial much of the country is marking this year.

Freezing the Baseline

Through 1926, AASHO's Executive Committee worked through the states' requests for changes in routing or numbering; one review of AASHO's records counts 132, though the total is disputed. At AASHO's annual meeting in Pinehurst, North Carolina, James urged immediate adoption. The plan was not perfect, he said; further revision would not improve it, and its worst flaws came from efforts to meet narrow local viewpoints. He also reported that 22 states had nearly finished marking their U.S. routes, 10 more were underway, and 14 had ordered signs. On November 11, 1926, AASHO adopted the system.

The named trails did not outlast it. The Lincoln Highway Association, the strongest of them, ended its formal operations on September 1, 1928. By 1933, James could tell AASHO that the scheme had proven easy to extend and resistant to local favoritism. The administrative arrangement endures as well: requests to add, change, or remove a U.S. route still go to AASHO's successor, AASHTO.

SE Lessons for Practitioners

- **Select the system before you name its parts.** The Joint Board refused to discuss numbers until the routes were chosen. Arguments about identifiers are usually arguments about architecture in disguise; settle the architecture first, or the naming debate will settle it for you.
- **An identifier scheme is an architecture decision.** Encoding direction and rank in the number let a stranger navigate any state with no local knowledge. When identifiers carry structure, users can reason about the system from the identifier alone, so design that structure as deliberately as any interface.
- **Leave room in the namespace.** James left numbers unassigned, and Route 66 exists only because the grid had a gap when a dispute needed one. Reserve values in any numbering, addressing, or interface scheme; spare capacity is what lets you resolve conflicts later without renumbering everything.
- **Whatever meaning you encode will be read as a commitment.** Once a zero meant first class, a number became something a state could claim was owed to it. Decide in advance which meanings an identifier carries, and be prepared to defend each one as a requirement.
- **Write selection criteria down, and give them teeth.** The board had a one-percent guideline, yet the system nearly doubled between August 1925 and adoption. Criteria with no enforcement mechanism erode one reasonable local exception at a time; track the cumulative effect, not just each request.
- **In a federation, the standard must give the owners something.** The states owned the roads and adopted the plan by ballot. Putting the state's name on the shield, after a 10–9 vote went the other way, was a concession of identity that bought participation. Where you cannot compel adoption, design it in.
- **Downstream commitments freeze the baseline whether or not you approve it.** Missouri's 600,000 maps and 32 states already marking routes made the plan expensive to change before it was final. Track what downstream work has committed to, and baseline when the cost of further change exceeds the value of improvement, as James argued at Pinehurst.
- **Plan change control as a permanent function.** AASHO's Executive Committee handled the change requests of 1926, and its successor still reviews route-numbering requests a century later. A standard that lasts needs a configuration authority that lasts with it.

This Month in SE History: Direct Distance Dialing — Ten Digits Across a Continent

November 10, 1951 — Seventy-Five Years

On November 10, 1951, Mayor M. Leslie Denning of Englewood, New Jersey, dialed ten digits and reached Mayor Frank Osborne of Alameda, California, with no operator on the line. AT&T's account puts the time to connect at eighteen seconds. Customers of three exchanges in Englewood and neighboring Teaneck could now dial eleven major cities themselves, using a three-digit area code and a seven-digit number.

Until then, people assembled every long-distance call. Operators in several cities each handled a piece of the route, and the work was slow and costly. Replacing them posed a systems question much like the one the highway officials had faced. How do you let any subscriber address any of millions of telephones, across local numbering schemes that had grown up independently, with electromechanical switches that act on digits as they arrive?

The Plan Came First

The Bell System's answer began with its own operators. In the early 1940s AT&T developed Operator Toll Dialing, starting with a new No. 4A toll crossbar switch in Philadelphia in 1943. In 1947 it fixed the address format for the continent: a nationwide numbering plan of 86 areas, 77 in the United States and 9 in Canada, each identified by a three-digit area code. The 1951 Englewood cutover put that plan in subscribers' hands.

The rules were written for machines. Every area code had 0 or 1 as its middle digit, which distinguished it from a local exchange code. A state or province with a single area code got a 0 in the middle; states with several got a 1. Because a rotary dial sends more pulses for higher digits, the quickest codes to dial went to the places with the heaviest traffic: 212 for New York City, 213 for Los Angeles, 312 for Chicago.

Michigan received three of the original codes: 313 for the southeast, 517 for the middle of the Lower Peninsula, and 616 for the west. The Upper Peninsula split from 616 as 906 in 1961. Detroit's 313 received an overlay, 679, only in 2025, seventy-eight years after the code was assigned.

