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Member: National Academy of Engineering
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Fellow: American Institute for Medical and Biological Engineering

Vision for Automotive Safety*:*

Make US roadways, vehicles and infrastructure the safest in the world for its users through comprehensive planning and implementation.

Implementation of this Vision:

I am in a unique position due to my personal and professional relationships which were developed over the last 35 years with all stakeholders (such as government, industry, academia, and non-governmental organizations.) Throughout my career, I have received professional and/or personal recognition from many different stakeholders groups, who are well aware of my capabilities and accomplishments. Through my participation and leadership in many national/international organizations, forums and technical working groups, I have successfully blended and balanced the various visions and priorities of different organizations in order to implement change.

Education:

June, 1973	Ph.D Bio-Mechanics	Wayne State University
June, 1968	M.S. Mechanical Engineering	Wayne State University
June, 1965	B.S. Mechanical Engineering	Bihar College of Engineering

Awards and Recognition:

- Elected to the National Academy of Engineering - 2006
- Recipient of the Ralph H. Isbrandt Automotive Safety Engineering Award – 2005
- Recipient of the John Paul Stapp Award for the best paper in the 2003 Stapp Car Crash Conference
- Bertil Aldman Award from the International Research Committee on the Biomechanics of Impact, 1999
- Henry Ford Technology Award – Deployable Bolster – 1995
- First Recipient National Award for the Advancement of Motor Vehicle Research and Development, 1994
- NHTSA Engineering Excellence Award for Safety, 1991 and 2009
- Henry Ford Tech. Award – Side Impact Model – 1990

Leadership Positions on National and International Forums:

- Advised governments such as Canada, Australia and U.S. on the development of relevant crash regulations. I was also instrumental in the 1998 modification of FMVSS208, which succeeded in minimizing unintended side effects of first generation airbags.
- Past Chairman/Member Biomechanics and Crashworthiness Sub-Committee of the Motor Vehicle Safety Research Advisory Committee of NHTSA
- Chairman ISO Working Group 3 (development of test procedures to evaluate the effect of airbag deployments on out-of-position occupants in frontal and side impacts) 1990-2000. The test procedures were incorporated in the FMVSS208 in US and the TWG for side impact test procedures by all manufacturers selling in US.
- Chairman of a Technical Working Group established by a consortium of Domestic and International Automotive Manufacturers charged by the Administrator of NHTSA to develop an Industry wide agreement to improve compatibility between light trucks and cars in US. I successfully developed such an agreement which has been in place since 2005.
- Leader of the U.S. delegation to the an International Standards Organization working group charged with developing scientifically-based injury criteria for various body regions that could be used to evaluate vehicular crash worthiness. (1987-1999)

Experience and Major Contributions:

Ford Motor Company, 1973 to 7/31/2008:

I worked in various areas of the Company since joining Ford Motor Company in 1973 and conducted basic and applied biomechanics research in the following areas:

- impact responses of the skull/brain, cervical/thoracic/lumbar spine, chest and extremities (arm and lower leg and the pelvis)
- impact tolerance of the human body
- application of biomechanical principles in vehicle designs (vehicle structure designs and restraint systems) to improve real world safety.

I also pioneered the development and application of modeling techniques for:

- human surrogates
- vehicle structures in various impact modes
- restraint systems (i.e., seatbelts, frontal airbags, side airbags and side curtains)

As a Technical Fellow in Automotive Safety (1994 – 2008), I reported directly to the Chief Technical Officer of the Company and the Vice-President of Research and Advanced Engineering. I was responsible for directing the research, development and implementation of active and passive safety technologies worldwide.

My contributions in safety research have been recognized by the U.S. Secretary of Transportation (1994), by NHTSA (1990) and by Europe (I.R.C.O.B.I.) in 1999. I have advised various governments around the world in establishing relevant regulations and research programs which enhance real world safety. I have led working groups and participated in committees of professional organizations such as SAE, International Standards Organization (ISO) and the International Harmonization Research Activity.

Some of my contributions in specific areas are listed below:

<u>Biomechanics:</u>

- Development of responses and injury criteria for 3-year old child surrogates in airbag testing. This research formed the basis of U.S. regulations (FMVSS208) for neck injury criteria (Nij).
- Developed an injury risk function (Prasad and Mertz curves) associating Head Injury Criteria (HIC) with risk of skull fracture and serious brain injuries. These HIC functions are now used in regulations worldwide and the injury risk function is used to evaluate effectiveness of restraint systems in the real world.
- Developed neck injury risk functions for various sized ATD's which are used by NHTSA in current regulations.
- Developed injury risk functions which associated measured chest deflections of various sized ATD's with real world chest injuries in frontal crashes.

- Developed Injury risk functions and criteria for tibial injuries in frontal crashes.
- Developed ankle injury criteria.
- Developed response and injury criteria for the lumbar spine shear in the A-P and lateral modes.

Modeling:

- Developed non-linear whole body finite element models of the skull/brain, chest, abdomen, pelvis, femur and the tibia/fibula.
- Developed lumped mass and finite element models of vehicle structures in frontal and side impact.
- Developed multi-link and finite element models of various frontal and side impact crash test dummies.
- Developed vehicle structural rate effects for use in vehicle crash models.
- Developed models of air bags.

Safety Regulations:

- Led the analysis of the side effects of unbelted FMVSS208 regulation in U.S.A., and established the need to change the regulation to allow "depowered" airbags.
- Responsible for Ford's corporate responses to various rulemaking activities worldwide. The current FMVSS208 regulations are based on biomechanical research conducted under my direction.

Restraint Systems and Vehicle Design:

- Developed performance guidelines for frontal and side air bags and curtains to further improve protection of in-position occupants and reduce injuries to out-of-position occupants.
- Developed system design guidelines for vehicle structures designed to enhance occupant protection in frontal, side and rear impacts.
- Developed structural design guidelines to enhance compatibility between heavy and light weight vehicles involved in crashes.

Publications and Patents:

- Over one hundred technical papers (see attached list) various areas of biomechanics and automotive safety. The majority of these papers are in peer reviewed technical journals and conference proceedings and transactions of the SAE.
- Five patents awarded covering side impact restraint, external airbags and accident avoidance technologies.

WSU Department of Biomechanics, 1966 – 1973:

- Developed and experimentally verified a 2-D model of the human spine, head and pelvis subjected to +Gz and ± Gx accelerations
- Discovered a duel-load path in the spine and the role of articular facets in +Gz acceleration
- Developed and experimentally verified hyperextension devices to substantially increase human tolerance to impact in the vertical direction.
- Predicted and experimentally verified the existence of compressive forces in the spine restrained by military harness systems in purely frontal accelerations. The phenomenon of the straightening of the thoracic spine was predicted by the 2-D model, and later verified by experiments.
- Evaluated the ability of the severity index for predicting head injuries
- Identified the need for biofidelic head forms for testing of helmets
- Developed specialized load cells for measuring in-vivo axial loads developed in the lumbar spine during +Gz acceleration.

Publications:

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P. Prasad and H.S. Mertz: The position of the U.S. Delegation to ISO Working Group 6 on the Use if HIC in the Automotive Environment, SAE Paper No. 851246, 1985.

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