Standing Committee on User Information Systems (AND20)
John L. Campbell, Chair

Meeting the Information Needs of the Road User

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INTRODUCTION AND OVERVIEW

The Transportation Research Board's (TRB's) Standing Committee on User Information Systems (AND20[1]) focuses on the information exchange between the transportation system and the user. Committee members and friends support, define, present, and disseminate impactful research on informational requirements, user capabilities, and situation/environmental conditions affecting the adequate and accurate transmission of information to road users. The committee provides a forum for productive events and activities that have consistently fostered: professional collaborations with like-minded professionals from industry, the consulting world, and academia; opportunities for life-long friendships; and important contributions to transportation safety. The committee's scope includes all road users, all modes of transportation, and the many interesting interactions between users and modes.

This brief paper provides a glimpse into a TRB committee that has been involved with every challenge, technology, and evolution of user information systems going back over 40 years. From Freeway Incident Management (FIM), to Advanced Traveler Information Systems (ATIS), to Automated Highway Systems (AHS), to Changeable Messages Signs (CMS), to Intelligent Transportation Systems (ITS), and to our current interests in Connected and Automated Vehicles, AND20 has been engaged and involved in some of the world's most pressing transportation challenges. Despite the many changes in roadway design, technological innovations, research methodologies, and even road users themselves, AND20 has remained focused on understanding the needs and requirements of the road user and supporting the development and design of safe and effective transportation systems.

Below, we present the productive past, exciting present, and bright future of AND20 – an established and capable committee that exemplifies the mission of TRB to promote innovation and progress in transportation through research.[2]

LOOKING BACK – A RICH AND PRODUCTIVE HISTORY

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[1] Note that TRB's alphanumeric designation for the User Information Systems committee was originally A3B08 and became AND20 during 2004.

[2] The authors thank past chairs Beverly Kuhn and David Yang for generously providing many historical documents related to the User Information Systems committee.

The Early Days – A Focus on Freeways
Several TRB committees in the 1960s, 1970s and 1980s addressed topics that would become AND20's main scope - the exchange of information between the transportation system and the user. These committees included the Traveler's Services Committee and the Freeway Operations Committee. Looking back at some of their key accomplishments, we can see how a historical focus on designing transportation systems that meet the needs of the users has provided both a philosophical and a methodological foundation for the work we do today.

Freeway Moving Merge Systems
The focus of freeway management in the 1960s was on monitoring freeway traffic using television cameras and roadway detectors, followed by analyzing the real time information so lane control displays, variable speed signs, and entrance ramp signs could report current traffic flow information directly to freeway and ramp users. Ramp meters used pre-timed or fixed control or gap –acceptance as the decision algorithm. Freeway moving merge system (MMS) used a similar concept to gap-acceptance control but added the feature of displaying to the driver the presence of an acceptable gap in the freeway right lane through a system of moving lights along the left side of the freeway onramp. The first moving merge system was tested by Texas Transportation Institute in 1968, on their abandoned airport under contract with the Federal Highway Administration. The MMS was later tested in Woburn, Massachusetts on Route 128.

Two MMS were individually tested at the Woburn ramp, first a 'green band' system and second a 'pacer' system. Both systems were operated by a Raytheon 703 mini-computer with 12,000 words of core storage which was used for surveillance, decision making, and system control. Peripheral equipment included a high-speed paper tape unit for reading the operational programs and a magnetic tape for recording real-time data. All roadside equipment, such as detectors, sensors, special signs, driver displays were interconnected and with the computer by hard-wire to a nearby trailer. Seven sets of inductive traffic responsive loops, 200 feet apart, were installed in the freeway right lane. Each set of loops measured vehicle arrival, speed, and length. Five presence detectors were installed in the acceleration lane to detect the presence of stopped vehicles. The 700-foot ramp had a queue detector at the head of the ramp, a check-in and check-out detector, and a merge detector. Given the state of the computer technology in the 1960's the success of the MMS in Woburn was a truly an amazing success.

Freeway Incident Management (FIM) Workshops
The FIM Specialties Workshops were originally sponsored by the Freeway Operations Committee and the Travelers Services Committee. The first FIM workshop was initiated by Samuel C. Tignor, chair of the Travelers Services Committee, by asking Joe McDermott, chair of the Freeway Operations Committee, to help sponsor the workshop on the Sunday prior to the beginning of the TRB Annual Meeting in Washington, D.C. These workshops were held for about 10 years, starting on January 13, 1985 or the Sunday starting the week of TRB meetings. The committee meetings were well attended with typically 75 to 100 people attending at least for the first 6-8 years. As a result of these workshops, the committee published Transportation Research Circulars, Number 298 and Number 326, that described the first and second Sunday FIM specialty conferences. We see in these workshops an early and strong commitment to sharing and exchanging information across TRB and – of course – a precursor to the Sunday Human Factors workshops at the Annual Meeting that AND20 supports today (see also below).