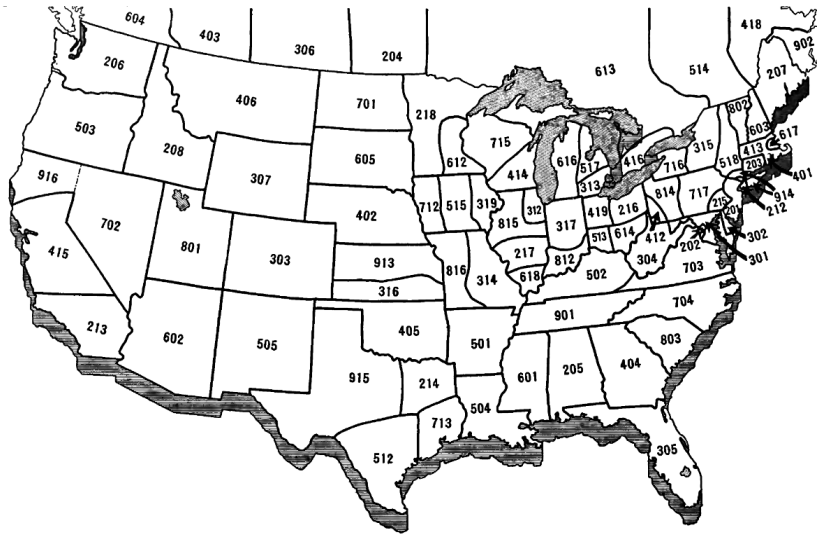


Figure 2. The 1947 plan. The middle digit of every code is 0 or 1, a rule that let switches recognize an area code on sight and, four decades later, made the plan hard to expand. (Ralph Mabbs, Bell Telephone Magazine, Winter 1947–1948, via Wikimedia Commons)

What the Operator Used to Do

Removing the operator removed more than a voice on the line. Operators also chose routes and recorded the details needed for billing, and direct dialing needed machines for both. Bell Laboratories described Automatic Message Accounting in September 1951 as the means that would permit a wide expansion of subscriber dialing. Routing had limits of its own. The early equipment could not translate enough digits to reach every destination directly, so calls to San Francisco used a special temporary code, 318. The workaround was retired only when card translators capable of six-digit translation arrived in 1952–53.

Those dependencies set the pace. Direct dialing spread slowly through the 1950s and accelerated in the early 1960s; by 1967 there were 129 area codes.

Four Decades of Headroom

The middle-digit rule allowed 144 possible area codes. The 1947 plan assigned 86 and held 58 in reserve, and the reserve lasted more than forty years. When it ran out, the rule that made area codes easy for machines to recognize had to be relaxed, which meant changing equipment across the network. The first area code with a middle digit other than 0 or 1 entered service in Alabama on January 15, 1995.

SE Lessons for Practitioners

- **Define the interface before the implementation.** The numbering plan was fixed in 1947, four years before any customer dialed a long-distance call. Every switch, translator, and billing system that followed was built to it. A stable interface lets the implementation behind it evolve for decades.
- **Make the format recognizable to the machine that parses it.** The 0-or-1 middle digit told a switch it was reading an area code. Parsability is a requirement, and the structure that satisfies it should be written down with the rationale, because someone will eventually need to change it.
- **Optimize for the traffic you actually have.** Assigning the fewest dial pulls to the busiest areas saved time on millions of calls. Know which use case dominates before you allocate scarce resources, and document the exceptions you make.
- **When you automate a person, inventory everything the person did.** The operator routed and recorded billing as well as connecting calls. Direct dialing waited on accounting and translation equipment, and the 318 workaround shows what happens at the edge of the design. List the implicit functions before you remove the human who performs them.
- **Reserve capacity, and know what it will cost to exceed it.** Fifty-eight spare codes bought more than forty years. The same rule that made codes easy to recognize made expansion expensive. Every constraint that simplifies today's design is a migration someone must plan for later.

Sidebar: Sixty Years Ago — Lunar Orbiter 2 and the Landing-Site Problem

November 6, 1966 — Sixty Years

Lunar Orbiter 2 lifted off from Cape Canaveral on November 6, 1966, entered lunar orbit on November 10, and photographed the Moon from November 18 to 25. Its assignment came from a program that had not yet flown: Apollo needed to know where a crewed lander could set down safely. NASA lists the mission's targets as 13 primary and 17 secondary candidate landing sites along the lunar equator. On November 23 the spacecraft also took an oblique view across the crater Copernicus from about 45 kilometers up, which the press called one of the great pictures of the century.

The spacecraft reflected a deliberate choice to rely on proven hardware. Boeing, the prime contractor under NASA's Langley Research Center, proposed a photographic system from Eastman Kodak, the contractor for a reconnaissance camera system already flying for the Air Force. The film was developed on board with Kodak's semi-dry Bimat process, scanned, and transmitted to Earth. Langley's evaluators judged Boeing's proposal the most likely to meet the program's objectives at the lowest cost per photograph returned.

Artemis faces the same problem at a new destination. NASA identified 13 candidate landing regions near the lunar south pole in 2022 and narrowed them to nine in October 2024, using Lunar Reconnaissance Orbiter data to assess terrain, lighting, and communication with Earth. Specific sites will be chosen once launch dates are set, because the dates determine the lighting and trajectories. Members joining the November 15 Expedition will find both the Apollo Lunar Module and the Artemis Human Landing System rendered in LEGO bricks.

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