The morning sessions at the FIM conferences had presentations on how to manage and respond to freeway incidents and the afternoon session was organized so the attendees could review case studies of actual freeway incidents that had previously occurred. The morning session usually provided time for 4 to 6 speakers to discuss how their states or cities planned for responding to freeway incidents when they occurred. Significant meaningful work was done on this problem starting in the mid-1980s by some organizations, but many others were struggling on determining what should be done. The focus on actual case studies in the FIM workshops helped bridge this knowledge gap. At least 12 case studies were examined from 1984 to 1990. The FIM conference goal was to share information among organizations that would minimize the lost time to motorists and make roadways safer during periods of traffic disruptions. The Federal Highway Administration sponsored research on incident management and developed a movie on the topic in cooperation with CALTRANS and Illinois DOT.

A TRB Annual Meeting Tradition – the Sunday HF Workshops
AND20 has played a continuing role in supporting what has become a TRB tradition and – for some - the highlight of the TRB Annual Meeting: the Sunday Human Factors Workshop Series. Each year, this series features a set of carefully selected workshops that reflect a range of timely human factors topics. Some discussion of the HF workshops has been a part of almost every formal committee meeting going back 20 years. In reviewing minutes of past discussions and meetings, some impressive themes are evident: (1) a consistent focus on critical and emerging issues and technologies in human factors, (2) a requirement that speakers be knowledgeable and reliable, and (3) post-workshop assessments to see what worked and what did not. Topics under discussion and/or sponsored through the years include: ITS Evaluation Methodologies, Criteria for Lighting Design, Pedestrians and Facilities Design, Safety & Mobility for Older Women. Driver Information Needs, Digital Billboards on the Highway: A Bright Future, Pedestrian Facilities, Signal Detection and Railroad Crossings, and Emerging Issues and Technologies in Driver Information Systems. In all, a range of 'classical' human factors issues related to how road users perceive and utilize information from the roadway environment, combined with 'hot topics.' classical topics than the emphasis on new CV and AV topics that we see today.

Initiating the Development of the Human Factors Guidelines for Road Systems
A key AND20 subcommittee is AND10(2), the *Human Factors Road Design Guides*, a Joint Subcommittee of AND10 and AND20. Looking back, we can see that the genesis for this subcommittee and for the NCHRP activities it started (i.e., producing the Human Factors Guidelines for Road Systems: Second Edition [NCHRP Report 600] in 2012) was a series of discussions at the TRB Annual Meeting back in 1998. There, the AND20 committee records show a meeting in which the following was proposed – *"No authoritative, single reference document, handbook, or guideline is available in any country that describes the user performance criteria needed by highway designers, traffic engineers, and automotive engineers in developing and operating an efficient and safe highway transportation system. A small group of international human factor professionals and traffic engineers recognized this need and have developed a preliminary outline for a "Human Factors Guideline for Safe Highway Design and Telematics."* At that time, the membership of the group was international, with representatives from Finland, France, Germany, Netherlands, Sweden, and the United States. This reflected the original intent of the human factors guide, which was to develop the content of the guide for applicability roadway designs all over the world. Our Emeritus member, Dr. Sam Tignor, was

instrumental in organizing that meeting, persuading others of the need and value in having human factors guidelines for road system design and currently chairs the AND10(2) subcommittee. He is a member of the NCHRP Project panel for NCHRP 17-80, which is overseeing the development of the 3rd Edition of the *Human Factors Guidelines for Road Systems*.

The 2015 Inaugural Debate

AND20's Inaugural or 'Great' Debate of 2015 was inspired and organized by then-Chair David Yang. The committee decided in mid-2014 to host a debate at the 2015 Annual Meeting as a way of adding an interesting and fun event to the meeting, and spent the remaining months of 2014 selecting on a topic, planning the debate format, and identifying participants. The focus of the debate was a hot topic in 2014: the many traffic information applications that were becoming available to travelers (mostly through their cell phones), including applications associated with routing, incidents, parking, events, etc. In the transportation and traffic information community, this topic was the focus of many news reports, journal articles, and informal blog entries in the United States and worldwide, with considerable discussion surrounding the value, accuracy, safety, and overall efficacy of such applications.

The committee members decided that the central proposition of the debate would be: *Traffic information from apps have a significant influence in my travel decision-making process.* The AND20 team arguing on behalf of the "For" position was Sushant Sharma (captain), Jing Dong, and Pete Costello. The team arguing on behalf of the "Against" position was Costas Antoniou (captain), Yingyan Lou, and Virginia Lingham. John Campbell moderated the debate. The format of the debate was a formal Team Policy-type debate, with prescribed order and strict time limits on the individual segments, as summarized in Table 1.

Table 1. The Structure and Timing of AND20's 'Great Debate' of 2015

Segment/Speech	Allocated Time (minutes)
Main Debate	
Introduction of the topic, format and individual teams. Conduct first survey of audience opinions.	15
Opening Argument-For	10
Opening Argument-Against	10
Rebuttal Argument-For	8
Rebuttal Argument-Against	8
Closing Argument-Against	4
Closing Argument-For	4
Audience Participation & Discussion	
Questions from the audience and/or the moderator to either the for or against teams, or both	3 minutes per team, per question 50 minutes total time
Conduct second survey of audience opinions.	10

Invitations describing the debate were widely distributed within the larger AND00 Users Performance Section (Four Committees) and as the debate commenced, a large crowd gathered to watch, learn, and to cheer on their favorite team. David Yang introduced the debate and the participants. Subsequently a lively debate ensued, featuring passionate, well-reasoned arguments from both teams, snappy rebuttals, and plenty of opportunities for questions and discussion by the audience. A winner was declared, and an appreciative audience congratulated and applauded

the participants one last time; Figure 2 below shows the peaceful aftermath of AND20s 'Great Debate' of 2015.

Figure 2. Debate Participants – Still Friends After a Heated Battle.

Members, Friends, Friends Who Became Members, and Members Who Became Friends
Assessing new technologies, identifying research needs, and communicating research findings are critical activities for every TRB committee, and AND20 has been a model committee in that regard. However, the core contribution of AND20 through the years has never been its focus on technical issues or topics – it has been the energy, commitment, and productivity of its members and friends. In this regard, AND20's current members and friends owe a great debt to the tireless efforts of a great many individuals. This includes recent past chairs Phil Garvey, Beverly Kuhn, and David Yang. A review of our committee membership rosters going back 20 years is impressive. Many names appear and re-appear in the records as individuals served on the committee, rotated out, and then came back to serve again, including Sue Chrysler, Suzie Lee, Sam Tignor, Mohamed Abdel-Aty, Jeff Adler, Thomas Granda, Joe Moyer, Bryan Katz, Asad Khattak, and many others. In short, hundreds of transportation professionals have contributed thousands of hours to the enduring work of this committee over the years. Thank you past members and friends!

WHERE ARE WE TODAY? AND20 IN 2019
The user-system interaction, and the issue of how to convey information to road users in an efficient and safe manner are topics of timely relevance in the world of connected and automated vehicles. Historically, the driver has been the one and only user of vehicle information systems. However, over the last few years, this category has expanded to include a wider group of users, both inside and outside the vehicle.

This drastic transformation in vehicle user population and related Human Factors challenges are reflected in the activities and research priorities of AND20. In the recent past,

activities of the committee centered on topics like driver distraction induced by using in-vehicle infotainment systems. Despite these still representing themes of primary relevance for Human Factors and Road Safety, the committee recently expanded its domains of interest by furthering the investigation of user information systems in the context of automated and connected vehicles. The 2019 Call for Papers sponsored by the committee, for example, sought submission in the topics of *vehicle interfaces for external communication with road users (human drivers, bicyclists, pedestrians etc.)* and *design of human-machine interfaces for automated driving systems.*

In keeping with its mission to promote discussion and research on the role of emerging technologies in transportation, in 2019 members of the committee organized a well-attended workshop with the title *Human–Machine Interfaces in Vehicle Automation: Inside and Outside the Vehicle.* The workshop saw the participation of experts from academia, industry and the wider road safety community. Two main topics were at the center of the discussion. First, attendees focused on the role of exterior human-machine interfaces for fully-automated, SAE level-5 vehicles. The Society of Automotive Engineers (SAE) has a task force on Lighting for Automated Driving Systems (J3134) whose focus is on the development of guidelines for the design of HMI for safe and efficient vehicle-to-pedestrian communication. The activities of this task force as well as other related NHTSA projects were at the center of the discussion. The second topic covered in the workshop was Driver Monitoring Systems (DMS), and the role these will play in ensuring drivers' engagement during partially and conditionally-automated driving. The conversation focused on the design of systems like GM Supercruise, and the need for developing training programs to facilitate drivers' learning of advanced vehicle technology.

The themes of the lectern and poster sessions sponsored by AND20 are also reflective of the strong trajectory toward connected and automated vehicles. At the 2019 Annual Meeting, the committee-sponsored lectern session examined *New Strategies for Warning Systems in the Connected World.* Presentations focused on a variety of topics including vehicle-to-pedestrian and vehicle-to-bicyclists communication. Likewise, the poster session saw an increase in the number of contributions addressing the role of human-machine interfaces in enabling effective communication between road infrastructure and users. Ahmed, Yaf and Gaweesh (2019), for example, presented preliminary findings from their assessment of the HMI design for the Wyoming Connected Vehicle Program. Likewise, Zhao and colleagues (2019) presented results from their study investigating the effects of connected vehicle-based variable speed limit on simulated driving under varying environmental conditions.

The AND20 subcommittee structure allows members and friends a means to 'plug in' to AND20 and the larger TRB community via smaller groups with a narrower focus. In particular, the less formal structure of the subcommittee provides greater flexibility to explore and communicate ideas and on-going research. Currently, AND20 sponsors three subcommittees. The joint subcommittee on *Human Factors of In-Vehicle Systems* (co-sponsored with AND10) is currently chaired by Dr. Dawn Marshall from the National Advanced Driver Simulator (NADS) at the University of Iowa, and focuses on vehicle user interaction with in-vehicle systems for information, entertainment, control, and warning. Objectives of this subcommittee are improving the safety and utility of in-vehicle systems through the identification of research needs, and sharing research findings and methodologies. The second subcommittee is chaired by Dr. Samuel Tignor from the Virginia Polytechnic Institute and State University. This subcommittee on *Human Factors Road Design Guides* has the responsibility to assist in the development of the human factors guideline for road design. Input from other TRB committees investigating road

geometrics, highway operations and capacity, and user information are considered by members of this subcommittee to assist designers and traffic engineers in developing solutions that ensure the safety of all road users. The third, and last, is the joint subcommittee on *Digital Billboards* sponsored by all AND00 committees, and chaired by Jerry Wachtel from the Veridian Group, Inc. The subcommittee promotes research addressing the design of digital billboards for effective infrastructure-to-vehicle communication. These AND20 subcommittees, in addition to their technical opportunities for committee members and friends, are a rich source of collaborations with other AND00 committees.

In its early days, as in recent years and today, the membership of the committee has attracted a variety of researchers and professionals from the wide transportation community. Today, the committee, chaired by Dr. John Campbell from Exponent Inc., has a total of 30 members and one Emeritus Member. Members hold academic and research scientist positions at universities, transportation centers, and consulting firms in North America and Asia. With a diverse background from civil engineering, cognitive science, and epidemiology, members of the committee all focus their work and research on addressing Human Factors issues of User Information Systems.

THE ROAD AHEAD FOR AND20

Looking to the future, AND20 will no doubt evolve to adjust the changing transportation landscape; however, our focus on the information exchange between the transportation mode and the user will remain intact.

Advances in automated vehicle technology will need human factors evaluations, simulations, and other User Information Systems-focused research to support the roll out of the technology that is not only safe, but also designed in a way that is understood and accepted by users.

Even further out on the horizon, new transportation modes such as flying autonomous vehicles (aerial taxis), Hyperloop, or even commercial space travel are beginning to emerge in the next 10-20 years as possible new transportation modes. AND20 will be prepared to address these new challenges.

Within the TRB structure, the committee may adjust to add or remove subcommittees and/or participate in joint subcommittees to allow for greater reach of the work and perspectives of its members. We will likely see a topic area emerge that will become the next ATIS Joint Subcommittee, which was so successful in the 2000s.

AND20 will continue to lead the way with creative and innovative ways to interact at our meetings. The Human Factors workshops continue to be very popular at the Annual Meeting each year and the committee expects to continue to support the workshops each year with new ideas and speakers. AND20 will also seek to align its research needs statements with critical issues and funding opportunities.

IN CONCLUSION

Whatever the technology, whatever the technical issue, whatever the societal implications, AND20 has a record championing the information needs of all road users in all transportation modes. Most of all, the AND20 members and friends have always maintained strong and enduring commitments to developing, conducting, and communicating impactful research. In the future, we will see these commitments and values held by the AND20 committee applied to a host of challenges, including:

- Transformational and disruptive technologies driven by connectivity and automation,
- Road user demographics that are changing due to shifts in where we live, where we work, how we travel, and how long we live, and
- The implications of a host of new, battery-powered vehicles (e.g., cars, shuttles, bikes, and scooters) on the ways we travel and our corresponding information needs.